ROMANIA

JOINT CONVENTION ON THE SAFTEY OF SPENT FUEL MANAGEMENT AND ON THE SAFETY OF RADIOACTIVE WASTE MANAGEMENT

NATIONAL REPORT

FIRST REPORT
MARCH 2003

ROMANIAN NATIONAL REPORT FOR THE JOINT CONVENTION ON THE SAFETY OF SPENT FUEL MANAGEMENT AND ON THE SAFETY OF RADIOACTIVE WASTE MANAGEMENT

Foreword

The Romanian National Report is prepared to fulfill he Romanian obligation as signatory of the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

To do so, the report follows closely the Guidelines Regarding the Form and Structure of National Reports provided in the attachement to the IAEA document INFCIRC/604 of July 1, 2002.

This report is produced on behalf of Romania by the National Commission for Nuclear Activities Control (CNCAN) under the Ministry of Water and Environmental Protection.

To prepare this report, CNCAN received contributions from the organizations belonging to the Ministry of Industry and Resources as follows:

- SC "Nuclearelectrica S.A." as the National Company with Nuclear Power Production Subsidiary "CNE-Prod" Cernavoda (NPP Unit 1), Nuclear Power Development Subsidiary "CNE-Invest" Cernavoda (NPP Unit 2), and "Nuclear Fuel Plant" (FCN) Pitesti,

- "Autonomous Company for Nuclear Activities" with its Subsidiary for Nuclear Research Pitesti (SCN), and

- "National Uranium Company S.A." with "Feldioara Subsidiary" (Uranium Milling Plant), "Bihor Subsidiary" (uranium mines), "Banat Subsidiary" (uranium mines), and "Neamt Subsidiary" (uranium mines).

CNCAN received also contributions from the "National Atomic Energy Agency", belonging to the Ministry of Education and Research, that coordinates the activity of the National Institute for Physics and Nuclear Engineering - Horia Hulubei" (IFIN-HH Magurele).

The National Commission for Nuclear Activities Control would like to express its gratitude to all institutions and organizations which contributed to produce the Romanian National Report for the Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management.

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SECTION A. INTRODUCTION

In order to prevent acute effects as result of nuclear accidents as well as the generation of genetic effects and cancers by ionizing radiation to human beings and other living organisms, spent fuel and radioactive waste shall be managed safely.

The issue of managing spent fuel and radioactive waste started to be considered in Romania in the nineteen fifties, when the first nuclear research reactor was put in operation, and the number of applications using radioactive sources rapidly increased.

The technical and social issues of safe management of spent fuel and radioactive waste were not sufficiently assessed at the beginning. As the radiation practices developed, and science and technology progressed, the awareness of the above mentioned issues increased in Romania as well. After 1996, the starting of operation of NPP Cernavoda Unit 1 - the first Romanian nuclear power plant, the spent fuel and radioactive waste management issue became more complex.

It should be noted that, due to economical difficulties met before the end of the former political regime and in the transition period which started in 1989, some delay occurred in establishing and implementing a national policy and strategy for spent fuel and radioactive waste safe management, especially for the non fuel cycle area.

However, by ratifying the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management, Romania has shown its willingness to undertake all the necessary steps for achieving the required level in the safe managing of the spent fuel and radioactive waste.

The report presents the situation of spent fuel and radioactive waste management activities in Romania, showing the existing situation, the safety issues of concern and the future actions to address these issues.

The presentation follows the content proposed by IAEA in scope of reporting the conformity with the provisions of Joint Convention on the Safety of the Spent Fuel Management and on the Safety of Radioactive Waste Management.

This report is produced on behalf of Romania by the National Commission for Nuclear Activities Control (CNCAN) under the Ministry of Water and Environmental Protection, and includes the contributions from the main organizations involved in the spent fuel and radioactive waste management.

The conclusions of the report show that generally, the spent fuel and radioactive waste are managed safely in Romania.

However, there are issues of concern, which are sumarised in Section K of this report. Among the issues identified, the main immediate problems are:

- the set up of the National Agency for Radioactive Waste (ANDRAD) and the establishing of the National Strategy for Spent Fuel and Radioactive Waste Management;
- the establishing of the Fund for Radioactive Waste Management and for Decommissioning;
- the refurbishment of the Radioactive Waste Treatment Plant (STDR) Magurele;
- the return to Russia (or the assurance of conditions for extended storage) of the VVR-S research reactor spent fuel.

The National Commission for Nuclear Activities Control in its capacity of Romanian regulatory body will continue to monitor closely the solving of the issues of concern identified in this report.

SECTION B. POLICIES AND PRACTICES

Article 32. Reporting, paragraph 1

i. Spent fuel management policy

As Romania has decided to use the open fuel cycle, considering spent fuel as radioactive waste, the objective of Romanian spent fuel management policy is to assure safe management of spent fuel, according to the principles stated in IAEA Safety Fundamentals SS No. 111-F "The Principles of Radioactive Waste Management", applied for the specifics of spent fuel. The Romanian radioactive waste management policy is detailed in subparagraph *iii*.

The main characteristics of Romanian radioactive waste management policy, specific for spent fuel, are:

- The spent fuel management, including the transport, shall be authorized, and shall be performed according to the provisions of the applicable laws and regulations.
- According to the law, the import of spent fuel is prohibited.
- The current policy for ensuring safe management of spent fuel (as well as radioactive waste in general) suppose, according to the new Governmental Ordinance no.11/2003 on spent nuclear fuel and radioactive waste management, including final disposal, the establishing, during this year, of the National Agency for Radioactive Waste (ANDRAD) as a competent authority for coordination, at national level, of the safe management of spent fuel and radioactive waste. The Governmental Ordinance no. 11/2003 will be approved by law during this year.
- Also, according to the Law no.111/1996 (as amended) the Fund for Radioactive Waste Management and for Decommissioning shall be set-up in the next future, and the contributions to the fund shall start to be collected.
- At present, the main role in establishing the policy and strategy for spent fuel management is played by the regulatory body: National Commission for Nuclear Activities Control (CNCAN). After the establishing of ANDRAD, CNCAN shall have a more limited role in the establishing of radioactive waste and particularly spent fuel management policy and strategy, mainly for verifying if the requirements for nuclear and radiological safety, safeguards, and physical protection are met by the policy and strategy, according to the provisions of Romanian laws and regulations. Of course, the spent fuel regulatory policy will remain exclusively under the responsibility of CNCAN.
- The responsibility for the storage of the spent fuel belongs to the operator of the NPP or research reactor (former operator in the case of shut-down reactor Magurele), till it is transferred to the future organization in charge with long term storage or disposal (or till it is returned to the country of origin, if such arrangements are or will be in place).

The general characteristics of Romanian radioactive waste management policy, will be presented in subparagraph *iii*, while the strategy for spent fuel management will be presented at letter e) of the subparagraph *ii*.

ii. Spent fuel practices

a) NPP spent fuel management

Romania has only one nuclear power plant, Cernavoda Nuclear Power Plant, equipped with five PHWR - CANDU-6 Canadian type reactors - with a 705 MW(e) gross capacity each, in different implementation stages. Unit 1 is in commercial operation since December 2, 1996, Unit 2 is under construction and Units 3, 4, 5 are under preservation.

The legal representative of the nuclear power production sector in Romania (the utility) is Societatea Nationala “Nuclearelectrica” S.A. (SNN). SNN is a governmental owned company reporting to the Ministry of Industry and Resources. The company has its Headquarters in Bucharest and three subsidiaries:

- CNE-PROD Cernavoda (CNE-PROD), the operator of Cernavoda NPP - Unit 1;
- CNE-Invest Cernavoda, in charge with the completion of Unit 2 and with the preservation of Units 3,4,5;
- Nuclear Fuel Plant in Pitesti (FCN).

The CANDU-6 type reactor is a pressurized heavy water reactor, using natural uranium dioxide as fuel. A fuel channel contains 12 fuel bundles, zyrconium alloy cladded, of approximately 50 cm length. The fuel is cooled by heavy water coolant flowing through the fuel channels that are surrounded by heavy water moderator. The natural uranium fuel and the heavy water are produced in Romania. The CANDU-6 type reactor is fueled and defueled during operation. This allows quick replacement of a fuel bundle, if a fuel pin failure does occur. Systems are in place, that allow the early detection of a fuel leak and for localization of the channel that contains the leaking fuel. In the defueling process of that channel, the group of 2 bundles containing the leaking one is identified. This bundles are sent to the Failed Fuel Bay. Latter, if the failure was important, and fuel leakage is continuing after the fuel was removed from the reactor, this fuel can be canned (till now, it was not the case). It has to be mentioned that the fuel failure rate is extremely low.

The current operations for management of spent fuel Cernavoda NPP are:

- Defueling of fuel from a channel (normal, or, in case of leakage, early);
- Sending of the failed fuel for storage in the Failed Fuel Bay;
- Sending of the normal fuel for storage in the Spent Fuel Bay;
- Storage of spent fuel for at least 6 years for cooling;
- Transfer of the fuel to the Spent Fuel Dry Storage (50 years designed period of dry storage).

It has to be mentioned that the Spent Fuel Dry Storage for Cernavoda NPP is under construction, and it is scheduled to be operational in April 2003.

b) TRIGA spent fuel management

TRIGA reactor is owned by the Autonomous Company for Nuclear Activities through its Subsidiary for Nuclear Research Pitesti (SCN). The TRIGA reactor is a pool type reactor, with 2 cores: Steady State Reactor (SSR), operated at maximum 14 MW, and Annulus Core Pulse Reactor, that can give a pulse of 20,000 MW, or can be operated as a steady reactor at maximum 500 kW.
The fuel originally used for SSR was HEU type (93% enrichment). In present the conversion of the core to use LEU (20% enrichment) is taking place. The ACPR fuel is a LEU fuel (20% enrichment). All fuel is Incalloy cladded, and was delivered by USA. The reactor started to operate in 1979. The spent fuel is stored in the spent fuel storage pool, i.e. a lobe of the underwater transfer channel, between the TRIGA reactor and the Post Irradiation Examination Laboratory (LEPI) hot cells. It has to be noted that Romania has adhered to the US Government policy with respect to return to the country of origin of HEU type fuel spent in American research reactors abroad. According to the agreement signed by Romania, till 2006 all the HEU type fuel shall be spent and, till 2009, it shall be returned to USA. Already in 1999, a first shipment to USA of HEU spent fuel was performed.

c) LEPI spent fuel management

In the hot cells of this laboratory can be examined destructively and non destructively experimental fuel of CANDU type, but made of low enriched uranium, in order to reach the necessary burn-up during irradiation in TRIGA reactor. Consequently, some amounts of irradiated fuel roads and fragments were produced and are dry stored in pits sited in the hot cells of LEPI.

d) VVR-S reactor spent fuel management

The VVR-S reactor sited in Magurele is owned by the National Research & Development Institute for Physics and Nuclear Engineering “Horia Hulubei” (IFIN-HH), subordinated to the Ministry of Education and Research. The tank type reactor was commissioned in 1957, and operated at a power of 2 MW. The reactor was permanently shut down in 1997, and a governmental decision for decommissioning was issued in 2002. The EK-10 type (10 % enrichment) fuel was used at the beginning of operation. After 1985 the new type of S-36 fuel (36 % enrichment) was used. Both types of fuel are aluminium cladded.
During the operation of the reactor, the spent fuel unloaded from the core, was stored for cooling for at least 2 years in the cooling pool, sited at reactor hall. After cooling period, the spent fuel was transferred in one of the 4 storage pools, sited close to the reactor building. At present, the last core is still stored in the cooling pond, waiting for transfer, while the rest of spent fuel is stored in the storage ponds.
During the operation history, a few minor incidents (resulting in mechanical deformation) did occur during the handling of the spent fuel. These incidents could explain the fact that at present in one of the storage ponds, a moderate amount of Cs-137 concentration of activity was detected. However the relative long period of storage of the fuel raise the question of corrosion, and CNCAN imposed more stringent observance of the important water parameters (pH, conductivity, activity, Cl, O, etc.). In the same time, IFIN-HH is requested to perform the assessment of the fuel status, and if necessary, to take measures for canning of defective fuel.

e) National spent fuel management strategy

The national spent fuel strategy has to be established, as well as the whole radioactive waste management strategy, by ANDRAD, and will be approved by a multi governmental body, to be created. This body will include also representatives of the CNCAN. As this will take time, CNCAN, in its capacity of regulatory body for nuclear activities, has established that, for the purposes of authorization and control, the following spent fuel management provisional strategy is supposed to be valid, till the national strategy will be issued.

