ROMANIA

CONVENTION ON NUCLEAR SAFETY

ROMANIAN NATIONAL REPORT

Fourth Revision

September 2007

FOREWORD

This report demonstrates how Romania has fulfilled its obligations under the Convention on Nuclear Safety.

The structure of the 4th national report is similar to that of the reports previously submitted by Romania, following the guidelines of INFCIRC/572/Rev.2, while the content has been significantly changed, due to the use of the synopsis of relevant IAEA safety requirements. Therefore, the information provided in the previous reports has been further detailed and updated, highlighting, where necessary, the most significant developments since the 3rd Review Meeting of the Contracting Parties.

This report has been prepared by the National Commission for Nuclear Activities Control, in consultation with and incorporating contributions from the National Company “Nuclearelectrica” SA.

TABLE OF CONTENTS

INTRODUCTION

1. Current role of Nuclear Power in Romania

The new “Energy Strategy of Romania 2007 – 2020”, outlining the national plans for the development of the Romanian energy sector, has been recently approved by the Government.

Romania's nuclear policy encompasses the development and use of nuclear energy and other nuclear fuel cycle activities in Romania as well as oversight of the development and enforcement of nuclear legislation and regulations to ensure that all fuel cycle activities are strictly regulated and controlled to the highest standards to ensure public health and safety.

With only one nuclear reactor in operation (Cernavoda NPP Unit 1), the nuclear share has been of 9% of the total energy production. At present, Unit 2 is in final stage of commissioning (tests at full power). The two units of Cernavoda NPP will cover up to 18% of Romania’s total energy production. The Government has plans to further increase nuclear generating capacity through the commissioning of Units 3 and 4 of the Cernavoda NPP.

Table 1. List of Romanian nuclear installations

Reactor	Type	Gross Capacity MW(e)	Construction Start	First Criticality	Operating Status
Cernavoda-1	CANDU-6	706.5	1980	16th of April 1996	In operation
Cemavoda-2	CANDU-6	706.5	1980	6th of May 2007	Has achieved full power on the 12th of September, 2007
Cemavoda-3	CANDU-6	720	1980	-	Under Preservation
Cemavoda-4	CANDU-6	720	1980	-	Under Preservation
Cemavoda-5	CANDU-6	-	1980	-	Under Preservation

Long term commitment to nuclear power development, considered one of the drivers of the Energy Strategy, builds on the well developed national nuclear infrastructure, proven and safe technology and excellent performance of Cernavoda NPP, as well as on the positive public perception of the nuclear energy.

2. Main Governmental Organisations with responsibilities in the nuclear sector

The Ministry of Economy and Finances (MEF) establishes the national strategy in the energy field and is the major shareholder of the nuclear energy production sector, nuclear research & engineering, nuclear fuel and heavy water production.

The National Commission for Nuclear Activities Control (CNCAN) is the nuclear safety authority of Romania, responsible for the regulation, licensing and control of nuclear activities, ensuring the peaceful use of nuclear energy and the protection of public and workers from the harmful effects of ionising radiation. CNCAN elaborates the strategy and the policies for regulation, licensing and control with regard to nuclear safety, radiological safety, non-proliferation of nuclear weapons, physical protection of nuclear installations and materials, transport of radioactive materials and safe management of radioactive waste and spent fuel, as part of the National Strategy for the development of the nuclear sector. CNCAN reports to the Prime Minister, through the Prime Minister's Chancellery.

The Ministry of the Environment and Sustainable Development (MEDD) is the central authority for environmental protection and has specific responsibilities in the licensing and control of nuclear installations.

The State Inspectorate for Boilers, Pressure Vessels and Hoisting Installations (ISCIR), subordinated to MEF, is responsible for the licensing and control of the pressure systems and equipment, including those used in nuclear and radiological installations, with appropriate consultation and collaboration with CNCAN.

The National Agency for Radioactive Waste Management (ANDRAD), subordinated to MEF, is responsible for the coordination, on national level, of the safe administration process of spent nuclear fuel and of radioactive wastes, including their disposal.

The Nuclear Agency (AN), subordinated to MEF, promotes the peaceful use of nuclear energy and the related research and development programmes and is responsible for developing the strategy for the nuclear sector, as part of the national energy strategy.

3. Main companies in the Romanian nuclear power industry

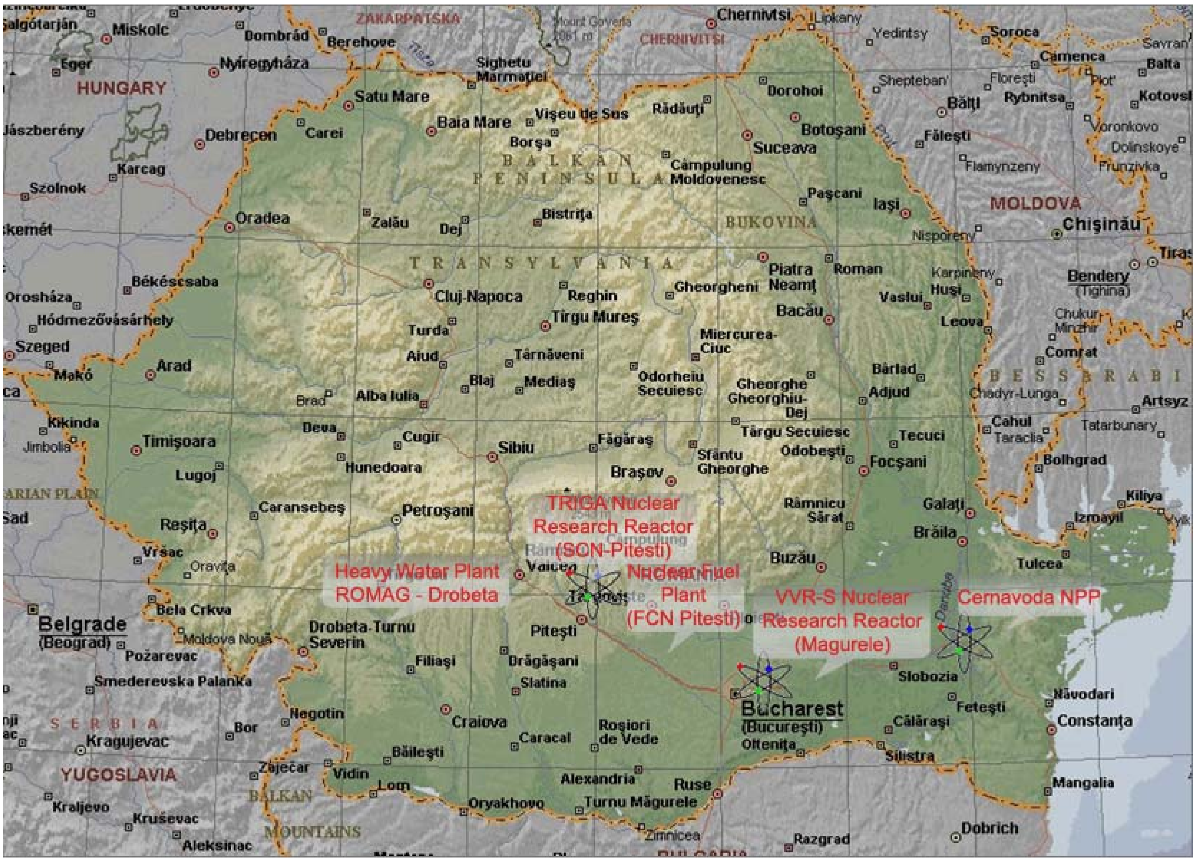
The National Company "Nuclearelectrica" SA (Societatea Nationala Nuclearelectrica SA, further referred to in this report as SNN) is the owner and operator of Cernavoda NPP. The company includes two subsidiaries, no legal persons, one for nuclear power production (Cernavoda NPP) and one for nuclear fuel production (Nuclear Fuel Plant - FCN Pitesti), respectively. SNN is a government owned company, subordinated to MEF.

The fabrication of the CANDU nuclear fuel started in 1980, through the commissioning of a CANDU type Fuel Pilot Plant operating as a department of the Nuclear Research Institute (ICN) Pitesti. The separation of the Nuclear Fuel Plant from ICN, as a distinct branch, occurred in 1992. In 1994, AECL and Zircatec Precision Industries Inc. (Canada) qualified the Nuclear Fuel Plant (FCN) as a CANDU 6 fuel manufacturer. The plant supplies the fuel necessary for the operation of both units of Cernavoda NPP. The high quality of the domestic nuclear fuel produced in Romania was proven by its behaviour and performance during the reactor operation period: the failure rate was of 0.04% at an average burnup factor of 170 MWh/kgU. Not a single flawed fuel bundle has been recorded during the operation of the Cernavoda NPP Unit 1 since June 2001.

The Autonomous Company for Nuclear Activities (RAAN) is also a government owned company, responsible for heavy water production and nuclear research and engineering. RAAN is subordinated to MEF and includes three subsidiaries, no legal persons:

- Heavy Water Plant (ROMAG - Drobeta)
- Institute for Nuclear Research (ICN - Pitesti)
- Centre for Nuclear Projects Engineering (SITON - Bucharest)

The National Company for Uranium (CNU), also government owned and subordinated to MEF, is responsible for the administration of the national uranium mineral resources and performs geological research and exploitation activities for uranium ores, ores processing and concentrates refining, their transport and marketing. CNU is the supplier of sinterisable UO_2 power for the nuclear fuel manufacturer (FCN Pitesti).



4. Main themes and safety issues presented in the report

The main issues addressed in the present report can be summarised as follows:

- Changes to the Romanian legislative and regulatory framework, taking account of the development of international safety standards and recognised good practices;
- Measures taken by CNCAN to improve the effectiveness of the regulatory activities;
- Improvement initiatives taken and planned by the licence holder to further enhance the safety of the nuclear power plants.

More comprehensive information has been provided in this revision of the report for demonstrating the fulfilment of obligations under the Convention, taking account of the latest recommendations provided in the “Synopsis of the relevant IAEA safety requirement statements” document.

ARTICLE 6 - EXISTING NUCLEAR INSTALLATIONS

Each Contracting Party shall take the appropriate steps to ensure that the safety of nuclear installations existing at the time the Convention enters into force for that Contracting Party is reviewed as soon as possible. When necessary in the context of this Convention, the Contracting Party shall ensure that all reasonably practicable improvements are made as a matter of urgency to upgrade the safety of the nuclear installation. If such upgrading cannot be achieved, plans should be implemented to shut down the nuclear installation as soon as practically possible. The timing of the shutdown may take into account the whole energy context and possible alternatives as well as the social, environmental and economic impact.

6.1 Background

As presented in the introduction, a total of five nuclear power reactors were intended to be built in Romania on Cernavoda site. Unit 1 is currently operating, while Unit 2 is in final stage of commissioning (tests at full power). The construction of the other three units on the site was stopped at different stages, and these units are currently under preservation. It is expected that in the following couple of years the construction of Units 3 and 4 will be restarted. All units are pressurised heavy water reactors (PHWR), CANDU 6 type.

Romania has ratified the Convention on Nuclear Safety through the Law no. 43 / 24 May 1995. The reviews required under Article 6 of the Convention have been assimilated to the normal licensing process, as Unit 1 of Cernavoda NPP was commissioned between the years 1993 and 1996 and work on Unit 2 restarted in 2001.

The previous national reports under the Convention have included information on the historical development of the Cernavoda NPP project and on the safety reviews performed. Therefore, the information previously presented has been further detailed and updated by this report and is provided under the relevant articles (mainly under Articles 14, 17, 18 and 19).

6.2 Summary of significant developments

The information provided in this section represents an overview of significant developments since the 3rd Review Meeting, particularly in relation to the challenges and areas for improvement highlighted by the observations made in the Summary Report.

Human Performance

The notable developments in the area of human performance enhancement include the implementation of the Human Performance Programme (addressed under Article 12), the improvement of the training programmes and facilities for the main categories of personnel with jobs important to safety (addressed under Article 11).

Transition to an integrated Management System

Cernavoda NPP is undergoing a process of transition from the Quality Management System to an Integrated Management System in accordance with the latest IAEA requirements and guidance on this matter. Information on the current activities for the development and implementation of the integrated Management System for Cernavoda NPP is provided under Article 13.

Safety assessments

Information on the safety assessments for Cernavoda NPP is presented under Article 14, which gives an overview of the existing safety analyses for Units 1 and 2, outlining the differences in approach for the two units.

Up to date, for the safety analyses support for the licensing of the two units (accident analyses in the FSARs), the utility has relied mainly on the plant designer. However, over the years the licence holder developed its own capability of performing accident analyses, using state of the art computer codes and methodologies and, in the framework of the Safety Analysis Strategic Programme, started to perform a new set of analyses for Unit 1, in accordance with the current regulatory requirements and standards.

The progress made with the Safety Analysis Strategic Programme proves that the utility has now a good in-house capability of performing deterministic safety analyses. However, more efforts are still to be made for building the capability of performing severe accident analyses and for developing plant specific severe accident management guidelines.

The Probabilistic Safety Analysis Programme has also been subject to continuous development. During 2005 - 2007, after the Level 1 PSA for full power was finalised, the scope of Cernavoda Unit 1 PSA was extended considering the events initiated during shutdown and low power operating modes.

Starting with March 2006, the Risk Monitor (EOOS) has been in field trial use in Main Control Room, Planning Department and Safety & Compliance Department of Cernavoda NPP Unit 1, based on specific departmental procedures issued in 2006 and reviewed in 2007. From June 2007, after finalising the Level 1 PSA for all plant operating states, work is ongoing to extend the Risk Monitor to include low power and shutdown states operation.

As a first step in the development of PSA for Unit 2, a qualitative evaluation of the Unit 2 design changes versus Unit 1 design, using the probabilistic approach, was performed during the construction phase of Unit 2. The current regulatory requirements impose the performance of a detailed, plant specific, PSA for Unit 2, of the same scope and quality as for Unit 1. The PSA study for Unit 2 has to be finalised and submitted to CNCAN within 6 months after the start of Unit 2 operation. Starting with January 2006, the system modelling analysis for Cernavoda NPP Unit 2 has begun. As part of this work, the necessary information about design, operation and testing of each system have been collected and is used to develop the master logic fault tree model for Unit 2.

Radiological Safety

From the radiological safety point of view, in Romania have been registered, since 2004, important developments, starting with completion of the related legislation, passing trough significant technical improvements, ending with new projects, aimed to reduce at the minimum possible level the radiation exposures due to NPP operation.

In this respect, CNCAN issued in 2005 new requirements regarding the limiting and monitoring of radioactive discharges from NPP, which have been transposed in the respective NPP internal regulations, accordingly revised in 2006-2007.

Also, in order to implement more efficient the ALARA principle, the NPP revised at the end of 2006 the related procedure, describing in more details the entire ALARA process. In this respect, the NPP implemented from 2006 a Radiation Working Permit system, too. As a practical aspect, the NPP uses from 2005 a teledosimetry system, aimed to monitor in real time the dose and dose rate values measured with electronic dose meters worn by those workers activating in significant radiological risk areas (especially in planned outages), using a wireless system and personal alarm modules.

Regarding the control of the public exposure due to Cernavoda NPP, an important progress was done by modernising the original Gaseous Effluent Monitoring System, which will assure the redundancy of the monitoring and sampling lines, by introducing a new monitoring line for particulate, iodine and noble gases and two passive collectors for total tritium and total C-14 further determination. This updated system has been installed in Unit 2, being completely operational in present. For Unit 1, it was approved the modernisation of the system, at the moment the purchasing and installation contract being just signed.

Another important achievement is the Tritium in Air Monitoring System, designed to collect air samples from those areas in the containment where is likely to be tritium and to indicate the levels of tritium, in order to assist the location of leak sources. This system represents an improvement of the original CANDU-6 project and it has been installed in Unit 2 of Cernavoda NPP, being completely operational in present. The same system was approved to be installed also in Unit 1, at the moment the purchasing and installation contract being just signed.

In order to mitigate the occupational and the public exposure to tritium, by reducing the tritium concentrations into the heavy water, Cernavoda NPP initiated a project of a detritiation facility for Unit 1, with extension possibilities for Unit 2 and, eventually, for Unit 3 and Unit 4. In present, it was finalised the feasibility study, the following steps being to obtain the necessary licenses for design, construction and commissioning of the detritiation facility.

Further information on the developments in the area of radiation protection are presented under Article 15.

Emergency preparedness

Extensive information is provided under Article 16 with regard to the developments in the area of emergency planning and preparedness, including the re-organisation of the emergency response arrangements, the establishment of the Cernavoda On-Site Emergency Control Centre, the emergency exercises performed, etc.

Design upgrading

An overview of the design modifications and upgrading for Cernavoda NPP Units, resulting from operational experience feedback and changes in regulatory requirements, is provided under Article 18.

Operation

Progress has been made with regard to the collection and analysis of operational experience. The utility has taken actions for encouraging the initiation of Abnormal Condition Reports (ACRs) for low-level events and near-misses. This determined an increased participation of plant staff into the process and resulted in a high number of ACRs. Also the efforts in teaching and practicing advanced investigation and assessment techniques have resulted in a higher contribution of plant staff in the analysis of the important conditions and events. More specialists have been trained in Root Cause Analysis (RCA) techniques such as TapRooT and ASSET so that an alternative method is available to check the validity of the analysis. In this respect, the actions will continue with correlated efforts between the Operating Experience Group, Human Performance Group and Training Department.

The utility has established a strategy for developing plant specific severe accident management guidelines. Up to date, activities have been performed to identify the necessary resources for the implementation of this strategy. Information on this issue is provided under Article 19.

6.3 External Review Missions

IPSART Missions

Two IAEA IPSART missions (held in May 10-19, 2004 and May 9-13, 2005) reviewed the PSA Level 1 Internal Events and PSA Level 1 Seismic, Internal Fire, Internal Flood and High-Energy Line Breaks Events for Full Power Operation Cernavoda NPP Unit 1. The main recommendations provided by IAEA expert's team have been considered and implemented in the updated PSA model. Some recommendations are still to be implemented, such as the completion of the screening analysis for other external events that are relevant for Cernavoda NPP.

Another IPSART mission, requested for an independent review of the qualitative risk evaluation of design changes at Unit 2 based on Probabilistic Safety Assessment for Unit 1, was conducted during the period of 7-11 March 2005.

The review report concluded that most of the evaluated design changes are aimed to improve the reliability of systems and equipment or eliminate deficiencies identified in the Unit 1 design and enhance the plant response towards internal initiating events, fires, floods, and seismic events. A clear and traceable approach for the qualitative evaluation of design changes was developed and consistently followed during the analysis process in almost all cases. Through a successive screening, it was demonstrated that for the vast majority of the design changes, the positive (or at least neutral) impact on risk was obvious. When it was not obvious, a more detailed analysis was performed to assess the impact of the design changes on PSA elements (e.g. for internal events: initiating events, accident sequences, human actions, etc.) to prove the absence of adverse impact on the core damage risk.

OSART Missions

At the beginning of 2005, an IAEA Operational Safety Review Team (OSART) Mission was conducted for Cernavoda NPP. The purpose of the mission was to review operating practices in the areas of Management Organisation and Administration; Training and Qualification; Operations; Maintenance; Technical Support; Operating Experience, Radiation Protection; Chemistry; and Emergency Planning and Preparedness.

Cernavoda NPP senior management made of resolving the OSART recommendations and solutions one of its foremost objectives and established, after the review, an oversight process to monitor the improvements initiated as a response to OSART findings.

The actions initiated by Cernavoda NPP in response to the Recommendations and Suggestions were embedded into the improvement programmes established for each of the five Key Result Areas (KRA) from the 5 year Development Strategy:

- Work force management (KRA # 1)
- Operations & Safety Culture (KRA # 2)
- Work processes & programmes (KRA # 3)
- Equipment reliability (KRA # 4)
- Financial performance (KRA # 5)

A follow-up OSART mission was conducted in November 2006 to perform an in-depth review of the corrective actions taken to improve performance of Cernavoda plant, for each recommendation and suggestion resulted from the previous OSART mission. Benchmarking, self-assessment, revision of policies, programmes and procedures, walkdowns, training and coaching are the key elements of the progress noted by the follow-up OSART mission.

Improvement actions were implemented in the areas of human performance enhancement, operating experience collection and analysis, maintenance enhancement programme, equipment reliability process, management of temporary modifications , fire protection programme, material condition and housekeeping.

ARTICLE 7 - LEGISLATIVE AND REGULATORY FRAMEWORK

1. Each Contracting Party shall establish and maintain a legislative and regulatory framework to govern the safety of nuclear installations.

2. The legislative and regulatory framework shall provide for:

i. the establishment of applicable national safety requirements and regulations;

ii. a system of licensing with regard to nuclear installations and the prohibition of the operation of a nuclear installation without a licence;

iii. a system of regulatory inspection and assessment of nuclear installations to ascertain compliance with applicable regulations and the terms of licences;

iv. the enforcement of applicable regulations and of the terms of licences, including suspension, modification or revocation.

7.1 Overview of the legislative and regulatory framework governing the safety of nuclear installations

7.1.1 Brief history of the development of the legislative framework and of the regulatory body

Since 1955 up to present, the rules of functioning, the organisational structure, the subordination level and the attributions of the regulatory authority for nuclear safety have suffered a series of modifications which will be highlighted by presenting a short evolution of the legislation that governed the development of the nuclear sector in Romania.

In 1955, by Decision of the Council of Ministers - HCM 903/1955, the basis of the Committee for Nuclear Energy were set, with the mandate of ensuring the resources for research in nuclear physics and its application in science and technology. This Committee for Nuclear Energy was reporting directly to the Council of Ministers of Romania.

In 1961, by Decision of the Council of Ministers - HCM 741/1961, the work with ionising radiation sources became regulated and the Committee for Nuclear Energy was designated as the responsible regulatory body for licensing of activities using ionising radiation sources. By the same Decision, a Commission for Direction and Control and Nuclear Units was established inside the Atomic Physics Institute (IFA) and designated as the control body, its rule of functioning being approved by the Committee for Nuclear Energy. By this Decision, the first administrative rules, as well as regulatory provisions were established for radioprotection, work safety, personnel training and medical examinations, specific for the work with ionising radiation sources.

Beginning with 1968, the responsibility of the Committee for Nuclear Energy was to direct and to coordinate, from scientific and methodological points of view, the development of nuclear activities in Romania, with the objective of implementing the state's strategy and policies for this field. These attributions were established by Decision HCM 1299/1968, on the organisation and functioning of the Committee for Nuclear Energy. By this Decision, the Committee for Nuclear Energy becomes responsible for the elaboration of the national nuclear program and for monitoring and controlling its implementation. At the same time the Atomic Physics Institute of the Academy of Romania becomes subordinated to the Committee for Nuclear Energy.

In 1969, by Decree of the State Council no. 870/1969, which was approved by Law no. 7/1970, the State Committee for Nuclear Energy (CSEN) was established, as the central body of state administration responsible for implementing the state's policy for the nuclear field. These responsibilities were later modified by the Decree of the State Council (DCS 282/1972), the role of CSEN in the regulation, licensing and control of nuclear activities being strengthened. For a long period of time, up to 1989, nuclear activities in areas such as promotion, development, nuclear installations commissioning, operation and regulation were handled by CSEN.

While CSEN had the overall responsibilities for licensing and regulation, the ISCAN division within CSEN was responsible for performing the inspection activities.

In 1974 the Law 61/1974 on the deployment of nuclear activities in Romania was issued, which appointed the State Committee for Nuclear Energy as the central body of the state administration ensuring the implementation of state's policy in the nuclear field and which strengthened and expanded the attributions of CSEN - ISCAN for regulation, licensing and control of nuclear activities.

Even if the responsibilities of ISCAN were formally consistent with the international practices, in reality the authority of the regulatory organisation suffered because it was acting as a division of CSEN, which was responsible for both promotion/operation and regulation of nuclear activities. Despite these difficulties, the regulatory organisation started to issue nuclear safety regulations, based on Law No. 61/1974. These regulations were essentially based on the IAEA - NUSS series, and the provisions of the US 10 CFR. Moreover, following a prescriptive approach, the Romanian regulatory organisation was fully involved in the control of all important phases of the national nuclear program.

Later, the organisation and functioning of the State Committee for Nuclear Energy were modified by Decree no. 85/1979, which stipulates as attributions of the committee the licensing and control of the nuclear activities on the Romanian territory and also the responsibility for controlling the implementation of quality assurance requirements in the design, manufacture and construction of nuclear power plants and other installations related to nuclear power engineering.

In 1982, Law no. 6/1982 regarding the quality assurance for nuclear units and installations was adopted, stating that “the State Committee for Nuclear Energy controls and is responsible for the accomplishment of the quality assurance requirements in design, manufacture, construction and operation of the nuclear units and installations, and of the execution of products and supply of services for these units and installations”. The Law 61/1974 and the Law 6/1982 were abrogated by the Law no.111/1996.

The State Committee for Nuclear Energy was dissolved by the Decree 6/1990 and its attributions in the nuclear energy field were transferred to the Ministry of Electric Energy.

As the new institutional framework had created conditions to separate promotion/operation of nuclear energy from regulation activities, by Decree no. 29/1990, on the 8th of January 1990, the National Commission for Nuclear Activities Control was established, taking over the mandate and responsibilities of State Inspectorate for the control of nuclear activities and of the quality assurance in the nuclear field.

The rule of functioning and the attributions of the National Commission for Nuclear Activities Control were established by Decree no. 221/1990, CNCAN becoming the central body of the state administration having the national authority for the licensing and control of all the activities related to the peaceful use of nuclear energy. The National Commission for Nuclear Activities Control had as main duties the licensing of the siting, construction and operation of nuclear installations and the control of the measures taken by the licensees to ensure the protection of personnel, population and environment from the harmful effects of ionising radiation.

By Government Decision 983/1990, CNCAN was subordinated to the Ministry of Environment. The Ministry of Environment, which later became the Ministry of Waters, Forests and Environmental Protection (1992), was given the attributions of regulation, licensing and control for the nuclear field, this being fulfilled through CNCAN, as distinct body in its organisational structure.

In 1996, the Law 111 on the safe deployment of nuclear activities came into force. The national competent authority in the nuclear field, that was empowered to exercise the attributions for regulation, licensing and control in accordance with the Law 111/1996 was the Ministry of Waters, Forests and Environment Protection, through the National Commission for Nuclear Activities Control. In 1997, by Government Decision no. 249/1997 the organisation and functioning rule of the National Commission for Nuclear Activities Control were approved.

The Law no. 16/1998, brought some amendments in relation to the observance of principles stipulated in the Convention on Nuclear Safety, ratified by Romania through the Law no. 43/1995. Thus, the National Commission for Nuclear Activities Control was transferred from the subordination of the Ministry of Waters, Forests and Environment Protection to the direct subordination of the Government. A set of additional duties for CNCAN were stipulated by the amendments, based on the principles mentioned in the Convention on nuclear safety, as follows:

- to elaborate normative acts and to initiate legislative acts;
- to control the implementation of international agreements in force relevant to the nuclear field;
- to perform activities of public information;
- to initiate, with the endorsement of the Ministry of Foreign Affairs, actions to promote Romania's specific interests in the relations with the International Atomic Energy Agency, the Nuclear Energy Agency, and other international organisations specialised in regulation and control of nuclear activities;
- co-operation with similar organisations from another states, according to the law.

By Government Decision 287/1998 the organisation and rule of functioning of CNCAN, as a specialised body of the central public administration, with legal personality, reporting directly to the Romanian Government, were approved. In 2001, CNCAN was again subordinated to the Ministry of Waters and Environmental Protection.

The Law no. 384/2001 amended the Law no 111/1996 in order to allow enterprises without legal personality to apply for a licence, according to the provisions of Art. 8. This amendment appeared in the framework of transition to a market economy with the aim to offer to small enterprises such as consulting rooms, set up according to the Government Ordinance no 124/1998, and private enterprises of services in support of medical treatment and diagnosis, set up according to the Government Urgency Ordinance no 83/2000, the possibility to supply services in the medical field.

CNCAN independence was re-established in 2004, when it was separated from the Ministry of Waters and Environmental Protection, according to the Rule approved by the Governmental Decision 1627/2003 on the organisation and functioning of CNCAN.

The Law no 193/2003 brought a set of completions and amendments to the Law no. 111/1996, on one hand as result of the accession process (observance of the provision of Directive 92/3/Euratom, implementation of the recommendations contained in the Council Report on Nuclear Safety in the Candidate Countries in the Context of Enlargement) and, on the other hand, as result of the worldwide concerns regarding acts of terrorism. The main modifications were:

- entire financing of CNCAN from the tariffs received for the licensing and control of nuclear activities;
- the appointment of CNCAN personnel, which develops activities in radiological areas, as exposed workers;
- possibility to set-up technical support organisations for CNCAN;
- the special provision to allow the transit of radioactive waste on the Romanian territory, for the alignment to the provisions of Directive 92/3/Euratom, in the circumstances when the import remains forbidden;
- strengthening of the attributions of CNCAN inspectors;
- definition of terrorism acts in nuclear field for sizing the threat over nuclear installations and facilities, in order to enhance their physical protection;
- penal infringement in case of unauthorised decommissioning of nuclear or radiological installations or unauthorised (un-notified) ceasing of nuclear activities.

Law no. 63/2006 brought new amendments and completions to Law no. 111/1996. Some of these amendments were required for the harmonisation with European Union's legislation. An additional provision was introduced also in Chapter "Final and Transitory Provisions", stipulating that upon accession the safeguards activities shall be developed according to the provisions of the Euratom Treaty.

The completion of the Law no. 111/1996 was also necessary in order to regulate some situations that may appear as result of transition to the market economy. For example, specific provisions were introduced in the Law, with regard to the custody of the nuclear and radiological materials for the cases in which a licensee goes bankrupt.

Amendments of the Law no. 111/1996 were necessary also for a clearer wording of some articles and for renouncing to use of the syntagma “promotion activities” in a certain context, in order to eliminate any potential for confusion. This measure originated in the European Commission recommendations contained in 2004 Regular Report to clarify and resolve the overlapping of certain institutional responsibilities between CNCAN and the Nuclear Agency, which is responsible for the promotion of nuclear activities.

In observance of the principle of correlation between the legal acts on the same level, an article referring to the Ministry of Administration and Interior was repealed, taking into account that the mentioned provisions are included in the Law no. 333/2003 on facilities, goods, and assets guarding and individuals’ protection and in the Law no. 508/2004 on setting-up, organisation and functioning of the Directorate for the Investigation of Organised Crime and Terrorism.

Completions regarding the licensing regime were introduced also in order to take account of the risk associated with the different nuclear activities. Thus, the licences are issued according to three levels: licence, registration and notification. There was also a clearer separation made between the capacity as an owner, user or operator of a nuclear installation, as holder of the different licences.

Other amendments were performed in order to correlate the provisions of Law 111 with those of the Law no. 481/2004 on civil protection. Some completions to an appendix of the law, regarding introduction to the proper definition for illicit traffic, uranium and thorium ore and for the definition completion of the radiological installation, were also brought through this amendment.

On the 27th of June 2006, the Law no. 111/1996 on the safe deployment, regulation, licensing and control of nuclear activities, was republished. In this report, it will be further referred to as “the Law”.

7.1.2. Structure and content of the Law

The purpose of the Law is to provide for a comprehensive legal framework for regulation, licensing and control of all activities related to the peaceful use of nuclear energy. The content of the Law is described as follows:

Chapter I - General Dispositions

This chapter defines the purpose of the law, the activities which are within the scope of the law, as well as the authority, mandate and responsibilities of CNCAN.

The Law applies to the following activities and sources:

a) research, design, possession, siting, construction, assembly, commissioning, trial operation, operation, modification, preservation, decommissioning, import and export of nuclear installations;

b) design, possession, siting, construction, assembly, commissioning, operation, preservation and decommissioning of installations for milling and processing of uranium and thorium ores and of installations for the management of wastes resulted from the milling and processing of uranium and thorium ores;

c) production, siting and construction, supply, leasing, transfer, handling, possession, processing, treatment, use, temporary or permanent storage, transport, transit, import and export of radiological installations, nuclear and radioactive materials, including nuclear fuel, radioactive waste, and ionising radiation generating devices;

d) production, supply, and use of dosimetric equipment and ionising radiation detection systems, materials and devices used for the protection against ionising radiation, as well as containerisation or means of transport for radioactive materials, especially designed for such purposes;

e) production, supply, leasing, transfer, possession, export, import of the materials, devices, and equipment specified in Annex 1 to the Law;

f) possession, transfer, import and export of unpublished information related to materials, devices and equipment pertinent to the proliferation of nuclear weapons or other explosive nuclear devices, as specified in Annex 1 to the Law;

g) manufacturing of products and supply of services designed for nuclear installations;

h) manufacturing of products and supply of services designed for radiation sources, dosimetric control instruments, ionising radiation detection systems, materials and devices used for the protection against ionising radiation.

i) orphan sources, from their detection to their final disposal as radioactive waste.

In accordance with the Law, CNCAN is the national competent authority that exercises regulation, licensing and control attributions in the nuclear field. CNCAN is a public institution of national interest, with legal personality, having its headquarters in Bucharest, chaired by a President with the rank of State Secretary, coordinated by the Prime Minister through the Prime Minister’s Chancellery. The first chapter of the Law also establishes the modality of CNCAN financing.

The general dispositions also include statements with regard to the banning of nuclear proliferation activities and import of radioactive waste and spent fuel (unless the waste and spent fuel originates from Romania).

Chapter II - Licensing Regime

This chapter is structured in two sections: “Licences and Permits”, and “Licensing Conditions.”

The first section defines all the activities for which a formal authorisation from CNCAN is needed, under the form of a licence or permit. It also set the general framework for the licensing process, including the licensing stages for the nuclear installations.

The licences for nuclear installations are granted to legal persons, at their request, if they prove compliance with the provisions of the Law and specific regulations issued by CNCAN. According to the Law, the licences issued by the CNCAN shall be drawn up by levels of exigency, depending on the risks associated with the activities that are subject to licensing.

The licenses are applied for and issued, respectively, either simultaneously or successively, separately for each kind of activity or for each nuclear or radiological installation operating independently, belonging to the applicant's property. The licensing of construction or operation phases for any nuclear or radiological facility may only take place if for the previous phases have been granted all the types of necessary licenses.

For a nuclear installation such as a nuclear power plant, the licensing stages include design, siting, construction, commissioning, trial operation, operation, repair and/or maintenance (as major refurbishment), modification (as major upgrades), preservation and decommissioning.

Partial licences may also be issued to cover the construction or operation stages of nuclear and radiological facilities. Partial licences issued simultaneously or successively for one and the same stage may have the character of a provisional decision of CNCAN, if the applicant expressly requests so. In such a case their validity shall extend up to the issuing of the final licence of that type, but no more than two years with an extension right, on request, for two more years, when all necessary information is not available in due time. The partial licence can be withdrawn by CNCAN whenever it finds a lack of concern on the part of the licence holder for the completion of the necessary information in support of the application.

The licences and the permits are granted for a period established in accordance with the regulations developed by CNCAN. The licences and permits are not transferable.

Apart from situations when the licence holder is no more legally constituted or loses the legal personality, the licences can be suspended or withdrawn, partially or in total, for all cases of:

- non-compliance with the legal and regulatory provisions, or with the limits and conditions of the licence;
- failure to implement the corrective actions dispositioned as a result of the regulatory control;
- new situations, from technical point of view, or of other nature, that had been not known prior to the issue of the licence, and which could impact upon the safe deployment of the licensed activities.

The practice permits can be suspended or withdrawn for all cases of non-compliance with the provisions of the applicable regulations.

The second section of Chapter II provides the general conditions that an applicant shall meet for obtaining a licence, such as:
- to demonstrate the provision of adequate resources for carrying out the activities in a safe manner;
- to take all the necessary measures, at the level of the current technological and scientific standards, to prevent the occurrence of any damage that may result due to the construction and operation of the nuclear installation;
- to prove that has organisational capacity and responsibility in preventing and limiting the consequences of failures having the potential for a negative impact on the life and health of his own personnel, on the population, on the environment, on the property of third parties or on his own assets;
- to have arranged indemnification for liability in case of nuclear damage;
- to ensure that the decision-making process for safety matters in not unduly influenced by third parties;
- to have established arrangements, in accordance with the provisions of the specific CNCAN regulations, for ensuring radiological safety, physical protection, quality management, on-site emergency preparedness;
- to have established a system for the information of the public.
- to prove that has adequate and sufficient material and financial arrangements for the collection, transport, treatment, conditioning and storage of radioactive waste generated from the licensed activities, as well as for the decommissioning of the nuclear installation upon termination of operations, and has paid the contribution for the establishment of the fund for the management of radioactive waste and decommissioning;
- to prove that has obtained all the other licenses, agreements, approvals in accordance with the legislation in force, that are prerequisites for the licence issued by CNCAN.

Further information on the general conditions regarding the assurance of sufficient financial and human resources is provided under Article 11, while the conditions for obtaining a licence for the quality management system are described under Article 13.

Chapter III - Obligations of the Licence Holder

This chapter establishes the general obligations of the licence holders and responsibilities for the safety of their licensed installations, including nuclear waste management and decommissioning. Relevant excerpts from the Law are provided in this report under Article 9.

Chapter IV - Control Regime

The legal provisions stated in this chapter empower CNCAN to carry out inspections at the licence holders as well as at the applicants for a licence, to control the application of the relevant regulatory requirements.

CNCAN inspectors are empowered to perform the necessary control activities at the site where the activities subject to licensing are deployed, as well as at any other location which may be connected to these activities, including the home or other location of any natural or legal person that may carry out activities related to nuclear and radiological installations or have possession of any nuclear or radiological materials, including related information.

The control activities are performed for any of the following situations:

- before granting the licence for which an application has been submitted;
- for the whole period of validity of the licence (periodic, as well as unscheduled or unannounced inspections);
- based on a notification/request made by the licence holder;
- for cases when it is suspected that installations, devices, materials, information, activities, etc., that are under the scope of the Law, exist or are performed without having been registered and subjected to licensing/authorisation process.

Following the control, CNCAN may disposition, if deemed necessary, the suspension of the activities and cease of operation/use of the respective installation, materials, devices, equipment, information, etc. that are possessed/operated/used without a licence or the operation/possession of which could pose a threat.

In exercising the control mandate, CNCAN representatives are empowered to:

a) access any place in which activities subject to the control may be deployed;
b) carry out measurements and install the necessary surveillance equipment;
c) request the taking or receiving of samples from the materials or products directly or indirectly subject to the control;
d) compel the controlled natural or legal person to ensure the fulfilment of the provisions mentioned under points a) – c) and to mediate the extension of the control to the suppliers of products and services or to their subcontractors;
e) have access to all the information necessary for achieving the objectives of the control, including technical and contractual data, in any form, with observance of confidentiality if the holder makes explicit requests in this sense ;
f) compel the licence holder to transmit reports, information, and notifications in the form required by regulations;
g) compel the licence holder to keep records, in the form required by regulations, of materials, of other sources and activities subject to the control, and to control these records;
h) receive the necessary protective equipment, for which the applicant or licence holder shall arrange.

For the whole duration of the control activities, CNCAN representatives have the obligation of observing the applicable licensing conditions, as imposed upon the personnel of the licence holder.

CNCAN representatives have the following attributions, to be exercised after conclusion of the inspection/control activity:

a) to draw up a report stating the results of the control, the corrective actions requested, and the deadlines for their implementation;
b) to propose the suspension or withdrawal of the licence or practice permit, under the terms of the Law;

c) to propose the information of the legal prosecution bodies in the cases and for the violations specified under the Law;
d) to request that the licence holder to applies disciplinary sanctions to the personnel guilty of violations specified in the Law;
e) to apply the sanctions for contraventions, as specified in the Law, to the persons vested with the statutory responsibility of representing the licence holder in the relation with the public authorities;
f) to apply the sanctions for contraventions, under the terms of the Law, to the personnel guilty of commission of the respective violations.

Chapter V - Attributions and Responsibilities

This chapter defines the attributions and responsibilities of CNCAN, as well as those of the other governmental organisations that have different roles in the regulation, monitoring or control of the various nuclear activities. The provisions stated in Chapter V of the Law are described in this report under Article 8.

Chapter VI - Penalties

This chapter defines the violations, including criminal offences, acts of terrorism and contraventions, and the respective penalties entailed, specifying that the offences of attempt are also subject to prosecution. The unauthorised deployment of any of the activities subject to licensing or approval under the terms of the Law constitutes a criminal offence.

Chapter VII - Provisional and Final Dispositions

This chapter includes provisions with regard to the validity of the licences and permits issued prior to the coming into force of the Law, the possibility of appealing against any regulatory decision claimed to have caused a prejudice, etc.

The Annexes to the law include the following:

Annex 1: List of materials, devices and equipment pertinent to nuclear proliferation;

Annex 2: Definitions;

Annex 3: Authorities having various attributions in controlling nuclear activities:

1. CNCAN;
2. Local Authorities for Public Health;
3. State Inspectorate for Environmental Protection;
4. State Inspectorate for Boilers, Pressure Vessels and Hoisting Installations (ISCIR);
5. The National Committee for emergency situations (within the Ministry of Interior and Administration Reform);
6. General Police Inspectorate (within the Ministry of Interior and Administration Reform);
7. State Inspectorate for Labour Protection from the Ministry of Labour, Family and Equal Opportunities;
8. National Agency for the Control of Exports;

9. National Authority for Customs;
10. The Romanian Bureau of Legal Metrology.

Annex 4: List of organisations without legal personality, that can hold a licence under the terms of the Law (consulting rooms).

7.1.3 Development of regulations

CNCAN is empowered by Law to develop regulations in order to detail the general legal requirements as well as any other regulations necessary to support the licensing and control activities.

The ordinary Law 24/2000 on “Legislative technique for elaboration of the normative acts” and the Governmental Decision 555/2001 for “Appointing a Regulation regarding procedures for submitting draft normative acts to governmental endorsement” establish the general provisions, technical rules and administrative procedures for the development of all Romanian regulations (normative acts).

All the regulations issued by CNCAN are mandatory and enforceable. The regulations are developed in observance of relevant international standards and good practices.

The Quality Management System of CNCAN includes also a procedure for drafting regulations and a process is in place to ensure internal consultation among CNCAN departments regarding the draft regulations. This is usually undertaken prior to the external consultation. The aim of the internal review is to provide an independent assessment of the scope, structure, content and implications of the regulatory documents, by persons not directly involved in their production. In some cases, external experts are also involved in the review the draft regulations developed by CNCAN staff. The correctness with regard to technical and legal aspects is observed.

The regulations in draft are sent for external consultation to all interested organisations in order to receive feedback. The comments and suggestions received are analysed and discussed in common meetings. As a consequence of this review process, the regulations may suffer some amendments. Subsequently, the final revision of the regulation is approved by the President of CNCAN and then submitted for publication in the Official Gazette of Romania. Besides publication in the Official Gazette, in order to provide for broader dissemination, CNCAN publishes the regulations separately in brochures, as well as on the website.

In accordance with the provisions of the Law, CNCAN has the responsibility for reviewing the regulations whenever it is necessary for these to be consistent with international standards and with ratified international conventions in the domain, and for establishing the measures for the application thereof.

Various sources of information relevant for updating the system of regulations and guides are used, including international cooperation as well as feedback from the operators and from CNCAN inspectors based on their experience from the enforcement of the regulations.

Besides the needs arisen from the licensing process, priorities for development of regulations were established as part of the harmonisation process in the WENRA countries. During the harmonisation study, the national regulations have been benchmarked against the reference levels established by the Reactor Harmonisation Working Group based on the Safety Requirements and Safety Guides of the IAEA Safety Standards Series. The regulations benchmarked as part of the WENRA harmonisation study are listed below:

- Nuclear Safety Requirements (NSR) - Nuclear Reactors and Nuclear Power Plants (1975), which contains provisions concerning licensing basis documentation, site evaluation criteria and design criteria for NPPs.
- Requirements for prevention and extinction of fires, applicable in the nuclear activities (1976);
- Nuclear Safety Requirements on Emergency Plans, Preparedness and Intervention for Nuclear Accidents and Radiological Emergencies (1993);
- Regulation on granting practice permits to operating, management and specific training personnel of Nuclear Power Plants, Research Reactors and other Nuclear Installations (2004);
- The set of regulations on Quality Management Systems for nuclear installations (NMC series, 2003) which contain provisions related to the quality assurance and safety of operation, maintenance, in-service inspection, testing, modifications, training of personnel, procurement activities, etc.
- Technical Prescriptions for Design, Execution, Assembling, Repair, Verification and Operation of Pipes under Pressure and of Elements of Pipes from Nuclear Plants and Facilities (NC2-83) issued by the State Inspectorate for Boilers, Pressure Vessels and Hoisting Installations (ISCIR).

Since the completion of the benchmarking, CNCAN has published the following regulations:

- Requirements on Containment Systems for CANDU Nuclear Power Plants (2005);
- Requirements on Shutdown Systems for CANDU Nuclear Power Plants (2005);
- Requirements on Emergency Core Cooling Systems for CANDU Nuclear Power Plants (2006);
- Requirements on Fire Protection in Nuclear Power Plants (2006).
- Requirements on Periodic Safety Review for nuclear power plants (2006).
- Requirements on Probabilistic Safety Assessment for nuclear power plants (2006).

The requirements on the special safety systems for CANDU NPPs (containment system, shutdown systems and emergency core cooling system) endorse the Regulatory Documents issued by the Canadian Nuclear Safety Commission.

A regulation containing requirements on Safety Classification of Systems, Structures and Components of Nuclear Power Plants is currently under review following external consultation, while a regulation establishing requirements on Modifications to Nuclear Power Plants is under drafting. Also a regulation on

Commissioning of Nuclear Power Plants is under drafting. The revision of the NSR regulation establishing general design criteria is scheduled to start this year.

The revision of the set of 13 QMS regulations covering activities related to all the phases of the lifetime of nuclear installations has started this year, to take account of the latest IAEA Requirements and Guides on Management Systems. The set of regulations on Quality Management Systems is described under Article 13 - Quality Assurance.

The Fundamental Requirements on Radiological Safety for nuclear and radiological installations were issued by CNCAN in 2000, and they transpose the Council Directive 96/29/EURATOM of 13 May 1996 laying down basic safety standards for the protection of the health of workers and the general public against the dangers arising from ionising radiation. Since then, the regulatory framework in the field of radioprotection was completed with specific requirements on various aspects, such as individual dosimetry, designation of Qualified Experts in Radioprotection, issuance of Practice Permits for different nuclear activities, licensing of undertakings, occupational radioprotection of outside workers, etc. In 2005, CNCAN issued a set of specific technical requirements on the radioactive discharges from nuclear and radiological installations. Further information on these is provided under Article 15 - Radiation Protection.

The complete list of laws, treaties, regulations, etc. related to the safety of nuclear installations and activities is provided in Annex 1 of the report.

7.1.4 Progress with the implementation of the national action plan for the harmonisation of safety requirements

The results of the benchmarking (finalised in 2005) and the current situation, based on a self-assessment against the latest revision of the WENRA reference levels, have been used as input to the national action plan (provided in Annex 2 of the report) for the elaboration of regulations and for implementing measures to cover all the issues identified.

The evidence that has been used for benchmarking is heavily relying on documentation that has been approved by CNCAN, having the updated safety analysis report as the major source of information for verification of the implementation. A number of plant's procedures, especially operating procedures and their technical basis' documents, inspection and maintenance procedures, as well as procedures relevant for the control of modifications, have also been checked for more detailed information relevant to specific reference levels. In addition, the industrial standards and codes used for the plant design and various operational programmes (e.g. periodic inspection programme, fire protection programme, etc.) have been consulted. As part of the verification process, CNCAN staff has also conducted inspections and interviews with different technical managers from the plant. For specific issues related to design, the design manuals for various systems and the accident analyses, as well as the probabilistic safety assessments have been consulted for ensuring the accuracy of the information presented during benchmarking.

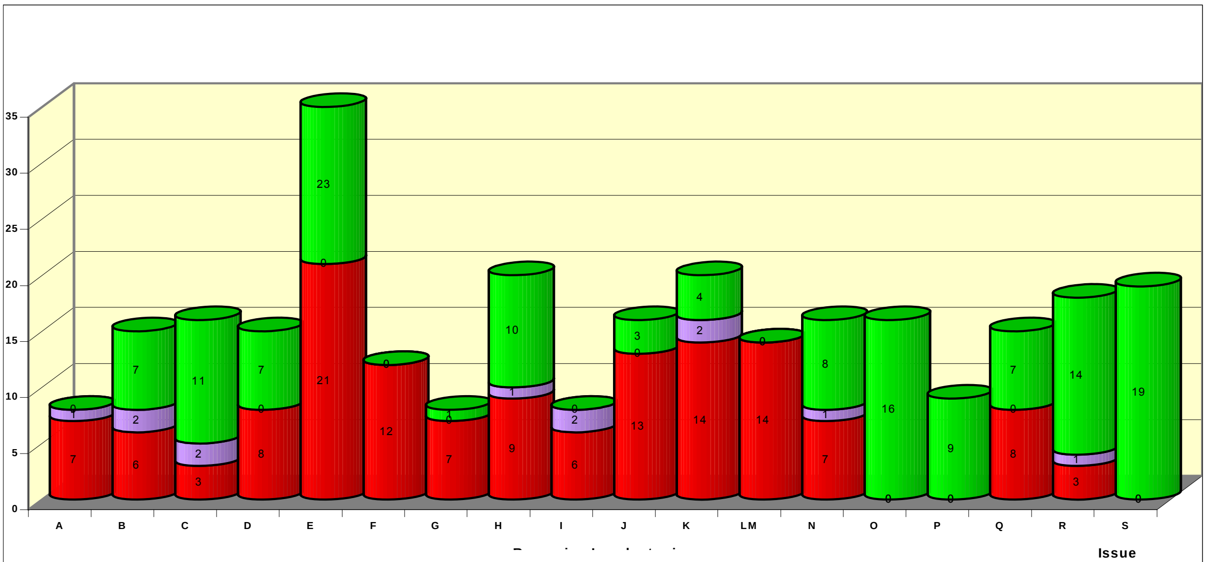


Fig. 7.1 Current situation of the regulatory requirements

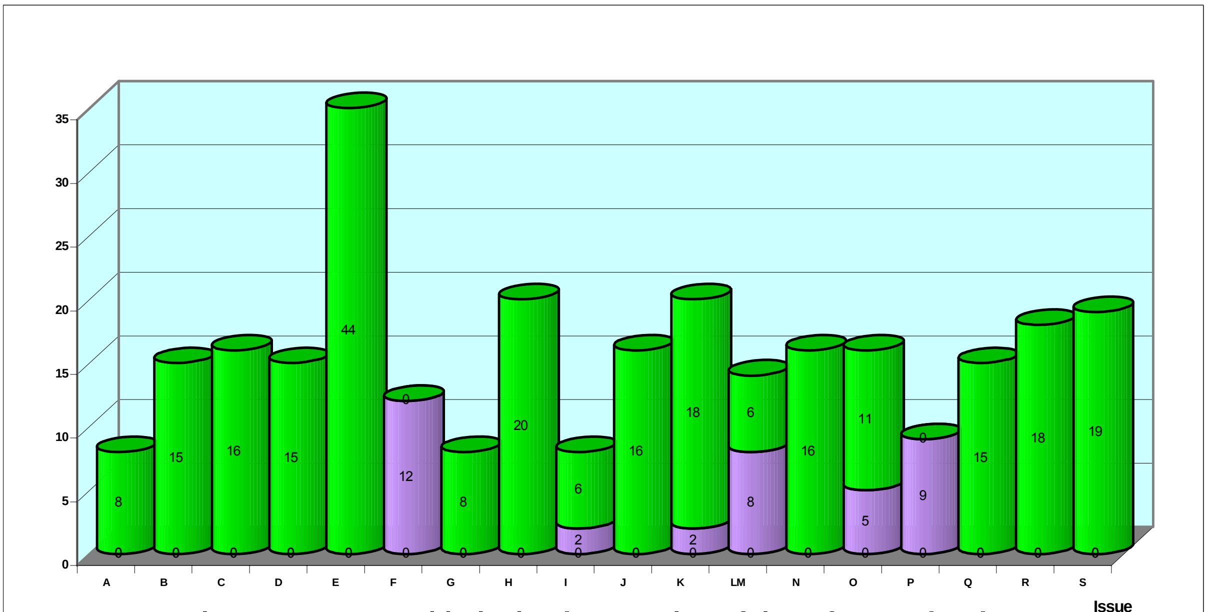


Fig. 7.2 Progress with the implementation of the reference levels

- Already harmonised
- Reference levels that are met by equivalent regulatory requirements, or are not applicable due to design specificities, or the implementation of which is in progress
- Reference levels that remain to be formally endorsed by national regulations, in accordance with the action plan

The graphs presented in Fig. 7.1-2 are based on the latest developments, both with regard to the regulations issued after the completion of the benchmarking and the ongoing activities of the utility for implementing a severe accident management programme (issues F, LM), developing PSA Level 2 (issue O) and performing a PSR (issue P).

7.2 Overview of the licensing practices

The current licensing practice for Cernavoda NPP is based on the provisions of the Law and of the regulations issued by CNCAN. The requirements specified in the Law and the regulations are rather general and therefore a number of mechanisms are in place to ensure effective management of the licensing process. This section only gives general information on the licensing process, the more detailed aspects being emphasised in relation with the different activities covered by the Articles 11 - 19.

The detailed regulatory requirements, as well as the assessment and inspection criteria used by CNCAN in the licensing process are derived from a number of sources, such as:

- Romanian regulations;
- Limits and Conditions specified in the different licences;
- IAEA Safety Standards and Guides;
- ICRP recommendations;
- Regulatory documents developed by CNSC and US NRC;
- Applicable Standards and Codes (CSA, ANSI, ASME, IEEE, etc.);
- Safety related documentation produced by the licensee and approved or accepted by CNCAN (e.g. Safety Analysis Reports, Safety Design Guides, Design Manuals, reference documents, station instructions, operating manuals, technical basis documents, etc.)

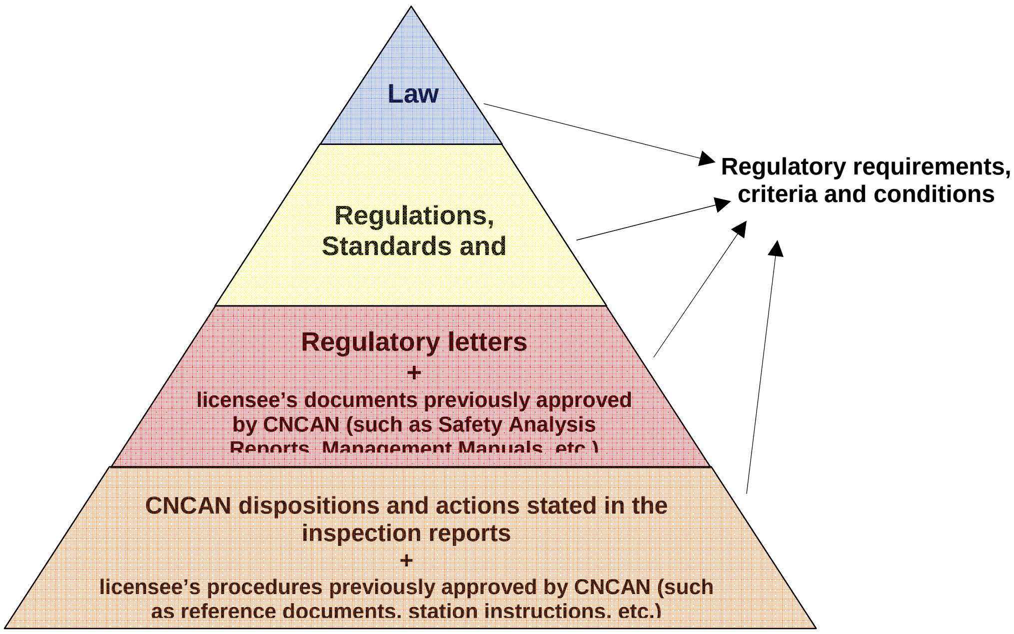


Fig. 7.3 - Documents containing requirements used by CNCAN in the licensing

Apart from the formally issued (published) regulations, the requirements established by CNCAN in the licensing process are imposed through regulatory letters. Requirements and dispositions are stated also in the inspection reports.

Control of licensing submissions is described in the Quality Management System of CNCAN, within the framework of which a set of procedures have been established that define the different activities and tasks performed by the different organisational divisions involved in the licensing process. The licensing process is documented according to CNCAN internal procedures.

The licensing submissions include, as the main document, a safety analysis report having a content in accordance with the specifications established by CNCAN for each stage of the licensing process. In addition to the safety analysis reports, various supporting documents are submitted by the applicants to demonstrate the safety of the nuclear installation and the fulfilment of all the relevant legislative and regulatory requirements.

The review process performed by CNCAN is documented by one of the following means:

- evaluation reports;
- regulatory letters;
- inspection reports, containing findings and dispositions;
- written minutes as result of the licensing meetings (common meetings between CNCAN staff and the representatives of the licence holder or applicant).

If the review concludes that all the requirements have been met by the applicant, a licence is issue by CNCAN, for a limited period of time (usually 2 years). All the limits and conditions derived for each specific case are clearly stated in the licence, which includes sections devoted to quality management, emergency preparedness, radiation protection, reporting requirements, compliance with licensing basis documents, the hierarchy of documents of the licensee, etc.

For example, the content of a licence for operation includes:

- facility and activities covered by the licence;
- period of validity, provided that all conditions are met;
- general conditions specifying the documents on which the licence is based;
- specific conditions on the facility organisation and personnel;
- specific conditions for the operation (limits and conditions);
- specific conditions related to radiation protection of personnel, public and environment;
- specific conditions regarding approvals for design changes and changes in the operating conditions;
- specific conditions for the management of records;
- specific conditions governing the procurement, possession, use, transfer, and storage of the nuclear fuel, of the nuclear and radiological materials, etc;
- specific conditions regarding safeguards;
- specific conditions regarding physical protection;
- specific conditions regarding quality management;
- reporting requirements (incident reporting, quarterly and annual reports);
- specific conditions regarding the periodic safety review;
- status of emergency preparedness arrangements (to be described in quarterly reports).

The licensing process for siting, construction, commissioning and operation of a nuclear power plant is detailed under Articles 17 - 19.

According to the Law, a licence for the quality management system has to be obtained from CNCAN, as pre-condition for the issuance of the construction / commissioning / operation / decommissioning licence. The licensing of the quality management systems is applied not only to the operators of nuclear installations but also to the suppliers of products and services for the nuclear installations. More detailed information on this matter is provided under Article 13 - Quality Assurance.

For detailing the requirements in the Law with regard to the issuance of practice permits, the procedures and conditions for issuing a practice permit for the personnel involved in the operation and management of the nuclear installations are established by the "Regulation on granting practice permits to operating, management and specific training personnel of Nuclear Power Plants, Research Reactors and other Nuclear Installations". More information on licensing of personnel with safety related duties is provided under Article 11 - Financial and Human Resources, in section 11.6.

7.3 Regulatory Assessment, Inspection and Enforcement

In accordance with the provisions of the Law, CNCAN is empowered to request from the licensees, or from the applicants for a licence, all the documentation needed for the regulatory decision making process on safety related matters. The documentation that needs to be submitted to CNCAN for review and approval is usually specified in the regulations. Additional support documentation is requested on a case by case basis and specified in regulatory letters, minutes of the meetings between CNCAN staff and licensee's representatives, etc. According to the Law, the licensees and applicants have the obligation of facilitating CNCAN inspections and access to documentation and to provide all the information required by CNCAN.

The safety related documentation made available to CNCAN includes a large variety of documents, such as safety analysis reports, (quality) management manuals, different kinds of safety assessments and technical evaluations, information reports and procedures (reference documents, station instructions, operating procedures, work plans, etc.).

The responsibilities for the review and assessment of the technical documentation submitted by the licensees or applicants are assigned to the different technical divisions within the organisational structure of CNCAN, in accordance with the provisions of the Quality Management Manual of CNCAN.

The regulatory review activities are planned, performed and reported as per internal procedures and instructions in order to assure the availability of internal resources and, as appropriate, external resources and to establish efficient interfaces with the licensees, as important tools for nuclear safety regulation management. Each technical division has specific attributions and develops assessment and inspection procedures and plans in the respective areas under their responsibility.

For major reviews, such as those performed by CNCAN prior to granting a licence or an approval for a licensing milestone, a management by process is used and interdisciplinary teams are established, which include experienced staff from all the technical divisions and units involved in the licensing of NPPs, with the necessary expertise for covering all the areas of review. Most of the experts responsible for the assessment of the safety related documentation are participating also in the teams that perform the inspections. It should be noted that the assessments and inspections performed in the framework of the major reviews mentioned above are performed supplementary to the assessment and inspection activities deployed by each division on a regular basis. The activities of the various technical divisions in the area of safety assessment and inspections for Cernavoda NPP are coordinated by a Project Manager.

Examples of procedures used in the framework of the major/interdisciplinary reviews are given below:

- Assessment of safety documentation attached to the application for a licence;
- Review and Assessment Activities of CNCAN during Commissioning and Trial Operation;
- Renewal of Operating Licence;
- Review of Commissioning Specifications;
- Regulation of Commissioning Stage;
- Documents to be attached to an application for an operating licence and their distribution;
- Approval of reactor power ascension during Phase “B” and Phase “C” of the commissioning stage;
- Preparation of specialist assessment work requests and assessment reports or comments;
- Assessment of nonconformities/nuclear events reportable to CNCAN;

The assessment and inspection criteria are usually specified in the internal procedures of CNCAN. However, these criteria are of a rather general nature and situations arise for which more detailed criteria are established ad-hoc, with adequate justification based, as the case may be, on safety assessments, engineering judgement or recognised good practices.

The key objective of CNCAN inspection programme for Cernavoda NPP is to monitor compliance with the legal, regulatory and licensing requirements, and to take enforcement action in the event of non-compliance. The inspections for Cernavoda NPP are planned in a systematic manner by the staff from CNCAN headquarters and the resident inspectors, with the aim of ensuring a proactive identification of the deficiencies and deviations from good practices that could result in non-compliances.

The inspection planning for Cernavoda NPP is periodically reviewed and modified as new information on the facility or organisation is obtained. The inspections are normally focused on those areas that would pose a significant risk, or for which a poor performance has been recorded. However, if an assessment finds good performance in an area, the results may be used to reduce the frequency and depth of the future inspections.

The inspections performed by CNCAN include:

- scheduled inspections, planned and performed either by each of the technical divisions, or jointly, with the occasion of the major licensing milestones;
- unscheduled and/or unannounced inspections, some of these being reactive inspections, in response to incidents;
- routines and daily observation performed by the resident inspectors.

Examples of inspection activities and tasks performed by CNCAN inspectors, are given below:

- review of plant operation reports;
- review of progress on outstanding safety issues;
- review of the past safety performance of the plant;
- review of the status of committed safety improvements;
- review of the station requests with regard to deviations from conditions in the OP&Ps.
- quality management audits
- review of temporary & permanent modifications to ensure they are consistent with the licensing basis for the plant for the following types of documents;
- system inspections;
- observation of operating practices & work;
- monitoring of the training programme implementation;
- monitoring of emergency drills;
- monitoring of the radiological protection practices;
- independent assessment of the radiological impact on environment.

Resident inspectors in the NPP Surveillance Section have a very important role in the daily observation and assessment of the activities on site. The team of resident inspectors is responsible for producing the first draft of the annual inspection plan, which is then reviewed and supplemented by the staff in the CNCAN headquarters.

Examples of activities performed by the resident inspectors are given below:

- verification of the implementation of the dispositions and recommendations resulted from previous inspections;
- independent preliminary investigation of events significant for safety;
- inspections in the field for observing and gathering information on the general progress of plant activities;
- detailed system inspections, for observing the performance of maintenance activities and the status of related documentation;
- daily verification of the various records and reports related to the operation of the plant;
- evaluation of the practices in different areas of activity to observe adherence to procedures, with focus on radiation protection aspects, preventive maintenance activities, testing of the special safety systems, personnel training, quality assurance, etc.

- monitoring of the emergency preparedness arrangements;
- surveillance of the performance of activities during the planned outages with regard to configuration of the safety related systems, radiation protection of the personnel, work involving contractors, elaboration and review of the safety documentation (procedures, work plans, modification proposals, etc.);
- witnessing the performance of tests or other activities performed on safety related systems, usually according to an inspection plan that includes Witness Points (WP) and Hold Points (HP) (this approach is used mainly for monitoring the commissioning activities of Unit 2 and for the planned outages of Unit 1).

A series of routine inspections is used by the NPP Surveillance Section to monitor the physical state of the systems and the operating parameters, that cover all safety relevant areas of the plant. These routines are performed periodically, for each area the inspection activities being fully covered every 3 months, to verify the implementation of the relevant plant programmes and plans.

The areas covered by the routine inspections are:

- Reactor Building;
- Service Building;
- Turbine Building;
- High Pressure Emergency Core Cooling Building;
- Emergency Water System Building;
- Secondary Control Area;
- Standby Diesel Generators Building;
- Spent Fuel Bay;
- Pump House;
- Chillers Building;
- Fire Response Command Area.

During planned outages are inspected also the areas not accessible during operation at power.

Besides the routines, the resident inspectors perform daily visits to the control room, for verifying the main operating parameters and the different aspects related to work planning and control of temporary modifications. The resident inspectors participate also as observers in the daily planning meetings of the plant management. Daily reports are elaborated by the NPP Surveillance Section and forwarded to the CNCAN headquarters for information on the plant status and for ensuring awareness of any inspection findings.

The inspection findings are generally classified based on the following criteria:

- Nonconformities with potential impact on public safety/nuclear safety;
- Nonconformities with potential impact on environmental protection;
- Nonconformities with impact on plant security;
- Nonconformities with impact on work safety;
- Nonconformities with impact on production;
- Non-compliances with management system requirements.

The assessment and inspection activities performed by CNCAN staff are documented by one of the following means:

- assessment reports;
- inspection reports;
- written minutes of the meetings with licensee's representatives.

These documents are also made distributed to the licensee, in addition to the regulatory letters that summarise the main regulatory requirements and dispositions based on findings arising from the review process.
In accordance with the provisions of the Law, CNCAN has in place a system to enforce compliance through graded measures. Therefore, the possible actions that CNCAN can take in the event of non-compliance are:

- dispositions for licensee action (these are stated in each inspection report);
- action notices/directives through regulatory letters;
- licence amendments;
- restricted reactor operation;
- revocation or suspension of the license;
- prosecutions.

ARTICLE 8 - REGULATORY BODY

1. Each Contracting Party shall establish or designate a regulatory body entrusted with the implementation of the legislative and regulatory framework referred to in Article 7, and provided with adequate authority, competence and financial and human resources to fulfil its assigned responsibilities.

2. Each Contracting Party shall take the appropriate steps to ensure an effective separation between the functions of the regulatory body and those of any other body or organization concerned with the promotion or utilisation of nuclear energy.

8.1 Description of the Attributions and Responsibilities of CNCAN

The development of the legislative framework of and the regulatory body has been described under Article 7. The general attributions and responsibilities of CNCAN are stipulated in the Chapters I and V of the Law, and are further detailed in the Rule for Organisation and Functioning of CNCAN, approved by Governmental Decision.

The mandate of CNCAN can be summarised as follows:

- CNCAN is the national authority competent in exercising regulation, licensing and control in the nuclear field, for all the activities and installations under the scope of the Law.
- CNCAN elaborates the strategy and the policies for regulation, licensing and control with regard to nuclear safety, radiological safety, non-proliferation of nuclear weapons, physical protection of nuclear installations and materials, transport of radioactive materials and safe management of radioactive waste and spent fuel, as part of the National Strategy for the development of the nuclear sector, approved by Governmental Decision.
- CNCAN is responsible to ensure, through the regulations issued and the dispositions arising from the licensing and control procedures, that an adequate framework is in place for the deployment of activities under the scope of the Law.
- CNCAN is responsible for revising the regulations whenever necessary for the correlation with the international standards and ratified conventions in the nuclear field and for establishing the necessary regulatory measures for their application.

CNCAN has the following attributions and responsibilities:

a) Initiates projects for normative acts in its area of competence and issues regulations in the nuclear field, consulting as necessary the other authorities with attributions in this domain, according to the Law;
b) Reviews and consents to all the normative acts with implications for the nuclear field, prior to their coming into force;
c) Approves, in accordance with the Law, the intervention plans for the cases of nuclear accident and participates in the intervention;
d) Collaborates with the central authority for environmental protection and controls the implementation of the activities of the environmental radioactivity monitoring network;

e) Requests to the competent authorities in the field of national security to perform the necessary checks for the persons with responsibilities in the field of nuclear activities, in compliance with the specific regulations;
f) Initiates, with the consent of the Ministry of Foreign Affairs, activities for cooperation with IAEA and with other international organisations specialised in the nuclear field;
g) Cooperates with similar institutions/authorities from other states;
h) Controls the implementation of the provisions of international treaties and agreements in force, with regard to safeguards, physical protection, illicit traffic, transport of nuclear and radioactive materials, radiation protection, quality assurance in the nuclear field, nuclear safety, safe management of spent fuel and radioactive waste, and the intervention in case of nuclear accident;
i) Establishes and coordinates the national system for evidence and control of nuclear materials, the national system for evidence and control of radiation sources and of nuclear and radiological installations, and the national registry of radiation doses received by the occupationally exposed personnel;
j) Cooperates with other authorities that have, according to the Law, attributions with regard to the safe operation of nuclear and radiological installations, correlated with the requirements for the protection of the environment and the population;
k) Ensures public information on matters that are under the competence of CNCAN;
l) Organises public debates on matters that are under the competence of CNCAN;
m) Represents the national point of contact for nuclear safeguards, for the physical protection of nuclear and radiological materials and installations, for the prevention and combat of the illicit traffic of nuclear and radioactive materials, and for radiological emergencies;
n) Orders the recovery of orphan sources and coordinates the recovery activities;
o) Licences the execution of nuclear constructions and exercises control over the quality of constructions for nuclear installations;
p) Carries out any other duties stipulated by the Law, with regard to the regulation and control of nuclear activities.

8.2 Position of CNCAN in the Government Structure

As shown in Fig. 8.1, CNCAN is completely separated and independent from all the organisations concerned with the promotion or utilisation of nuclear energy. The responsibilities assigned to CNCAN by the Law are concerning solely the regulation, licensing and control of nuclear activities.

Information on the historical development of the Romanian nuclear regulatory authority has been provided under Article 7.

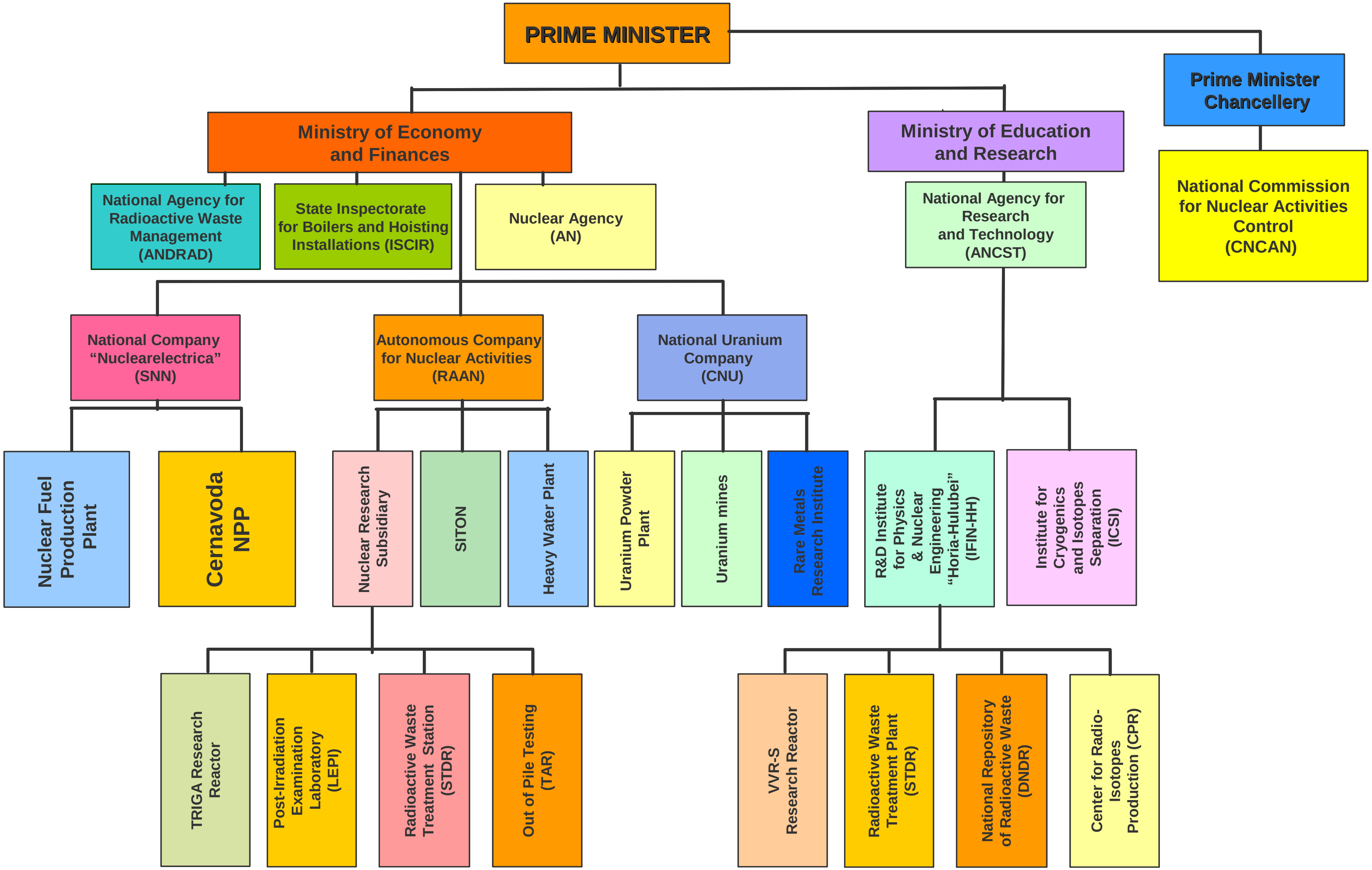


Fig. 8.1 Main organisations in the nuclear field in Romania

CNCAN reports annually or as requested to the Prime Minister, through the Chief of the Prime Minister's Chancellery, on the status of the regulation, licensing and control activities. In addition, whenever the situation requires, CNCAN presents reports on:

- Events that may affect the safe operation of nuclear facilities.
- Situations that may affect national interests or the radiological protection of population and environment on the Romanian territory.

CNCAN exercises its functions independently from the ministries and other authorities of the central public administration, subordinated to the Government.

As shown in Fig. 8.1, the companies and organisations that operate or own the main nuclear and radiological installations are subordinated to the Ministry of Economy and Finances and to the Ministry of Education and Research. The main organisation responsible for the promotion of nuclear activities for peaceful purposes is the Nuclear Agency (AN), which is also subordinated to the Ministry of Economy and Finances.

For ensuring transparency of its activities and decision making process, CNCAN routinely consults with and ensures information of all the organisations that have an interest in its regulatory activities, including licensees and other nuclear industry representatives, governmental, local and municipal authorities, departments and agencies as well as interest groups and individual members of the public.

8.3 CNCAN Organisational Structure and Human and Financial Resources

CNCAN is chaired by a President nominated by the Prime Minister. The position of the CNCAN President is assimilated to that of State Secretary. The President of CNCAN, with the advice of the Prime Minister's Chancellery, organises the subsidiary structures of the divisions of CNCAN depending on actual needs and conditions of the activities of CNCAN. The organisational structure of CNCAN and the modifications thereof are approved by Governmental Decision. The current organisational structure of CNCAN is shown in Fig. 8.2.

The management of CNCAN is done through the Management and Licensing Committee. The Committee is formed by the President, the Directors of the Divisions and the Heads of the Sections and Compartments under direct subordination to the President.

The Management and Licensing Committee receives technical support from the Advisory Committee, formed by specialists in different areas relevant for the regulation and control of the nuclear activities. The structure and authorities/responsibilities of the Advisory Committee are approved by the President of CNCAN.