The strategy considered by CNCAN for spent fuel management comprises:

- NPP spent fuel:
  - 6 to 7 years wet storage in the Spent Fuel Bay;
  - 50 years dry storage in the Spent Fuel Dry Storage (this period could be extended to 100 years, if the behaviour of the storage will be in accordance with the present suppositions);
  - deep geological disposal in a national repository, that has to be operational after maximum 45 years from now.

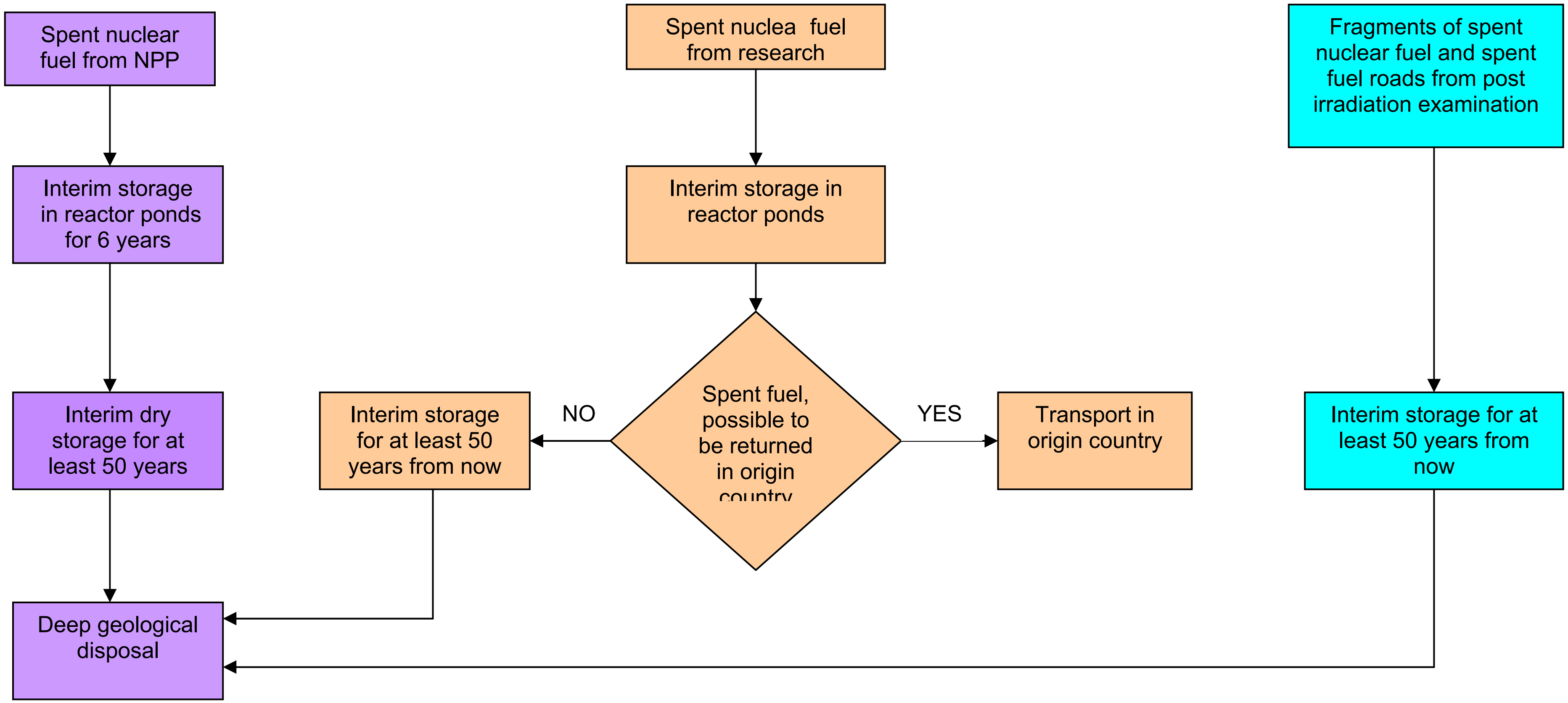
- VVR-S reactor spent fuel:
  - improvement of the chemistry of the water in the cooling and storage pools in order to extend the time for wet safe storage of the fuel;
  - characterization of the fuel cladding status, in order to determine if and when encapsulation is necessary;
  - exploring the possibility for sending the spent fuel to the country of origin (Russian Federation), preferably as soon as possible, in order to avoid the need for prior encapsulation;
  - if returning of spent fuel to Russia is not possible, assuring the conditions for safe storage of the spent fuel till the conditions for final disposal are met;
  - deep geological disposal in the future national repository, which, according to the strategy for NPP spent fuel, has to be operational after maximum 45 years from now

- TRIGA reactor spent fuel:
  - wet storage in the storage pool, in LEPI building;
  - considering return to the country of origin of LEU fuel;
  - if return of fuel is not possible, considering the need for dry storage to cover at least 50 years (using own built storage or the NPP dry storage);
  - deep geological disposal in the future national repository.

- LEPI spent fuel fragments and spent fuel elements:
  - storage in hot cells;
  - If dry storage of TRIGA spent fuel is realized, storage of LEPI spent fuel together with TRIGA fuel;
  - deep geological disposal in the future national repository.

The strategy considered by CNCAN for spent fuel management is summarized in Figure 1.

Figure 1. Current provisional strategy for spent fuel management.



iii. Radioactive waste management policy

The objective of Romanian radioactive waste management policy is to ensure safe management of radioactive waste, according to the principles stated in IAEA Safety Fundamentals SS No. 111-F "The Principles of Radioactive Waste Management". The Romanian radioactive waste management policy and strategy are fully taking into account the general and radioactive waste management specific requirements presented in IAEA Requirements No. GS-R-1: Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety. The main general aspects of radioactive waste management policy are presented below:

- The current policy for ensuring safe management of radioactive waste suppose the establishing, during this year, of the National Agency for Radioactive Waste (ANDRAD) as a competent authority for coordination, at national level, of the safe management of spent fuel and radioactive waste.
- Also, according to the Law no.111/1996 (as amended) the Fund for Radioactive Waste Management and for Decommissioning shall be set-up in the next future, and the contributions to the fund shall start to be collected.
- At present, the main role in establishing the policy and strategy for radioactive waste management is played by CNCAN (the regulatory body). After the establishing of ANDRAD, CNCAN shall have a more limited role in the establishing of radioactive waste management policy and strategy, as it is explained in subparagraph *i*. Of course, the radioactive waste regulatory policy will remain exclusively under the responsibility of CNCAN.
- Any producer of radioactive waste is responsible for the management of that waste and for the decommissioning of its facility; he shall bear the expenses related the collection, handling, transport, treatment, conditioning, temporary storage and disposal of the waste he has produced, and shall pay the legal contribution to the above mentioned fund.
- The radioactive waste management, including the transport, shall be authorized by CNCAN according to the law, and shall be performed according to the provisions of the applicable laws and regulations, assuring safety of facilities, protection of human health and environment, protection of future generations.
- In the authorization process, the minimization of radioactive waste shall be required.
- The timing for decommissioning and radioactive waste disposal shall assure, as far as applicable, the requirements for not imposing undue burden on future generations.
- According to international agreements signed with neighbor countries, the protection of human health and environment beyond national borders shall be assured in such a way that the actual and potential health effects will be not more detrimental that those accepted for Romania.
- According to the law, the import of radioactive waste is prohibited.
- The discharge of gaseous and liquid radioactive effluents from any nuclear facility shall be limited, according to derived emission limits approved by CNCAN, and further reduced, according to optimization principle.
- The contributions required for the above mentioned fund, as well as the authorization tariffs and fees, shall discourage the possession and use of old installations, and the possession of radioactive waste and spent radiation sources

that have to be transferred for treatment, conditioning, and disposal (or long term storage).

- By conditions set in the operating authorization, and by regulatory dispositions, the holder of authorization is requested to send the spent radioactive sources and the radioactive waste for treatment and disposal or long term storage at dedicated facilities.
- Any waste management or spent fuel management facility shall have a decommissioning generic plan; for new facilities, this requirement applies from the design stage, when the application for the siting authorization is submitted to CNCAN.

The strategy for radioactive waste management will be presented at letter g) of the subparagraph *iv*.

iv. Radioactive waste management practices

a) NPP radioactive waste management

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 tight control to minimize the environmental impact.

The aqueous liquid wastes are collected and after a certain purification (if appropriate) are discharged into the environment by an approved “dilute and disperse” solution.

It can be concluded that at Cernavoda NPP, gaseous and aqueous liquid waste after collection and purification, are safe discharged in accordance with international agreed standards for protection of public and environment.

The organic liquid wastes are packaged in stainless steel drums and stored in the basement of the Service Building, in the proximity of the Reactor Building.

The operational solid radioactive wastes including mainly compactable and non-compactable solid waste, spent filters cartridges and spent resins are safe managed within the plant facilities, designed, built and operated to meet internationally agreed standards.

The solid and organic liquid radioactive waste management at Cernavoda NPP includes the initial basic step of pretreatment of waste, as defined in the IAEA Safety Fundamentals No. 111-F “The Principles of Radioactive Waste Management”. It consists of collection, segregation, compaction (if appropriate) and include a period of interim safe storage.

According to the provisional radioactive waste management strategy, to be presented at letter f), short-lived low and intermediate radioactive waste will be disposed off in a near surface repository, planned to be built till 2010. In order to reach this target, main priorities in the next future at Cernavoda NPP are:

- radioactive waste characterization
- identification of safe and cost effective technologies for treatment of organic liquid wastes.