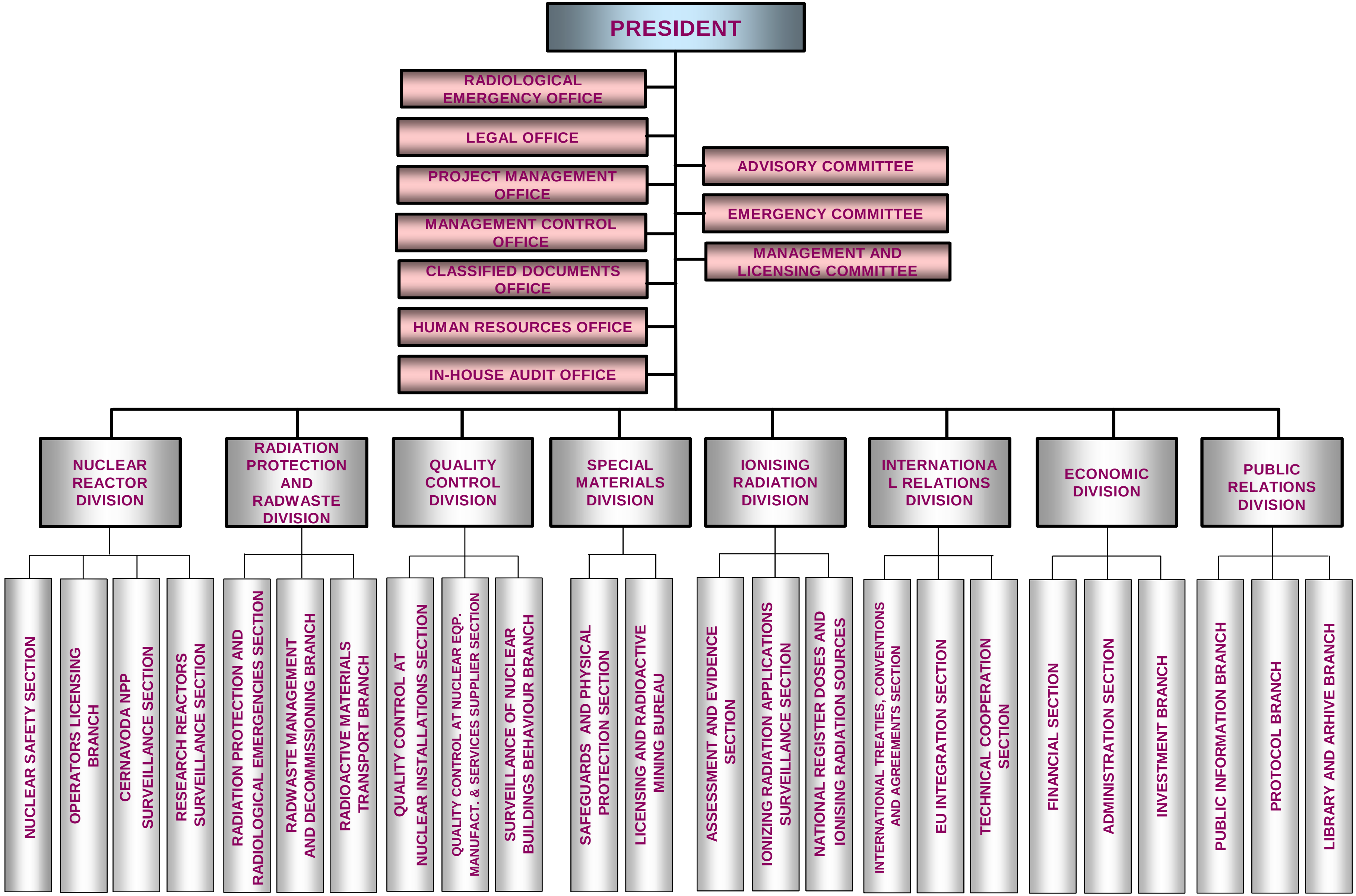


Fig. 8.2 CNCAN Organisational Structure

The organisational structure and staffing of CNCAN is properly arranged in order to cover with specialists all the assessment and inspection activities required in all phases of a nuclear installation (site selection, design, construction, commissioning, operation and decommissioning).

The main Divisions involved in the regulation, licensing and control of Cernavoda NPP are:

- Nuclear Reactors Division;
- Quality Control Division;
- Radiation Protection and Radioactive Waste Division;
- Special Materials Division.

As described under Article 7, CNCAN staff evaluate and process applications for CNCAN licences; develop and prepare licensing recommendations; administer CNCAN policies and procedures; monitor, audit and inspect nuclear facilities and activities; draft and administer licenses; evaluate the qualifications and performance of licensees and their staff; prepare documents and reports; review reports and records; develop and enforce regulatory standards and requirements. The Nuclear Reactors Division is mainly responsible for the review and assessment activities related to nuclear safety, but is usual practice to involve staff from other divisions and sections as needed, especially on the occasion of review of major licensing submissions, which is organised as a project, with distribution of tasks among sections and individuals.

In specific cases, external consultants are also employed to assist CNCAN staff in review and assessment activities or in the development of regulations. In addition, CNCAN benefits from external expertise through IAEA technical co-operation projects, PHARE projects and bilateral agreements.

At present, the total number of staff positions is 171. The adequate number of staff was determined taking into account the work necessary to be performed, in different fields of activity. The new organisational structure, approved in 2006, corresponds to the new challenges in the field (such as the increase in the number of licence applicants, the commissioning for Cernavoda NPP Unit 2, etc.).

Adequate processes are in place to ensure that CNCAN staff is competent for the assigned duties. These include appropriate criteria for the recruitment of qualified personnel, as well as the continuous training aimed at maintaining and enhancing the competencies.

The recruiting process consists of a written examination and an oral examination/interview. The subjects chosen by CNCAN for the examinations are based on a complex bibliography, consisting of a variety of topics related to nuclear field, including both technical aspects and legislation in the domain. The examination board is formed by the senior experts from the top management level of CNCAN. CNCAN can also request the participation, as members of the examination board, of Professors from the Polytechnics University and the Faculty of Physics or other specialists in the nuclear field. In the process of hiring new staff, CNCAN takes into consideration the education of the candidates in the nuclear field of study and their performances, including diplomas/degrees and their background and working experience in the nuclear sector.

Training of the staff is recognised as vital and the necessary resources are devoted to it. This objective is achieved by using in-house training and also external support, especially through IAEA Technical Co-operation Programs or bilateral agreements. The job-related performance of all CNCAN staff is formally evaluated each year in accordance with CNCAN administrative policies and procedures.

In accordance with the Law, CNCAN collects the money for its budget from fees charged for performing inspection activities and technical assessments and for granting licences, permits and authorisations. The fees charged for these activities are established through the Regulation for Taxes and Tariffs, elaborated by CNCAN in consultation with the Ministry of Economy and Finances and approved by Governmental Decision. The Regulation for Taxes and Tariffs is periodically reviewed to ensure that CNCAN funding is sufficient to adequately cover all the expenses associated with the efficient performance of regulatory activities.

8.4 Quality Management System

CNCAN has established and implemented a Quality Management System in compliance with the EN ISO 9001:2001 requirements. For the improvement of the Quality Management Manual and CNCAN operational procedures, CNCAN experts have received assistance through several PHARE projects.

The Quality Management Manual of CNCAN describes the policies with regard to the regulation, licensing and control activities, the strategic objectives and plans, the interfaces at national and international level, the responsibilities of the organisational units of CNCAN, the mechanisms for measuring, evaluating and improving the effectiveness and efficiency of the regulatory activities, etc. It also provides a set of general requirements applicable to the performance of activities within all organisational units and the specific requirements applicable to the assessment and inspection activities performed by the technical divisions. The more detailed requirements and criteria are set in the procedures defining the various regulatory processes.

In order to ensure the adequate implementation and improvement of the QMS, all relevant procedures are sent for review and approval to all the divisions and departments. The Quality Management Manual and all the internal procedures are available in electronic format on the local area network.

8.5 Cooperation with other national authorities

The licensing system is administered by CNCAN in cooperation with other governmental authorities (ministries and agencies) in such areas as health, environment, transport, labour, security, etc. The issues raised by these authorities are taken into account before licences are issued by CNCAN, providing that there is no conflict with the provisions of the Law and CNCAN regulations. All other licences granted by other governmental authorities are prerequisites to the CNCAN licences. An exception would be the environmental authorisation issued by the Ministry of Environment and Sustainable Development after the issuance of the operation licence by CNCAN. The environmental agreement, issued by the same Ministry is however a prerequisite to the siting licence.

This section summarises the responsibilities and attributions of the other authorities empowered by the Law to control specific activities in the nuclear field.

The State Inspectorate for Boilers, Pressure Vessels and Hoisting Installations (ISCIR) of the Ministry of Economy and Finance is responsible for the licensing and control of the pressure systems and equipment, including those used in nuclear and radiological installations, with appropriate consultation and collaboration with CNCAN. ISCIR establishes technical prescriptions for the design, execution, assembling, repair, verification and operation of pressure systems and equipment for nuclear power plants and performs assessments and inspections for verifying compliance with the requirements stated in the Technical Prescriptions (the set of regulations issued by ISCIR). These requirements are based on the applicable codes and standards (ASME, CSA) referenced in the technical prescriptions. ISCIR approves and registers the design of pressure systems and equipment. It also supervises the qualification of welders as well as the inspection of pressure systems and equipment. Obtaining of all necessary ISCIR authorisations and approvals constitutes a prerequisite for obtaining the licence from CNCAN for a certain licensing stage or milestone.

The Ministry of Environment and Sustainable Development, which is the central authority for environmental protection, manages the network for monitoring the environmental radioactivity on the Romanian territory, ensuring the necessary information for the integrated system for monitoring of the environmental parameters. The environmental agreements and authorisations are issued by the Ministry of Environment and Sustainable Development in consultation with CNCAN and the Ministry of Public Health, based on the provisions of the Law, complemented as appropriate with specific licensing and control criteria as established through the environmental regulations. The environmental agreement constitutes a prerequisite for the siting licence issued by CNCAN. The environmental authorisation is issued after CNCAN has granted the operation licence. The Ministry of Environment and Sustainable Development provides information with regard to the results of the monitoring activities and collaborates with CNCAN and with the Ministry of Interior and Administration Reform for establishing the necessary measures in response to the identification of any abnormal values or trends in the monitored parameters.

The Ministry of Public Health is responsible for licensing:

a) the introduction to the social and economic circuit, for utilisation or consumption purposes by the population, of products that were subject to irradiation or which contain radioactive materials;

b) the introduction to the medical field, for medical treatment and diagnosis purposes, of sealed or open sources, of ionising radiation generating devices, and of pharmaceutical products containing radioactive materials.

For this purpose, the Ministry of Public Health develops its own licensing and control system and regulations, in consultation with CNCAN and the interested ministries. The Ministry of Public Health organises:

a) the network for monitoring the contamination with radioactive materials of food products, over the whole food chain, drinking water inclusive, as well as of other goods destined to be used by the population; in this way it ensures the monitoring of the degree of radioactive contamination of these goods and products, whether manufactured in Romania or imported, to be used on the Romanian territory.

b) the epidemiological monitoring system of the health condition of the occupationally exposed personnel, and of the hygiene conditions in units in which nuclear activities are deployed; it also monitors the influence exercised by these activities on the health of the population, and issues the sanitary approvals in accordance with the regulations in force; these sanitary approvals need to be obtained prior to the application for the licence issued by CNCAN for the respective activity or installation.

Whenever necessary, the Ministry of Public Health informs CNCAN and the other interested ministries of its findings in the monitoring activity, and collaborates with these in order to establish any joint actions that may be called for.

The National Committee for emergency situations (within the Ministry of Interior and Administration Reform) is responsible for ensuring the coordination of the preparations for intervention in case of nuclear accident, in co-operation with all specialised bodies of the central and local public administration with attributions in these matters. The General Inspectorate for Emergencies (IGSU), a specialised organisation inside the Ministry of Interior and Administrative Reform, is responsible for developing and maintaining updated the intervention plans radiological emergencies, caused by nuclear accidents in nuclear plants located on the territory of other states, that may affect the Romanian territory due to cross-border effects, as well as the general off-site intervention plans for nuclear plants on the Romanian territory.

The National Agency for the Control of Exports (ANCEX) oversees the import and export of goods and technology listed in the Annex 1 to the Law (materials, devices and equipment pertinent to nuclear proliferation). The duties of ANCEX include the authorisation of imports and exports of such nuclear products, the examination of import certificates issued by the relevant authorities of the importing states in order to decide over the issuance of an export licence and the verification of all aspects of the import and export of goods and technologies subject to control and participation in international co-operation in this field.

The National Authority for Customs controls and allows the introduction on the Romanian territory or the exit from the Romanian territory of any goods for which a licence is needed from CNCAN, under the terms of the Law, by verifying the possession of the necessary licences.

The Fire Protection Brigade of the General Inspectorate for Emergencies (IGSU) of the Ministry of Interior and Administration Reform establishes the general rules concerning fire protection, applicable also to nuclear installations. It also collaborates with CNCAN in the development of the specific nuclear safety regulations concerning fire protection. The authorisation issued by the Fire Protection Brigade needs to be obtained prior to the application for a licence granted by CNCAN.

As described under Article 7, Annex 3 of the Law gives a list of authorities having attributions in controlling various aspects related to nuclear activities. Although their attributions and responsibilities are established by the legislation in force, CNCAN has also signed formal Memoranda of Understanding with each of these organisations, for ensuring the prevention of potential gaps and overlaps in the implementation of their respective duties and responsibilities.

8.6 International cooperation and exchange of information

In the area of international cooperation and exchange of information, CNCAN maintains relations with a number of nuclear regulatory authorities and organisations worldwide, through bi-lateral arrangements and commitments under international conventions in the nuclear field.

The international activities in which CNCAN is involved include the participation in the activities of WENRA and its technical working groups, the annual meetings of the Senior Regulators from countries that operate CANDU NPPs, the contribution to the initiatives at European Union level and the participation in various IAEA activities. CNCAN also participates, as observer, in the annual session of the Nuclear Law Committee (NLC) of the NEA/OECD.

With regard to technical assistance received from international organisations, CNCAN is a beneficiary of technical cooperation projects managed by the IAEA, at national and regional level. Through these projects, CNCAN received expert missions and support in the organisation of international and national seminars. Technical assistance was received by CNCAN also from the European Union, through nuclear safety projects approved through Financing Agreements concluded for each programming year.

In order to ensure the exchange of information relevant to nuclear safety, CNCAN has a number of bi-lateral agreements with regulatory bodies from other countries. Also, CNCAN has established agreements or arrangements with neighbouring countries on notification and assistance in case of nuclear accident. All the agreements concluded in the nuclear field are listed in the Annex 1.

8.7 The IRRS Mission to CNCAN

During the period of 16 - 26 January 2006, CNCAN received an IAEA Integrated Regulatory Review Service (IRRS) mission, as a follow-up of IRRT and RaSIA missions carried out in 2002 and 2004, respectively.

This mission was the first follow-up mission integrating both IRRT and RaSIA content using the IRRS concept and providing for a more comprehensive review of the national regulatory infrastructure for nuclear, radiation, radioactive waste and transport safety.

The mission had as objective the review of both the progress in implementing previous recommendations or suggestions and the areas where significant changes have been reported since the IRRT and RaSIA missions.

The review was organised in the following areas:

A. Legislative and Governmental Responsibilities;
B. Authority, Responsibilities and Functions of the Regulatory Body;
C. Organisation of the Regulatory Body;
D. Authorisation Process;
E. Review and Assessment;
F. Inspection and Enforcement;
G. Development of Regulations and Guides;
H. Emergency Preparedness;
I. Waste Management and Decommissioning;
J. Radiation Protection;
K. Transport of Radioactive Material.

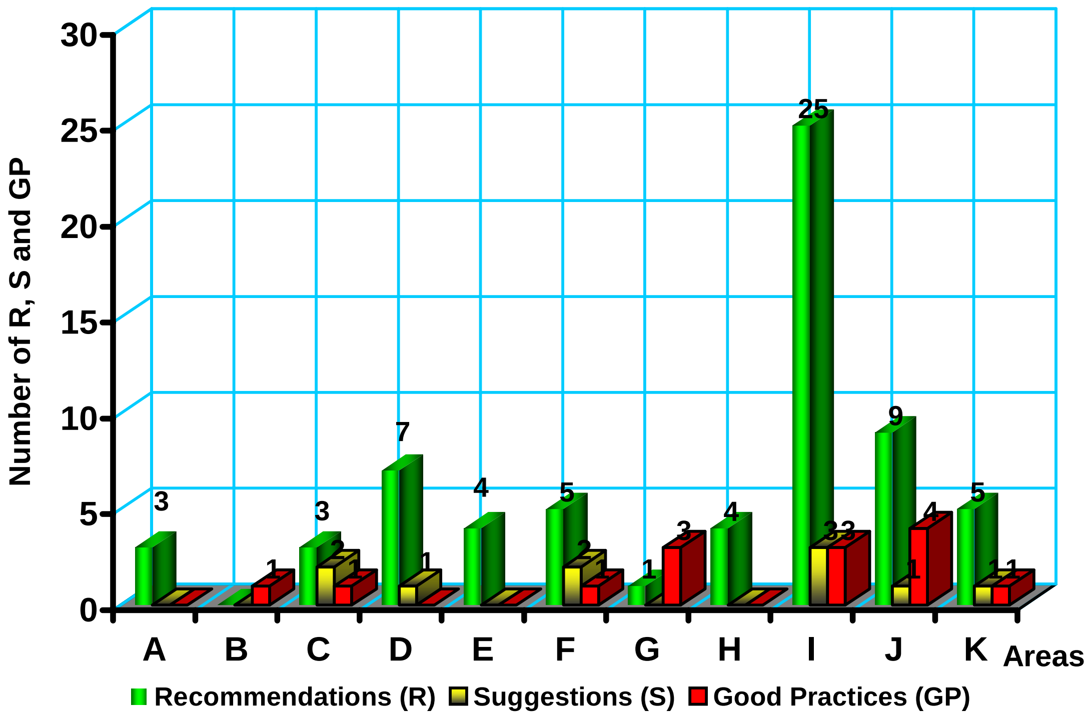


Fig. 8.3 Distribution of IRRS findings for each of the review areas

The review team noticed that CNCAN has taken a number of initiatives to improve its effectiveness and efficiency and that many recommendations and suggestions from the previous missions have been successfully addressed, particularly those for which CNCAN had full responsibility for implementation. Progress has been identified particularly with regard to the development of regulations, the management of the licensing process, the inspection programme and the nuclear safety strategy established by CNCAN.

However, new challenges have been identified and new recommendations or suggestions have been made, for areas where improvements are necessary or desirable to further strengthen the legal and governmental infrastructure for nuclear, radiation, radioactive waste and transport safety.

With regard to the regulatory infrastructure for nuclear safety, the findings relate to the need for further development of the regulations, enhancement of safety assessment capabilities and the recruitment of qualified staff for filling the vacancies. The recommendations and suggestions provided have been used as input to the strategic plan of CNCAN, which in the area of nuclear safety includes as key objectives:

- Finalising the harmonisation process of the national legislative framework in the area of nuclear safety, in line with the European and international practices and standards;
- Modernising of the licensing process and inspection management in observance of the development of European and international good practices;
- Further developing staff expertise in safety assessment and review, particularly with regard to the use of computational tools for deterministic and probabilistic analyses.

The results of the IRRS mission are recognised as a good basis for the continuous improvement of CNCAN effectiveness. The most relevant IRRS recommendations, in relation to the duties of CNCAN for the regulation, licensing and control of installations under the scope of the Convention on Nuclear Safety, are presented in Annex 3 to the present report, together with their implementation status.

ARTICLE 9 - RESPONSIBILITY OF THE LICENCE HOLDER

Each Contracting Party shall ensure that prime responsibility for the safety of a nuclear installation rests with the holder of the relevant licence and shall take the appropriate steps to ensure that each such licence holder meets its responsibility.

9.1 Definition of the legal responsibilities of the licence holder

The Romanian Law on the Safe Deployment, Regulation, Licensing and Control of Nuclear Activities, further referred to as the Law, clearly stipulates that the prime responsibility for the safety of a nuclear power plant rests with the license holder.

As detailed under Article 7, a licence is needed for each of the stages of the life time of a nuclear installation. The general conditions that an applicant shall fulfil in order to obtain a licence have also been presented under Article 7. Compliance with these general licensing conditions, as well as with all the provisions of the Law that are directed to the licensee, with the provisions of the applicable specific regulations and with the conditions embedded in the licence, is mandatory and enforceable.

The clear definition of legal obligations ensures that by no means the licensee's responsibility for safety could be diminished or shifted towards the regulatory authority. Compliance with the legislative and regulatory requirements does not relieve the licensee of its responsibility to ensure that safety is maintained and continuously improved.

The attributions and responsibilities of CNCAN are also stated in the Law, defining the role of the regulator in ascertaining that the licensees are taking all the necessary measures to ensure and maintain the safety of the nuclear installations. The regulatory system and processes for licensing, review, assessment, inspection and enforcement, as well as the attributions and responsibilities of CNCAN have been described under the Articles 7 and 8.

The main responsibilities of the licence holder are stated in Chapter III of the Law and are further detailed in the specific regulations issued by CNCAN and in the conditions attached to each license. The articles 25 - 28 from the Law, relevant to license holders for activities directly related to nuclear power plants, are given below, for illustration.

Art. 25. - (1) The licence holder has the obligation and the responsibility to take all necessary measures for:
a) ensuring and maintaining:
- *nuclear safety, protection against ionising radiation, physical protection, on-site emergency preparedness and the quality assurance for the activities deployed and/or the associated radiation sources;*
- *a strict record of the nuclear and radioactive materials, as well as of all radiation sources used or produced in the activities under the licence;*

b) complying with the technical limits and conditions stipulated in the licence and for reporting any deviations, in accordance with the specific regulatory requirements;

c) deploying only activities covered by the licence in force;
d) developing its own system of requirements, rules and instructions as to ensure that the licensed activities are carried out without posing an unacceptable risks of any kind.
(2) The liability for nuclear damage, caused during or as a result of an accident that could arise from the deployment of the licensed activities or of other activities resulting in the death, injury to the corporal integrity or health of a person, destruction, degradation, or temporary impossibility of using any goods, rests entirely with the licence holder, under the terms established by law and by the international agreements to which Romania is a party.

Art. 26. - For the deployment of any nuclear activities generating or having generated radioactive waste, the licence holder shall:
a) be responsible for the management of radioactive waste generated by the licensed activities;
b) bear the expenses related to the collection, handling, transport, treatment, conditioning and temporary or permanent storage of the waste;
c) pay the legal contribution to the Fund for the management and final disposition of the radioactive waste and spent fuel and for the decommissioning of the nuclear installations.

Art. 27. - The licence holder shall:
a) develop and submit for approval to CNCAN a programme for the preparation of the decommissioning;
b) produce the proof of having paid the legal contribution to the Fund for the management and final disposition of the radioactive waste and spent fuel and for the decommissioning of the nuclear installations.

Art. 28. - (1) The expiry, suspension or withdrawal of the licence does not exonerate the licence holder or the person having taken over the property title over the nuclear or radiological materials and installations covered by that licence, from the obligations stipulated under Articles 25 - 27, nor from those deriving from the conditions stipulated in the licence.
(2) Prior to the termination of the activities or decommissioning of nuclear or radiological installations, as well as prior to any transfer, partial or whole, of the nuclear or radiological installations and materials, the licence holder shall apply and obtain, under the terms stipulated in the present Law, a licence to own, preserve, decommission or transfer the respective installations and materials, as applicable.
(3) The licence or practice permit issued on the grounds of the present Law does not exonerate the license or permit holder from observing the legislation in force.
(4) The termination of nuclear activities shall take place in compliance with the provisions of the specific regulations issued by CNCAN.
(5) CNCAN establishes the concrete modality of application of the present law whenever its provisions cannot be applied simultaneously with other legal provisions in force, with the consultation of the relevant public administration authorities, giving priority to the observance of the conditions for the safe deployment of the nuclear activities.

9.2 Mechanisms by which the licensees ensure and demonstrate the effective fulfilment of their prime responsibility for safety

In fulfilling its prime responsibility for safety, beyond simple compliance with the legislative and regulatory provisions in force, the licensee has developed and implemented its own system of requirements, rules, procedures and instructions, with the objective of ensuring that any risks associated with its activities remain acceptable and are minimised to the extent possible. This system is described in documents that form part of the licensing basis, for each stage of the lifetime of the nuclear installation, such as the Safety Analysis Reports and the Integrated Management Manual.

The safety related activities contracted to the external organisations are effectively controlled by the licensee, who acts as an intelligent customer and remains fully responsible for the implications of the work performed. The interfaces with the external organisations are described in the Integrated Management Manual and the licence holder has in place a system for selecting contractors, monitoring and assessing their performance and maintaining effective communication with the aim of ensuring the consistent application of high standards of safety and quality.

The safety demonstration for licensing purposes has been addressed under Article 7 and is presented in detail under Article 14. Further information on the Integrated Management System of the licensee, including aspects related to the use of contractors, is provided under Article 13.

The licence holder for Cernavoda NPP is the National Company Nuclearelectrica (SNN - Societatea Nationala Nuclearelectrica S.A.), which is the corporate organisation having juridical personality. Although the authority for plant operation has been delegated to Cernavoda NPP Branch, the statutory responsibility for safety rests with the SNN. (The simplified diagram of the organisational structure of SNN is given in Fig. 9.1)

In this respect, SNN is responsible to ensure that all the requirements deriving from the applicable legislation are fulfilled and to provide resources and support for the safe and reliable operation of Cernavoda NPP. The responsibilities discharged by SNN include the strategic planning and assignment of technical and financial resources necessary for the safe and reliable operation of the NPP, the fuel production and the research and development programmes, the promotion of the safety and organisational culture, the provision of legal support, the administration of relations and interfaces with external organisations and regulatory authorities, and the information of the mass-media and the public.

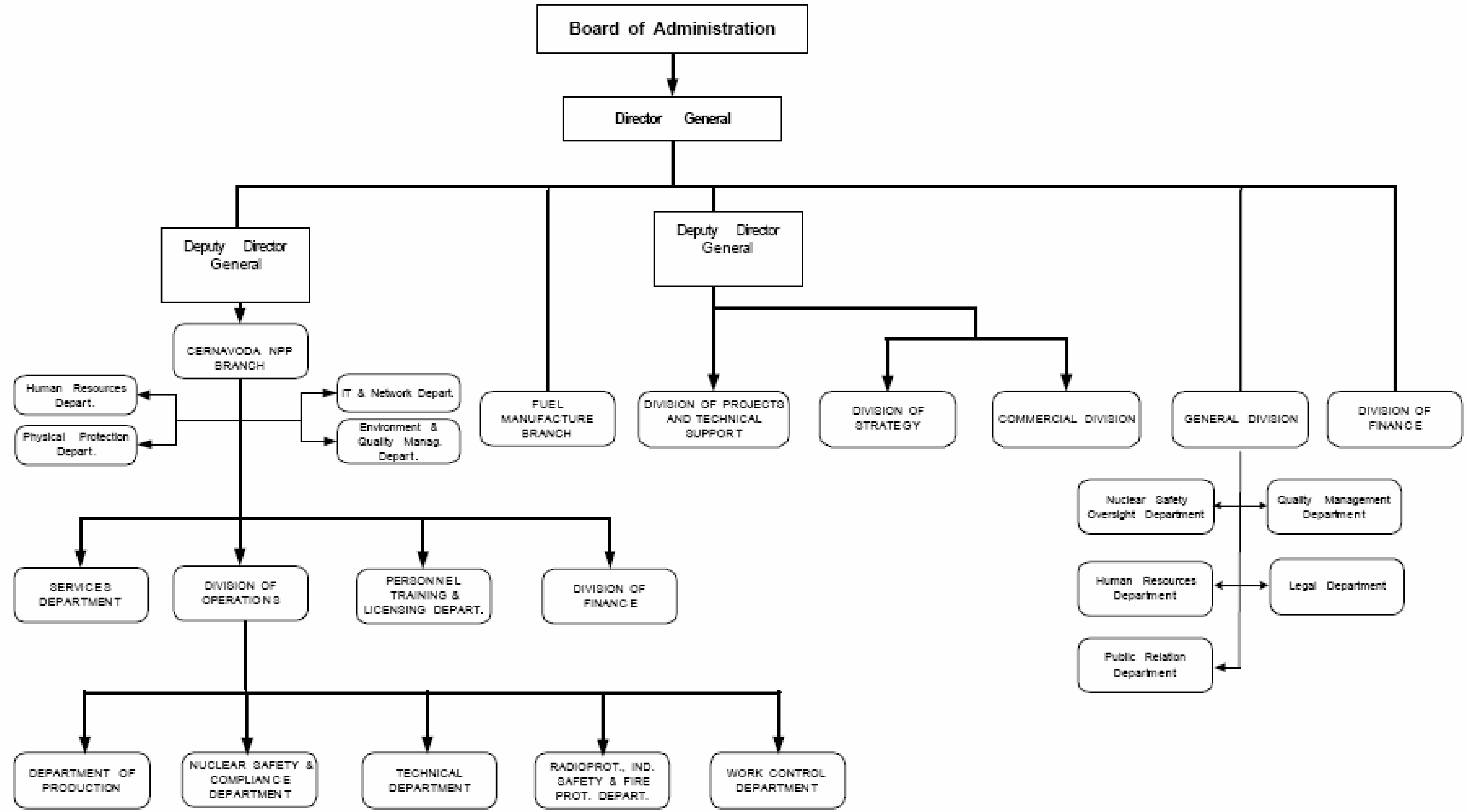


Fig. 9.1 Simplified diagram of the organisational structure of SNN - National Company Nuclearelectrica

Various mechanisms are in place to ensure awareness of safety issues at the corporate level and to inform and influence business decisions. Through the audits and independent assessments conducted by the Division for Nuclear Safety Oversight and the Department for Quality Management, SNN ensures that the safety and quality policies are observed and applied to the expected standards and that the programmes for the improvement of safety and quality are effectively implemented. The attributions and responsibilities of these organisational units are defined in specific procedures at corporate level. The corresponding activities and responsible units (e.g. independent assessment function, safety oversight, etc.) at the plant level are defined in the Integrated Management Manual of Cernavoda NPP and in specific plant procedures (these are further detailed under Article 13).

The plant safety is assessed quarterly by the Plant Safety Oversight Committee (PSOC). The role of this committee is to maintain awareness of the plant safety issues at the plant management team level, recommendations and expectations being provided to the managers, who subsequently inform the employees in their areas of activity. The strategy in place is to evaluate and review the plant safety performance, programs, actions and indicators. It initiates reviews and actions to improve and maintain high standards of safety and Safety Culture at the station.

The Senior Superintendent of the Division of Nuclear Safety Oversight of SNN attends regularly these meetings and informs the SNN Director General of the most important findings. An example of PSOC meeting agenda is shown in Table 9.1:

Table 9.1 – Plant Safety Oversight Committee Meeting Agenda

Agenda Item	Responsible
1. Review of previous actions. (the actions with implementation problems should be discussed under this item)	Management of Quality and Environment (MQ&E) Superintendent
2. Review of significant safety issues of the plant: 2.1 Health Report for safety & safety related systems. 2.2 Status of specific (individual) and generic safety related systems problems (specific and generic safety related and process equipment failures that have a potential negative impact on overall reactor safety); “Hot issues” from Planning database should be included. 2.3 The plant risk report for the previous quarter and the past 12 months, using the Risk Monitor (EOOS tool). 2.4 Safety significant plant projects (progress status to be reported).	Process Systems Senior Superintendent Safety & Compliance (S&C) Sr. Superintendent Support: Technical Unit Superintendents Licensing & Reliability Superintendent Station Project Superintendent
3. Review status of MPA / TDMOD 3.1 The adherence to the Engineering Dept. plan to develop the technical solutions for approved safety significant MPAs (plant modifications); 3.2 A review of temporary modifications (TDMOD) for safety systems and the adherence to their closure	Engineering Sr. Superintendent

program; 3.3 The adherence to the safety significant MPA implementation program.	Work Control Sr. Superintendent
4. Review status of: 4.1 OIs records for safety related systems (trend report/ status of proposed operation instructions closure date; these OIs are issued and used prior to implementation of permanent modifications to operating manuals OMs) 4.2 Planned or implemented significant changes to any APOP (emergency operating procedures)	U1/ U2 Operations Sr. Superintendent
5. OPEX and Corrective Actions Program 5.1 Review of reportable events – (since last meeting and trend report). 5.2 Trend of events reporting (RCA's - on different categories) 5.3 Significant external OPEX reported 5.4 Status of Root Cause investigations	Performance Monitoring Superintendent
6. Review actions resulted from relationship with CNCAN. 6.1 Actions from licensing process. 6.2 Documents sent to CNCAN for resolution (review and approval) 6.3 Actions resulted from CNCAN inspections.	S&C Sr. Superintendent MQ&E Superintendent
7. U1 / U2 interface safety issues: -Commissioning -Licensing -Design Modifications	U2 Senior Superintendent U1 S&C Senior Superintendent
8. Nuclear Safety Performance Indicators	Performance Monitoring Superintendent
9. Status of TOE / ODM actions The progress of open TOE/ODM (Technical Operability Evaluation/Operational Decision Making) actions and the actions closed in the last quarter should be presented under this item.	S&C Sr. Superintendent (TOE actions) Operations Sr. Superintendent (ODM)
10. New items (as proposed in advance by PSOC members)	S&C Sr. Superintendent

The plant safety status is also evaluated at the Corporate Committee meetings and the Administration Board meetings. These meetings are held on a monthly basis with the participation of the Director of Cernavoda NPP Branch, who is a member of the Corporate Executive Board as Deputy Director General of SNN (equivalent with Chief Nuclear Officer in similar organisations).

The means through which the licensee demonstrates its commitment to maintaining and continuously seeking the improvement of safety, include:

- initiating and establishing safety enhancement programmes and ensuring the allocation of adequate resources;
- fostering the involvement of all plant personnel in the development of the management system;
- monitoring, reviewing and assessing the safety performance and taking timely actions to correct and prevent reoccurrence of any situations detrimental to safety;
- the effective use of the operating experience feedback and of the results of the safety reviews and assessments in developing and maintaining up to date the safety related policies, programmes, procedures and instructions, taking into account also the evolution of international standards and good practices.

As a member of international nuclear operators' organisations, such as COG (CANDU Owners Group) and WANO, the licensee has the opportunity to participate to the various programmes and projects coordinated by these, in order to enhance safety in plant operation through the exchange of information on operating experience. Examples of these activities are:

- exchange of abnormal condition reports;
- exchange of different type of reports on specific issues and of periodic information bulletins;
- receiving peer reviews and also participating as team members in the peer reviews for other NPPs;

In accordance with the reporting requirements imposed through regulatory documents and the licensing conditions, the reports submitted to CNCAN by the licensee for an operating nuclear installation (Cernavoda NPP Unit 1) include the following:

- Event Assessment Reports - to describe and assess the unplanned events;
- Quarterly Technical Reports (QTRs) - to present the overall technical performance and general information related to station operation for a period of three months; these official documents are based on and issued in addition to the monthly reports from each division of the operating organisation and include performance indicators and trends; the fourth QTR of the year is issued as annual report. The QTRs provide information on safety systems reliability performance, dose statistics and radioactive effluents emissions, performance indicators, a review of process, safety and safety support systems including the design changes, a review of the nuclear fuel and heavy water management, the results of the chemistry control, radiation control, a review of the emergency planning, a reactor core safety assessment, etc. These reports include also information on the financial and staffing arrangements.
- Radiological Environmental Monitoring Reports - submitted annually to present the results of the off-site radiological environmental monitoring program and any corresponding calculated doses.

- Periodic Inspection Programme Reports - submitted within 90 days from the completion of any inspection carried out in accordance with the Periodic Inspection Programme.
- Reliability Reports - submitted to provide an evaluation of the reliability of any safety related system that has specific reliability requirements stated in the licensing documents. A review of the updated documents is provided with the focus on the design changes and their impact on the analysis results.
- Reports on the status of the training programme for the licensed operations staff.
- Report on the status of Systematic Assessment of Critical Spare Parts Programme.
- Report on the status of Preventive Maintenance Programme.
- Report on the status of Ageing Management Programme.
- Report on the status of Safety Analysis Strategic Programme.
- Updates of the Final Safety Analysis Report are submitted to CNCAN in the framework of the licence renewal process.

The monthly reports submitted by the licensee for the installation during the phases of construction and commissioning (Cernavoda NPP Unit 2) provide the status of activities in the following areas:

- programme for training and qualification of plant personnel;
- environmental monitoring programme;
- planning, scheduling and budget control;
- engineering / quality surveillance;
- construction;
- material management;
- commissioning;
- safety and licensing;
- quality assurance;
- industrial safety;
- services;
- finances;
- human resources, etc.

9.3 Interface between the licence holder and CNCAN

The various interfaces needed to support the continuous communication between the licensee and the regulator are well established and described in specific procedures for all the safety related activities of the plant, which are subject to licensing, require approval from or notification to CNCAN, or that are under regulatory surveillance.

Regarding Cernavoda NPP, the interface activities are formally managed by SNN Director General or by the Deputy Director General in charge of Cernavoda NPP branch. The responsibility for maintaining the interface with CNCAN for the licensing activities has been delegated by the Director General of SNN to the Director of the Cernavoda NPP Branch, who will be further referred to as the Site Manager.

As mentioned under Article 7, a Project Manager for the licensing activities of Cernavoda NPP is appointed by the CNCAN President, with the responsibility of coordinating the activities of the various divisions involved in the safety review and assessment. The CNCAN Project Manager is the counterpart of the Site Manager for ensuring the formal interface between the regulator and the licence holder.

Cernavoda NPP, primarily through the Safety and Compliance Department, has a daily dialogue with the regulatory authority through the CNCAN site inspectors. Formal correspondence is exchanged as needed to clarify and resolve issues and to ensure that all requirements are met as required to obtain licenses, approvals and authorisations. In addition, working meetings are established at the local level to promote a free flow of information and to resolve small issues expeditiously.

In SNN head office the interface activities with CNCAN are coordinated and ensured mainly by the Nuclear Safety Oversight Department, but also by Quality Management Department. When necessary, the technical support is ensured by Cernavoda NPP specialists.

The main interface activities consist of:

- Licensing meetings;
- Regulatory inspections;
- Plant procedures and documents review and approval process;
- Investigations related to abnormal occurrences;
- Meetings for discussion of draft regulations;
- Development of Licensing Basis Documents and Licensing Programme for future units;
- Regular information meetings for discussing the progress of various plant programmes, etc.

Maintaining a continuous communication with the licence holder is of vital importance for CNCAN in discharging its statutory responsibilities. As established by regulations, there are given timeframes for response by the regulatory body to any request of the licensee or of any applicant. The formally established timeframes may not always be sufficient and may impose a burden on CNCAN staff taking into account the volume of safety documentation the needs to be reviewed and assessed prior to making a decision with regard to a major licensing milestone. Therefore the approach used by CNCAN has been to agree with the licensee/applicant for a licence a programme and a schedule that implies submission of the safety documentation well in advance to the time of licensing application. In addition, CNCAN receives quarterly or monthly reports on the plant activities and there are monthly licensing meetings that ensure effective means for communicating to the applicant the findings arisen from the evaluation of the documents submitted and for receiving feedback.

ARTICLE 10 - PRIORITY TO SAFETY

Each Contracting Party shall take the appropriate steps to ensure that all organisations engaged in activities directly related to nuclear installations shall establish policies that give due priority to nuclear safety.

10.1 Safety Policy of Cernavoda NPP

In accordance with the Law, the licensee has the prime responsibility to ensure and maintain the safety of the nuclear installations. Regulatory provisions are in place which require the licensee to develop and implement policies that give safety the highest priority.

The general safety principles governing the activities performed by all site personnel performing activities in the construction, commissioning and operation of Cernavoda NPP are stated in the Nuclear Safety Policy reference document and in the Integrated Management Manual.

The principles stated in the Nuclear Safety Policy are reiterated and the concrete means for their implementation are detailed in other station procedures (RD - reference documents, SI - station instructions, IDP - interdepartmental procedures, etc.), with clear definition of the responsibilities of the station personnel for each operation. The implementation of these principles is ensured also by the provision of specific initial and refreshment training courses aimed at enhancing safety culture.

The major administrative control for the implementation of the Nuclear Safety Policy is the reference document entitled "Operating Policies and Principles" (OP&P). The OP&P is part of the licensing basis for the plant, and its initial issue, as well as modifications thereto are subject to regulatory approval. This document describes how the utility operates, maintains and modifies the safety-related systems in order to maintain the nuclear safety margins. The OP&P contains the clear definition of the authorities and responsibilities of managers and operating staff. Also, it defines the specific operating limits for safety related systems, which must be maintained all the time to ensure that the plant always complies with its analysed operating envelope.

In addition, to prevent, mitigate and accommodate any potential nuclear incident or accident, the OP&P require compliance with the following principles:

- operating limits affecting public safety must be adhered to;
- defence-in-depth shall be maintained;
- fall back actions/countermeasures must be established;
- conservative decision making for improved overall safety must be applied.

In accordance with the conditions stated in the licenses for the units of Cernavoda NPP, compliance is mandatory with the provisions of the Nuclear Safety Policy, Operating Policies and Principles, the Integrated Management Manual, as well as with the provisions of any other procedure or document pertaining to the licensing basis.

As stipulated in the Nuclear Safety Policy, the governing principles in the OP&P shall not be intentionally violated under any circumstances. An overview of the principles stated in the Nuclear Safety Policy of Cernavoda NPP, and of the means by which they are implemented, is given as follows.

a) *Nuclear Safety has the utmost priority, overriding if necessary the demands of production or project schedule. All decisions shall be made and reinforced consistent with this statement.*

This key principle of nuclear safety culture is governing the decision making processes and all the activities of Cernavoda NPP. The Nuclear Safety Policy document states the responsibilities for all employees (Station General Manager / Managers / Supervisors / Individual employees) and is communicated to all site personnel, including contractors, as part of their training.

The training syllabus includes specific requirements as to the know-how of the station objectives regarding nuclear safety, quality, personnel health and safety. The knowledge of these objectives and the associated requirements is annually refreshed for the personnel involved in the performance of safety related activities. The communication of the safety principles relevant for the performance of any task is also done also as part of any pre-job briefing.

The mission, the vision and the objectives of the operating organisation are communicated to all the personnel, published and clearly displayed throughout the site and on the utility intranet site that is available to all employees, as to ensure that all the individuals are conscious that through the correct and timely fulfilment of their assigned duties they contribute to the safe and reliable operation of the plant.

b) *To compensate for potential human or equipment failures, a defence in depth concept shall be implemented and maintained, applied at multiple levels of protection (prevention, surveillance, mitigation, accident management and emergency response), including successive barriers for the prevention of the release of radioactive materials to the environment.*

The plant design incorporates the various features of the defence in depth concept intended to provide adequate coverage for possible equipment failures. Station procedures are intended to maintain or enhance this through Configuration Control programme, which provides the framework for the review and control all the proposed modifications. Human factors considerations are adequately taken into account in the design of the plant and in the development of procedures.

A comprehensive set of procedures covering all situations from normal operation to accident management is in place, structured, developed and maintained in accordance with the requirements of the management system and administrative controls are implemented, for adequate staffing, reviews and checks of activities prior to, during and after implementation, as appropriate. A graded approach for the application of the management system requirements is implemented to ensure that the extent of approvals and reviews required is dependent upon the importance of the planned activity especially with regard to its impact on nuclear safety.

c) *Personnel engaged in safety related activities shall be trained and qualified to perform their duties. Taking into account the potential for human error, actions shall be established for facilitating correct decision-making by the operator and for limiting the possibility for wrong decisions, by providing the necessary means for detecting and correcting or compensating for errors.*

The overall training policies and the means for their implementation are defined in the reference documents “Station Training Concept” and “Systematic Approach to Training”.

In accordance with the licensing conditions, the Nuclear Safety Policy and the provisions of the Integrated Management Manual, all managers and supervisors shall ensure that the staff is fully competent for their assigned duties. This includes training to ensure that individuals understand the safety significance of their duties.

Training of all new employees is provided according to the station instruction “Orientation training program for new employees”. The training program includes the provision of refresher courses to ensure that expertise is maintained at the required level. Each job position (or group of similar positions) has its own Job Related Training Requirements (JRTR) providing information about both the initial and continuing training needed for the specific job. Each department has the responsibility to prepare a generic JRTR for its staff. JRTRs for each job position are reviewed by the line managers at least once per year based of the results of the staff performance evaluation. Training records are maintained and stored in the training archive. A database containing all the information from the files is provided to ensure easy access.

Stabilisation of the work-force and increased opportunity for training due to the commissioning of Unit 2 has allowed the Unit 1 employees to upgrade their own knowledge level.

The training received by contractors at the organisation they belong to is verified as part of the evaluations / audits that the utility is regularly performing for all their suppliers of services, in order to ensure that they continue to maintain adequate standards of quality and safety and provide the expected level of performance. The licence holder has also adequate arrangements to provide additional training for the contractors with regard to nuclear safety and safety culture aspects, plant specific features, etc.

More detailed information on the qualification and training of plant personnel is provided under Article 11.

d) *A strong organisational structure with well defined responsibilities for nuclear safety at all levels shall be established and maintained.*

The Station Organisational Chart and associated Job Descriptions document the general areas of responsibility. The responsibilities and lines of authority are clearly defined in the Integrated Management Manual and also included and detailed, as appropriate, in the Reference Documents and Station Instructions, including those activities, checks, reviews and approvals needed to ensure that safety is properly taken into account in all activities.

The operating licence includes specific conditions on the plant organisational structure and staffing, requiring that these shall be in accordance with the provisions of the approved Integrated Management Manual and that the modifications to the organisational structure and staffing levels shall be adequately justified and documented and shall be reported in writing to CNCAN within 30 working days prior to their implementation, for regulatory review and approval. Further information on the management of organisational change is provided under Article 13.

e) *Operation of the plant shall be conducted by authorised personnel following administrative controls and adhering to approved procedures.*

Training and qualification programs have been in place to ensure that staff can be authorised for their assigned duties. All formal authorisations for personnel required to be licensed by CNCAN for station operation have been received.

The station system of documents providing administrative instructions and operating procedures includes the Integrated Management Manual, Reference Documents, Station Instructions, Operating Manuals, Maintenance Procedures, etc. These documents are issued and kept updated to ensure an adequate procedural framework for the conduct of plant activities in a safe manner.

All managers, senior superintendents and superintendents are responsible to ensure that the staff is fully competent for their duties, that tasks are carried out as defined in procedures and that procedures are complete, clear and unambiguous. This includes training, observation and coaching to ensure that individuals understand the safety significance of their duties.

f) *The safety review of procedures, analyses and design changes shall be completed before the effective commencement of the work.*

This requirement is generally included as a responsibility of those who prepare and those who verify any safety related documents and is specifically addressed and detailed by the various station procedures. In particular, the Safety and Compliance Department is given a special responsibility to review station documents such as Operating Manuals, Operating Instructions and Design Manuals to ensure that all the safety requirements are met.

The different stages of review and testing of modifications provide reassurance that the safety is not adversely affected. Further information on the safety categorisation and the assessment of modifications is provided under Article 14.

By maintaining an effective communication with the plant vendor and other utilities operating and providing support for the operation of CANDU NPPs worldwide and participating in the research and development projects within the CANDU Owners Group (COG), the utility ensures that the current state of the art for safety is also taken into account when planning and designing any important plant modifications.

g) *Procedures will be followed and, when unexpected situations arise, appropriate expert assistance shall be obtained before proceeding. In such cases, the safety intent of the procedures shall be maintained.*

For cases in which situations may occur which had not been previously analysed and for which no adequately clear and detailed procedures had been prepared, conservative decisions are required to ensure that no activities are initiated which could have a negative impact on safety. Asking for guidance from more experienced or qualified persons when faced with an unfamiliar task or situation is required at all staff levels. The importance of asking for guidance from the immediate supervisor when unsure what to do is emphasised during staff training.

Any activity that would imply a deviation, even temporary, from a procedure or work plan has to be assessed from the point of view of its impact on safety, justified and planned in detail, and the approvals needed for its performance need to be obtained from the same level of authority as for the procedure or work plan that would have been normally followed. The elaboration, verification and approval of any special procedures which would be needed for the performance of such activities would follow the normal process in accordance with the provisions of the Integrated Management Manual.

The procedures "Abnormal Condition Reporting" (ACR), “Technical Operability Evaluation (TOE)” and “Operational Decision Making” (ODM), together with their supporting documents (such as inter-departmental procedures - IDPs and information reports - IRs) giving further detailed guidance for their implementation, contain provisions for the actions to be taken in cases where unexpected situations arise (in this context meaning situations pertaining only to normal operation, including power manoeuvres, maintenance, testing, refuelling, and not to the occurrence of initiating events or accident situations, which are dealt with by using the emergency operating procedures), or for cases not fully covered by specific and explicit procedures (situations which could be regarded as deficiencies in plant documentation).

h) *A set of operational limits and conditions shall be defined to identify safe boundaries for plant operation.*

The boundaries for safe operation, based on the safety analyses for the plant, are included in the appendixes of the OP&P. The technical basis for the operating limits and conditions in the OP& P are provided in Chapter 16 of the FSAR.

OP&P documents the safe envelope within which the plant is to be operated, setting the limits and conditions for normal operation and the actions to be taken by the operating staff in the event of deviations from the OLCs.

Operating Policies and Principles (OP&P) covers all operational states and temporary situations arising due to maintenance & testing, containing administrative controls, the limiting safety system settings and the limiting conditions for operation and stipulating the minimum amount of operable equipment.

Actions to be taken in case of deviations from the OLCs and the time allowed to complete these actions are provided in the “Impairments Manual”. References to this document are made in OP&P and the Impairments Manual is available in the control room.

Detailed surveillance requirements, design specific features and specific administrative controls are provided in the system Operating Manuals (OMs), Operating Manual Tests (OMT) and Standard Operating Sequences (SOS).

i) *Events significant for safety shall be detected and shall be subject to in-depth evaluation, and measures shall be implemented promptly to correct the root causes, to disseminate the lessons learned and to monitor the effective implementation of the corrective actions. Plant management shall have access to safety relevant operational experience from other nuclear power plants around the world.*

The Reference Document "Operating Experience Programme" contains the Plant policies for Operating Experience. Specific guidance is given in other documents such as Station Instructions (SI), Internal Department Procedures (IDP) and Information Reports (IR), which include provisions for the reporting, analysis of events (including low level events) and the determination and tracking of corrective measures required.

The Operating Experience (OPEX) Programme is defined and supported by the following set of station procedures:

- SI "Abnormal Condition Reporting" (ACR)
- SI "Reportable Events to CNCAN"
- IR "ACR Process Guidance"
- IDP "Processing ACRs"
- SI “The Root Cause Analysis”
- IDP "Trend Analyses"
- SI "Operating Experience Feedback"
- IDP "Processing External Information"
- IDP "Performance Indicators for OPEX - self-assessment window".

The procedure “Abnormal Condition Reporting” describes the process of identification, evaluation and analysis of the Abnormal Conditions occurred at Cernavoda NPP or at other nuclear power plants, the final objective being to establish corrective actions to preclude occurrence of major events or their recurrence in case that they already have occurred.

The plant personnel is responsible for:

- Identifying and reporting the abnormal conditions occurred at the plant;
- Maintaining a focus on lessons learned from in-house and industry experience and actively promoting the use of operating experience in current activities;
- Implementing the corrective actions resulted from operating experience process;
- Reporting of the actions implemented to the next level of management.

The list of ACR Initiation Criteria is given in an annex to the procedure “Abnormal Condition Reporting”, with the specification that it represents only the main groups for classification of the problems defined in abnormal condition report, more details on the criteria inside each group being included in ACR Process Guidance document.

Any person that identifies something abnormal should define the problem and evaluate the impact on nuclear or personnel safety, or production. When there is not clear that the event has no impact, the person shall initiate an ACR, completing the necessary forms in accordance with the procedure and classify the condition in one or more of the groups in the list, which is reproduced below for exemplification:

1. Equipment/ Component failures (critical equipment list);
2. Materials/components deficiencies (installation/functioning)
3. Procedures/ Manuals/ Documentation discrepancies;
4. Drawing discrepancies;
5. Procedural Violations;
6. Inadequate Review/ Resolution;
7. Discrepancies Associated with alarms, setpoints, calibrations;
8. Personnel Error/ Work Practice deficiencies;
9. Incorrect scoping of systems, equipments, and components;
10. Un-analysed conditions, safety analysis discrepancies, safety issues not previously identified or reviewed;
11. Radiological event;
12. Any violation of OP&P specifications;
13. Procurement/ Spare Parts deficiencies;
14. Industrial Safety deficiencies;
15. Deficiencies, concerns or issues resulting from regulatory agencies, industry and internal operating experience, inspections, observations or publications;
16. Reportable events to CNCAN or to other regulatory authorities;
17. Fire Protection deficiencies;
18. Deficiencies that have a potential for affecting the environment;
19. Deficiencies/problems occurred in the normal processes of the station;
20. Modifications of chemical parameters;
21. Rework.

The abnormal conditions discovered in the plant which can or could have effect on nuclear safety, personnel safety, environment or production are registered, classified by their importance and systematically analysed. Actions resulting from the analysis of the plant events are concurred by management and have assigned responsibilities and target dates for completion. The corrective actions address causes and contributors, and they might be corrective, preventive or for improvement. Specific processes are formalised within departments/sections, through which information and lessons to learn from internal and external operating experience are systematically searched and used within current activities (jobs evaluation and planning, pre-job briefing, modification processing, training, industrial safety, etc). Coordination of all these processes is done by OPEX contact personnel who support the Performance Monitoring / OPEX section.

The reports for events meeting the criteria in the procedure “Reportable Events to CNCAN” are issued to the Regulatory Body in a written format, in accordance with the provisions of this procedure.

Further information regarding the investigation of abnormal events and the dissemination of lessons learned is provided under Article 19.

j) *A questioning attitude when dealing with safety issues is expected from every employee and shall be encouraged. Recognition of, and admitting to mistakes shall also be encouraged. When sanctions are necessary, these shall not be applied in such a way as to encourage the concealment of errors.*

Management does not use direct sanctions against individuals as a result of incidents or errors. Any repetition of problems or individual patterns of poor performance are dealt with collectively, through interviews and performance appraisals with the objective of determining the cause and helping the individual to make corrections. Any punitive measures taken are not connected to specific incidents. As a result, an open environment has been created for reporting problems and errors by various levels of staff.

In accordance with the responsibilities stated in the Nuclear Safety Policy, all individuals shall actively participate in those nuclear safety policies that fall within their area of responsibility. When the employees engaged in activities affecting safety related functions or structures, systems and components believe that a deficiency in nuclear safety exists, they are responsible for notifying their Supervisor, the Safety & Licensing Manager and/or the Station Manager. If in the employee's opinion the notification does not receive appropriate attention, the employee has the right and obligation to contact successively higher levels of management.

k) *Cernavoda Operating Policies and Principles (OP&P) shall not be knowingly violated. If conditions are found to exist which conflict with the OP&P, the affected system(s) shall promptly be placed in the normal configuration or in other known safe state or the reactor shall promptly be placed in safe shutdown state.*

Where deviations from the Operating Policies and Principles are needed, justification is properly documented and Regulatory Authority approval is obtained prior to the event. Unplanned violations of the limits are promptly dealt with using Operating Manuals and Impairment Manual guidelines for ensuring the correct course of actions and meeting the appropriate time limits. Such violations are reported to the regulatory authority in accordance with the reporting requirements.

l) *A set of nuclear safety standards shall be established against which the safety performance of Cernavoda NPP shall be assessed. Where these standards are not met, corrective action shall be implemented.*

The policy statements of the operating organisation with regard to health and safety, quality and environmental protection are given in the Integrated Management Manual of Cernavoda NPP. The authorities and responsibilities of the management at all levels are also defined, with the senior management being responsible for the development and the implementation of the Integrated Management System for Cernavoda NPP, aligned with the requirements of the Quality Management System of SNN and in compliance with all the regulatory provisions and the applicable standards. The connection between the safety of the plant and its reliable operation is recognised and reflected in the policies of the operating organisation.

Senior management is also responsible for establishing measurable objectives, consistent with the policies of the operating organisation, and for ensuring that adequate mechanisms are in place for the assessment of safety and quality performance in achieving these objectives. Such mechanisms include the use of indicators and trends for plant performance and the conduct of regular reviews and assessments of various types and scope, including external peer reviews, for specific areas of activity and also for assessing the effectiveness of the management system as a whole.

The safety and quality objectives for Cernavoda NPP include:

- preventing the occurrence of abnormal events;
- enhancing safety culture;
- ensure that the safety and reliability targets for the safety related plant items are met;
- maintaining strict control of design configuration in compliance with the design basis;
- maintaining the competence and qualification of the personnel;
- ensuring compliance with the applicable legislative and regulatory provisions;
- ensure effective use of the operating experience;
- eliminating work accidents and severe injuries;
- minimising doses to occupationally exposed personnel;
- protection of the ecosystems, efficient utilisation of natural resources and prevention of pollution;
- maintaining effective emergency preparedness.

Specific objectives and performance criteria are established for each area of activity within the management system for Cernavoda NPP and their achievement is periodically evaluated, according to plant procedures, with the results documented and reported monthly to the management.

The overall indicators used for plant performance are those established by WANO. Also specific indicators for monitoring current performance in specific functional areas were established by CNE Cernavoda. The performance indicators data is reported monthly in a graphical format to indicate trends, allow comparisons of actual versus expected results. Whenever targets are not met or adverse trends are observed, actions are initiated for determining the reasons and for implementing corrective actions. The performance indicators and trends are also included in the quarterly reports submitted to CNCAN.

Improvement initiatives are defined within a series of plant improvement programs, each of them having an assigned responsible and objectives defined, scheduled and budgeted for each calendar year. The stage of these programs is reported monthly to management in a dedicated meeting.

The initiatives are oriented into 5 key results area, namely:

- Work force management (KRA # 1) - for the development and optimisation of the station and staff;
- Operations & safety culture (KRA # 2) - for enhancing the safety and reliability of plant operation and improving the safety culture;

- Work processes & programmes (KRA # 3) - for improving the quality of processes and work system;
- Equipment reliability (KRA # 4) - for increasing station and equipment performance
- Financial performance (KRA # 5) - for improving economic efficiency.

The improvement programmes are part of the Strategic Development Plan of Cernavoda NPP, which clearly identifies the plant objectives and how they will be achieved and is formally distributed to each plant employee. The progress of this strategy is discussed monthly with the Plant Divisions Managers and an action program schedule is prepared with all the actions and responsible groups to meet the improvement plans of the plant.

m) *The station shall comply with all regulatory nuclear safety requirements. The station shall resolve with the regulatory authority any requirements or interpretations of these that would not appear to be beneficial to the health and safety of the public or the workers.*

The licence holder retains the primary responsibility for the safety of the plant when implementing any changes to processes or systems that may affect safety. the changes resulting from regulatory review and inspection activities follow the normal plant processes for the initiation, assessment and implementation of modifications.

The various regulatory requirements that are integrated in the framework of the management system are carefully reviewed to ensure that their intent is fully understood and that there are no conflicting requirements. Clarification is sought from CNCAN and the other regulatory authorities, as the case may be, for any requirement the interpretation of which needs further detailing.

(n) *Managers at the most senior level shall demonstrate their commitment to nuclear safety by giving continuous attention to the processes that have a bearing on safety and by taking immediate interest in the significant safety issues when these occur.*

The primary responsibility for nuclear safety at Cernavoda NPP resides with the senior management, who initiates regular reviews of the safety performance of the organisation and of the practices contributing to nuclear safety with the objective of achieving and maintaining an effective safety culture and a high level of operational safety. Adequate arrangements are in place to ensure that safety significant issues are timely brought to the attention of the senior management. Specific processes, such as “The safety assessment by management (Plant Safety Oversight Committee - PSOC”, “Operational Decision Making” and “Technical Operability Evaluation” are established and implemented to ensure that due priority is given to any safety significant issues.

The management team of the plant meets daily to focus on the safety and production issues and the Site Manager provides context and direction to the team. Information on the regular reviews of the management system is provided under Article 13.

(o) *Managers shall ensure that the staff respond to and benefit from established practices (culture) and by their attitude and example shall ensure that their staff is continuously motivated towards high levels of performance in discharging their duties.*

Management oversight and feedback is provided daily in a field observation program. All management levels act as role models with regard to the implementation of the safety policy of the plant. The Manager's field assessment programme requires the managers to inspect the plant areas according to a specific monthly programme. After finishing the assessment, the manager has to discuss issues with the participants of the evaluation and also reinforce the management expectations such as work quality, safety, conservative decision-making, reactor safety and public safety, depending on the involvement of the workers. Information on the observation and coaching by managers is provided under Article 12.

10.2 Overview of the regulatory activities for the evaluation of the safety management of the plant

CNCAN staff routinely audits the license holder's compliance with the OP&P and the Nuclear Safety Policy and perform regulatory inspections to ensure adherence to station procedures. In order to evaluate the safety management at the plant, CNCAN checks the compliance with the regulatory requirements following the regulatory procedures established for assessment and inspection, as described under Article 7.

CNCAN verifies that the licensee has accomplished its responsibility, to ensure the continuous availability of safety-related fundamental resources, including adequate management, operation and support personnel, and the various physical plant resources needed for the safe design, testing, operation, and maintenance of the plant. The results of CNCAN assessment and inspections are incorporated into the licensee's overall plant management and corrective action programs. The issues and findings are viewed in terms of trends as well as their apparent risk.

The results of plant continuous monitoring and periodic safety assessment by the licensee are available to the regulator by means of Shift Supervisors Log, Quarterly Technical Reports, Surveillance Programmes, results of Probabilistic Safety Assessments and Deterministic Nuclear Safety Analyses and also by communication with CNCAN site-dedicated inspectors, on daily basis.

In monitoring the licensee's arrangements for managing safety, CNCAN reviews the use of indicators throughout a licensee's organisation to improve safety and the measures taken to prevent adverse trends in any of the safety related indicators. However, in the licensing process, the performance indicators are used by CNCAN only as support information.

ARTICLE 11 - FINANCIAL AND HUMAN RESOURCES

1. Each Contracting Party shall take the appropriate steps to ensure that adequate financial resources are available to support the safety of each nuclear installation throughout its life.

2. Each Contracting Party shall take the appropriate steps to ensure that sufficient numbers of qualified staff with appropriate education, training and retraining are available for all safety-related activities in or for each nuclear installation, throughout its life.

11.1 Legal Provisions Stating the Obligation of the Licensee for Ensuring the Availability of Adequate Financial and Human Resources

As required by the Law, the licensee is responsible for ensuring both adequate financial and human resources to support the safety of the Cernavoda NPP throughout its lifetime. The relevant paragraphs of the article 18 of the Law are quoted below:

Art.18. "A licence for deployment of activities involving nuclear installations (as specified in the art. 8 of the Law) shall be granted only if the applicant fulfils the following conditions:
a) is capable of demonstrating the professional qualification, for all job positions, of its own personnel, the personnel's knowledge of the nuclear safety and radioprotection regulatory requirements, the probity of the personnel that have authority for decision making in managing the work deployed during construction and operation of the nuclear installation or in managing other activities in the nuclear field (of which mentioned at art. 8 of the Law);
b) is responsible to ensure that the personnel, permanently or temporarily employed, which deploys professional activities in vital points of the nuclear installation or has access to classified documentation, is reliable and licensed by the competent authorities in this regard;
c) is capable of demonstrating that has all the technical resources, technologies and material means necessary for the safe deployment of its activities.
[…]
e)is responsible that the personnel assuring the operation of the nuclear installation have the necessary knowledge, as appropriate for the position assigned, with regard to the safe operation of the installation, the risks associated, and the applicable nuclear safety measures.
f) takes all the necessary measures, at the level of the current technological and scientific standards, to prevent the occurrence of any damage that may result due to the construction and operation of the nuclear installation;
[…]
j) has adequate and sufficient material and financial arrangements for the collection, transport, treatment, conditioning and storage of radioactive waste generated from the licensed activities, as well as for the decommissioning of the nuclear installation upon termination of operations, and has paid the contribution for the establishment of the fund for the management of radioactive waste and decommissioning

These obligations are also stated and further detailed in the conditions of each of the licenses granted by CNCAN. The status of the financial and human resources is periodically reported to CNCAN through the Quarterly Technical Reports (QTRs).

11.2 Availability of resources to support the safety of Cernavoda NPP throughout its lifetime

The licence holder for Cernavoda NPP is a Government Owned Company. It has the authority to raise revenue through the sale of electricity in order to ensure that adequate financial resources are available to support the operation and the safety of Cernavoda NPP throughout its lifetime.

Based on actual rate changes and the predictions for the future, detailed analyses have shown that sale of energy on the market will ensure in Romania enough financial resources to operate the plant and support improvement programmes as necessary.

Cernavoda NPP maintains one budget structured as Operation and Maintenance and Capital Improvement respectively. The plant budget is based on the budgets prepared by each plant division, which include salaries, training, investments, consumables and services. The Site Manager, the Administration Board and the Ministry of Economy and Finances, approve the plant budget, based on the capacity of energy production of the plant and in an amount that guarantees the safe operation of the plant, including the necessary investments to maintain and improve the plant performance.

The budget for Operation and Maintenance usually covers most of the safety improvements to the plant. However, if the need arises for improvements at a larger scale, as for example as an outcome of the Periodic Safety Review, it is expected that these will be covered by the Capital Improvement section of the budget. Such situations are factored in for establishing the future electricity rate to be charged to the customers.

The expenditures of SNN are dictated by the company's financial position, current and planned performance, service obligations (load forecast), and financial and business strategies. These inputs are used to develop a set of affordability envelopes, one for ongoing operating expenditures, and one for capital investments.

11.3 Financing of Safety Improvements

As a rule, ongoing safety-related programmes are financed from the operations and maintenance envelope, and large scale improvement projects, including safety related projects, are financed from the capital envelope. In either case, the costs of safety improvement programmes / projects would become part of the base rate and recovered through rates charged to customers.

Within each envelope, programmes/projects are ranked in accordance with prioritisation criteria that reflect the corporation's operating, business and financial objectives. The licence holder assigns a high priority to safety-related programmes and projects and ensures that adequate financial resources will be provided to support the safety improvements throughout the life of the nuclear power plant.

Starting with 2006, by signing an agreement to join the R&D Programme within the COG, SNN became a participant member, obtaining access to the results of the research performed after the date of the agreement coming into force. Starting with 2007, SNN acquired the voting right and participates actively in the COG R&D Programme.

In order to make more effective use of the research results, as well as for promoting work in areas of special interest for Cernavoda NPP, the licensee has established the procedural framework for developing the related projects and has nominated project responsibles in his own organisation, as well as in the structure of the COG. The specialists from the Romanian research institutes will also be involved in the activities of evaluation and assessment of the results made available through the COG R&D Programme.

11.4 Financial Provisions for Decommissioning and Radioactive Waste Management

Up to present, the licensees, including Cernavoda NPP, had to pay an annual contribution for supporting the activity of ANDRAD (the National Agency for Radioactive Waste, which is the competent authority for the coordination, at national level, of the safe management of spent nuclear fuel and of radioactive waste, including disposal) and for deployment of activities mentioned in the annual plan for waste management and decommissioning.

At Cernavoda NPP, the costs of the current activities for the management of spent fuel and radioactive waste, including the costs associated with the Intermediate Spent Fuel Dry Storage Facility, are included in the operational costs.

For the costs associated to the long term management, such as disposal of spent fuel and radioactive waste management, including decommissioning costs, SNN will pay the financial contributions to the Fund for Radioactive Waste Management and Decommissioning.

The annual contributions of the licensees to the fund have been set by the Governmental Decision regarding the establishment and the administration of the financial resources necessary for the safe management of the radioactive waste and of the decommissioning of nuclear and radiological installations, issued in September this year.

11.5 The Rules, Regulations and Resource Arrangements Concerning the Qualification, Training and Retraining of Personnel with safety related jobs

Romanian regulations related to Training, Qualification and Retraining for operating personnel involved for research reactors and nuclear power plants have been in place since 1975, well before starting the construction of Cernavoda NPP.

When Romania bought the CANDU technology, the training issue had been considered since the early phase of the contract negotiations. The initial training for management, operation, and technical maintenance key personnel was provided in Canada. About 100 persons were trained in an operational Canadian nuclear power plant prior to be assigned to any commissioning / operation activities, in order to allow them to fulfil their position responsibilities safely, effectively and efficiently.

Together with technical design, Romania endorsed the training concept and training programmes for operation staff, fuel handling staff, maintenance staff and radiation protection staff. The adopted programmes have been continuously adapted and improved based on IAEA Guides related to NPP Personnel Training & Qualification, and INPO / WANO recommendations related to Training System Development. In this way, a Systematic Approach to Training (SAT) has been implemented in Cernavoda NPP training activities. Reference Documents (RD), Station Instructions (SI) and Internal Department Procedures (IDP) have been put in place to establish a structural Training Concept for NPP Personnel. The structure of the Training Concept is illustrated in Fig. 11.1.

11.5.1 Summary of significant developments

Since 2004, progresses were made in improving the training programmes for Cernavoda NPP personnel in order to achieve a high level of performance in training and qualification of plant staff with duties in the safe and reliable plant operation.

In order to provide assurance that the licensed operators successfully completing the programme will be able to perform their jobs in a safe and efficient manner, and to ensure the development of their ability to anticipate, detect and properly respond to plant conditions with the goal of preventing or, at a minimum, mitigating unanticipated plant transients, a Job and Task Analysis (JTA) was performed for Shift Supervisor and Control Room Operator positions. The training objectives developed using the JTA were used to improve the Authorisation Training Programme for Shift Supervisors and Control Room Operators.

In order to maintain and enhance nuclear safety and reliability of the plant, a Human Performance Programme was designed and implemented for the plant personnel. In this way, by improving individual and teamwork skills the frequency and severity of plant events are reduced.

The training programme for managers, supervisors and their successors was revised to ensure that the competence of the persons in managerial and supervisory positions is maintained and that experienced and qualified staff is available to fill any manager or supervisor position, in the event that a position becomes vacant.

A specific training programme for OPEX Single Point of Contact (SPOC) persons was implemented in order to provide them with adequate knowledge and skills in event investigation, root cause analysis, accessing and searching internal and external (COG, WANO) operating experience database, as part of plant OPEX

Programme. Presentations of the lessons learned from recent plant events and nuclear industry experience are included as applicable in classroom, simulator and on-the-job training to prevent occurrence/ recurrence of errors.

A training programme for the personnel involved in the commissioning of Cernavoda NPP Unit 2 was designed and implemented based on SAT principles. The programme addresses the essential capabilities and qualifications necessary to support plant commissioning and operation. Personnel from the operating organisation (operators, maintainers, systems engineers) were included in the commissioning training programmes. The training needs for Unit 2 personnel have been identified based on Table Top Analysis performed for similar jobs from Unit 1 of Cernavoda NPP. The required level of qualification and experience is specified for each position in the organisation. Basic training materials were prepared well in advance compared to the commissioning schedule. Because the Unit 2 is of the same base design as Unit 1, the training materials from Unit 1 have been used for training of the personnel involved in the commissioning of Unit 2. For design differences, specific training materials were prepared before the commencement of any commissioning activities.

The evaluation process of training programmes was improved in order to increase the effectiveness of personnel training.

Training facilities (such as classrooms, simulator) were improved in order to support training activities. The modernisation of the Full-Scope Simulator was finished to the end of September 2006. Instructional media equipment is available to provide a variety of instructional methods and to help for achieving learning objectives. Also, a project to develop a computer-based training programme is in place and will be finished at the end of 2007.

11.5.2 Training Organisation and Facilities

The complexity and risk level of the facilities and equipment of a nuclear power plant require high quality manpower and its preservation in time. Therefore, the licence holder considers the work performed in the human resources field as a priority and particular attention is paid to the strategy related to personnel recruitment and personnel loyalty / jobs stability, as well as to the sustained improvement of training and specialisation quality.

The plant organisational structure includes a Training Department, headed by a Training Senior Superintendent who reports directly to the Site Manager. The Site Manager has the overall responsibility for the qualification of plant personnel and supports the Training Department with the necessary resources including staffing and facilities.

The Training Department provides effective training to support the station goal of having competent and qualified staff capable of ensuring the safe and reliable operation of the Cernavoda NPP and is in charge of coordinating all the training activities at the plant through the departmental Training Coordinators. All the

training programmes provided by the departments are approved by the Training Senior Superintendent.
The structure of the training organisation, the accountability, functional responsibilities, level of authority and lines of communication facilitate the accomplishment of established training goals and objectives.

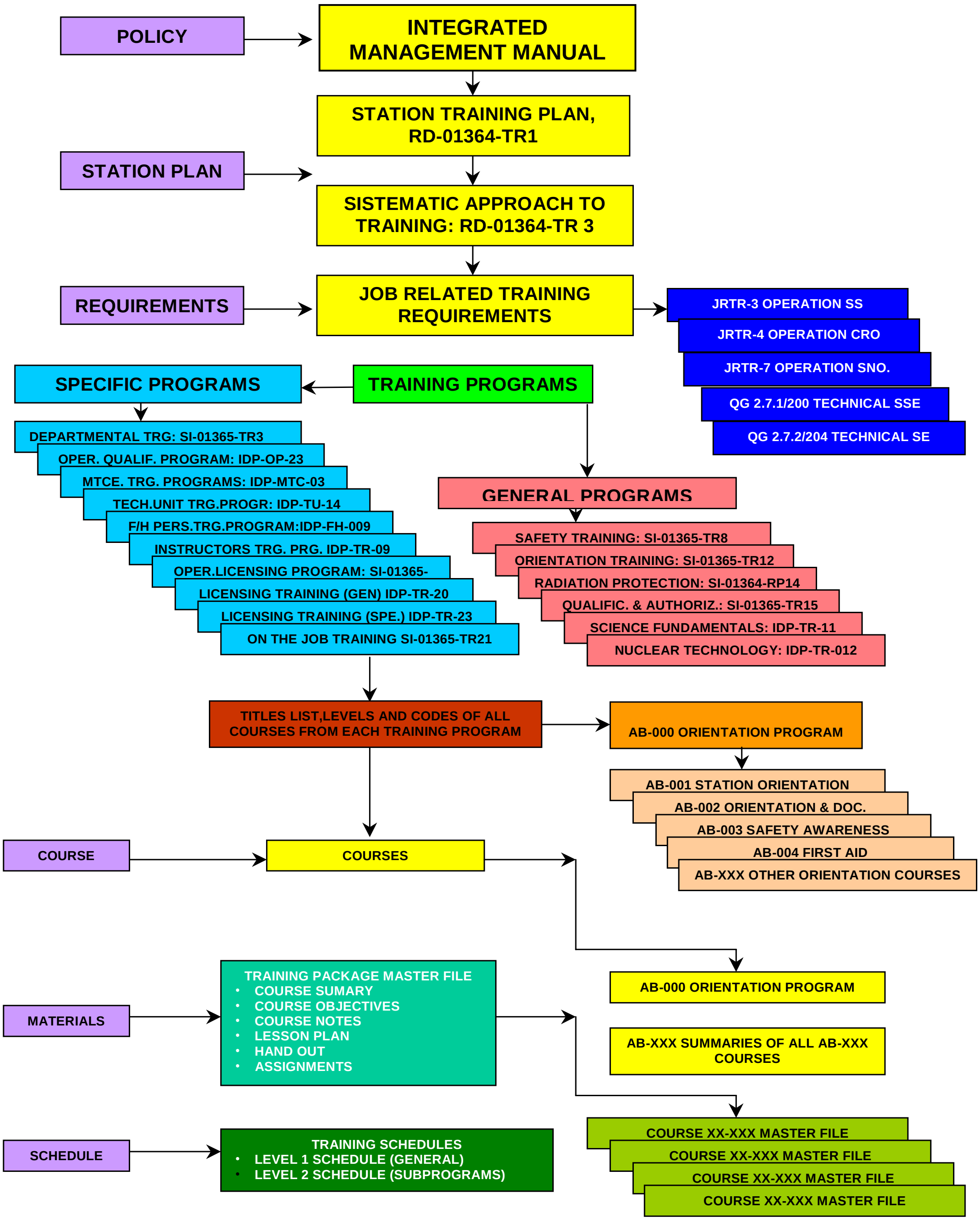


Fig. 11.1 - The Training Concept Structure

The responsibility of identification and ensuring the relevant training to a particular position rests with the direct supervisor of that position. This responsibility is extended for any job changes that arise in his/her department. The Training Senior

Superintendent helps supervisors to identify future needs for training and development by observing personnel performance, monitoring training and work activities, monitoring plant and external operating experience.

Yearly, the Training Department provides an analysis of the training needs for the next year based on the requests of the different plant departments. Recently, the plant started analysing the training needs for the next five years. According to the results of the analysis, new hiring or contracts are arranged. The managers and supervisors are responsible to ensure that production requirements do not interfere with the need for personnel to be trained. In order to allow the entire personnel to fulfil their position responsibilities safely, effectively and efficiently, all staff is provided with appropriate opportunities to take the relevant training, before they are assigned to carry out tasks that require the corresponding knowledge or skills.

The department is organised in six groups: Simulator, Operations Training, General Training and Skills, Programmes Coordination, Orientation and Authorisation Training, and Public Relations.

The Training Senior Superintendent ensures that the department is organised and administrated such that following specific activities are conducted effectively and efficiently:

- Development of the training processes and procedures in accordance with the Systematic Approach to Training methodology;
- Identification of training requirements (initial and continuing) for all plant positions as a result of job and/or task analysis;
- Definition, development and implementation of training and qualification programmes to meet the training requirements for plant staff and contractors;
- Provision of qualified classroom and on-the-job instructors, of the training facilities i.e. classrooms, instruction books, simulator, mock-ups, training aids and equipments;
- Processing and maintaining documents and records generated by training activities;
- Evaluation and reporting on training performance and training processes or/and programmes' improvements based on their results;
- Ensuring Simulator Maintenance and Operability and maintaining up-to-date configuration control of the simulator and other training facilities and equipment;
- Information of the public and authorities on specific nuclear power issues and the preservation a positive image of Cernavoda NPP inside the country as well as abroad;
- Developing and maintaining a proper internal communication and suitable relationships with the mass-media, as well as good cooperation with professional and industrial associations that activate in the nuclear domain.

The Training Centre has twelve classrooms that are well equipped with white boards, smart boards, flipcharts, video and computer systems, overhead and LCD-projectors. Some of them have equipment, spare parts, and mock-ups that represent plant components. The opportunity to provide on-the-job training (OJT) on the same equipment in Unit 2 has also been used. Some of the classrooms are used as study rooms and are equipped with current reference documents, procedures, and training manuals.

A Full-Scope Simulator is used for the training of operating personnel on operational states and for abnormal operation conditions. The simulator is mainly used for the training of licensed personnel and operators who are part of the emergency response team. Also, the simulator is used for the regulatory examinations of the personnel applying for the practice permits issued by CNCAN.

The Full-Scope Simulator has been made available prior to Unit 1 criticality and was modernised in 2006. The Full-Scope Simulator of Unit 1 is also used for Unit 2 operators' training. The differences between Unit 1 and Unit 2 were analysed and documented. Subsequently, during the training development phase, the different tasks were identified and suitable training methods were built into the programme.

Physical fidelity of the simulator is maintained by analysis of the changes made after each outage at the plant Main Control Room (MCR) and providing appropriate remedies. Before the implementation of any modification at the plant, all the necessary safety assessments and evaluations are made and if the modification influences the simulator proper actions are implemented.

The simulator facility is equipped with video cameras that provide the possibility to record all the training activities made during each session. It is also possible to record all the major parameters during the training session and to keep the data for debriefing purposes.

11.5.3 Training Programmes for personnel with safety-related jobs

According to Cernavoda NPP training policy, the plant staff shall be qualified for the tasks that they are assigned to perform. The training programmes are performance based and linked directly to the tasks that an individual is expected to perform as part of the job. Training programmes are based on SAT principles and address the essential capabilities and qualifications to support the safe and reliable operation of the plant.

As the organisational structure and position responsibilities at Cernavoda NPP are similar to those used at other CANDU stations, training needs derived from these functions have been used to prepare standard training programmes & courses. Subsequently, each department of Cernavoda NPP performed a job analysis, identifying training needs required for effective job performance. Each department then documented its training needs by preparing a generic Job Related Training Requirements (JRTR) or Qualification Guide for each position, or group of similar positions.

Having the JRTRs or Qualification Guides for each position, the training objectives have been established and the training materials developed. Based on this, it was possible to design and implement training programmes for all plant personnel with safety related duties. In addition to the knowledge and skills required to ensure and maintain the technical competence, the training requirements related to development of managerial and supervisory skills are also included in JRTRs or Qualification Guides.

JRTRs and Qualification Guides provide information about both the initial and continuing training needed for the specific job. Each department has the responsibility to prepare generic JRTRs and Qualification Guides for its staff, and line managers are responsible for reviewing the training needs for each job position at least once per a year based of the results of the staff performance evaluation.

In order to ensure that all plant personnel who may be required to perform safety related duties have sufficient understanding of the plant and its safety features, the Initial Training Programme for plant personnel consists of two main parts:

- General technical nuclear training programme;
- On-the-Job training programme.

The general technical nuclear training programme consists of the following topics:

- Orientation – a generic programme provided to all new employees in order to familiarise them with the plant, its physical layout, the basis of plant operation, station organisation and administrative procedures which govern its day-to-day operation. In addition, the programme provides an introduction to industrial safety, nuclear safety, safety culture, the quality assurance requirements, the requirements for radiation protection and actions to be taken in the event of an emergency situation on site. The last part of the Orientation training course is a “Departmental Introduction” where new employees get specific workplace training. This training is provided according to the individuals’ training plans.
- Industrial safety – a programme which provides staff with the required safety awareness and safety knowledge appropriate to their job duties;
- Science fundamentals and nuclear technologies – courses intended to provide plant staff with the knowledge to enable further understanding of the principles of plant systems and equipment operation;
- Plant systems training – provides a technical understanding of the plant major systems in both the nuclear and conventional areas.

After completion of the training, written and, as necessary, practical tests are provided to ensure mastering of the acquired knowledge by the trainees and their ability to perform work safely. In addition, an evaluation of the trainees’ performance at the work place is made by their supervisors to assess and correct the knowledge assimilated and skills achieved.

The On-the-Job training programme is based on job specific courses and activities in order to provide the knowledge and skills, as well as familiarisation with the reference documents, station instructions and work procedures, for a particular job.

Continuing training programmes were defined and implemented in order to maintain and improve employee’s job performance and to develop their position-specific knowledge and skills. Continuing training programmes cover re-qualification for any qualifications that have a specified lifetime, refresher training to maintain and improve skills, lessons learned from industry operating experience, plant systems/equipment modifications and procedure changes, as well as measures needed to correct performance problems or identified weaknesses in the training content or delivery.

Lessons learned from events at the plant and also from those reported by the external organisations form an integral part of training and preparation for work. The Training Department's OPEX Single Point of Contact (SPOC) has subscribed to and is monitoring the relevant COG newsgroups. Relevant parts of OPEX information are disseminated and brought to the attention of working groups via pre-job briefings and just-in-time training. Presentations on significant events are also delivered regularly to selected plant staff (the presentation material is prepared based on the Root Cause Analysis Report / Investigation Report, WANO SER or SOER, etc.).

Incorporating lessons learned enhances the relevance of training content to job performance requirements by illustrating the circumstances of the event / situation, the actions initiated to resolve it and additional actions that could have been taken to prevent or mitigate it.

11.5.4 Overview of the Training Programmes for the major categories of personnel with safety related jobs

Control Room Operators and Shift Supervisors

The scope of the programmes and the content of the specific training courses are based on the Job and Task Analysis completed for the respective job positions. For a Control Room Operator (CRO), it takes at least three years to pass through the intermediate steps of field operator, specific classroom training, simulator training, and co-piloting. The Shift Supervisor (SS) needs two more years to be promoted from the position of CRO, as well as passing through special training courses, such as those concerning the modification approval policy, refuelling machine operation, safety management, etc.

Each training package is developed based on learning objectives to support the specific knowledge and skills needed. Every modification in plant systems leads to appropriate training before its implementation.

Trainees are evaluated in three stages: after classroom training, after simulator training, and after the co-piloting period. There is not only a management evaluation of each shift crew through the exams provided twice a year but also a peer assessment during the shift, done by the off-duty shift staff.

Every shift passes through the continuing training three or four times a year. Such training sessions have duration of one week, one third of which consisting of classroom training and the other two thirds being dedicated to simulator training.

Field Operators (Equipment Operators)

The training topics for the equipment operators' qualification programme are established based on the training objectives coming from the results of job analyses made by the Training Department and Operations Department and from performance evaluations. The training programmes and related materials are developed by the Training Department and validated by the Operations Department. Along with the courses provided by the Training Department, skills checks are conducted in the field by an OJT (on-the-job training) instructor. At the end of every training session, the operators are evaluated by written tests (following classroom training), or by field and practical evaluation (following the on-the-job training) The training and qualification programme for plant operators allows for streaming of operators into separate qualification (duty) areas of plant operation, such as Balance of Plant, Common Support Systems, etc. Each operator has to pass yearly refresher training in the emergency preparedness programme, safety culture and environmental and work protection. In case of modifications, just-in-time training is provided for field operators to inform them on the plant status. This training is done before the modification is implemented.

Maintenance Personnel

The Maintenance Personnel are divided into four major duty areas: Mechanical, I&C/Electrical, General Services and Assessment. The Training and Qualification Programme for each position from the duty areas mentioned above was developed based on training requirements resulted from Table Top Analysis and contents of the classroom training (orientation, science fundamentals, equipment and nuclear technology and systems training) organised and delivered by the Training Department instructors and skills training organised and delivered by the Maintenance Department as on-the-job training.

At least once per year the on-the-job training provided by each OJT instructor is evaluated and results are recorded to monitor performance. All the maintenance staff is monitored by management and supervisors to ensure their qualifications are adequate for the assigned duties. Maintenance supervisors issue quarterly reports based on observation of subordinate staff as well as self-assessment reports to ensure relevant trainee assessment.

The continuing training is split into training courses that are provided in classrooms and practical training provided at the mock-ups or plant equipment in the workshops to maintain necessary skills. Just-in-Time training is provided in case of any modification just before its implementation.

Technical Support Personnel

The Training and Qualification Programme for the staff of the Technical Department follows the philosophy of Duty Area training and qualifications set out in INPO ACAD 98-004 - Guidelines for Training and Qualification of Engineering Personnel.

Orientation and core subject classroom training (science fundamentals, technical, basic systems, etc) are delivered by the Training Department. Duty Area Mentoring and experience training is done via the Technical Department.

Duty areas have been defined for System Engineering, Design Engineering and Reactor Safety. Within each duty area, a set of tasks has been established. Skills and abilities have been identified for each task and the supporting courseware to provide the underlying knowledge and skills has been specified in Qualification Guides. A formal practical evaluation covering tasks in a duty area is required before the engineer is qualified to work in that specific area.

Instructors

Instructors' tasks and activities are analysed to identify the knowledge and skills needed to perform their instructional responsibilities. The products of this analysis are the Job Related Training Requirements for instructors. These are reviewed periodically to ensure they are the current basis of the instructional knowledge and skills training programme.

An initial training programme is designed to ensure that instructors possess the technical competence and instructional skills necessary to conduct high quality training. This training programme is intended to prepare a competent, full-time instructor. Continuing training programmes are aimed at maintaining and improving the instructional and technical skills following initial instructor qualification.

Considering simulator training of the licensed operators as a very important part of their development and for maintaining ability to fulfil the responsibilities dictated by their position, the Simulator Instructor positions are staffed with experienced operators. Simulator instructors have to pass through, as minimum, the initial licensing training programme for Control Room Operator (CRO) position. After that, they have to spend no less than twenty shifts per year working in the Main Control Room.

All the plant (equipment) operator instructors are competent equipment operators and supervisors that have passed trough the training course for trainers and are knowledgeable of the current plant configuration.

Periodically, the Training Senior Superintendent and the training supervisors monitor and evaluate instructors' performance to ensure that training staff possess and maintain the technical knowledge appropriate for their positions and the instructional capabilities appropriate for their training functions. Feedback forms from observations and self-assessments are also used to check the quality of the training provided.

Management Personnel

Cernavoda NPP managerial staff has an essential role in setting the standards and expectations for all personnel in all aspects of organisation's activities. In addition, it is essential that management staff themselves visibly meet these standards and help their staff to understand why these standards are appropriate. Also, Cernavoda NPP managers have a major influence on organisational culture. They are expected to maintain high levels of nuclear safety and at the same time to be more efficient in reducing the cost of production. Such circumstances underline the need to give managers of all levels the necessary training to succeed in such a demanding environment.

Based on the necessary competencies, roles and responsibilities required for the management staff, a Development and Training Programme is established and implemented. The content of the management staff training programme was established in order to allow for individualised development, having mandatory development components at various management levels and also to support the identification of the specific individual manager's needs.

The focus of the training is on management and leadership courses in order to achieve, maintain and improve the management and supervisory abilities and leadership skills. The courses are developed and delivered in relation with two management categories: supervisory and senior management and their respective roles, responsibilities and competencies.

The content of the training has two major components: Initial and Continuing training. Both of them comprise Classroom training, and On-the-job training.

Classroom training includes internal courses delivered by Cernavoda NPP instructors, plant Subject Matter Experts (SMEs) or by external experts and external courses provided, on or off site, through international organisations (COG, WANO, IAEA, etc).

The On-the-Job training for managers is focused on coaching combined with staff rotation.

Continuing training is designed to assist the managerial staff to maintain and improve their job performance and to develop their position-specific knowledge and skills. It is based on job performance and consists of: Refresher Training, Update Training *(*derived from Station Actions determined by Abnormal Condition Reports, observations from training self-assessments and internal audits, changes in the legislative and regulatory framework or in the licensing conditions, internal and external training evaluations, operating experience feedback, plant modifications, procedures changes, etc.) and Developmental Training (based on self-directed improvement programmes such as attendance in miscellaneous courses, workshops, forums, coaching activities, etc. and on self-study).

The training for the personnel working within the company's headquarters is also focused on the attributions of each category of jobs, and provides the knowledge necessary for performing the activities in an efficient manner and with full awareness of any implications for safety. The personnel is trained both inside the company (on-the-job training courses and workshops) and outside the company: participation in conferences, symposia, international events within the programmes organised by IAEA-Vienna and WANO – Atlanta Centre and COG – Toronto Canada, as well as in other courses on subjects related to nuclear power plants.

Contractors

The training and qualification of contractor personnel must be provided by the company to which they belong, in accordance with the specifications stipulated in the terms and conditions of the contract, to ensure that they are competent to perform the assigned tasks.

Cernavoda NPP, with the involvement of the department responsible for the contractors' work, has the obligation of evaluating the formal training and qualification of the contractor personnel, in order to verify and guarantee their competence.

A training programme is also provided for contractor personnel before they are allowed to work on site, which includes basic knowledge of plant layout, the basics of plant operation, station organisation and administrative procedures governing its day-to-day operation. In addition, the programme provides an introduction to conventional and nuclear safety, safety culture, the relevant requirements of the plant's management system, the requirements for radiation protection, and action in the event of an emergency situation on site. Additional training is also provided for some of the contractors, as necessary, on selected parts of the position-specific initial training.

Continuing training programme for contractor personnel includes lessons learned from industry operating experience, applicable equipment modifications or procedural changes related to their work, radiation protection re-qualification, as well as additional training on selected subjects of the initial specific training.

Personnel with emergency response functions

For plant management, technical and operating staff with emergency response functions, the training programme includes basic topics related to: typical scenarios for nuclear accidents and potential threats / consequences, differences between Design Basis Accidents, Limited Core Damage Accidents and Severe Core Damage Accidents, decision making criteria in the early phase of an accident, etc.

In addition, a strategy for the development and delivery of training programme for Severe Accidents Management Guides (SAMG) users and support staff is under approval process. This training programme will provide a basic understanding of severe accident phenomena, detailed understanding of the basis for the SAMG content and hands-on experience with the use and application of all SAMG elements.

11.5.5 Review and Update of the Training Programmes

The training programmes are periodically evaluated and revised to maintain and improve personnel training. The evaluation of training performance is provided by managers, supervisors, and the Training Department, according to the plant procedure Training Evaluation Process".

The evaluation of the training programmes is based on:

- feedback from management observation of the training activities;
- feedback from trainees;
- peer or supervisor evaluation of classroom instructors or of the on-the-job instructors;
- feedback from self-assessment of training activities;
- analysis of training indicators.

The Training Senior Superintendent, line managers and supervisors periodically observe training activities (classroom, simulator, on-the-job training, etc.). Personnel performance is observed periodically, as part of Human Performance Programme, to verify that training and qualification programmes are producing competent workers. During evaluation, the management pays special attention to the trainees' awareness of their safety roles, Stop-Think-Act-Review (STAR) principles, their understanding of the intent of the procedures, cases when the work should be stopped, safety rules, and the application of the ALARA principle. Feedback from participants and their supervisors on training content and how well the training programme prepared the personnel to perform their jobs is used to revise and improve the training programme. Also, a system of Individual Performance Evaluation has been put in place, mostly for Personnel Performances Annual Evaluation.

If the personnel's training is identified as causal factor for performance deficiencies, the scope of corrective actions is to bring the current level of personnel performance to the desired level and includes, as appropriate:

- changes in training programmes;
- changes in training materials;
- refresher training programmes;
- conduct of a job or task analysis or a training needs analysis.

Analysis of results of post-training evaluations and observations of the employees' performance at the work place help to determine potential training improvements. The areas for improvement identified are analysed in the Training Oversight Committee and in the Training Programme Review Committee, and the approved corrective actions are monitored through the Corrective Action Process.

Any changes in plant procedures, processes and systems/equipment modifications are analysed to identify any impact on training programmes, materials and settings and to initiate and implement the necessary corrective or improvement actions.

11.5.6 Training through external organisations:

In addition to the standard training programmes, a non-standard training is considered for NPP personnel qualification. This category includes all cooperation in the area of training with other external organisations (IAEA, WANO, COG, EPRI, manufacturers, equipment suppliers etc.). This is a very important part of key personnel development through courses, fellowships, workshops and development programmes participation, organised and sponsored by above-mentioned organisations.

Cernavoda NPP has a good cooperation also with two of the Romanian Universities (Bucharest and Constanta) to provide some Science Fundamentals and Nuclear Technologies training for technical, maintenance and operations plant personnel.

Other Romanian specialised organisations provide training for plant personnel in the areas of management training as well as technical and skills training to meet the national legal requirements related to qualification and authorisation of plant staff.

Training provided by external organisations is well controlled according to the plant procedure “Training through outside organisations”. Feedback forms are filled out by trainees and reports from independent evaluators are analysed to make a decision about future needs.

11.6 Regulatory Activities for assessing training effectiveness

Specific requirements in the area of training are provided in the “Regulation on granting practice permits to operating, management and specific training personnel of Nuclear Power Plants, Research Reactors and other Nuclear Installations”, the “General Requirements for Quality Management Systems Applied to the Construction, Operation and Decommissioning of Nuclear Installations” and in the “Specific Requirements for the Quality Management Systems Applied to the Operation of Nuclear Installations“.

The “Regulation on granting practice permits to operating, management and specific training personnel of Nuclear Power Plants, Research Reactors and other Nuclear Installations” defines the conditions that the applicants shall fulfil in order to obtain a practice permit from CNCAN and contains also detailed requirements on the training programmes for the categories of licensed personnel, with special focus on the control room operators.

The categories of licensed personnel for NPPs, as stated in the above-mentioned regulation, together with the corresponding job positions for Cernavoda NPP, are listed as follows:

a) The Nuclear Power Plant Personnel for operating activities in the Main Control Room - Control Room Operators and Shift Supervisors

b) The Nuclear Power Plant Personnel for Management activities:

1. Site/Station Manager ;
2. Production Manager;
3. Technical Manager;
4. Health Physics Senior Superintendent;
5. Operation Senior Superintendent;
6. Training Senior Superintendent ;
7. Quality Assurance Manager;
8. Safety and Compliance Senior Superintendent.

c) The instructors for the training activities for the NPP operating personnel;

The regulation establishes:

a) The qualification requirements for the operating personnel and the management personnel, starting from the commissioning phase of the nuclear installation up to complete removal of the nuclear fuel from the core, of the management personnel and the specific training trainers/instructors;

b) The steps of the licensing process for each category;

c) The methodology of granting the practice permits for the above mentioned personnel and covers:

-Objectives of candidate's assessments;
-Content and phases of evaluation;
-Methodology of examinations by CNCAN;
-Criteria and performance indicators.

CNCAN examinations are performed in accordance with the provisions of the regulation and the internal procedures which are part of the Quality Management System of CNCAN, such as "Organisation and Procedure for Evaluation of Training and Examination Process for Operator licensing" and the directives issued by the CNCAN senior management with regard to the nomination of the members of the examination board and the rules for conducting the examination.

The general subjects for the examination of Operating Personnel (CRO&SS) are chosen to be relevant for the knowledge of nuclear installation safety systems operating limits and conditions, capabilities to operate under normal conditions, abnormal conditions or emergency conditions, team working skills, communication and coordination skills. The examinations consist of written and oral tests and practical examination at the Full Scope Simulator (static and dynamic tests). An independent evaluation of the co-piloting training in the NPP Control Room is also done by CNCAN.

Regarding the examination of the instructors, the technical knowledge, skills, attitudes are evaluated based on the same methodology used for the examination of operators. The instructional and assessment capabilities in their assigned areas of responsibility are evaluated through practical exams (classroom, simulator, etc.).

The examination objectives in the evaluation of managerial personnel are chosen to reflect the performance associated with the job at all three levels: organisational, as part of a process and at individual level. The content of the examination is established to give an overview of the candidate's knowledge, skills, attitudes and capabilities in specific areas of responsibility. The examination consists of an interview covering different aspects related to the organisational structure, responsibilities and levels of authority, human performance issues, safety culture, work planning, coaching and observation of their subordinates.

The practice permits granted by CNCAN following the satisfactory performance of the candidates in all the subjects/tests of the examination, are valid for a definite period of time, as stated in the regulation (e.g. in case of operators, 2 years since the first licensing and 3 years after renewal), provided that the licensed person has continuity in the same activity and a good performance on the respective job.

The training programmes for the licensed personnel are submitted to CNCAN for review and approval. The implementation of the training programmes for all personnel with duties important to safety and the observance of the station training policy are also extensively reviewed and assessed by CNCAN through periodic audits.

ARTICLE 12 - HUMAN FACTORS

Each Contracting Party shall take the appropriate steps to ensure that the capabilities and limitations of human performance are taken into account throughout the life of a nuclear installation.

12.1 Summary of significant developments in the area of Human Performance

The importance of the human performance in ensuring safe operation of a nuclear power plant is recognised by both the licence holder and CNCAN. While the importance of human factors for the design is considered as vital, the focus has been lately shifting towards the human performance issues associated with the construction, the commissioning and the operation stages.

Efforts are made to continuously enhance human performance, by means of:

- developing and improving the mechanisms by which the human errors can be detected, analysed and corrected;
- developing and enhancing the training programs to effectively incorporate the operating experience feedback;
- develop and enhance means to correctly evaluate human performance.

Notable progress has been made with regard to the development of the Human Performance Programme for Cernavoda NPP, which started in 2004 as a pilot project in the Production Department (Operations, Maintenance, Chemistry and Fuel Handling) of Unit 1 and has been subsequently extended to Radioprotection, Technical and Quality Management departments. A plan for including Unit 2 personnel has been issued and implementation started in May 2007. Once the two units will operate under a single organisation, the Human Performance Programme will function for the entire personnel.

The developments in the area of personnel training, reported under Article 11, are also a significant contributor to the improvement of human performance.

12.2 Managerial and Organisational Issues

The organisational and managerial philosophy adopted at Cernavoda NPP takes into account the capabilities and limitations of human performance and the responsibilities for ensuring and improving the quality of the human performance are established hierarchically.

Clear lines of authority and communication throughout the organisation are established so that each individual is aware of his accountability and responsibility in ensuring nuclear safety.

The station management is responsible for establishing a safety culture that emphasises to each individual engaged in an activity related to the safety of the plant the necessity for their personal commitment and accountability.

The management provides the necessary expectations, facilities and tools to support human performance. Examples of responsibilities of the management with regard to the improvement of human performance are given below:

- Clearly communicating performance expectation through meetings, policies and procedures;
- Emphasising the reasons behind the established safety practices and procedures, together with the consequences for safety of shortfalls in personal performance;
- Providing sufficient and proper facilities, tools and equipment, and support to the staff;
- Conducting self-assessments;
- Conducting field observations and coaching the personnel to use the best work practices.

In addition, for each level of management the specific level of authority is defined in the station Operating Policies and Principles (OP&P), the Nuclear Safety Policy and the Integrated Management Manual and detailed in other station procedures and documents, to ensure that individuals are aware of their responsibility and of the limits of their authority with regard to decision-making on safety issues.

12.3 Human Performance Programme

At the end of 2005, Cernavoda NPP Unit 1 Senior Management decided to extend the Human Performance Programme for all plant departments, recognising that proper observation and coaching will increase safety and economic achievements.

A permanent “Human Performance Group” was developed to support all departments in their effort to improve performance. The group is directly subordinated to the Station Manager and two operators are part of this group. Each department nominated a Single Person of Contact with the task to maintain a close relation between department personnel and the Human Performance Group.

Adequate documentation has been produced to define the framework of the programme and to support its implementation and continuous improvement. The status of the programme is periodically reviewed, during monthly meetings of Human Performance Working Committee (HP Group – Single Points Of Contact) and during the Quarterly Oversight Meetings (Human Performance Oversight Committee).

The main components of the programme are:

- Training (theoretical and practical);
- Observation and coaching;
- Use of Event Free Tools (EFT);
- Event and trend analysis;
- Focus of the month.

Training

Specific training and an adequate communication process are used to ensure awareness of the expectations with regard to the implementation of the Human Performance Programme.

Management at all levels are included in the training programme in human performance, for familiarisation with the terminology, the framework of the HP Programme, the different aspects of using the EFT, the expected behaviours and the role of initiatives in the framework of the HP Programme, for each level within the organisation.

Observation and Coaching

Using the Human Performance Programme, several levels of managers and supervisors perform field observation and coaching. A Station Instruction has been developed to provide them with the necessary guidelines. This programme requires that using a time schedule, in each day at least one plant manager to be in the field observing different activities and providing feedback.

The objectives of Observation and Coaching are to:

- emphasise the expectations with regard to behaviour and attitudes;
- correct work practices that are below the expected standards;
- help the workers to successfully finalise the assigned duties;
- identify and eliminate event precursors;
- obtain feedback from the employees in order to initiate improvement processes towards enhanced safety performance

For the area being assessed, the manager verifies the strengths and the points that need to be improved. After finishing the assessment, the manager has to discuss issues with the participants to the evaluation and also reinforce the management expectations such as work quality, safety, conservative decision-making, reactor safety and public safety, depending on the involvement of the workers. To record the positive aspects or the deficiencies noted during management inspections a new electronic application was developed, from which all plant personnel can gain inputs.

In order to monitor the effectiveness of the safety management system the set of safety performance indicators has been extended. Importance of contractors' contribution to plant safety performance was recognised and reconsidered. Consequently their supervision was improved by better documentation of responsibilities and contractual requirements.

Event Free Tools

Several Event Free Tools (EFT) have been established at Cernavoda NPP, through which emphasis can be made on the reduction of events and errors. The EFT include the Pre-Job Briefing and the Post-Job Debriefing, three-way communication, use of and adherence to procedures, STAR principle, conservative decision-making, questioning attitude, etc.

The use of the EFT is now embedded in the thinking process of Operations, Fuel Handling and Maintenance personnel. The implementation of human performance indicators demonstrates the improvement made and the acknowledgement of the usefulness of those tools by the staff. The expectations are that EFT will be effectively and successfully used by all the plant personnel, including contractors.

Human Performance Indicators

The performance indicators for the Human Performance Programme are established at three levels:

- Level 1 (strategic indicators):
    - Number of EFD (event free days) clock resets due to human error
    - Observation and Coaching Process Adherence
- Level 2 (efficiency indicators):
    - Number of Reportable Events Caused by Human Error
    - Human Performance Error Rate
    - First Three Causal Factor Recurrence
    - HP Training
    - Number of transients due to Human Errors
    - Number of unplanned outages due to Human Factor
- Level 3 (departmental indicators).

Focus of the month

The Human Performance Group is developing the “Focus of the Month”. This constitutes an additional means for the reinforcement of good work practices and management expectations. The coordinator of the Human Performance Programme selects the subject for the focus of the month based on the incidence of causal factors and performance indicators’ trends. Once the subject identified, the Human Performance Group communicates the information to the plant personnel, including relevant OPEX information and this issue is monitored closely in the observation and coaching activities.

12.4 Analysis of human errors

The Abnormal Condition Reporting programme has been enhanced through replication of good practices from various benchmarking exercises and technical support missions. Self-assessments revealed that the majority of staff recognised the need for a comprehensive reporting programme that included low-level event reporting.

The aspects related to encouraging the initiation of Abnormal Condition Reports (ACRs) for low-level events and near-misses determined an increased participation of plant staff into the process and resulted in a high number of ACRs. The mentality was smoothly shifted from reporting only significant events to report low-level occurrences. In the current stage, the objective is to obtain concurrence for reporting near-misses and other “soft” human performance issues.

Any deficiency in the practices or observed human error is immediately recorded and as appropriate an Abnormal Condition Report or Corrective Action Report is issued for comprehensive evaluation and correction of the cause.

Systematic root cause analyses of the events based on the ASSET and HPES methodologies are conducted and the personnel from various compartments of the plant are involved in the performance of the necessary investigations. The involvement of the personnel from the Training Department in the activities related to the identification and analyses of the events allows a quick understanding of the human errors that are detected and a timely inclusion of the lessons learned in the corresponding training courses.

The Human Performance Enhancement System methodology is a method to identify the various contributing factors and root causes of events that have been originated by human errors. The thoroughness with which an error or a human performance problem will be investigated and analysed depends upon the perceived significance (e.g. safety, potential economic impact, etc.) of the event sequence in which the error occurred or the potential for harm that an adverse human performance trend presents. In addition, the role of the error in an event sequence will also influence the extent to which an error is investigated. An error that was the root cause of an event will likely receive more attention than an error that only contributed to the event. Factors that would be assessed would be work organisation and planning, work practices, man-machine interfaces, work place factors and hazards, personal factors, but also organisational factors like resource management, change management and managerial methods.

Event and causal factors charts used in support of this analysis method identify all those contributors so that corrective actions can be developed to minimise recurrence of the same and similar problems.

Also, the events that had direct impact on nuclear safety, personal safety or production and have been directly caused by an inappropriate human act would reset the Event Free Clock. Event Free Clock is an indicator of station human performance events. The average number of days between events will be monitor with a goal of having less events of this kind.

More information regarding the investigation of events is provided under Article 19.

12.5 Consideration of human factors and the human - machine interface in the design

The design of the plant ensures that most regulation and control functions are automatic in order to reduce effort of the operating staff and the probability of human errors.

Automatic actuation of control or protection systems is provided to respond to equipment failure or human error which could cause a plant parameter to exceed normal operational limits or a safety system trip set point. The overall plant design and the specific design of protection systems ensure that operator intervention is only required in cases where there is sufficient time for the diagnosis of plant conditions and the determination and implementation of operator actions.

The design of the control room incorporated a strategic placement of the instrumentation and controls used in safety related operations and in accident management. Specific attention was provided to device grouping, layout, labelling and annunciation. Appropriate attention to human factors and man-machine interface concerns ensured that the information available in the control room is sufficient for the diagnosis of anticipated events or transients and for the assessment of the effects of any actions taken by the plant operators.

Most of the information related to the Nuclear Steam Plant (NSP) status and part of the Balance of Plant (BOP) side is provided to the operator via the two station control computers (DCCs). The BOP and Common Systems control and monitoring is achieved by a DCS (Distributed Control System) and the relevant alarms or control signals important for the safety of the plant are transferred from the DCS to the DCCs.

The functions of the Control Computer System are:

- Control / Monitoring;
- Alarm / Annunciation;
- Display / Data Recording.

The information important for the safety of the plant must remain available to the operators at all times so that they won't exclusively count on the control computers. Normal parameter limits exceeding and abnormal states of the equipment are annunciated to the MCR operator. Alarm windows located on the different MCR panels work simultaneously with the alarm messages given by the control computer system.

The operator in MCR is provided with all necessary information that allows a safe control of the plant for all operation modes, including for the cases when the dual computer system is lost and only conventional control devices remain available. In case of dual control computer system unavailability, the alarm windows become the sole source of annunciation. However, these are required for monitoring the safe shutdown of the plant, as fast shutdown is actuated in the event of dual control computer failure.

A Secondary Control Area (SCA) enables the operator to take all the necessary measures for maintaining the plant in a safe shutdown condition for the events in which the MCR would become unavailable.

The environmental conditions in the MCR are equivalent with those for an office. A radiation monitor is in place to prevent access contaminated personnel and equipment to the MCR area. In addition to these standard conditions, in order to maintain and extend them in case of emergency, functional isolation was provided to ensure MCR operating capability.

The access route from the MCR to the SCA, and related areas to which the operator must have access, are adequately qualified to be maintained for events causing the MCR to become unavailable. The systems that provide working/habitability conditions in SCA are designed to ensure adequate protection to the operator when he is in the SCA, against accidental radioactive releases. SCA is provided with ventilation/ air conditioning system, seismically qualified and independent from the other ventilation/air conditioning systems of the plant. Working/habitability conditions are maintained by conventional strainers, radiation shielding, portable equipment for monitoring the radiation level and portable breathing equipment, smoke and fire detectors, drinkable water and first aid equipment.

More detailed information on how the human factors are taken into account in the design is provided under Article 18.

12.6 Procedural aspects

The development of procedures takes into account both the correctness of the technical information provided and the way in which the information needs to be organised and presented to the user in order to minimise the potential for errors.

Technical aspects were built in the initial operating procedures, whereas the form was changed following INPO standards. Changes to the operating procedures are allowed providing that the proposed change would have no appreciable impact on the validity of the documents supporting the operating license.

The administrative process reflects the station policy expressed in the Cernavoda Integrated Management Manual (IMM) which also sets the hierarchy of the procedures (a diagram showing this hierarchy is provided under Article 13). This process is reflected in the procedure “Operating Manual Content”, which states the responsibilities, authorities, and the necessary steps to design the operating documentation.

Operating procedures (for both normal and emergency conditions) and maintenance procedures provide detailed instructions for the completion of assigned tasks. The availability of accurate and clear procedures minimise the possibility for human error and supports the man-machine interfaces.

Controls in the main and secondary control rooms, and the associated Control Equipment Rooms, are only operated by, or under the direction of, authorised personnel, in accordance with the approved station procedures. Effective use of communication protocols and operating personnel's familiarisation with the operation of systems and the location of the system controls minimises the chances of human errors.

Sufficient information is provided in the field, so that the equipment operators can easily ascertain the status of an individual plant systems or equipment and perform the necessary tasks, in accordance with the approved procedures and work plans. System alignment verifications and post-maintenance testing are routinely performed to detect and correct human errors that may occur during system manipulation or maintenance.

Any work to be performed within the station is assessed and a work package is prepared. Based on station processes related to work evaluation, all information existing in the station maintenance database are reviewed and as appropriate any concern or errors related to work practices or human errors are addressed within the work package and pre-job briefing in order to avoid their recurrence. Also for each human error recorded, a specific “just in time” training program is performed for the addressed groups in order to avoid future occurrence of the same problem.

Any modification to the plant (including procedures) undergoes the “Modification Proposal and Approval Process” (MPA), described in a station instruction which includes a “modification control review screen” questionnaire, based on which different factors affected by the proposed modification are identified. Factors directly linked to human performance and man-machine interface are included in the modification control review screen. Criteria are specified for classifying the modifications, and the potential for affecting human factors leads to the classification of a proposed modification as “major”, to ensure that comprehensive assessments are performed and that all the applicable requirements are met for all the stages of the implementation. Modifications classified as “major” are also submitted to CNCAN for review and approval.

Further information on the different categories of procedures is provided under Article 19.

12.7 Shift staffing

As required by Law, specific regulations and the licence conditions, the nuclear power station must have on duty sufficient qualified operating staff at all times, to ensure that the station, whether running or in shutdown, is operated in a safe and reliable manner.

Shift staffing is defined by a Station Instruction which specifies the process of managing the activities of the operating shift crews (including responsibilities of the operators and maintenance shift personnel) and also specifies the number of persons required to be at station and their responsibilities to cover different situations.

The various members of the shift crew shall have, besides their normal duties, responsibilities for responding to various abnormal events such as fire, personnel injury, etc. The shift personnel receive special training as required for these additional duties.

Besides the shift personnel, an “on-call” list is at all time available for the Shift Supervisor. The list includes both the personnel nominated for technical and administrative problems, and member of the Command Unit for Emergency Situations (unit / site / general emergency).

12.8 Fitness for duty

Cernavoda NPP has regulations and station procedures which describe the fitness for duty policy and principles for all personnel.

All NPP employees must be medically and psychologically examined according to the Safety and Health Management System (as part of the integrated management system) and Human Resources station instructions. The main procedures setting requirements on the fitness for duty are as following:

- “SNN personnel code of conduct” (corporate level document)
- SI “Site access control”
- Departmental “Code of Conduct” documents
- IDP “Shift Turnover”

These procedures and instructions contain responsibilities for:

Employees, that have the obligation to:

- manage their health in a manner that allows them to safely perform their job responsibilities.
- come to work fit for duty (without being under the influence of any substance such as drugs or alcohol) and perform their duties of the job in a safe, secure, productive, and effective manner during the entire time they are working
- notify their supervisors when they are not fit for duty and when they observe a co-worker acting in a manner that indicates the he or she may be unfit for duty.

Managers, that have the obligation to:

- observe the attendance, performance, and behaviour of the employees under their supervision.
- follow the specific plant procedures when an unusual behaviour is identified.

The compliance with the rules of the fitness for duty, as mentioned above, starts from the hiring process when the medical records, criminal records and psychological profiles are verified. During the employment period, periodical mandatory medical checks are performed with for the entire personnel.

Preventive random checks for alcohol and drug intoxication are carried out as per station instruction “Site Access Control”. Annual evaluation of personnel performance is performed as per station instruction “Staffing and Staff Development”.

Regulatory requirements on fitness for duty, with focus on the control room operators, are stated in the “Regulation on granting practice permits to operating, management and specific training personnel of Nuclear Power Plants, Research Reactors and other Nuclear Installations”.

12.9 The Role of the Regulatory Authority Regarding Human Performance Issues

One of the roles of CNCAN is to ensure that the licence holder adequately includes human factors in the design, assessment and operation of nuclear facilities. This role is accomplished by directly interacting with the licence holder in activities related to design (including design changes) and modifications to procedures and processes. This is done through the normal process for review and assessment of safety documentation submitted by the licence holder or applicant for a licence, as well as through the regulatory audits and inspections.

An important aspect of the regulatory activities for assessing the adequacy of the human performance of the personnel with jobs important for safety is the process of licensing operating personnel, instructors and managers of the plant, as described under Article 11.

ARTICLE 13 - QUALITY ASSURANCE

Each Contracting Party shall take the appropriate steps to ensure that quality assurance programmes are established and implemented with a view to providing confidence that specified requirements for all activities important to nuclear safety are satisfied throughout the life of a nuclear installation.

13.1 Legislative and Regulatory Provisions

The Romanian legislative and regulatory framework relevant to quality assurance for activities related to nuclear installations has been subject to continuous development since 1982, when the law regarding Quality Assurance for Nuclear Installations (Law 6/1982) was issued under the directions of the former State Committee for Nuclear Energy (CSEN). The Law No. 6/1982 was abrogated when the Law 111/1996 came into force.

As required by the Law, any organisation deploying activities important to nuclear safety shall establish Quality Management Systems (QMS) and shall submit an application to CNCAN for obtaining the relevant licence.

In accordance with the provisions of article 24 of the Law, the QMS in the nuclear field for the design, siting, procurement, construction, installation, commissioning, operation, decommissioning or conservation phases of a nuclear installation are subject to licensing; the same applies to the QMS established by the suppliers of products and services to be used in nuclear installations and classified as important for nuclear safety.

The licences are granted by CNCAN in accordance with the provisions of the Law and the Romanian regulations on QMS. The conditions that the applicant for a licence has to meet, as stated in the law, are:

a) to demonstrate the professional qualification, for all job positions, of its own personnel, the personnel's knowledge of the nuclear safety requirements, as well as the probity of the personnel that have authority for decision making in managing the activities to be performed under the licence;
b) to ensure that its own personnel involved in the activities to be performed under the licence has the necessary knowledge and awareness of the impact that the deviations from the quality standards and specifications for the products and services supplied to nuclear installations would have with regard to nuclear safety;
c) to establish and maintain a controlled quality management system in its own activities, and to ensure that its suppliers of products and services, as well as their sub-contractors along the whole chain, establish and maintain controlled quality management systems.

All the above mentioned licensing conditions are further detailed and supplemented with specific requirements established through the set of regulations on QMS. The current Romanian regulations on QMS for nuclear installations and activities have been developed by CNCAN based on the Canadian Standards series N286 and

Z299, ISO 9000/2000, IAEA 50-C/Q SG and the drafts of GS-R-3 and GS-G-3.1 (DS-338 and DS-339 from 2003). The list of QMS regulations is given below, as follows:

1. Licensing of the quality management systems applied to the construction, operation and decommissioning of nuclear installations (NMC-01);
2. General requirements for quality management systems applied to the construction, operation and decommissioning of nuclear installations (NMC-02);
3. Specific requirements for the quality management systems applied to the evaluation and selection of the sites for nuclear installations (NMC-03);
4. Specific requirements for the quality management systems applied to the research and development activities in nuclear field (NMC-04);
5. Specific requirements for the quality management systems applied to the design of nuclear installations (NMC-05);
6. Specific requirements for the quality management systems applied to procurement activities for nuclear installations (NMC-06);
7. Specific requirements for the quality management systems applied to the manufacturing of products and the supply of services for nuclear installations (NMC-07);
8. Specific requirements for the quality management systems applied to the construction and assembling activities for nuclear installations (NMC-08);
9. Specific requirements for the quality management systems applied to commissioning activities for nuclear installations (NMC-09);
10. Specific requirements for the quality management systems applied to the operation of nuclear installations (NMC-10);
11. Specific requirements for the quality management systems applied to the decommissioning activities for nuclear installations (NMC-11);
12. Specific requirements for the quality management systems applied to the activities of producing and using software for research, design, analyses and calculations for nuclear installations (NMC-12);
13. Requirements for the establishment of classes for the graded application of the quality management system requirements for manufacturing of products and supply of services for nuclear installations (NMC-13).

The QMS of each participant in a nuclear project (owners, operators, contractors, suppliers, etc.) are developed and implemented in accordance with the provisions of the above mentioned regulations, providing an adequate framework to ensure that all activities important to nuclear safety are properly managed throughout the life of a nuclear installation.

CNCAN is currently in progress of revising the whole set of regulations on QMS, taking account of the IAEA Safety Standards and Guides GS-R-3, GS-G-3.1 and DS349. Until the revision process will have been completed, the provisions of the regulations on QMS are in force and considered to be applicable also in the context of the integration of the management systems.

13.2 Development of the integrated Management System for Cernavoda NPP

In accordance with the Law, the provisions of the regulations on QMS for nuclear installations (NMC series issued by CNCAN), the licence conditions and the requirements of the SNN Quality Management Manual, Cernavoda NPP has established a Management System which integrates the requirements of regulations and standards applicable to nuclear and conventional industry, regarding nuclear safety, quality assurance, environment management, health and personal safety, physical protection and security.

The integrated Management System currently in place builds upon the Quality Management System that was implemented in accordance with the CNCAN regulation NMC-10. The latest IAEA requirements and guidance on management systems have also been taken into account by Cernavoda NPP in the transition from quality management system to an integrated management system.

The Integrated Management Manual (IMM) of Cernavoda NPP has been issued in 2006 and has been also approved by CNCAN. The structure of the document is mainly based on the CNCAN regulation NMC-10 and includes specific chapters to cover the requirements in ISO 14001; ISO 17025 and OHSAS 18001. The IMM describes the Management System applicable for the operation of Cernavoda NPP, including the policies, principles and processes through which the station mission and objectives are achieved.

The QMS established for the commissioning of Unit 2, valid until the start of operation, has been used in conjunction with the IMM, which includes also general provisions regarding the management of commissioning activities. After the start of Unit 2 operation, the management of the Cernavoda NPP (the whole site) will be done in accordance with the IMM. Most of the applicable procedures have been revised to ensure the transition to the new management system.

13.3 Management Responsibility

To ensure the fulfilment of its mission to operate Cernavoda NPP in a safe and efficient manner, the licensee has established and implemented clear policies, in compliance with all the requirements deriving from the applicable laws, regulations and standards.

The policies of the station for nuclear safety, quality, environment and personnel health and safety are set and communicated to the personnel by means of training programmes (initial and periodic knowledge refreshing) and displaying the policies at working places.

The strategic plans of Cernavoda NPP are established for 5-year periods, with clear objectives in line with the station policies. Specific procedures have been developed describing how the strategic plans, goals and objectives are established and periodically re-assessed in order to ensure that the policies of the organisation are adequately observed and implemented.

Management at all levels is responsible to ensure the implementation of the Management System requirements. Senior management (the Site Manager) is ultimately responsible for the effective implementation of the management system. Management expectations are clearly stated and supported by a comprehensive observation programme which involves all managers and supervisors.

An independent Department for Environment and Quality Management, reporting to the Site Manager, is established and appropriately staffed for developing and monitoring the implementation of the Management System.

All documents describing the Management System specify also the management responsibilities related to the allocation of resources for the implementation and supervision of the addressed activities.

In order to ensure that adequate resources (human, financial, material, etc.) are allocated to implement and continuously improve the Management System, all station activities are grouped in basic and improvement programmes. Each basic or improvement programme is developed based on specific procedures and has a predefined structure. For each programme an owner is assigned, who has the responsibility to establish the necessary human and material resources for implementation. Each programme has a budget allocated, and the budget consumption is periodically reviewed and reported to the management level.

The amount of resources necessary to carry out the activities of the organisation and to establish, implement, assess and continually improve the management system is determined and provided by the senior management of the licence holder, based on the assumptions made and needs identified by the programmes' owners.

The general information on the management of resources has been provided under Article 11.

13.4 Graded application of the Management System requirements

A graded approach is used for the implementation of the management system requirements, that had been used also in the context of the QMS, in accordance with the regulatory provisions which state that the grading shall be reflected in:

a) the managerial level giving the approvals;
b) the extent of the managerial assessment;
c) the level of detailing and review of documents;
d) the extent and type of verifications;
e) the frequency and depth of audits;
f) the extent of surveillance;
g) the extent of requested corrective actions;
h) the extent of the records kept;

i) the type and content of personnel training / qualification requirements;
j) the extent of material traceability requirements;
k) establishing requirements for the records to be issued and for those to be kept for the entire lifetime of the nuclear installation;
l) the level of using independent verifications;
m) the degree of detailing of the process of identification, disposal and solving of non-conformances.

The regulations NMC-02 and NMC-13 contain detailed provisions for the establishment of quality classes for the graded application of the quality management system requirements, to ensure a consistent approach to grading for both the NPP and the suppliers of products and services.

In accordance with the regulatory provisions in force, nuclear safety significance (reflected in the safety class) is the first of the factors contributing to the assignment of the classes for graded application. Other factors taken into account include the complexity of the design and the difficulty in validating it; the complexity and difficulty of the execution process, the uniqueness or recentness of the product, service or process; the necessity of special processes, methods or equipment for verification or inspections; the difficulty of testing the functionality by inspections or testing after installation, necessity for personnel special training, economical considerations.

The graded approach is reflected in the procedures describing the different station processes. As an example, for the procurement processes a specific procedure is in place (“Graded Application of the Management System Requirements”), that describes the methodology for establishing the quality classes (four classes) for purchasing products and services. In accordance with the methodology given in the above mentioned procedure, for each product or activity a grade is assigned to each factor and a final score is then calculated, based on which the class is assigned. The contributing factors are of different weights, the nuclear safety significance being the most important.

Another example of grading is presented in the Corrective Action Process procedure, where the level of approval for closure is established based on the importance of the addressed issue. For example, if the addressed issue is a regulatory body concern, approval for closure is given by the Site Manager, while for an issue such as an improvement requirement the level of approval for closure can be limited to that of the direct superintendent/manager responsible.

13.5 Process Implementation

13.5.1 Transition to Management by Process

The transition from the old concept of managing activities to the new approach based on processes is being done gradually for Cernavoda NPP. As a general rule, all the activities needed for / associated with the achievement of a certain outcome are constituted in a process and are accordingly planned and assessed to ensure that the expected results are obtained.

In order to ensure a smooth transition from the old system to the new concept all the documents were reviewed and, based on the issues addressed, adequately grouped under the appropriate processes. As a result, the number of station procedures has been reduced by 30% with regard to RDs (from 54 RDs to 32 at present) and it is expected that the number of SIs will decrease by 40% approximately. This new approach gives the opportunity of reducing at a minimum the number of different documents describing the same activities.

As Unit 2 is expected to start operation by the end of this year, a comprehensive revision programme has been developed and implemented for the review and update of the procedures used at Unit 1 in order to extend their applicability to both units of Cernavoda NPP.

The hierarchical structure of Management System documentation is shown in Fig. 13.1. As observed from the figure, the documents defining processes are considered second tier documents, presenting a general description of the principles and structure of the process.

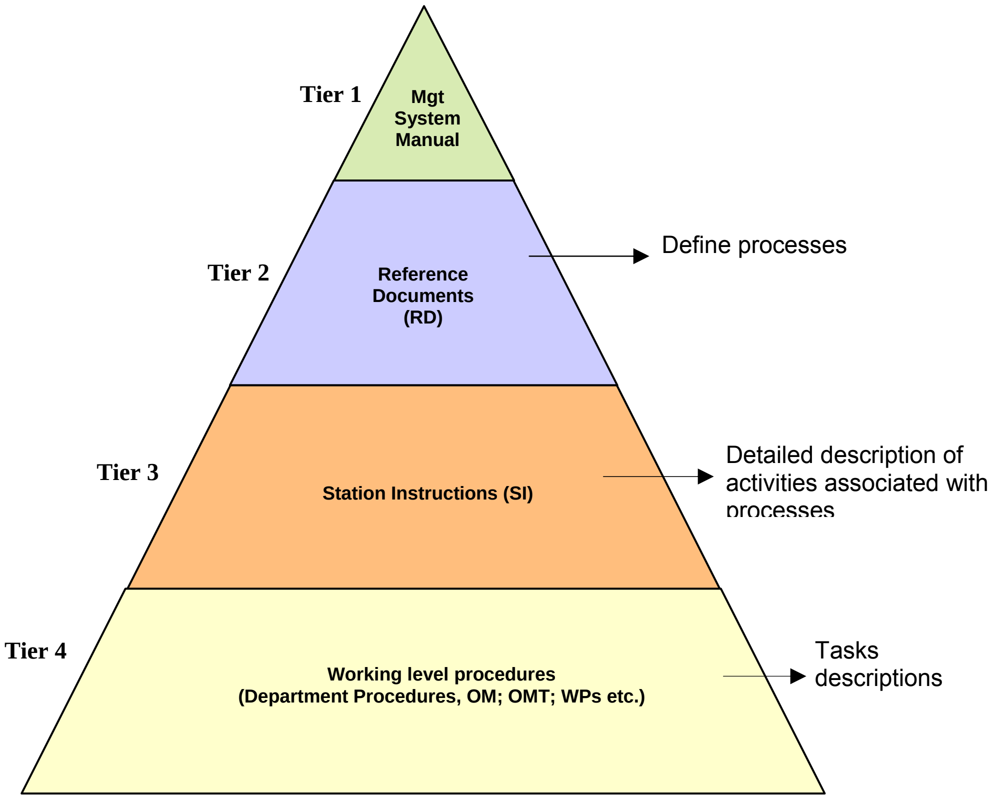


Fig. 13.1 - Structure of Management System documentation for Cernavoda NPP

The list of Cernavoda NPP processes, grouped into three main categories, is given in Fig. 13.2, for exemplification. It should be noted that the list of processes is not frozen, new processes being introduced as the need arises. Ten of the processes identified have already been defined (i.e. documented), the rest being currently under development, with the documentation in different stages of completion.

Managerial Processes	Key (core) Processes, structured on functional areas	
Direction and Management of the activities *Management Systems Evaluation* *External Interface Control* *Process Management*	***Operation*** *Control and monitoring of equipment state* *Chemistry control* *Effluent control* *Reactivity Control* ***Maintenance*** *Work planning* *Maintenance activities*	***Equipment Reliability*** *Maintenance Programmes* *Surveillance Programme* *Continuing equipment reliability Process* ***Configuration control*** *Change control* *Maintain and control design limits*

Support Processes	
Provide human resources *Environment control* *Training activities* *Emergency preparedness* *Physical Security* *Document control and management of records* *Procurement*	*Financial services* *Health and Safety programme* *Obtain and maintain licences* *Project management* *Nonconformities and Corrective Action control* *Fire Protection*

Fig. 13.2 - Process Model for Cernavoda NPP

13.5.2 Process ownership

For each process an individual is assigned as the process owner, who is responsible for:

- delimitating the process boundaries;
- developing the diagrams for the performance of the process;
- identifying the documentation that describes the activities within the process, evaluate it for completeness, ensure that it adequately reflects the process and maintain it up to date;
- identifying the interfaces with other processes;
- ensuring that the process meets all the applicable requirements and that it reflects the objectives of the station;
- establishing performance indicators for the process and for monitoring its efficiency;
- reporting on the performance of the process and promoting its improvement.

Clear procedures are established that define the individual responsibilities of those involved in the development, implementation and supervision of the activities and processes in such a manner that any conflict between responsibility and authority is avoided and that no undue delays in the performance of the work are introduced.

When outsourcing is used for activities within the station, the contractor personnel are working under the direct supervision and control of plant staff and the activities are performed using station procedures and respecting the rules established by these procedures. The operating organisation retains overall responsibility when contracting any activity.

13.5.3 Generic Management System Processes

Control of documents and records

This process has been categorised as a support process and is defined in the procedure "Documents Control and Management of Records". The procedure describes the main steps of the process including: necessity for documentation, categories of documents, responsibilities of persons involved in the preparation, review and approval, revision process, review for the applicability, distribution process, etc.

Each station procedure includes, in the section establishing the responsibilities of the involved personnel, also the requirements and specifications necessary to ensure an effective control of the various documents associated with the respective process or activity. Requirements and specifications regarding the records to be kept are also included as a distinct section in each station procedure.

Communication

Adequate means and interfaces are established for ensuring effective communication at all levels within the operating organisation and also with the external organisations. The general requirements and responsibilities for communication are specified in the IMM and further detailed in each station procedure, as an integral component of each process and activity, vital for ensuring their correct performance.

Purchasing

Prior to the selection of suppliers, the utility performs an initial evaluation for determining the capability of suppliers and the acceptability of their management systems. Suppliers are then periodically audited to assess the level of their proficiency in the area of interest. The frequency of the audits is determined by factors such as safety significance of the work and the performance records of the supplier.

In order to ensure that the suppliers of items/products and services for the safety related systems maintain adequate management systems for meeting the requirements imposed through contracts, the utility performs periodic evaluations (audits) of the suppliers' activities. E.g. the external audits/evaluation are organised when/in case of:

- significant changes in the management systems of the suppliers, such as restructuring or major revisions of procedures;
- recurrent deficiencies in the products supplied by subcontractors, etc.

At the beginning of each year, a plan for auditing the suppliers/contractors is elaborated by Cernavoda NPP and approved by SNN and CNCAN. Personnel involved in the auditing of external organisations/contractors/suppliers is usually ISO certified.

The responsibilities for procurement activities are described in a set of appropriate procedures describing the procurement process, including identification of the need for purchasing, establishment of procurement requirements, selection of the supplier (including supplier evaluation), request for quotation, placing the purchase order, surveillance activities, verifications/inspections upon reception, etc.

Any activity dedicated to a safety related system, which is performed by contractors is based on Inspection and Test Plans approved by Station and Regulatory Body. Hold/Witness points are established and their surveillance is performed by the station personnel during work performance. E.g. Monthly there is an inspection of the fuel being manufactured. As established by Inspection and Test Plans, some bundles are separated to be analysed by the station inspectors.

Control of products

The products are the results of processes/activities. In some cases, in order to realise a product, input from different processes is used. The final quality of a product depends on the input data, on the knowledge and qualification of those using the input data in transforming them in output data, on the verification provided in order to ensure that the final results of an activity achieve the desired results, etc. Cernavoda NPP develops a comprehensive system to ensure that all the activities and resources involved in realising a certain result (product) are adequately managed. This includes the following aspects:

- processes, activities and tasks are well defined (documented in administrative and working level procedures);
- requirements for human resources are specified (type of qualification for persons involved, skills, communication, etc. are described in detail in the applicable procedures);
- material and financial resources are identified and provided (the evaluation process of each activity is documented, ensuring that all is started only after all facilities, tools, spare parts , etc. have been provided);
- risks associated with work performance are controlled and minimised (all activities are appropriately assessed and all risks associated with performing the work are identified, documented and adequate protection is provided e.g. protection equipment, isolating devices, pre-job briefing, fire protection measures, etc.);
- acceptance criteria for the results are established (for each activity or task, the desired results and the measurable values are specified in the applicable procedures);
- the verifications required are defined (as appropriate, the type of verification, the methods of verification and validation of the results are specified in the procedure describing the work);
- the responsibilities for carrying out the execution, control and supervision of the work are defined (where applicable through step by step working level procedures documenting all these responsibilities, including responsibilities at interface);

- testing requirements are specified, as appropriate, for the validation of the results (testing requirements are usually provided in working level procedures);
- the necessity for records is specified (the values of the results are usually recorded in order to be used for demonstrating that desired results were achieved or for further use, for comparison, when similar activities or tasks are performed).

Management of organisational change

The management of organisational change is described in the plant procedure "Managing and Leading Change Initiatives", which establishes the steps to be followed for the planning, control and implementation of the change initiatives, including the provisions for allocation of resources, communication and monitoring.

The scope of the procedure is to provide the framework for the management of change initiatives such as:

- those that would result in significant changes to the Station Programmes;
- those that would result in significant changes to Station Processes and would require major revisions to documents;
- those that would affect the Station Organisational Structure (impacting on more than one department), etc.

The responsibilities for review, assessment, approval, ownership of the implementation process, etc. are also stated in the procedure, as well as the criteria for determining the importance of the change. The procedure includes guidelines for preparing the justification for the proposed change, developing the implementation and communication plan, monitoring, reinforcement and review of effectiveness.

13.6 Measurement, Assessment and Improvement

Several mechanisms are in place to ensure the review of the effectiveness of the Management System established and implemented at Cernavoda NPP and its continuous improvement.

The process for conducting evaluations of the Management System is defined in the procedure "Evaluation processes within Cernavoda NPP". In accordance with this procedure, three types of evaluation are used:

- Independent Assessments (audits, surveillance activities, external audits performed by different organisations e.g. SNN Audits, CNCAN audits, IAEA OSART Missions, WANO Peer Reviews, etc.);
- Self - Assessment;
- Management Reviews (Annual Management System Review, PSOC).

13.6.1 Monitoring and Measurement

For each programme/process, appropriate performance indicators are established, which are periodically reviewed (monthly, quarterly, biannually or annually) and their results and trends are reported to the management. A level approach (usually colour) is associated with each indicator so that a qualitative interpretation of the performance can easily be made. For indicators which have recorded a low value (e.g. yellow or red colour), assessments are performed to identify the causes and corrective actions are established aimed at improving the performance of the addressed activity and implicitly the associated indicators.

13.6.2 Self - assessment

Cernavoda NPP has established and implemented a self-assessment process for continuously evaluating the performance of the systems and processes of the plant. The criteria used in evaluating the performance have been established for each area of activity, based on WANO and OSART guides and standards, as well as on the internal procedures of the station.

Self-assessments are periodically conducted to evaluate the activities and processes and identify the potential for improvements and optimisation. The actions resulted from these evaluations are included for tracking in the Corrective Actions Database.

The means for evaluating the performance of a process in meeting the established objectives and criteria, the responsibilities of the personnel involved in the process, the requirements for reporting of the results from self-assessments and for initiating improvement or corrective actions are described in the procedure “Self-assessment process at Cernavoda NPP” .

13.6.3 Independent Assessment

According to the procedure “Evaluation processes within Cernavoda NPP”, the independent assessments are categorised as:

- internal audits;
- external audits;
- peer reviews;
- technical reviews;
- surveillance of activities.

The internal audits are based on a plan approved by the Site Manager, the corporate Quality Management Unit and CNCAN. The planning of the internal audit activities is done in accordance with the station procedure for internal audits and inspections of the management system. The personnel of the audit team is qualified in accordance with the applicable regulations and standards and is not involved in any of the activities being assessed. As appropriate, specialists from different areas are involved in the audit teams in order to increase the efficiency of the audit.

Specialists included in the audit team do not have any responsibilities involvement in the work performed in the audited areas. The leaders of the audit team are certified auditors.

Examples of areas subject to internal audits:

- the performances of the safety related structures, systems, equipment, components and software;
- the performance of the maintenance activities;
- the condition of the safety related SSCs and the implementation of the programmes for testing and inspections;
- the development, review, use and updating of the management system documentation;
- the implementation of nuclear safety requirements and the safety culture;
- the activities related to personnel training;
- the implementation of the corrective actions and their efficiency.

The audits established through annual plans are supplemented as necessary for situations when there is a concern with regard to the quality of the results of a process/activity or to their efficiency, or when significant changes have been introduced in station processes.

A report is produced as a result of every internal audit and submitted for approval to plant management. The corrective and preventive actions or recommendations in the audit reports are introduced in the Corrective Actions Database and monitored through the Corrective Actions Process for the station. The internal audit reports are also made available to SNN and to CNCAN within two weeks from the completion of the audit.

The external audits are conducted at Cernavoda NPP by the Quality Management Unit of SNN and by the regulatory organisations and certification bodies. This category includes the audits performed by CNCAN.

The peer reviews are conducted on specific areas by groups of internal or external experts, with the aim of identifying improvement opportunities and of promoting good practices. This category includes also the review missions by international organisations.

The technical reviews are independent assessments requested by the management. Their scope is the evaluation of the technical aspects of a process or of an activity, with focus on the identification of means for improvement. This type of reviews is described in the procedure “Information Reports”.

The surveillance of the activities is considered as the most suitable evaluation technique, being more flexible and requiring a lesser degree of formalism than the audits. It provides immediate feedback and detailed information on a specific activity or area of activities, being also used to monitor the implementation of observations/recommendations previously made.

13.6.4 Management System Review

A process for periodic review of the MS by management is established and implemented, in accordance with the procedure “Evaluation processes within Cernavoda NPP”. The review takes in consideration the results of the audits, self-assessments, etc., and is oriented to find opportunities for improvements of the system. As a rule, the review is performed annually, although supplementary reviews can be performed after new processes are introduced, or in case that the efficiency in the implementation of the management system requirements is below expectations, in order to identify causes and initiate timely corrective actions.

The review includes aspects related to:

- the adequacy of the management system documentation for each area of activity;
- the fulfilment of the tasks having impact on safety related SSCs;
- the conformity with the licence conditions and regulatory requirements;
- the fulfilment of the objectives and standards for training;
- the fulfilment of the objectives and standards for maintenance;
- the conformity with procurement standards for replacement of materials and components;
- the use of operating experience feedback;
- organisational issues such as levels of authority and responsibilities, internal and external interfaces, communication, etc.

For all the areas of activity, the review is focused on identifying results that fall short of the expectations and causes that contribute to and determine these results, and on establishing measures to correct deficiencies and improve performance.

The periodic review of management system efficiency does not substitute the normal processes for identifying and correcting deficiencies and is not intended to be used for performing detailed technical assessments or for the general evaluation of plant administration. Such processes are performed separately and provide input to the periodic review of the management system.

13.6.5 Non-conformances and corrective and preventive actions

Each process at the Station contains information on the measures to prevent the installation or the use of items, services or processes that do not conform to their specifications.

A specific Abnormal Condition Reporting (ACR) process is established and implemented. For any item, document, service or activity which does not meet the specified requirements, the non-conformances are:

- identified, documented, introduced in the Corrective Actions Database and reported;
- reviewed and remedial actions determined, executed, verified, and appropriately recorded;
- controlled to prevent unauthorised use or implementation.

Also the recommendations resulting from different evaluation reports such as self-assessment, internal or external audits, and regulatory inspections, are included in the Corrective Actions Database and their status is reported monthly by Environment and Quality Management Department to the Site Manager, with copies to the division managers, in order to establish appropriate actions.

An integrated Corrective Action Process is established and implemented, that integrates the actions from the different evaluation processes. The actions are normally split in three categories:

- Corrective actions;
- Preventive actions;
- Improvement actions.

For each action there is a responsible assigned and a deadline for implementation. Clear responsibilities are established for the implementation, monitoring the progress of the work, documenting the respective activities and verifying the efficiency of the corrective, preventive or improvement action to provide reassurance that its objectives are met.

13.6.6 Improvement

The results from all the evaluations performed, as described in the previous sections, are used to identify opportunities for improvement of the station processes and of the management system as a whole, and to follow up on their implementation. As necessary, specific programmes and projects are established when comprehensive improvement initiatives are undertaken, e.g. for Development of a Component Engineering Process, etc.

13.7 Regulatory Activities

According to the current licensing practice, each participant in a nuclear project has to demonstrate to the satisfaction of CNCAN the fulfilment of all the requirements of the applicable QMS regulations.

In the case of Cernavoda NPP, several review mechanisms are used by CNCAN to evaluate compliance with the legislative and regulatory requirements:

- assessment of the QMS Manual/ Integrated Management Manual and the conduct of comprehensive audits and inspections prior to granting the licence for the respective phase of the nuclear installation;
- review and approval of the (Quality) Management Manuals and a range of documents within the (Quality) Management Systems;
- evaluation and licensing of the personnel with major responsibilities in the establishment and development the (Quality) Management Systems;
- the review of the arrangements for the quality management included in Chapter 17 of the Safety Analysis Report (PSAR or FSAR, depending on the stage in the lifetime of the installation);

- periodic audits, supplemented by inspections, to verify compliance with the licensing conditions and the arrangements made to ensure the continuous improvement of the management system;
- audits and inspections for verifying licensee's arrangements for the contracted work;
- audits and inspections at the various suppliers of products and services for the nuclear installation, and at their sub-contractors, to verify compliance with the conditions of their respective licences and with the provisions of the applicable regulations.

Regarding the Romanian practice of licensing contractors, there are currently over 100 companies that are licensed or authorised by CNCAN. If the items/services provided by a subcontractor are to be used for equipment / systems classified as safety-related, then the subcontractor shall be licensed/authorised by CNCAN. As appropriate, periodic audits are performed in order to check if the licensed/authorised suppliers and subcontractors maintain their capabilities and continue to meet the requirements of the applicable regulations.

This approach should not be considered as having the potential for diminishing the licensee's responsibility, as it only constitutes an additional mechanism to provide confidence that the specified requirements for all activities important to nuclear safety are satisfied. It should be noted that the QMS are licensed by CNCAN from the point of view of the arrangements for and impact on nuclear safety.

The QMS manuals describing the quality management systems implemented by suppliers and subcontractors have to be submitted to CNCAN for review and approval and a licence/authorisation from CNCAN is needed as a prerequisite for obtaining a contract for supplying products or services for the nuclear power plant. This however is not sufficient, as a supplier having a QMS licensed by CNCAN can still be rejected by the utility if the criteria used for the utility's own evaluation are not met.

Cernavoda NPP performs a comprehensive evaluation of the technical capabilities and of the QMS of any supplier, in accordance with the station procedure defining the procurement/purchasing process. Only the suppliers found acceptable are considered qualified to provide services for the utility. As appropriate, periodic audits are performed in order to check if the accepted suppliers and their subcontractors maintain their capabilities.

For each of the audits and inspections performed, at the NPP or at the various contractors, CNCAN staff produces detailed reports of the audit findings and forwards them to the licence holders of the involved organisations. When deficiencies are observed, the licence holders are notified and required to take corrective actions. Depending on the non-compliances identified, enforcement actions are also taken by CNCAN, in compliance with the provisions of the Law.

ARTICLE 14 - ASSESSMENT AND VERIFICATION OF SAFETY

Each Contracting Party shall take the appropriate steps to ensure that:

(i) Comprehensive and systematic safety assessments are carried out before the construction and commissioning of a nuclear installation and throughout its life. Such assessments shall be well documented, subsequently updated in the light of operating experience and significant new safety information, and reviewed under the authority of the regulatory body;

(ii) Verification by analysis, surveillance, testing and inspection is carried out to ensure that the physical state and the operation of a nuclear installation continue to be in accordance with its design, applicable national safety requirements, and operational limits and conditions.

14.1 Regulatory requirements on assessment and verification of safety

A general description of the Romanian licensing system for nuclear installations Romania was given in Article 7, while the more detailed aspects of the licensing process, including safety assessments and verifications, for the different stages of the lifetime of a nuclear power plant are discussed under the Articles 17, 18 and 19.

The regulatory requirements on the assessment and verification of safety are established mainly by the following regulations:

- Nuclear Safety Requirements (NSR);
- Requirements on Containment Systems for CANDU NPPs;
- Requirements on Shutdown Systems for CANDU NPPs;
- Requirements on Emergency Core Cooling Systems for CANDU NPPs;
- Requirements on Probabilistic Safety Assessment for nuclear power plants;
- Requirements on Periodic Safety Review for nuclear power plants.

Relevant requirements for assessment and verification of safety, for the different phases of a nuclear installation project, are included also in the set of regulations on Quality Management Systems for nuclear installations (NMC series, presented under Article 13) which contain provisions related to the quality assurance and safety of operation, maintenance, in-service inspection, testing, modifications, etc. The other regulations mentioned under Article 7 also contain requirements for the assessment and verification of safety for specific areas (e.g. fire protection, radiation protection, etc.). As described under Article 7, regulatory requirements are also established based on applicable international standards, codes and guides.

Up to present, the licensing process for Cernavoda NPP involved the updating of the Final Safety Analysis Report every two years, in view of the licence renewal for an operating reactor. New methodologies, computer codes, experimental data, and R&D findings have to be used or incorporated in the updated Safety Report. The CNCAN requirements also specify the criteria for quality and validation for both analysis and computer codes, in order to ensure adherence to current standards. Tools and methodologies used in the Safety Report have to be proven according to national and international practices, and validated against relevant test data and benchmark solutions. The list of codes used for safety analysis for all CANDU stations (the standard analysis tool set) is defined and maintained by the CANDU Owners Group. SNN (the licence holder for Cernavoda NPP) is a member of this group.

14.2 Safety assessments for Cernavoda NPP

14.2.1 Background

For the purpose of safety assessment all major systems in CANDU reactors are categorised as process systems or special safety systems. All special safety systems are independent from all process systems and from each other.

The CANDU safety philosophy is based on the concept of single/dual failures. Single failure is a failure of any process system which is required for the normal operation of the plant and dual failure is a combination of the single failure events and a simultaneous failure or impairment of one of the special safety systems.

There are established requirements that the plant is designed and operated such that the single failure events and the dual failure events do not exceed a frequency of one per three years and one per three thousand years respectively. The probability for any significant release of radioactivity shall be less than 10^{-7}/year. In order to meet these targets, the unavailability of the special safety systems must be 10^{-3}/year, or less. The existence of two independent fast shutdown systems in CANDU reactors, each with an unavailability of less than 10^{-3}/year allows the assumption that at least one will operate when called upon by a process failure. The CANDU safety philosophy does not consider a triple failure, i.e. a coincident process system failure and unavailability of two special safety systems, which has a probability of less than10^{-7}/year.

Safety analyses are performed to demonstrate to the regulatory body that dose limits for postulated accidents do not exceed targets and to show that other credible sequences of events would not lead to unacceptable consequences. The safety analyses also sets the requirements for the special safety systems (shutdown systems, emergency core cooling system and containment system). For the purpose of the accident analyses, only those events for which the intervention of one or more of the special safety systems is required to prevent fuel failure or the release of radioactive material to the environment are considered. These are referred as a serious process failures.

Typically, events were grouped according to the process system where single failure are postulated to occur. These include the primary circuit, the steam and feed water system and the fuelling machine.

Coincident failure analysis is a systematic assessment of postulated dual failures. Each postulated process failure is systematically coupled with a failure of one of the special safety systems. Loss of the shutdown systems is excluded from required dual failure sequences because the design includes two independent shutdown systems which are each capable of shutting down the reactor.

A distinguishing feature of dual failure assessment is that the analysis of CANDU 6 reactors must show that:

- coolable core geometry is retained even if the ECCS were to be impaired;
- radioactive releases are adequately prevented even if the containment system were to be impaired.

The deterministic approach uses several generic assumptions which are applied in assessing the consequences resulting from the postulated accidents. These include the following:

- Reactor trip occurs at the second trip signal on the less effective shutdown system.
- Intervention by the operator is not credited during the first 15 minutes following the clear and unambiguous indication that an initiating event has occurred and that operator action is required.
- Mitigating automatic action by process system response is not credited.
- Each special safety system is assumed to be in its minimum acceptable configuration.

As part of the compliance with more detailed regulatory guidelines, safety analysis must also prove reactor trip coverage, by demonstrating that there are two diverse trip parameters, wherever practicable, that are detected by the sensing and control logic of each shutdown system for each serious process failure.

The resulting radiation dose for both a susceptible individual at the site boundary and to the surrounding population are derived for the events in the accidents analysis matrix. These must meet the guidelines which have been established by the regulatory body.

These analyses, together with the assumptions on which they are based, define the analysed state or condition of the plant. As such, they identify the envelope within which the plant must be operated in order to assure consistency with the supporting accident analysis. This can place specific performance requirement in terms of capability and availability on station system, components and instrumentation. In general, these special requirements are translated into operating practice by the Operating Policies and Principles Reference Document as well as the operating manuals, including the Impairments manual.

Another analytical technique that has been used for CANDU reactors is the Safety Design Matrix, for dealing with matters of interdependency, post-accident operation and actions requiring operator intervention. The safety design matrix contained a combination of fault trees and event trees. In a Safety Design Matrix (SDM), event sequences are developed starting with an initiating event and concluding with a stable plant condition in which an adequate heat sink for fuel cooling exists, or to an acceptable low event frequency. The event frequency is generated from fault trees prepared to identify the frequency of occurrence of different failure modes of a system. The event sequences address reactor shutdown, both by regulating and shutdown system action, and adequacy of fuel cooling for all post-accident time frames. The assumption used in the SDMs are not conservative as those used in deterministic analyses. They also identify operator action over a large time scale and factor in a reliability model for the operator based on the quality of information he receives and stress he is exposed to. As a result SDMs are a more realistic representation then the deterministic analyses of the of the consequences to a similar initiating event.

The SDMs originally developed by AECL for Point Lepreau Nuclear Generating Station have been reviewed against Cernavoda NPP Unit 1 design and issued as supporting documents for FSAR Chapter 15. The SDM studies which were developed for Cernavoda NPP Unit 1 are:

1) Containment Operation;
2) Moderator as a Heat Sink;
3) Loss of Shutdown Cooling;
4) Moderator and Shield Cooling System as a Heat Sink;
5) Reactor Building Flooding;
6) Operation Following an Earthquake;
7) Flooding in Turbine and Service Building;
8) Total Loss of Service Water;
9) Inadvertent Addition of Positive Reactivity;
10) Loss of Electrical Power;
11) Small LOCA and ECC Operation;
12) Large LOCA and ECC Operation;
13) Loss of Instrument Air;
14) Loss of Steam Generator as a Heat Sink;
15) Dual Computer Failure.

In conjunction with SDMs, detailed reliability analyses for the most significant safety related systems have been developed. The selected systems are continuously monitored and the reliability analyses yearly updated consequently. The following reliability analyses have been performed:

1) Reliability Analysis for Emergency Core Cooling System;
2) Reliability Analysis for Shutdown System No. 1;
3) Reliability Analysis for Shutdown System No. 2;
4) Reliability Analysis for Containment System;
5) Reliability Analysis for Emergency Power Supply System;
6) Reliability Analysis for Emergency Water Supply;
7) Reliability Analysis for Auxiliary Feedwater System;
8) Reliability Analysis for Reactor Regulating System (Stepback on Neutronic Parameters);
9) Reliability Analysis for Shutdown Cooling System;
10) Reliability Analysis for Class III Standby Diesel Generators;
11) Reliability Analysis for RSW -Backup Cooling Water System.