Currently, the implementation of the NPP radioactive waste management strategy was slowed down due to changes of the legal framework in the field.
The new Governmental Ordinance no. 11/2003 on spent fuel and radioactive waste management including their disposal states that the National Agency for Radioactive Waste Management "ANDRAD" is responsible for establishing the national radioactive waste management strategy and for its implementation. The Fund for Radioactive Waste Management and for Decommissioning will provide financial means allowing the safe management of radioactive waste, including spent fuel. Allocation of financial resources by the Cernavoda NPP to the fund mentioned above, shall be done based on radioactive waste management programs which mainly address siting, construction, operation and institutional control for spent fuel and radioactive waste repositories. The fund shall include also the decommissioning component.

b) Fuel Fabrication Plant radioactive waste management

The Fuel Manufacturing Plant (FCN) in Pitesti has operational and administrative arrangements including special designated facilities for safe management of gaseous, liquid and solid wastes, offering protection to the workers, general public and environment.

The gaseous waste, containing dust and particles, are filtered and discharged in the environment in a controlled and approved manner.
The aqueous liquid wastes, including radioactive waste waters for uranium recovery and residual waters are collected, stored for a short period of time and based on administrative arrangements are sent to a licensed radioactive waste operator – Pitesti Nuclear Research Institute – for appropriate treatment and discharge.

The combustible liquid waste, including spent solvent and contaminated oils, is collected and safe stored on site. This waste category is subject to report to the IAEA safeguards, annually.

The solid wastes, containing waste for uranium recovery and combustible waste are collected, packaged and sent to the licensed operator Pitesti Nuclear Research Institute for further treatment and/or conditioning.

The non-combustible solid waste, containing waste for which no any recovering is intended are sent to the Feldioara repository for disposal based on administrative arrangements approved by CNCAN.

The zyrcaloy solid waste is sent to a foreign company for recycling.

In the next future, actions in the field of radioactive waste management at the Nuclear Fuel Plant will be focused, on the following:

- to document the radioactive waste management operational activities associated with collection, segregation, storage and transfer of waste to different waste operators;
- to assure independent monitoring of occupational exposure of those workers that are involved in radioactive waste management activities;
- to identify further technical solution for combustible liquid waste;
- to identify and to get approved a recycling solution for very low contaminated solid waste.

c) SCN radioactive waste management

The Subsidiary for Nuclear Research Pitesti (SCN) of the Autonomous Company for Nuclear Activities is responsible for the management of its own radioactive waste. This include the treatment, conditioning and storage before disposal or long term storage of the radioactive waste resulted on the site of SCN. In order to perform this management, SCN has its own Radioactive Waste Treatment Plant Pitesti (STDR Pitesti). Among the most important practices that generate radioactive waste it shall be mentioned the operation of the TRIGA reactor, the operation of the Post Irradiation Examination Laboratory (LEPI), the secondary radioactive wastes from operation of STDR, and the radioactive wastes resulted from different research laboratories of SCN. In STDR are also treated, with uranium recovery, the liquid and burnable solid radioactive wastes resulted from the production of CANDU type fuel, in FCN Pitesti which is sited in the same place as SCN Pitesti. Also organic liquid radioactive wastes produced in Cernavoda NPP can be treated in STDR Pitesti.

STDR has available the following facilities for the treatment and conditioning of radioactive wastes:

1. Installation for treatment, by evaporation, of liquid low - active beta - gamma radioactive waste.
2. Installation for conditioning in concrete of the radioactive concentrate obtained during the evaporation treatment of liquid radioactive waste; the installation is used also for conditioning in concrete the solid radioactive waste.
3. Installation for treatment and conditioning in bitumen of spent ion exchangers.
4. Installation for treatment, with U recovery, of liquid radioactive waste resulted from the fabrication of CANDU-type nuclear fuel.
5. Installation for treatment by incineration, with U recovery, of solid radioactive waste resulted from the fabrication of CANDU - type nuclear fuel.
6. Installation for treatment and conditioning of organic liquid wastes from Cernavoda NPP.
7. Installation for decontamination of sub-assemblies and spare parts.

STDR Pitesti has available a laundry for decontamination of individual protective clothes.

The radioactive wastes, treated and conditioned in long-lasting matrices are disposed of at the National Repository for radioactive Wastes Baita Bihor provided they are satisfying the maximum concentration of activity allowed for disposal in that facility.

In the LEPI facility are stored, supplementary to spent fuel fragments and spent fuel elements, short lived radioactive wastes with higher activity than allowed to be disposed in the National Repository for Radioactive Wastes Baita-Bihor (e.g. Co sources with high activity resulted from medical treatment practices). Also long lived radioactive waste resulted from the reactor TRIGA can be stored in the hot cells of LEPI.

Both STDR and LEPI, like each facility within SCN Pitesti, have their own ventilation system. The releases into the environment pass through HEPA filter batteries for radioactive aerosols retention. The releases from the ventilation systems are monitored. At STDR, the Installation for treatment by incineration, with U recovery, of solid radioactive waste resulted from the fabrication of CANDU-type nuclear fuel has its own local ventilation system composed by 2 cyclones, 2 bag type filters and a HEPA filter battery. The hot cells of LEPI have also their own local HEPA filtration battery.

d) IFIN-HH radioactive waste management

The management of the non-fuel cycle radioactive wastes from all over Romania is centralized at IFIN – HH in the Radioactive Waste Treatment Plant (STDR). Final disposal is carried out at the National Repository for Radioactive Wastes (DNDR) at Baita-Bihor.

Radioactive wastes, containing short lived radionuclides, including spent sealed sources are collected, treated and conditioned at IFIN – HH before final disposal, provided they are satisfying the maximum concentration of activity allowed for disposal at Baita Bihor repository. The long lived radioactive wastes including spent sources, are stored on site at STDR Magurele.

Radioactive wastes treated at STDR Magurele arise from three main sources:

1. Wastes originated from the VVR-S research reactor during operation and the future decommissioning works.
2. Local wastes from other facilities operating on IFIN – HH site. These wastes include the own wastes generated during the normal activities of the STDR.
3. Wastes from non-fuel cycle practices all over the country (i.e. medical, biological, research and industrial applications)

The radioactive wastes treated and conditioned at STDR Magurele are both liquid and solid wastes.

The contaminated water from VVR-S reactor results mainly from the drainage of systems and equipment of the reactor and of the spent fuel ponds. Other sources related to VVR-S reactor are from the active drainage and collecting systems which collect the used water from hot cells, showers, together with the leakage collected from the radioactive circuits.

Among the other facilities operating on IFIN-HH site, the Radiochemical Production Center is the most important source of low and intermediate level liquid radioactive waste.

From the operation of the STDR, internal liquid effluents arise from drainage systems, from the individual protective clothes decontamination (laundry) and from equipment decontamination.

Solid wastes collected from the research reactor and other IFIN – HH departments as well as from off-site IFIN-HH are classified as follows:

1. Combustible type: cloth, paper, wood, etc.;
2. Compactable, non-combustible type: glass, metal sheet, and plastic materials;
3. Non-compactable, non-combustible type: metal, ceramics, rubber, etc.:
4. Spoilage, putrefying type: dead animal bodies, plants, fruits, vegetables, etc;
5. Short-lived spent sources;
6. Long-lived spent sources and radioactive waste.

The Radioactive Waste Treatment Plant was commissioned in 1975 and it represents a fully import from Fairey Engineering Limited – England.
The STDR basically consists of liquid and solid waste treatment and conditioning facilities, a radioactive decontamination center, a laundry and an intermediate storage area.
The liquid treatment is performed in two steps: precipitation and evaporation.
The solid treatment includes the following methods: segregation, compacting, shredding, incineration.
After treatment the waste can be conditioned in drums by cementation. The short-lived spent sealed sources are also conditioned in drums by cementation.

Except the central building which contain installations for treatment and conditioning the waste, the laboratories and the offices, the plant includes five interim storage rooms used for the interim storage of radioactive waste and spent sources, and a building for two 300 m^3 tanks in which are collected the contaminated waters from the nuclear research reactor, radioisotope production department and nuclear medicine department.
A vault type storage with 4 cellules intended for storing used filters of VVR-S reactor, actually contains radioactive wastes originated from the operation of VVR-S reactor.

STDR Magurele has available the following facilities for the treatment and conditioning of radioactive wastes:

1. Installation for aqueous liquids treatment;
2. Installation for incineration of solid combustible radioactive waste;
3. Installation for solid non-combustible radioactive waste compaction;
4. Installation for cement conditioning;
5. Installation for decontamination of sub - assemblies and spare parts.

STDR Magurele has available a laundry for decontamination of individual protective clothes.

STDR Magurele has its own ventilation system. The releases into the environment pass through a filter battery for radioactive aerosols retention. The Installation for incineration of solid combustible radioactive waste has its own local ventilation system composed by 1 cyclone, 1 electrostatic separator, and a HEPA filter battery. The release from the incineration installation is monitored.

In 1985 was put into operation the National Repository for Radioactive Waste (DNDR) – Baita, Bihor county, sited in Apuseni Mountains, in an old exhausted uranium exploration mine. Using the existing concepts at '80 years' level concerning the final disposal of the low and intermediate level (institutional) radioactive wastes, and relying on internal standards and international recommendations, the underground constructions were dimensioned to dispose about 21.000 standard drums.
The repository, operated by IFIN-HH, is authorized in present for disposal of short lived radionuclides. According to the records, very few amounts of activity of long lived radionuclides were disposed off at Baita-Bihor repository, at the beginning of operation.

- After 1999, new waste acceptance criteria were established for Baita - Bihor repository. The maximum activity concentration per radionuclide is presented below. The summation criterion is applied for accepting the waste. The limits for disposal of the radioactive waste at Baita - Bihor are now in a review process, based on the preliminary safety assessment of the repository.

Table: Maximum content admitted for packages stored at Baita - Bihor Repository.

Radionuclide	**Max. admitted activity [Bq/m^3]**
C-14	$1*10^{11}$
Ni-59	$2*10^{9}$
Nb-94	$2*10^{7}$
Tc-99	$1*10^{8}$
I-129	$1*10^{5}$
Cl-36	$3*10^{5}$
H-3	$1.5*10^{10}$
Co-60	$1*10^{11}$
Ni-63	$1*10^{11}$
Sr-90	$5*10^{9}$
Cs-137	$1*10^{10}$
α-emitting radionuclides with a lifetime over 5 years	$1*10^{7}$
β and γ-emitting radionuclides with a lifetime over 5 years, not included in this table	$5*10^{8}$
Radionuclides with a lifetime below 5 years	$2.5*10^{11}$

e) National Uranium Company radioactive waste management

The National Uranium Company is responsible for uranium mining and milling activities. The “Bihor Subsidiary”, “Banat Subsidiary”, and “Neamt Subsidiary” are responsible for uranium mining. The “Magurele Subsidiary” is responsible for the geological field work and exploration for uranium and thorium. “Feldioara Subsidiary” is responsible for the Uranium Milling Plant.

According to the new regulations, the sterile rock dumps (i.e. with uranium content lower than 0.004 %), have to be remediated like non radioactive rock dumps. The dumps containing low grade ore, resulted from mining and exploration works shall be kept under conservation, and the rocks shall be used for filling the closed uranium mines. The National Uranium Company is also responsible for the restoration of environment from the old uranium mining practices.

The liquid radioactive waste produced by Feldioara Uranium Milling Plant is sent to two special insulated tailing ponds. The first tailing pond, named Cetatuia II, was designed to be built in 3 stages, due to high investment costs. The first part is now filled and it is in closing process. The second part was commissioned in 2001. The third part is planned to be commissioned after 2011, when the second part will be filled.