In addition to the deterministic analyses, Safety Design Matrices and Reliability Studies, probabilistic analysis have also been developed. Following CNCAN requirements, a PSA level 1 for the design was prepared and reviewed by IAEA through an IPERS mission (1995) and subsequently after implementation of the mission recommendations. The results of the design PSA came up with the recommendation to improve the design through a series of design changes that were implemented during commissioning phase.

Information on the deterministic analyses performed for Cernavoda NPP Units 1 and 2 and on the current status of the Safety Analysis Strategic Programme and the PSA Programme are provided in the following sections.

14.2.2 Deterministic safety assessments

The deterministic analyses, including the description of initiating events, event sequences, acceptance criteria, methodology, results and interpretation are provided in Chapter 15 of the FSAR.

For Cernavoda NPP Unit 1, the process systems failures analysed include:

- loss of reactor regulation;
- LOCA events (large LOCA and small LOCA);
- pressure tube rupture;
- channel flow blockage;
- end-fitting failure;
- fuelling machine events;
- pipe breaks in HT auxiliary systems;
- loss of off-site power;
- seizure of a primary heat transport system main pump;
- pressurisation events - primary side;
- depressurisation events - primary side;
- feedwater line breaks;
- steam main breaks;
- steam generator tube failure.

Each of the above mentioned process systems failures (initiating events) were analysed for the case in which the ECCS and the containment system are available, and also in combination with various failures/impairments to either ECCS or containment functions. Large LOCA and small LOCA events are analysed also in combination with loss of off-site power and with impairments to either ECCS or containment system functions.

For Cernavoda NPP Unit 2, the analyses provided in the Chapter 15 of the FSAR were grouped in sections dedicated to:

- Heat transport system LOCA events
- Heat transport system non-LOCA
- Steam and feedwater circuit events
- Moderator events
- Shield cooling events

The heat transport system LOCA section consists of large and small break analysis both with and without Class IV electrical power (off-site power). Events that affect a single fuel channel resulting in a small break in the heat transport system are assessed separately. These events are: spontaneous pressure tube rupture, channel blockage leading to channel failure, complete failure of a channel end fitting leading to ejection of fuel from the channel, inlet feeder breaks. Also included are single and multiple steam generator tube failures. Heat transport non-LOCA events analysed are: complete and partial loss of Class IV electrical power, seizure of a single heat transport pump, loss of reactivity control, and loss of heat transport system pressure and inventory control. Steam and feedwater circuit events include steam line breaks inside and outside containment, feedwater line breaks, loss of steam generator feedwater flow and loss of secondary circuit pressure control. Moderator and shield cooling system events include loss of flow, loss of heat sink and loss of inventory.

The initiating events (failures of the process systems) are also analysed in combination with impairments to the emergency core cooling system or to the containment system.

The following events are explicitly analysed with a subsequent loss of Class IV power: large LOCA, small LOCA, a single steam generator tube rupture, steam line breaks and feedwater system failures. The analysis of loss of Class IV power for small LOCA is applicable to the analysis of single channel events, which include pressure tube rupture, channel flow blockage, end fitting failure and feeder breaks.

The safety analysis for Unit 2 were based on the guidelines provided in the document “Requirements for the Safety Analysis of CANDU Nuclear Power Plants (C-6, June 1980, issued by AECB). Examples of safety analysis requirements introduced by C-6 that differ from previous practices are given as follows:

- a requirement for a systematic review for the identification of postulated initiating events;
- five event classes, replacing the two categories of single and dual failures;
- correlation of event classes with probability of occurrence and allowable release limit;
- more explicit consideration of combinations of postulated initiating events with failures of mitigating systems (not just the classical dual failures).

A Safety Analysis Strategic Programme was developed by Cernavoda NPP Unit 1 and approved by CNCAN. The main objective of the Safety Analyses Strategic Programme is to get a better definition of the plant safe envelope. Also, the program intended to create and develop a group that will be able to perform and re-evaluate the safety analyses results. The program purpose was to update, based on plant specific models and state of the art computer codes, the entire set of accident analyses included in the Cernavoda Unit 1 Safety Analyses Report. This programme is also aimed at maintaining and developing site capabilities to deal with safety related operational issues and also generic safety issues.

The first step considered in the project was to develop plant specific models, to be used with the last version of the computer codes. As part of this stage, primary circuit and secondary side models have been developed. Specific models for single channel analyses have been developed. Specific models for containment and dose calculation were also developed. As part of this stage there were prepared, verified and approved a number of about 31 internal reports. Each report is focused on the description of the plant systems and components and of the models developed for each of these. The models have been tested with similar conditions and the results have been compared with available results.

After the preparation and approval of all these models, another set of reports have been prepared in order to present the methodology that will be used for safety analyses purposes. For each initiating event that has to be analysed in detail, based on plant specific models, a specific report has been prepared. Up to date there have been completed 6 reports of this type, and another report is in an advanced stage of preparation.

Once the methodology was prepared and approved, for each of these initiating events, the analysis of the initiating events has been started. Up to date there are 2 different reports (for Large LOCA, Large LOCA and Consequent Loss of Class IV power) that have been prepared and approved. Also, there are 3 other reports that are in different stages of verification and approvals (Large LOCA with Loss of Containment, Large LOCA with Loss of Containment and subsequent Loss of Class IV Power, Steam line break, Large LOCA and Loss of ECC functions, and Loss of Feedwater system).

Up to the end of the year there will be finalised and approved another set of 6 reports, each one presenting a different analysis. The rest of the reports included in the Safety Analyses Strategic Programme will be performed in accordance with an internal plan, with the intention of finalising all the analysis reports within the next two years.

The generic severe accident analyses and severe accident management guidelines (SAMGs) developed by the CANDU Owners Group for CANDU 6 are used by Cernavoda NPP in the elaboration of plant specific analyses and SAMGs. At the moment, specific information reports and procedures are prepared at the plant for establishing the framework for this programme, including the allocation of resources and the necessity of training, the activities that need to be performed with external support, etc.

14.2.3 Probabilistic safety assessments

The Level 1 PSA study for Cernavoda NPP Unit 1 started in September 2000. After the successful completion of a limited scope Internal Events PSA, the project continued by addressing the impacts of Seismic Events, Internal Fire, Internal Flooding and High-Energy Line Breaks on Cernavoda Unit 1 core damage frequency. Together with the internal events analysed in the first stage of the project, these hazards are considered to be the relevant contributors to the NPP operational risk.

The objectives of the project were:

- To develop a PSA study that will provide the necessary input data required to address regulatory and safety issues at Cernavoda Unit 1;
- To provide a detailed and robust PSA model that will be used as the basis for the implementation of a Risk Monitor system (EOOS).

The study has been performed in subsequent stages and has been reviewed by several IAEA IPSART Missions. At this moment the quality of the Level 1 PSA study provides the required support for developing Cernavoda Unit 1 risk-informed applications (e.g. the Risk Monitor).

The risk monitor has been developed based on the internal events PSA and is now under scope extension and validation in order to be used as on-line Risk Monitor. The process to apply the Level 1 PSA results in different plant programs is also under development.

Until the technical bases and processes for PSA applications will be defined, a direct way to get benefit from the analyses is to consider the first level results, insights and recommendations documented in the PSA reports. These are based on the sensitivity analyses, which are usually performed as part of the main PSA and also on the knowledge gained by the PSA team members during the PSA study development.

During 2005 - 2007, the scope of Cernavoda Unit 1 PSA was extended considering the events initiated during shutdown operating modes. The CNE Cernavoda Unit 1 PSA model resulted after this stage will be used in two directions:

- To identify potentially significant contributors to plant risk from events that occur during shutdown operation;
- To extend the Risk Monitor EOOS of CNE Unit 1 to include shutdown states operation in order to be used for risk evaluation in the next planned outages.

According to the licensing requirements for Cernavoda Unit 2 a Probabilistic Safety Assessment study is also necessary to be elaborated. Because, at the construction stage of Unit 2, the majority of the design changes of Unit 2 (as compared to the reference plant - Unit 1) were elaborated at the conceptual level and they were not described in sufficient detail to support the development of the PSA study, a two step strategy was established. Considering the timeframe for the development of the probabilistic analyses the first step of this strategy was to develop a qualitative risk analysis using the existing PSA level 1 study of Unit 1 as reference, compared with the new conceptual design changes that to be implemented at Unit 2. Consequently, the second step was to develop the PSA study for Unit 2 when the design changes are described in detail.

A qualitative evaluation of the Unit 2 design changes versus Unit 1 design using the probabilistic approach was performed during the construction phase of Unit 2. Further on, the licence holder will perform a PSA Level 1 internal and external events study for Unit 2, which will be used in the decision process in operation based on a detailed programme agreed with CNCAN. The due date for finalising the PSA Level 1 internal and external events study for Unit 2 is in 6 months from the start of operation of Unit 2.

The licence holder intends to perform PSA Level 2 in similar conditions as for PSA Level 1 for Unit 1. Basically, the cut-sets of PSA Level 1 will be used to characterise the containment behaviour. After this, the necessary of SAMGs will be evaluated.

On a contractual basis, SNN has access to CANDU Owners Group (COG) severe accidents analysis database which will be used as inputs for PSA Level 2. The estimated date for finalisation of PSA Level 2 is the end of 2009.

14.3 Continued Monitoring of Nuclear Power Plant

14.3.1 Assessment and verification of plant modifications

Plant procedure "Design modifications policy" covers both permanent and temporary modifications. According to this procedure the number of simultaneous temporary modifications must be kept to a minimum. The procedure "Temporary Modifications" deals only with temporary modifications. The period of a temporary modification is limited. Sometimes temporary modifications are used as an intermediate stage before implementing a permanent modification. The status of temporary modifications which might have an impact on plant's safety is at all times known by operating personnel and reported to the management of the plant.

According to station specific procedures, modifications are classified in two classes: major (corresponding to modifications in categories 1 and 2 as provided in the IAEA NS-G-2.3) and minor (corresponding to category 3 in the safety guide). As a result of application of an evaluation screening process the type and safety significance of the modification are determined.

After the initial assessment performed to categorise the modification, a more comprehensive assessment is undertaken for major modifications. The graded approach is used in establishing the extent of the assessment. For major modifications, all the safety aspects are considered in the assessments and a demonstration that all the relevant safety requirements are met must be submitted to CNCAN. The non-routine operations or tests are treated in the same way as a major change or as a temporary modification that may affect the safety envelope. All major and safety relevant modifications (permanent, as well as temporary) are submitted for approval to CNCAN.

The Operating Licence Conditions state that excepting the cases for which CNCAN is granting written approval, there shall be no modification, not even temporary, which might diminish the nuclear safety margins resulted from the accident analyses included in the Final Safety Analysis Report, especially to the Shutdown Systems No. 1 and 2, the Containment Systems, the Emergency Core Cooling System and any support system for the above mentioned systems. This applies also for any other safety-related system, which are referred to in the plant Reference Document "List of safety related systems".

Cernavoda NPP Nuclear Safety Policy and OP&P documents state that safety review of procedures, analysis, design changes shall be completed before the work is started. To comply, a dedicated process for all work/activities or modifications other than routine operation and maintenance has been in place since the early commissioning phase and require the use of a work plan for the implementation of each activity.

Examples of the plant internal procedures related to design changes are given below:

- RD “Design Change Policy”
- RD ”Management and control of modifications”
- RD “Document Control and Records”
- SI "Modification Proposal and Approval Process"
- SI “Temporary Modifications”
- SI "Design Modification Implementation"
- SI "Configuration Change Determination"
- SI "Modification Close-Out"
- SI "Management and Control of Drawings"
- SI "Technical Specifications"
- SI "Design Revision Package”
- SI "Technical Calculations/Analyses and Design Verification"
- SI "Use of Replacement Materials, Parts and Equipment"

The initiation of the process is done in accordance with the procedure “Configuration Change Determination”. As a result of application of an evaluation screening process the type and safety significance of the modification are determined.

The requirements for installation, inspection and testing are developed according to the procedure “Design Modification Implementation”.

After the implementation steps are completed, the system is declared as “available for service” and modification is “closed out” (in compliance with “Modification Close-Out”). This means that the modification tests meet the safety and performance requirements and all affected documentation is updated and the personnel is trained.

14.3.2 Surveillance Programmes

The Operating Licence Conditions require having in place a programme for the continuous monitoring of the plant safety parameters. At Cernavoda NPP, the continued monitoring of the nuclear installation is carried out through the Surveillance Programme. The purpose of the programme is to verify that provisions made in the design for safe operation, which were verified during construction and commissioning phases, are maintained throughout the life of the plant. At the same time, the program verifies that the safety margins are adequate and provide a high tolerance for anticipated operational occurrences, errors and malfunctions, and detect in time any deterioration that could results in an unsafe condition.

Also, as per Operating Licence Conditions, the compliance with the following reference documents and station instructions, prepared by the utility and approved by CNCAN, is mandatory: “Maintenance Philosophy and Programme”, “Mandatory Testing”, “Surveillance and Routine Testing”, “Predictive Maintenance System”, “Preventive Maintenance System”.

All important input data and main assumptions used in deterministic/probabilistic analyses supporting the plant licence were included in a comprehensive document Safety Analysis Data List (SADL). The document also identifies the corresponding design data together with the applicable design references. SADL are submitted to CNCAN as part of the licensing basis documentation.

The purpose of the SADL is to demonstrate that the specific design of the plant is compatible with the safety analyses. This objective is achieved if the data and assumptions used in the accident analyses are confirmed against the design data documented in the final design manuals (when applicable). Where achievable, the design data were confirmed by specific commissioning tests. In case of inconsistencies between the results of the commissioning tests and the safety analysis data/assumptions, then more in-depth assessments are provided to confirm adequate safety margin.

These data constitute the main acceptance criteria for continuous operation of the plant. As surveillance results are obtained, the person conducting the surveillance activity, according with specific work procedures, compares them with the acceptance criteria. If the results fall outside of tolerances, corrective actions are initiated, in accordance with appropriate work procedures. The surveillance programme includes appropriate actions to be taken for postulated deviations from the acceptance criteria, based also on safety analyses.

Surveillance results are examined by appropriate qualified persons, to provide assurance that all results satisfy the acceptance criteria from safety analyses and also to analyse the result trends that may indicate equipment deterioration. Where the trends indicate an unsafe direction of safety performance and the corrective actions can solve the problem only for a short period of time, a modification of the configuration is the subject of a safety assessment. The surveillance results represent also the plant specific data that are used as input data for the periodic review of deterministic and probabilistic analyses.

The Surveillance Programme for Cernavoda NPP is divided into the following activities/programmes:

a) Monitoring of Plant Parameters and System Status

This includes main control room routines, field inspections, sampling analysis, and system surveillance programme. These activities give an immediate indication of the plant status and offer the input data for the calculation of the predictive availability of the operating systems. A comprehensive programme for system surveillance was developed at Cernavoda NPP using INPO guidelines.

b) Mandatory Testing Program

Mandatory tests are developed in accordance with the reliability claims made within the probabilistic analyses of the safety related systems. The test results offer an overview of the "actual-past" unavailability of the standby safety systems and allow immediate corrective measures in the case the test failed.

c) Checking and Calibrating of Instrumentation

A calibration verification test is intended to check whether a known input to the instrument or channel gives the required output. Also, it verifies that the response times are within the specified limits. This activity gives the confidence in instrumentation indications and its associated response time.

d) In-Service Inspection Programme

The document which establishes the framework for the Inaugural and Periodic Inspection Programme of NPP Cernavoda Unit 1 and Unit 2 is the Periodic Inspection Programme Document (PIPD) based on the Canadian standard CAN/CSA N. 285.4 – 94: Periodic Inspection of CANDU Nuclear Power Plant Components.

Industry and own operating experience was used to upgrade the Periodic Inspection Programme:

- Feeders inspection requirements changed to address possible damages observed in other CANDU stations;
- Steam Generators were modified to allow proper inspection;
- Piping inspection programme upgraded using “CHECKWORKS™” software.

e) Preventive and Predictive Maintenance Programme

The objective of preventive maintenance (PM) is to prevent equipment breakdown through a planned program of activities in order to ensure continued availability for service. The objective of the plant predictive maintenance program is to improve plant safety and reliability through early detection and diagnosis of equipment problems and degradation prior to equipment failure. This activity is based on monitoring the health of the system and associated equipment, measuring and analysing trends of critical performance parameters.

A strong and technically sound maintenance programme for critical equipment was fully implemented at Cernavoda NPP using EPRI (Electric Power Research Institute -USA) guidelines. Supporting predictive programmes (vibration measurements, oil analysis, ultrasound detection, thermography etc) were also developed. Systematic collection of equipment ‘as-found’ data, industry and station OPEX started to be used for continuous monitoring of programme’s performance.

The activities for fulfilling the CNCAN requirement to describe the way the results of the PSA level 1 for Cernavoda NPP Unit will be used in operation and the development of the feedback process using the root cause methods and to develop the adequate database are currently ongoing.

f) Ageing Management Programme

Cernavoda NPP Plant Life Management (PLiM) Programme integrates Preventive / Predictive Maintenance Programmes, Ageing Management Programme, Obsolescence Mitigation Programme, Environmental Qualification Programme and

System Surveillance/Health Monitoring Programmes. In this way, the PLiM Programme integrates all aspects regarding ageing and degradation processes of the plant. The purpose of this program is to maintain the performance in acceptable limits of critical Systems Structures and Components (SSC), throughout the plant life, based on implementation of several long term technical programmes.

Up to date, the Pilot PLiM programmes developed with AIEA support were completed. Cernavoda NPP joined the COG R&D programs in order to ensure strong technical basis for the station PLiM.

Using the experience gained and benchmark missions to other nuclear facilities, a full set of reference documents and station instructions were prepared to sustain the extension of PLiM Program to all major plant assets. Also, a strategic plan was issued to develop dedicated Functional Groups and Duty areas within station organisation in order to ensure proper support to PLiM programmes.

g) Systematic assessment of Critical Spare Parts Programme

The critical spare parts inventory was revised based on the findings of equipment failure mechanisms analysis. Also, a shelf life programme for spare parts was implemented.

14.3.3 Implementation of Risk Monitor (EOOS)

A risk monitoring program (Equipment Out Of Service - EOOS) has been developed based on the existing PSA model and Equipment Out Of Service software developed by DS&S as an EPRI contractor.

The PSA model has been built as a master F/T that includes the failure logic for all the accident sequences ending in a Core Damage State. The logic model development fully exploits the advance techniques and features available in CAFTA environment. Mainly those techniques involve use of a limited number logic flags, inclusion of initiating events identifiers inside the system F/T top events to simulate the initiating event’s impact on different equipments, trains or systems, restructure the input logic in order to allow the quantification engine to work faster while generating the minimal cut-sets for all initiating events in a single run.

The next step in building the risk monitor model was to replicate the failure logic existing in the base PSA and introduce configuration flags inside the master logic F/T in order to account for any operating state an active equipments can be at a particular moment in time (ON/AUTO/OFF).

Mapping the relevant BEs to the corresponding equipments and constructing the operator panel interface were subsequent steps required to translate the PSA specific language to the operator’s language.

The following features provided to the Risk Monitor developed for Cernavoda NPP have to be emphasised:

- Dynamic recalculation of some initiating events frequencies based on the IEs F/Ts re-evaluation.
- Ability to increase the frequency of LOOP and General Transient by a factor varying between 2-10 (based on a subjective engineering judgment) to simulate the impact of some conditions which are not explicitly included in the PSA.
- Ability to check misalignments based on F/T supporting logic.
- Ability to recalculate the failure probability of the most significant standby equipments based on equations that consider the time elapsed from the last test.
- Ability to identify and prioritise the operator actions to reduce the risk based on the importance measures (RRW for the Equipments OOS show what equipments are worth to be returned in service and RIR for the in service equipments show what equipments are worth to be protected or their failure probability to be reduced).

The risk thresholds have been defined by splitting the CDF variation interval in for regions. Two reference values have been used: the base CDF (the PSA value while setting up maintenance unavailability to zero) and the maximum acceptable CDF value. Each zone is represented by a colour consistent with those used in the Significance Determination Process colours:

- Green (Insignificant Risk Increase) – No actions required in respect with the risk management.
- White (Potentially Significant Risk Increase) – Limit the duration. Evaluate the importance of OOS and I/S equipment and do not approve any work resulting in a higher action level. Inform Shift Supervisor.
- Yellow (Significant Risk Increase) – Same action as for white plus: Allocate all available resources to return in service the most risk significant equipment. Define and implement compensatory measures. Inform the production and Safety Managers.
- Red (Unacceptable Risk Increase) – Same measures as for Yellow plus: Request for extra resources. Inform the Station Manager and initiate a Technical Operability Evaluation meeting.

An updating and configuration control process is in place to ensure that the following types of modifications are identified on a day by day plant operation review and their impact on risk is considered: permanent/temporary configuration changes, hardware changes, changes to the plant operating procedures or maintenance procedures, changes to the component unavailability data as a result of the plant specific reliability data collection program.

Internal department procedures have been developed in order to define how the risk monitor is to be used by three categories of users:

- Main Control Room – keep the risk monitor updated with all relevant plant operating configurations, use the risk colour thresholds;
- Planning Department – 13 weeks schedules evaluation;
- Safety & Compliance Department – Safety Cases Evaluation (check list to be used by R&R engineers), AOTs assessment and compensatory measures for risk reduction (based on cumulative risk increases thresholds), CDF monitoring and reporting on the monthly Plant Safety Oversight Committee meetings.

The risk monitor is now in a field trial use in Main Control Room, Planning Department and Safety and Compliance Department. The feedback from the users is being used to refine and improve the PSA model and to optimise the process for providing meaningful insights in support of the day by day operational decision making. After one year of field trial the plant personnel become more and more familiar with PSA and more interested on how PSA can support their activities.

14.3.4 Periodic Safety Review

Up to date, the Romanian licensing system required a safety review to be carried every two years by Cernavoda NPP Unit 1, in order to support the license renewal. The main safety issues, having the current Safety Analysis Report as the main document under review, correspond largely to the 14 safety factors proposed by IAEA's Safety Guide NS-G-2.10. The scope of Periodic Safety Reviews in the general understanding being more comprehensive, the benefit of carrying such reviews is recognised and it is likely that the Romanian licensing approach will be changed in the future.

In 2006, following a recommendation received from an IRRS Mission organised by IAEA and also as a result of the participation in the study "Harmonisation of Reactor Safety in WENRA Countries", CNCAN issued a regulation on Periodic Safety Review of Nuclear Power Plants, as a first step towards the changing of the licensing system. At present, the regulation requires a PSR to be conducted at every ten years, without explicitly mentioning its role in the licensing process. The Romanian regulation is based on the Safety Guide NS-G-2.10, having the 14 "safety factors" defined as "areas of review", for each of these having specified most of the "generic review elements" given in the Appendix to the IAEA guide.

This year CNCAN has approved the scope and programme of the PSR for Cernavoda NPP Unit1, together with the Quality Assurance plan. Preparatory work is currently done by the utility as part of the 1st Phase of the PSR.

14.4 Description of the regulatory review process

CNCAN staff is usually performing complex technical assessments/evaluations when reviewing safety documentation (Safety Analysis Report and the supporting technical documentation) submitted in support of license applications. Technical evaluations are also performed for event analyses and when approving operation documentation. Other types of evaluation (inspections, audits, etc.) are described in Article 7.

The main responsibilities of CNCAN staff performing safety assessment activities are:

- To determine whether the conceptual design is safe and meets applicable regulatory criteria;
- To determine whether the operating envelope is consistent with safety requirements, including regulatory requirements;
- Perform evaluations of the proposed plant modifications;

- Provide the basis for the decision of issuing licences and approvals.

Safety evaluations of the safety documentation are technically oriented in the areas of:

- Deterministic analyses - Thermalhydraulic, Reactor Physics, Stress Analyses (for civil structures, systems and components);
- Probabilistic analyses - Reliability Analyses;

14.4.1 Review and Assessment in the licensing process

Regarding Cernavoda NPP Unit 1, the review and assessment activities has been focused on:

- Station safety performance;
- Significant events reported by the licensee;
- Temporary configuration changes;
- Plant modifications;
- Operating licence renewal documents:
  - Cernavoda NPP Unit 1 FSAR, 2001 edition;
  - Addendum 2003, to Cernavoda NPP Unit 1 FSAR, 2001 edition;
  - Addendum 2005, to Cernavoda NPP Unit 1 FSAR, 2001 edition;

Regarding the construction and commissioning of Cernavoda NPP Unit 2, the review and assessment have been focused on:

- Preliminary Safety Analysis Report;
- Design implementation;
- Changes to the authorised design;
- Construction activities;
- Construction and commissioning procedures;
- Final Safety Analysis Report;
- Assessment of commissioning safety objectives and test results.

The review and assessment activities aimed at verifying compliance with the following:

1. Safety Principles and Design Criteria;
2. Defence in depth concept achievement;
3. Systems Separation Philosophy;
4. Special safety systems design requirements;
5. Design Codes, Standards and Safety Guides.

with the goals to :

- determine whether the applicable safety objectives and requirements for each aspect or topic have been met;
- determine if safety analyses cover both normal and fault conditions;
- determine whether the submissions have been provided sufficiently complete, detailed and accurate.

14.4.2 Specific areas of review

Evaluation of design modifications

CNCAN has in place a process of continuous assessment of design modifications of safety related systems starting from the early stage of the construction phase, in order to ensure conformance with the licensing basis. The criteria based on which the design modifications are to be submitted for approval to the regulatory authority, taking into account the potential magnitude and nature of the associated hazards, are stated in the “Operating Policies and Principles” – the document containing the operating limits and conditions.

The list of design modifications / safety improvements of Unit 2 proposed by the plant vendor (AECL) has been assessed and agreed upon by the utility and submitted for approval to CNCAN prior to the restart of the project.

For Units 3 and 4 of Cernavoda NPP, following issuance by CNCAN of specific documents containing licensing requirements, the utility prepared lists of proposed design modifications to be implemented in order to meet the licensing mandated changes and latest versions of the applicable codes and standards, as well as other modifications due to obsolescence, operating experience feedback, etc. These design modifications have been agreed by CNCAN in principle and the implementation will be evaluated in depth.

Deterministic Safety Analysis

The activities relevant to the review of the deterministic safety analysis submitted by the licensee included:

- assessment of nuclear safety documentation submitted by the utility as support for design changes of Cernavoda NPP Unit 1 and Unit 2;
- verification of methodologies and assumptions used in accident analyses for Cernavoda NPP Unit 2 (PSAR for Cernavoda NPP Unit 2);
- review of Fire Hazard Analysis Report for Cernavoda NPP Unit 1;
- review of overpressure protection report for Primary Circuit and Special Safety Systems;
- review of the methodology for Seismic fragility calculation as support for Cernavoda NPP Unit 1 Seismic PSA;
- review of the methodology for Seismic Hazard Analyses for Cernavoda site.

Lately, due to the lack of resources, CNCAN has not systematically performed its own computer aided safety analyses in the field of thermalhydraulics, reactor physics and stress analyses. The safety analyses submitted by licensee have been usually assessed by CNCAN staff by verifying the computer codes models assumptions, as well as the input and output data validity against the design specifics of the Cernavoda 1 NPP. Independent analyses were however performed in specific circumstances using external expertise (design organisations from abroad, expert missions etc.). This will remain the practice to be used for the following couple of years, until the internal capability of performing independent analyses is re-established. CNCAN uses for its internal assessment process the experiences and practices gained by its staff during various fellowships under the IAEA Technical Co-operation Programs and PHARE Projects.

Probabilistic Safety Analyses

Probabilistic Safety Analyses level 1 (internal and external events) for Cernavoda NPP Unit 1 and Unit 2, submitted in support of Cernavoda licence applications have been reviewed up to now with external support coming through IAEA IPSART missions or PHARE projects.

CNCAN made use of technical assistance from IAEA in order to independently review PSA study level 1 internal and external events, and through PHARE projects in order to evaluate, from regulatory point of view, the Seismic PSA Methodology and Fire Protection Programme for Cernavoda NPP Unit 1.

Integration of PSA in the regulatory system, to contribute to the regulatory decision making process, is one of CNCAN objectives to improve efficiency in regulatory activities.

CNCAN staff uses the PSA level 1 study results in order to review the improvements related to:

- development of plant specific abnormal operating procedures to support operator actions in mitigating plant response after initiating events.
- operators training, considering the insights of this study.

Taking into account that the present PSA results provide valuable data, CNCAN now evaluates the proposal and plans of the utility regarding the use of this study as support for Cernavoda Unit 1 plant operation in the following areas:

- Developing an on-line safety monitor program for risk-informed decision making.
- Providing support to maintenance program optimisation.
- Providing risk-informed insights for evaluations of design changes affecting nuclear safety.
- Providing justifications required to relax allowed equipment outage times and frequency of testing and inspection activities.

The PSA results are currently used by the CNCAN staff in planning system inspections activities and evaluation of nuclear events.

Radiological safety assessments

The radiological safety assessments are performed by the CNCAN specialised technical division (Radioprotection and Radioactive Waste Division) and consist mainly of verifications of the conformity of the radiological safety documents sent by the applicant/licensee with the applicable regulatory requirements. In this respect, the implementation of the radiological zoning, the system of radiological monitoring of working places, the monitoring system of radiation exposures of the workers, the ALARA principle implementation program, the derived emission limits, the radioactive effluents monitoring programs, the radioactive waste management program, the counting system for radiation sources, the radiation protection training program, as well as the on site emergency intervention plan must be approved by CNCAN during the licensing process. All these documents and programs must be fully implemented before starting the operation of the NPP and they must be revised by the licensee periodically and whenever necessary. Those radioprotection programmes which can be changed during the operational phases of the NPP, must be documented to justify the change, in order to be approved. Each revision is submitted for CNCAN review and approval.

ARTICLE 15 - RADIATION PROTECTION

Each Contracting Party shall take the appropriate steps to ensure that in all operational states the radiation exposure to the workers and the public caused by a nuclear installation shall be kept as low as reasonably achievable and that no individual shall be exposed to radiation doses which exceed prescribed national dose limits.

15.1 Regulatory framework for radiation protection for Nuclear Power Plants

In accordance with the provisions of the Law, CNCAN is empowered to issue regulations for the detailed specification of the general requirements on the protection against ionising radiation and to control their implementation.

In this respect, CNCAN has issued a number of regulations regarding the radiological safety of nuclear and radiological installations, the following being the most important ones applicable to nuclear power plants:

- Fundamental Requirements on Radiological Safety;
- Requirements on Individual Dosimetry;
- Requirements for Limiting Radioactive Discharges into the Environment;
- Requirements for the Monitoring of Radioactive Emissions from Nuclear and Radiological Installations;
- Requirements for the Environmental Radioactivity Monitoring around Nuclear and Radiological Installations;
- Requirements for the Calculation of Dispersion of Radioactive Effluents, Discharged into the Environment by the Nuclear Installations;
- Requirements for the Meteorological and Hydrological Measurements at Nuclear Installations;
- Requirements on the Issuance of Permits for Exercising Nuclear Activities and the Designation of Qualified Radioprotection Experts.

The other national authorities involved in the licensing process, with regard to aspects relevant to the radiological safety, are:

- The Ministry of Environment and Sustainable Development, which issues the environmental agreement (as a prerequisite for the siting licence issued by CNCAN) and the environmental authorisation (after CNCAN granting the operation licence).
- The Ministry of Public Health, which issues the sanitary approvals, in accordance with the regulations in force.

15.2 Implementation of legislative and regulatory requirements on radiation protection for Nuclear Power Plants

According to art. 37 of the Fundamental Requirements on Radiological Safety (NFSR), the licensee has the general obligation of taking all the necessary actions to reduce the radiation exposure of the workers to the most reasonable low level. The licensee is also responsible for the assessment and implementation of the measures regarding the radioprotection of occupationally exposed workers, as stipulated in the chapter VI of NFSR (radiological zoning, requirements for controlled areas and monitored areas, classification of occupationally exposed workers, information, training and authorisation of workers, radiological monitoring of the workplace, individual monitoring of radiation exposure of the occupationally exposed workers, monitoring of radiation exposure in case of accidental and emergency exposures, recording and reporting of the results of individual monitoring of radiation exposure, investigation and reporting of overexposures and abnormal exposures, general requirements for the medical surveillance, medical conditions and special medical surveillance of the occupationally exposed workers, etc.).

In this respect, the nuclear power plant has developed individual company policies, regulations and procedures, based on the national laws and regulations, latest ICRP/IAEA recommendations and operating experience of other nuclear power plants. The implementation of the Radiation Safety Policies and Principles is directed through a comprehensive set of programmes developed by the Health Physics Department and is detailed in radiation protection procedures covering all aspects of radiation safety. Furthermore, where necessary and appropriate, Operating and Maintenance procedures include radiation safety aspects. Radioprotection programmes are documented and approved by CNCAN, as follows:

- Personnel training and qualification programme;
- Operational radiation protection of occupationally exposed workers;
- Personnel dosimetry programme;
- Public radiation protection;
- Radioactive waste management programme;
- Management of controlled radiation sources;
- Planning and preparedness for emergency response programme.

As stipulated by art. 42 of NFSR, for each controlled and monitored area, the licensee must nominate in writing, at least one responsible person for the radiological safety, which shall be in charge of the application of these Requirements and of the specific regulations in the respective area. The Radiological Safety Responsible must possess an Exercising Permit issued by CNCAN, in the field and specialisation according with the practices carried on in the controlled/monitored area. In certain cases, CNCAN can request this position to be ensured by a special department, managed by a Qualified Expert in Radioprotection (a person having the necessary knowledge and training to carry out the physical, technical or radiochemical tests to evaluate the doses and/or for giving advice in order to ensure an effective protection of individuals and the correct use of protective equipments, and whose capacity to act as expert in this matter is recognised by CNCAN, by issuing an exercising permit, in accordance with the specific regulations).
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In this respect, the radioprotection function of the Cernavoda NPP organisation is assigned to the Health Physics Department, which is led by a Qualified Expert in Radioprotection, designated as the NPP Radiological Safety Responsible. The NPP Health Physics Department is responsible for:

- implementing Radiation Safety Policies and Principles;

- issuing Radiation Safety Regulations, which define the specific application of these policies and principles;
- establishing, in consultation with the other NPP Departments, the Radiation Safety Programmes;
- continuously assessing the effectiveness of all aspects of the Radiation Safety Programmes and communicating the findings and recommendations to the station management.

The Health Physics Department is directly reporting to Cernavoda NPP Director, who is responsible to assure sufficient resources for the implementation of the radiation protection programmes.

The Health Physics Department includes a Radioprotection Technical Section, a Radiation Control Section, the Individual Dosimetry Laboratory and the Environmental Control Laboratory. As requested by CNCAN, the Technical Radioprotection Section Head and the Chief of the Individual Dosimetry Laboratory, were designated as Qualified Experts in NPP Radioprotection.

Also, the CNCAN specific regulations stipulate that the capability of the laboratories which provide dosimetric services and perform radioactivity measurements on effluent samples and environmental samples must be recognised by CNCAN. In this respect, the Individual Dosimetric Laboratory and the Environmental Control Laboratory of the NPP Health Physics Department were designated by CNCAN to be able to perform the respective measurements, according to the Requirements on the Designation of Notified Bodies for the Nuclear Field.

15.2.1 Dose Limits

In Romania, the dose limits for the population, as stipulated in art. 25 of NFSR are:

- 1 mSv per year of effective dose; in special situations, CNCAN may authorise an annual superior limit of up to 5 mSv in a year, provided that the average of the effective dose on a period of 5 consecutive years does not exceed 1 mSv per year;
- 15 mSv per year, equivalent dose for the lens of the eye;
- 50 mSv per year, equivalent dose for the skin.

For the occupationally exposed workers, art. 22 of NFSR establishes the following dose limits:

- 20 mSv per year, effective dose;
- 150 mSv per year, equivalent dose for the lens of the eye ;
- 500 mSv per year, equivalent dose for skin;
- 500 mSv per year, equivalent dose for the extremity of hands and legs.

In order to maintain doses as low as reasonably achievable, Cernavoda NPP has established an administrative limit for the occupationally exposed workers of 18 mSv/ year effective dose.

15.2.2 Occupational Exposure

As stipulated in art. 55 – 57 of NFSR, the licensee shall ensure the systematic individual monitoring of all category A workers (occupationally exposed workers for whom there is a significant probability of receiving an effective annual dose or an equivalent annual dose higher than three tenths of the legal limit of the respective dose); in those cases where these workers are likely to receive significant internal contamination, individual monitoring shall include also internal contamination monitoring. For the category B workers (those occupationally exposed workers not included in category A), the individual monitoring shall be at least sufficient to demonstrate that such workers are correctly assigned to this category.

In order to fulfil these requirements, Cernavoda NPP has established and implemented an Individual Dosimetry Programme, which is intended to provide a proper evaluation, measurement and recording of radiation doses received at Cernavoda NPP by occupationally exposed workers (both Cernavoda NPP employees and external workers - contractors). All workers of Cernavoda NPP are classified as category A workers. All radiation types which are significant from the dosimetry point of view are monitored with appropriate frequency and monitoring devices for accurate determination of external and internal doses likely to be received.

The routine individual dosimetry programme consists of:

- Monthly evaluation of individual penetrating dose equivalent, $H_{p(10)}$, due to gamma radiation and individual superficial dose equivalent, $H_{s(0.07)}$, due to beta & gamma radiations, both measured with individual TLD's;
- Estimation of committed effective dose, E_{50}, due to tritiated heavy water intakes, by LSC beta-spectrometry analyses of urine samples, provided with a frequency depending on the tritium concentration on the last sample (90, 28, 7 or 1 day);
- Estimation of committed effective dose, E_{50}, due to gamma-emitters intakes, by in vivo measurements with Human Body Counter; the monitoring frequency is for each new person at the initialisation in the DOSERECORDS database and quarterly (for Fuelling Machine personnel), annually (for some other NPP compartments) and once in 3 years (for the rest of the NPP personnel).

Special individual monitoring is provided in the following situations:

- Working in neutron fields: the external doses due to neutrons, $H_{p(10)}$ is assessed by integrating in time the neutron dose rate measured with portable neutron monitors in the most exposed area of the working place;
- Working in not homogenous radiation fields: the workers must wear several TLDs;
- Working in high, variable, no homogenous radiation fields: the worker must wear an electronic dosimeter with direct reading and acoustic alarms;
- For those activities which entail anticipated exposures to tritium significantly higher than the usual situation, the urine samples must be provided before and after the work; when there are known or suspected significantly high, unanticipated, exposures to tritium, all those persons which might be affected

must provide supplementary urine samples for evaluation of the committed effective dose;

- For those activities which entail anticipated exposures to gamma-emitters significantly higher than the usual situation, the whole body monitoring must be performed before and after the work; when there are known or suspected significantly high, not anticipated exposures to gamma-emitters, all those persons which might be affected must perform supplementary whole body monitoring;
- For those activities which entail anticipated beta-gamma dose rates at contact with extremities 10 times higher than those registered at the thorax level: the worker must wear TLDs for extremities.

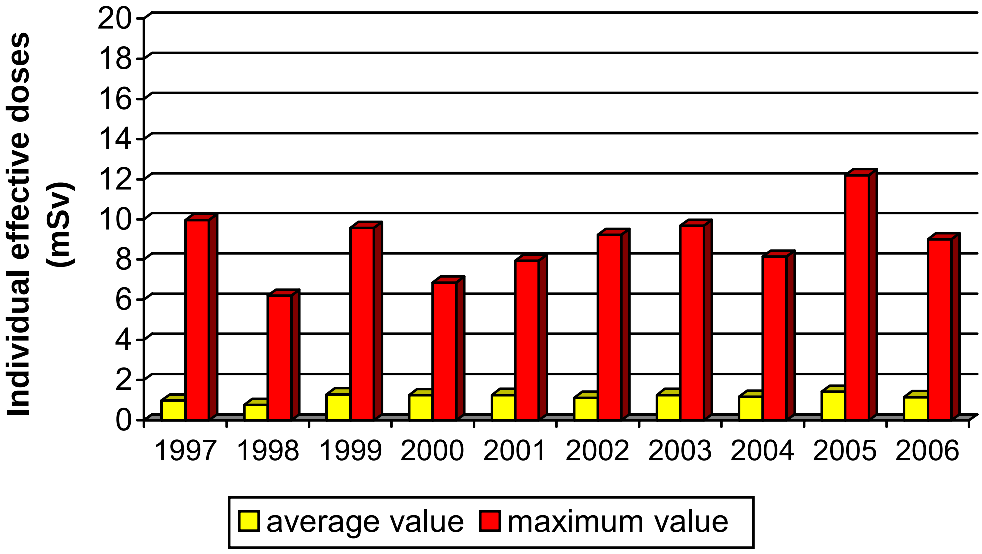
The management of the estimated doses is done trough a dedicated software and database (DOSERECORDS), which also issue routine reports. The dose registrations are reported as follows:

- Daily and monthly reports regarding the systematic individual monitoring;
- Quarterly reports to the NPP management;
- Half-yearly reports to CNCAN;
- Annually and at the end of working for NPP to the employee (own and outside workers);
- At request, to external organisations.

The dosimetric services are provided for the NPP by the Individual Dosimetry Laboratory. Since 2001 this laboratory participates on international intercomparison exercises, as a member of PROCORAD Association from France, for H-3, C-14 and gamma-spectrometry analyses in urine. The results for each category of analyses met the acceptance criteria, the laboratory being designated as “reference laboratory” for C-14 in urine in 2001, 2004, 2006 and 2007 and for H-3 in urine in 2004, 2006 and 2007.

The average effective dose for a Cernavoda NPP worker in 2006 was 1.15 mSv with a maximum of 9.01 mSv. The evolution of mean and maximum individual effective doses for Cernavoda NPP workers is shown in Fig. 15.1.

Fig. 15.1 Evolution of individual effective doses for Cernavoda NPP workers



The Individual Dosimetry Programme is supplemented by a Monitoring Programme of Working Places, established and implemented in order to evaluate the radiological conditions in the NPP controlled areas, assuring by this a decisional support in those matters regarding the warning, access control, approval of works and individual monitoring, as well as a valuable back-up for estimation of the individual doses. The routine monitoring programme includes:

- Measurements of gamma and neutron dose rates, tritium in air concentrations, aerosols (alpha, beta, gamma), iodine in air, (alpha, beta, gamma) surface contamination levels; the scope and frequency of measurements inside the NPP are established taking into consideration the anticipated hazards and are modified, as the case may be, based on the accumulated experience.
- Contamination monitoring of the personnel: the contamination of all employees walking from zone 1 (a controlled area containing systems and equipments which can be significant sources of contamination and/or dose rates higher than 10 µSv/h)to zone 2 (a controlled area without radioactive systems and sources, excepting those approved sources, usually without contamination, but which can be contaminated and where the dose rates are less than 10 µSv/h) and zone 3 (a controlled area without radioactive sources, excepting those approved sources, with very low probability of contamination spread from adjacent areas and where the dose rates are less than 0.5 µSv/h) is monitored. From zone 1 to zone 2 it is necessary to monitor the beta-gamma contamination of hands and foot, from zone 2 to zone 3, the beta-gamma contamination of whole body.
- Contamination monitoring of materials and equipment: all the materials and equipments moving from zone 1 to zone 2 are monitored for beta-gamma contamination and, for radioactive materials (solid waste and transport equipments), the gamma dose rate.
- Surveillance of radiation fields for routine activities: these checks are specified in the Radiation Work Permit and they must be performed by the employees before starting the work.

The communication and registration of the results of the monitoring programme of NPP working places are made trough warning panels placed in field, monitoring sheets and Hazard Info database electronic system.

15.2.3. Public Exposure

As requested in art.109 of NFSR, the release into the environment of liquid or gaseous radioactive effluents can be made only in compliance with the DELs approved by CNCAN.

Also, the Radioprotection Regulation of Cernavoda NPP stipulates that the radioactive emissions levels shall be maintained below the DELs approved by CNCAN, in order to optimise the public radiation protection. In this respect, the station established operating targets for both liquid and gaseous emissions, depending on the approved DELs.

According to the CNCAN monitoring requirements, the NPP shall ensure the adequate monitoring of all radioactive discharges, at the source as well as in the receiving media, in all operational phases (from preoperational to decommissioning) and conditions (normal operation and radiation emergency situations). In this respect, the radioactive effluents of Cernavoda NPP are monitored in the discharge points, trough the Gaseous and Liquid Radioactive Emissions Monitoring Programme and in the environment, trough the Environmental Radioactivity Programme.

15.2.3.1 Radioactive Releases

According to the Gaseous and Liquid Radioactive Emissions Monitoring Programme, the radioactivity emissions are continuously monitored by the Gaseous Effluent Monitoring System (GEM) and Liquid Effluent Monitoring System (LEM), installed in both units and continuously sampled for further periodic laboratory analyses.

The potentially contaminated air inside NPP comes from:

- Central Contaminated Exhaust System: the air from this system is filtered through a High Efficiency Particulate Air (HEPA) filter;
- Reactor Building Exhaust System : the air from the Reactor Building is passed through a pre-filter, a HEPA filter, an activated charcoal filter (to retain radioiodine) and a final HEPA filter;
- Spent Fuel Bay Exhaust System : filtration of this air is similar to that of the Reactor Building;
- D_2O Enrichment Tour Exhaust System: this air is not filtered, because it contains only tritium
- In those areas of the station where heavy water systems exist, the Closed Cycle Vapour Recovery System recovers much of the tritium.

After filtering, all potentially contaminated exhaust air is routed to the exhaust stack, which disperses it to the environment. Representative samples of the air flow in the stack are continuously extracted and routed to the GEM, by an isokinetic sampling system. The GEM is designed to:

- monitor the total activities of particulate, radioiodine and noble gases;
- alarm (locally and in MCR) when predefined release setpoints are exceeded;
- collect samples on adequate sampling media, for further laboratory analyses to determine the particulate, radioiodine, total tritium and total C-14 content of gaseous effluents.

The particulate filters are changed and measured daily, by gamma-spectrometry and gross-beta analyses. The charcoal filters for radioiodine are changed and measured daily, by gamma-spectrometry analyses. In case of High Activity Release Alarm provided by GEM, the filters are immediately changed and measured in the Chemical Laboratory. In routine situations, the filters are measured in the Individual Dosimetry Laboratory, which also analyses the H-3 and C-14 concentration in effluent samples. The tritium (as tritiated water) is extracted from the molecular sieves and measured by LSC, daily in Unit 1 and twice per week in Unit 2. The C-14 is extracted from the NaOH solution and measured by LSC, daily in Unit 1 and weekly in Unit 2. These laboratory analyses results represent the data of the NPP gaseous discharges that are officially reported to the management and to the relevant authorities.

Radioactive liquid wastes resulted from the operation of Cernavoda NPP are collected in five liquid effluent hold-up tanks (approx. $50m^3$ each). Before each discharge, the content of a tank is recirculated, in order to assure a good homogeneity and a representative sample is taken, which will be analysed in the Chemical Laboratory for gross-gamma activity and tritium concentration. Based on these laboratory analyses, the Shift Supervisor will approve the discharge if the radioactive level is below the established limits. In order to limit the radioactive concentration, during the discharge it must be assured a minimum dilution factor. If radioactive aqueous liquid waste doesn't meet the requirements to be discharged as liquid effluents, they must be treated and transformed to be suitable for intermediate storage.

Each liquid discharge from the NPP is monitored by the LEM, which is designed to:

- continuously monitor the gross-gamma activity discharged;
- collect a representative integrated sample, for further laboratory analyses;
- automatically stop the discharge and provide an alarm (locally and in MCR) if a preset count rate set point is exceeded, or if any malfunction occurs on LEM.

The samples collected by LEM are measured in the Individual Dosimetry Laboratory, by gamma-spectrometry analyses, LSC for H-3 concentration, LSC on weekly composite samples for C-14 concentration, gross-beta analyses on weekly composite samples. These laboratory analyses results represent the data of the NPP liquid discharges that are officially reported to the management and to the relevant authorities.

Supplementary, the Individual Dosimetry Laboratory measures, weekly, an integrated sample (continuously collected) from CCW, by gamma-spectrometry and gross-beta analyses and LSC for H-3 determination. These samples are analysed only for verification purposes.

As requested by the CNCAN Requirements for the Monitoring of Radioactive Emissions from Nuclear and Radiological Installations, the capability of the laboratory performing the radioactivity measurements on effluents samples must be recognised by CNCAN. In this respect, the Individual Dosimetry Laboratory which provides the official data on radioactive discharges, beside dosimetric services for Cernavoda NPP, was designated by CNCAN as a "notified body" not only for dosimetric services, but also for radioactive effluents monitoring.

A summary of the gaseous and liquid emissions data are reported quarterly to CNCAN, the fourth report representing the annual one. The results of the Gaseous and Liquid Radioactive Emissions Monitoring Programme are also included in the annual report on environmental monitoring programme. Also, any gaseous emission exceeding the limits is immediately notified to CNCAN.

During 2006, all the radioactive emissions were under the operating targets. Fig. 15.2 shows the evolution of gaseous emissions from Cernavoda NPP. The effective dose to population, resulted from the gaseous emissions during 2006, is 11.40 μSv/year for a critical group member. Fig. 15.3 shows the evolution of liquid emissions from Cernavoda NPP. The effective dose to population, resulted from the liquid emissions during 2006, is 3.37 μSv/year for a critical group member.

Fig. 15.2 Evolution of Gaseous Emmissions from Cernavoda NPP

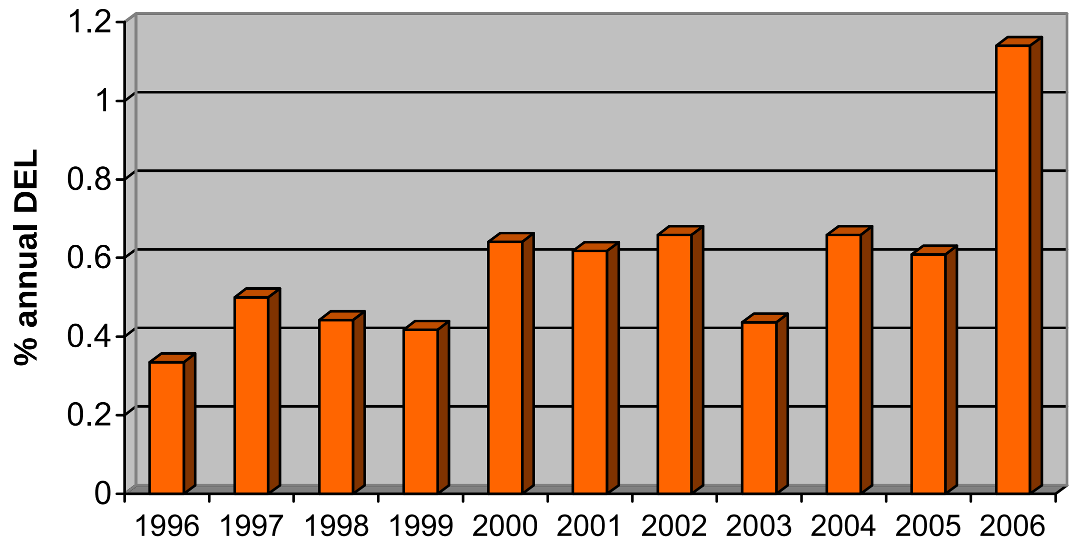
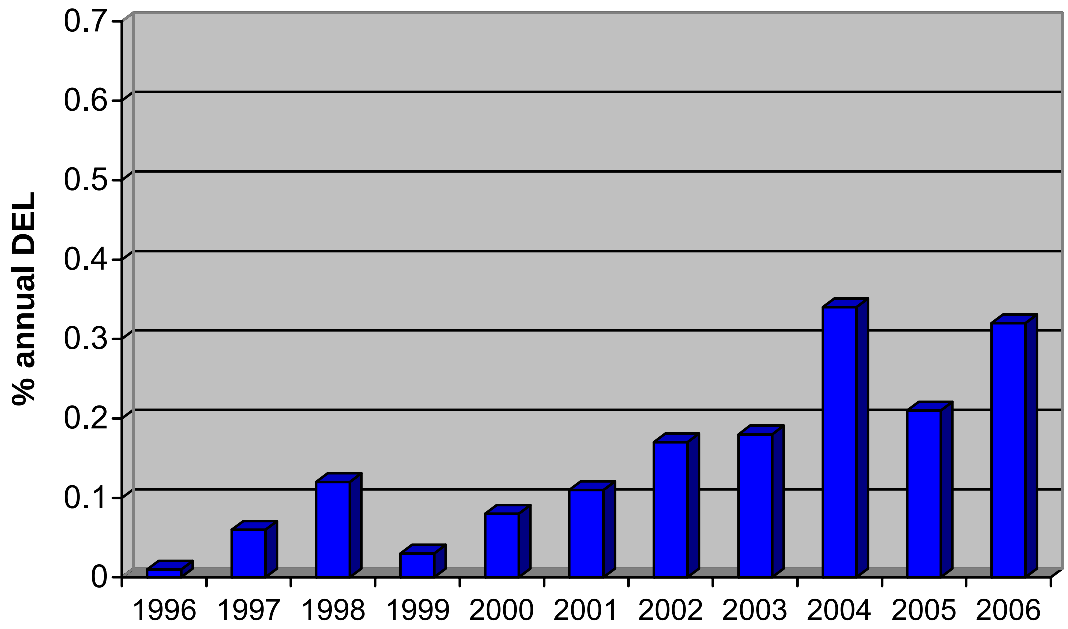


Fig. 15.3 Evolution of liquid emmissions from Cernavoda NPP



15.2.3.2 Environmental Radioactivity Monitoring

The Environmental Radioactivity Monitoring Programme of Cernavoda NPP was designed to assure a correct evaluation of the doses for a member of the critical group, by determining the increases of the radioactive levels in the specific environmental media, due to the NPP operation, a correct assessment of the effluents control and monitoring, based on environmental measurements and an estimation of the doses to population in case of significant radioactive releases.

The environmental radioactivity monitoring in Cernavoda area was started in 1984, based on a preoperational monitoring programme. The operational programme was established and approved in 1995, being implemented in March 1996.

Table 15.1 shows the sample types, sampling frequencies, as well as analytical methods and frequencies established by the environmental monitoring programme of the station. All the samples were analysed in the Environmental Control Laboratory, located at 2 km from Cernavoda NPP Unit 1. Starting with 2002, the laboratory participated on international intercomparison exercises, organised by PROCORAD Association from France, for H-3, C-14 and gamma-spectrometry analyses in urine and water. The results obtained for each category of analyses met the acceptance criteria, the laboratory being designated as “reference laboratory” for C-14 analyses in 2005 and 2006 and for H-3 analyses in 2007.

Table 15.1: Environmental samples type, sampling frequencies, analytical methods and analytical frequencies

Sample type	Sampling frequency	Analytical method	Analytical frequency
Particulate in air (*)	Monthly	γ- spectrometry, retarded gross-β	Monthly
Iodine in air (*)	Quarterly	γ- spectrometry	Quarterly
H-3 in air (*)	Monthly	LSC	Monthly
TLD (*)	Quarterly	Direct reading	Quarterly
Surface water	Weekly	γ- spectrometry, gross-β LSC for H-3	Monthly
CCW Canal water (*)	Weekly	γ- spectrometry, gross-β LSC for H-3	Weekly
Infiltration water	Monthly	γ- spectrometry, gross-β LSC for H-3	Monthly
Ground water	Monthly	γ- spectrometry, gross-β LSC for H-3	Monthly
Soil	Twice per year	γ- spectrometry, gross- β	Twice per year
Spontaneous vegetation	Annually	γ- spectrometry, gross-β LSC for H-3 & C-14	Annually
Sediment	Twice per year	γ- spectrometry, gross- β	Twice per year
Milk	Weekly	γ- spectrometry, LSC for H-3	Weekly
		Gross- β, LSC for C-14	Monthly

Atmospheric deposition	Monthly	γ- spectrometry, gross- β	Monthly
Fish	Twice per year	γ- spectrometry, gross-β LSC for H-3 & C-14	Twice per year
Meat	Annually	γ- spectrometry, gross-β LSC for H-3 & C-14	Annually
Vegetables	Annually	γ- spectrometry, gross-β LSC for H-3 & C-14	Annually
Fruits	Annually	γ- spectrometry, gross-β LSC for H-3 & C-14	Annually
(*) integrated samples (continuous sampling)			

The monitoring and environmental sampling points around Cernavoda NPP are shown in figures 15. 4 – 7.

Fig. 15.4 Air sampling and integrated gamma dose monitoring points around Cernavoda NPP (5-30 km)

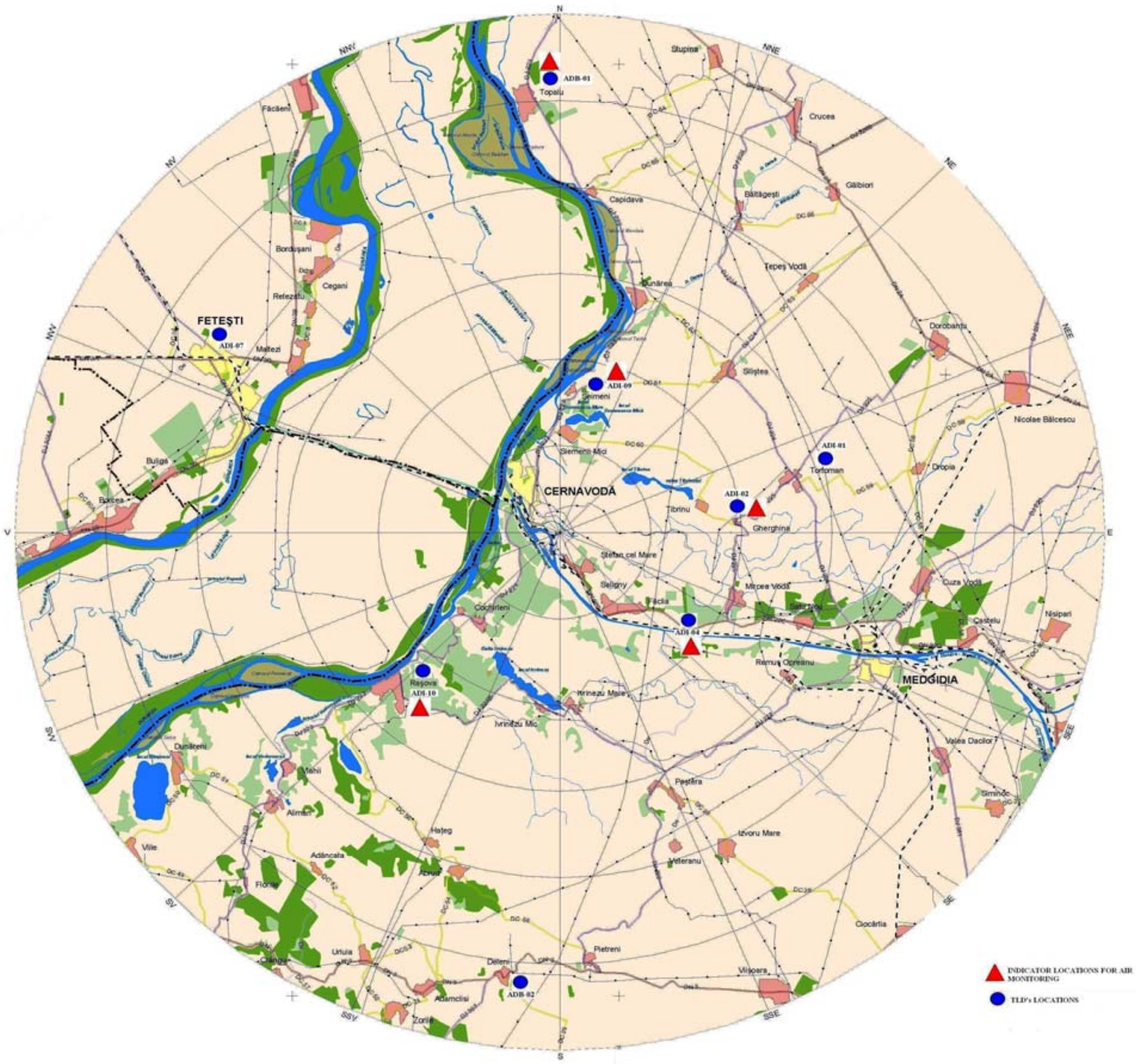


Fig. 15.5 Environmental sampling locations around Cernavoda NPP

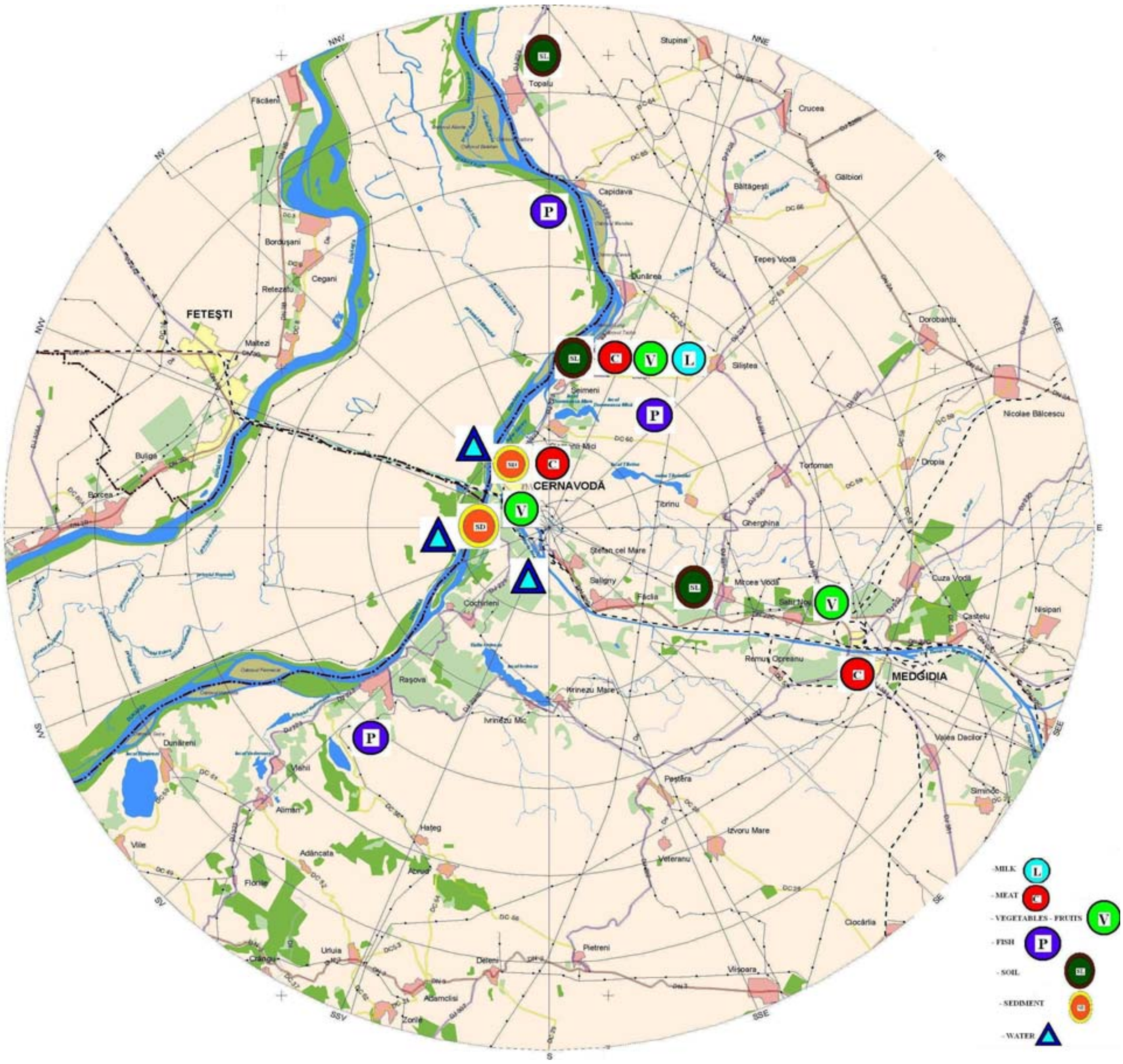


Fig. 15.6 Air sampling points around Cernavoda NPP (1-5 km)

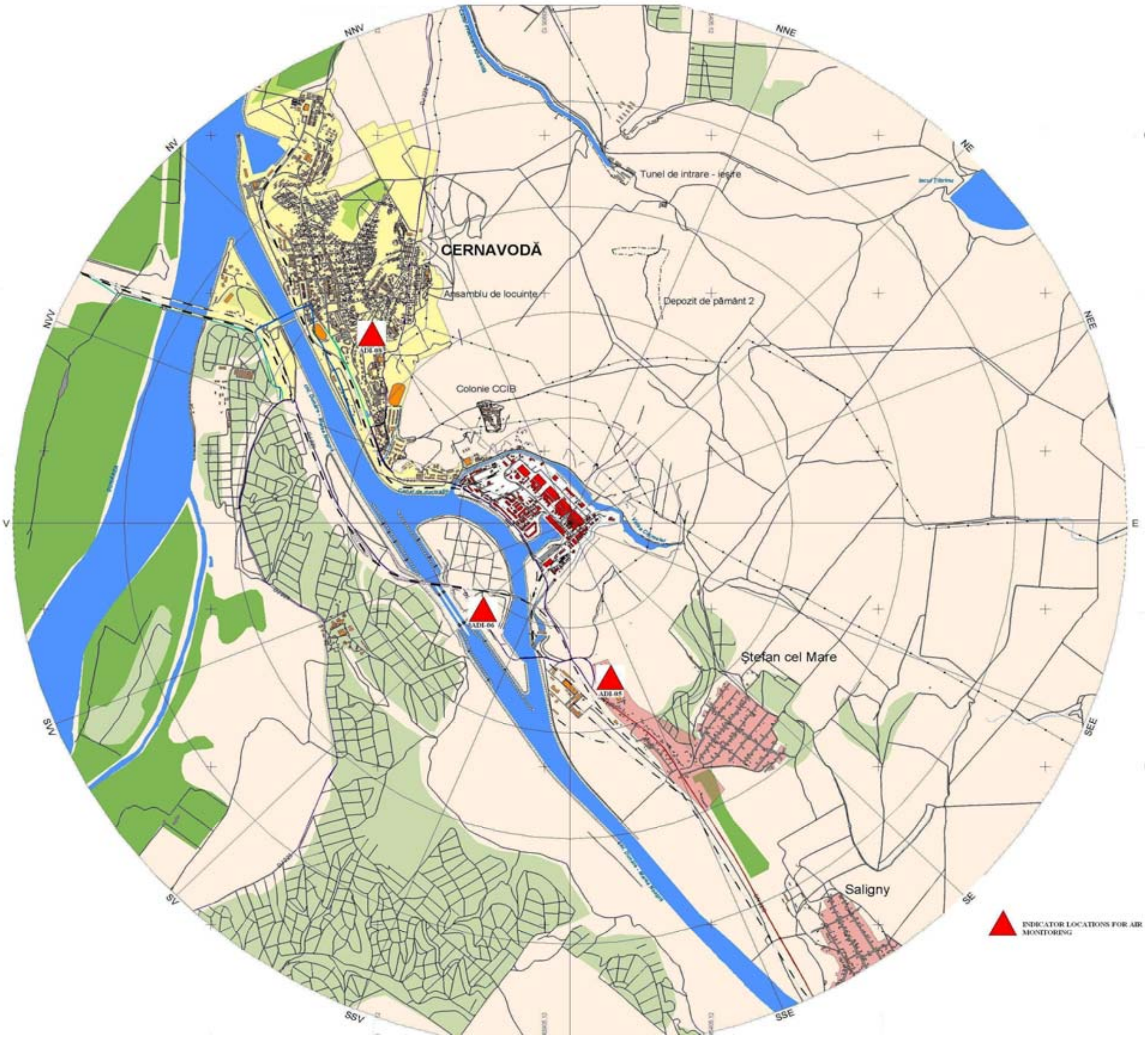
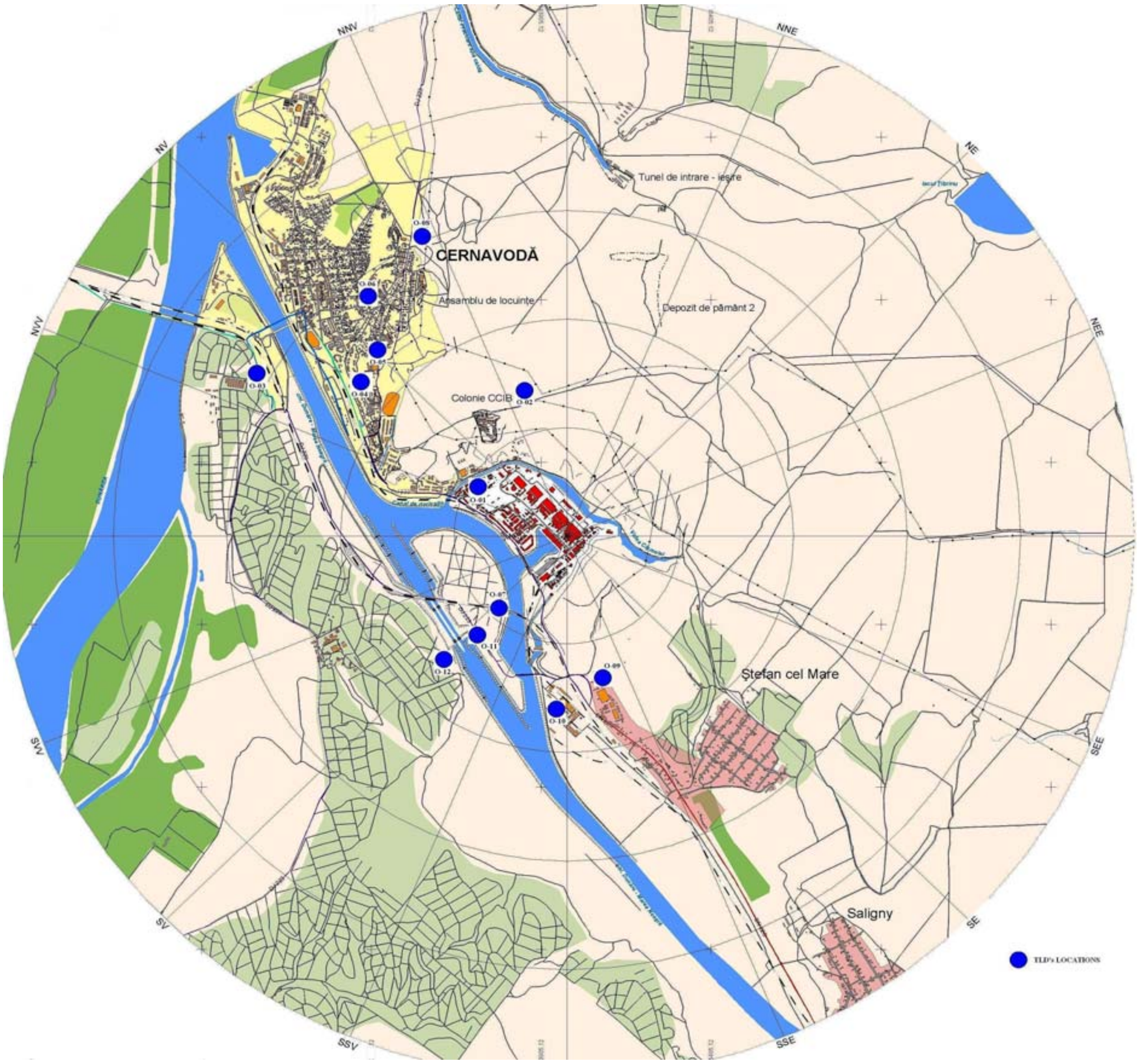


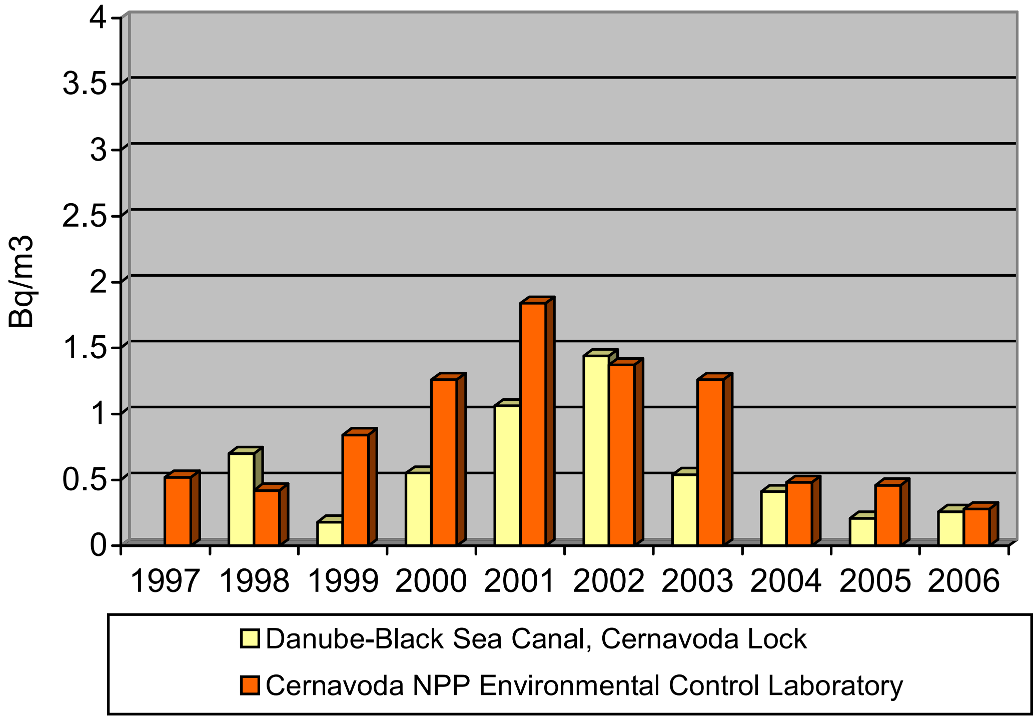
Fig. 15.7 Integrated gamma dose monitoring points around Cernavoda NPP (1-5 km)



During 2006, the radioactivity measurements showed the presence of tritium in the majority of environmental samples, the obtained values being comparable with the detection limits. Following are presented the distribution of the values detected in 2006 on the most important sampling points and sample types, in comparison with the past years.

The natural concentration of H-3 in air, determined between 1994 and 1996 as part of the preoperational monitoring programme varies between 0.032 Bq/m^3 and 0.186 Bq/m^3. In 2006, the average value of H-3 in air for the sampling stations located at distances higher than 10 km from NPP was 0.068 Bq/m^3, for the sampling stations located at distances between 5 and 10 km was 0.214 Bq/m^3 and for the sampling stations located outside the NPP perimeter, at distances lower than 5 km, the average value was 0.394 Bq/m^3. Fig. 15.8 shows the evolution of H-3 in air for 2 sampling stations located in Cernavoda town.

Fig. 15.8 Evolution of Tritium in air, around Cernavoda NPP



In 2006, the average value of H-3 concentrations in surface water sampled from the Danube and the Danube – Black Sea canal was 19.36 Bq/l. The evolution of H-3 concentrations in surface water from 3 sampling points is shown in Fig. 15.9.

The tritium concentration measured in different environmental samples are used to calculate the doses received by the population. Thus, the doses received by the population of Cernavoda in 2006 are: 0.324 μSv due to the ingestion of tritium and 0.048 μSv due to the inhalation of tritium, with a total of 0.372 μSv. Figure 15.10 shows the evolution of the doses to Cernavoda population due to the presence of tritium into the environment.

According to art. 88 of the Requirements for the Monitoring of Radioactive Emissions from Nuclear and Radiological Installations, the licensee who monitors the radioactive effluents at the source, as well as in the receiving media, as requested by the applicable CNCAN regulations, shall present the results of both the associated monitoring programmes, in such a form to demonstrate the conformity with the dose constraint established by CNCAN. Furthermore, as stipulated in art.16

of the above mentioned Requirements, the licensee shall assure the validity of the dose calculations based on the radioactive emissions using the results of the environmental radioactivity monitoring programme.