After first settling of the tailings, the liquid waste is transferred to the second tailing pond, named Mittlezop, for final settling. From this pond, the waters are pumped to the decontamination plant, where the remaining traces of uranium are removed, before the waters are discharged in the Olt River.

Between the two mentioned tailing ponds there are three solid radioactive waste storage area. The first two storage areas are of trench type. The low level radioactive wastes were buried into existing clay layer and were covered by clay. The third storage area was also digged in the clay. The storage has the lateral walls made by concrete. The bottom of storage consists of compacted clay. The fourth wall will be build in the future, when the area will be filled.

By closure, the tailing ponds and the third solid radioactive waste storage area will become repositories, provided that the closure solution satisfies the regulatory safety requirements. For the first two solid radioactive waste storage areas that are closed and covered, it is also necessary to assess the safety prior to get the authorization for transforming the storage areas in repositories.

f) Geolex S.A. radioactive waste management

Geolex S.A. is a small company, dedicated for geological field work and exploration. The activities related to uranium and thorium are now closed, and the company shall bear the responsibility for environmental restoration.

g) National radioactive waste management strategy

As it was explained for spent fuel management strategy, the national radioactive waste strategy has to be decided, by ANDRAD, and will be approved by a multi governmental body, to be created. This body will include also representatives of CNCAN. As this will take time, CNCAN, in its capacity of regulatory body for nuclear activities, has established that, for the purposes of authorization and control, the following radioactive waste management provisional strategy is supposed to be valid, till the national strategy will be issued.

The strategy considered by CNCAN for radioactive waste management comprises:

- Intermediate level waste is considered together with low level waste. The distinction is made between short lived and long lived intermediate and low level radioactive waste.
- The institutional short lived waste including spent sources is treated and conditioned, and finally disposed in the Radioactive Waste National Repository, at Baita - Bihor.
- The long lived institutional and research reactors radioactive wastes (i.e. the wastes and spent sources that contain long lived radionuclides above the limits for disposal in Baita - Bihor repository) are stored at STDR Magurele and LEPI Pitesti. The long lived institutional wastes shall be stored for at least 50 years, with prior conditioning, waiting for disposal together with long lived wastes and spent fuel from NPP.
- The same is true for short lived spent sources that are exceeding the disposal limits, with the difference that most of these sources are expected to be disposed latter, in the same repository.
- Till this moment, all the radioactive wastes produced in the NPP are stored at its site. For these wastes it is expected the construction of a new treatment plant and of a surface repository, which shall accommodate the short lived radioactive waste from the NPP.
- The strategy for construction of the NPP short lived radioactive waste repository shall consider the accommodation of institutional short lived radioactive waste, after filling of Baita - Bihor repository.
- The NPP wastes that will not be allowed to be disposed in the repository shall be stored, waiting for geological disposal, together with the spent fuel. Meantime, conditioning of such wastes shall be realized as soon as practicable.
- The uranium milling tailing wastes are stored in tailing ponds, near the milling facility plant. The existing strategy consists in considering the ponds as repositories. After filling the ponds, closure works will be done for isolate the repository from environment.
- Also three storage areas for uranium milling and fuel fabrication solid radioactive waste are placed near the tailing ponds. The intention is to transform these storages in repositories for uranium and radium contaminated solids.

For mining tailings, the existing strategy is in-situ capping combined with relocating of the most active wastes in the mines, during their decommissioning.

The strategy considered by CNCAN for radioactive waste management is summarized in Figures 2 and 3.

Figure 2. Current provisional strategy for long lived radioactive waste management.

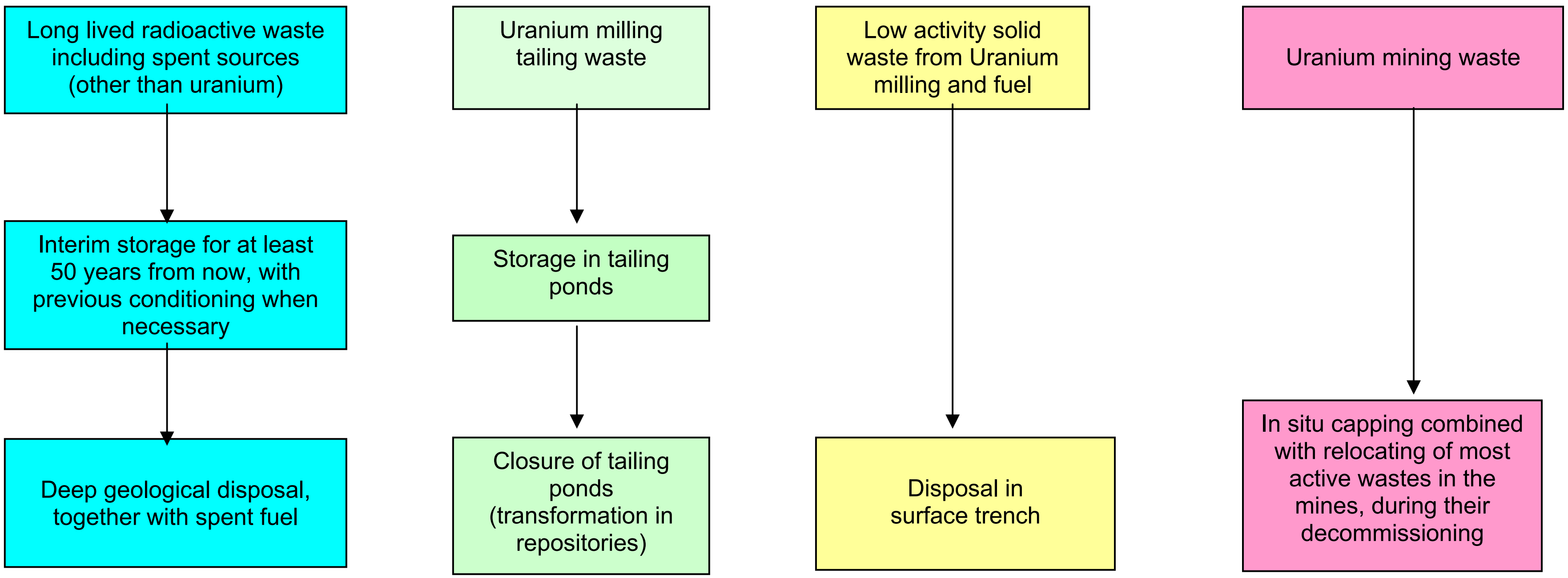
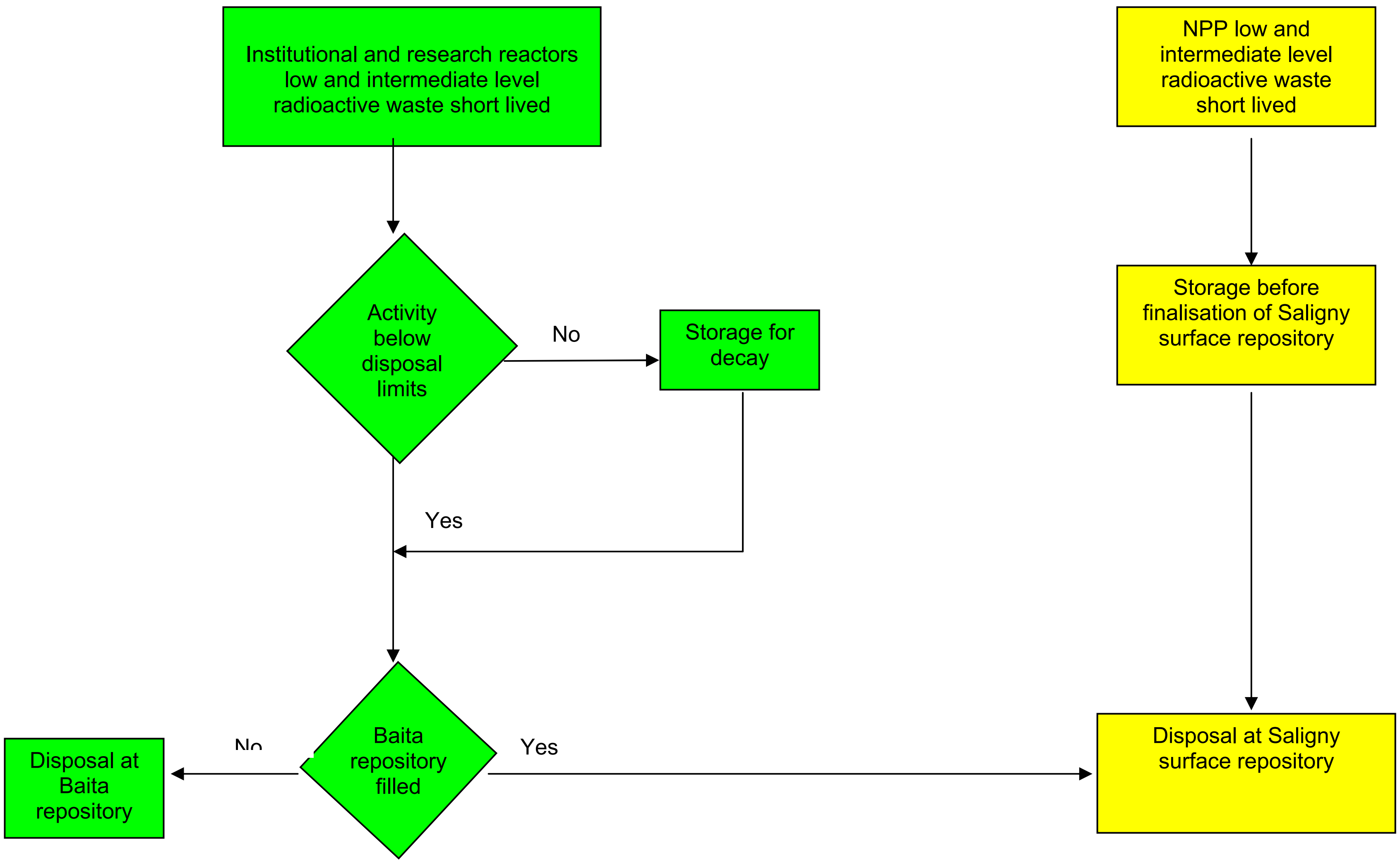


Figure 3. Current provisional strategy for short lived radioactive waste management.



v. Criteria to define and categorize radioactive waste

According to the definition presented in the Law no. 111/1996 on the safe deployment of nuclear activities (as amended), radioactive wastes are those materials resulted from nuclear activities for which no use was foreseen, and which contain or are contaminated with radionuclides in concentration above the exception limits. According to the spent fuel policy, spent fuel is considered radioactive waste.

In present in Romania there is not a national regulation for categorization the radioactive waste. It is intended to issue such a regulation among the set of regulations on radioactive waste management to be issued till the end of 2004.

The NPP has its own classification system of radioactive waste, that was established for operational purposes.
During the operation of Cernavoda NPP the following categories of solid wastes are generated:
a) Spent resins;
b) Spent filters cartridges;
c) Low activity solid wastes, Type 1 (contact gamma dose rate < 2 mSv/h);
d) Medium activity solid wastes, Type 2 (contact gamma dose rate between 2 mSv/h and 125 mSv/h) and Type 3 (contact gamma dose rate higher than 125 mSv/h).

The liquid radioactive wastes generated at NPP Cernavoda are:
e) Aqueous;
f) Organic.

a) Spent resins

Spent resins are obtained from the various purification systems of the process fluids. When taking them out of these systems, the direct contact radiation dose is usually higher than 10^{-2} mSv/hour. Therefore, special protection and shielding measures have been provided for their transportation, handling and storage.

The characteristics of the spent resins handled within the plant systems are ranging within large limits. Both the activity and composition of the radionuclides retained in the ionic exchange resins, depend mainly on the function which the purification system performs within the plant, by using the respective resins. Thus, the resin activity developed in the purification system of the heat transport system, or of the water in the spent fuel bay is due mainly to Cesium 134 and 137, which originate from fuel elements. Resin activity developed in the purification system of the moderator is due mainly to Cobalt 60 and Chrome 51, which result from the activation of the structural material with neutrons.

b) Spent filters cartridges

The spent filters cartridges result from the following process systems: heat transport purification system, moderator purification system, spent fuel bay water purification system, heat transport pump sealing system, D_2O supply system for the fuelling machine, active drainage system.

The spent filter cartridges usually have, when they are discharged from the plant process systems, a radiation dose up to 5 mSv/hour and in severe situation, until 50 Sv/hour. (Highest dose rate reached till now was 12 mSv/h for a large filter cartridges from Spent Fuel Bay - Cooling and Purification System).

There are 5 types filter cartridges, having the overall sizes presented in the following table.

Table: Size characteristics of Cernavoda NPP generated spent filters cartridges.

Sizes	Type 1	Type 2	Type 3	Type 4	Type 5
Diameter (mm)	455	381	366	254	120
Height (mm)	1400	1173	1156	1143	1150

The spent filter cartridges of 1- 4 types are handled by means of a large flask, having a weight of 8.6 - 8.8 tons (including the cartridge).

Spent cartridges of type 5 are handled by means of a small flask, which has a weight of 2.7 tons (including the cartridge).

Protection wall thickness of the flasks have been calculated in order to provide a radiation dose reduction from 50 Sv/hour to 0.25 mSv/hour in case of a large flask and from 50 Sv/hour to 0.15 mSv/hour in case of a small flask.
The spent filter cartridges are unloaded from the process systems, are dried (H-3 < 5 μSv/h) and then carried to the Interim Solid Radioactive Waste Storage Facility.
Transfer of spent filter cartridges is performed by means of suitably shielded containers.
By acting the handling cable, the used filter is lifted inside a flask. The loaded flask is transported again on the carriage, and then the new filter is introduced inside the installation and the flask is transferred to the Interim Solid Radioactive Waste Storage Facility to be unloaded into the cylindrical pipes of the storage cells.

c) Low activity solid wastes

Solid low active wastes are produced from various operations, which are daily performed in the plant. They consist mainly of materials from decontamination and maintenance operations, protection clothes and metallic parts, as well as contaminated materials and equipment. Waste is collected in bags, which are checked for tritium before compacting. If tritium is detectable the bags are dried.

The solid wastes are collected into 220L stainless steel standard drums, approved by CNCAN.

The radioactive waste collection points are established to assure that all the wastes are collected and a primary waste segregation is performed.
For each collection point specific container and label requirements are defined.

Solid radioactive wastes are collecting separately, as either compactable or non-compactable wastes.

- Compactable waste includes paper, textiles, plastics, rubber and other compactable materials.
- Non compactable waste include: general waste (tools, metallic parts, wood pieces, construction waste) and special waste (glass, iodine, particulate and tritium filters cartridges, molecular sleeve).

d) Medium activity solid wastes

Medium activity solid radioactive wastes (type 2 and 3) are produced in small quantities and only under special circumstances. They are remotely handled with suitable shields or additional containers.

- The medium activity solid wastes type 2 are classified as compactable and non-compactable waste.

Compactable waste includes: paper, textiles, plastics, rubber and other compactable materials.

Non - compactable waste are classified as follows:
- general waste: tools, metallic parts, wood pieces, construction materials;
- special waste: spent filters cartridges from plant purification circuits;

- The medium active solid waste type 3 are only non-compactable waste. They consist of spent filters cartridges, activated reactor components or other highly-contaminated materials. These kind of waste are produced in small quantities and only under special circumstances. They are handled by means of special shielded containers.

e) *Aqueous radioactive wastes*

The aqueous liquid wastes collected by the Liquid Radioactive Waste System are categorised as follows:
- Level 1 low activity wastes, resulted from laundry, showers, some laboratories and drainages of Service Building, and having the activity between 3.7×10^{-1} Bq/l – 3.7×10^{2} Bq/l;
- Level 2 medium activity wastes, resulted from the system of upgrading havy water, decontamination of equipments and washing of plastic objects, other laboratories and drainages of Service Building, and having the activity between 3.7×10^{1} Bq/l – 3.7×10^{4} Bq/l;
- Level 3 medium activity wastes, resulted from the drainage system of the Reactor Building, and from the drainages of spent fuel pools and of spent fuel storage tanks, and having the activity between 3.7×10^{4} Bq/l – 3.7×10^{6} Bq/l.

Generally, the Level 3 medium activity wastes are treated for decontamination before release.

f) Organic radioactive wastes

Organic liquid radioactive wastes consist of spent oils, spent solvents, liquid scintillate cocktails, flammable solids, sludge, which cannot be processed through Liquid Radioactive Waste System because of their environmental impact.
The sources of liquid organic wastes are as follows:

- *oils*: lubricating oils from pumps and motors used in Zones 1 and 2 contaminated mainly with tritium (at Cernavoda NPP there are three controlled zones; the level of risks and potential of contamination decreases as follows: Zone 1, Zone 2 and Zone 3);
- *solvents*: from the decontamination area and from the laboratories and maintenance activities spent solvents consist of: white spirit, ethylene glycol, alcohol ethyl, toluene, chloroform, acetone;
- *liquid scintillator* contaminated mainly with tritium and segregated by tritium content. Liquid scintillator from sampling of Moderator System, PHT Systems and their auxiliaries is segregated from liquid scintillator from sampling of Liquid Effluents Systems;
- *radioactive sludge*, from maintenance activities on the active drainage contaminated with gamma nuclides;
- *flammable solids* (solid – liquid mixture) from maintenance activities contaminated with gamma nuclides.

When sufficient volumes of such waste have been accumulated they will be treated according to the quantity and type of radioactivity they contain.
Lubricated oils and solvents are collected in metallic cans and transferred in the Service Building basement; they are stored in radioactive 220L stainless steel drums, authorized by CNCAN.
Flammable solids are stored in the Service Building basement in 220L stainless steel drums, authorized by CNCAN.
Organic liquid wastes are handled and stored as per NPP’s Radiation Protection Procedures.

It has to be mentioned that the categorization that will be established in the future Romanian regulation on radioactive waste classification shall be intended mainly for disposal purposes. The characterization of the NPP waste is required by the regulatory body, prior to issue the siting authorization for the future surface repository.

The radioactive waste of the Nuclear Fuel Plant Pitesti is categorized in:

- Solid;
- Liquid.

The solid radioactive wastes are categorized in:

- Containing U;
- Low activity combustible;
- Low activity noncombustible.

The liquid radioactive wastes are categorized in:

- Recyclable;
- Non-recyclable;
- Combustible.

The characteristic annual quantities of radioactive wastes generated from the operation of Nuclear Fuel Plant are given in the following table.

Table: Radioactive waste generated by the Romanian Nuclear Fuel Plant.

SOLID WASTES				
Waste type	Description	Quantity	Activity	Specific radionuclide
Containing U	Filters	1 tone / yr	-	Natural Uranium
Low activity/ combustible	Rags, paper, plastics, wood, rubber	2 tone / yr	-	Natural Uranium
Low activity/ noncombustible	Metallic components	10 tone / yr	-	Natural Uranium

LIQUID WASTES				
Waste type	Description	Quantity	Activity	Specific radionuclide
Recyclable	Technological waters	2400 m^3/ yr	3-5 gU/l	Natural Uranium
Non-recyclable	Residual waters	600 m^3/ yr	>3 mgU/l	Natural Uranium
Combustible	Organic solvents	1-2 m^3/ yr	50-100 gU/l	Natural Uranium

As previously mentioned in paragraph *iv*, subparagraph *b)* of this section, the Nuclear Fuel Plant transfers all types of generated liquid and solid radioactive wastes to different licensed waste operators for further treatment, conditioning and/or disposal. The policy principle here is to transfer the waste as soon as possible since it was generated. According to the administrative arrangements and approved by CNCAN, once the waste was transferred to the waste operator, the fuel plant and consequently SNN like legal representative of the plant has no more any responsibility for radioactive waste management including disposal of wastes.

The exception is represented by the combustible liquid waste. This category of wastes currently includes spent organic solvents (tri-butyl phosphate and kerosene contaminated with uranium). Only this category of waste can be reported like Nuclear Fuel Plant's inventory for the scope of the Convention.

By the end of 2002, there are about 9 m^3 combustible liquid waste stored on-site.

At STDR Pitesti the radioactive wastes are categorized in:

- Solid low-active radioactive waste;
- Spent ion exchangers;
- Solid combustible radioactive waste containing natural uranium (produced in the Fuel Fabrication Plant Pitesti);
- Liquid low - active radioactive waste;
- Liquid radioactive waste containing natural uranium (produced in the Fuel Fabrication Plant Pitesti);
- Organic liquid radioactive wastes from Cernavoda NPP.

It has to be mentioned that uranium wastes produced in the Fuel Fabrication Plant Pitesti are treated in STDR for uranium recovery; consequently, all the wastes resulted from the STDR activity are short-lived, and can be disposed at Baita-Bihor repository.

In the LEPI facility are stored:

- Short lived radioactive waste with high activity (spent sources);
- Long lived radioactive waste resulted from the reactor TRIGA.

At STDR Magurele the solid radioactive wastes are categorized in:

- Combustible;
- Compactable, non-combustible;
- Non-compactable, non-combustible type;
- Spoilage, putrefying type;
- Short-lived spent sources;
- Long-lived spent sources and radioactive waste;
- Operational waste from VVR-S reactor, not characterized, stored in the vault type storage with 4 cellules.

With the exception of the last 2 categories, all are short-lived radioactive waste. The liquid radioactive waste at STDR Magurele is only aqueous low level waste, short lived.

SECTION C. SCOPE OF APPLICATION

Article 3.

Article 3.1: Romania does not reprocess spent fuel, as it was decided to use open fuel cycle. By consequence Romania does not declare reprocessing to be part of spent fuel management.