Fig. 15.9 Evolution of Tritium in surface water

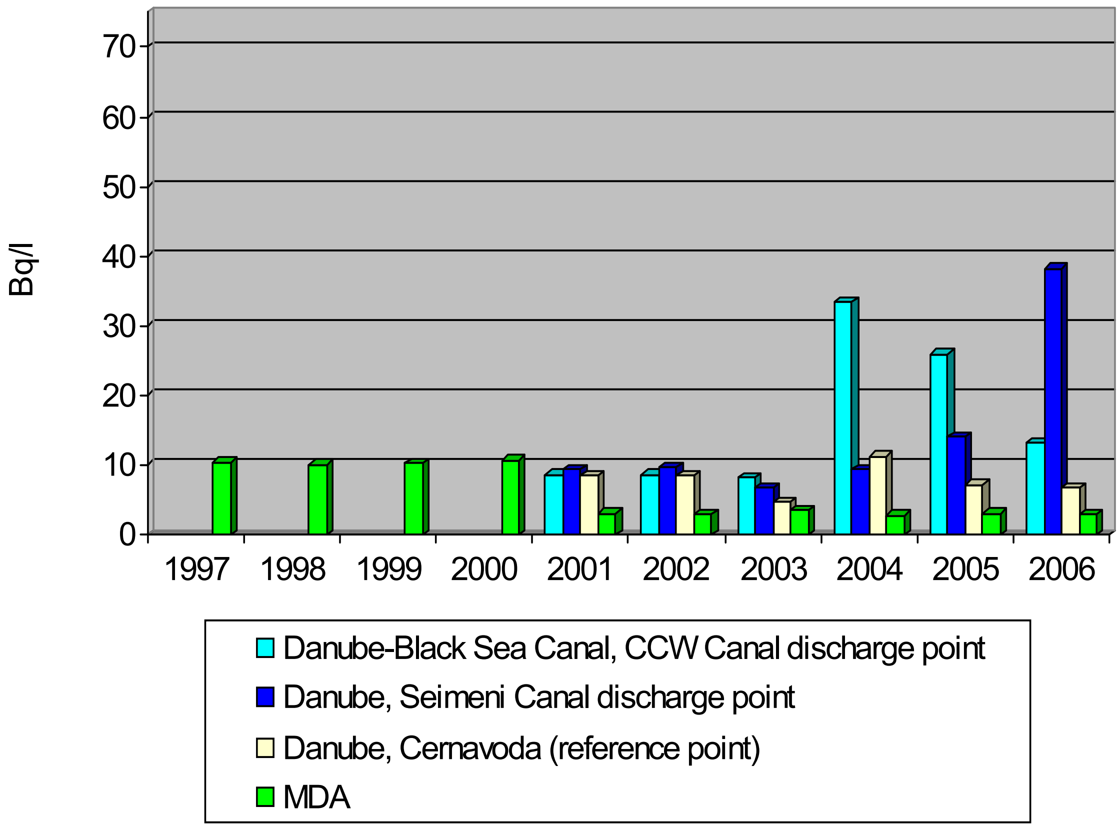


Fig. 15.10 Evolution of H-3 doses for Cernavoda people, as resulted from the environmental monitoring program

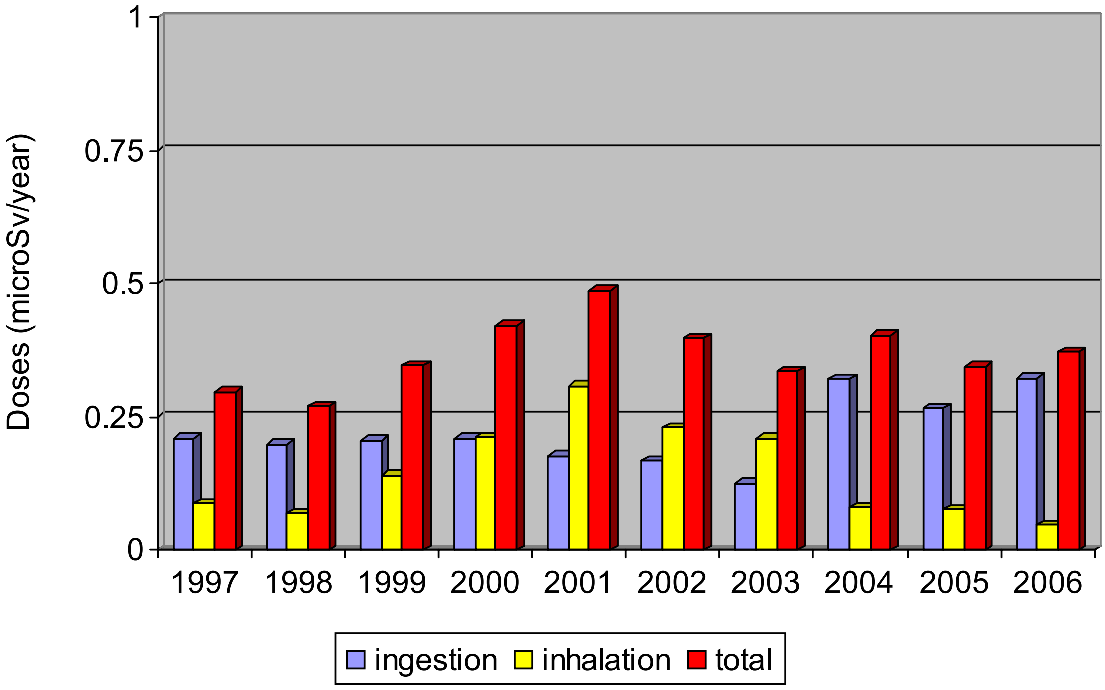
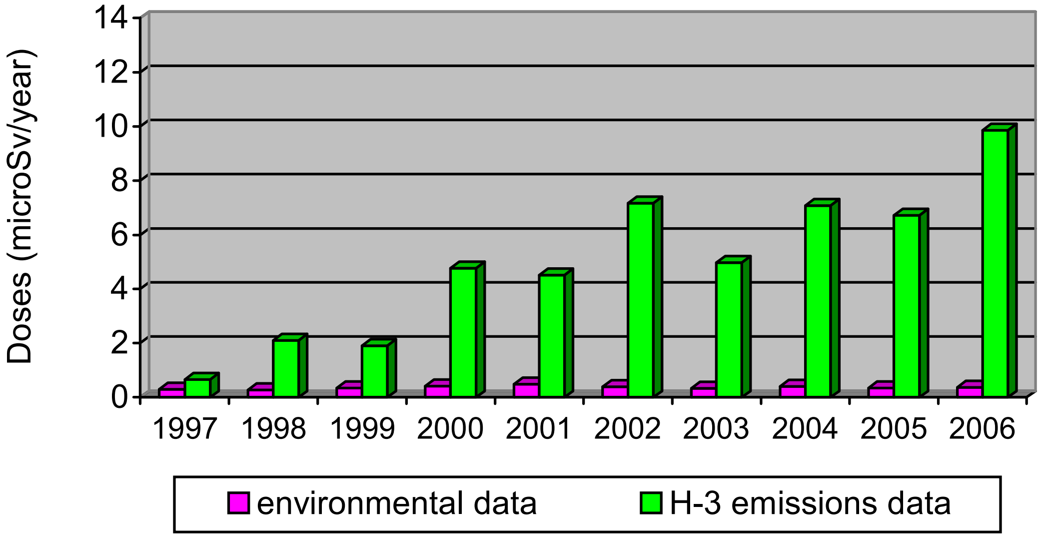


Fig. 15.11 shows the evolution of the doses received by the population of Cernavoda, due to the presence of tritium in the surrounding environment, calculated with the results of both programmes (effluents monitoring and environmental monitoring programme). As can be seen, the doses calculated based on the tritium emissions data are with one order of magnitude higher than those calculated based on the tritium concentrations measured in the environmental samples. This demonstrates not only the doses to population are below the dose constraint for Cernavoda NPP (with one to two orders of magnitude), but also the models used for calculating the Derived Emission Limits are conservative.

Fig. 15.11 Evolution of doses to Cernavoda population, estimated from evironmental and discharges data



The results of the monitoring programmes deployed by Cernavoda NPP are verified for their validity, by the different responsible Romanian authorities. According to the legislative framework in Romania, the main ministries and organisations having responsibilities in the field of environmental radioactivity monitoring (including the surveillance of food stuffs) are:

- Ministry of Environment and Sustainable Development, which organises the Environmental Radioactivity Monitoring Network on the Romanian territory;
- Ministry of Public Health, which organises the epidemiological monitoring system of the health condition of the occupationally exposed personnel and of the hygiene conditions in nuclear installations, follows up the influence of nuclear activities on the population health;
- National Commission for Nuclear Activities Control (CNCAN);

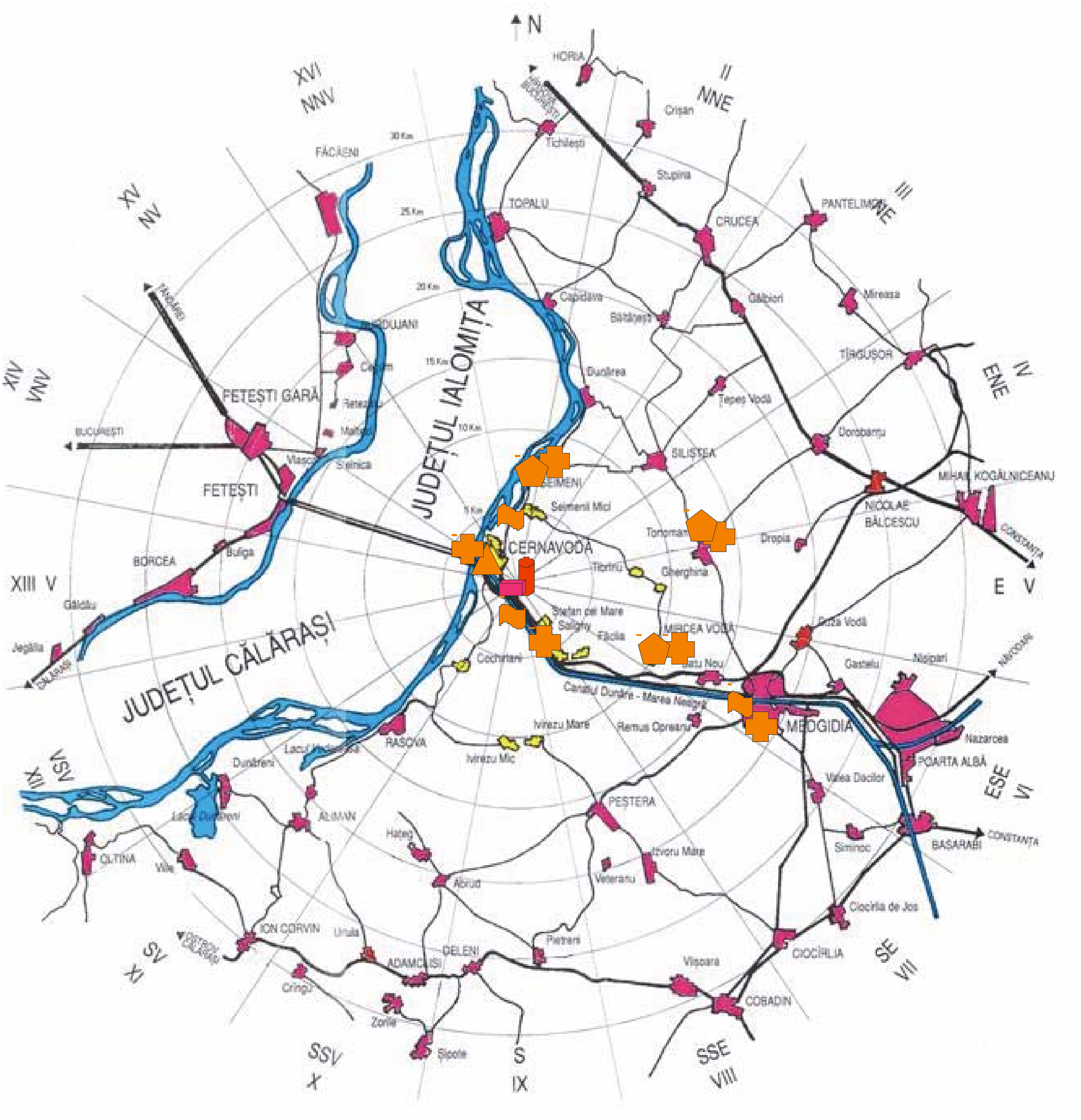
According to the Law on the safe deployment, regulation, licensing and control of nuclear activities, CNCAN is empowered to control the licensee, in order to verify the compliance with the national legal requirements and licensing conditions. In addition, the art.111 of the Requirements for the monitoring of radioactive emissions from nuclear or radiological facilities stipulates that in the case of nuclear installations that may have a significant environmental impact, CNCAN may deploy its own environmental radioactivity monitoring programme in the vicinity of the nuclear installation, in order to check the results supplied by the licensee and to confirm that public exposure to radiations is maintained below the dose constraints imposed by CNCAN.

Thus, CNCAN issued a routine environmental radioactivity monitoring and control programme for the influence area of Cernavoda NPP, as part of the "Annual Plan for Inspections in the off-site environment of nuclear installations", approved by the President of CNCAN. The types of samples, sampling frequencies, analytical methods and frequencies are given in Table 15. 2. Fig. 15.12 shows the map with the sampling points.

Table 15.2: Environmental samples type, sampling frequencies, analytical methods and analytical frequencies, as established in the CNCAN Environmental Monitoring and Control Programme

Sample type	Sampling frequency	Analytical method	Analytical frequency
Air	Periods of 72 hours	LSC for H-3 & C-14	Monthly
Precipitations	During precipitation	LSC for H-3	Monthly
Surface water	Monthly	γ- spectrometry, LSC for H-3	Monthly
Soil	Twice per year	γ- spectrometry, LSC for H-3	Twice per year
Agricultural soil	Annually	γ- spectrometry, LSC for H-3	Annually
Vegetation (grass)	Twice per year	γ- spectrometry, LSC for H-3	Twice per year
Milk	Monthly	γ- spectrometry, LSC for H-3	Monthly
Vegetables & fruits	Annually	γ- spectrometry, LSC for H-3	Annually

Figure 15.12: CNCAN environmental sampling points around Cernavoda NPP



The results of the CNCAN Environmental Radioactivity Monitoring & Control Programme are compared with the results reported by the licensee. The analysis of the comparison is a component of the reference work for the renewal of the NPP operation license.

15.2.4 Optimisation of Radiation Protection

15.2.4.1 Radiation Workers

As requested by art.16 of NFSR, the licensee shall take all the necessary actions to optimise the radioprotection, by ensuring that all exposures to ionising radiation, including the potential ones, are maintained at the lowest reasonably achievable level (ALARA principle).

In order to keep the radiation exposures as low as reasonably achievable, the NPP has applied various measures, including design measures, procedural control of activity performance, planning for unusual situations, personnel training and qualification in radiation protection, specific procedures, such as:

- ALARA process
- Radiation Work Permit

In order to implement the ALARA process, two committees have been established at Cernavoda NPP:

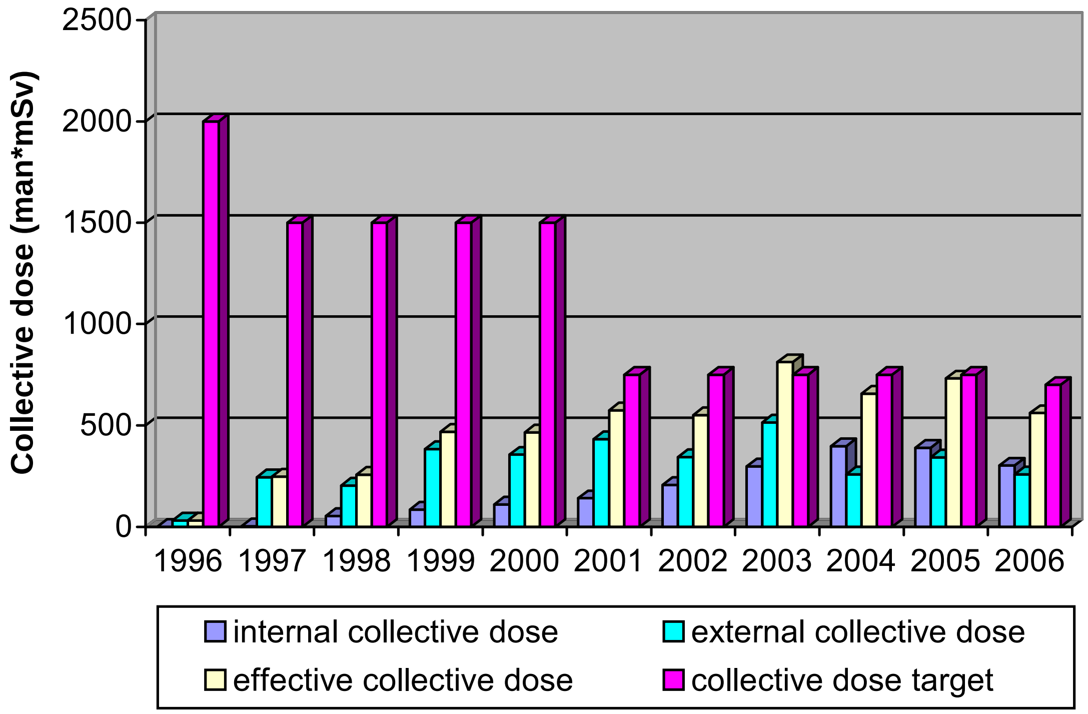
- A technical ALARA committee, which analyses and approves the action plans to reduce the exposures at the departments level, proposes the ALARA objectives and targets at NPP level, periodically approves the ALARA results and recommends programmes to improve the ALARA process; this committee is lead by the Health Physics Chief Engineer and it is composed by the NPP ALARA Coordinators (of the NPP and of the following departments: Operations, Maintenance, Fuelling Machine, Health Physics, Chemical Laboratory, Non Destructive Analyses Laboratory);
- ALARA NPP committee, which approves the ALARA objectives and targets at NPP level, analyses the evolution of ALARA indicators and proposes actions for correcting and changing those objectives, analyses the opportunity to implement specific ALARA actions; this committee is lead by the NPP Director and is composed by the Technical Director, Production Director, Operations, Maintenance, Health Physics and Works Control Chief Engineers, ALARA Coordinator on NPP.

The main responsibility of the ALARA coordinators is to monitor the evolution of the principal ALARA indicators (collective dose on the department and on NPP, the contribution of the internal dose to the total dose on the department and on the NPP) and to compare them with the targets established for the compartment and the NPP. If the collective dose registered on a quarter exceeds with more than 25% the target, the ALARA coordinator must issue a report to analyse the causes; the report must contain proposals for corrective actions and/or the justification of the necessity to modify the target value.

Another practical measure to control the radiation exposures is the Radiation Work Permits system, trough which the activities deployed in radiological risk areas are identified, so that the radiological conditions are assessed, in order to establish and implement the adequate radioprotection measures. If the estimated collective dose for a certain work exceeds certain established levels, supplementary analyses and approvals are needed to deploy the respective work. For example, if the estimated collective dose is higher than 20 man*mSv, the ALARA coordinator of the compartment must issue an ALARA action plan, which must include all the supplementary radioprotection measures, the progress of the work, the preliminary requirements and the techniques for controlling the exposure. During the progress of the work, the collective dose is monitored against the estimated one, so that the necessary measures for minimising the exposures could be taken in due time. After completion of the work, an analysis of the estimated against realised values must be done, in order to identify the efficiency of the dose reduction and special working techniques, the problems occurred and the lessons learned, the probable causes for significant discrepancies between received and estimated collective doses, if there is the case.

Fig.15.13 shows the evolution of the annual collective dose registered at Cernavoda NPP, compared with the respective target. The maximum value (812.28 man·mSv) was registered in 2003 and it was caused by the prolonged outages of the NPP (planned outage and unplanned outage due to the very low Danube level).

Fig. 15.13 Evolution of the occupational exposure at Cernavoda NPP



15.2.4.2. Public

According to art.18 of NFSR, the dose constraints for the public, established by CNCAN, shall be used as superior margin in the radioprotection optimisation process. This must be done by using the dose constraint into the calculations of Derived Emission Limits (DEL), as stipulated by the new CNCAN Requirements for Limiting Radioactive Discharges into the Environment (issued in 2005).

For this reason, the NPP reviewed this year its DELs, which will be fully implemented by the 1st January, 2008, the major changing being the use of the dose constraints established by CNCAN for Cernavoda NPP (0.1 mSv/year for each unit and 0.05 mSv/year for Spent Fuel Intermediate Dry Storage facility) instead of the legal dose limit for population (1 mSv/year) in the calculation of DELs. In this respect, the data reported in Fig. 15.2-3 refer to the old DELs.

As a consequence of recalculation of DELs, and in order to accomplish the requirements of the new CNCAN Requirements for the Monitoring of Radioactive Emissions from Nuclear and Radiological Installations and the Requirements for the Environmental Radioactivity Monitoring around Nuclear and Radiological Installations, the NPP revised this year the Radioactive Release Monitoring Programme and, respectively, the Environmental Radioactivity Monitoring Programme.

15.2.4.3 Detritiation project

The design features of a CANDU reactor for ensuring the control of tritium can be considered as conceptual barriers which prevent and minimise the occupational exposures to tritium and the tritium emissions into the environment.

The fundamental method to mitigate both the occupational and the public exposure to tritium consists in reducing the tritium concentrations into the heavy water by „detritiation", in this way the consequences of heavy water leaks being reduced at their source. The efficiency of the following barriers is decreasing in this order: tightening of leaks, vapours recovery, confinement, purging.

In this respect, Cernavoda NPP initiated a project for a detritiation facility for Unit 1, with extension possibilities for Unit 2 and, eventually, for Unit 3 and Unit 4.

The main objectives of the project are:

- to reduce and maintain the tritium concentration in moderator heavy water at about 10 Ci/kg;
- to reach the above mentioned target in 3 – 4 years of operation;
- upgrading heavy water to about 99.95%.

A feasibility study was already undertaken for this project. The next step of the project is to obtain the licences and approvals necessary for design, construction and commissioning. The project duration was estimated to 5 years.

ARTICLE 16 - EMERGENCY PREPAREDNESS

1. Each Contracting Party shall take the appropriate steps to ensure that there are onsite and off-site emergency plans that are routinely tested for nuclear installations and cover the activities to be carried out in the event of an emergency. For any new nuclear installation, such plans shall be prepared and tested before it commences operation above a low power level agreed by the regulatory body.

2. Each Contracting Party shall take the appropriate steps to ensure that, insofar as they are likely to be affected by a radiological emergency, its own population and the competent authorities of the States in the vicinity of the nuclear installation are provided with appropriate information for emergency planning and response.

3. Contracting Parties which do not have a nuclear installation on their territory, insofar as they are likely to be affected in the event of a radiological emergency at a nuclear installation in the vicinity, shall take the appropriate steps for the preparation and testing of emergency plans for their territory that cover the activities to be carried out in the event of such an emergency.

16.1 Description of the legislative and regulatory framework for on-site and off-site emergency planning and preparedness

Emergency preparedness and response in Romania has been re-organised according to Governmental Ordinance no. 21/2004, regarding the National System for the Management of Emergencies. Also other regulations (Governmental Decisions) were issued in this regard:

- GD no. 1489/2004 regarding the organisation and functioning of the National Committee for Emergencies;
- GD no. 1491/2004 for the approval of the frame Regulation on the structure, attributions, functioning and endowment of the committees and operative centres for emergencies;
- GD no. 1492/2004 on the organisational and functioning principles and attributions of the professional emergency services;
- GD no. 2288/2004 for the approval of the nomination of the main support functions which the ministries, state authorities and non-governmental organisations have to perform in order to prevent and manage emergency situations.

The national emergency response scheme, as established by this new legislation, is described in section 16.2.2.

The Law on the safe deployment, regulation, licensing and control of nuclear activities stipulates, as one of the licensing conditions, the obligation of the applicant to institute and maintain his own approved system for the intervention in case of nuclear accidents. Also, the licensee has the obligation and responsibility to take all necessary measures in order to ensure and maintain his own emergency plan in case of nuclear accident, and the development of his own system of requirements, regulations, and instructions ensuring the deployment of licensed activities without unacceptable risks of any kind. The responsibility for nuclear damage caused during or as a result of an accident that might occur by deployment of the activities under the license or of other activities resulting in the death, damage to the corporal integrity or health of a person, destruction, degradation, or temporary impossibility of using some goods rests entirely upon the licensee, under the terms established by law and by international commitments Romania is a party to.

Article 40 of the Law stipulates that the co-ordination of the intervention preparations in case of nuclear accident shall be ensured by the National Committee for Emergency Situations (CNSU) within the Ministry of Interior and Administration Reform (MIRA), in co-operation with all specialised bodies of the central and local public administration with powers in these matters. The intervention plan in case of nuclear accident for the site of nuclear installations shall be developed by the licensee, together with all the responsible central and local public authorities and specialised organisations; the on-site intervention plans shall be approved by CNCAN, which has also the responsibility to evaluate periodically and control the applicability of the plan.

The intervention plans in case of radiological emergencies, caused by nuclear accidents in NPPs located on the territory of other states that may affect the Romanian territory, by transboundary effects, as well as the general off-site intervention plans for nuclear plants on the Romanian territory are prepared by the General Inspectorate for Emergency Situations (IGSU) within MIRA. These general intervention plans are submitted for approval to CNSU and their applicability has to be periodically assessed and controlled by IGSU. The central and local public authorities with powers in the field of preparedness and practical response to a nuclear accident are responsible for developing their own plans correlated with the general intervention plan. These plans must be approved by the respective authorities' managers, with the advice of IGSU and their applicability has to be periodically assessed and controlled by IGSU.

According to art. 5 of the Law, CNCAN is empowered to issue regulations for the detailed specification of the general requirements on intervention in case of nuclear accidents. In this respect, specific requirements are provided in the following regulations:

- Fundamental Requirements on Radiological Safety (NFSR);
- Specific Requirements for the Quality Management Systems applied to the Operation of Nuclear Installations (NMC-10);
- Nuclear Safety Requirements on Emergency Plans, Preparedness and Intervention for Nuclear Accidents and Radiological Emergencies (approved by Ministerial Order No. 242/1993).

Chapter X of NFSR includes specific requirements regarding the radiation protection in interventions, stipulating that, for obtaining a licence from CNCAN, for any nuclear activity, the applicant shall take into consideration all types of radiological emergencies which could arise from the practice, assesses the spatial and temporary distribution of radioactive substances dispersed in case of radiological emergencies and, consequently the corresponding potential exposures. Based on these evaluations, the applicant shall elaborate an adequate intervention plan, at all necessary levels, commensurate with the extent of all possible types of radiological emergencies.

The licensee is responsible to ensure that intervention plans are tested to an appropriate extent at regular intervals. Also, the licensee is responsible to notify immediately any radiological emergency occurring on site and to take all the necessary measures to reduce the consequences of the radiological emergency. For the adequate accomplishment of its own tasks concerning the intervention, the licensee has to perform an initial provisional assessment of the circumstances and the consequences of the radiological emergency and to communicate it immediately to the competent authorities. As a general principle, the intervention has to be focused on the source, to reduce or stop the direct radiation and radioactive emissions, to reduce the transfer of radioactive substances to the environment and to the individuals, to reduce exposure and organise the treatment of victims.

According to art. 182 of NMC-10, the analysis, approval and revision of the on-site emergency intervention plan shall be controlled and the responsible public authorities shall have the possibility to analyse each revision of the plan, to ensure the coordinated reaction to any emergency situation and at any moment. The on-site emergency intervention plan shall include the following elements:

a) classification of events that generate emergencies and the response to emergency situations;
b) notification and action of the emergency organisation, including the normal and alternative communication means, both on site as well as with the external emergency organisations;
c) necessary actions to meet the objectives of the emergency plan;
d) competence and responsibilities of the emergency organisation;
e) technical assessment of the emergency situation and the implications, including the conditions in the installation, the radiological protection and the damage of the rector core;
f) actions to protect the personnel in the installation or on site, including the census of the personnel and the evacuation;
g) recommendation of all off-site protective actions outside the installation for the external emergency organisations;
h) ensuring the timely and accurate information of the responsible public authorities, including mass-media communication;
i) agreements with the external organisations supporting the emergency plan and the applicable procedures;
j) organisation, authority and responsibilities for the coordination of the re-entering the installation and recovery actions;
k) identification of emergency planning zones, equipment and resources;
l) detailed references to the emergency operation procedures and emergency response actions for rescue, operation of the security systems and of the communication ways.

Nuclear Safety Requirements on Emergency Plans, Preparedness and Intervention for Nuclear Accidents and Radiological Emergencies (approved by Ministerial Order No. 242/1993 - this regulation will be further referred to as MO 242/1993) are establishing the specific actions to be taken by the operator, competent authorities and other responsible public authorities for planning, preparedness and intervention in the following cases:

- nuclear accidents at nuclear installations;

- radiological emergencies resulted from licensed practices;
- radiological emergencies resulted from transboundary effects.

According to these requirements, any operator of a nuclear installation has to make preparations, in conjunction with national, regional and local public authorities and support organisations, for coping with nuclear accidents. Also, a General Emergency Plan has to be prepared for any nuclear risk area in the country, which may be threatened by a radiation emergency. This Plan shall cover all activities planned to be carried out by all responsible authorities and organisations involved in case of an emergency situation leading to, or likely to lead to, a significant release of radioactivity beyond the site boundary of the nuclear facility.

Art. 8 of MO 242/1993 stipulates that the initial fuel loading of a nuclear reactor is only permitted provided that the licensees and the public authorities have established the emergency intervention plans and have proved, by means of an exercise, that they are prepared for emergency situations. In other words, the organisation of this exercise constitutes a prerequisite for obtaining CNCAN approval for the Fuel Loading milestone of the commissioning phase of a NPP. Furthermore, as stipulated in art. 186 of NMC-10, the operator shall establish a plan to perform the exercises and verifications for the testing of all emergency plan elements and shall perform a detailed annual analysis of the emergency response, in order to establish corrective actions to ensure the maintenance of the necessary capability to respond to emergency situations.

The MO 242/1993 is currently in the process of being revised as “Fundamental Requirements on Preparedness, Planning and Intervention in case of Nuclear Accidents and Radiological Emergencies” and completed by other specific requirements, as part of the process of harmonisation of the national legislation with the new recommendations of EU and IAEA (GS-R-2, EPR-Method 2003, EPR-Medical 2005, EPR-Exercise 2005, EPR-First Responders 2006).

16.2 Implementation of Emergency Preparedness Measures, Including the roles of the Regulatory Authority and of the other organisations

16.2.1 Classification of emergency situations

According to MO 242/1993, the radiation emergencies at nuclear installations are classified as follows:

- Station Alert;
- Station Emergency;
- Off-site Emergency;
- General emergency.

Under the process of revising the MO 242/1993, these classification criteria will be modified, according with the IAEA-TECDOC-953 Updated / October 2003.

In order to harmonise the emergency classification with the classification used in other NPPs across Europe, these new classification was already introduced into the On-site Emergency Plan of Cernavoda NPP. Thus, the emergencies at Cernavoda NPP are classified as follows:

- Alert;
- Facility Emergency;
- Site Area Emergency;
- General Emergency.

As stipulated in the On-site Emergency Plan of Cernavoda NPP, in case of radiation emergencies the response actions should begin without any delay and be coordinated from the start. To facilitate this, an event classification system was established, in order to predefine the response actions for each emergency class. The events are classified on the basis of the actual or potential consequences of an incident for the public, environment, station personnel and property.

The classification of the events at Cernavoda NPP is given in Appendix 16.1. The classification criteria are the following:

- station / systems / personnel status;
- radiation hazards.

In order to classify the events, the radiation hazards criteria are applied in those cases when the dose rates increases are associated with the station / systems / personnel status impairment.

Based on the station / systems / personnel status, the events are grouped in:

- radiation events at nuclear systems, grouped upon the safety function impairment (loss of reactivity control, inadequate fuel cooling, containment isolation system impairment);
- radiation events at Spent Fuel Bay, Shielded Work Station or Intermediate Dry Spent Fuel Storage;
- other events (fires, chemical incidents, medical incidents, etc.).

Based on the radiation hazards, the events are classified taking into account:

- the radiation levels expressed in terms of external dose rates, determined on the base of the surveys and sampling performed by the on-site and off-site survey teams and Perimeter Gamma Monitors readings;
- the total activity released to stack, determined on the base of laboratory analyses of Gaseous Effluent Monitors filters and Gaseous Effluent Noble Gases Monitor readings;
- the activity in the containment, determined on the base of results provided by the Post Accident Sampling System.

Appendix 16.1

Event Classification at Cernavoda NPP

I. STATION / SYSTEMS / PERSONNEL STATUS

Events	Emergency Class
1. Radiation events at station nuclear systems	
Events with radiation consequences both on-site and off-site, caused by: ▪ loss of reactivity control; ▪ loss of core structural integrity; ▪ degradation of a process system, which make necessary to initiate the special safety systems (Emergency Core Cooling and Containment Isolation System), concomitantly with the Containment Isolation System impairment.	**General Emergency**
Events with on-site radiation consequences and with potential off-site effects, caused by the degradation of a process system, which make necessary to initiate the special safety systems (Emergency Core Cooling and Containment Isolation System), concomitantly with the Emergency Core Cooling impairment.	**Site Area Emergency**
Events with on-site radiation consequences, caused by the degradation of a process system, which make necessary to initiate the special safety systems (Emergency Core Cooling and Containment Isolation System), these acting as per design.	**Facility Emergency**
Events with on-site radiation consequences, caused by the degradation of a process system, which don't make necessary to initiate the special safety systems (Emergency Core Cooling and Containment Isolation System).	**Alert**

2. Radiation events at Spent Fuel Bay / Shielded Work Station / Intermediate Dry Spent Fuel Storage	
Airplane collapse on the Intermediate Dry Spent Fuel Storage	**General Emergency**
Fall of the transfer flask loaded with a basket on the storage platform (the basket leaves without biological protection)	**Site Area Emergency**
Fall of a basket during storage cylinder loading	**Site Area Emergency**
Fall of the transfer flask loaded with a fuel storage basket (60 fuel bundle) during the transfer to the Intermediate Dry Spent Fuel Storage	**Site Area Emergency**
Fall of a fuel storage basket (60 fuel bundle) in the Spent Fuel Bay / Shielded Work Station	**Facility Emergency**
Fall of a fuel bundle / a fuel pallet (24 fuel bundle) in the Spent Fuel Bay	**Alert**
3. Other events	
Events which will conduct to the Secondary Control Room Activation	**Facility Emergency**
Fires	**Alert**
Chemical spills	**Alert**
Medical incidents	**Alert**
Minor incidents with radiation consequences for the station personnel (ex.: small loss of D_2O HTS or moderator, incidents involving radioactive sources)	**Alert**
Incidents during the radioactive waste transfer to Intermediate Solid Radioactive Waste Storage	**Alert**
External events which lead to actual or potential loss of the access to the site / communication with the site for a long period of time	**Alert**

II. RADIATION HAZARDS

	General Emergency	Site Area Emergency	Facility Emergency
External dose rate ($\dot{H}_{ext}$) in normally occupied areas of the station: *(areas where in normal conditions the dose rates are smaller than 10 µSv/h)*	$\dot{H}_{ext}$ > 10 mSv/h	1 mSv/h < $\dot{H}_{ext}$ < 10 mSv/h (potentially lasting several hours)	0.1 mSv/h < $\dot{H}_{ext}$ < 1 mSv/h (potentially lasting several hours)
External dose rate ($\dot{H}_{ext}$) at off-site / beyond the site boundary:	$\dot{H}_{ext}$ > 1 mSv/h	0.1 mSv/h < $\dot{H}_{ext}$ < 1 mSv/h	0.01 mSv/h < $\dot{H}_{ext}$ < 0.1 mSv/h
Total activity released to stack (confirmed release), averaged on 15 minutes, which lead in 1 hour the off-site doses:	H > 1 mSv	H > 0.1 mSv	———
Total activity in the containment, based on the results from PASS:	Λ_{GN} > 9.0 E+14 Bq	4.5 E+13 Bq < Λ_{GN} < 9.0 E+14 Bq	7.0 E+8 Bq < Λ_{GN} < 4.5 E+13 Bq
	Λ_{I} > 1.0 E+13 Bq	6.0 E+11 Bq < Λ_{I} < 1.0 E+13 Bq	32.0 E+6 Bq < Λ_{I} < 6.0 E+11 Bq

16.2.2. Overall national emergency preparedness structure

According to the new legislation, the National System for the Management of Emergencies is composed of three types of structures:

- the decisional structure – the committees for emergencies;
- the executive structure – the inspectorates for emergencies;
- the operational structure – the operative centres for emergencies.

All the decisional, executive and operational structures are established on three levels: national, county and local.

As a decision structure, at national level is organised the National Committee for Emergency Situations (CNSU). The CNSU is set-up under the co-ordination of the Prime Minister and managed by the Minister of Interior and Administrative Reform (MIRA). All the ministerial, county and local Committees are subordinated to CNSU. The County/Local Committees for Emergencies are directed by the county Prefect / local mayor.

As an executive structure, at national level is established the General Inspectorate for Emergency Situations (IGSU), a specialised organisation of MIRA. IGSU has the responsibility of permanent co-ordination of the prevention and management of emergency situations, at national level. At county / local level, there are established County / Local Inspectorates for Emergencies, acting as public professional emergency services.

Inside each Inspectorate for Emergency Situations is set-up an Operative Centre for Emergencies, with permanent activity, ready to activate the emergency organisation in case of an accidental event. These Operative Centres for Emergencies are receiving notifications for all types of emergencies, including radiation events.

Also, the responsible organisations at national level are operating such Operative Centres for Emergencies, in accordance with the legal provisions in their field of activity. As an operational structure, at national level is functioning the National Operative Centre of IGSU.

In order to fulfil the legal responsibilities in case of a nuclear accident or radiological emergency, CNCAN has recently established its own Emergency Response Centre (ERC), as part of the National System for the Management of Emergencies.

CNCAN – ERC acts as a support centre performing technical analysis and prognosis of the emergency situations with focus on the nuclear safety, radiation protection and radiological consequences, in nuclear and radiological emergency situations:

- independent analysis,
- technical recommendations in the nuclear safety field,
- technical recommendations in the radiation protection field,

- environmental radioactivity measurements (field and laboratory measurements).

CNCAN – ERC is the national contact point in relation to any type of radiation emergency. As part of the National System, CNCAN-ERC is communicating with IGSU Operative Centre and with other operative centres of public authorities.

There is established a National Centre for Intervention Co-ordination in case of a Nuclear Accident or Radiological Emergency (CNCI), where representatives of central public authorities are activated in case of an emergency. The automatic connection of CNCI with the operative centres of the responsible organisations is to be established, for data transfer and exchange of information. According to an agreement expressed by all parts (CNCAN, IGSU, Research Institute IFIN-HH in Magurele), the RODOS system shall be implemented in CNCI, in order to support the decision making process, especially in the late phase of an accident, but no funds are available in present for implementing the RODOS system in CNCI.

By law, the Ministry of Interior and Administrative Reform (MIRA) is responsible for the management of nuclear and radiological emergencies, IGSU and CNCAN being the national competent authorities in case of nuclear accident or radiological emergency. At local level, the intervention is coordinated by the Local / County Committees for Emergencies and performed by the Local / County Inspectorates for Emergencies. When the emergency situation cannot be solved by the local authorities, the national level (CNSU and IGSU) is activated, in order to support the local intervention. Written agreements and protocols are in place between the responsible organisations, at local and central level, for common activities and exchange of information in emergency situations.

In accordance with the provisions of Governmental Ordinance 21/2004, CNCAN, as national competent authority in the nuclear field, has the following specific functions in the National System for the Management of Emergencies:

- Monitoring of specific dangers and risks, together with their associated negative consequences, and
- Informing, notifying and alerting.

CNCAN has, in the field of radiation emergency preparedness and response, the following responsibilities:

- to notify an emergency to national & international responsible organisations;
- to create, update and disseminate information inside the country and outside (through IAEA and through bilateral agreements with other states) on the overall view of the safety status of the nuclear installation / radiological facility and on the radiological situation;
- to perform technical assessments and to advise the CNSU representatives (the decision makers at national level) on the safety status of the nuclear installation / radiological facility;
- to give technical advise to and supervise the public authorities and the licensees on nuclear/ radiological safety issues;

- provide advice to licensees, as necessary, on additional steps to be taken to mitigate the consequences of the accident and avoid harm to the public and the environment;
- recommend to CNSU representatives the protective actions for the population in case of an emergency;
- assess and advise CNSU representatives on the appropriate information which are to be distributed to the media and the general public for accurate, timely and comprehensive information regarding the emergency;
- assess and advise CNSU representatives on the appropriate long term post-emergency protective actions;
- advice for protective measures for industry, trade, traffic and customs.

The response organisations have the following responsibilities:

- to elaborate and revise to date an adequate emergency plan;
- to assure by means of laws, Governmental Ordinance, decrees, the legal basis for protection of the population, environment and property, medical care, financial compensations, etc. in emergency situations;
- to establish and maintain a proper structure of the intervention sources able to: advice on nuclear safety and radioprotection, sample and analyse samples, keep in contact with police, army and fire fighting forces, keep contact and receive advice from water management bodies, agriculture produce control bodies, medical services, meteorological forecast facilities.
- to organise and maintain an emergency co-ordination centre equipped with technical means for the expertise of the emergency and sufficient communication means;
- to organise exercises and drills, to maintain the level of personnel training and equipment availability for emergency situations;
- to establish levels for the triggering of the emergency in case of transboundary emergencies.

16.2.3. On-Site and Off-Site Emergency Intervention Plans

The objective of the On-site Radiation Emergency Plan along with its supporting documents is to ensure effective emergency preparedness and response to emergency situations at the nuclear installation. The purpose of the On-site Radiation Emergency Plan is to identify the essential elements of a response to a radiation emergency and to describe in general terms the measures required to control and mitigate the radiological accident consequences within the site and to minimise the off-site effects.

The On-site Radiation Emergency Plan emphasises the immediate on-site response actions. Also, it does cover the off-site emergency for the first few hours of the radiation incident having an impact on the public and the environment. The plan includes the classification of radiation incidents, the evaluation of on-site incidents and the response actions. It identifies also the material and human resources necessary to implement these actions, and defines the organisation and the responsibilities for the personnel involved for every phase of an incident. The On-site Radiation Emergency Plan is implemented through the On-site Radiation Emergency Procedures.

In order to develop adequate emergency arrangements for Cernavoda multiunit NPP, in line with best international practice and experience, many components of the Emergency Preparedness and Response Programme were amended in the last years. The former Emergency Preparedness and Response Programme was covering one single functional unit of Cernavoda NPP and it was based on the following concept: during an emergency situation, the Shift Supervisor was having the overall responsibility for directing and coordinating all the response activities from the Emergency Control Centre (located in the Main Control Room), the senior management and technical staff assisting the Shift Supervisor.

Based on the recommendations of a Nuclear Safety Expert Project (PHARE PROJECT de Angelis-010-RO/Phare A6-01), Cernavoda NPP started a process of building two On-Site Emergency Control Centres (OSECC), common for both Units (1 and 2), (separate from the Main Control Rooms), in this way changing the philosophy of emergency intervention. Consequently, the On-site Emergency Plan was revised to include a clear command and control organisation, allowing management of the site during an emergency at strategic, tactical and operational level and reducing the tasks performed by the Shift Supervisor and shift staff.

This improving process of the emergency response arrangements at Cernavoda NPP was realised within the framework of the OSECC Project, started in 2003, and dedicated to build the On-Site Emergency Control Centres (main and alternative) and adjust all the components of the Emergency Preparedness and Response Programme to the requirements for a multiunit NPP. The new On-site Emergency Plan was approved by CNCAN in 2005. The project was finalised with the declaration of the OSECC as operational on the 10th April 2006. After this date it was started the training of the emergency management and support personnel who will activate in the OSECC in case of an emergency, the training sessions being finished on 29th May 2006.

The applicability of the revised On-site Emergency Plan, as well as the operational capacity of the OSECC have been tested through the emergency response exercise for Unit 2 licensing, which was organised as the annual exercise of Cernavoda NPP on 14th December 2006, being coordinated from the OSECC. Witnessed by CNCAN and the public authorities, the exercise has proven the capability of plant to cope with radiation emergencies.

The on-site emergency organisation ensures a complete on-site response to emergency situation as well as covering the off-site emergency responsibilities of Cernavoda NPP. The size of the on-site emergency organisation depends on the type of the emergency event and its evolution in time.

At the first indications of an event, the Station Shift Supervisor has the responsibility to identify the causes and effects of the emergency situation and anticipates its evolution. The transients without radiation consequences, such as medical incidents, fire or chemical spills are not taken into account by the on-site emergency plan, being handled by the application of specific emergency procedures.

The class of the event is established by the Shift Supervisor after assessing the station / systems / personnel status or the radiation hazards. The site personnel warning (through the Public Addressing System and through the site siren, depending on the incident class) will initiate the emergency response.
In case of emergencies which do not need the OSECC to be activated (alerts) the response activities are directed and coordinated from the Main Control Room and they are performed by the Response Team formed by shift personnel.

In case of emergencies which do need the activation of OSECC, the Shift Supervisor will notify the emergency management and support personnel and he will accomplish the Emergency Manager duties till the authorised person will take over. Taking over the Emergency Manager responsibilities will occur in the same time with the OSECC activation, meaning at the moment when the Command Unit (Emergency Manager, Emergency Technical Officer, Emergency Health Physicist and Emergency Administrative Officer) will be present in the OSECC. The necessary time to set-up the OSECC is of 15 minutes, during normal working hours, and 1 hour, after normal working hours.

The purpose of the emergency operation activities is to bring back the station in a safe state, to ensure an adequate fuel cooling and to stop the radioactive releases from the station. These are realised by applying the adequate emergency operating procedures.

In order to prevent an escalation of the threat and to mitigate the consequences of any actual radioactive release or radiation exposures, the Technical Support Group will provide technical advice in a timely manner to the Emergency Manager and to the Shift Supervisor.

In case of radiation emergencies with off-site effects, Cernavoda NPP is responsible for initiating protective actions for the public, by notifying the public authorities and making recommendations on protective measures for the population. The responsibility to decide and implement these recommendations belongs to public authorities involved in the off site intervention.

In all phases of an emergency, notification forms are sent by fax to the public authorities involved in the intervention off the site, as follows:

- “Radiation Emergency Notification” form, sent as soon as possible after the declaration of the incident;
- the “Source Term Description” form is used only if the containment is boxed-up; the form is sent when enough data are available and, after this, each hour or when situation changes;
- the “Radiological Information” form is sent when a radiological release from the containment is in progress and data from the stack and/or from the On-site/Off-site Monitoring Team are available; after that, it is sent each hour or when the situation changes;
- the “Radiation Emergency Termination” form is sent when the Emergency Manager declare the termination of the emergency.

The protective actions to be recommended for the population are established based on the projected doses and the off-site ambient dose rates.

The projected doses are calculated:

- during the planning process, in case of emergencies followed by an immediate radioactive release from the containment, for a zone being at 10 km radius around the plant (Urgent protective action planning zone), in the most unfavourable meteorological conditions for dispersion (F stability class); the protective actions are established comparing the calculated projected doses with GILs and will be recommended to public authorities immediately after the assessment and classification of the incident;
- during the emergencies, taking into account the current radiological conditions in the containment and the meteorological conditions affecting the dilution of the release; the protective actions established by comparing the calculated projected doses with GILs are used to be recommended to public authorities or to prepare the containment depressurisation strategy.

In case of radiation emergencies with off-site effects, Cernavoda NPP is also responsible to determine the amount of radioactivity released. In this respect, the Off-site Monitoring Team of the plant will perform off-site survey and sampling activities. The off-site survey and sampling results are used:

- to update the emergency class and refine the strategy for response, if necessary;
- to establish the protective actions comparing the measured dose rates with the OILs calculated during the emergency planning process;
- to recalculate OILs and update the protective actions comparing the measured dose rates with the new OILs.

Thus, at the beginning of the emergency, the protective actions are established by comparing the measured dose rates with the Operational Intervention Levels (OILs) calculated during the emergency planning process based on GILs. After the information about the emergency condition and the concentration of the radionuclides released from the plant becomes available, having impact on the considered assumptions for OIL calculation, some OILs are recalculated, according to specific health physics procedures. Then, protective actions are established comparing the measured dose rates with the new values of the OIL.

The GILs and OILs values, as established in the Cernavoda NPP On-site Emergency Plan are presented in Appendix 16.2.

The protective actions for the on-site personnel are established based on the incident classification and the results of in-station and on-site surveys, performed by the On-site Monitoring Team.

Appendix 16.2

Generic Intervention Levels, as defined in Cernavoda NPP On-site Emergency Plan (*)

Protective Action	Generic Intervention Level (avertable dose)
Sheltering	10 mSv
Evacuation	50 mSv
Iodine prophylaxis	100 mGy

Generic Intervention Levels, as defined in OM 242/1993 (#)

Protective measure	Doses to be compared with the intervention level	Intervention Level (mSv)			
		Whole body		Thyroid, lungs, skin	
		inferior	superior	inferior	superior
Sheltering	External dose plus committed intake dose during the first 24 hours	3	30	30	300
Evacuation	External dose plus committed intake dose during the first 24 hours	30	300	300	3000
Administration of stable iodine	Committed dose by intake of I-131 during the first 24 hours	-	-	30	300

(*) In order to provide to decision makers rapid information to establish the moment when the protective actions should be implemented, it was decided to consider the GILs as single values (as recommended by IAEA reference documents), inside the respective intervals established by MO 242/1993

(#) The recommended IAEA generic intervention levels will be adopted after the revision of MO 242/1993.

Protective actions based on external dose rate measurements from the plume

OIL	Value	Protective actions
OIL 1	1 mSv/h (a),(c)	Evacuate or provide substantial shelter (b) for this sector, the adjacent sectors and the sectors closer to the plant. Until evacuated, people should be instructed to stay inside, with their windows closed.
OIL 2	0.1 mSv/h (c)	Take thyroid blocking agent, go inside, close windows and doors and monitor radio and TV for further instructions.

a) If there is no indication of core damage, OIL 1 = 10 mSv/h.
b) "Substantial shelter" is provided by specially designed shelters or the inside halls or basements of large masonry buildings. Shelter should be considered only for 24-48 hours and its effectiveness must be confirmed by monitoring, especially in high dose rate areas.
c) Monitor evacuees and instruct the public on decontamination measures.

Protective actions based on external dose rate measurements from the deposition

OIL	Value	Protective actions
OIL 3	1mSv/h	Evacuate or provide substantial shelter within the sector
OIL 4	0.2 mSv/h (a),(b)	Consider relocating people from the sector
OIL 5	0.001 mSv/h	Restrict immediate consumption of potentially contaminated food and milk in the area, until samples are evaluated

a) This OIL has to be recalculate based on sample analysis as soon as possible
b) For 2-7 days after the accident

Under emergency situations, all possible efforts are made to keep the emergency exposures of the intervention personnel below the legal dose limit of 20 mSv/y. It is permitted to exceed the legal dose limit in the following situations:

- saving life or preventing serious injury;
- averting a large collective dose or preventing the development of catastrophic conditions.

For these situations, the Emergency Manager approves the dose exceeding. All reasonable efforts will be made to keep doses below 100 mSv, except for life saving actions, in which the dose limit is 500 mSv. Workers who undertake actions in which the dose may exceed the maximum single year dose limit shall be volunteers, clearly and comprehensively informed in advance about the associated health risk and as much as possible, trained in the actions that might be required.

After termination of the emergency, the Station Manager has to establish a Recovery Organisation. If significant in-plant radiological hazards exist (beyond those experienced during normal operation), the following activities have to be considered:

- performing extensive surveys of affected plant areas (radiation, contamination and airborne levels);
- radioactive waste processing, using supplementary portable equipment (if abnormal quantities of radioactive waste are present).

In order to ensure an effective response to a radiological event, a good coordination between Cernavoda NPP actions and public authorities actions is necessary. In this respect, periodic meetings are organised between Cernavoda NPP representatives and public authorities representatives, in order to establish their specific responsibilities, the notification means, the content and format of the information to be exchanged during an emergency, the necessary agreements for the support which might be required by the plant, the organisation of the periodic general emergency exercises.

During an emergency with off site effects, the Cernavoda NPP Management Representatives will go to Cernavoda Townhall and Constanta County Emergency Inspectorate, in order to ensure the interface between the OSECC and the public authorities coordination centres (Local Operation Emergency Centre and, respectively, County Operation Emergency Centre). Their main responsibility is to provide to off-site responders accurate and reliable technical information, in a timely manner.

The on-site emergency plan covers all the activities performed on the Cernavoda NPP site in case of an emergency in order to protect the station personnel. It also covers the initial actions that must be performed to protect the population in the first hours of an emergency, which may have an off-site impact. The responsibility for off-site emergency planning lies with the public authorities. NPP shares some of the off-site emergency responsibilities with the Public Authority, especially in the initial stage of an emergency with off-site implications.

The on-site and off-site emergency plans, included in the general intervention plan, describes in general terms the measures required to control and mitigate the accident and to protect the site personnel and the public in case of an emergency. The actions to be followed by responsible personnel (personnel designated to respond to specific emergency situations) in order to meet the objectives of the emergency plan, are described in details in the on-site and the off-site emergency procedures.

In Romania, besides the Cernavoda NPP influence area, there are another three nuclear risk areas (emergency planning zones, as per IAEA TECDOC 953):

- the influence area of Kozloduy NPP (the Bulgarian NPP situated at few km distance from the Romanian – Bulgarian border, in the southern part of Romania);
- the influence area of VVR-S Research Reactor (under conservation to be decommissioned), in Bucharest – Magurele;
- the influence area of TRIGA Research Reactor in Pitesti – Mioveni.

For each nuclear risk area, there are county plans for intervention in case of nuclear accidents and also, there is a national plan for intervention in case of nuclear accidents, under revision. Also, a national intervention plan for radiological accidents is under preparation. Together, the two documents will form the National Intervention Plan for Radiation Emergencies. County emergency plans for radiological accidents were elaborated in the last years and were approved by IGSU.

Two General Radiation Emergency Plans are in place for Cernavoda NPP and for Kozloduy NPP influence area. The plans describe the external organisations and their responsibilities during an incident at nuclear facilities, which may have an off-site impact. The plans also contain the description of the essential steps for off-site emergency response activation, the protective action levels, and the protective measures. The protective actions, and the organisation in charge to implement these actions, are identified for each emergency planning zone. Also, the plans describe the recovery activities, the international assistance, the periodic exercises, and the updating and revision of plans. Emergency procedures are in place, at all levels, in order to perform the response functions declared in the intervention plans.

The county emergency plans for radiological accidents are considering different types of accidents involving radioactive sources and materials used in medical, industrial, research or education facilities which can occur in a county (radioactive materials transport accidents, as well as finding, misplacing or losing radioactive sources). These plans specify the way to obtain expertise and services in radiation protection field, at local level, in a timely manner. When the situation impose, CNCAN experts are coming at the place of the accident for radiological investigations. Arrangements are in place between CNCAN and IGSU, CNCAN and NBC-Police for intervention in case of an accidental event involving radioactive materials.

Arrangements have been made in the last years for general practitioners and emergency staff to be made aware of the medical symptoms of radiation exposure and of the appropriate notification procedures if a nuclear or radiological emergency are suspected, and there are irregular training courses in this field.

The Polyclinic of Cernavoda and County Hospital in Constanta have been prepared to treat injured people, for the eventuality of a radiation event at Cernavoda NPP. At national level, there is established a place for initial treatment of overexposed people at the Clinic for Radiopathology belonging to the Institute for Public Health in Bucharest.

16.2.4. Public information

The On-site Radiation Emergency Plan of the operator and the Off-site Radiation Emergency Plans of the public authorities establish the responsibilities, the resources and the interfaces required for informing the public in case of a nuclear emergency. Joint information centres, staffed by representatives of the nuclear facility and of the public authorities, are established at the local and national levels.

As stipulated by the On-site Emergency Plan of Cernavoda NPP, those emergencies with off-site effects are to be notified to the response organisations (Cernavoda Townhall, Constanta County Emergency Situations Inspectorate, IGSU, CNCAN), including critical information about the plant status and protective action recommendations for the public. Also, during an emergency, the link between the plant personnel and the public authorities is ensured through the Cernavoda NPP representatives at Local / County Emergency Situation Committees, as member of these committees. In this respect, Cernavoda NPP Public Relations Officers will go to Cernavoda Townhall / Constanta County Emergency Inspectorate, to ensure an accurate and reliable technical information, in a timely manner, for the mass-media, by means of:

- informing the press agencies of emergency conditions and emergency response activities;
- developing methods to monitor broadcasts, bulletins and reports for misinformation; to respond quickly to public and media inquiries; and to rapidly respond to rumours or misinformation;
- providing in advance and ongoing information to the media and public on subjects that would be discussed during an emergency, such as radiation, nuclear plant operation and the on-site emergency plan.

CNSU, at national level, and the County Committees for Emergencies, at local level, are responsible to give instructions and information to the public. The local and national TV and mass-media are used to keep the public informed about the accidental / radiological event.

CNCAN, and also the operator, have the responsibility to support the public authorities in informing the public with accurate, timely and comprehensive information regarding the emergency, trough their representatives at national level, in CNSU, and at local level, in the County Committees for Emergencies.

At national level, the information includes aspects regarding the status of the nuclear / radiological facility and the status of planning / implementing the protective actions for population. At local level, the information includes also instructions and warnings for the population in the affected area.

Arrangements are in place in all nuclear risk areas in the country for prompt warning and instruction of population in the emergency planning zones, in case of an accidental event. The public in the vicinity of Cernavoda NPP and Kozloduy NPP has received printed information about the threat and how to behave in the case of an emergency. At local / county level, a Public Information Group is established in case of emergency in order to provide information to mass-media and population.

16.3. Training and Exercises

According to MO 242/1993, all the response organisations must organise exercises, train the personnel and maintain an adequate level of training and all the necessary resources for an efficient response. The response authorities must have sufficient personnel, adequately qualified and trained for performing the actions provided by the intervention plan. At all levels of planning, the intervention plans must establish the types, frequencies and evaluation methods of exercises and drills, as well as the training necessity of the response personnel.

Furthermore, the licensee shall ensure the adequate initial and periodical training for the personnel authorised to declare emergency situations and to manage the intervention, personnel responsible for the evaluations necessary to be performed in emergency situations, teams assigned for radiological monitoring and decontamination, control room and field operators, fire fighting teams, repair teams and those assignees for evaluation of damages, rescue and first-aid teams. The personnel assigned for emergency response shall be regularly trained, at least every three months. The licensee has to maintain and verify the training of its own personnel by organising annual exercises. The exercise shall be planned such that they cover all the seasons and all meteorological conditions. All the exercises shall be followed by a critical evaluation in which will participate also representatives of the competent authorities. Also, the licensee has to participate in all the exercises organised by the public authorities, for the verification of the general intervention plan.

In this respect, Cernavoda NPP has in place a “Training, qualification and prequalification programme in emergency response of Cernavoda NPP personnel”. Also, a systematic programme of exercises is established. The exercise types carried out at Cernavoda NPP are of the following types:

- Quarterly Emergency Drills, dedicated to train one or more components of the On-site Emergency Organisation, are organised quarterly with each operation shift crew and annually with each emergency management and support shift crew; the objectives of these drills are planned for every 3 years and are established so that the On-site Emergency Organisation personnel, in a 3 years period, is trained for all type of emergencies;

- Annual Emergency Exercises, dedicated to test almost all areas of the Cernavoda NPP emergency plan, are organised during the normal work programme, with each operation shift, emergency management and support shift, through rotation; these exercises are witnessed by CNCAN and the other public authorities involved in the off-site intervention;
- General Emergency Exercises simulate an emergency which results in radioactive releases outside the station and which requires the intervention of county and / or national public authorities; they are organised in collaboration with the public authorities, involving the neighbouring population, besides station personnel and public authorities personnel, at least once in three years and they have various scenarios in order to verify and test different parts of the emergency plan; they start at different hours of day and night, under various meteorological conditions and are scheduled to involve each operation shift / emergency management and support shift, through rotation, as much as practical;
- Exercises with external resources, carried out to ensure the harmonisation of the site personnel response with the external resources which are taken into account in the emergency plan; because the On-site Emergency Plan establishes the Military Fire-fighters support in the fire intervention actions, annually is organised a fire drill involving the Military Fire-fighters, with the general objectives of familiarising the Military Fire-fighters with the plant layout and of testing the cooperation between the Fire Intervention Team of the plant and the Military Fire-fighters.

The exercises end with an analysis and a balance of activities in order to evaluate the ability of the various components / organisations involved. The deficiencies noted during the exercises that indicate a lack of skills or knowledge will be corrected with appropriate training.

As regarding the number of Cernavoda NPP personnel involved in emergency response, in case of alerts, the response activities are directed and coordinated from the MCR and they are performed by the shift personnel. There is sufficient number of qualified personnel in each shift, able to perform response activities until the emergency organisation is augmented, if necessary. Absolute minimum shift complement ensures the number of trained personnel who are necessary for initial response actions. This complement will be augmented by shift civil fire fighters, shift security personnel, shift personnel in training, day personnel. In case of emergencies which do need the OSECC to be set up, the Shift Supervisor will notify the emergency management and support personnel and will accomplish the Emergency Manager’s duties, till the authorised person will take over them. At least 3 persons from day personnel are appointed and trained for every emergency management and support position of the On-site emergency organisation. In order to ensure the continuity of the human resources in case of emergency, the appointed persons are scheduled, both during normal working hours and after normal working hours (on-call).

Also, in this respect, arrangements are in place for the selection and training of personnel in all the organisations of the CNSU. Important training courses and exercises, both national and international were conducted in the last years in the field of radiation emergency preparedness and response. The effectiveness of the response is tested and enhanced through carrying out periodical radiation emergency exercises for all areas and facilities. Once in a few years, all the responsible organisations participate in the national large scale exercises organised by IGSU. The frequency of the training and exercises became constant in the last 3 – 4 years, with at least one major international exercise and one major national exercise being organised by CNCAN in partnership with national and international institutions. The exercises are followed by an evaluation report, in order to assess the capability of the various response organisations to fulfil their attributions and to recommend measures for improving the response.

The most important international exercise in which CNCAN and other responsible organisations of CNSU were involved in the last two years, was ConvEx – 3(2005) International Emergency Response Exercise. The exercise was organised by Inter – Agency Committee for Response to Nuclear Accidents (IACRNA) and International Atomic Energy Agency (IAEA), in collaboration with CNCAN, IGSU and Cernavoda NPP. It was hosted by Romania, during May, 11 - 12, 2005 and lasted for 39 hours.

During the exercise, the international organisations and IAEA Member States tested the international and bilateral arrangements and capabilities dedicated to the nuclear and radiological emergencies. 62 Member States and 8 international organisations participated in ConvEx-3 exercise.

The general objectives of the exercise were:

- to test whether the organisations' staff appropriately responded to media reports and inquiries about a nuclear accident, in a timely manner;
- to test whether activation procedures of the Romanian Emergency Response System were timely and appropriately implemented;
- to test whether relevant actions according to procedures for exchanging information were timely and appropriately implemented;
- to test whether media information was issued in a co-ordinated manner, timely and appropriately;
- to test whether other response actions were justified and applied timely and appropriately.

The Cernavoda NPP acted as the simulator of the nuclear accident and originator of the emergency messages. The messages were analysed and routed by CNCAN in Romania to IAEA in Vienna, as EMERCON forms, accessing the ENAC IAEA's website. The IAEA further relayed the messages to the international community and acted as a technical support within the ConvEx framework.

Before the exercise, CNCAN developed the communication field, using: Internet, 8 lines telephone / fax, mobile phones (for Internet, data transmission, voice). Dedicated lines were established with Cernavoda NPP, IGSU – CNCI, IAEA – Incident and Emergency Centre, Bulgaria, Greece, Hungary, Slovakia, Russian Federation and Ukraine. During the exercise, CNCAN provided a dedicated website for this event and posted there the EMERCON messages transmitted to IAEA and partner states according to bilateral agreements, press releases, information presenting the event. Information was updated periodically. The CNCAN emergency website was accessed by 46 countries and more than 90 international organisations. During the 39 hours of exercise, CNCAN received 207 messages and transmitted 228 messages.

The actions of the local authorities in charge of implementing countermeasures in Cernavoda town area were performed under the coordination of IGSU.

Deficiencies were identified during the exercise and corrective actions were implemented, in the field of communication, information exchange, management of emergency situations and public information.

16.4. International Arrangements

According to art. 35 of the Law, one of the main attributions of CNCAN is to control the implementation of the provisions of international treaties and bilateral agreements on the intervention in case of nuclear accident, such as:

- IAEA Convention on Early Notification of a Nuclear Accident;
- IAEA Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency;
- Convention Regarding the Liability for Nuclear Damages;
- Bilateral Agreements on Early Notification of Nuclear Accidents and Exchange of Information on Nuclear Installations with Bulgaria, Greece, Hungary, Slovakia, Russian Federation and Ukraine.

In this respect, CNCAN is the national contact point as per IAEA Conventions for Early Notification and Assistance (according to IAEA letter EPR/CP(0100) from 16/11/2000), with the following functions (as defined in ENATOM, 2000):

- National Warning Point;
- National Competent Authority for Domestic Accidents;
- National Competent Authority for Accidents Abroad.

ARTICLE 17 –SITING

Each Contracting Party shall take the appropriate steps to ensure that appropriate procedures are established and implemented:

(i) for evaluating all relevant site-related factors likely to affect the safety of a nuclear installation for its projected lifetime;

(ii) for evaluating the likely safety impact of a proposed nuclear installation on individuals, society and the environment;

(iii) for re-evaluating as necessary all relevant factors referred to in sub-paragraphs (i) and (ii) so as to ensure the continued safety acceptability of the nuclear installation;

(iv) for consulting Contracting Parties in the vicinity of a proposed nuclear installation, insofar as they are likely to be affected by that installation and, upon request providing the necessary information to such Contracting Parties, in order to enable them to evaluate and make their own assessment of the likely safety impact on their own territory of the nuclear installation.

17.1 Regulatory requirements and licensing process for the siting phase

The general aspects regarding the regulatory framework and the licensing process have been provided under Article 7. This section gives details specific to the licensing process for the siting phase.

The licensing process and the general criteria for siting are set by the provisions of the Romanian regulation Nuclear Safety Requirements (NSR) - Nuclear Reactors and Nuclear Power Plants, in force since 1975, which was based on the regulatory requirements of US NRC (10 CFR). The requirements on the quality assurance for site evaluation and selection activities have been later formalised by CNCAN, through the regulation NMC-03 (Specific requirements for the quality management systems applied to the evaluation and selection of the sites for nuclear installations). The regulation NMC-03 contains provisions for the different stages of the siting process, including the examination and assessment of various potential sites, the confirmation of the chosen location and the arrangements for site monitoring for the lifetime of the nuclear installation.

Although at the moment no plans exist for the selection of new sites, a revision of the regulation NSR (Nuclear Safety Requirements - Nuclear Reactors and Nuclear Power Plants) is envisaged, to take account of the latest developments in international standards and guides on this matter, with the purpose of providing a formalised set of criteria for the periodic re-evaluations of all the site-related factors.

The licensing documentation for the siting of Cernavoda NPP has been prepared in accordance with the provisions of the NSR regulation. The documentation substantiating the safety demonstration for site acceptance is constituted by the Initial Safety Analysis Report (ISAR), together with the supporting technical studies and evaluations. The ISAR provides adequate justification for the site selection and summarises the assessments performed to ensure that the site characteristics are suitable for the design, construction, commissioning and operation of the facility. Although the emphasis of the report is on the identification and investigation of those site characteristics, which bear on safety, the report must also contain sufficient information on the conceptual design and operation of the nuclear installation. The preliminary evaluations of the impact on the environment are also included in the ISAR.

In accordance with the NSR regulation, the ISAR has to include, as a minimum, the following:

- the description and the safety assessments of the site (demographic, hydrological, meteorological, seismic, geological, ecological conditions, etc.);
- preliminary analysis of the risks for the health and safety of the population, both from normal operation and design basis accidents;
- the proposed limits for the radioactivity discharges through liquid and gaseous effluents into the environment;
- the monitoring and confinement means which will be used in design for maintaining the radioactivity levels of the effluents as low as reasonably possible;
- the estimation of the quantities of radioactive substances released annually through liquid and gaseous effluents, in normal operation;
- the preliminary calculations of the atmospheric dispersion and the evaluation of doses to the population, for normal operation as well as for design basis accidents.

The NSR regulation includes also the list of main elements taken into account by the nuclear regulatory authority when analysing the acceptability of the site proposed for a nuclear power plant:

1. Reactor design characteristics and the operation mode proposed:
   a) The proposed mode of operation, specifying the nominal power for operation and the nature and inventory of radioactive materials contained;
   b) Technical regulations and standards applied in the design;
   c) The extent to which the plant design contains unique or unusual characteristics contributing significantly to the probability of occurrence of accidents or to the consequences of radioactive releases;
   d) The safety characteristics and features to be considered in the technical calculations for the installation and the barriers to be breached before the accidental radioactive releases to the environment could occur.

2. Population density and site area characteristics, including those of the exclusion area and the low population area.

3. The physical characteristics of the site, including seismic, meteorological, geological and hydrological data, and:
   a) Demonstration the plant design complies with the national regulations for seismic design of nuclear power plants. No nuclear installation will be sited closer than 500 meters to areas known as active seismic faults;
   b) The consideration and the evaluation of the meteorological characteristics of the site and the surrounding areas;
   c) The consideration and the evaluation of the geological and hydrological characteristics of the proposed site which may significantly influence the radioactive releases from the nuclear power plant; special measures shall be in place if the plant is proposed to be constructed on a site

which would accidentally allow a significant quantity of radioactive effluents to infiltrate the groundwater or the nearby river currents.

For site evaluation purposes, provisions are included in the above mentioned regulation also with regard to the determination of the exclusion area, the low population area and the maximum number of inhabitants allowed there. In this respect, a radioactive release from the reactor core following a design basis accident is required to be postulated together with the predicted containment leak rate and the site specific meteorological conditions. For these analyses, including the presentation of the basis for the numerical values used, the following are required to be considered:

a) An exclusion area of such dimensions that an individual located at any point on its boundary, for two hours following the onset of the postulated fission product release, would not receive a total radiation dose for the whole body in excess of 25 rem or a total radiation dose to the thyroid in excess of 100 rem (for adults), from exposure to radioactive iodine.

b) A low population area of such dimensions that an individual located at any point on its outer boundary, who is exposed to the radioactive cloud resulting from the postulated fission product release (for the entire time period of its passage) would not receive a total radiation dose for the whole body in excess of 25 rem or a total radiation dose to the thyroid in excess of 100 rem (for adults), from exposure to radioactive iodine. Also, the collective dose calculated for these conditions for any radial sector of 22.5 degrees shall not exceed 10^6 man.rem.

For multi-unit sites the regulation requires for the following considerations to be taken into account:

a) if the reactors are independent, so that an accident occurring at one of them cannot affect the safe operation of any of the other reactors, the requirements on the determination of the exclusion area and of the low population area shall be complied with by each of the reactors;

b) if the reactors are interconnected to the extent that an accident occurring at one of them can affect the safe operation of any of the other reactors, the dimensions of exclusion area and low population area shall be based on the hypothesis that all interconnected reactors release simultaneously the postulated quantities of fission products; this requirement may be relaxed in relation to the degree of coupling between reactors, the probability of accidents occurring simultaneously and the probability of individual exposure to radiation effects from simultaneous releases.

c) it shall be demonstrated that the total radioactive effluent releases from the simultaneous operation of multiple reactors at the site will not exceed the allowable limits established by the regulations in force.

The site licence for Cernavoda NPP (intended for five units) has been granted in 1979 by CSEN (see Article 7 for information on the development of the nuclear regulatory authority in Romania). The safety documentation for demonstrating the fulfilment of regulatory requirements and criteria comprised of the Initial Safety Analysis Report (ISAR) and the supporting technical studies and evaluations.

The factors taken into account in the evaluation of the site from the nuclear safety point of view included both those related to the characteristics of nuclear reactor design and those related to the specific site characteristics. In accordance with the regulatory requirements, comprehensive safety assessments have been performed to demonstrate that the reactor design ensures a very low probability for accidents resulting in significant radioactive releases and that the site choice and the technical measures taken to mitigate the consequences of the accidents, should these occur, ensure adequate protection of the public and environment.

17.2 Safety assessment of site related factors

The data collected during the examination, assessment and confirmation of site belong to the following categories:

a) data on the current and historical status of the site, resulting from censuses, geological, hydrological, meteorological and seismic data, records of examinations and other similar sources;
b) data regarding indirect explorations, resulting from direct or calculated information, from the collection of data, from testing and investigations performed in other purposes;
c) data from direct explorations, obtained from sampling, direct examination or from site tests;
d) laboratory tests.

The collection of data on site characteristics continued throughout the construction and operation phases, to verify the information obtained before the construction stage and to update it as necessary, to provide reassurance with regard to the adequacy safety margins.

The NSR regulation contains general provisions on what the Preliminary Safety Analysis Report (PSAR) and Final Safety Analysis Report (FSAR) have to include, with regard to the information related to the site and its continuous monitoring after the issuance of the siting licence:

- The PSAR (for the application for a construction licence) shall include:
  - the description and safety analysis of the site with special emphasis on the elements decisive for the design solutions; the focus should be on the factors taken into account in the choice for the site;
  - the description of the preoperational monitoring programme of the site characteristics, including environmental factors (on site and off site), which shall start at the same time as the construction activities; this includes the measurement of the natural radiation background and initial radioactive contamination, if any;
  - the safety assessments for the main structures, systems and components of the nuclear installation, that have a decisive influence on the acceptability of the concrete features of the site;
  - the structure and the content of the intervention plan in case of emergency situation.
- The FSAR (for the application for the commissioning licence) shall include:

- the results of the preoperational monitoring programme of the environmental factors for the site and the surrounding areas (initiated at the start of the construction);
- the types and quantities of radioactive materials expected to be produced during the operation of the plant and the means provided for controlling and limiting the radioactive effluents and associated radiation exposures;
- the intervention plans for emergency situations and the emergency preparedness arrangements.

The assessments performed (initial and updated) for the site-related factors are provided in the technical evaluations and studies referenced in the ISAR, PSAR and FSAR respectively. These evaluations and studies have been performed in accordance with the national regulations and the recommendations in the IAEA Safety Guides, the US NRC Regulatory Guides, applicable international standards, etc. Their results are summarised in Chapter 2 of the FSAR for Cernavoda NPP, which contains also a detailed description of the site characteristics including:

- Geography and demography: description and localisation of the site, population distribution on a 30 km radius area, density of population in the ring area between 30 and 100 km radius, transitory population, populated centres;
- Industrial facilities, transport routes and military facilities in the area: industrial facilities and activities, premises of economical and industrial development, railroad transport network and traffic characteristics, statistics of railroad accidents on a five year period, road traffic, dangerous goods transports in the area, naval transport, technical characteristics of the Danube-Black Sea Canal, winter phenomena on the Danube and Cernavoda area, perspective of naval traffic development until 2030, civil aircraft traffic, airport aircraft crashes and flight corridors, military facilities in the area, potential accidents caused by human and industrial activities in the area including explosions, toxic gas releases, gas and oil mains explosions;
- Meteorology: regional and general climatologic conditions, local meteorology, normal and extreme values of meteorological parameters, air circulation, atmospheric stability, meteorological phenomena, potential influence of the plant on the local climate;
- Hydrology: surface and underground waters, plant siting relative to water sources, Danube river, Danube-Black Sea Canal, flooding scenarios;
- Geology and seismology: regional geology, geotectonic structure of the site, hydro geological conditions, correlation between geological structure, tectonic movement and seismic activity, seismic faults in the area, maximum observed earthquake and maximum possible earthquake, site seismic characteristics, seismic hazard assessment input data and models, seismic design data confirmation.

The human induced hazards have been evaluated by using conservative analysis methods of the actual and estimated data (for 2000-2030 prognosis period) on industrial facilities and activities, naval, terrestrial and air transports, as well as military facilities and activities. For these categories of activities, there are evaluated potential accidents (explosions, toxic substances emissions, fires, missiles generation) occurring at industrial facilities around Cernavoda NPP (30 km radius),

postulated explosions on terrestrial and naval transport routes in the vicinity of the plant, potential accidents due to air transports in the surrounding area (more than 30 km from the NPP), potential accidents due to military activities around Cernavoda NPP site.
As with regard to the demographic data, the study on the distribution and density of the population in the influence area of the plant is generally updated for the revision of the Final Safety Assessment Report, as required by CNCAN for the renewal of the operating licence. Thus, the "Systematisation Study regarding the Localities, Population and Industry in the Cernavoda NPP Siting Area" was latest revised in 2000 and it includes not only actual data (registered in 2000), but also estimations for the distribution and density of the population in 2010, 2020 and 2030.