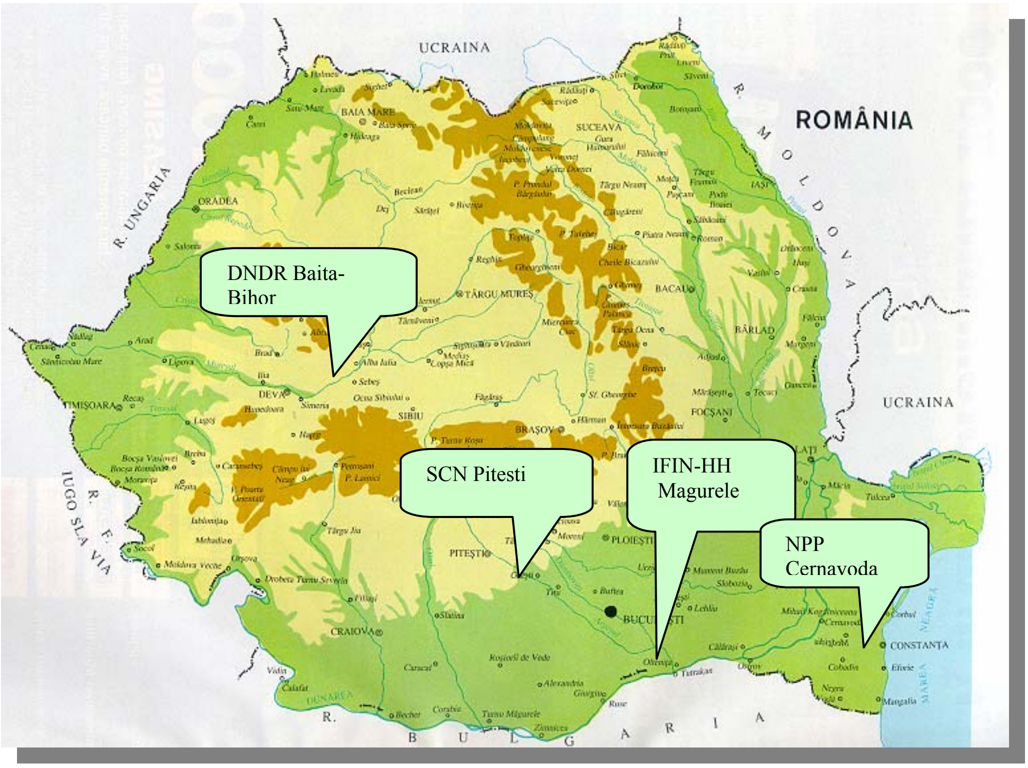
Article 3.2: Romania does not declare as radioactive waste for the purposes of the Convention any waste that contains only naturally occurring radioactive material and does not originate from the nuclear fuel cycle.

Article 3.3: Romania does not have military or defence programs that produce spent fuel. The very low amounts of radioactive waste that result from radiological practices in military area, are transferred permanently to and managed within exclusively civilian programs. By consequence Romania does not declare spent fuel or radioactive waste within military or defence programs as spent fuel or radioactive waste for the purposes of the Convention.

SECTION D. INVENTORIES AND LISTS

Article 32. Reporting, paragraph 2

i. List of spent fuel management facilities subject to the convention, their location, main purpose and essential features



1. Cernavoda NPP spent fuel management facilities

NPP Cernavoda is located at 1 km distance of town Cernavoda, close to Danube river.
CNE-PROD, the operator of Cernavoda NPP-Unit 1, has the following spent fuel management facilities:

- The Spent Fuel Bay;
- The Spent Fuel Intermediate Dry Storage Facility.

The facilities are located at NPP site, in Cernavoda.

a) The Spent Fuel Bay

Cernavoda NPP uses on - power continuous refueling method imposed by the use of natural uranium fuel.
A wet storage facility, specifically named Spent Fuel Handling System, was provided for each reactor as part of the NPP project. This system includes the following:

- discharge and transfer equipment located in the Reactor Building;
- spent fuel reception and storage equipment located in the Service Building;
- spent fuel reception bay located in the Service Building;
- main storage bay: Spent Fuel Bay and defected fuel bay, located in the Service Building.

The transfer of spent fuel between reactor and service buildings is underwater through a transfer canal.

The discharge equipment consists of two valved spent fuel ports located above water and two elevators travelling between the port and an underwater transfer mechanism in the discharge bay. The transfer mechanism is a horizontally running cart, driven from above water. The elevator and transfer equipment are motorised. The drives are located in a shielded room.

In operation, the reactor's fuelling machine seals to one of the spent fuel ports in the fuelling machine maintenance lock and discharges the fuel through the spent fuel port onto the elevating ladle. The elevator lowers the fuel to the transfer equipment, which in turn conveys it to the reception bay where further handling is done manually.

The reception bay communicates, under water with the Spent Fuel Bay on one side and with a small defected fuel bay on the other side.

In the reception bay, the spent fuel is manually off loaded under water from the transfer mechanism and placed on storage trays. Canned defective fuel, however, is routed for storage in the defected fuel bay.

Defected fuel is manually canned in the discharge bay before transfer to the reception bay to limit the spread of contamination.

Motorised cranes or monorails are provided in the bays as required for fuel handling. The storage bay has an underslung manbridge.

According with design data, the Spent Fuel Bay has a capacity of 50,000 CANDU fuel bundles and the defected fuel bay has a capacity to store for thirty years plant operation the canned defected fuel. Sixteen cans are initially provided, each with capacity of one bundle.

Currently, subject to inventory report for the scope of Convention is the Spent Fuel Bay.

The Cernavoda Unit 1 Spent Fuel Bay

b) The Spent Fuel Intermediate Dry Storage Facility

Due to a limited capacity of the wet storage facility, a dry spent fuel facility is presently in construction on Cernavoda NPP site to prolong the storage capacity. After at least six years in the Spent Fuel Bay, the spent fuel will be transferred to the dry facility.

The Spent Fuel Interim Dry Storage Facility is located at around at 700 m SW-W from the first reactor, closed to the envelope of the initially fifth planned reactor on-site. Its designed storage capacity will be expanded gradually from 12,000 to 324,000 spent fuel bundles. (It can accommodate the spent fuel inventory of two reactors).

The dry storage technology is 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.

The concrete storage modules have two sealed barriers for storing the spent fuel. The first one is a seal welded stainless steel basket containing 60 spent fuel bundles. The second container is a seal welded cylinder containing 10 baskets.

Twenty storage cylinders are in one storage module for a total capacity of 12,000 bundles per module.

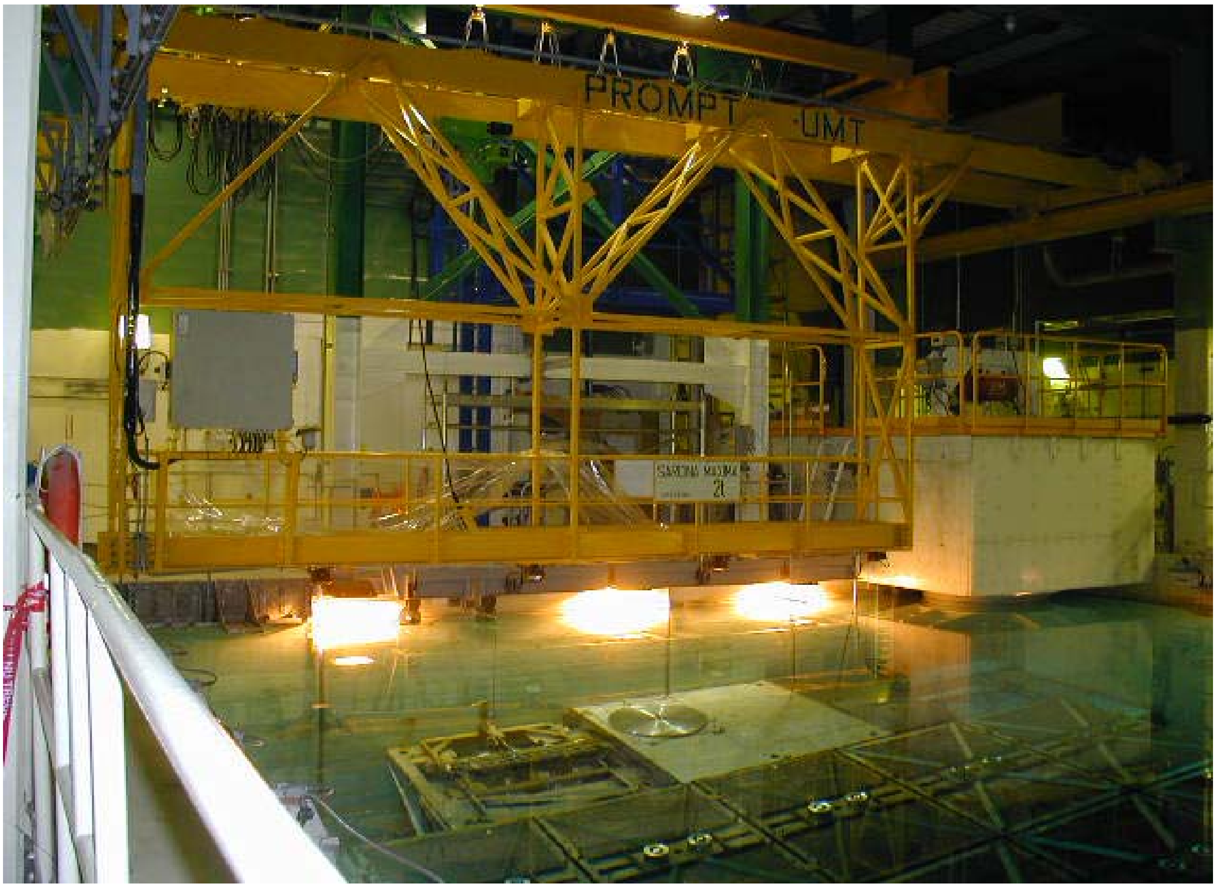
The fuel is prepared for dry storage in the Spent Fuel Bay and in the Shielded Work Station (SWS) which will be a new construction in extension to the Service Building. adjacent to the spent fuel storage bay area.

The facility is designed to meet the stringent Safeguards requirements imposed by the International Atomic Energy Agency (IAEA) for the control of nuclear fissile materials.

The spent fuel intermediate dry storage operations consist of three main activities: the fuel preparation, the fuel transfer and the fuel storage.

Fuel Preparation

The fuel preparation activities are performed in the main spent fuel storage bay. Spent fuel bundles are transferred from trays into fuel baskets that can hold 60 bundles in a vertical position. Fuel bundle handling equipment located on the in-bay worktables, assorted tools, and lifting equipment are used for this transfer operation. Once filled, the baskets are inspected, moved under the chute, and lifted out of the storage bay into the SWS where the fuel is dried and the basket is seal welded.