The site area has been also evaluated with regard to ease of access for resources in the event of contingency and emergency response evacuation, availability and adequacy of off-site services (reliability of the grid), etc.

The applicable natural external events analysed include earthquakes, surface faulting, meteorological events (including severe weather conditions), lightning, flooding (due to precipitation, dam bursts, etc.), slope instability, behaviour of foundation materials, etc. A systematic reassessment of the site-related factors will be performed in the framework of the first Periodic Safety Review for Cernavoda NPP.

The initial geological studies for the site have been performed by ISPH (the Institute for hydroenergetical studies and design) and approved by the nuclear regulatory authority after independent assessment made by D'Appolonia engineering consulting company. The seismologic data both of the site region and off-site (as bases for the design) have been determined by the National Institute for Earth Physics, certified by the nuclear regulatory authority for siting seismological studies. The results of the studies and their interpretation are also documented in Chapter 2 of the FSAR.

The licensee has re-evaluated the seismic safety of Cernavoda NPP in the framework of the project for developing probabilistic safety assessments. As a first step, the seismic re-evaluation of the site has been performed, using Probabilistic Seismic Hazard Analysis (PSHA) as the preferred methodology. The results of the Hazard Analysis have been used as input to the seismic PSA for the plant. The seismicity of the site and surrounding 300 km area was reassessed with state of the art methodology, seismic hazard study confirming the design data. Assistance from IAEA has been received in the development and the review of the PSHA and seismic PSA of the plant. The PSHA done for Cernavoda NPP confirmed the design provisions for qualification of the plant to a seismic event (design basis earthquake) of 0.2g, taking into account that the frequency for an earthquake of 0.2 g to occur is lower than 1E-3, as assumed in the design process and in the safety assessments included in the FSAR.

17.3 Evaluation of the impact on the population and the environment

As required by the Law 137/1995 on environmental protection, a detailed assessment of the impact of the installation on the environment has to be prepared by the applicant, and submitted to the governmental and local environmental agencies for their review. The environmental agreement issued by the central authority for environmental protection has to be obtained prior to the issuance of the siting licence, or of the construction licence (for the case in which a unit is built on an already licensed site) granted by the nuclear regulatory authority. The environmental authorisation is issued by the central authority for environmental protection (the Ministry of Environment and Sustainable Development) after the issuance of the operation licence by CNCAN.

During the preoperational stage, the licensee is responsible to monitor the distribution and the characteristics of the population around the installation, its occupations and habits, food consumption rates and origins of consumed food, ways to spend the time, as well as agricultural and aquatic characteristics (species, agricultural practices, gardening activities, etc.); all these data have to be periodically verified during the operational stage of the plant. Also, the use of the river water must be monitored in the vicinity of the plant and as far downstream as might be subject to significant contamination.

According to CNCAN requirements on monitoring of the radioactive discharges into the environment, the licensee is responsible for supplementing the environmental radioactivity monitoring programme with support studies, dedicated to other types of measurements and/or activities of collecting general data about the environment and population characteristics. In this respect, the licensee is responsible to ensure, not only during the preoperational stage, but also for the entire period of operating the plant, the monitoring of climate conditions and hydrological characteristics of the rivers receiving the liquid effluents (according to the CNCAN requirements on meteorological and hydrological measurements for nuclear installations).

The general objective of the above mentioned support studies is to detect the occurrence of important changes of the environment, which may significantly affect the radionuclides transfer into the environment and thus the exposure pathways. In such cases, the licensee shall reassess and accordingly modify the environmental radioactivity monitoring programme, and submit it for approval by CNCAN.

Starting with 1984, Cernavoda NPP deployed a preoperational monitoring programme, which was contracted by two Romanian Nuclear Research Institutes (IFIN Magurele and ICN Pitesti). The sampling points were established taking into consideration the distances from the future NPP effluents discharging points, the predominant wind direction, the presence of the population and its food consumption habits. The procedures for sampling, sample preparations and measurements were established and agreed by the two contractors. Generally, samples of air, surface, drinking and ground water, soil, sediment, spontaneous and cultivated vegetation, as well as food and feed were quarterly collected and analysed for their radioactive content by total alpha and beta measurements, gamma spectrometry, tritium, uranium and Sr-90 determination. The results were reported to the NPP quarterly and annually. The measurements made under this preoperational program detected the environmental radioactivity changes resulted following the Chernobyl accident in 1986; starting with 1990, the radioactive concentrations in the majority of the environmental media returned to the normal values, registered before 1986, excepting the Cs-137 in soil and sediment which is still present in some points, in low concentrations, showing a decreasing tendency. The results of this program are used as reference values in the estimation of the impact of Cernavoda NPP operation on the surrounding environment.

Cernavoda NPP operates a meteorological tower, 80 m high, located at approx. 1.5 km from the plant and equipped with sensors placed at 3 levels (10 m, 30 m and 80 m). The meteorological data (air temperature, wind direction and speed, precipitations) are automatically sent to the MCR and SCR at 10 minutes intervals; in 2004, the system was updated by changing the sensors, modifying the software and setting up a new monitoring point.

Starting with 2002, Cernavoda NPP contracted, besides the meteorological prognosis services, monthly diagnosis services provided by Constanta Regional Meteorological Centre of the National Administration for Meteorology. The data provided through this contract are in good agreement with the data provided by the on site meteorological tower, even there are differences between the two locations (in terms of level, data collecting techniques, physical distance between them of about 2 km). The hydrological data (level and temperature, daily flows, monthly upstream/downstream temperature gradient) of the Danube river are provided for Cernavoda NPP on a contractual base, by the National Company “Romanian Waters”. All these data are reported annually by the plant, together with the environmental radioactivity data, as resulted from the monitoring program.

More information on the environmental radioactivity monitoring programme is provided under Article 15.

17.4 Consultation Procedure

The procedure for obtaining a construction license for a nuclear installation includes the obligation to perform and submit an environmental impact assessment (EIA).

The neighbouring countries that could be affected by the installation are notified on the basis of the international Convention on Environmental Impact Assessment in a Transboundary Context (ESPOO Convention), to which Romania is a contracting party.

ARTICLE 18 - DESIGN AND CONSTRUCTION

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the design and construction of a nuclear installation provides for several reliable levels and methods of protection (defence in depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and to mitigating their radiological consequences should they occur;

(ii) the technologies incorporated in the design and construction of a nuclear installation are proven by experience or qualified by testing or analysis;

(iii) the design of a nuclear installation allows for reliable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface.

18.1 General description of the licensing process for the design and construction phases

The general aspects regarding the regulatory framework and the licensing process have been provided under Article 7. This section gives details specific to the licensing process for the construction phase.

As a first step in the licensing process for the construction of a new unit (provided that the site licence had been issued, as it is the case for Cernavoda NPP), a Licensing Basis Document (LBD) is submitted for approval to CNCAN.

The LBD includes all applicable regulatory documents (including those established by other authorities than CNCAN), codes and standards, safety design requirements, the list of all the design basis events, safety analysis requirements, and the general requirements for the stages of construction, commissioning and operation. The applicable international safety standards and guides are also endorsed by means of the LBD.

The LBD and the preliminary Safety Design Guides (SDG), which are included as an attachment to the LBD, are project specific documents. The LBD is reviewed by CNCAN, which imposes changes and/or additional requirements, as the case may be. Once approved, the LBD becomes the main document based on which the licence applicant establishes arrangements for the work to be performed in the preparation of the Preliminary Safety Analysis Report (PSAR).

The PSAR constitutes the main document submitted by the applicant to CNCAN for review and approval for obtaining the Construction Licence. The PSAR includes, as a minimum, chapters covering the following aspects (in accordance with the provisions of the regulation Nuclear Safety Requirements (NSR) - Nuclear Reactors and Nuclear Power Plants):

- Description of the site safety taking into account:
    - compliance with chapters "Site selection" of NSR;
    - description of the site characteristics monitoring programme to be implemented up to operation;
- Analysis of the compliance with the safety requirements for the main systems of the installation at the nominal design values of operation;

- Presentation of any new or unusual design solutions used and evaluation of their impact on the safety;
- Preliminary data and solutions adopted in the design, construction, commissioning and operation of the nuclear installation so that to ensure compliance with requirements on:
  - General Design Criteria (GDC) as in NSR (this regulation endorsed the general design criteria in General Design Criteria in 10 CFR Part 50 Appendix A)
  - basic correlation between the design parameters and the GDC;
  - various types of information to confirm the provision of acceptable safety margins;
  - preliminary safety evaluation of the plant systems to confirm that they assure an acceptable safety margin during normal operation, transients and accidents and the existence of the adequate technical and administrative measures to cope with postulated events.
- Description of the technical limits and conditions;
- Description of the administrative organisation and the measures taken to comply with the nuclear safety requirements;
- Description of the quality assurance programme;
- Identification of the systems, components, design solutions, etc. which need a special research programme to be completed prior to operation in order to demonstrate the full compliance of the installation with the safety requirements.
- Short description of the emergency plan to be implemented up to operation.

The SDGs detail and interpret the safety design requirements coming from various sources (e.g. regulatory documents from the country of origin, Romanian regulations and requirements, industrial codes and standards, safety evaluations), and which apply to several systems or several areas of the unit. The design bases for each structure and system are detailed in their respective Design Manuals (DMs). The SDGs and DMs are updated in the construction phase and subsequently in the commissioning phase, to take account of any changes that may arise.

The list of Safety Design Guides that were produced for each of the Cernavoda NPP units is given below:

- SDG-001: Safety Related Systems - identifies the safety related systems, and provides an interpretation of safety requirements for each system for application in the design process;
- SDG-002: Seismic Qualification;
- SDG-003: Environmental Qualification;
- SDG-004: Grouping and Separation;
- SDG-005: Fire Protection;
- SDG-006: Containment extensions - provides guidance for the design of containment isolation features;
- SDG-007: Balance of Plant Safety Related Performance - describes the safety related requirements (e.g. reliability requirements) specifically placed upon Balance of Plant systems.

The Final Safety Analysis Report (FSAR), SDGs, DMs and any other documents referenced in the FSAR (such as technical evaluations and studies, safety analyses, procedures, commissioning reports, drawings, etc.) constitute the documentation that substantiates the safety demonstration for the operation of the plant.

The main licensing milestones during the construction phase include the reception and storage of the heavy water, the reception and storage of the nuclear fuel and the heavy water loading into moderator system. After these are completed and compliance with all the applicable requirements is demonstrated, the application for the commissioning licence is submitted to CNCAN. The complete list of licensing milestones is given under Article 19.

Through all the construction phase, CNCAN inspectors perform audits and inspection in accordance with the regulatory inspections programme and periodic licensing meetings are also held to discuss with the licensee's representatives the progress of the project and any outstanding issues and significant findings. Comprehensive assessments and inspections are performed especially on the occasion of the licensing milestones. For each of the licensing milestones a formal approval/authorisation is granted by CNCAN to the licensee to further proceed with the work, provided that all the specific requirements and conditions have been fulfilled. For example, prior to granting the approval for heavy water loading into the moderator system, one of the conditions is for the licensee to demonstrate that all construction activities related to the plant systems needed for that milestone are completed, that the necessary verifications and tests have been performed with acceptable results and also that all the required documentation is available and adequate.

During the construction phase, the main process used by the licensee to confirm that the structures and systems are installed and completed as per design is the Construction Completion Assurance (Construction CA).

The Construction CA process encompasses all the assessment and verification activities necessary to provide reassurance that the as-built plant fulfils all the design requirements, as well as all the requirements deriving from the applicable regulations, codes and standards on nuclear safety and quality assurance and also the applicable jurisdictional requirements.

The independent verification of the work performed during construction and of the construction completion status is done by the commissioning personnel, in the process of turnover from construction to commissioning, in which the responsibility is transferred from the Construction organisation to the Commissioning organisation. This turnover process is done by systems or groups of systems. A controlled process is in place to manage incomplete items. All the Construction Managers are responsible for the turnover process in their discipline and for preparing the respective Construction CA Statements and submitting them to the Construction General Manager, who is in charge of preparing the Overall Construction Completion Certificate. This Certificate is forwarded to SNN (the licence holder) for review and endorsement. The Construction Completion Certificate, approved by SNN, is submitted to CNCAN as part of the application for Fuel Load, which is the first licensing milestone after the commissioning start.

18.2 Measures for ensuring the application of proven technologies

An important general requirement in the Romanian regulation “Specific requirements for the quality management systems applied to the design of nuclear installations” (NMC-05) is that the design and associated design documentation are to be verified to ensure its correctness and that all specified requirements have been fulfilled. Provisions relevant to the area of design are specified also in the regulation “Specific requirements for the quality management systems applied to the activities of producing and using software for research, design, analyses and calculations for nuclear installations” (NMC-12).

The design verification can be done through reviews (supervisory review, independent third party review, etc.) and / or by testing. Complexity, novelty, safety implication of the design, standardisation degree, etc., determine the extent of the design verification.

The verification requirements are identified in the engineering quality plans implemented during manufacturing, construction, commissioning and operation stages. These plans identify the design activities to be verified, the extent of verification, persons involved in verification, methods and position in the design cycle, etc. All the above requirements are covered by specific verification procedures. Any improvements in the existing design or redesign of the systems or components are subject to the same verification as the original design in order to confirm that all the existing analyses are valid and the design is correct.

The design activities can be performed only by organisations recognised or licensed by CNCAN. When the design activities are contracted to other design organisations, the contractors shall be licensed or agreed by CNCAN, or it shall be ensured by other means that the design work is verified in the same manner as mentioned above. The Design Authority for the plant has the responsibility to check that the contractors have performed such design verifications and that the particular designers have used correctly the design inputs.

Verification or certification, where required, of design reports, stress reports, seismic or environmental qualification reports, are usually carried out by the supplier or other specialised and authorised organisation, in accordance with applicable codes, standards and procedures. Test requirements, procedures, assumptions, data and results are documented and records are kept for ensuring design traceability.

The design authority evaluates the test results against acceptance criteria and conclusions of the test are recorded and filed in design history files. When tests are required to be performed by a contractor, test requirements are specified in the procurement documents.

Computer software programmes used for design, design analysis, plant and safety system control, safety analyses, and computer-assisted design are verified, validated and documented. Such verifications, validations and documentation are controlled through appropriate procedures.

When selecting a manufacturer's standard product, the design is subjected to review and/or testing to demonstrate the satisfactory performance of the item. Alternatively, to ensure satisfactory performance of the item, the design authority may evaluate the manufacturer's evidence of verification.

Since the early stages of the development of the Romanian nuclear programme, the contractual arrangements between the licence holder and the designer/vendor have been focused on ensuring that sufficient design information is provided to ensure the safe operation and maintenance of the plant and to support the development of national competence and expertise with regard to CANDU design.

Arrangements are in place also to obtain technical advice and support with regard to any safety related issues for which external expertise would be needed, as the design authority of Cernavoda NPP maintains a close relation with the plant designer and vendor (Atomic Energy of Canada Limited - AECL) and with the other CANDU operators worldwide (through the CANDU Owners Group - COG).

18.3 Examples of design changes for Cernavoda NPP Units

The licensing basis document for each unit of Cernavoda NPP included a general overview of the design of the reference plant and the design changes to be incorporated based on the experience from the commissioning and operation of other similar NPP units (CANDU 6), results of new safety analyses, well as those needed to respond to the changes in regulations, codes and standards.

This section gives some examples of design modifications for Units 1 - 3 of Cernavoda NPP as included in the LBDs. It should be noted that the number of design changes performed for each unit since the approval of the LBD (including changes during the phases of construction, commissioning and operation) is significantly greater than that proposed in the LBD (which only represent the notable improvements arising from the operating experience available at the time of the application for a construction licence).

Cernavoda NPP, Unit 1

Unit 1 of Cernavoda NPP was commissioned between the years 1993 and 1996. The design installed and commissioned in Romania has incorporated most of the significant safety related design changes already made by other organisations operating CANDU-6 up to late 80's. Supplementary, during commissioning a few other hundreds of design changes were incorporated that originated from:

- CANDU 600 operating experience, especially Point Lepreau, Gentilly 2 and Wolsung;
- safety assessments performed in Canada following the occurrence of some incidents at other nuclear power plants;
- the probabilistic safety evaluations performed to verify the adequacy of design.

Some examples of modifications incorporated in the "as-commissioned" Cernavoda NPP Unit 1 are given below:

- modification of the control room design to consider human error factors;
- new material used for the pressure tubes (Zr-2.5%Nb);
- improved trip coverage;
- automation of the low power conditioning for the trip of shutdown systems on low pressuriser level and low boiler level;
- improvements to increase ECCS reliability;
- provisions for the post LOCA collection of leakage from ECC pumps;
- provision of redundant back-up cooling for RSW system;
- improvements of instrument air reliability;
- improvements of the containment liner to minimise the leak rate;
- provisions for annulus gas recirculation;
- provision for a facility for post LOCA sampling of Containment Atmosphere;
- improvements of the fire protection, etc.

Examples of design changes implemented after the start of operation:

- Removal of ADP functions from BLC program to an independent program - MIT (Mitigation Program) in order to avoid the failure of the ADP function at BLC program failure (clear separation between the safety function and process function).
- Modification of the start-up system to ensure complete independence of the redundant diesel generators of the EPS.
- As a result of the thermalhydraulic analyses for review of LPECC flow capacity in case of LOCA event, a design modification for replacement of the two 100% capacity strainers for Cernavoda Unit 1 has been implemented in 2002, in order to prevent sump filter clogging in case of LLOCA and to ensure the required performance of the pump under the design basis operating conditions for a minimum mission period of three months.

The process for initiating, assessing and implementing design changes is defined by a set of plant procedures, with the aim of ensuring effective configuration control and conformance with the design basis of the plant. Information on the design change process has been provided under Article 14.

Cernavoda NPP has a feed-back program to assess and implement the design modifications and improvements from Unit 2 to Unit 1, in order to maintain an equivalent level of nuclear safety with Unit 2. Some of the design changes considered in the LBD for Unit 2 have already been implemented also in Unit 1. For the rest of the changes a special programme is under development, for the review of these design changes and for determining which are those that are reasonably practicable to implement in Unit 1.

The assessment of the reasonable practicability of the above mentioned changes, will be completed in the framework of the first Periodic Safety Review of Cernavoda Unit 1.

Cernavoda NPP, Unit 2

The work on Unit 2 restarted in 2001. Unit 1 engineering documentation was updated to be used as reference for Unit 2 and the existing facilities and buildings were recertified.

In the period for which the construction of Unit 2 was stopped, there have been many developments in the nuclear industry worldwide. For example, CANDU plants similar to Cernavoda 1 and 2 have been built and placed in service in South Korea (3 units at Wolsung) and in China (2 units at Qinshan). In addition, during this period, additional experience has been gained from the operation of CANDU plants worldwide.

All the improvements resulting from the commissioning and operating experience were considered in the process of identification of the feasible design changes for Unit 2, account being taken of the stage of the construction work. After thorough review, 156 design changes were selected for implementation on Cernavoda Unit 2. These changes can be categorised as follows:

- Design changes to meet revised licensing requirements. These changes are in response to revision of codes, standards or regulatory requirement documents. Since the original design of Unit 1 was completed, some of the codes, standards and regulatory licensing requirements have been revised to improve consistency and to increase the margin of safety. In general, these changes can be categorised as safety improvements.
- Changes due to development of CANDU technology. In general, these changes result in improved performance or reliability of operation.
- Design changes to replace equipment where the equipment used in Unit 1 is approaching obsolescence, and modernisation will result in improved availability of spare parts and maintenance.
- Other design improvements for enhancing system or station performance.

Examples of safety improvements are given below:

- Provision of a second independent steam generator crash cooldown system, to improve reliability of the secondary circuit as a heat sink for the intact loop in case of LOCA and for the failed loop for small breaks;
- Improved EWS reliability (protection against single failures);
- Automation of start-up of LP ECC to eliminate the need for operator action to manually switch from MP to LP ECC operation 15 minutes after a LOCA;
- provision for redundant flow paths for ECC pump suction from dousing tank and redundant dousing tank level instrumentation;
- Provision of an on-power gross containment leakage monitoring system, to give additional assurance of containment boundary integrity for the periods between the full-scale leak rate tests;
- Provision of hydrogen igniters to prevent hydrogen accumulation in the Reactor Building in case of LOCA;
- Increased chromium content of lower outlet feeders, to ensure better protection against flow-induced corrosion and erosion;
- Post Accident Monitoring System;

- Modification to ensure Environmental qualification for all systems' components required to manage and mitigate consequences in Reactor Building after steam line or heat transport pipe break (LOCA).

Since the approval of the LBD, the were more than 200 additional changes implemented in Unit 2. All the design changes were implemented through a rigorous Design Changes process that required the approval of the designer for all the special safety systems. All design changes were assessed for impact on plant safety and when it was the case (for the modifications classified as major) they were also submitted to CNCAN for review and approval.

Cernavoda NPP, Unit 3

In 2006, CNCAN has approved the LBD for Unit 3. However, no application for a construction licence to re-start the work on Unit 3 had been submitted so far. The construction of Unit 3 started in the early 1980s but was stopped in 1992 when the Government decided to focus resources on the completion of Unit 1. When construction works on Unit 3 were halted, the civil buildings and structures, including the reactor building, the service building, the turbine-generator building were significantly developed.

The Reference Plant for Cernavoda 3 will be the as-commissioned Cernavoda 2 plant except for changes that are required to meet the latest Codes and Standards, any licensing mandated changes, design modifications to deal with obsolete equipment and address operating feedback from Cernavoda Units 1 and 2 identified before the project start.

Examples of proposed design changes:

- Shield Cooling System improvement to ensure adequate relief capacity for the calandria vault during a severe core damage accident, such that following a postulated severe accident with loss of moderator heat sink, the pressure in the Calandria Vault will not rise beyond the design value;
- Provision of a recovery system for moderator and PHTS for ensuring that moderator draining in case of situations such as stagnation feeder break or pressure tube rupture does not impair the effectiveness of the moderator as a heat sink for HTS breaks combined with unavailability of ECCS.
- Strengthening the design of the seal plates and the containment extensions (including isolation valves) for sustaining the pressure and temperature for main steam line break + complete failure of dousing.
- Improved ergonomics of the control room (modified layout of panels to enhance operator monitoring and control capabilities, addition of two large screen displays in the centre of the MCR panels to enhance operator's awareness of plant state and to support teamwork and team behaviour, improved ergonomics, etc.)

Cernavoda NPP, Unit 4

The situation of Unit 4 is similar to that of Unit 3, having also as Reference Plant the as-commissioned Cernavoda 2 plant except for changes that are required to meet the latest Codes and Standards, any licensing mandated changes, design modifications to deal with obsolete equipment and address operating feedback from Cernavoda Units 1 and 2 identified before the project start. The LBD for Unit 4 has also been approved by CNCAN.

18.4 Defence in Depth

For design and construction, the Defence-in-depth approach to ensure low probability of failures, or combinations of failures, which may result in significant radiological consequences includes the following:

- The provision of multiple physical barriers to the uncontrolled release of radioactive materials to the environment;
- Conservative design and high quality of construction to provide confidence that the potential for failures leading to abnormal plant conditions will be minimised;
- The provision of reliable engineered protective devices in addition to the inherent safety features;
- Automatic actuation of the safety systems, allowing the operators sufficient time for diagnosing the events and taking actions in accordance with the procedures;
- Provision of multiple means for ensuring each of the essential safety functions, i.e. reactivity control, heat removal and the confinement of radioactivity;
- Regrouping of the above systems or means of achieving the safety functions into two independent groups, so that each group can satisfactorily carry out all the essential safety functions in the absence of the other group;
- Provision of equipment and procedures to back up accident prevention measures, to control the course and limit the consequences of accidents.

The physical barriers considered for a CANDU NPP include the fuel matrix, the fuel sheath, the heat transport boundary, the containment envelope and the exclusion zone).

The safety philosophy of CANDU reactors, based upon the principle of defence-in-depth, employs redundancy (using at least two components or systems for a given function), diversity (using two physically or functionally different means for a given function), separation (using barriers and/or distance to separate components or systems for a given function), and protection (seismically and environmentally qualifying all safety systems, equipment, and structures).

For design purposes, the safety related systems and structures have been defined as those which, by virtue of failure to perform the safety functions in accordance with the design intent, could cause the regulatory dose limits for the plant to be exceeded, in the absence of mitigating system action.

The safety related systems and structures of a CANDU NPP can be broadly categorised as follows :

- Preventative: Systems and structures that perform safety functions during the normal operation of the plant, to ensure that radioactive materials remain within their normal boundaries. These are systems and structures whose failure could cause a release exceeding the regulatory dose limits during normal plant operation, in the absence of further mitigating actions, or whose failure as a consequence of an event could impair the safety functions of other safety related systems.
- Protective: systems and structures that perform safety functions to mitigate events caused by failure of the normally operating systems or by naturally occurring phenomena.

Some systems may perform both protective and preventative safety functions, and therefore may have more than one safety category designation.

The protective systems defined above are further identified as:

- Special Safety Systems, which include Shutdown System No. 1, Shutdown System No. 2, Emergency Core Cooling, and Containment.
- Safety Support Systems, which provide services needed for proper operation of the Special Safety Systems (e.g., electrical power, cooling water). These systems may have normal process functions as well.

The Special Safety Systems are always in standby during the normal operation of the plant and ready to mitigate the consequences of any serious process failure. They are totally independent from the process systems.

The Special Safety Systems and standby safety related systems have been physically separated by their assignation into two groups (Group 1 and Group 2) in order to provide adequate protection against common cause failures from events such as:

i) Turbine disintegration and resultant missiles;
ii) Fires that can lead to uninhabitable control centre, wide spread system damage, etc.;
iii) Aircraft crash;
iv) Failure of a common process e.g. Electrical Power Systems, Service Water System, etc.;
v) Common adverse environment e.g. extremes of temperature, pressure, humidity, radiation, toxic gases, etc.

In addition, within each group, there is separation between each the Special Safety Systems and between the channels of a system. The separation is achieved by the physical arrangement of equipment and of protective channels.

The essential safety functions that can be performed by either Group 1 or Group 2 are:

- reactor shutdown;
- fuel cooling;
- confinement of radioactivity;

- providing the operators with the alarms and indications required to assess the state of the unit and to take the necessary actions to mitigate the consequences of an accident.

The systems belonging to the two groups are shown in Table 18.1.

Safety Function	Group 1 Systems	Group 2 Systems
Reactor shutdown	SDS#1	SDS#2
Fuel cooling	ECCS	Emergency Water System (EWS) Emergency Power System (EPS)
Limiting the release of radioactivity		Containment
Station monitoring	Main Control Room	Secondary Control Area

Table 18.1 CANDU Safety Groups

Each group includes one SDS and either the ECCS or the Containment, because the analyses of the most severe cases, as presented in the Safety Report, assume one SDS system is unavailable and that either the ECCS or Containment is unavailable. As it is not possible to suffer more than those unavailabilities, it follows that the safety of the facilities is ensured at all times. Component redundancy is built-in for the Special Safety Systems to ensure that the single failure criterion is satisfied. Special Safety Systems satisfy an unavailability target of 10^{-3} years/year, which effectively requires redundancy of all critical components.

The availability of these systems is verified during operation by regular safety system component tests. Specific requirements are applied to the triplicated instrument cables and the duplicated power and control cables for safety-related systems. The odd and even concept of on-site power distribution is applied to equipment, the raceway system and junction boxes, in order to maintain physical separation between the odd and even systems to achieve maximum reliability under normal and abnormal conditions

To satisfy reliability requirements to meet safety objectives, the Group 1 Electrical Power System is equipped with standby Diesel generators supplied with support services from Group 1 systems. The power distribution system is designed to prevent propagation of electrical faults to the Group 2 Emergency Power Supply System and vice-versa. The portions of the distribution system needed to supply electrical power from the Group 2 Emergency Power Supply System to components required for the earthquake events are seismically qualified.

CANDU 6 is a proven design and sufficient information is publicly available on the general design features and on the CANDU safety philosophy and approach to prevention, mitigation and management of accidents. Therefore, this section only gives some examples of CANDU design features relevant for each of the levels of the defence in depth.

Prevention

- The reactor coolant pressure boundary is designed in accordance with ASME Section III - Class 1 requirements, as supplemented by Canadian Standards in the areas not covered by the ASME Code. The pressure tubes of the PHTS have "leak-before-break" characteristics. The plant is provided with extensive and sensitive leak detection systems. The presence of tritium in the PHTS makes the leak detection very efficient even for very small leaks.
- The on-line tritium in water detection system is used for revealing leaks to heat exchangers and to the S/G tubes.
- PHTS leaks open to Reactor Building atmosphere are revealed by the increasing of D_2O vapours recovery or by balance of heavy water into PHTS.
- The probability of occurrence of a sudden large-size break in a pressure tube is extremely low, in view of the following considerations:
  i) the tube-wall thickness is much smaller than the critical crack size for catastrophic failure so that leakage will precede tube rupture ("leak-before-break");
  ii) a leak of a pressure tube can be detected quickly (by means of the surveillance system analysing the gas contained in the annular space between pressure tubes and calandria tubes) thus allowing ample time for corrective action;
  iii) the pressure tubes and their end-fittings can be inspected by means of ultrasonic techniques, thus providing an up-to-date overview of the state of the pressure tubes;
  iv) although the pressure tubes are designed to serve for the entire life time of the plant, they can be replaced with relative ease, thus permitting early elimination of tubes showing any signs of faults.
- On-power refuelling implies that the power distribution reaches an equilibrium in less than a year from initial start-up, and remains virtually unchanged for the reactor's operating life. This greatly simplifies the analysis of core behaviour as a result of postulated accidents.
- On-power refuelling also allows defective fuel to be detected, localised and removed from the core, reducing the contamination of the reactor coolant piping and simplifying maintenance.
- CANDU fuel is very reliable, being composed of natural uranium oxide. Almost no fuel failure happens before the fuel is removed after nominal burn-up.
- There is no criticality hazard in the handling or storage of the UO_2 fresh/spent fuel because it is not enriched and cannot be arranged in a critical array, except for in heavy water.

Control

- CANDU NPPs are provided with extensive instrumentation and control systems, capable of monitoring those variables and systems that can affect the fission process, the integrity of the reactor core, the PHTS pressure boundary and the containment. Most control functions for the reactor and the

Balance of Plant, including automatic start-up, are performed by two identical, independent digital computers, each capable of complete station control. The two computers run simultaneously, one acting as instantaneous back-up to the other. Protection functions are, however, not performed by the digital process control computers but by Programmable Digital Controllers (PDCs), there being strict separation between control and protection systems.

- The Reactor Regulation System (RRS) is part of the fully computerised control system that is also responsible for boiler pressure and level control, unit power regulation, primary heat-transport pressure and inventory, and turbine run-up.
- The design philosophy for the RRS is to limit the maximum rate of reactivity additions to a value low enough to achieve safe control in all conditions. The neutronic flux spatial control system is designed to maintain stable control of the power distribution for any of the normal movements of other control devices such as adjuster rods or liquid zone controllers. The reactivity change due to refuelling is also adequately controlled by liquid zone controllers.
- The low excess reactivity of the CANDU core leads to relatively low reactivity worth of the control devices, limiting the potential severity of postulated loss-of-regulation accidents.
- Apart from the four systems employed by RRS, using control rods, adjuster rods, light water compartments and poison addition into the moderator region, two independent and diverse fast-shutdown systems are provided.
- Furthermore, the relatively open core lattice of the CANDU reactor permits complete separation between control and protection functions also for the neutron poison devices (i.e. the control rods used by RRS are the 4 mechanical control absorbers - MCA, while the SDS #1 uses 28 shutoff rods; poison addition to the moderator is done by RRS through the moderator liquid poison system, while the SDS #2 inserts poison from its own liquid injection shutdown units).
- To insure that localised overrating of the fuel does not occur an array of self-powered flux detectors is provided for application in the regional overpower protective (ROP) system. A separate array of detectors is provided for each of the two shutdown systems.
- The self-protection functions of the RRS (Stepback and Setback) are essential to ensure that station operation is within the boundaries assumed in the analyses. In the majority of event scenarios, the above mentioned self-protection functions can avoid reaching the trip set points of the Shutdown Systems (SDS#1 & SDS#2). The availability of the Reactor Regulating System (RRS) is absolutely required for maintaining the reactor in the critical state. Consequently, on a loss of RRS, the reactor is tripped immediately, with no attempt at re-start.
- Heavy-water neutron kinetics is slower by several orders of magnitude than light-water kinetics, this making the control easier because of the inherent kinetic behaviour of the delayed neutrons.

- Provision of passive heat sink after common mode events like loss of electrical power is ensured by thermosyphoning through the steam generators.
- The plant is provided with two separate control rooms in different locations, each with capability of shutting down and cooling the reactor to cold conditions, and providing continuous monitoring-of-the-plant information to the operating staff; this capability is still maintained in each control room even if total failure of all equipment in the other control room is assumed.

Protection

- The Special Safety Systems are fully automated, although they can be actuated manually if required. Each system is independent of the others, employing its own sensors, logic, and actuators. Each system uses triplicated logic in two out of three logic configuration, (three sensor circuits, with two-out-of-three voting), with the ability to be tested on-line.
- SDS#1 uses solid shutoff rods (stainless steel sheathed cadmium absorbers), dropping by gravity into the core, and is capable of shutting down the reactor for the entire spectrum of postulated initiating events. SDS#2 uses high-pressure liquid poison (gadolinium nitrate) injected into the (low-pressure) moderator, and is also capable of shutting down the reactor for the entire spectrum of postulated initiating events.
- Each SDS, acting alone, is capable of shutting down the reactor within less than 2 seconds and maintaining it subcritical under cold conditions, for all accident scenarios. In safety analysis, the two most effective of 28 shutoff units for SDS#1 are assumed unavailable. Likewise, one of six liquid poison injection nozzles for SDS#2 is assumed unavailable. Prompt criticality is not reached in accident conditions, as shown by analysis.
- The positive reactivity that would be introduced by loss of coolant accidents constitutes the only pressure-dependent reactivity effect in CANDU. The largest positive reactivity insertion would be from a large LOCA and is well within the capability of mechanical and hydraulic shutdown systems. The reactivity feedback from steam line breaks, cold or light water injection, or sudden turbine stop valve closure is negative.
- Although the void coefficient in CANDU is positive, this is not an issue for CANDU 6, in view of the following considerations:
  i) The total amount of positive reactivity involved, even upon complete voiding of the PHTS is relatively small; for the core at equilibrium, at nominal power conditions, the total reactivity introduced by completely voiding all pressure tubes in the core region is of about 15 mk (2.6 $). To put this in perspective, the normal operating control range of a CANDU is about ±7 mk. The reactivity worth of the shutoff rods in total is - 80mk. The reactivity worth of gadolinium injected by SDS#2 is -400mk.
  ii) The mean neutron lifetime is of 10^{-3} sec, so that power excursions involving the same amount of reactivity are less severe than in the case of LWRs.

iii) The use of pressure tubes permits subdivision of the core region into two separate sub-systems (thermalhydraulic loops which are isolated from each other in case of LOCA), which further reduces the amount of total positive reactivity to that introduced by complete voiding of one sub-system;

iv) The effectiveness of the shutdown system, particularly in the postulated event of a large LOCA, has been evaluated using the latest developed calculation methods and models. The revisions to the analysis methodology and input assumptions have been rather extensive and the results have confirmed that the design performance requirements of the shutdown systems are met.

- An important intrinsic safety feature of the CANDU reactor is that all neutron control devices are installed in the low-pressure moderator region, where, in case of a postulated LOCA due to a break in the headers or feeders, they are not subjected to potentially severe hydraulic forces. The moderator also provides a low-pressure environment for the control rods, eliminating the "rod-ejection" scenarios. In addition, the location of neutronics measurement devices in the moderator avoids subjecting this equipment to a hot, pressurised environment.
- Under any operating state, the CANDU 6 has a number of heat sinks. At full power, the main heat sink is provided by the four steam generators. The other heat sinks become more important when in a shutdown state or during abnormal events. This can be either through the Shutdown Cooling System (SDCS), the Emergency Water Supply System (EWS), or the Boiler Make-up water system (BMW).
- The steam generators with the Feed Water System remove reactor heat during normal plant operation. The Auxiliary Feedwater System and/or the Shutdown Cooling System removes the decay heat during plant shutdown. These systems belong to Group 1, they are designed to remove normal and decay heat and are powered by the normal (Class III, II and I) electrical power systems.
- The Shutdown Cooling System (SDCS) is designed for the full nominal operating pressure and temperature of the PHTS, so it can, if needed, be connected to the PHTS immediately following reactor shutdown, precluding the need for depressurisation after a loss of heat sink.
- Following a common mode event that may disable the above means of decay heat removal, a second independent means of decay heat removal is provided by the Emergency Water Supply (EWS) System which is powered independently by the Emergency Power Supply (EPS) System. Accordingly, the EWS and EPS Systems belong to Group 2.
- The EWS system has a function/feature known as the Boiler Makeup Water (BMW). This subsystem automatically feeds water under gravity to the secondary side of the boilers when they become depressurised following a loss of boiler feedwater. The source of BMW system is the water stored in the dousing tank.

- It should be noted that the Group 1 and Group 2 means of removing decay heat have the PHTS and the steam generators in common. Open path to atmosphere is ensured by Group 1 (ASDV) and Group 2 (MSSV) relief devices.
- The ECCS can maintain or re-establish core cooling by supplying coolant to all reactor headers. It consists of three phases: high-pressure water injection (used during the early stages of an event), medium pressure water supply from the containment building's dousing tank (used during the intermediate stages), and low-pressure water supply based on recovery from the building's sump. The ECCS is designed for LLOCA - 100% break of the largest pipe (reactor header). The discharge area is equal to twice the cross-sectional area of the pipe assumed to fail. Sensitivity analysis for the comparison of a 100% longitudinal break and a double ended guillotine break has shown very similar results, so longitudinal breaks have been modelled for all break sizes up to 100%.
- Considerations with regard to the ECCS:
  - i) the simple configuration of the individual fuel channels facilitates coolant delivery to all core locations;
  - ii) the correct performance of the ECCS does not constitute the final defence against core meltdown in case of LOCA; the accident analyses, supported by experiments, indicate that a LOCA combined with ECCS failure, though resulting in substantial fuel damage (including partial melting of the cladding) and some deformation of the pressure and calandria tubes, does not result in fuel melting; the decay heat can be removed by conduction through the walls of the pressure and the calandria tubes into the moderator, and rejection by the moderator cooling system, which can remove than 4% of the total thermal power, enough to accept decay heat indefinitely.
- The Containment System forms a continuous, pressure-confining envelope around the reactor core and primary heat-transport system. In the CANDU 6 design it consists of a pre-stressed, post-tensioned concrete structure, an automatically-initiated dousing system, building coolers, automatic isolation system and a filtered air discharge system. The containment system prevents releases of significant amounts of radioactivity to the public in the event of failure of the nuclear components of the heat transport system. The design basis event considered is any LOCA event concurrent with dousing failure. This event presents the highest potential in terms of peak pressure. However, the events related to steam systems breaks are also considered in terms of maintaining structural integrity of containment. The containment structure and all other parts of the containment boundary, are pressure and leakage tested before first criticality and leakage tested periodically thereafter.

Mitigation

- The large-volume, low-pressure, low-temperature moderator surrounding the fuel channels acts as a heat sink in LLOCA + LOECC scenarios (which for CANDU are included in the design basis), rendering negligible the risk of fuel meltdown. The pressure tubes will sag and/or strain into contact with the calandria tube where further deformation will be arrested by the cooling of the moderator system.

- In a loss of heat sink or loss of flow event (such as a total station blackout), the reactor coolant will heat up and pressurise which can cause the pressure boundary to fail. In a CANDU reactor experiencing the same initiating event the fuel heat-up in the fuel channels will cause one of the many pressure tubes to rupture, depressurising the system by blowdown into the moderator well before boiler tube might fail and before a high pressure melt ejection can occur. The pressure tubes are like fuses in this instance. Failure of one channel is sufficient to limit widespread channel failures because it results in rapid heat transport system depressurisation and induced blow down cooling. Furthermore, heat transport system depressurisation occurs well before potential formation of molten core conditions, thereby assuring that high pressure melt ejection does not exist as a containment challenge in CANDU reactors.
- A large volume of light water surrounds the calandria vessel in the calandria vault. Thus, the design ensures a passive heat sink capability which, in many event sequences, would provide significant time delays in the progression of the accident.
- Since the geometry of the CANDU core is near optimal from a reactivity standpoint, any rearrangement under severe accident conditions ensures shutdown.
- The bottom of the large calandria vessel provides a spreading and heat removal area for core debris following a severe core damage accident.

18.5 Specific consideration of human factors and man-machine interface

The reliable, stable and easily manageable operation of the CANDU reactors is facilitated by the use of a digital computer system, which offers many advantages over the human operator in terms of carrying out routine data handling, decision making and control functions.

Control Computer System functions are:
- Control/Monitoring;
- Alarm/Annunciation;
- Display/Data Recording.

Those functions for all the NSP side of the plant and part of the BOP side are accomplished via the control computer system (DCCs), which consists of two identical computers DCC-X and DCC-Y.

The control computer system is designed to work permanently with one control computer active and the backup control computer in “warm stand-by”, each computer being capable of independent and complete overall plant control. Each control computer has an availability greater than 99% which results in an availability of 99,99% for two computers system (computers, peripheral equipment and input-output interface).

The keyboards associated to the computer system have been custom designed and manufactured “on demand” and they consist of dedicated keys for specific display and numeric keys for input data. The requests for display of variables and all the requests to change the setpoints and controls can be transmitted via the display keyboard. In order to reduce the probability of errors inputs when making a request or a command two different keys shall be successively pushed (i.e. ENTER and EXECUTE).

In case of a control computer (DCC) failure, the associated contacts scanner is automatically transferred to the standby control computer in order to process the contact inputs that will generate the alarm messages on colour CRTs. The transfer can also be done manually. When both computers fail, the reactor is shutdown and the annunciation alarm windows system only will continue to provide alarms for the systems remaining in operation after reactor shutdown. The operator can determine the cause of a trip annunciated by the alarm system, both considering the displayed alarms and analysing the printed copy and comparing the information.

In addition to the information provided under Article 12, examples of operating design features that positively influence the operators’ capacity of control and action are summarised as follows.

Centralisation

The Main Control Room (MCR) design is based on the philosophy of having sufficient information displayed to allow the operator to safely control the plant. All equipments (main control panels/desks, panels for signal processing, annunciation and alarming) and information required for the safe operation of the nuclear power plant in all its anticipated (configurations and/or situations) modes of operation are centralised in Main Control Room (MCR) in order to provide an overall control of the plant.

The information related to safety systems status, along with the information referring to the other plant systems, is sufficient to allow the operator to estimate the initiation, nature and the extent of a transient or accident and to intervene in accordance with the relevant emergency operating procedures. The display of information necessary for the operator to evaluate plant status or the evolution of certain process parameters is redundant, using conventional technique as well as colour CRTs, allows correlation of information and has a high reliability. These features, together with general characteristics of display (availability, readability, accuracy, uniformity, standardisation, hierarchy) help the operator to easily understand the information.

Layout

Operator’s desk is located in the MCR, in such a manner that allows him to see all the control panels, and is provided with a keyboard and a monitor associated to the computer system which constitutes the interface between the operator and DCC.

Enough space is available in the MCR to allow access at the different control panels and free moving.

The control panels for the safety systems are grouped (in the left side of the MCR) and the process system control panels arrangement reflects the power generating and transport process from the reactor to the turbine-generator. Control panels are separated in four distinct groups:

a. Special safety system control panels;
b. NSP control panels, Steam generation and power generation control panels;
c. Control panels for the electric part and the auxiliary systems;
d. F/H (Fuel Handling) control panels.

In the layout of each system, consideration was given to the location of the controls based on process function and/or plant area, as well as to the location of the controlled elements. Complex process systems and electrical systems are displayed on mimic diagrams. The information is compactly displayed and grouped by channel and by operational function. For example, the instrumentation required to control a process is located near the instrumentation providing process information.

The control panels have been designed for “operator standing”, because of the low number and frequency of manoeuvres that the operator has to perform from these control panels. Operator’s desk and F/H panels are designed for “operator sitting down”.

The annunciation windows are located on the upper part of the control panels which is slightly inclined to the operator; the indications, CRTs, Auto/Man stations of the loop controllers and sometimes certain control devices are located on the central part of the panel; the control devices (handswitches) are located on the panel’s desk.

Annunciation devices

Annunciation is made in the MCR directly or on local panels, which transmit to MCR bulk alarms. Process parameters exceeding specified limits, equipment failures and actions not accomplished or incomplete are annunciated. The alarm annunciation setpoints for the situations that need operator’s intervention are set so that the operator has sufficient time to react to the alarm conditions.

In order to select the alarms by importance, the following classification was made:
- centralised alarms in the MCR;
- local alarms in the field with a regrouped alarm provided in the MCR.

The MCR alarm annunciation system consists of: two colour CRTs (located on the main control panel) for alarm messages annunciation, a facility to provide a printed record of all alarm messages (on a system basis or for the entire unit, with sufficient information to enable them to be arranged in the chronological order of their occurrence to provide the sequence of events) and alarm windows located on different MCR panels. It also provides Hand-Switches Off-Normal annunciation on corresponding MCR panels.

Types of displays available on demand on monitors:

- bar charts;
- graphic trends;
- status displays;
- special displays;
- numerical variable displays;
- liquid zones displays;
- simplified process diagram displays;
- process limits and setpoints displays.

The format of the display is adequate to the task and helps the operator to determine the faults in case of an event. For example, the bar charts allow comparison between parameters, the graphic trends allow the analysis of a parameter evolution, and status display gives an overview upon systems and equipments.

Alarm windows and control panels in MCR are normally free of visual annunciation in normal mode of operation, this helping the MCR operator to identify any discrepancy or abnormal situations by the presence of annunciation from alarm windows, from Off-Normal annunciation or from discrepancies lights. Centralised alarms are selected by priority. Operator’s attention will be caught by the priority through a colour code. Alarm windows annunciate reactor trip, setback, stepback, turbine generator trips, high voltage breaker trips as well as any other relevant process alarms. The alarm windows are grouped and they correspond with system allocation on panels. Audible annunciation is also provided in association with the visual annunciation.

The annunciation system has been designed to be flexible, by allowing the suppression of low importance alarms during major events in order not to distract the operator’s attention.

Labelling

Inscriptions (labels) on the alarm windows and the alarm messages displayed on annunciation CRTs have been elaborated in two stages: first the system engineers have created them, and then they have been passed through a process of standard and suggestive abbreviation.

There have been taken a number of measures in order to optimise the balance between the lack of space and the necessity of having explicit inscriptions, as well as to reduce the need of consulting the operating manuals:

- the labels are colour coded function of the systems they refer to: safety systems, process systems and power supply classes;
- the labels are located under the equipments;
- the texts are comprehensible, with minimum abbreviation; the abbreviations have an unique sense (so that there is no coincidence between two abbreviations coming from different texts).

Control devices

The components of the control devices are characterised by function, operating mode, aspect and reliability.

Generally, control elements are located on MCR panels so they can be easily operated, their position being correlated to the indicating devices (which sometimes confirm the action), located at operator's eye level.

The most important control devices are located in the middle of the panel. As much as possible, handswitch position succession is standardised. The handswitches are integrated in the mimic diagrams where practical. When they are not integrated in the mimic diagrams they are grouped on a system/equipment basis. Button type control devices are arranged based on the operation sequences, usage frequency and priority. The buttons that should not be activated by mistake are provided with protection, by being physically separated or protected by lids.

All the above-mentioned measures are meant to provide a support for the operator so he can maintain the skills acquired during training.

Secondary Control Area

In case of DBE (Design Basis Earthquake) or MCR unavailability, the safe shutdown condition of the plant is maintained from the Secondary Control Area (SCA). SCA provides the necessary controls and indications in order to accomplish the following safety functions:

1) shutdown the reactor and maintain it in a safe shutdown state for an indefinite period;
2) remove decay heat from the reactor core and thus prevent any subsequent process failure which might lead to the release of radioactivity to the public in excess of allowable limits;
3) maintain a containment barrier against radioactive release;
4) display of post-accident parameters in order to enable the operator to assess the state of the Nuclear Steam Supply System (NSSS).

The equipment necessary to initiate and monitor the shutdown of the reactor and the cooling of the core is kept in four seismically qualified control panels. The SCA panels contain the controls and indications for the following main parameters and systems:

- Emergency Core Cooling System;
- Moderator temperature;
- PHT temperature;
- SG level and pressure;
- Emergency Water System;
- Dousing system;
- Containment Isolation system.

Controls, indications and alarm windows are provided for SDS#2 and a SDS#1 trip pushbutton is also provided. The reactor is maintained in a safe shutdown state by an interlock between SDS#2 and the poison extraction system.

Manual actions

The design ensures that the number of operator actions that need to be performed on a short time scale is kept to a minimum. All special safety systems actions following an initiating event are performed automatically. All automatic actions have the capability of being initiated also manually, from the MCR and SCA. The manual actions credited in the accident analysis are assumed to occur not earlier than 15 minutes after a clear and unambiguous information (alarms) requiring operator action has been received.

ARTICLE 19 - OPERATION

Each Contracting Party shall take the appropriate steps to ensure that:

(i) the initial authorisation to operate a nuclear installation is based upon an appropriate safety analysis and a commissioning programme demonstrating that the installation, as constructed, is consistent with design and safety requirements;

(ii) operational limits and conditions derived from the safety analysis, tests and operational experience are defined and revised as necessary for identifying safe boundaries for operation;

(iii) operation, maintenance, inspection and testing of a nuclear installation are conducted in accordance with approved procedures;

(iv) procedures are established for responding to anticipated operational occurrences and to accidents;

(v) necessary engineering and technical support in all safety-related fields is available throughout the lifetime of a nuclear installation;

(vi) incidents significant to safety are reported in a timely manner by the holder of the relevant licence to the regulatory body;

(vii) programmes to collect and analyse operating experience are established, the results obtained and the conclusions drawn are acted upon and that existing mechanisms are used to share important experience with international bodies and with other operating organizations and regulatory bodies;

(viii) the generation of radioactive waste resulting from the operation of a nuclear installation is kept to the minimum practicable for the process concerned, both in activity and in volume, and any necessary treatment and storage of spent fuel and waste directly related to the operation and on the same site as that of the nuclear installation take into consideration conditioning and disposal.

19.1 Description of the licensing process for commissioning and operation

The general licensing process has been described under Article 7. This section only provides additional information, specific to the licensing process for the stages of commissioning and operation.

19.1.1 Commissioning

Regulatory requirements and licensing process for the commissioning stage

In compliance with the requirements established by the regulation Nuclear Safety Requirements (NSR) - Nuclear Reactors and Nuclear Power Plants, the main document based on which the Commissioning License is issued is represented by the Final Safety Analysis Report (FSAR) - which includes the following:

- updates on technical evaluation/assessment performed at PSAR stage;
- the results of the environmental monitoring program on site and the surrounding areas;
- a description and analysis of the structures, systems and components of the installation, with emphasis upon performance requirements, the technical justification of their selection and the evaluation required showing that the safety functions will be accomplished;

- the types and quantities of radioactive materials expected to be produced during operation and the means provided for controlling and limiting the radioactive effluents and the associated radiation exposures;
- the organisational structure, including the responsibilities and authorities, and personnel training programmes;
- managerial and administrative controls to be used to ensure the safe operation of the facility;
- plans, programs and procedures for pre-operational testing and initial operation;
- plans for conduct of the normal operation, including maintenance, surveillance, and periodic testing of structures, systems and components;
- emergency plans and emergency preparedness arrangements.

General regulatory provisions, focused on the quality management of the commissioning activities, are given in the regulation "Specific Requirements for the Quality Management Systems Applied to the Commissioning Activities of Nuclear Installations" (NMC - 09).

CNCAN also establishes detailed requirements with regard to the licensing deliverables needed to demonstrate compliance with nuclear safety requirements, for each milestone of the commissioning stage. The licensing deliverables are constituted by the documentation that is submitted to CNCAN as support of the licensing applications, including the applications for the approvals associated with each of the milestones. The milestones of the licensing process are given as follows.

Phase A Milestones

Pre-operational and Operational testing:
- Acquire and store D2O – AD;
- Moderator D20 Fill – MD;
- Reactor Building Leak Rate Test – LT;
- Acquire and Store Nuclear Fuel - AF;
- Hot Conditioning of the Heat Transport System - HC;
- Power Failure (Loss of Class IV Power) – PF;
- Load Fuel – LF;
- PHT Fill with D2O – HD;
- Hot Performance Tests with D2O – HP.

Phase B Milestones

Tests at Low Power:
- First Reactor Criticality – CR

Phase C Milestones

At Power Testing:
- Power Increase to 5%FP - PI
- Power Increase to 25% (PP1), 50% (PP2), 75% (PP3) and 100%FP (PP4)
- Tests at Full Power Operation (FP)

For the commissioning stage of each of the Cernavoda NPP units, a licensing schedule was established, including the provision of separate approvals for each licensing milestone, based on the appropriate support documentation. Based on the experience gained during the commissioning of Unit 1, a similar process was used also for Unit 2, with regard to both the activities of the commissioning organisation and the regulatory activities for review and inspection. Based on the experience gained and practices used by CNCAN during licensing process of Cernavoda 1 NPP, more detailed requirements for various licensing milestones have been established for Cernavoda 2 NPP. Since the processes followed for the commissioning of Units 1 and 2 of Cernavoda NPP are very similar, the information provided in this section is applicable to both units, unless specified otherwise.

Overview of the Commissioning Programme

The commissioning Programme for Cernavoda NPP, consisted of comprehensive plant systems functional and operational tests and integrated tests. The main objective was to confirm that the entire plant is ready for normal full power operation as designed.

Principal safety functions and requirements for the safety related systems, structures and components are documented early in the design process, in Safety Design Guides (SDGs), as mentioned under Article 18. SDG-001 presents a list of all systems and structures deemed to have a safety function, and for each instance an explanation is given as to what the safety function is included in the design. From there, SDG-001 lists the high level safety requirements that are imposed in order to ensure effectiveness of the specified safety function.

With the SDG-001 giving high-level safety design requirements, other project documentation specifies more detailed requirements. Examples of such project documentation include other SDGs, design guides, design manuals, program specifications, safety (thermal-hydraulic, stress, reliability) analysis reports, manufacturer’s manuals, etc.

Commissioning Specifications and Objectives (CSOs), which include Safety Objectives, define the system commissioning requirements necessary to assure that sufficient checks and tests are performed to demonstrate that the plant systems comply with the applicable design, safety and regulatory requirements. Unit 2 CSOs incorporated the relevant Key Commissioning Objectives (KCOs) developed during Unit 1 commissioning.

The Unit 2 FSAR has been reviewed by CNCAN and approved in May 2006. Chapter 14 of the FSAR contains the general objectives and major tests to be performed during the commissioning process. The Commissioning Licence has been issued in October 2006. Compliance with the Commissioning License conditions and requirements has been assessed throughout the entire commissioning process by inspections, verifications and evaluation of relevant documentation (operating limits and conditions, abnormal operating procedures, operating procedures, unplanned events reported to CNCAN, etc.).

The commissioning programme was conducted on a milestone basis in parallel with the Licensing Programme agreed with CNCAN. Each milestone was achieved, and documented processes were set in place to demonstrate that:

- the testing activities were well defined and clearly detailed and the objectives of the tests were well established, in such a manner that the equipment and systems are placed in service, design specifications confirmed, and safety assumptions validated.
- the testing activities were scheduled, reviewed and performed without jeopardizing at any time the plant safety, and the status of the plant was appropriate for the corresponding commissioning activities.
- the process of test results evaluation provided assurance that all the applicable assumptions and conclusions included in the safety documentation were adequately demonstrated.
- all the required operating documentation including baseline data collection forms for systems and components was prepared and available to the operating personnel.
- test records essential to demonstrate that commissioning activities have been performed in accordance with specified requirements were collected, assembled, validated and filed to storage by the Operations Document Control Centre, as a part of the individual system commissioning packages.
- the Commissioning test results together with the process in place to review, evaluate and approve them, referred to as Commissioning Completion Assurance (CCA), were used to obtain approval to proceed beyond the licensing milestones and release hold points agreed with CNCAN.

All of the above were sustained by a framework of processes described within the following procedures:

- System Commissioning Procedures;
- Standard Commissioning Procedures;
- Commissioning Records and Files;
- Transfer of Operating Control to Shift Crews;
- Commissioning Completion Assurance (CCA);
- Commissioning Technical Process;
- Commissioning Planning Process;
- Commissioning Reports;
- Commissioning Specifications and Objectives;
- Work Permit and Equipment Guarantee System during Commissioning;
- Temporary Modifications during Commissioning Prior to Fuel Load;
- Temporary Modifications during Commissioning after Fuel Load;
- Commissioning Execution Process;
- Operating Manual Tests;
- Work Request System;
- Work Plans;
- Operating Flowsheet Preparation;
- Operating Manuals;
- Commissioning Temporary Operating Procedures;
- Preparing, Issuing and Revising Commissioning Program Documents and Directives;
- Document and Template Management;

- Commissioning / MT Engineering Interface;
- Integrated Commissioning Tests Coordination;
- Commissioning Unplanned Event Reports (CUERs).

The Commissioning Program Phases and Objectives are summarised in the Table 19.1.

Commissioning Programme Phases	Main Objectives
Commissioning Phase A Pre operational Testing Hot conditioning Initial fuel loading Zero Power Hot Functional Testing	• To verify the adequacy of plant design and prepare the plant systems and equipment for power operation • To confirm that critical parameters and system performance are as designed before taking the plant to high power • To test systems to meet jurisdictional requirements • To operate the systems in the pre-power mode and demonstrate their operability • To load the initial fuel charge • To obtain baseline data for systems and component performance
Commissioning Phase B Initial criticality and Low Reactor Power Physics Testing	• To confirm reactor core and reactivity mechanisms configuration as per design • To confirm the effectiveness of both shutdown systems • To confirm the neutronic instrumentation performance • To confirm reactivity coefficients applicable to the reactor at low power • To validate reactor core model • To demonstrate the adequacy of the Reactor regulating System
Commissioning Phase C (at power testing)	• To commission feed water, turbine, main generator and auxiliaries • To confirm that under both steady state and upset conditions, reactor and balance of plant parameters behave as per design • To demonstrate that plant can be safely operated at any power level up to full power under expected normal and abnormal operating conditions

After completion of system by system commissioning in phase A and with appropriate systems turned over to Operations, nuclear operation began with the first approach to criticality of the reactor and subsequent low power testing.

The main purpose of these tests was to detect and correct any problems related to design, fabrication or installation of equipment and instrumentation that could affect the optimal operation of the reactor or could result in the reactor being operated in an unanalysed configuration (i.e. in a state not covered by the safety analysis). Also, because of these concerns, the following checks were made:

- the reactor regulating system performance at low power;
- the performance of reactor shutdown systems;
- the fundamental characteristics of the reactor core by reactivity and flux distribution measurement and assessment.

All the prerequisites for the approach to criticality were fulfilled. In other words, all the required systems for the start-up of the reactor were available and in an operational state. This included both reactor shutdown systems.

Prerequisites for performing a test were specified in each individual test procedure. The sequence of testing was outlined in start-up test sequences, such that required prerequisite testing was completed prior to performing a subsequent test. Any special test instruments required were specified to be installed, calibrated and checked in the test procedure that specified the test equipment. Where these test instruments were not for future use, they were removed from the systems and systems returned to their normal states.

A special procedure was set-up to issue a "Summary Test Report" (STR) by each commissioning engineer after each test of power step of Phase B (or C). The purpose of the STRs was to assure that:

- The Phase B or C or power step of Phase C commissioning program clearly demonstrated that the systems involved met their design intent.
- The results of the commissioning program showed that the systems involved operated within the limits and according to the performance stated in the Safety Report.
- The plant could go into the next phase or power step of Phase C.

Through the review processes set in place for the verification and assessment of the Commissioning Test results it was ensured with reasonable confidence that all the objectives were met and the assumptions and conclusions from the safety support documentation were adequately demonstrated during Phase B Commissioning.

Examples of phase B tests:

- SDS#1 trip test;
- SDS#2 trip test;
- Power manoeuvres to verify RRS response;
- Stability check of Average Zone Level;
- Reactivity calibration of Liquid Zone control System;
- Transfer of RRS control from DCCX to DCCY and back;
- Manual stepback test;
- Reactivity calibration of Adjuster Absorbers, mechanical control absorbers, shut off rods and moderator poison addition system;
- SDS#1 and SDS#2 Ion Chamber shutter speed;
- Confirm response to loss of RRS at low power.

Examples of phase C tests:

- Transport System parameters at various power levels;
- Complete HTS LRV Hot Stroke Timing Tests;
- Functional Test of DCC restart and transfer of control at 2% FP;
- Complete thermosyphoning test on Main Heat Transport System;
- Dual Computer Failure Test at 15%FP;
- Monitor Solid Control Absorber System response to the dual DCC failure;

- Monitor system response to dual DCC failure;
- Load Rejection Test at various power levels;
- Loss of class IV test;
- SDS#1 and SDS#2 trip tests.

Regulatory Surveillance Programme

The detailed programme for tests to be performed on a system by system basis and for integrated tests for all phases has been elaborated by the licensee and submitted to CNCAN for review and approval. The programme, including specific safety objectives and acceptance criteria has been reviewed for compliance with design intent and safety analyses and approved by CNCAN. From this programme, safety relevant tests have been selected to be witnessed by CNCAN inspectors and included in the regulatory surveillance programme (RSP).

CNCAN programme for surveillance of the commissioning activities for Unit 2 included more than 180 Witness Points (WP) for all the phases of the commissioning programme. The Hold Points (HP) coincided with the licensing milestones. The distribution of the regulatory WPs for each of the commissioning phases is given in Fig. 19.1.

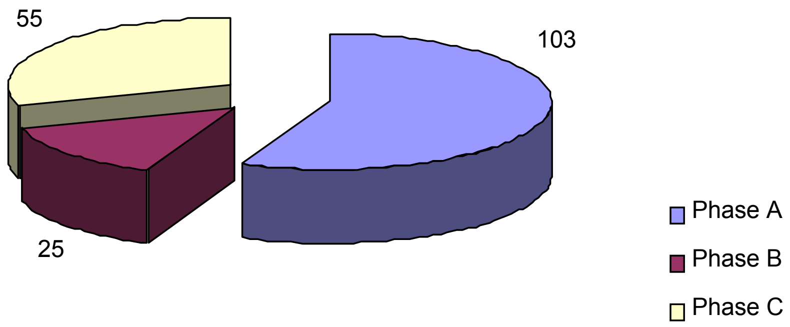


Fig. 19.1 Distribution of CNCAN Witness Points (WP) for the commissioning phases (Unit 2)

During the commissioning stage, the regulatory authority granted the following permits/approvals:

- permit to load fuel;
- permit to load D2O in the Primary Heat Transport System;
- permit for the first criticality;
- permit for power increase up to 5% FP;
- permits for power increase in stages, up to 100% FP.

Before granting each of these permits, CNCAN inspectors performed comprehensive inspections and verification of documentation related to the status of construction and commissioning activities for systems important for safety, as well as verification of results of important tests like reactor building leak rate test, channel flow verification, loss of class IV power supply, loss of both digital control computers, thermosyphoning test, etc.

As an example, with regard to the assessment of the project status for the first criticality, the licensee submitted to CNCAN, in compliance with the Commissioning Licence conditions, a report regarding the plant status, containing a detailed review of all scopes of work that have an impact on the plant readiness for criticality. The results of the review had to demonstrate that the activities have been completed as necessary for ensuring safe and reliable plant operation. This report was submitted to CNCAN in support to the application for the permit for reaching first criticality. The report took into consideration the following activities:

1. Systems, structures and equipments turnover from Construction Department to Commissioning Department, clarification of deficiencies, completeness of as-built documentation;
2. Systems, structures and equipments turnover from Commissioning Department to Execution/Operations Department;
3. Commissioning activities;
4. Clarification of deficiencies;
5. Design changes;
6. Radiation protection program (procedures, preparing, equipment);
7. Reference Documents and Station Instructions;
8. Personnel training (based on the minimum training requirements);
9. Training manuals (elaboration and approval for use);
10. Chemical control (safety related systems);
11. Quality management system;
12. Physical protection;
13. Operating manuals (preparation, approval and acknowledgment);
14. Operational flowsheets (revised);
15. Operating manual tests (preparing, approval and acknowledgment);
16. Call-ups and routines (elaboration, approval, acknowledgement);
17. Maintenance programmes and procedures (elaboration, approval, acknowledgement);
18. Housekeeping and housecleaning (equipments, systems, buildings, site), etc.

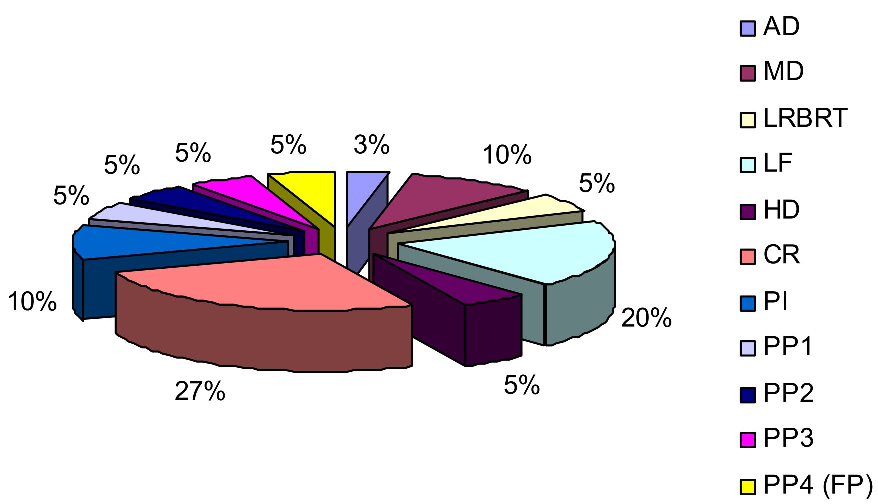


Fig. 19.2 Distribution of the safety documentation evaluated by CNCAN staff for each of the main licensing milestones up to date (Unit 2)

The adequacy of the commissioning tests was judged based on the review of the test results, which have to demonstrate that all the relevant requirements and procedures have been observed and that safety objectives and acceptance criteria are met. The review of acceptance criteria formed part of the review of the document containing specific commissioning safety objectives and acceptance criteria for all safety related systems, which has been approved by CNCAN well in advance of the actual tests performance. The commissioning test results were listed in the commissioning completion assurance reports (CCA) containing a comparison to the acceptance criteria.

The regulatory surveillance plan (RSP) enabled CNCAN to effectively control step by step the commissioning process to verify that the plant, as built, meets the design safety requirements.

Meeting of Pressure Vessel Authority (ISCIR) requirements was a prerequisite for obtaining the licences and permits issued by CNCAN. The reactor coolant pressure boundary was subject to a pre-operational hydrostatic test and leakage test. Periodic inspection consists of visual inspections, surface inspections, volumetric inspections, integrative inspections, dimensional inspections, etc., in compliance with the provisions of CAN/CSA-N.285.4 and CSA-CAN3-N285.0.

19.1.2 Trial Operation

The trial operation license for Cernavoda Unit 1 was granted by CNCAN based on the first revision of the Final Safety Analysis Report, which included the results of the commissioning phase (commissioning reports conclusions, the achievement of key commissioning objectives, etc.). Also, some other documents regarding the assessment of significant changes from safety point of view and the status on the implementation of different station programmes were submitted to CNCAN as support documentation for the license. Summary of these station programmes is presented below:

- Nuclear Safety Policy;
- Reliability Programme;
- Unplanned Events Assessment Programme;
- Safeguards Programme;
- System Surveillance Programme;
- Radiation Safety Programme;
- Radiation Waste Management Programme;
- Effluent and Environmental Monitoring Programme;
- ALARA Programme;
- Emergency Preparedness and Response Programme;
- Fire Protection Programme;
- Quality Assurance Programme;
- Training Programme;
- Design Modification Control Programme;
- Periodic Inspection Programme;
- Maintenance Programme;
- Housekeeping Programme;

- Safety Analyses Strategic Programme.

The target date for issuing the Trial Operation Licence for Unit 2 is September 2007. A revision of parts of the Final Safety Analysis Report including commissioning phase results has to be submitted and approved by CNCAN. The implementation status of station programs mentioned above will also be verified for Cernavoda Unit 2.

19.1.3 Operation

For the first operating licence, Cernavoda NPP, Unit 1, has prepared a second update of the Final Safety Analysis Report, to include the main results obtained during the trial operation period.

The reports on the design modifications and the status of the station programs were updated. A special focus was directed to the assessments of the unplanned events and the major objectives during that period, as for example the annual planned outage.

The operating license has then been renewed every two years, as required by the current licensing process. The main support documents based on which the license was granted were the revisions of FSAR which included all the design changes implemented in that period. Also, the applications contained descriptions of the major plant processes including the surveillance, configuration management, preventive maintenance, training, etc. and the implementation status of the actions required by CNCAN.

Currently, Final Safety Analysis Report (FSAR) of Cernavoda NPP Unit 1 is reviewed and updated every two years, unless otherwise required by CNCAN in an official letter, typically related to operator's request for NPP modification. The updated FSAR is submitted to CNCAN and includes mainly the following aspects:

- new or updated safety analyses using current best-estimate methods and information;
- design and procedural changes;
- results of self-assessments;
- changes of plant procedures;
- the status of the plant programmes with regard to:
    - ·physical condition of the nuclear power plant;
    - ·nuclear safety policy;
    - ·control of modifications;
    - ·systems surveillance;
    - ·strategic plan for renewal of nuclear safety analyses;
    - ·ageing and environmental qualification;
    - ·radioprotection;
    - ·environmental impact;
    - ·organisation and administration;
    - ·shift structure for maintenance and operating personnel;
    - ·plant personnel training;

- ·periodic inspections;
- ·systematic revision of spare parts;
- ·preventive maintenance;
- ·development of the PSR programme;
- ·emergency planning;
- PSA results.

Based on the results of the surveillance program and periodic review of safety performance, the station established a set of safety performance indicators, which are reported monthly to the station management. Also, the safety performance is reported quarterly to the regulatory authority via Quarterly Technical Reports (QTR). The fourth QTR presents a safety performance review of the past year.

As per regulatory requirement, Quarterly Technical Reports present also monitoring results regarding:

- reliability and reactor safety;
- station performance;
- production summary and outages;
- station operations (plant upsets, reactor performance and fuel management, core monitoring);
- reportable events (description, root causes, corrective actions and recommendations);
- plant changes;
- nuclear fuel;
- heavy water management;
- controlled radioactive sources management;
- radioactive material transportation;
- radiation control & employee safety;
- radioactive waste management;
- radioactive effluents;
- environmental monitoring;
- alarms;
- fire protection;
- reactor safety assessment;
- special safety systems;
- standby safety systems;
- human resources/training;

CNCAN staff performs a daily check of plant status by means of daily reports issued by CNCAN resident inspector and Shift Supervisors Log made available by the licensee.

19.2 Operational Limits and Conditions

In compliance with the provisions of the regulation Nuclear Safety Requirements (NSR) - Nuclear Reactors and Nuclear Power Plants, the FSAR includes a chapter with the technical limits and conditions for operation, established on the basis of the analyses and evaluations included in the FSAR and amendments thereto. In accordance with the above mentioned regulation, the technical limits and conditions include items in the following categories:

a) Safety limits and the setpoints for actuation of the safety systems;
b) Limiting conditions for operation;
c) Surveillance requirements (relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within safety limits, and that the limiting conditions for operation will be met);
d) Design specific features (those features of the installation such as materials of construction and geometric arrangements, which, if altered or modified, would have a significant effect on safety and are not covered in categories described in paragraphs a), b) and c) above);
e) Administrative controls (relating to organisation and management, procedures, recordkeeping, review and audit, and reporting necessary to assure operation of the facility in a safe manner).

The OLCs are derived from the safety analysis included in the Chapter 15 of FSAR and are approved by the CNCAN as part of the Operating License. Chapter 16 of the FSAR is dedicated to the description of OLCs and of their technical bases. The licensee cannot change the OLCs them without prior approval of the Regulatory Authority.

A fundamental requirement of nuclear safety is to operate and maintain the nuclear power plant within a defined "safe operating envelope" in accordance with the design intent and the licensing basis. The safe operating envelope is defined by the Final Safety Report. Specific operating limits as resulted from the "safe operating envelope" are added to the safety limits as defined by the safety evaluations.

The "safe operating envelope" is defined by a number of safety requirements from which the most important are:

- Requirements on special safety systems, and safety related standby equipment or functions, e.g. set points and other parameters limits, availability requirements.
- Requirements on process systems, e.g. parameter limits, testing and surveillance principles and specifications, including performance requirements under abnormal conditions.
- Pre-requisites for removing special safety systems and other safety related or process standby equipment from service.

The safe operating envelope is implemented by means of the OLCs, which are included in the set of operating documents consisting of Operating Policies and Principles, Impairments Manual, Operating Manuals and Operating Manual Tests. These operating documents support the fulfilment of the Operating Licence conditions and ensure that the plant will be operated in safe conditions.

As it is the case with the majority of CANDU units around the world, Cernavoda NPP Units have the Operating Policies and Principles (OP&P) as the top tier document in the hierarchy of operating documentation, establishing the safe envelope the plant must be operated within. This document states operating rules, principles and limits to maintain the plant in a safe analysed state. It also rules the interface between plant management and regulatory body. The OP&P document contains safety systems licensing limits, basically defining minimum system configuration to meet availability targets and to ensure the integrity of the physical barriers against radioactive releases.

The Impairments Manual provides further assistance for the operator to determine system availability. The Impairments Manual contains also the required actions to be taken for various safety systems or safety related systems impairments that render those systems less than fully capable to perform their functions as per design.

For Special Safety Systems, which are dormant systems, specially designed to protect the public from radiological risk, a hierarchy of three levels of impairment has been defined with “Level 1” being the most severe and “Level 3” the least severe. For each level of system impairment specific actions are designated. Alarms have limits conservatively chosen to early alert the operator when impairment limits are challenged.

All operating personnel directly responsible for the conduct of operations are subjected to a rigorous selection, training and examination process to acquire and demonstrate the necessary knowledge and skills. An integral part of the training programme (that is presented in detail under Article 11) consists of specially designed training courses to explain the rationale for all OP&P limits and conditions. All modifications to plant design and/ or approved limits include, prior to their implementation, the provision of appropriate operator training on the changes and their effect. All changes to OP&P are approved by CNCAN and any OP&P limit or condition violation is an event reportable to CNCAN.

The OP&P is periodically reviewed and updated as necessary, based on the results of the latest safety assessments performed, operating experience feedback and various modifications (including organisational changes and modifications to plant systems, processes and procedures).

19.3 Procedures for normal operation

The operating licence issued by CNCAN includes specific references to documents such as Operating Policies and Principles, Maintenance Philosophy and Program, Integrated Management Manual. All these documents include, directly or by reference to appropriate procedures, rules that must be followed in performing activities related to operation, maintenance, inspection and testing.

The compliance with the requirements included in the operating licence and in the documents specifically referenced by this document is mandatory for the licence holder and any deviation must be timely reported to CNCAN.

The OP&P contain the general policies and limits that govern the operation of the station and the responsibilities of operating personnel. The OP&P is not as detailed as other operating procedures (e.g. systems Operating Manuals). However, it includes rules according to which the operating activities have to be authorised.

Consequently, compliance with the articles of the OP&P ensures that, in the event of an expected or unforeseen situation, operation will be managed with a minimum of adverse effects. The OP&P does not apply only to personnel performing operating manoeuvres, but to all personnel taking part in the operation of the station. Therefore, the rules established by the OP&P must be known and complied with by members of all services and administrative units working at the site.
One of the main responsibilities of the Shift Supervisor is to ensure that station activities comply at all times with the OP&P, especially in situations that are not covered in operating manuals. To assist him, the Control Room Operator is also qualified to make a judgment.

OP&P require that Special Safety Systems and the other safety related systems are subjected to regular testing where their reliability or effectiveness cannot be inferred from normal operating experience. Test intervals are consistent with reliability evaluations contained in current licensing submissions. The station Surveillance Programme satisfies this requirement. The Surveillance Programme includes planned activities carried out to verify that the plant is operated within the prescribed operational limits and conditions, and to detect any deterioration of structures systems and components that could result in unsafe conditions.

These activities can be categorised as:

- Monitoring plant parameters and system status;
- Checking and calibrating the instrumentation;
- Testing and inspecting structures, systems and components;
- Test results evaluation.

The aim is to verify that provisions made in the design for safe operation and confirmed during construction and commissioning, continue to be adequate throughout the lifetime of the plant. At the same time, the verifications are aimed at ensuring that the safety margins are both adequate and provide high tolerance for anticipated operational occurrences, errors and malfunctions. The Surveillance Programme is defined in a Reference Document type of procedure and is detailed and supported by a number of Station Instructions that cover mandatory testing, preventive maintenance and inspections.

Detailed procedures are prepared to cover all normal, abnormal and emergency conditions. The OP&P document specifies the operating boundaries that are an integral part of the written instructions to operators, and the authorities of the station staff. Safety margins are provided for all limits by means of staggered alarms designed to maintain high confidence that OP&P limits are not exceeded during plant transients from normal operation or in the event of a plant system breakdown.

All normal operating procedures (including systems Operating Manuals) are controlled and approved instructions that support the operational strategy for preventing unsafe conditions of the plant. The alarm response procedures (ARM, WARM, and FARM) are instructions for the anticipated abnormal occurrences; their strategy is to provide the necessary instructions to limit the transient frequency.

The majority of procedures are written in English since station annunciation is in English, but decision was made to translate procedures for selected areas or systems. Appropriate training was provided to all the originators, procedure reviewers and users. Where procedures are available both in English and Romanian, priority is given to the Romanian version if differences exist. All station personnel must follow applicable procedures and the necessary approvals must be obtained prior to any deviation from any procedure.

Plant equipment and controls in the main control room are only operated by operators licensed by CNCAN or under the direct supervision of these operators. Continuous training and refresher training including full scope simulator guarantees that the level of knowledge and skills is adequate to support safe plant operation under both normal and upset conditions. Standards are set and expectations are communicated by plant management in various types of documents. All are reinforced during periodical evaluations including simulator training sessions, coaching and observation.

The set of operating procedures for Cernavoda NPP includes documents in the following categories:

- Operating Manuals (OM);
- Annunciation Response Manuals (ARM);
- Window Alarm Response Manuals (WARM);
- Field Annunciation Response Manuals (FARM);
- Standard Operating Sequences (SOS);
- Overall Unit Operating Manuals (OUOM);
- Abnormal Plant Operating Procedures (APOP);
- Emergency Response Operating Manual.

Initially, the operating procedures were developed by the Technical Department using equipment/ systems specifications from design manuals, guides and safety requirements, for all station systems. In the last years the decision was made to format all operating documentation using INPO guides, and a new dedicated procedure writing group was organised as part of the Operations Support Group.

All individual system OMs include references to station OP&P for easy access to all limits applicable and reflect the limitations specified in the OP&P. They include also normal and some abnormal operating procedures. The process is described by the station procedure “Operating Manual Content”. The same document describes the format for the Annunciation Response Manuals since they are derived from the original Operating Manuals as alarm and operator actions to stabilise and troubleshoot the individual systems.

Temporary operating instructions (OI) are issued anytime a change is needed in one of the OM’s until a new revision is in place, or to provide operators with information for new systems/ equipments, in the absence of an OM. The OIs are reviewed periodically to maintain the validity and cancelled when no longer required.

Standard Operating Sequences (SOS) were developed for jobs of a recurrent nature and with a certain degree of complexity to justify the use of a standard document.

For specific situations such as plant start up and shut down or plant upsets, the coordination between various system operation is provided in the form of Overall Unit Operating Manual (OUOM) which is a PERT diagram representation of the necessary steps or procedures (from systems' OMs) to be performed for a particular plant state to be reached.

All plans shall include hazards and contingency actions for any adverse situations that may develop from the sequence of steps/ events to be performed. CNCAN approval is also necessary for activities that may challenge safety envelope as stated in OP&P document. Multiple layers of reviews and approvals are built in to process of developing non-routine activities.

The process, including detailed steps of preparation, review, safety and operational screening and approvals, including those by Station Manager and CNCAN, is described in the station procedure governing the Work Plans.

Information on the surveillance programmes and the associated procedures has been provided under Article 14, section 14.3.2.

19.4 Response to anticipated operational occurrences and accident situations

Specific station procedures are in place, that have been designed to mitigate the effect of the abnormal event initiator and direct the operator to bring the plant to a safe state that usually is defined as cold shut down state. The response to anticipated operational occurrences and to accidents is controlled through a hierarchical system of station procedures as follows:

- Operating Manuals - include procedures used by the plant operation staff during routine operation of the nuclear power plant and its auxiliaries and information regarding the alarm functions associated with the plant systems (set points, probable cause, operator response, etc.);
- Impairment Manual - includes actions to be taken by the operator in case that operation is close to or getting outside the specified limits of the safe operating envelope;
- Abnormal Plant Operating Procedures - which direct the operator during accident conditions and are designed to restore the plant to a safe condition and ensure protection of the health and safety of the plant personnel and the general public;
- Emergency Response Operating Manual - includes operator's actions in case of medical, chemical, fire or on-site radiation events.

Administrative procedures are in place to express the management expectations for the operating crew when dealing with plant transients, aiming to eliminate confusion and obtain consistency in crew performance. These documents set responsibilities and give authority to licensed personnel to recognise the abnormal event and deal with its consequences.

When a transient occurs, it is Shift Supervisor's responsibility to recognise situations that may cause OP&P or licence violations and / or a threat to plant safety or to personnel. Crew response to transient is defined in station procedure “Transient Response Strategy”, and it is declared that the transient ends when the unit is in a known and stable state.

Abnormal Plant Operating Procedures (APOPs) are designed for predefined design basis accidents, when safety functions are challenged, and are referred to as event-based type of procedures. The initial diagnosis of the event is of major importance and requires extensive operator expertise to recognise specific symptoms. The process is described in a specific station instruction. While the APOPs E01 to E10 are event based, APOPs G01 and G02 are symptom based.

The list of APOPs is provided in the Table 9.2.

Document name	Document title
APOP-000	SS/ CRO Transient Response Strategy
APOP-E01	Dual Computer Failure
APOP-E02	Loss Of Feedwater
APOP-E03	Loss Of Instrument Air
APOP-E04	Loss Of Service Water
APOP-E05	Loss Of Class IV Power
APOP-E06	Large LOCA
APOP-E07	Small LOCA
APOP-E08	Steam Generator Tubes Failure
APOP-E09	Partial Loss Of Class IV Power
APOP-G01	Generic Heat Sink (MCR)
APOP-G02	SCA Operation
APOP-E10	Very Low Suction Bay Level

The Emergency Response Operating Manual includes procedures to deal with the following type of emergencies:

- Radiological;
- Medical;
- Chemical;
- Fire;
- Extreme weather conditions;
- Spent fuel transfer/ transport incidents;
- Spent fuel bays and spent fuel dry storage facility incidents;
- Loss of Main Control Room.

This manual provide the necessary criteria to classify the emergency and easy access to each of the sections containing the necessary measures to be taken for the different types of emergencies. The overall process is governed by the on-site Emergency Plan.

Development of Severe Accident Management Guidelines (SAMG)

Based on the generic CANDU Owners Group (COG) SAMG development & implementation guides, Cernavoda NPP established its strategy in order to develop and implement station specific SAMGs and associated tools (diagnostics, computational aids, background documents). An assessment of human resources needed to support this process has been made for each of the main activities foreseen in this strategy.

Preparation of plant-specific SAMGs will be started by customisation of the generic COG documentation package for Cernavoda NPP, by removing extraneous information not applicable to the station, adding station-specific details and information and making any other adjustments required to address unique aspects of the plant design and/or operation.

In order to begin the preparation of the Severe Accident Guides (SAGs) / Severe Challenge Guides (SCGs) and Computational Aids (CAs), the following preliminary activities are envisaged, as the first step of the development of plant specific severe accident management strategy:

- Establishing setpoints for SAMG entry, entry to/exit from various SAGs/SCGs, as entry criteria from DCF (Diagnostic Flow Chart) / SCST (Severe Challenge Status Tree) to SAGs and SCGs and as criteria for determining the availability of equipment used to implement different mitigating strategies. Each setpoint value used in the SAGs/SCGs will be identified along with the basis/reference for the selected value.
- Assessment of plant instrumentation survivability (measuring ranges, environmental qualification) in severe accident conditions used to identify the SAMG entry conditions, to diagnose plant conditions for the selection of appropriate strategies and to confirm/monitor the success of strategy implementation. This is an on - going activity and will be finalised by the issue of an information report.
- A background document will be prepared for each element of the SAMG package (each guideline, diagnostic and computational aid). The primary purpose of the background documents is to provide general reference material for the purpose of training or guiding SAMG preparation/revision. A total number of 23 standalone documents and 23 background documents was identified.
- A number of Enabling Instructions will also be prepared in order to instruct the Main Control Room operating staff on how to establish non-standard equipment configurations or operational sequences not covered in the operating procedures. The final number of Enabling Instructions will be established only after the plant specific SAMG initial package will have been completed.

19.5 Engineering and Technical Support

The station organisational chart for Cernavoda NPP documents the general areas of responsibility. The structure of the organisation considers the needs for engineering and technical support and for this reason it includes a strong Technical Unit covering Systems Performance Monitoring, Design Engineering, and Safety & Compliance.

Also, it should be mentioned that a strong link is maintained with Romanian research institutes and with the designer of the plant, Atomic Energy Canada Limited, Romania being member of CANDU Owner Group.

Operations & Maintenance budget contains also provisions for the funding necessary to hire external institutes for services in the areas of research, design modification, safety analyses, maintenance, inspections, etc.

19.6 Reporting of incidents significant to safety

The Operating Licence requires reporting of abnormal conditions/ events according to the station procedure “Events Reportable to CNCAN”, which establishes the criteria and the method for reporting of events to CNCAN.

The document includes 35 criteria related to public safety, environmental protection, radiation protection, production, and security. The procedure was kept updated by periodic revisions to address the current Regulatory reporting requirements, and to clarify the scope and intent of the reporting criteria regarding the impact of the event on the nuclear safety, in accordance with the latest international practices.

In addition to this procedure, a Protocol for communicating events of interest to the regulatory (outside the scope of the reportable events) was agreed by CNE management and CNCAN.

Operator’s responsibilities during a transient include also notifying management. If the situation requires immediate notification to the Regulatory, as per guidance in the station procedure “Events Reportable to CNCAN”, the on-call station manager will inform CNCAN as appropriate. Specific steps for communicating via telephone and fax are set with CNCAN, such as this communication to be effective whenever it is performed. A written notification will be made to CNCAN during the next working day.

The current process for reporting the abnormal conditions within CNE Cernavoda ensures that for any abnormal occurrence a report is issued immediately when the condition occurs or when it is acknowledged. Thus the report for the abnormal event will be issued immediately after stabilising the situation and having the plant in a stable and safe state.

This report will be analysed according to station procedure for “Abnormal Conditions Reporting”, which means taking necessary steps for investigating, determining causes and taking adequate corrective actions to prevent recurrence.

At the end of investigations, when the corrective actions plan is approved by Management, but not later than 25 working days, a written Assessment Event Report will be submitted to CNCAN. This report will contain information related to the chronology of the event, significance to safety, causes and corrective actions taken by the plant to prevent recurrence.

Assessment Event Reports are prepared for those events that could have significant adverse impact on the safety of the environment, the public, the personnel, such as: serious process failures, failures of the special safety systems, trips of the shutdown systems, actuation of the ECCS or Containment system, violations of the OP&P/ licence conditions, release of radioactive materials in excess of target, doses of radiation which exceed the regulatory limits, events which interfere with IAEA safeguards system, etc.

19.7 Operational Experience Feedback

For Cernavoda NPP the station goal with regard to operating experience is to ensure effective and efficient use of lessons learned, from own operating experience as well as from that of other plants, to improve plant safety and reliability.

Station events and human performance problems result from weaknesses or breakdowns in station processes, practices, procedures, training, and system or component design that were not previously recognised or corrected. This is the reason why Cernavoda NPP considers, as the main topic of the Operating Experience Programme, the Event Analysis System, comprising identification, evaluation and analysis of operational events (both internal and external) in order to establish and implement corrective actions to avoid re-occurrence. The procedures that support the OPEX Programme have been listed under Article 10.

The basis for Operating Experience Program was set in place since the early stage of the commissioning phase of Unit 1, with the objective to ensure:

- the reporting, reviewing, assessing of the station unplanned events and establishing of the necessary corrective actions;
- information exchange within CANDU Owners Group (COG) and WANO, regarding abnormal conditions, technical problems, research and development projects, etc.

The WANO recommendations following the Peer Review conducted in August 1997 for Cernavoda NPP provided the opportunity for a better understanding and reconsideration of the Operating Experience Programme. As a result, all the activities related to this topic were assigned to a new structure, the Operating Experience Group. The programme was implemented based on prevention of incidents - the path to excellence in operational safety. The implementation of this new system has been confirmed by WANO in 2000 and 2003, the program being now developed in an integrated and centralised manner.

19.7.1 Internal operating experience

Classification of the abnormal conditions is based on their impact (actual or potential) on nuclear safety, personnel safety, environment or production. The detail of level investigation is based on the classification of the abnormal conditions, starting from registering trend analysis for the minor abnormal conditions, to systematic analysis of root causes for major impact events.

For each event investigated, previous similar conditions are taken into account and if an emerging trend is identified, the classification of the abnormal condition will be upgraded to reflect the significance of the condition because of the re-occurrence (i.e. even if an abnormal condition, considered as a singular occurrence, is deemed to be classified “minor”, it will be investigated as “important”, if a series of similar occurrences is identified).

According to the current station instruction “Abnormal Condition Reporting” (ACR), events that meet the investigation threshold established by this procedure are investigated using root cause analysis methodologies. A management sponsor (at management/senior superintendent level) for each root cause analysis event is responsible for establishing investigation scope and depth, and provide oversight of the investigation team. The investigation team is formed of specialists from all disciplines involved in the analysis of the event. Members of analysis team are responsible to provide technical support for all steps of investigation using a root cause methodology (HPES or ASSET).

Each stage of the investigation is requested to be performed within a specific time frame. For instance, a root cause analysis will be performed within 20 working days from the occurrence of the event, an apparent cause investigation in 10 days and an evaluation (assignment of corrective actions at supervisory level) will be normally done in 5 days. These targets are assigned and followed using the computerised database for the event reports.

The process of event investigations and identification of corrective actions is standardised. A standard format for Root Cause Analysis Reports is issued, together with instructions for filling in the reports. The reports evaluate previous similar events and determine if previous corrective actions were not effective, and also generic implications of the events are taken into account.

When the root cause analysis is finalised, and the proposed Action Plan is prepared, a Root Cause Analysis Review Committee (RCARC) meeting is arranged. The meeting is chaired by the Station Manager; RCARC approves the root cause analysis and the corresponding action plan. Proposed actions are then transferred into Station Action database, and followed to completion.

The Operating Experience (OPEX) group prepares and distributes the OPEX information packages throughout plant’s departments and working groups including shift teams. These packages are available for everybody and discussed in regular (monthly/quarterly) meetings. Relevant parts of OPEX information are brought to the attention of working groups via pre-job briefings and just-in-time training.

If necessary, specific training and reinforcement actions are set for specific working groups, to discuss the lessons learned from these events. For most important events, like plant upsets or serious human performance events, training materials and station information bulletins are issued, with emphasis on the most important aspects of the events. The root cause analysis reports are available in the station events database for further reference.

The use of the procedure “Abnormal Condition Reporting” has been addressed also under Article 10, where the list of ACR initiation criteria has been provided.

During the Unit 2 commissioning a process called Commissioning Unplanned Event Reporting (CUER) has been in place for reporting problems during commissioning that could end up as unplanned events. The process described in the procedure with the same name is used to learn lessons from these events, to track identified actions and to provide follow-up of actions to minimise recurrence or severity of recurrence.

As the main goal of the CUER process is to share lessons learned, to avoid repeating mistakes and to improve overall commissioning processes, the filing of a CUER Initial Report is not restricted to “reportable events”. The evaluation of any event is based on risk and most investigations rely on apparent cause techniques. In addition, CUER data are reviewed for repeated and generic problems with commissioning performance, processes and equipment, to identify and implement corrective actions and improvements.

The CUER process ensure the recording of events, provisions for analysis/investigation as warranted and tracking of any resulting actions. The CUER process has been applied through all phases of commissioning of Unit 2, until its operation will be integrated with the operation of Unit 1, at which time the Cernavoda Station Abnormal Condition Reporting Process will be adopted.

Trending of the low-level events

The general interest in a “learning organisation” is to report and record as many low-level events as possible. These are non-consequential events that highlight latent organisational weaknesses and increase the chances of error during the performance of a specific task by a particular individual.

Analysing the trends of low level events allows identifying underlying organisational weaknesses that may generate events with significant impact. Identification of low-level events and understanding the common aspects that connect those events provides adequate justification to proactively establish new barriers (or strengthen old ones) in order to prevent future significant events.

The information regarding the abnormal conditions reports is maintained in a database that tracks all the related information. The events are coded against causal codes and other parameters that allow periodically trend analysis to show emerging trends and new issues. Coding of ACRs has been continually improved to provide for meaningful parameters and clear quantitative criteria for identification of an adverse trend.

The trend analysis are performed biannually, or at station management request, and presented graphically, with comments and proposal for corrective actions. The Trend Analysis report contains all the analyses performed by the OPEX group, is verified and approved by the senior management (Safety & Compliance Senior Superintendent and the Technical Manager) and is also discussed during periodic management meetings.

19.7.2 External operating experience

The external information on operating experience proved to be a very important tool in improving station performance. Therefore, the second main topic of the operating experience program is the Information Exchange Program, with bi-directional use:

- collecting of external information and distribution to the appropriate station personnel;
- submitting the internal operating experience information to external organisations.

The station procedure "External Operating Experience Feedback" is in place for screening for applicability the information provided by external organisations like COG, WANO and IRS. For the major events (e.g. WANO Significant Operating Experience Reports/Significant Event Reports, events level 2 or higher on INES scale), an Abnormal Condition Report is issued, and the analysis is performed using a gap analysis template. This means that the station actual processes, procedures and work practices are compared with the recommendations given in the reports, a gap is identified between current situation and recommended aspects, and actions are defined to fill in the gap. Further processing is performed according to station instruction "Abnormal Conditions Reports".

Except this formal processing and tracking of significant industry events, plant personnel has access to the COG Operating Experience Database and to WANO/INPO websites and operating experience posts and monitors daily the new events posted on these websites. The bulk of the records is posted only for information, but might be used while reviewing in-house events, design modifications or looking for relevant just-in-time operating experience for certain activities / evolutions.

The international nuclear organisations require a prompt notification regarding events occurred at the station in order to offer well-timed information to the world community. For the information exchange programme, a COG / WANO contact officer, appointed by the station management, with the following general responsibilities maintains the relation between Cernavoda NPP and COG / WANO:

- serving as a liaison between COG / WANO and Cernavoda NPP;
- reviewing the incoming messages and distributing them to the appropriate persons;
- ensuring the transmittal of the required information/reports to COG / WANO;
- ensuring optimum participation by the station personnel.

The criteria for reportable events to COG and WANO are defined by these organisations in reference documents. These criteria are:

- Severe or unusual plant transients;
- Malfunctions or improper operation of safety systems;
- Major equipment damage;
- Excessive radiation exposure or severe personnel injury;
- Unexpected or uncontrolled release of radioactivity in excess of off-site or on-site regulatory limits;
- Fuel handling or storage events;
- Deficiencies of design, analysis, fabrication, construction, installation, operation, configuration management, man-machine interface, testing, maintenance, procedure or training deficiencies;
- Other events involving plant safety, reliability or significant loss of production;
- Any other events of generic interest to CANDU NPPs.

Still, a number of events that do not meet these criteria but are considered of interest to the industry, representing various opportunities for improving work practices and procedures or finding about particular design or equipment flaws that could be corrected before they occur in site are reported. Thus, the reports shared with the industry might not reach the level of reporting, but still contain significant learning points.

Cernavoda NPP level of event reporting to external organisations has significantly improved in the last two years. Number of event reports to the external organisations is monitored at the station level and complies with the targets for reporting set by these external organisations.

At Regulatory level, CNCAN is member of the International Reporting System (IRS), contributing to international experience exchange by reporting generic events or issues of interest for the nuclear community. All events reported to CNCAN by the Cernavoda NPP are independently assessed by CNCAN from two points of view: INES rating and analysis using a recognised methodology (ASSET, HPES) for direct and root causes determination as well as appropriateness of the corrective actions established by the licence holder. The applicability of corrective actions resulted from nuclear events reported through IRS is also assessed, their implementation in Cernavoda NPP being surveyed by means of regulatory topical inspections.

Information obtained from the internal and external operational experience is used for multiple purposes, such as:

- Improving the operating practices and plant staff training programmes;
- Improving the plant design;
- Input for Ageing Management Programme;
- Assessment of necessity for updating of the safety analyses (deterministic and probabilistic), etc.

19.8 Management of Spent Fuel and Radioactive Waste

Minimisation of waste

Waste minimisation is considered in Romania as an important issue, having direct impact on radioactive waste management.

A main means for reduction of the radioactive waste generated is the clearance of the waste. CNCAN has issued the “Requirements for clearance from licensing regime of materials resulted from licensed nuclear practices”. The above mentioned regulation establishes clearance levels, both for conditional and free release of materials from radiological zones. In order to minimise the waste, the producer shall also consider the secondary waste when assessing the treatment and conditioning of the radioactive waste. This requirement is considered by CNCAN in the licensing process.

Generation of radioactive waste associated with CANDU spent fuel is minimised through:

- the quality of fuel;
- online refuelling (this allows timely detection and removal of the failed fuel;)
- canning of the failed fuel.

For all spent fuel, the control of water parameters in wet storages, and control of confinement and of the isolating air parameters for dry storage minimises the generation of radioactive waste associated with spent fuel management.

Control of treatment and interim storage of radioactive waste

The solid radioactive waste is pre-treated and conditioned in stainless steel drums. The waste is then stored waiting for reconditioning and disposal. For final disposal the waste shall be repacked in normal steel drums and conditioned in concrete cells.
The spent ion exchange resins are, for the time being, stored in special storage tanks. A solution for longer term storage of the resins has to be found in the future.

Programmes to manage radioactive waste

Cernavoda NPP has all operational arrangements including special designated facilities for proper current management of its gaseous, liquid and solid operational radioactive wastes, in order to assure the protection of the workers, the public and the environment.

The gaseous wastes are collected by ventilation systems, filtered and released through the ventilation stack under a strict control to minimise the environmental impact. The aqueous liquid wastes of NPP are collected and after adequate purification by using ion exchange resins (if necessary), are discharged into the environment. Spent ion resins are collected and stored in special tanks. The organic liquid waste is solidified in polymeric absorbent structure and stored on site. The solid waste from NPP is collected, segregated, compacted (if it is the case) and conditioned in stainless steal 220 l drums. For the final disposal, scheduled to start after the year 2014, the waste shall be repacked in normal steel drums and conditioned in concrete cells.

At present at the NPP it is in progress the implementing of the waste characterisation process followed by implementing of clearance process. The waste characterisation process will lead to the definition of a new classification system according to the acceptance criteria for disposal.

Management of spent fuel

The spent fuel system of Cernavoda NPP Units 1 and 2 were designed to meet adequate safety standards as used in Canada. The Spent Fuel Bay of Cernavoda NPP – Unit 2 design meets the general requirements as described in the IAEA Safety Series 116 – Design of spent fuel storage facilities by including the following:

- measures to limit radioactive releases and radioactive exposures of workers and the public (including detection of leakage through the bay walls and floor);
- measures to prevent anticipated operational occurrences and accident conditions from developing into unacceptable severe accident conditions;
- provision for ease of operation and maintenance of essential equipment;
- provisions, through equipment and procedures, for retrieving spent fuel from storage.

Even though it is generally accepted that the Fuel Handling and Storage Systems of Cernavoda NPP Unit 1 and of the Unit 2 ensure required safety, it has to be noted that in order to enhance safety, modifications for the fuelling/defuelling machine design were introduced by the designer, due to the application of new design requirements issued by CNSC and endorsed by CNCAN, and due to feedback of operational experience.

It should be mentioned also that, prior the restarting of the construction of Unit 2, a review of the nuclear safety of the unit under construction was performed through a PHARE project. One of the ten tasks of this project, entitled Task 5 - Assessment of Nuclear Safety of On-Site Facilities regarding Nuclear Fuel and Radioactive Waste, concluded that the safety is assured according to western standards. However, recommendations were made for supplementary analyses and for initiating design changes, if the results of the analyses show that design changes are recommended. Also, in Task - 6 Evaluation of Adequacy of Engineered Provisions for Radiation Protection, it was recommended to review the suitability and application of the spent fuel pool surface finish and to consider the installation of a suitable metallic liner, to fulfil the secondary containment requirement. This design change was already implemented in the construction of Unit 2.

After 6 years of storage in the Spent Fuel Bay, the spent fuel is transferred to the Spent Fuel Dry Storage. The Spent Fuel Dry Storage Facility is located on the NPP site, close to the containment building of Unit 5. Its designed storage capacity will be expanded gradually from 12,000 to 324,000 spent fuel bundles. (It can accommodate the spent fuel inventory from two reactors). The dry storage technology is based on the MACSTOR System. It consists of storage modules located outdoors in the storage site, and equipment operated at the spent fuel storage bay for preparing the spent fuel for dry storage. The spent fuel is transferred from the preparation area to the storage site in a transfer flask. The transportation is on-site. At present three storage modules were constructed with a total storage capacity of 36,000 spent fuel bundles.

Appendix 19.1 - Operating performances of Unit 1

The operating performances of Unit 1 are shown in Fig. 19. 3 - 15.

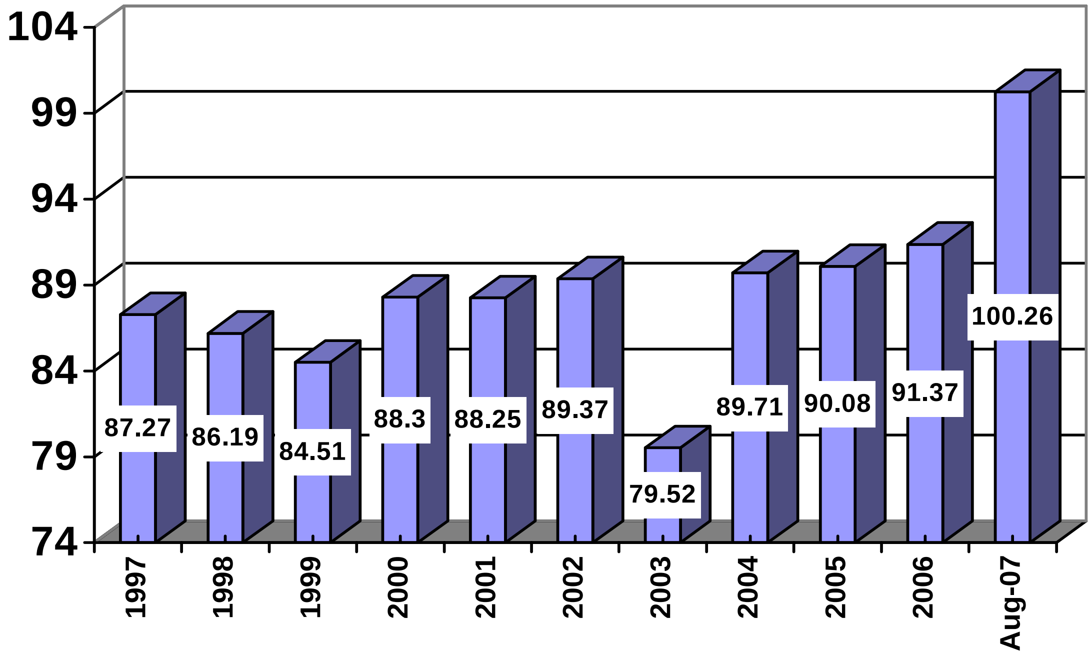


Fig. 19.3 Unit 1 Capacity Factor

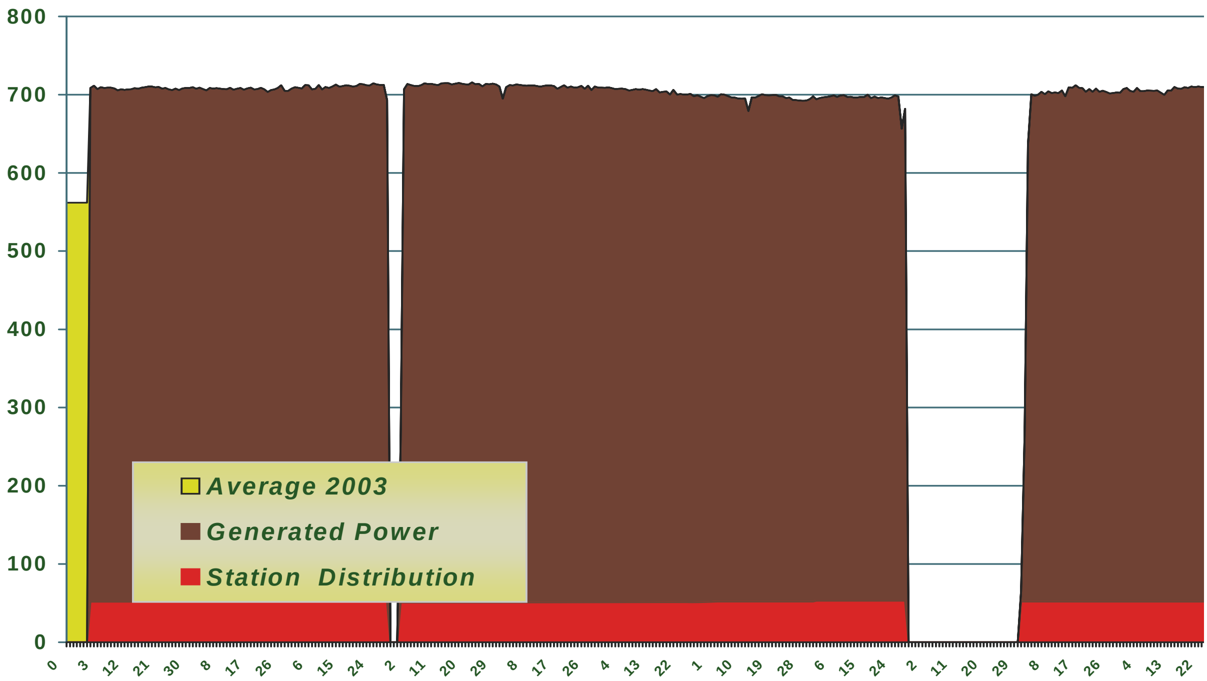


Fig. 19.4 Station Performance 2004

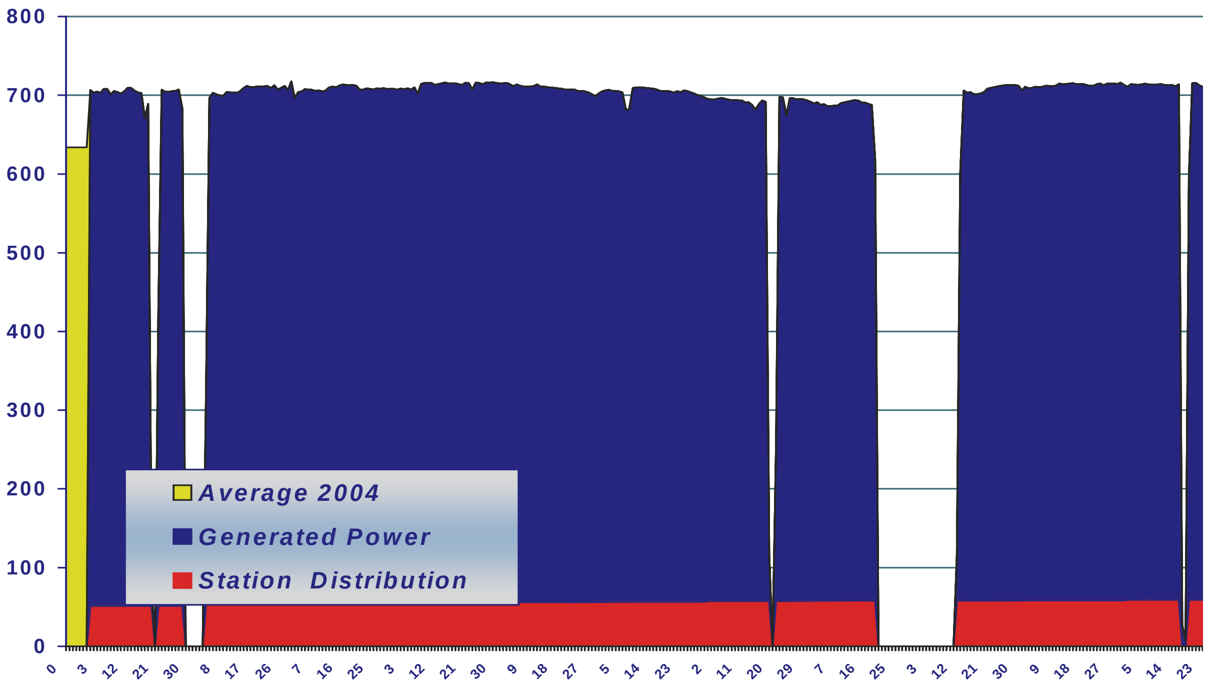


Fig. 19.5 Station Performance 2005

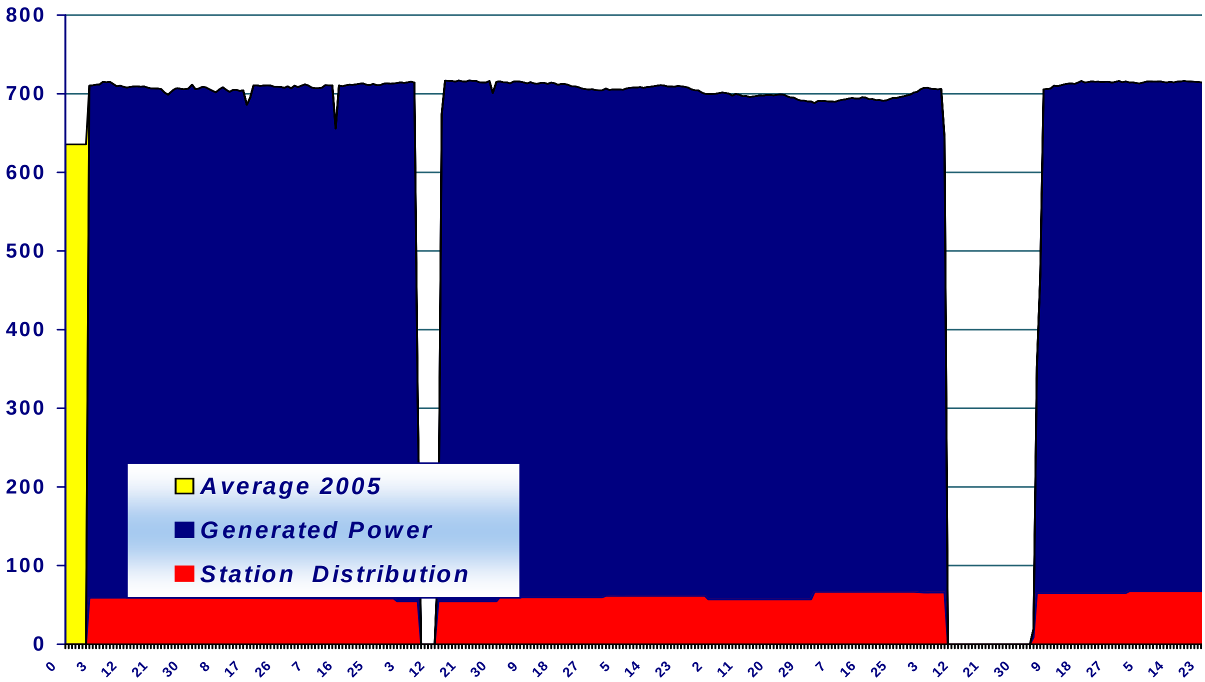


Fig. 19.6 Station Performance 2006

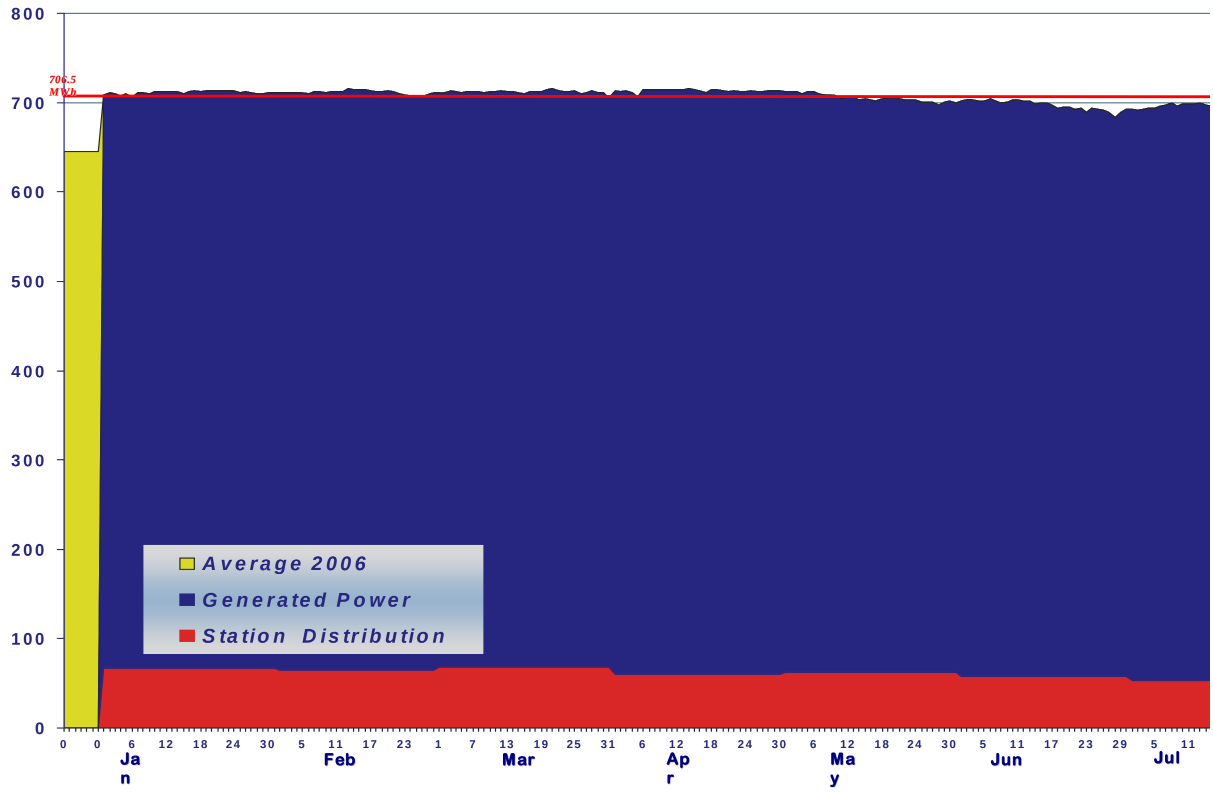


Fig. 19.7 Station Performance 2007

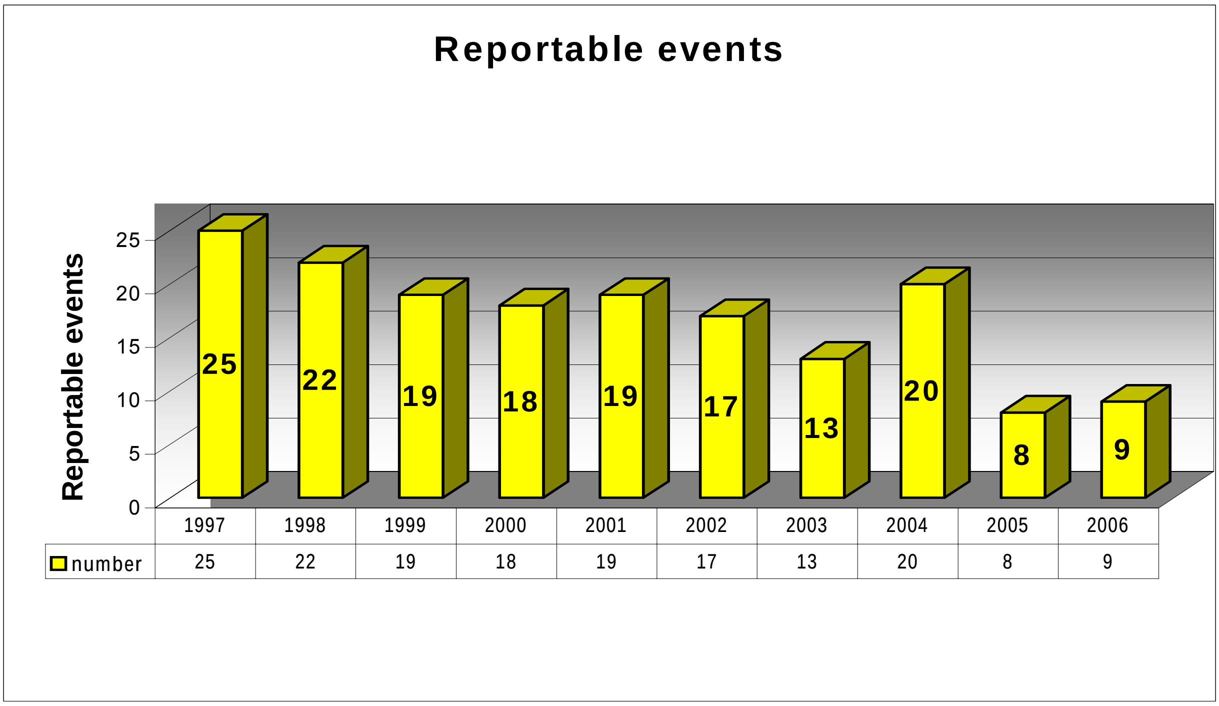
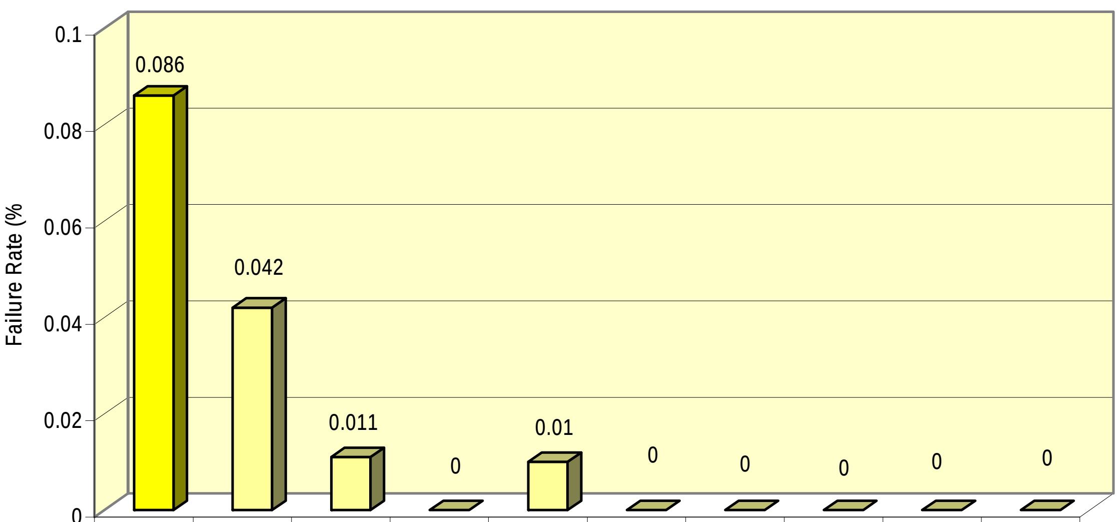
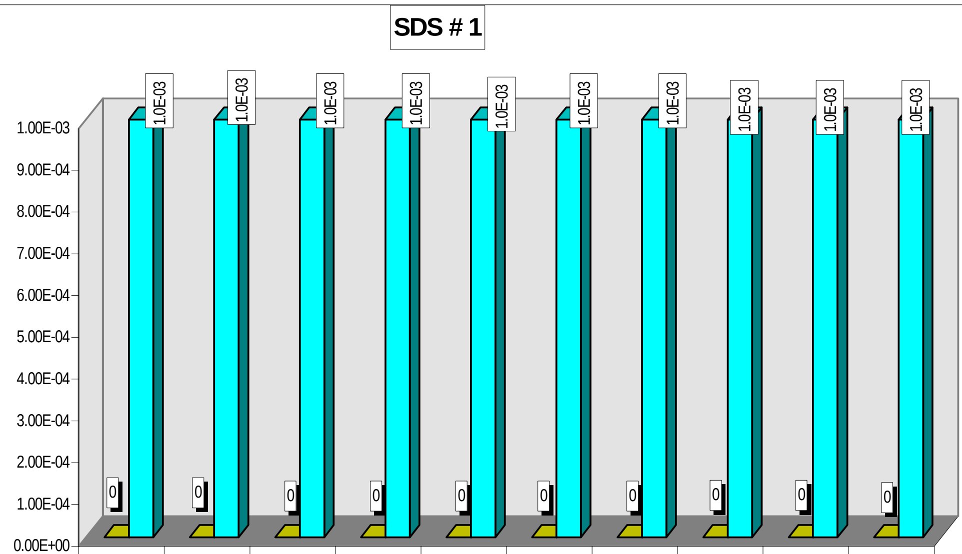


Fig. 19.8 Number of reportable events



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Failure Rate	0.086	0.042	0.011	0	0.01	0	0	0	0	0

Fig. 19.9 Fuel Failure Rate evolution since the start of Cernavoda Unit 1 Commercial Operation



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
INDICATOR VALUE	0	0	0	0	0	0	0	0	0	0
TARGET	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03

Fig. 19.10 Shutdown System # 1 Unavailability

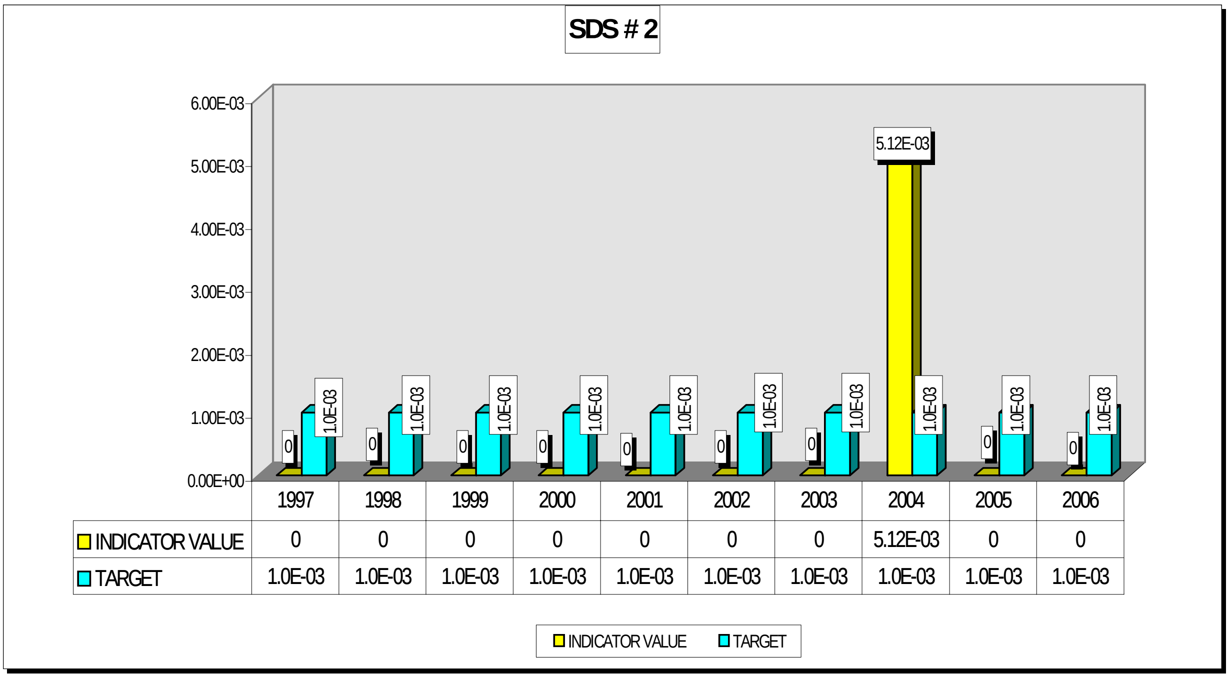


Fig. 19.11 Shutdown System # 2 Unavailability

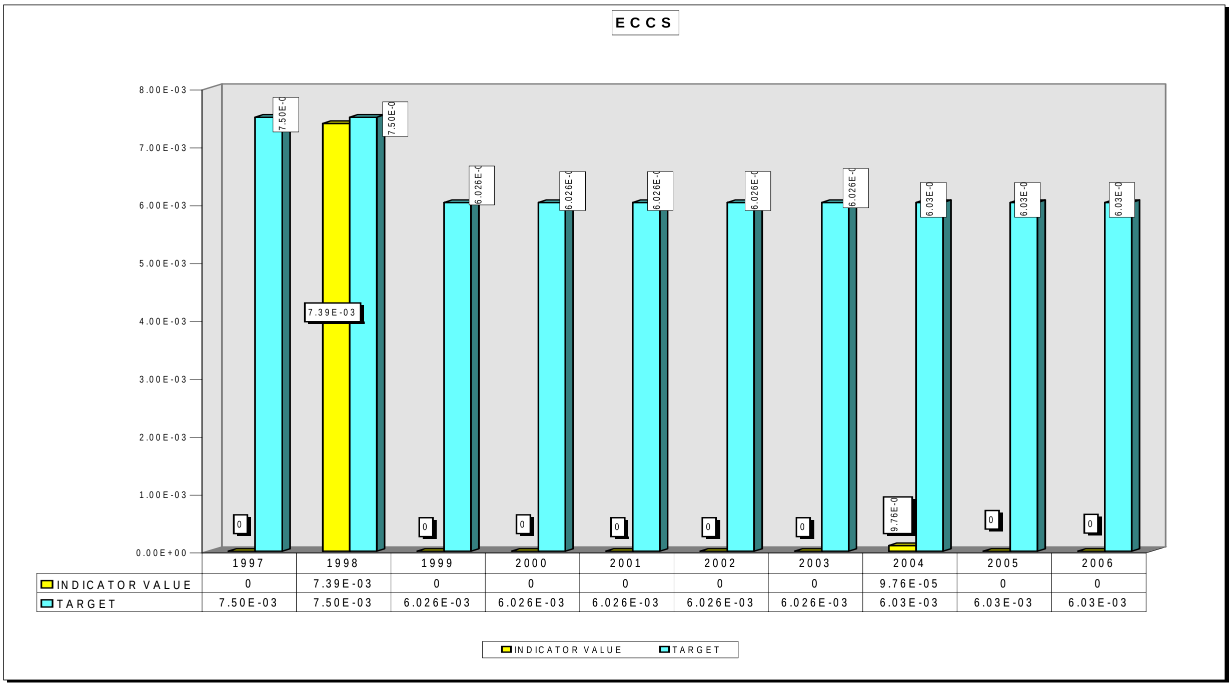
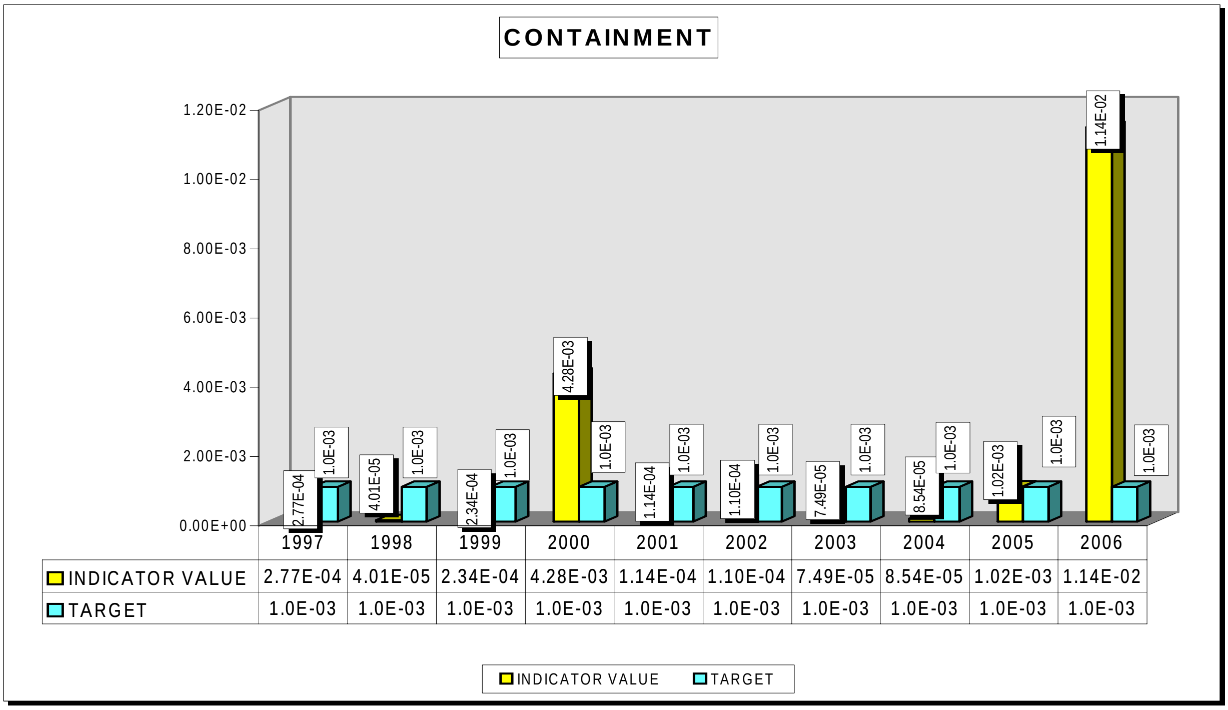


Fig. 19.12 Emergency Core Cooling System Unavailability



	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
INDICATOR VALUE	2.77E-04	4.01E-05	2.34E-04	4.28E-03	1.14E-04	1.10E-04	7.49E-05	8.54E-05	1.02E-03	1.14E-02
TARGET	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03	1.0E-03

Fig. 19.13 Containment Systems Unavailability

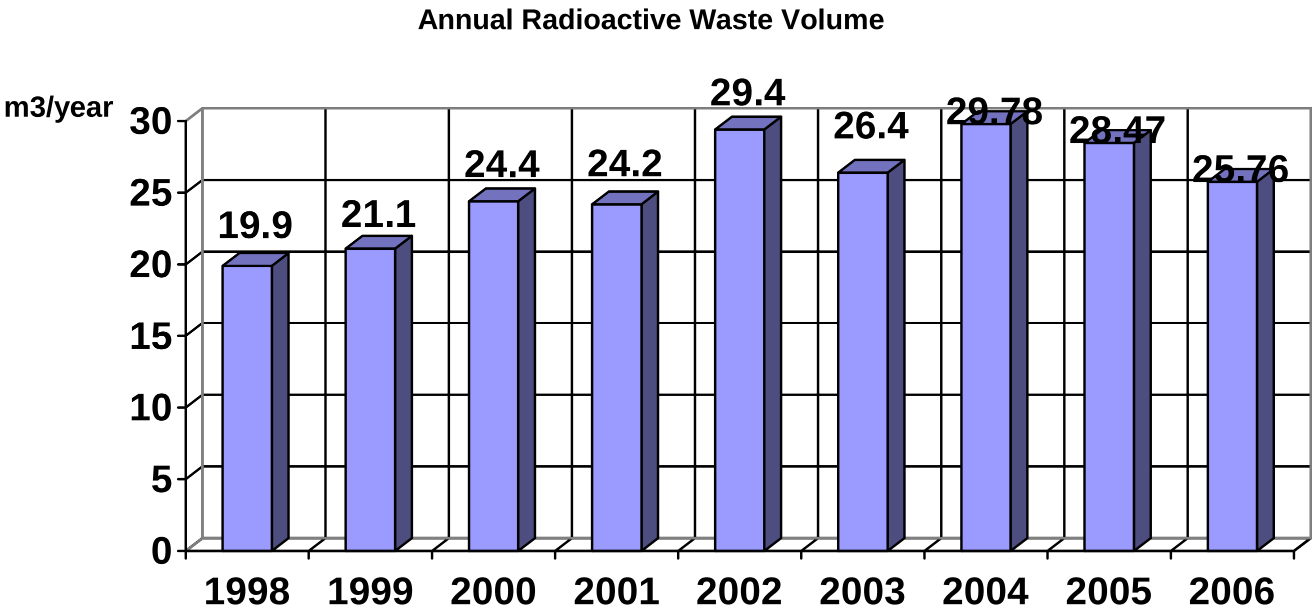


Fig. 19.14 Cernavoda 1 NPP Annual Radioactive Waste Volume (m^3/year)

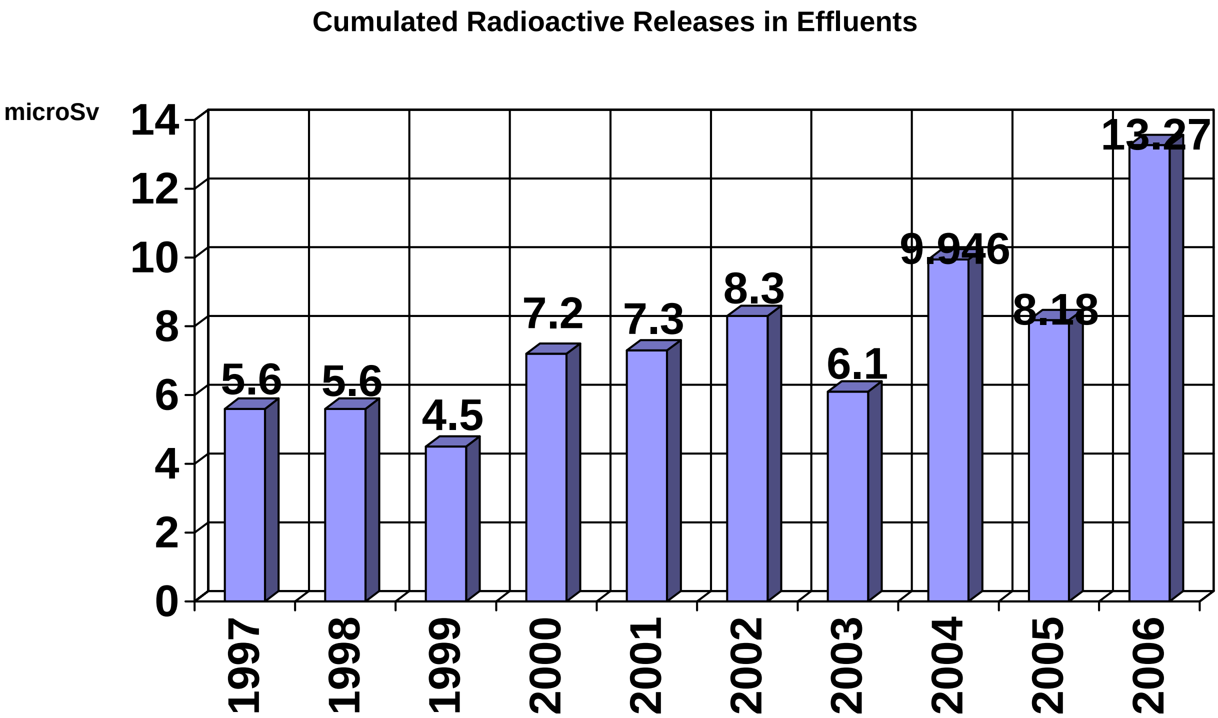


Fig. 19.15 Dose to population from Cernavoda 1 NPP Cumulated Radioactive Releases in Effluents

LIST OF ACRONYMS

ACR - Abnormal Condition Report

ALARA - As Low As Reasonable Achievable

AN - Nuclear Agency

ANCEX - National Agency for the Control of Exports

ANCST - National Agency for Research and Technology

ANDRAD - National Agency for Radioactive Waste Management

APOP - Abnormal Plant Operating Procedure

BE - Basic Events

BOP - Balance of Plant

CANDU - Canadian Deuterium Uranium Reactor

CNCAN - National Commission for Nuclear Activities Control

CNU - National Uranium Company

COG - CANDU Owners Group

CPR - Centre for Radio-Isotopes Production

CRO - Control Room Operator

CSEN - State Committee for Nuclear Energy

IFIN – HH - R&D Institute for Physics and Nuclear Engineering “Horia Hulubei”

IR - Information Report

ISCAN - State Inspectorate for Nuclear Activities Control

ISCIR - State Inspectorate for Boilers, Pressure Vessels and Hoisting Installations

JRTR - Job Related Training Requirements

DCC - Digital Control Computers

DCS - Distributed Control System

DEL - Derived Emission Limit

DM - Design Manual

DNDR - National Repository of Radioactive Waste

EFD - Event Free Days

EFT - Event Free Tools

EPRI - Electric Power Research Institute

EOOS - Equipment Out Of Service

GEM - Gaseous Effluents Monitor

HP - Human Performance

IAEA - International Atomic Energy Agency

ICSI - Institute for Cryogenics and Isotopes Separation

ICRP - International Committee for Radiation Protection

IDP – Inter-Departmental Procedure

IGSU - General Inspectorate for Emergencies

IPSART - International Probabilistic Safety Assessment Review Team

ISO - International Organisation for Standardisation

LEM - Liquid Effluents Monitor

LEPI - Post-Irradiation Examination Laboratory

LSC - Liquid Scintillation Counting

MCR - Main Control Room

MPA - Modification Proposal and Approval

NMC - Norms on Quality Management

NPP - Nuclear Power Plant

NSP - Nuclear Steam Plant

ODM - Operational Decision Making

OLC - Operational Limits and Conditions

OM - Operating Manual

OMT - Operating Manual Tests

OP&P - Operating Policies and Principles

OSART - Operational Safety Review Team

PHWR - Pressurised Heavy Water Reactor

PSA - Probabilistic Safety Assessment

PSOC - Plant Safety Oversight Committee

QMS - Quality Management System

QTR - Quarterly Technical Report

RAAN - Autonomous Company for Nuclear Activities

RCA - Root Cause Analysis

RD - Reference Document

RSE - Responsible System Engineer

RSP - Regulatory Surveillance Plan

SADL - Safety Analysis Data List

SAMG - Severe Accident Management Guidelines

SCA - Secondary Control Area

SDG - Safety Design Guide

SDM - Safety Design Matrix

SER - Significant Event Report

SI - Station Instruction

SITON - Centre for Nuclear Projects Engineering

SNN - National Company “NUCLEARELECTRICA”

SOER - Significant Operating Experience Report

SOS - Standard Operating Sequence

SS - Shift Supervisor

SSC - Systems Structures and Components

TLD - Thermo Luminescent Dosimeter

TOE - Technical Operability Evaluation

WANO - World Association of Nuclear Operators

WENRA - Western European Nuclear Regulators Association

ANNEX 1

LIST OF LAWS, GOVERNMENTAL DECISIONS, REGULATIONS, TREATIES, AGREEMENTS, CONVENTIONS

LAWS

1. Law no. 111/1996 on the safe deployment, regulation, licensing and control of nuclear activities, republished in the Official Gazette no. 552/27.06.2006
2. Law no. 703/2001 on the Civil Liability for Nuclear Damage, published in Official Gazette, no. 818/19.12.2001

RELATED LAWS

1. Council of State Decree no. 21/1970 for ratification of the Treaty on non-proliferation of the nuclear weapons, published in Official Gazette no. 3/31.01.1970
2. Council of State Decree no. 394/1972 for ratification of the Agreement between the Government of Romania and IAEA regarding safeguards within Treaty on non-proliferation of the nuclear weapons, published in Official Gazette no.123/08.11.1972
3. Law no. 106/1992 for adherence of Romania to the Vienna Convention on Civil Liability for Nuclear Damage and to Common Protocol on application of Vienna and Paris Conventions, published in Official Gazette no. 258/15.10.1992
4. Law no. 6/1993 for adherence of Romania to the International Convention from 1973 for prevention of pollution by ships, as modified by Protocol concluded in London, published in Official Gazette no. 57/18.03.1993
5. Law no. 20/1993 for ratification of the European Agreement establishing an association between Romania and European Communities and Member States of E.C., signed at Bruxelles on 1 February 1993, published in Official Gazette no. 73/12.04.1993
6. Law no. 31/1994 for adherence of Romania to the European Accord on international road transport of dangerous goods (ADR), published in Official Gazette no. 136/31.05.1994
7. Law no. 43/1995 for ratification of the Convention on Nuclear Safety, adopted in Vienna on 17 June 1994, published in Official Gazette no. 104/29.05.1995
8. Law no. 107/1996, Water Law, published in Official Gazette no. 244/3.10.1996
9. Governmental Ordinance no. 29/1997 on Aerial Code, republished in Official Gazette no. 45/26.01.2001
10. Governmental Ordinance no. 39/1998 on national standardisation activity in Romania, published in Official Gazette no. 43/ 30.01.1998
11. Law no. 197/1998 on the approval of Governmental Ordinance no. 19/1997 on transports, published in Official Gazette no. 425/11.11.1998
12. Law no. 203/1998 for ratification of the Protocol to amend the Vienna Convention on Civil Liability for Nuclear Damage, adopted in Vienna on 12 September 1997, published in Official Gazette no. 438/18.11.1998

13. Law no. 105/1999 for ratification of Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, published in Official Gazette no. 283/21.06.1999

14. Governmental Ordinance no. 48/1999 on road transport of dangerous goods, published in Official Gazette no. 401/24.08.1999

15. Governmental Ordinance no. 49/1999 on railway transport of dangerous goods, published in Official Gazette no. 401/ 24.08.1999

16. Governmental Ordinance no. 58/1999, for adherence of Romania to the Convention on facilitation of International Maritime Traffic (FAL), adopted in London on 9 April 1965 at the International Conference on facilitation of maritime voyage and transport, as modified and completed by amendments in 1984, 1986, 1989, 1991, 1993 and 1994, published in Official Gazette no. 413/30.08.1999

17. Ordinance of the Government no. 19/1997 on transports, republished in Official Gazette no. 552/11.11.1999

18. Urgency Ordinance no. 14/2000 on establishment of the civil protection formations for emergency intervention in case of disasters, published in Official Gazette no. 114/16.032000

19. Law no. 100/2000 for ratification of the Protocol between Romania and International Atomic Energy Agency, in addition to the Accord between Socialist Republic of Romania and International Atomic Energy Agency, for Application of Safeguards in Connection with the Treaty on Non-Proliferation of Nuclear Weapons, signed at Vienna, on 11.06.1999, published in Official Gazette no. 295/29.06.2000

20. Law no. 21/2001 on acceptance of some amendments of International Atomic Energy Agency Statute (IAEA) adopted at the 43-th session of General Conference on 1st October 1999, published in Official Gazette no. 102/28.02.2001

21. Law no. 176/2000 on medical devices, published in Official Gazette no. 79/24.01.2005

22. Law no. 608/2001 on assessment of products conformity, republished in Official Gazette no. 313/06.04.2006

23. Law no. 629/2001 for the approval of the Ordinance of the Government no. 124/1998 on organisation and functioning of medical consulting rooms, published in Official Gazette no. 724/13.11.2001

24. Law no. 57/2002 for the approval of the Urgency Ordinance of the Government no. 97/2001 on regulation of production, circulation and marketing of food, published in Official Gazette no. 73/31.01.2002

25. Law no. 57/2006 for the modification and completion of the Governmental Ordinance no. 7/2003 on the use of nuclear energy exclusively for peaceful purposes, published in the Official Gazette no. 301/04.04.2006

26. Law no. 26/2007 for the approval of Governmental Ordinance no. 31/2006 for the modification and completion of the Governmental Ordinance no. 11/2003 on the management of spent nuclear fuel and radioactive waste, including final disposal, published in Official Gazette no. 38/18.01.2007

27. Governmental Ordinance No. 11/2003 on Management of Spent Nuclear Waste and Radioactive Waste, modified and completed by Law no. 26/2007, republished in Official Gazette no. 289/02.05.2007

TREATIES, AGREEMENTS, CONVENTIONS concluded on state or governmental level under the responsibility of the National Commission for Nuclear Activities Control

1. The International Atomic Energy Statute, signed in New-York on 26.10.1956, ratified by Decree no. 123/1957

2. Agreement between the Popular Republic of Romania and the Union of Soviet Socialist Republics regarding the future development of collaboration in use of atomic energy for peaceful purposes, signed in Bucharest on 19 April 1962

3. Treaty Banning Nuclear Weapon Tests in the Atmosphere, in Outer Space and Under Water, adopted at Moscow on 5 August 1963, ratified by the Decree no. 686 of 31 October 1963, published in the Official Gazette no. 20 / 31 October 1963

4. Agreement between the Socialist Republic of Romania and the Socialist Federative Republic of Yugoslavia regarding the technical scientifically collaboration in the field of nuclear energy use for peaceful purposes, signed at Bucharest on 16 September 1967, approved by Governmental Decision no. 469 of 1968, published in Official Gazette no. 33 of 14 March 1968

5. Treaty on the Non-Proliferation of Nuclear Weapons, adopted at New York, on 12 June 1968, ratified by the Decree no. 21 of 31 January 1970, published in the Official Gazette no. 3 / 31 January 1970

6. Agreement between the government of Socialist Republic of Romania and the government of Republic of India on cooperation in the field of atomic energy use for peaceful purposes, signed in Bucharest on 30 August 1971, approved by the Government Decision no. 1451 of 1971, published in Official Gazette no. 141 of 13 November 1971

7. Treaty on the Prohibition of the Emplacement of Nuclear Weapons and Other Weapons of Mass Destruction on the Sea-Bed and the Ocean Floor and in the Subsoil Thereof, adopted at London, Moscow and Washington on 11 February 1971, ratified by the Decree no. 141 of 19 April 1972, published in the Official Gazette no. 48 / 8 May 1972

8. Agreement between Socialist Republic of Romania and International Atomic Energy Agency, for the Application of Safeguards in Connection with the Treaty on Non-Proliferation of Nuclear Weapons, signed in Vienna on 08.03.1972, ratified by Decree no. 394/1972

9. Agreement between the government of Socialist Republic of Romania and the government of Popular Republic of Poland on collaboration in the field of atomic energy use for peaceful purposes, signed in Warsaw on 23 February

1972, approved by Government Decision no. 468 of 1972, published in Official Gazette no. 52 / 12 May 1972

10. Agreement between the government of Socialist Republic of Romania and the government of Popular Republic of Bulgaria on collaboration and cooperation in the field of atomic energy use for peaceful purposes, signed in Bucharest on 21 May 1972, approved by Government Decision no. 1453 of 1972, published in Official Gazette no. 150 of 14 December 1972

11. Convention on Early Notification of A Nuclear Accident, adopted at Vienna on 26 September 1986, adhered by the Decree no. 223 of 11 May 1990, published in the Official Gazette no. 67 of 14 May 1990

12. Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency, signed in Vienna on 26.09.1986, Romania has acceded by Decree no. 223/1990

13. Vienna Convention on Civil Liability for Nuclear Damage, concluded in Vienna on 21.05.1963, Romania has acceded by Law no. 106/1992

14. Joint Protocol relating to the application of the Vienna Convention and Paris Convention concluded in Vienna on 21.09.1988, Romania has acceded by Law no. 106/1992

15. Convention on Physical Protection of Nuclear Material, signed in Vienna on 03.03.1980, ratified by Law no. 78/1993

16. Agreement between the Government of Romania and the Government of Republic of Argentina for the Cooperation in Peaceful Use of Nuclear Energy, signed in Buenos Aires on 27 November 1990, approved by Government Decision no. 354 of 23 July 1993, published in the Official Gazette no. 196 of 16 August 1993

17. Agreement between the Government of Socialist Republic of Romania and the Government of Canada for the Co-operation in the Development and Application of Atomic Energy for Peaceful Purposes, signed in Ottawa on 24.10.1977, entry into force on 14.06.1978, amended by change of notes on 12.10.1994

18. Convention on Nuclear Safety, adopted in Vienna on 17.06.1994, ratified by Law no. 43/1995

19. Agreement between the Government of Romania and the Government of Greece on Early Notification of a Nuclear Accident and Exchange of Information on Nuclear Facilities, signed in Athens on 10.03.1995, approved by Government Decision no. 332/1995

20. Memorandum of understanding for co-operation in nuclear safety between the National Commission for Nuclear Activities Control of Romania and the Korea Institute of Nuclear Safety, signed in Bucharest, on 21.09.1996, adopted by Government Decision no. 1032/1996

21. Agreement between the Government of Romania and the Government of Republic of Hungary on Early Notification of a Nuclear Accident, signed in Bucharest on 26.05.1997, approved by Government Decision no. 541/1997

22. Agreement between the Government of Romania and the Government of Republic of Bulgaria on Early Notification of a Nuclear Accident and Exchange of Information on Nuclear Facilities, signed in Kozloduy on 28.05.1997, approved by Government Decision no. 734/1997

23. Protocol to Amend Vienna Convention on Civil Liability for Nuclear Damage, adopted in Vienna on 12.09.1997, ratified by Law no. 203/1998

24. Memorandum of understanding for cooperation and exchange of information in nuclear safety between the National Commission for Nuclear Activities Control of Romania and the Hungarian Atomic Energy Authority, signed in Budapest, on 19.06.1997, ratified by Governmental Decision No. 273/1998

25. Memorandum of understanding for cooperation and exchange of information in nuclear regulatory affairs between the National Commission for Nuclear Activities Control of Romania and the Atomic Energy Control Board of Canada, signed in Ottawa, on 23.06.1997, ratified by Governmental Decision No. 272/1998

26. Agreement between the Greek Atomic Energy Commission of the Republic of Greece and the National Commission for Nuclear Activities Control of Romania for the early notification of a nuclear accident and exchange of information on nuclear facilities, signed in Bucharest, on 22.12.1997, adopted by Government Decision No. 271/1998

27. Agreement on co-operation and information exchange in the field of nuclear safety between the National Commission for Nuclear Activities Control of Romania (CNCAN) and Gesellschaft fur Anlagen und Reaktorsicherheit (GRS) Mbh, signed in Berlin, on 10.11.1998, adopted by Government Decision No. 94/1999

28. Comprehensive Nuclear Test Ban Treaty, adopted by the United Nations Organisation on 10.09.1996, ratified by Law no. 52/1999.