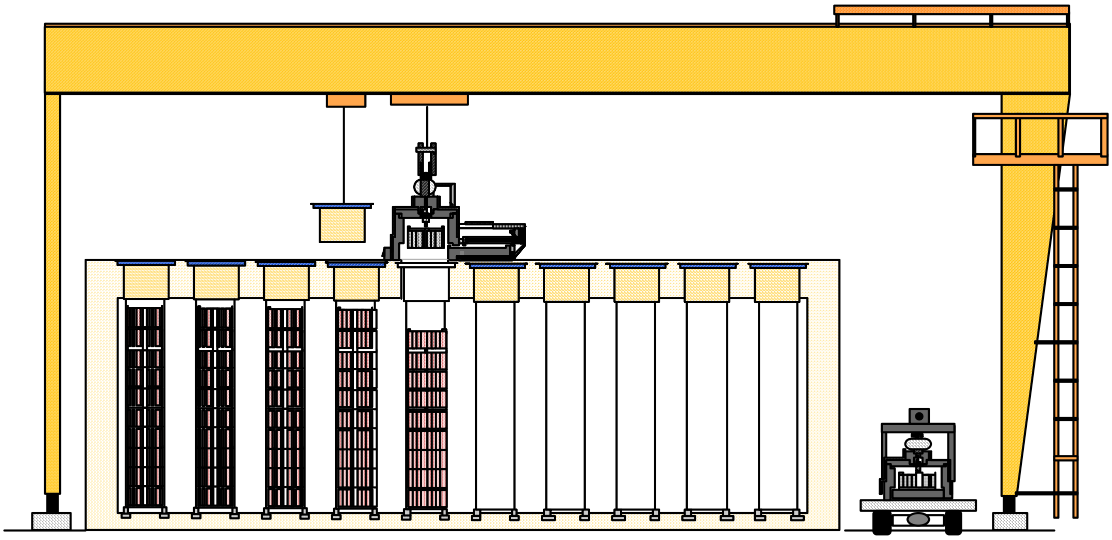
Modifications in Cernavoda Unit 1 Spent Fuel Bay
for preparing fuel for dry storage

Fuel Transfer

The transfer flask, pre-positioned over the SWS is used to move the basket out of the SWS. The service building extension crane then moves the transfer flask from the SWS onto the transporter, ready to be towed to the fuel storage area.

Fuel Storage

The fuel storage area consists of a fenced site, sized to accommodate 27 MACSTOR modules arranged in an array of 3 by 9 modules. The exact configuration may vary and will be confirmed during the detail design. The storage area will be initially provided with one storage module, the foundation for the second module, fencing for the first two modules, a gantry crane and the services necessary for the first module. Additional modules will be build in accordance with future plant needs.



Loading of fuel in the storage module of
Spent Fuel Intermediate Dry Storage Facility

Storage Module of Spent Fuel Intermediate Dry Storage Facility

(under construction)

2. SCN Pitesti spent fuel management facilities

SCN Pitesti, the operator of TRIGA reactor, has the following spent fuel management facilities:

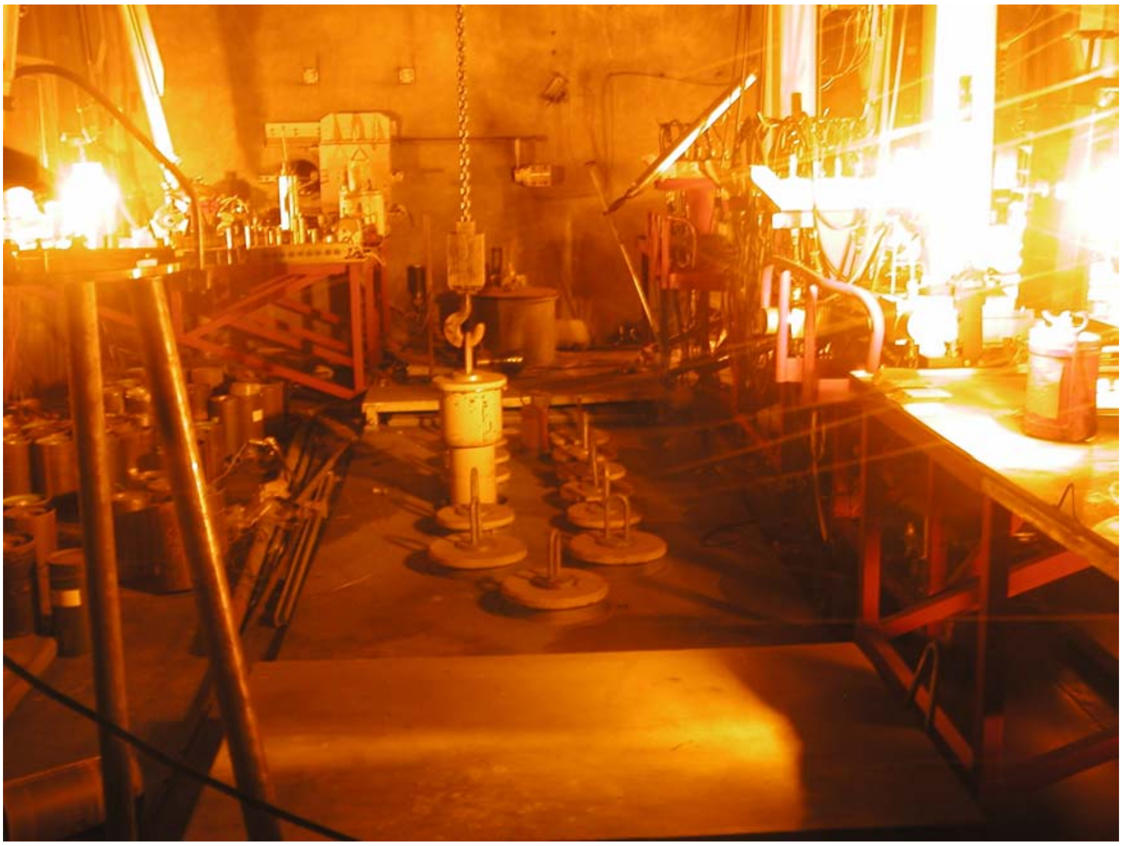
- The Spent Fuel Storage Pool;
- The Dry Storage Pits.

The facilities are located at SCN site in Mioveni, near Pitesti.

The spent fuel removed from the TRIGA reactor can be stored for one year in the reactor pool, in 6-bundle racks. After this time delay the spent fuel bundles are transferred in the spent fuel storage pool, close to the underwater transfer channel between the reactor and the LEPI hot cells area. Storage conditions are similar to those in the TRIGA pool. The storage time can be 20 to 30 years. Meanwhile, the encapsulation technology in steel cans will be developed for the spent fuel. The defective fuel will be double-encapsulated and the interim storage will be ensured by the spent fuel storage pool. The dimensions of the transfer channnel lobe representing the spent fuel storage pool are: $1 \times 4 \times 8$ m^3.

The irradiated experimental fuel roads and fragments resulted after examination in LEPI are stored in five dry storage pits. These pits are located in the hot cell of the LEPI, in the cell floor, and are sealed by lids. They are cylindrical in shape, steelcoated at the inside, having a storage capacity of 5 fuel bundles each. The fuel fragments are canned, and stored in the same pits.

Spent fuel storage pool at the TRIGA Reactor



Storage pits at LEPI for irradiated experimental fuel rods and fragments

3. IFIN-HH spent fuel management facilities

IFIN-HH, the owner and former operator of VVR-S reactor, has the following spent fuel management facilities:

- The Spent Fuel Cooling Pool;
- The Spend Fuel Storage Pools.

The facilities are located at IFIN-HH site in Magurele, near Bucharest (at approx. 8 km distance).

During the operation of the reactor, the spent fuel unloaded from the core, was stored for cooling for at least 1 year in the cooling pond, sited in the reactor hall.

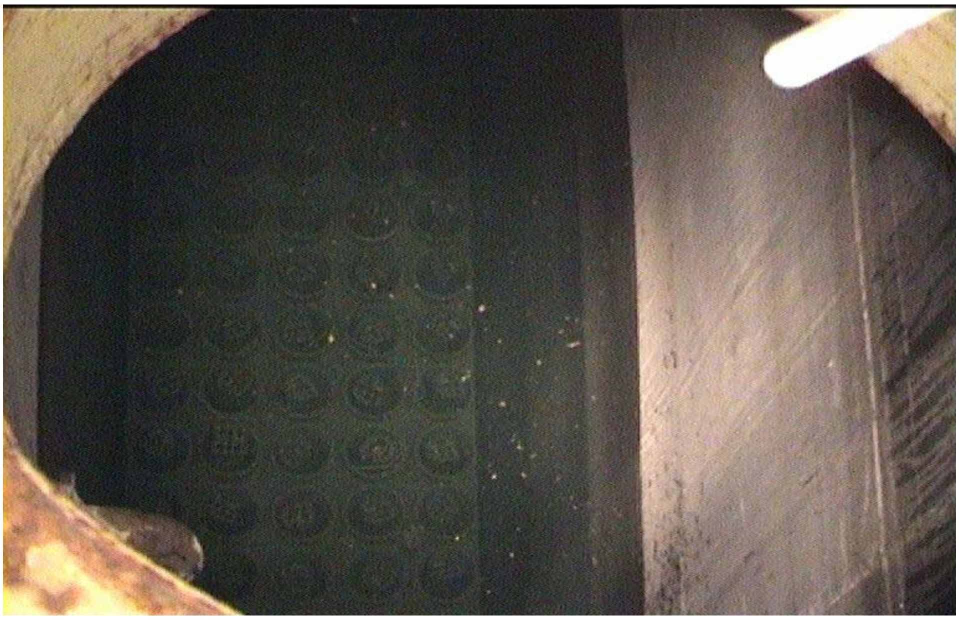
After cooling period, the spent fuel was transferred in 3 of the 4 storage pools (1 is still empty), sited in a separate building, close to the reactor building. At present, the last core is still stored in the cooling pond, waiting for transfer, while the rest of spent fuel is stored in the storage ponds.

The transport of the spent nuclear fuel assemblies from the cooling pond (placed in the reactor main hall) to the spent fuel storage ponds is assured by using the special container for spent fuel removal.

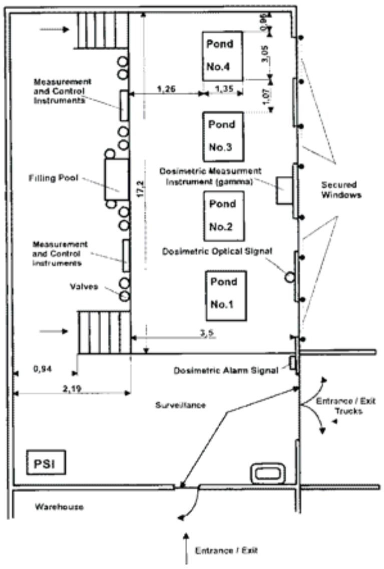
IFIN-HH spent fuel transfer cask

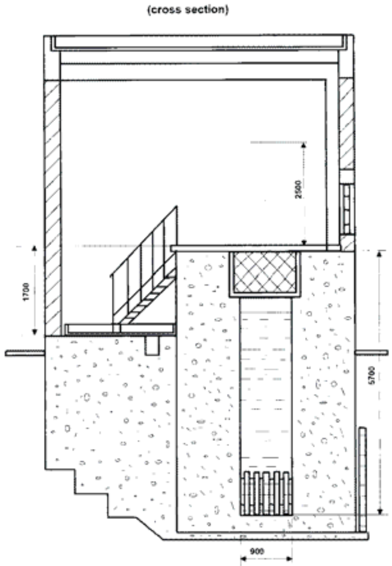
The description of the Spent Fuel Storage Ponds Facility is presented below.
This facility contains 4 identical ponds, each of them having the storing capacity of 60 fuel ensembles. Every pond having the outside sizes of 2750 mm × 900 mm × 5700 mm is made from a special aluminum alloy ($AlMg_3$), with the walls thickness of 10 mm and bottom thickness of 15 mm. Pond's lids are made from cast iron having the thickness of 500 mm; they provide only the biological protection for the maintenance personnel, during the water discharge. A 1.5 m concrete layer provides the lateral biological protection of the ponds.