29. Convention on Supplementary Compensation for Nuclear Damage, adopted in Vienna on 12.09.1997, ratified by Law no. 5/1999

30. Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management, adopted in Vienna on 05.09.1997, ratified by Law no. 105/1999

31. Agreement for co-operation between the Government of Romania and the Government of the United States of America concerning Peaceful Uses of Nuclear Energy, signed in Washington on 15.07.1998, ratified by Law no. 111/1999

32. Agreement between the Government of Romania and the Government of the United States of America on cooperation in the counteract of the proliferation of weapons of mass destruction and the promotion of the military and defence relations, signet at Washington on 30 March 1998, approved by the Government Ordinance no. 3 of 25 January 1999, published in the Official Gazette no. 28 of 26 January 1999

33. Protocol between Romania and International Atomic Energy Agency to the Agreement between Socialist Republic of Romania and International Atomic Energy Agency for the Application of Safeguards in connection with the

Treaty on Non-Proliferation of Nuclear Weapons, signed in Vienna on 11.06.1999, ratified by Law no. 100/2000

34. Memorandum of Understanding between the National Commission for Nuclear Activities Control of Romania and the National Atomic Energy Commission of the Argentine Republic, signed in Bucharest, on 15.07.1999, approved by Governmental Decision No. 61 /27.01.2000

35. Administrative understanding between the National Commission for Nuclear Activities Control of Romania and the Atomic Energy Control Board of Canada, signed in Ottawa, on 23.05.2000 and in Bucharest, on 29.05.2000, approved by Governmental Decision No. 1011/2000

36. Agreement between the National Commission for Nuclear Activities Control of Romania (C.N.C.A.N.) and the United States Nuclear Regulatory Commission (U.S.N.R.C.) for the exchange of technical information and cooperation in nuclear safety matters, signed in Vienna, on 20.09.2000, adopted by Government Decision No. 768/2001

37. Agreement between the National Commission for Nuclear Activities Control of Romania and the Division for Safety of Nuclear Facilities of the Republic of France for Exchange of Information and Co-operation in the field of Nuclear Safety, signed in Paris, on 8.08.2001, adopted by Government Decision no. 1178/2001

38. Agreement between the Government of Romania and the Government of the Russian Federation on early notification of nuclear accidents and information exchange on nuclear facilities, signed in Moscow, on 21.02.2002, adopted by Government Decision no. 423/2002

39. Agreement between the Government of Romania and the Government of the Slovak Republic on early notification of nuclear accidents and information exchange on nuclear facilities, signed in Bucharest, on 19.02.2002, adopted by Government Decision no. 422/25.04.2002

40. Memorandum of Understanding for Cooperation and Exchange of Information in Nuclear Regulatory Affaires between the National Commission for Nuclear Activities Control of Romania and the Atomic Energy Control Board of Canada, signed at Ottawa on 01 February 2003, and at Bucharest on 28 March 2003;

41. Agreement between the government of Romania and the preparatory Commission for the Comprehensive Nuclear-Test-Ban Treaty Organisation on the conduct of activities, including post-certification activities, relating to international monitoring facilities for the comprehensive nuclear- test-ban treaty, signed in Vienna on 13 June 2003, ratified by the Law no. 372 of 20 September, published in the Official Gazette no. 884 / 28 September 2004

42. Agreement between the Government of Romania and the Government of the Republic of Korea for the cooperation in peaceful use of nuclear energy in the development, research and industrial field, signed at Bucharest on 2 February 2004, approved by the Government Decision no. 756 of 14 May 2004, published in the Official Gazette no. 469 / 25 May 2004

43. Agreement between the Government of Romania and the Cabinet of Ministers of Ukraine on Early Notification of Nuclear Accidents and Exchange of Information in the Field of Nuclear and Radiation Safety signed at Vienna on 22 September 2004, approved by Government Decision no. 2118 of 30 November 2004, published in the Official Gazette no. 1267 of 29 December 2004

44. Agreement between the Romanian Nuclear Agency, the National Commission for Nuclear Activities Control and the US Department of Energy on cooperation in the field of the non-proliferation of nuclear weapons and the nuclear technologies, signed at New York on 19 July 2004, approved by the Governmental Decision no. 97 of 10 February 2005, published in the Official Gazette no. 178 of 1 March 2005

45. Agreement between the National Commission for Nuclear Activities Control of Romania (C.N.C.A.N.) and the Nuclear Regulatory Commission of the United States of America (U.S.N.R.C.) for the Exchange of Technical Information and Cooperation in Nuclear Safety Matters, signed at Vienna on 28 September 2005, ratified by the Governmental Decision no. 1857 of 22 December 2005, published in the Official Gazette no. 46 of 18 January 2006

46. International Convention for the Suppression of Acts of Nuclear Terrorism, signed in New York on 14 September 2005, ratified by Law no. 369 of 2006, published in Official Gazette no. 847 of 16 October 2006

47. Additional Agreement to the Memorandum of understanding for co-operation in nuclear safety between the National Commission for Nuclear Activities Control of Romania and the Korea Institute of Nuclear Safety, signed at Daejeon, on 1 December 2006.

48. Amendment to the Convention on the Physical Protection of Nuclear Material, adopted at Vienna on 8 July 2005, ratified by Law no. 419 of 2006, published in Official Gazette no. 1008 of 19 December 2006

49. Agreement 78/164/Euratom between the Kingdom of Belgium, the Kingdom of Denmark, the Federal Republic of Germany, Ireland, the Italian Republic, the Grand Duchy of Luxembourg, the Kingdom of the Netherlands, the European Atomic Energy Community and the International Atomic Energy Agency in implementation of Article III (1) and (4) of the Treaty on the non-proliferation of nuclear weapons (78/164/Euratom) and Additional Protocol 1999/188/Euratom to the Agreement between the Republic of Austria, the Kingdom of Belgium, the Kingdom of Denmark, the Republic of Finland, the Federal Republic of Germany, the Hellenic Republic, Ireland, the Italian Republic, the Grand Duchy of Luxembourg, the Kingdom of the Netherlands, the Portuguese Republic, the Kingdom of Spain, the Kingdom of Sweden, the European Atomic Energy Community and the International Atomic Energy Agency in implementation of Article III(1) and (4) of the Treaty on the Non-proliferation of Nuclear weapons, adopted by Law no. 185/2007, published in Official Gazette no. 467/11.07.2007.

DECISIONS OF THE GOVERNMENT OF ROMANIA

1. Governmental Decision no. 655/1990 on regulation on some rights granted to the workers which are occupationally exposed to ionising radiations
2. Governmental Decision no. 323/2000 on establishment of composition, the attributions and the rules for organisation and functioning of inter-ministerial Committee for railways transport of dangerous goods
3. Governmental Decision no. 1374/2000 for approval of Norms on application by stages in internal traffic of provisions of the European Accord on international road transport of dangerous goods (ADR), concluded in Geneva on 30 September 1957, to which Romania adhered by the Law no.31/1994
4. Governmental Decision no. 583/2001 establishing criteria to frame activities as research, exploration, exploitation or processing of nuclear raw materials within zones of class I or II of exposures to ionising radiation
5. Governmental Decision no. 71/2002 for approval of methodological Norms for establishment of procedures used in assessment process of products conformity from regulated domains, provided by Law no. 608/2001 on assessment of conformity of products and of the rules for application and use of national marking of conformity CS
6. Governmental Decision no. 916/2002 on approval of the List of materials, devices, equipment and information pertinent for the proliferation of nuclear weapons or of other explosive nuclear devices
7. Governmental Decision no. 1627/2003 on Approval of Rules for Organisation and Functioning of National Commission for Nuclear Activities Control, with subsequent additions and amendments
8. Governmental Decision no. 69/2007, on the modification and completion of the Rules for Organisation and Functioning of the National Commission for Nuclear Activities Control
9. Governmental Decision no. 70/2007, on the approval of the Regulation for Taxes and Tariffs for the licensing and control of nuclear activities.

REGULATIONS

1. Nuclear Safety Republican Norms - Nuclear Reactors and Nuclear Power Stations (1975)
2. Norms for fire prevention and suppression and for supplying with cars, installations, tools, apparatus, protection equipment and chemical substances for fire prevention and suppression, specific for nuclear activities (1976)
3. Order no. 40/1990 of the President of State Committee for Nuclear Energy, approving criteria for establishing radiological risk categories for workplaces of units licensed to perform nuclear activities

4. Technical Prescriptions for Design, Execution, Commissioning, Operation, Repair, Verification of Pressurised Installations with Nuclear Safety Functions (NC1-81)
5. Technical Prescriptions for Design, Execution, Commissioning, Operation, Repair, Verification of Pipes under Pressure and of Elements of Pipes from Nuclear Power Plants and Facilities (NC2-83)
6. Technical Prescriptions for Design, Execution, Commissioning, Operation, Repair, Verification of Pumps from Nuclear Power Plants and Facilities (NC3-86)
7. Technical Prescriptions for Design, Execution, Commissioning, Operation, Repair, Verification of Fittings from Nuclear Power Plants and Facilities (NC4-88)
8. Nuclear Safety Republican Norms on Planning, Preparedness and Intervention in Nuclear Accidents and Radiological Emergencies (1993)
9. Normative for granting and utilisation of individual equipment for protection against ionising radiation (2000)
10. Norms on Designation of Notified Bodies for nuclear domain, (2000)
11. Order no 25/15 February 2000 of the President of National Commission for Nuclear Activities Control, modifying the Nuclear Safety Republican Norms - Working Rules with Radiation Sources (1976)
12. Radiological Safety Fundamental Norms (2000)
13. Norms on Radiological Safety - Operational Radiation Protection of External Workers (2001)
14. Radiological Safety Norms - Licensing Procedures (2001)
15. Safeguards Regulations in Nuclear Field (2001)
16. Physical Protection Regulations in Nuclear Field (2001)
17. Fundamental Norms on Safe Transport of Radioactive Materials (2002)
18. Norms on International Shipments of Radioactive Materials involving Romanian Territory (2002)
19. Norms on radioactive contamination of foods and foodstuffs following a nuclear accident or radiological emergency (2002)
20. Norms on foods and food ingredients treated with ionising radiation (2002)
21. Norms on protection of individuals against ionising radiation in relation to medical exposures (2002)
22. Norms on licensing the use of radiation sources in outside protected areas (2002)
23. Norms on Requirements for Guards and Security Personnel Qualification (2002)
24. Norms on Radiological Safety - Operational Radiation Protection in Mining and Milling of Uranium and Thorium Ores (2002)
25. Norms on individual dosimetric monitoring (2002)

26. Norms on international shipments of radioactive waste involving Romanian territory (2002)

27. Norms on decommissioning of nuclear research reactors (2002)

28. Norms on Radiological Safety - Management of Radioactive Waste from Mining and Milling of Uranium and Thorium Ores (2002)

29. Norms on issuing of exercising permits of nuclear activities and designation of radiation protection qualified experts (2002)

30. Norms on Transport of Radioactive Materials - Licensing Procedures (2003)

31. Norms on Radiological Safety - Acceptance Procedures for External Units (2003)

32. Norms on authorisation of the quality management systems applied to the commissioning, operation and decommissioning of nuclear installations (2003)

33. General requirements for quality management systems applied to the setting-up, operation and decommissioning of nuclear installations (2003)

34. Specific requirements for the quality management systems applied to the evaluation and choosing of the nuclear installations sites (2003)

35. Specific requirements for the quality management systems applied to the research-development activities in nuclear field, (2003)

36. Specific requirements for the quality management systems applied to the design of nuclear installations (2003)

37. Specific requirements for the quality management systems applied to supplies activities dedicated to nuclear installations (2003)

38. Specific requirements for the quality management systems applied to the activities of manufacturing products and providing services dedicated to nuclear installations (2003)

39. Specific requirements for the quality management systems applied to the constructions and assembling activities dedicated to nuclear installations (2003)

40. Specific requirements for the quality management systems applied to commissioning activities of nuclear installations (2003)

41. Specific requirements for the quality management systems applied to the operation of nuclear installations (2003)

42. Specific requirements for the quality management systems applied to the decommissioning activities of nuclear installations (2003)

43. Specific requirements for the quality management systems applied to the ”software” used in the research and design activities dedicated to nuclear installations (2003)

44. Norms on Radiological Safety - Operational Radiation Protection in Deployment of Non-destructive Testing with Ionising Radiation (2003)

45. Norms on Radiological Safety on Interventional and Diagnostic Radiology Practices (2003)

46. Norms on Radiological Safety on Decommissioning of Mining and/or Processing of Uranium and Thorium Installations and Ores - Criteria for Release from the Licensing Regime of National Commission for Nuclear Activities Control, for Use for Other Purposes of Buildings, Materials, Installations, Dumps and Lands Contaminated from the Activities of Mining and/or Processing of Uranium and Thorium Ores (2003)

47. Fundamental Norms on the Safe Management of Radioactive Waste (2004)

48. Norms on Clearance Levels (2004)

49. Norms on Radiological Safety - Licensing Procedures of Mining and Milling Uranium and Thorium Ores, of Row Nuclear Materials and Fabrication of Nuclear Fuel (2004)

50. Norms on Calculation of Dispersion of Radioactive Effluents, Discharged into the Environment by the Nuclear Installations (2004)

51. Norms on Meteorological and Hydrological Measurements at Nuclear Installations (2004

52. Norms on Radiological Safety on Radiotherapy Practice (2004)

53. Norms on Radiological Safety for Nuclear Gauges (2004)

54. List of Accredited Dosimetry Laboratories Nominated by CNCAN (2004)

55. Normative for granting and utilisation of individual equipment for protection against ionising radiation (2005)

56. Norms on Establishing Classes for the Graded Application of the Quality Management System Requirements for Manufacturing of Products and Supply of Services for Nuclear Installations (2005)

57. Norms on Procedures for Licensing of Activities Involving Materials, Devices, Equipment and Information Pertinent for Nuclear Weapons and Other Nuclear Explosive Devices Proliferation (2005)

58. Norms on Granting Exercising Permits for Operating, Management and Specific Training Personnel of Nuclear Power Plants, Nuclear Reactors and Other Nuclear Installations (2005)

59. Norms on Radiological Safety on Nuclear Medicine (2005)

60. Norms on Categorisation of Radioactive Waste (2005)

61. Norms on Limiting the Emissions of Radioactive Effluents (2005)

62. Norms on Monitoring of Radioactive Emissions from Nuclear and Radiological installations (2005)

63. Norms on Environmental Radioactivity Monitoring around Nuclear and Radiological Installations (2005)

64. Norms on Control and Surveillance of International Radioactive Waste Shipments Involving Romanian Territory (2005)

65. Norms on Shutdown Systems for CANDU Nuclear Power Plants (2005)

66. Norms on Containment Systems for CANDU Nuclear Power Plants (2005)

67. Norms on Orphan Sources and High Activity Sealed Sources (2005)

68. Norms on Radioactive Materials Transportation (2005)

69. Norms on Licensing of Personnel Performing Temporary or Permanent Activities in Key Working Points in Nuclear Installations or Have Access to Top Secret Information (2006)

70. Norms on Licensing of Construction of Nuclear Buildings (2006)

71. Norms on Surface Repository of Radioactive Waste (2006)

72. Norms on Medical Exposures to Ionising Radiations for Medical and/or Biomedical Research (2006)

73. Guide on Design of Nuclear Installations Against Internal Sabotage (2006)

74. Norms on Periodic Safety Review of Nuclear Power Plants (2006)

75. Norms on Emergency Core Cooling Systems for CANDU Nuclear Power Plants (2006)

76. Norms on Protection Against Internal Fires and Explosions of CANDU Nuclear Power Plants (2006)

77. Guide on Exterior Illumination of Nuclear Installations (2006)

78. Norms on Radiological Safety for Decommissioning of Uranium and Thorium Mining and Milling Installations (2006)

79. Guide on Technical Requirements for Design, Sitting, Construction, Operation and Decommissioning of Uranium and Thorium Ores Storage Facilities and Waste from Uranium and Thorium Ores Mining and Milling (2006)

80. Norms on Medical Physics Experts (2006)

ANNEX 2

NATIONAL ACTION PLAN FOR HARMONISATION WITH WENRA REFERENCE LEVELS

National Action Plan of ROMANIA
in the framework of the WENRA initiative for "Harmonisation of Reactor Safety in WENRA Countries"

This plan outlines the issues which need to be addressed for harmonisation, until 2010, in accordance with the commitment taken by CNCAN as a member of WENRA. It should be noted that only "generic, formally issued, national safety requirements" were taken into account in the benchmarking of the legal side. Specific regulatory decisions that are legally binding and documented but do not address all licensees equally were not considered (this means that requirements established by the conditions attached to a licence, or by regulatory letters, were not considered in the benchmarking). Therefore, when it is specified in the table provided below that there is no legal requirement fulfilling a certain reference level, it means that there is no provision of a published regulation that fully and explicitly covers the requirement(s) stated in the respective reference level.

The national action plan is at the 3rd revision, being based on the self-assessment performed against the latest version of the reference levels, as published on www.wenra.org in January 2007.

Safety issue	Ref. level	Difference/gap that needs to be addressed with regard to: L = the legal side (regulations/guides) I = implementation	Action to be taken	Time for closing the action
A. Safety Policy	All	L: There are no legal provisions, other than the conditions attached to the operating, explicitly requiring the licensee to establish a safety policy.	A regulation containing requirements on the operation of NPPs will be issued.	2008
B. Operating Organisation	1.1	L: Justification of organisational structure is currently not addressed in the legal requirements, being regulated only through licence conditions.		
	3.1-2	L: Apart from licence condition there is no legal requirement concerning the number of staff necessary for safe operation of the plant, this being addressed more generally by the requirement of ensuring adequate resources.		

Safety issue	Ref. level	Difference/gap that needs to be addressed with regard to: L = the legal side (regulations/guides) I = implementation	Action to be taken	Time for closing the action
	3.3	L: There is no such provision in the existing regulations. See the above note for RLs 3.1-2	This regulation will include the reference levels in issues A, B, H, I, J, K, L+M and Q.	
	3.5	L: Existing legal requirements do not explicitly address the understanding of the licensing basis of the plant. The existing regulations have more general requirements, only addressing the obligation of ensuring adequate competence of licensee's personnel. Only the regulation stating requirements for the categories of staff that need to be licensed by CNCAN has more detailed provisions, including for the knowledge of the licensing basis, but only for control room operators, training instructors and managers.		
	3.6	L: In the existing regulations it is required for the licensee to establish an organisational unit responsible for procurement and for ensuring the adequate competence but there is no explicit provision for maintaining the sufficient number of staff for this unit.		
C. Quality Management	3.1	L: Reference level was not fully covered because the QMS regulations do not specifically mention that the "most senior management position" is accountable and responsible for the implementation of the QMS. This responsibility is assigned in more general terms to the senior management.	The reference levels will be covered as appropriate in the revision of the regulations on Quality Management Systems, which takes account of the new requirements and guidance issued by	2008
	3.4	L: Reference level was not covered because regulation does not mention "appropriate level of management" with regard to the reporting of non-conformances. Only for major non-conformances is specified that they have to be reported to the person in charge with the operation within the authorised limits.		

Safety issue	Ref. level	Difference/gap that needs to be addressed with regard to: L = the legal side (regulations/guides) I = implementation	Action to be taken	Time for closing the action
	3.5	L: There is no legal requirement specifically addressing the collaboration in the implementation of QMS.	IAEA (GS-R-3, GS-G-3.1, etc.).	
D. Training and Authorisation of NPP staff	1.1	L: No explicit reference is made in the existing regulations to the obligation of the licensee to establish a training policy.	The regulation on training and authorisation of plant personnel will be revised to include these reference levels. More general provisions, which are not specifically addressing the personnel licensed also by CNCAN, will be included in the regulation for operation.	2009
	2.1	L: There is no explicit legal requirement for the licensee to provide the training of contractors. The adequacy of the qualification and training received by the contractors at the organisation they belong to is verified through audits performed by the licensee at the suppliers of services. The utility provides only additional training, on-site, for the contractors.		
	3.2	L: Legal requirements are too general to cover the reference level, not explicitly addressing, for example, on-site emergency arrangements.		
	3.4	L: There is no legal requirement specifying the minimum number of days on the simulator.		
	3.5	L: Operational experience, as a general term, is not addressed with regard to training of operators, legal requirements explicitly addressing only the use of event reports for training purposes.		
	3.6	L: There is no legal requirement covering this reference level.		

Safety issue	Ref. level	Difference/gap that needs to be addressed with regard to: L = the legal side (regulations/guides) I = implementation	Action to be taken	Time for closing the action
	4.1	L: The staff controlling the changes are the members of a committee with a fixed composition, consisting of managers (job positions) for which licence from the regulatory body is required. There is no internal authorisation required for licensee's staff controlling changes, other than those required for a certain management level job position.		
	4.2	L: Legal requirements and implementation cover both situations (changing of position and extended absence) only for control room operators. There are no legal requirements for re-authorisation of other persons holding other job positions (management level positions) in case of extended absence.		
E. Design Basis Envelope for Existing Reactors	2.2	L: There is no legal requirement generally addressing the prevention of failure of a barrier as consequence of a failure of another barrier.	The reference levels in Issues E, F and G will be included in the regulation "Requirements on the Design of Nuclear Power Plants"	2008
	4.1	L: There is no legal requirement to cover completely what the reference level requires for inclusion in the design bases.		
	4.2	L: There was no legal requirement generally addressing the set of postulated initiating events and their selection, at the time of the benchmarking. The minimum list of postulated initiating events for CANDU is given in the annexes to the regulations on the safety systems that have been issued in the end of 2005 and in the beginning of 2006 ("Requirements on Containment Systems for CANDU Nuclear Power Plants", "Requirements on Shutdown Systems for CANDU Nuclear Power Plants" and "Requirements on Emergency Core Cooling Systems for CANDU Nuclear Power Plants").		

Safety issue	Ref. level	Difference/gap that needs to be addressed with regard to: L = the legal side (regulations/guides) I = implementation	Action to be taken	Time for closing the action
	5.2	L: There is no legal requirement that fully covers the reference level. However, general legal requirements exist for plant systems to be designed to withstand the effects of external events such as earthquakes, flooding, storm, snow, according to site specific conditions, but the list of events is not as detailed as the one given in the annex to the reference levels. With regard to implementation, some external events from the list were screened out of the analyses, based on site-specific considerations.		
	7.1	L: There is no legal requirement to address the grouping of PIEs into categories according to their probability of occurrence. There are no legal requirements assigning dose limits by accidents' probability of occurrence.		
	7.2	L: There are no legal requirements to cover this reference level.		
	7.3	L: Existing legal requirements do not specifically address maximum pressure and temperature for the reactor coolant pressure boundary.		
	7.4	L: There are no legal requirements to cover this reference level.		
	8.1 - 7	L: There are no legal requirements to cover these reference levels. Regarding E 8.5, according to the Romanian regulations the minimum allowable performance standards for the safety systems, as assumed in the accident analyses, have to be defined and listed in the SAR and in the Operating Policies and Principles for the plant. The minimum allowable performance standards take into account the requirement for the safety systems to be considered operating at their "performance level that is most penalising for the initiator"		

Safety issue	Ref. level	Difference/gap that needs to be addressed with regard to: L = the legal side (regulations/guides) I = implementation	Action to be taken	Time for closing the action
	9.4	L: For safety systems the reference level is covered by the Romanian regulations on CANDU “special safety systems”. However, the other existing legal requirements do not provide coverage of the reference level for all the safety related systems and not all the means for achieving reliability are explicitly addressed. This RL will be included in the regulation “Requirements on the Design of Nuclear Power Plants”.		
	10.1	L: There are no legal requirements addressing the automatic recording of parameters important to safety.		
	10.5	L: There is no legal requirement to fully cover this reference level. The existing requirements focus on the protection against radiation.		
	10.6	L: There are no explicit regulatory provisions regarding the independence of the supplementary control room.		
	10.10	L: There is no legal requirement to cover this reference level.		
	11.1	L: At the time of the benchmarking the reference level was not fully covered by the existing regulations. At present, it is considered to be largely covered by the provisions of the regulation on periodic safety reviews. However, given the fact that the reference level is aimed at ensuring reviews more frequent than with the occasion of PSRs, it will be included in the regulation “Requirements on the Design of Nuclear Power Plants”.		
	1.1, 2.1-2	L: In the existing regulations there is no explicit reference to beyond design basis accidents. I: The analyses for beyond design basis accidents are now available (for CANDU 6), but they have to be adapted, as necessary, for Cernavoda NPP.		

Safety issue	Ref. level	Difference/gap that needs to be addressed with regard to: L = the legal side (regulations/guides) I = implementation	Action to be taken	Time for closing the action
F. Design Extension for Existing Reactors	3.1 - 2, 4.1 - 5	L: There are no legal requirements to cover these reference levels. I: With regard to the implementation, the available severe accident analyses are used to assess the adequacy of the existing provisions and to identify all necessary improvements. The applicable beyond design basis events from the list provided in the appendix have been considered in the analyses. An assessment of the reasonably practicable design improvements will be performed as part of the PSR for Cernavoda NPP Unit 1. The year for completion of safety improvements if these are shown to be necessary, will be established after the above mentioned assessment is finalised.	The reference levels in Issues E, F and G will be included in the regulation “Requirements on the Design of Nuclear Power Plants”	L: 2008
	4.6	L: There is no legal requirement covering this reference level. I: High-pressure core melt ejection, as a threat to the integrity of the containment, is not possible in CANDU.		
	4.7	L: There is no legal requirement to cover this reference level. I: Means for preventing containment melt through are inherently provided by design (e.g. large volume of water in calandria vault allowing retaining of molten material inside the calandria vessel, the large surface area for melt relocation and large pool on containment floor if calandria vessel fails).		

Safety issue	Ref. level	Difference/gap that needs to be addressed with regard to: L = the legal side (regulations/guides) I = implementation	Action to be taken	Time for closing the action
G. Safety Classification of Structures, Systems and Components	1.1	L: The requirement for maintenance activities on SSCs to be commensurate with their safety class is not explicitly addressed by the existing legal requirements. However comprehensive regulations exist with regard to the application of the graded approach in all activities, the classification for the purpose of grading the requirements of the QMS having the safety classification as basis.	The regulation “Requirements on the safety classification of CANDU NPP SSCs” , currently in draft, includes all the reference levels in Issue G. However, as the RLs in Issue C are quite general, and they will be included in the regulation on design, together with the RLs in E & F.	2008
	2.1, 2.2 3.2, 4.1	L: There are no legal requirements covering these reference levels.		
	4.2	L: The qualification procedure is not addressed by the existing legal requirements.		
H. Operational Limits and Conditions	2.3	L: There is no legal requirement addressing modifications to OLCs. This issue has only been addressed by means of licence conditions.	A regulation containing requirements on the operation of NPPs will be issued. This regulation will include the reference levels in issues A, B, H, I, J, K, L+M and Q.	2008
	2.2	L: There is no legal requirement specifically addressing the process of review and update of OLCs. This issue is regulated through licensing conditions.		
	3.1	L: There is no legal requirement explicitly addressing the accessibility of OLCs for control room personnel.		
	4.1	L: The existing legal requirements refer only generally to plant procedures, not addressing specifically the document containing the OLCs.		
	5.1	L: There is no legal requirement covering this reference level.		

Safety issue	Ref. level	Difference/gap that needs to be addressed with regard to: L = the legal side (regulations/guides) I = implementation	Action to be taken	Time for closing the action
	5.2	L: There is no legal requirement covering this reference level.		
	6.1	L: There is no legal requirement addressing the time allowed for operating staff to complete actions required in the case of deviations from OLCs. The OLCs are under the control of the regulatory body, any modification to them being possible only with approval from the regulatory body The OLCs cover the provisions of RLs 6.1-3 .		
	6.2	L: The legal requirement is too general, not mentioning the specification of the time allowed to complete the action.		
	6.3	L: There is no legal requirement to cover this reference level.		
	8.1	L: There is no legal requirement concerning minimum staffing levels for shift staff. This is regulated through license conditions.		
I. Ageing Management	1.1	L: There is no legal requirement stated in a published regulation. The establishment of the Ageing Management Programme was required by licence condition.	All the reference levels in Issue I will be covered by the regulation containing requirements on operation. This regulation will include the reference levels in issues A, B, H, I, J, K, L+M and Q.	2008
	2.1	L: There is no legal requirement addressing the relevant ageing mechanisms.		
	2.2	L: The legal requirement is too general, providing no explicit reference to ageing specific surveillance activities.		
	2.4	L: There is no legal requirement stated in a published regulation. The establishment of the Ageing Management Programme was required by licence condition.		

Safety issue	Ref. level	Difference/gap that needs to be addressed with regard to: L = the legal side (regulations/guides) I = implementation	Action to be taken	Time for closing the action
	2.5	L: There is no legal requirement stated in a published regulation. The establishment of the Ageing Management Programme was required by licence condition.		
	3.2	L: The legal requirement for monitoring activities is too general, asking for the detection of any deficiency in due time, without addressing preventive and remedial actions.		
J. System for Investigation of Events and Operational Experience Feedback	1.2	L: In the existing legal requirements the undetected safety relevant events and the reduction of safety margin are not addressed.	A regulation containing requirements on the operation of NPPs will be issued. This regulation will include the reference levels in issues A, B, H, I, J, K, L+M and Q.	2008
	1.3	L: Staff designated for the dissemination of findings important to safety is not explicitly addressed.		
	1.4	L: Legal requirements focus on investigation of events, and do not cover the evaluation of all operational experience and also the corresponding training is not addressed.		
	1.5	L: Legal requirements focus on significant events and there is no explicit mention of timely implementation of corrective actions.		
	2.1	L: There is no legal requirement referring specifically to the organisation of information from operational experience, regarding both normal and abnormal operation.		
	3.2	L: Reporting of near misses is not addressed.		
	3.3	L: The legal requirements do not specifically address the information resulting from all operational experience, the focus being on information regarding plant's own operating experience.		

Safety issue	Ref. level	Difference/gap that needs to be addressed with regard to: L = the legal side (regulations/guides) I = implementation	Action to be taken	Time for closing the action
	3.4	L: Relevant events at other plants are not mentioned with regard to training of personnel with tasks related to safety and the legal requirements for training refer only to control room operators and to management level job positions.		
	4.1	L: The initial self-assessment of events important to safety is not addressed.		
	4.2	L: There is no legal requirement to cover the RL.		
	4.3	L: There is no legal requirement to cover the RL.		
	4.4	L: The legal requirements for establishing interfaces between the operating organisation and the organisations involved in design and construction do not specifically address obtaining advice in case of equipment failures but instead mentions the possibility of improving the design and construction activities based on insights from operation.		
	5.1	L: There are only legal provisions regarding regular analysis of the effectiveness of the OEF process in preventing event recurrence. Other performance criteria are not mentioned.		
	4.4	L: There is no rule that the licensee shall maintain liaison with the designer, manufacturer etc. with the aim of feeding back information.		
	1.1	L: Reassessment in the light of experience is mentioned only for the preventive maintenance program. The purpose of ensuring the availability, reliability and functionality of SSCs is not generally addressed for all the programmes, more detailed provisions existing for testing and surveillance than for maintenance and inspection.		
	2.1	L: The existing legal requirements do not fully cover the reference level. Inherent reliability and potential for degradation are not mentioned.		

Safety issue	Ref. level	Difference/gap that needs to be addressed with regard to: L = the legal side (regulations/guides) I = implementation	Action to be taken	Time for closing the action
K. Maintenance, In-service Inspection and Functional Testing	2.2	L: There is no legal requirement to cover this reference level.	A specific section on maintenance, in-service inspection and functional testing will be provided in the regulation containing requirements for operation and will cover all the reference levels in Issue K. The regulation on operation will include the reference levels in issues A, B, H, I, J, K, L+M and Q.	2008
	2.3	L: Incipient and recurrent failures are not addressed in the legal requirements.		
	2.4	L: There are no legal requirements for reviewing the maintenance programme in light of the operating experience and changes to the programme are not addressed.		
	3.1	L: The existing legal requirements are focusing on certain safety systems, not addressing all the SSCs important to safety.		
	3.2	L: The existing legal requirements do not address validation of procedures.		
	3.5	L: There is no legal requirement to cover this reference level.		
	3.6	L: There is no legal requirement explicitly addressing the process that should be followed with regard to repairs to SSCs.		
	3.7	L: There is no legal requirement to cover this reference level.		
	3.10	L: The qualification is not explicitly addressed.		
	3.11	L: The existing legal requirements are too general to cover the reference level.		
	3.12	L: There is no legal requirement to cover the reference level.		
	3.13	L: The reference level is not covered by the existing regulations. A regulation containing provisions regarding the leak rate tests and the testing of penetration seals and closure devices has been published, but it does not address the inspections for structural integrity.		

Safety issue	Ref. level	Difference/gap that needs to be addressed with regard to: L = the legal side (regulations/guides) I = implementation	Action to be taken	Time for closing the action
L+M. Emergency Operating Procedures + Severe Accident Management Guidelines	1.1	L: The requirement for developing procedures for emergency conditions is too general, not mentioning DBAs and BDBAs. There is no legal requirement for the development of SAMGs.	A regulation containing requirements on the operation of NPPs will be issued and will include the reference levels in issues A, B, H, I, J, K, L+M and Q. SAMGs are under development.	L: 2008 I: 2008
	2.1	L: The existing legal requirements are too general, not explicitly addressing the purpose of EOPs to recover the plant state to a safe condition.		
	2.2, 2.3, 2.4, 3.1, 3.3, 4.1, 4.2, 5.1	L: There are no legal requirements to cover these reference levels.		
	3.2	L: There is no legal requirement to address the entry and exit conditions for procedures. The available SAMGs need to be adapted to plant specificities.		
	6.1	L: The existing legal requirements do not include provisions for SAMGs.		
	6.2, 6.3	L: There is no legal requirement with regard to SAMGs.		
	1.1, 2.3, 3.2-3, 4.1, 5.1, 6.1-3	I: SAMGs are available but they need to be adapted to plant specificities.		
N. Content and Updating of Safety Analysis	1.1	L: The use of the SAR for continuous support of safe operation is not explicitly addressed. This is required through licence conditions. The practice until now was to renew the operating licence every two years and the main licensing document was the updated FSAR.	The regulation containing provisions	2008

Safety issue	Ref. level	Difference/gap that needs to be addressed with regard to: L = the legal side (regulations/guides) I = implementation	Action to be taken	Time for closing the action
Report	2.2	L: Shutdown state and accident conditions not addressed in the regulatory requirement which is too general.	on the SAR will be revised to include the reference levels in Issue N.	
	2.7	L: The regulatory requirement does not mention safety criteria and radiological release limits used for assessment of plant's response to postulated initiating events.		
	2.8	L: There are no legal requirements for describing operational experience feedback programme and ageing management programme in the SAR.		
	2.10	L: Policy & strategy not explicitly mentioned in the legal requirement.		
	2.13	L: The decommissioning plan and measures for coping with end-of-life aspects are required by the Law no. 111, on the Safe Deployment of Nuclear Activities, which does not give further specifications for including these in the SAR.		
	3.1	L: No explicit legal requirement is currently provided in national regulations regarding updating of SAR as soon as possible to reflect relevant standards and new regulations.		
O. Probabilistic Safety Analysis	All	L: The regulation on Probabilistic Safety has been published in 2006.	The regulation containing the reference levels in Issue O has been issued in 2006.	I: 2010
	1.1	I: PSA for shutdown state has not been finalised this year. PSA Level 2 will start in 2008.	Work on PSA Level 2 is scheduled to start	

Safety issue	Ref. level	Difference/gap that needs to be addressed with regard to: L = the legal side (regulations/guides) I = implementation	Action to be taken	Time for closing the action
	3.1, 3.4-5	I: There is an ongoing process for defining and implementing the use of PSA Level 1 results as support for safety management purposes. Up to present, only the use of the risk monitor has been defined and documented. For the rest of risk-informed applications that are envisaged, work is in progress.	in 2008.	
	4.2	I: Until now there was no such request.		
P. Periodic Safety Review	All	L: All the reference levels have been included in a regulation for PSR ("Norms on Periodic Safety Review of Nuclear Power Plants"), which was issued in May 2006. I: The reviews performed for license renewal, every two years, have been considered as a practice equivalent to the PSR. The first PSR for Cernavoda NPP Unit 1 will start this year.	The regulation on PSR has been issued. The PSR for Cernavoda NPP Unit 1 will commence this year.	I: 2010
Q. Plant Modifications	1.1-2	L: Up to date there is no legal requirement covering these reference levels.	A regulation concerning only plant modifications has been drafted, covering all the reference levels in Issue Q, but it will be issued as a section of the regulation with requirements on operation.	2008
	2.1	L: The existing legal requirements are too general with respect to permanent modifications.		
	2.2	L: There is no legal requirement to detail the steps of the process which should be followed for modifications to SSCs.		
	3.1	L: There is no legal requirement for performing an initial safety assessment.		

Safety issue	Ref. level	Difference/gap that needs to be addressed with regard to: L = the legal side (regulations/guides) I = implementation	Action to be taken	Time for closing the action
	3.2	L: There is no legal requirement for performing a more detailed safety assessment, depending on the results of the first assessment. The existing legal requirements address safety assessments only generally, without making a distinction. However there is a requirement for applying a graded approach to all safety related activities, based on safety classification of SSCs which may be affected by those activities.		
	3.3	L: There is no legal requirement covering this reference level.		
	3.4	L: There are only general requirements concerning the independent review of safety related activities, not specifically addressing the review of the modifications.		
R. On-site emergency preparedness	5.1	L: The identification of the knowledge, skills and abilities is not addressed by the existing legal requirements.	New regulations for emergency preparedness are under consultation with national stakeholders and will be issued in 2007. These regulations will include all the reference levels in Issue R.	2007
	5.2	L: Legal requirements refer only to Licensee's own personnel. The arrangements made for informing "all other persons present on the site" are not specifically mentioned.		

Safety issue	Ref. level	Difference/gap that needs to be addressed with regard to: L = the legal side (regulations/guides) I = implementation	Action to be taken	Time for closing the action
S. Protection against internal fires	-	Reference levels 2.2-3, 3.1-4, 5.1, 6.1, and 6.3-4 were qualified as B for the legal side, due to the fact that they were not fully covered by the existing regulations but they had been included in a regulation which was in draft at the time of the benchmarking. The regulation “Requirements on Fire Protection of Nuclear Power Plants” was issued in June 2006. It includes all the reference levels in Issue S, although some of them had been covered by an old regulation (used at the time of the benchmarking), whose requirements have been superseded by the new regulation.	The regulations on this matter have been revised. A new regulation “Requirements on Fire Protection of Nuclear Power Plants” has been issued in 2006.	-

ANNEX 3

IRRS RECOMMENDATIONS

and

ACTION PROGRESS

Overview of recommendations made by the IRRS mission and of the implementation status

The following table gives a selection of recommendations made by the IRRS team, in the areas and topics that are most relevant for the activities of CNCAN in the regulation, licensing and control of nuclear installations under the scope of the Convention. The implementation status provides an overview of the actions that were made or that are still in progress to resolve the issues identified, in relation to the respective recommendations.

No.	Area of Review	Code of IRRS Finding	Recommendation	Implementation status
1	Legislative and governmental responsibilities	R1.	The Government of Romania should consider revision of conflicting sections of Articles 3 and 17 of law 321/2003 and related government decisions and rules so that the regulatory body remains effectively independent and judgements can be made, and enforcement actions taken, without pressure from interests that may conflict with safety.	In 2006 Law 57/2006 was issued to modify and complete the Government Ordinance 7/2003 approved by Law 321/2003. The attributions and responsibilities of the Nuclear Agency (AN) have been accordingly modified by law 57, AN being now in charge with promotion of nuclear activities, under the subordination of Ministry of Economy and Finances.
2		R2.	The Government of Romania should consider repeal of overlapping sections of Articles 9 of law 320/2003 and related government decisions and rules so that clear responsibility could be assigned to the regulatory body for establishing safety principles, criteria, and regulations for safe management of spent nuclear fuel and radioactive waste.	According to art. 9 of the law 320/2003, ANDRAD in responsible only for the coordination of the management of spent fuel and radioactive waste. ANDRAD is subordinated to the Ministry of Economy and Finances. The regulation, licensing and control of the management of spent fuel and radioactive waste is under the responsibility of CNCAN. However, recognising that any potential for confusion should be avoided, measures will be taken for a clearer formulation of the legal provisions.

No.	Area of Review	Code of IRRS Finding	Recommendation	Implementation status
3	**Organisation of the regulatory body**	R4	The Government of Romania should consider a review of Governmental Decision 1627 / 2003 in order to provide CNCAN with greater flexibility in the management of its organisational structure.	Although Governmental Decision was revised, the process of approval of organisational structure (by the has not been changed (changes to CNCAN structure are approved by Governmental Decision). Even so, changes in the organisational structure of CNCAN have been done in 2007, taking into account recommendations made by IRRS.
4		**R5**	CNCAN should take all necessary steps to ensure that the vacant positions are filled by suitably qualified and experienced persons.	Three examination sessions for filling the vacant positions have been organised by CNCAN in 2006 and 2007. However, because the number of suitable qualified and experienced persons in the country is continuously decreasing, not all vacant positions were filled. Another session is scheduled for October 2007.
5	**Authorisation Process**	**R7**	CNCAN should revise regulations on safety requirements for authorisation of practices and facilities to include requirements for the documentation to be presented in support to the authorisation request to ensure compliance with the new IAEA safety standards and other international requirements taking into account the current authorisation needs.	CNCAN is in progress revising the regulation Nuclear Safety Requirements (NSR) - Nuclear Reactors and Nuclear Power Plants (1975), which contains provisions concerning licensing basis documentation, and which sets the requirements for the support documentation to be presented by the applicant for each stage of the licensing process, taking into account that the normal practice is to require a greater amount of safety documentation than just the Safety Analysis Reports referenced in the existing regulation (ISAR, PSAR and FSAR. The more detailed requirements for support documentation are however set in each of the regulations issued for specific areas (such as PSA, Fire Protection, etc.). See also R 13.

No.	Area of Review	Code of IRRS Finding	Recommendation	Implementation status
6		R 10	In order to place prime responsibility on the operator for ensuring quality assurance of component suppliers and subcontractors, the present Romanian Legislation should be modified at the earliest opportunity so that CNCAN is released from its obligation to issue quality assurance authorisations for component suppliers and subcontractors.	This is currently under discussion, to establish an alternative means for independently controlling the activities of the contractors, without licensing them. The prime responsibility of the operator is not diminished by the current practice of licensing contractors, as the utility can reject any contractors that do not meet its own criteria.
7		R13	The regulation "Nuclear Safety Norms - Nuclear Reactors and Nuclear Power Plants (1975)" should be updated so as to specify the format and content of Safety Analysis Report for various nuclear power plants in order to ensure compliance with the recent IAEA safety standards and international requirements on nuclear safety. The format and contents of SARs for nuclear installations other than NPPs should be addressed separately in appropriate regulations.	The regulation will be revised. The necessity of revising this regulation has arisen also from the benchmarking performed on the occasion of the WENRA study for harmonisation of nuclear safety requirements.
8	**Review and Assessment**	R14	CNCAN management should take actions to complete its internal review and assessment procedures, concentrating on assessment of compliance with the technical requirements contained in relevant regulations.	Completing the CNCAN internal review and assessment procedures set is in progress, as well as revising and updating the existing ones. Technical assistance through Phare projects is being used for high importance complex subjects, such as PSA and PSR. The set of procedures for review of PSA will be elaborated and issued by the end of 2008. Other internal procedures are currently under revision, to be issued by the end of this year (e.g. for review of design changes).

No.	Area of Review	Code of IRRS Finding	Recommendation	Implementation status
9		R 15	CNCAN should ensure that number of staff involved in safety analyses be increased as planned and receive appropriate training.	An expert in deterministic safety analyses, with 15 years of experience in SITON – Centre for Nuclear Engineering and Technology has been employed by CNCAN in March this year. See also R5.
10		R 16	CNCAN should ensure that adequate resources are allocated in its budget in order to allow acquiring necessary computational tools and for external support as necessary.	In accordance with the Law, CNCAN collects the money for its budget from fees charged for performing inspection activities and technical assessments and for granting licences, permits and authorisations. The fees charged for these activities are established through the Regulation for Taxes and Tariffs, elaborated by CNCAN in consultation with the Ministry of Economy and Finances and approved by Governmental Decision. The Regulation for Taxes and Tariffs is periodically reviewed to ensure that CNCAN funding is sufficient to adequately cover all the expenses associated with the efficient performance of regulatory activities. The last revision in June 2007 (previous one dating from 2004), changed the approach from “fee per activity” to “fee per utility” and provided for a significant increase of tariff level.
11		R17	Special attention should be devoted to enhancing of the CNCAN capabilities in the area of probabilistic safety assessment due to its importance not only for evaluating safety of nuclear installations, but also for future implementation of risk informed regulations as intended.	The Phare project RO 017_519.03.01 proposed in 2005 has been contracted and initiated in August 2007. The project, having as one of the objectives to improve CNCAN staff capabilities with regard to PSA review, has an implementation period of 14 months and includes 600 man-hours of theoretical and practical training.
12	Inspection and enforcement	R18	CNCAN should take immediate steps to fill the two vacant posts in the NPP surveillance team	Although the two vacant posts in NPP surveillance section were filled with one mechanical and one

No.	Area of Review	Code of IRRS Finding	Recommendation	Implementation status
			at Cernavoda. One of these should be a radiation protection expert.	electrical engineer, another vacancy was created, as one of the members of the original team left. See also R5.
13		**R19**	CNCAN should train new site inspection staff in all aspects of nuclear and radiation safety regulation to enable them to evaluate safety priorities and to ensure that they are fully aware of the inspection criteria.	During 2007 the new site inspectors received training in regulatory inspections and quality assurance during commissioning through the Phare project RO 016_815.02.02. Radiation protection training is ensured through participation at the NPP training programme.
14		**R21**	CNCAN should prioritise its inspection plans so as to focus on safety significant issues. This is applicable to all regulated installations, facilities and activities.	For Cernavoda NPP, the inspections are focused on those areas that would pose significant risk is case of poor performance of plant systems or staff. However, PSA insights are not used systematically at present, but activities are ongoing for developing the capability of using risk-informed regulatory applications.
15	**Development of regulations and guides**	**R23**	Government of Romania should consider the revision of Appendix 2 “definitions” of Law 111/1996 item 24 to exclude guidance from the definition of mandatory regulations.	This will be taken into account in the next revision of the Law.
16	**Emergency preparedness**	**R24**	CNCAN structure should be amended such that the emergency preparedness function reports directly to the CNCAN President.	CNCAN structure has been revised in 2006, the Radiological Emergency Office has been moved from the Radiation Protection and Waste Management Division and is now directly subordinated to the CNCAN President.

No.	Area of Review	Code of IRRS Finding	Recommendation	Implementation status
17		R25	CNCAN should ensure that all staff who may participate in the CNCAN emergency response organisation receive training on their specific roles in the National Emergency Plan and also in relation to the role of other organisations and individuals. This training should be repeated to accommodate new staff and refresher training for existing staff.	In the period of 2006-2007, supported by the Phare project RO 5812.06.01.01, CNCAN elaborated its Strategy for Operation of CNCAN Emergency Response Centre, including in the short-term action plan training of CNCAN staff in their role and responsibilities and participation of CNCAN staff in routine emergency exercises.
18		R26	CNCAN should review, and amend as necessary, its procedures relevant to its emergency preparedness after each major national exercise according to lessons learned.	The review of the procedures relevant to emergency preparedness has been done in the process of establishing the strategy for the Emergency Control Centre of CNCAN. See R25.
19		R27	Pending the completion of the PHARE Project that will provide a data link with Cernavoda, CNCAN should determine which documents and equipment is should be in place at the CNCAN emergency centre to enable the CNCAN experts to carry out their work during an emergency.	Phare project RO 5812.06.01.01 included also a supply component, through which adequate equipment was ensured for the CNCAN Emergency Response Centre (ERC). Development of supporting material for ERC: formal procedures, basic assessment data is included in the short-term action plan in CNCAN strategy for operation of the centre.
20	**Radiation protection**	R54	CNCAN should modify its own list of exposed staff so that to ensure that all staff working regularly or occasionally in controlled area in the plants or facilities is included.	CNCAN modified its own list of occupationally exposed personnel, in order to include all the inspectors entering controlled zones of radiological and nuclear installations; this professionally exposed personnel was also included in a medical surveillance program, for which CNCAN contracted a specialised medical centre. In order to assure the radiological surveillance of its professionally exposed workers, CNCAN contracted an accredited dosimetric body, as required by the legislation.

No.	Area of Review	Code of IRRS Finding	Recommendation	Implementation status
21		**R60**	CNCAN should ensure that the ALARA evaluation takes into account all activities during the outages at the NPP including internal exposure and the review and assessment of the ALARA evaluation is forwarded to CNCAN before outage.	The recommendation was implemented, the NPP procedure on the ALARA principle implementation process being revised and approved by CNCAN last year. Also, the radioprotection inspection before NPP outage is focused not only in those aspects regarding the necessary radioprotection equipments, but mainly in the assessment of ALARA evaluation of all planned activities, including internal exposures.

ANNEX 4

COMMISSIONING LICENCE FOR CERNAVODA NPP UNIT 2

GUVERNUL ROMANIEI
(THE GOVERNMENT OF ROMANIA)
CANCELARIA PRIMULUI MINISTRU
(PRIME MINISTER'S CHANCELLERY)

COMISIA NATIONALA
PENTRU CONTROLUL ACTIVITATILOR NUCLEARE
(NATIONAL COMMISSION FOR NUCLEAR ACTIVITIES CONTROL)

14 Libertatii Blvd., Bucharest 5, CP 42-4
Phone: +4021 316 05 72, Fax: +4021 317 38 87

LICENCE FOR THE DEPLOYMENT OF NUCLEAR ACTIVITIES
No. SNN U2 – 02/2006

Based on Article 8 and Article 24 of Law no. 111/1996, republished, regarding the safe deployment, regulation, licensing and control of nuclear activities, and based on the Decision of the Prime Minister no. 220/14.041.2006 regarding the nomination of the CNCAN President, and on the Nuclear Safety Regulations, based on the evaluation of the documentation presented in Appendix 01, Point 1, finding that the legal provisions are met,

NATIONAL COMMISSION FOR NUCLEAR ACTIVITIES CONTROL

LICENSES

SOCIETATEA NATIONALA „NUCLEARELECTRICA" SA

headquartered in Bucharest, 65 Polona St., postal code 010505, phone number: 021 203 82 00, fax number: 021 211 94 00, legal entity, registered at the National Registry of Commerce with no. J40/7403/98 and at the Commerce and Industry Office with Certificate of registration no. B 0212290/10.09.2003, Sole Registration Number 10874881;

to perform activities in the nuclear field for

COMMISSIONING
OF CERNAVODA NUCLEAR POWER PLANT UNIT # 2

according to the submitted documentation, the CNCAN Nuclear Safety Regulations, the licensing support documents and the conditions in Appendix no. 01, 02, 03, 04 which are part of this licence.

Valid from: 08.10.2006
Expiring on: 07.10.2008

President
signature of
Vilmos Zsombori

Appendix no. 01
to the Licence for deployment of nuclear activities No. SNN U2 – 02/2006, for the commissioning of Cernavoda Nuclear Power Plant Unit 2

GENERAL CONDITIONS

1. The present licence is issued based on the following documents:

(A) Licence application submitted by SNN letter no. 87552/11.08.2006, registered by CNCAN with no. 12639/VZ/11.08.2006, and the documents referenced by SNN in the letter;

(B) The Final Safety Analysis Report (FSAR) for Cernavoda NPP Unit 2, May 2006 edition, approved by the Technical-Economical and Scientific Council of SNN with licence no. 11/3.05.2006, submitted to CNCAN with SNN letter no. 83536/31.05.2006, registered by CNCAN with no. 8911/VZ/31.05.2006 and approved by CNCAN with letter no. 25826/5.06.2006;

(C) „Licensing Deliverables" document, code 82-IR-00551-001, revision 2, submitted by SNN letter no. 85680/5.07.2006 and registered by CNCAN with no. 10781/VZ/2006;

(D) The Licence for Quality Assurance in Nuclear Field no. SNN U2-01/2005, issued by CNCAN on 22.12.2004 to authorize the quality management system in nuclear field for the management of the construction-installation activities at Cernavoda NPP Unit 2, sent to SNN by CNCAN letter no. 32322/22.12.2004;

(E) Licence for deployment of nuclear activities no. SNN U2-01/2003, issued by CNCAN on 01.10.2003 for construction activities at Cernavoda NPP U2, sent to SNN by CNCAN letter no. 10534/LB/01.10.2003;

(F) Statute of Societatea Nationala „Nuclearelectrica" SA, published in the Official Gazette no. 246 of 3.07.1998, with the modifications mentioned in GD (Government Decision) no. 627/2000 of 13.07.2000, published in the Official Gazette, Part I, no. 357/31.07.2000;

(G) The Certificate of registration of Societatea Nationala „Nuclearelectrica" at the National Registry of Commerce by the Bucharest Law Court, no. B 0212290;

(H) „Quality Management Manual of SNN", document code SNN-MMC-001, revision 6, submitted to CNCAN with letter 83938/7.06.2006, approved by CNCAN letter 9332/VZ/07.06.2006;

2. The Commissioning of the nuclear installation is the subject of the conditions included in the License Appendices 02, 03 and 04, which are part of the present licence, and to which SNN shall comply.

3. CNCAN authorises SNN to store raw nuclear materials in the nuclear installation as indicated in Table 1 of Appendix 02 to the present licence, as well as other radioactive materials necessary for the commissioning of the nuclear installation licensed by the present document. Storage of raw nuclear materials and radioactive materials is subject to specific conditions included in Appendix 02 to the present licence, to which SNN shall comply.

4. The right gained by the licence holder cannot be transferred without CNCAN agreement, according to the provisions of Article 10 of Law 111/1996 on the safe deployment, regulation, licensing and control of nuclear activities, republished with the subsequent modifications and completions.

5. The present licence can be amended, modified, suspended or withdrawn by CNCAN, according to the provisions of Articles 11, 13 and 15 of Law 111/1996 regarding the safe deployment, regulation, licensing and control of nuclear activities, republished with the subsequent modifications and completions.

Appendix no. 02

to the Licence for deployment of nuclear activities No. SNN U2 – 02/2006, for the commissioning of Cernavoda Nuclear Power Plant Unit 2

CONDITIONS FOR THE COMMISSIONING OF THE NUCLEAR INSTALLATION

GENERAL CONDITIONS

1. The commissioning of the nuclear installation shall be performed in conformity with the following documents:

(A) SNN “Nuclear Safety Policy”, code SN-00-01, latest revision approved by CNCAN;
(B) SNN “Environmental Policy”, code SN-00-05, latest revision approved by CNCAN;
(C) SNN “Quality Management Manual of SNN” code SNN-MMC-001, latest revision approved by CNCAN;
(D) Cernavoda NPP Unit 2 “Cernavoda NPP Unit 2 Project Quality Assurance Manual”, code PMT-QAM-001.00, latest revision approved by CNCAN;
(E) Cernavoda NPP Unit 2 “Cernavoda NPP Unit 2 Commissioning Quality Assurance Manual”, code PMT-CQAM-001.02, latest revision approved by CNCAN;
(F) Cernavoda NPP Unit 2 “Operating Policies and Principles”, code 82-01364-RD-L1, latest revision approved by CNCAN;

The above mentioned documents shall not be modified unless written approval of the National Commission for Nuclear Activities, further referred as CNCAN, is given.

2. SNN shall provide to CNCAN all documents mentioned in the Information Report “Licensing Deliverable”, document code 82-00551-IR-001, latest revision approved by CNCAN.

3. Physical protection measures for the raw nuclear materials and for the nuclear installation shall be adopted and maintained in accordance with CNCAN requirements.

4. The Commissioning License for Cernavoda NPP Unit 2 enforces compliance with all requirements of Romanian legislation, applicable in the specific conditions of a nuclear installation.

5. Activities, reports, tests, inspections, analyses, procedural changes required by CNCAN, shall be executed with expedience.

CONDITIONS REGARDING THE APPROVALS OF CHANGES TO DESIGN AND OPERATION

6. Except for the cases for which CNCAN grants prior written approval, no modification shall be made, not even temporary, which could affect the safety margins resulted from the accident analyses included in the Final Safety Analysis Report, latest edition approved by CNCAN, or from the content of the documents referenced in the licence application and in the present licence, especially for the Shutdown Systems no. 1 and 2, Containment System, Emergency Core Cooling System or any other support system of the aforementioned, as well as for any other safety related systems referenced in the reference document "Nuclear Safety Related System List", code 82-01364-RD-C05, last revision approved by CNCAN.

7. Except for the cases for which CNCAN grants prior written approval, no change shall be made in the procedures, equipments or any other documentation which could generate possible events of different nature or with a higher probability of occurrence or more severe than those provided in the Final Safety Analysis Report, latest edition approved by CNCAN, and in other documents referenced in the licence application and in the present licence.

8. Change of the technical specifications and design drawings used by the manufacturer for manufacturing the fuel shall be made with prior CNCAN approval.

REPORTING REQUIREMENTS

9. Reporting shall be made in accordance with the following operating instructions, by case:
   a) "Commissioning Unplanned Events Reporting", code SI-01365-C26, latest revision approved by CNCAN;
   b) "Unplanned Events Reporting", code SI-01365-P13, latest revision approved by CNCAN.

10. SNN shall inform CNCAN in writing, on a monthly basis, upon the status of commissioning activities.

CONDITIONS REGARDING THE QUALITY ASSURANCE AND RECORDS MAINTENANCE PROGRAM

11. Necessary records shall be kept of all operation and maintenance activities, tests results, periodical inspections, any event that generated or could have constituted a risk for persons, personnel exposure to radiations, radioactive materials release, in order to demonstrate that the provisions of Law 111/1996 regarding the safe deployment, regulation, licensing and control of nuclear activities, republished, the CNCAN regulations and the conditions of the present licence, are met.

12. A nuclear fuel accounting system shall be implemented and maintained as per Station Instruction "Fuel Accounting", code SI-01365-T3, latest revision

approved by CNCAN. Any change in the content of this document shall be made only upon prior written CNCAN approval.

13. An updated registry of all documents related to the licensing of Cernavoda NPP Unit 2 shall be elaborated and maintained, in accordance with the reference document "Registry of Licensing Documentation", code RD-01364-L3, latest revision approved by CNCAN.

CONDITIONS REGARDING THE ACQUISITION, OWNERSHIP, USE, TRANSFER AND STORAGE OF NUCLEAR FUEL, NUCLEAR MATERIALS, RADIOACTIVE MATERIALS AND RADIATION SOURCES

14. The licence holder can store on Cernavoda NPP Unit 2 site nuclear fuel and nuclear materials, as shown in Table 1 below. Storage of such materials shall be previously approved by CNCAN.

No.	NUCLEAR FUEL OR NUCLEAR MATERIAL	ALLOWED QUANTITY
1	Fresh or used natural Uranium fuel bundles	Depending on the operating requirements
2	Heavy water	Depending on the operating requirements
3	Depleted Uranium	Depending on the shielding requirements

15. The staff that controls activities requiring working with nuclear fuel and nuclear materials shall be adequately trained and qualified on the radiation protection, criticality control and nuclear safeguards requirements.

16. The stored radioactive materials (including radioactive waste) shall be produced from/or they shall be directly related to the operation of Cernavoda NPP.

17. The radioactive waste shall be intermediately stored in accordance with provisions of station documents approved by CNCAN, provisions of the regulations in force and CNCAN requirements.

18. The list of the radiation sources and radiation installations owned and/or used shall be submitted each semester to CNCAN for approval.

19. The acquisition, ownership, use, transfer and storage of radioactive material as well as ownership, transfer and storage of radioactive wastes shall be made in accordance with provisions of station documents approved by CNCAN, provisions of the regulations in force and CNCAN requirements (including provisions on product, model or type authorisation and provisions on reporting).

CONDITIONS ON SAFEGUARDS

20. Ownership of raw nuclear materials and special fissionable products is subject to the following safeguards conditions:
    a) Safeguards measures for the nuclear installation imposed by CNCAN requirements shall be complied with, in accordance with the Treaty for the Non-proliferation of Nuclear Weapons, the Agreement between Romania and the International Agency for Atomic Energy regarding the application of safeguards, and the Additional protocol.
    b) Except for the cases for which written approval is granted by CNCAN, no measure shall be taken to interfere with the use of the installed surveillance equipment for or by IAEA.
    c) Except for the cases for which written approval is granted by CNCAN, no change shall be made regarding the fuel storage or handling or any other equipment or procedure referring to the aforementioned that could affect safeguards.

21. Changes in the nuclear materials inventory shall be reported to CNCAN, according to the requirements of the Safeguards Regulations in the nuclear field.

22. All changes referring to Article 2 of the Additional Protocol to the Safeguards Agreement shall be reported to CNCAN.

23. Any event related to theft or accidental loss of nuclear material shall be reported to CNCAN.

CONDITIONS REGARDING THE PHYSICAL PROTECTION

24. Access in Cernavoda NPP Unit 2 shall be controlled and limited to the personnel authorised by the licence holder, in accordance with the reference document “Physical Protection”, code RD-01364-A1, latest revision approved by CNCAN.

25. The Physical Protection System shall ensure prevention of any incident that could lead to unauthorized displacement of nuclear materials or radioactive materials release into the environment, by means of sabotage.

26. Dimensioning, as well as any modification of the physical protection system of Cernavoda NPP Unit 2, shall be approved by CNCAN.

27. Any incident related to Physical Protection System penetration attempts shall be reported to CNCAN.

CONDITIONS REGARDING THE CONTAINMENT LEAK RATE TEST

28. The Reactor Building Leak Rate Test shall be performed in compliance with the design requirements, current standards and CNCAN requirements. The test shall be performed before achieving reactor criticality with prior CNCAN notification, all support documents being previously approved by CNCAN.

CONDITIONS REGARDING THE COMMISSIONING PHASES

29. Except for the cases for which prior written CNCAN approval is granted, the following operations are forbidden in Cernavoda NPP Unit2:

    a) Fuel Loading in the Reactor;

    All legal requirements shall be met as well as all requirements included in Appendix 03 to the present licence, entitled “Prerequisites for obtaining CNCAN Permit for fuel loading into the reactor”, before the issue of the Permit for fuel loading into the reactor, except for the cases when written approval of CNCAN is granted.

    b) Heavy Water Loading into Primary Heat Transport Systems;

    c) Removal of Guaranteed Shutdown State (GSS) and Achieving First Criticality;

    All legal requirements shall be met, as well as all requirements included in Appendix 04 to the present License, entitled “Requirements for obtaining CNCAN Permit for first criticality” before the Permit for first criticality is issued, except for the cases when written CNCAN approval is granted.

    d) Power increase up to 5% of reactor nominal power;

    e) Power increase up to 25% of reactor nominal power;

    f) Power increase up to 50% of reactor nominal power;

    g) Power increase up to 75% of reactor nominal power;

    h) Power increase up to 100% of reactor nominal power;

30. It is forbidden to perform on-power refuelling or to redistribute the fuel within Unit 2 reactor, without prior written CNCAN approval.

CONDITIONS REGARDING RADIOPROTECTION OF PROFESIONALLY EXPOSED PERSONNEL, POPULATION AND ENVIRONMENT

31. The radioactive effluents from the nuclear installation shall be monitored and controlled so that emissions shall not exceed the effective dose for a person from the critical group, established by CNCAN at 0.1 mSv/year for Cernavoda NPP Unit 2. The calculation of the effective dose shall be done in accordance with the reference document “Derived Emission Limits”, code RD-01364-RP4, latest revision approved by CNCAN. This document shall not be modified unless written approval is granted by CNCAN.

32. Release of liquid radioactive effluents into the Danube-Black Sea Canal shall be performed only with prior CNCAN notification.

33. Management of operational radiation protection activities, of individual dosimetry activities, of radioactive wastes, of radiation sources and of planning and implementation of intervention in case of radiological emergency, shall be assumed only by accredited experts holding level 3 permits issued by CNCAN.

34. The financial value for 1man*Sv used in applying the As Low As Reasonable Achievable principle (ALARA) is 220.000 USD.

Appendix no. 03

to the Licence for deployment of nuclear activities No. SNN U2 – 02/2006, for the commissioning of Cernavoda Nuclear Power Plant Unit 2

PREREQUISITES FOR OBTAINING THE CNCAN PERMIT FOR MANUAL FUEL LOADING INTO THE REACTOR

1. Physical Protection

Based on the defence in depth concept, SNN shall demonstrate that the physical protection measures for systems and equipments associated with reactor Guaranteed Shutdown State maintenance and surveillance, reactor core surveillance and reactor protection are adequate.

SNN shall submit to CNCAN a detailed program containing the measures adopted for ensuring an adequate physical protection, based on the defence in depth concept.

2. Design Change Notice

SNN shall submit to CNCAN, for each milestone, the implementation plan of all design changes with impact on the nuclear safety, additional to those mentioned in Tables D.1 and D.2, Appendix D of “Cernavoda Nuclear Power Plant Unit 2 Completion Contract”.

3. Seismic Safari Recommendations

a) The Seismic Safari Report must be accepted by CNCAN.
b) Recommendations whose implementation after fuel loading could have a negative impact on the support systems operation after fuel load, shall be implemented.

4. Registry of Licensing Documentation

The Registry of Licensing Documentation shall be completely implemented and a copy shall be submitted to CNCAN.

5. Operating Principles and Policy

Starting with the manual fuel loading, Cernavoda NPP Unit 2 shall be maintained and operated in accordance with the limits established in the “Operating Principles and Policies” document, code 82-01364-RD-L1, latest revision approved by CNCAN. Any deviation from these limits shall be approved by CNCAN before implementation.

6. Guaranteed Shutdown State

SNN shall demonstrate the capability to fully implement the requirements established through the operating procedures for the Guaranteed Shutdown State.

7. Chemical analysis/control capability

SNN shall demonstrate the capability to perform adequate chemical analyses on Cernavoda NPP site, meaning that these must be accurate enough for the monitoring and maintenance of the moderator chemical parameters in order to maintain the Guaranteed Shutdown State.

8. Impairment Manual for Special Safety Systems and Safety Support Systems

The Impairment Manual for all Safety Special Systems and Safety Support Systems shall be elaborated, approved (by SNN) and implemented for use.

9. Capability for detection of fuel channel flow blockage

A document shall be prepared and submitted to CNCAN which will describe the philosophy, approach and capability for detection of fuel channel flow blockage and will describe in general terms the procedures that must be followed in this case.

10. Capability for detection of pressure tube rupture

SNN shall demonstrate that the systems necessary for detection of pressure tube rupture are fully operational.

11. Plant staff training and qualification programs

SNN shall demonstrate that the training and qualification programs for the plant staff are completed in order to meet the minimum requirements for safe operation prior to reaching first criticality.

12. Plant organisation and staffing

Starting with the manual fuel loading and up to declaring commercial operation, SNN shall ensure authorised operating personnel for Cernavoda NPP Unit 2, in accordance with CNCAN requirements in letter 25562/13.04.2006.

Qualified operating personnel shall permanently work in Cernavoda NPP Unit 2 in order to ensure its safe operation as per Station Instruction “Shift Activity”, code SI-01365-P38, latest revision approved by CNCAN, document which shall not be modified without CNCAN written approval.

Adequately justified changes in the organisation chart or in the organisation shall be reported to CNCAN at least 30 working days before their implementation and shall have prior written CNCAN approval.

Cernavoda NPP Unit 2 operating personnel training shall be performed based upon the Systematic Approach to Training principle, in accordance with document “Systematic Approach to Training”, code RD-01364-TR-03, latest revision approved by CNCAN. For training of the operating personnel of Cernavoda NPP Unit 2, the license holder shall meet the requirements of the following documents: “Personnel

Training Concept", code RD-01364-TR-01, "Training and Licensing program for NPP Operators", code RD-01364-TR-02, latest revision approved by CNCAN.

The training programs for the Shift Supervisors and the Control Room Operators and the associated revisions shall be submitted for CNCAN approval before they are implemented.

13. Preventive maintenance programmes/procedures

SNN shall confirm that the necessary and sufficient preventive maintenance procedures shall be available for application before fuel loading, in order to cover any maintenance activity for those systems that directly support fuel loading.

SNN shall prepare and submit to CNCAN a programme for the elaboration and implementation of preventive maintenance programmes of Cernavoda NPP U2 systems and components.

CNCAN shall be informed on a quarterly basis upon the preventive maintenance programmes status.

14. Inaugural inspection programme

The Inaugural Inspection Reports for the Moderator and for the Primary Heat Transport Systems shall be submitted for CNCAN approval.

15. Starting with fuel loading, the commissioning activities shall be performed in compliance with the following Reference Documents and Station Instructions regarding the radiation protection, management of radioactive waste and response in case of radiological emergency, latest revision approved by CNCAN:

(A) Environmental Monitoring Program, code SI-01365-RP15;
(B) ALARA Program, code SI-01365-RP16;
(C) Cernavoda NPP Radiation Protection Policies, Principles and Program, code RD-01364-RP02;
(D) Derived Emission Limits, code RD-01364-RP04;
(E) Site Radiological Emergency Plan, code RD-01364-RP08;
(F) Personnel Dosimetry Program, code RD-01364-RP06;
(G) Cernavoda NPP Radiation Protection Regulation, code RD-01364-RP09;
(H) Accident Management Policy, code RD-01364-RP14;
(I) Delivery, reception, use, expedition and record of controlled radiation sources, code SI-01365-RP01;
(J) Cernavoda NPP Radioactive Waste Management, code SI-01365-RP7;
(K) Emergency training, qualification and re-qualification program, code SI-01365-RP10;
(L) Exclusion zone control, code SI-01365-RP12;
(M) Post-accident recovery, code SI-01365-RP13;
(N) Process of training, certification of qualification level for radiation protection personnel and of the release of work permits for nuclear field at Cernavoda NPP, document code SI-01365-RP14;
(O) Radiation field work permit, code SI-01365-RP17;

(P) Dosimetry Program for Cernavoda NPP Personnel, code SI-01365-RP18.

16. Housekeeping and housecleaning

Level of housecleaning, and housekeeping and storage of materials for the systems and areas directly affected by fuel loading and for those that directly support the fuel loading shall be at the established level for starting plant operation, as per procedure “Housekeeping and Housecleaning”, code 82-01365-SI-C30.

17. Reference Documents and Station Instructions that involve CNCAN approval

SNN shall ensure that all Reference Documents and Station Instruction that have to be approved by CNCAN, applicable for manual fuel loading, are approved and fully implemented.

18. Radiological emergency exercise

a) A complete exercise as per the site Radiological Emergency Plan shall be finalized before fuel loading.
b) Personnel mentioned in the plan shall be completely trained.
c) A program for training update, instructions and exercises regarding personnel shall be completed and available before fuel loading.

19. Analysis of the project status at the manual fuel loading phase

SNN shall submit to CNCAN a report regarding the plant status, containing a detailed analysis of all activities with impact on the plant readiness for criticality. The report shall consider the following activities:

- Systems, structures and equipments turnover from Construction Department to Commissioning Department, clarification of deficiencies
- Systems, structures and equipments turnover from Commissioning Department to Operating Department
- Commissioning activities to be completed before criticality
- Status of implementation of design changes necessary before criticality
- Abnormal plant operating procedures (preparing, revising, approval)
- Unit 2 specific training manuals (preparing and approval for use)
- Maintenance personnel training
- Operators training
- Radiation protection training
- Operating manuals (preparing and approval for use)
- Operating manual tests (preparing and approval for use)
- Maintenance programs/procedures (preparing and approval for use)
- Dosimetry system (installation and commissioning)
- Supply (capability of maintaining the stock on specific levels, estimated terms for supply)
- Environmental qualification
- Housekeeping and housecleaning (site, buildings, systems, equipment)

Appendix no. 04

to the Licence for deployment of nuclear activities No. SNN U2 – 02/2006, for the Commissioning of Cernavoda Nuclear Power Plant Unit 2

REQUIREMENTS FOR OBTAINING CNCAN PERMIT FOR THE FIRST CRITICALITY

1. Application for CNCAN permit for the first criticality:

The application for CNCAN permit for the first criticality shall complete the commissioning license application with the following:

a) Status of completeness of construction activities;
b) Referencing all Reference Documents (RD) and Station Instructions (SI);
c) Description of all significant events during commissioning and summary of all actions taken in response to these events;
d) List of stress analyses including the specific identification number, revision and title of each stress analysis;
e) List of all ISCIR (Pressure Vessel Authority) records and certificates for systems and equipments;
f) A report to demonstrate operator's capability to ensure compliance with each of the operating principles and policies provisions.

2. ISCIR Authorisations

Final ISCIR approvals and operating authorisations are required for all systems and equipments.

3. Additional nuclear safety analyses

Additional nuclear safety analyses shall be completed.

4. Safety Analysis Data List

Safety Analysis Data List shall be revised and submitted for CNCAN approval.

5. Design Change Notice

All design changes shall be implemented until the first criticality.

6. Abnormal plant procedures

All abnormal plant procedures shall be completed (prepared, revised and approved), approved by SNN/MT and available for use.

7. Minimum shift complement

An evaluation is required to support the minimum shift complement specified in the Station Instruction "Shift Activity", code SI-01365-P38. The evaluation shall demonstrate that the most challenging condition/accident was chosen to determine the minimum shift complement and that the response capability proposed for emergency situations (in terms of number of people and qualifications) is adequate.

8. Training manuals

All training manuals necessary for the training of Cernavoda NPP technical, operating and maintenance personnel shall be completed and approved for use.

9. Training of technical, operating and maintenance personnel

The conditions for training of technical, operating and maintenance personnel for reactor start-up and for ensuring daily and adequate plant operation shall be fully implemented.

10. Containment gross leak monitoring system

Installation and commissioning of containment gross leak monitoring system must be completed.

11. Reactor Building In-Service Inspection Program

The Reactor Building In-Service Inspection Program, which shall include the containment in-service leak rate test, shall be completed and submitted for CNCAN approval. All support procedures shall be prepared, approved and available for use.

12. Containment report

The containment report shall be completed, approved (by SNN/MT) and available for use. The report shall be submitted to CNCAN.

13. Surveillance program and operating test program

Testing procedures – “Operating Manual Test” and **operating test program** shall be prepared, approved by SNN/MT and available for use.

14. Call-ups and routines

Call-ups and routines shall be prepared, approved by SNN/MT and implemented.

15. Operating Manuals

All operating manuals shall be prepared, approved by SNN/MT and available for use.

16. Reactor Heat Sink Manual

Reactor Heat Sink Manual shall be prepared, approved by SNN/MT and available for use.

17. Maintenance and repairs procedures

Maintenance and repairs procedures sufficient for the initial operation of the plant prepared, approved by SNN/MT and available for use.

18. Preventive maintenance system (documents SI-01365-P9, SI-01365-P10)

The preventative maintenance system shall be completed and available for use.

19. Derived Emission Limits compliance monitoring procedures

Derived Emission Limits compliance monitoring procedures shall be elaborated, approved and available for use.

20. Radiation protection procedures

Radiation protection procedures shall be elaborated, approved and available for use.

21. Seismic monitoring and seismic response

The seismic monitoring procedures and the operating procedures in case of a seismic event shall be prepared, approved and available for use.

22. Seismic Safari Recommendations

All recommendations of the Seismic Safari Report shall be subject to completion, except for those for which justification for implementation at a later licensing phase has been accepted by CNCAN.

23. Environmental Qualification

a) Cernavoda NPP Unit 2 structures, equipments and components compliance with the requirements of the safety guide “Environmental Qualification”, code 82-03650-SDG-003, shall be demonstrated.
b) Preparation, approval by SNN/MT and availability for use of the environmental qualification maintenance procedures shall be complete before reactor start-up.

24. Inaugural inspection reports

Inaugural inspection reports shall be completed and submitted to CNCAN for information.

25. Annulus Gas Recirculation

Installation and commissioning of the annulus gas recirculation system shall be complete.

26. Housecleaning and housekeeping

“Housecleaning and housekeeping” procedure, code 82-01364-SI-C30, shall be fully implemented.

27. Modification Control (“Design change policy”), code RD-T005

The Reference Document “Design change policy”, code RD-T005, shall be fully implemented.

28. Physical Protection

The Physical Protection system shall be installed and commissioned. All aspects of the physical protection plan shall be fully implemented.

29. Construction Completion Assurance

SNN shall submit for approval to CNCAN the final version of the Cernavoda NPP Unit 2 document “Construction Completion Assurance”.

30. Reference Documents and Station Instructions for CNCAN approval

SNN shall ensure that all Reference documents and Station Instructions applicable for the first reactor criticality that have to be approved by CNCAN are fully approved and implemented.

31. Commissioning Completion Assurance

After finalizing all necessary commissioning activities, all “Commissioning Completion Assurance” meetings and those postponed for resolution until criticality, the document “Commissioning Completion Assurance” shall be submitted to CNCAN for approval.

32. Project status analysis at the first criticality

SNN shall submit to CNCAN a report on the plant status, containing a detailed analysis of all activities that have an impact on the plant readiness for criticality. The results of the analysis shall demonstrate that the activities have been completed up to the limit necessary for ensuring safe and reliable plant operation required by the documents submitted to CNCAN for approval in support to the permit for the first criticality/ commissioning license.

The report shall take into consideration the following activities:

- Systems, structures and equipments turnover from Construction Department to Commissioning Department, clarification of deficiencies, completeness of the “as-built” documentation
- Systems, structures and equipments turnover from Commissioning Department to Operating Department
- Commissioning activities

- Clarification and solving of deficiencies
- Design change notices
- Radiation protection program (procedures, preparing, equipment)
- Reference Documents and Station Instructions
- Personnel training (based on the minimum training requirements)
- Training manuals (elaboration and approval for use)
- Chemical control (safety related systems)
- Quality management system
- Physical protection
- Operating manuals (preparing, approval and acknowledgment)
- Operational flowsheets (revised)
- Operating manual tests (preparing, approval and acknowledgment)
- Call-ups and routines (elaboration, approval, acknowledgement)
- Maintenance programmes and procedures (elaboration, approval, acknowledgement)
- Housekeeping and housecleaning (site, buildings, systems, equipments)

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