Spent fuel storage pools at the VVR - S Reactor



Spent fuel storage pool no. 3 at VVR - S Reactor





Upper View *Cross - Section View*

Spent Fuel Storage Ponds at VVR - S reactor

The water layer in every pond is 4.5 m, which plays the role of biological protection and coolant. Inside the ponds exist an aluminum rack, which contains 60 places for fuel storage. Serious safety problems concerning the condition of this fuel, particularly corrosion and leakage, must be avoid.

The environment around the storage is permanently monitored; samples of soil and vegetation are periodically gathered and analyzed to see if some contamination with fission products is present. The IAEA recommends water values of 1 μS/cm, but values up to 2 μS/cm might be accepted if the chlorine, copper and sulphate concentrations are very low. To maintain these parameters of the water in concordance with IAEA recommendations, recently, a filtration installation was designed, realized and put in operation, in order to improve the quality of the distilled water from the storage ponds.

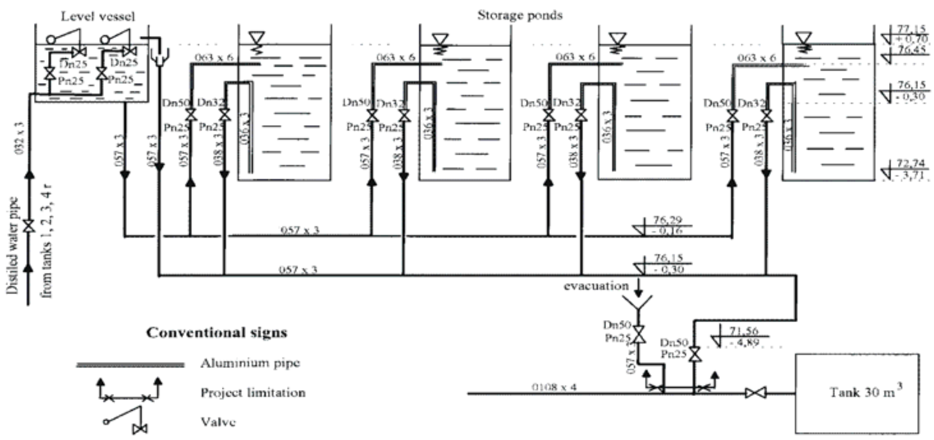


Figure 3. Distilled water - filling system.

ii. Spent fuel inventory

1. Cernavoda NPP spent fuel inventory

The CANDU – 6 fuel bundle used at Cernavoda NPP consists of 37 natural uranium fuel elements, arranged in three rings of 18, 12 and 6 elements, respectively, around one central element. Thirty-seven elements are held together at both ends by Zircaloy endplates.
The spent fuel mass parameters are:
Fuel bundle initial Uranium content: 18.9 kg U nat.
Nominal bundle mass 23.7 kg.

By the end of October 2002, the spent fuel stored in the Spent Fuel Bay of Cernavoda NPP Unit-1 accounted for 29,360 CANDU spent fuel bundles.

2. SCN Pitesti spent fuel inventory

The TRIGA storage pool contains:
- 106 TRIGA – HEU - type elements,
- 1 TRIGA – LEU - type element,
- 3 CANDU - type bundles,
- 1 CANDU - type experimental element.

The storage pits at the LEPI hot cell includes:
- approximately 20.77 kg uranium in LEU spent fuel elements and fragments, including approx. 0.1 kg unirradiated fuel,
- approximately 0.321 kg uranium in HEU spent fuel and fragments, including a few grams of unirradiated fuel,
- approximately 5.32 kg natural uranium in spent fuel elements and fragments, including 0.128 kg unirradiated natural uranium.

3. IFIN-HH spent fuel inventory

The total inventory of spent fuel in storage pools and cooling pool of IFIN-HH consists in:
- 153 EK-10 type assemblies (10 % initial enrichment) containing in total approximately 195.84 kg uranium
- 70 S-36 type assemblies (36 % initial enrichment) containing in total approximately 27.09 kg uranium.

iii. List of radioactive waste management facilities subject to the convention, their location, main purpose and essential features

1. CNE PROD radioactive waste management facilities

At CNE-PROD, the radioactive waste management systems are, as follows:
a) Solid Radioactive Waste Intermediate System
b) Organic Liquid Handling System
c) Spent Resins Handling System

Gaseous and liquid waste are managed within the following NPP's systems:
d) Gaseous Radioactive Waste System
e) Liquid Radioactive Waste System

a) The Solid Radioactive Waste Intermediate System

After pretreatment (segregation and compaction) the solid wastes are confined in 220L stainless steel drums and sent to the Solid Radioactive Waste Intermediate Facility.

The Solid Radioactive Waste Intermediate Facility is located within the inner security fence of the plant site and is designed for storage of low and intermediate wastes has a storage capacity produced by the plant, except spent ionic resins, reactivity control bars and spent fuel.
It consists of three above ground structures with a designed life of 50 years, as follows:

- a warehouse
- two concrete structures

The warehouse which is a concrete building with a total storage capacity of 2,400 m^3. Inside this structure 220L stainless steel drums containing compactable and non-compactable low and intermediate level solid radioactive waste are stacked on four level. The occupied capacity is about 120 m^3 by the end of 2002.

A concrete structure which consists of cylindrical concrete cells dimensioned to accommodate all low and intermediate level spent filter cartridges resulted from plant operation. Its designed storage capacity is of 57.77 m^3. Inside the concrete cells there are metallic cassette with bottom and cover designed to avoid cell contamination.

The dimensions of concrete cells are presented in the following table.
Table: Size characteristics of the Cernavoda NPP spent filters cartridges storage facility.

Type of concrete cells	Number of cells	Diameter (mm)	Height (m)
Large	30	512	3
Medium	84	408	3
Small	28	308	3

The occupied capacity is about of 0.8 m^3 by the end of 2002.

The warehouse (inside view)

The Solid Radioactive Waste Intermediate Facility

A second concrete structure for large and highly contaminated pieces has a total storage capacity of 41 m^3. It consists of eight concrete cubes which can be removed together with the waste content. Currently, the structure does not contain any waste.

b) Organic Liquid Handling System

Organic liquid radioactive wastes consist of spent oils, spent solvents, liquid scintillate cocktails, flammable solids, sludge, which cannot be processed through Liquid Radioactive Waste System because of their environmental impact.
The organic liquid handling system comprise the handling of: oils, solvents, liquid scintillators, radioactive sludge, flammable solids (solid + liquid mixture). These wastes are stored in 220L stainless steel drums in the basement of the Service Building.

Organic radioactive wastes

c) Spent Resins Handling System

CNE-PROD Cernavoda Spent Resins Handling System includes storage tanks for spent resins from the plant's purification circuits.
Storage of spent resins takes place in three vaults made of reinforced concrete lined with epoxy, located in the basement of the Service Building, in the proximity of the Reactor Building.
The capacity of each vault is of 200 m^3.

When this capacity was established, it has been considered that the amount of spent resins which would be produced would be about 26 m^3 (design figure) and the spent resins would be stored inside the plant for, at least, 10 years, before being discharged and carried to the disposal facility.

d) Gaseous Radioactive Waste System

Potentially contaminated air is circulated through four ventilation systems:

- *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.

- *Upgrader Tower Exhaust System*
  The air from this system is unfiltered since it contains small tritium quantities, only.

In areas of the station where heavy water systems are located, a Closed Cycle Vapour Recovery System recovers the majority of released tritium vapours.

All potentially contaminated exhausted air is routed to the exhaust stack, which discharge it.

e) Liquid Radioactive Waste System

Radioactive liquid wastes (aqueous) are collected in five liquid effluent hold-up tanks. They are located in the basement of Service Building. Each tank has a capacity of 50 m^3. After a sever control, the content of any tank shall be discharged to the Danube River or to the Danube - Black Sea Channel (via Condenser Cooling Water Duct).
A decontamination unit is provided to minimize the radioactive particles in any effluents if necessary. It includes filtering and ionic exchange by means of a pre-coat type filter using as filtering material ionic microresins and a special fiber material adequate for the colloidal filtration since the main contaminants consists of a combination of colloidal particles and ionic materials within a deionized water medium.

2. Nuclear Fuel Plant radioactive waste management facilities

a) Gaseous Radioactive Waste System

Air from potential contaminated indoors (areas dedicated to the fuel manufacturing and laboratories' rooms) is collected, filtered with high efficiency filters and discharged through the plant's stack.

b) Liquid Waste Temporary Storage Tanks

Storage of liquid radioactive wastes is made inside the basement of the plant building . Facilities for storage are: 3 stainless steel tanks of 10 m^3 each and 3 steel tanks of 60 m^3 each. They collect and store the different categories of liquid wastes.

c) Solid Waste Temporary Storage Platform

Storage of solid radioactive waste is realized on the Temporary Storage Platform for Low Contaminated Solid Waste. This is a platform on the ground located in the vicinity of the building of fuel manufacturing.
It is dedicated to temporary storage of different categories of solid waste collected in the plant and further, in short term, are transferred to different waste operators mentioned before in Section B.
The platform can store about 20 tones radioactive solid wastes.
It has a security fence with a physical protection system.

3. SCN Pitesti radioactive waste management facilities

a) Radioactive Waste Treatment Plant

The Radioactive Waste Treatment Plant has the following facilities:

a.1) Installation for treatment of low - active β-γ liquid wastes
- treatment capacity: 2.2 m^3/hour
- decontamination factor: 10^5
- treatment is done by evaporation.

Evaporator for treatment of low - active β-γ liquid wastes

a.2) Installation for conditioning in concrete of the radioactive concentrate obtained during the evaporation treatment of liquid radioactive waste; the installation is used also for conditioning in concrete the solid radioactive waste:

- treatment capacity: 280 l / 8 hours
- conditioning container: 218 l. barrel.

a.3) Installation for conditioning into bitumen of spent ion exchangers at the TRIGA reactor

- treatment capacity: 32 dm^3 / 8 hours
- conditioning container: 70 l. barrel
- bitumen type: I60 / 70.

a.4) Installation for treatment, with uranium recovery, of liquid radioactive waste resulting from the fabrication of CANDU – type nuclear fuel

- treatment capacity: 2000 m^3/year
- max. U concentration in the waste: 5 g/l
- max. U concentration in the effluent: 1 mg/l
- uranium separation is done by selective precipitation.

Rotating cellular filter for uranyl phosphate filtering

a.5) Installation for the incineration of solid radioactive waste contaminated with natural uranium from Fuel Fabrication Plant

- treatment capacity: 5 kg/hour
- incineration temperature: 900°C
- the plant includes a module for filtering off – gas comprising 2 serial cyclons, 2 bag type filters and 1 battery of HEPA filters.

Incinerator for solid radioactive waste contaminated with U-nat

a.6) Installation for treatment / conditioning for organic liquid radioactive waste with tritium content from Cernavoda NPP

- treatment capacity: max. 200 l / 8 hours,
- conditioning container: 218 l barrel.

Treatment / conditioning plant for organic liquid radioactive waste

a.7) Installation for decontamination of sub-assemblies and spare parts.
Characteristics:

- decontamination vessel capacity: 1 m^3
- decontamination solution temperature: 93°C.

STDR Pitesti has available an industrial-type laundry washing machine for decontamination of individual protective clothes:

- decontamination capacity: 40 kg/hour.

b) Post Irradiation Examination Facility

In the precinct and in the hot cells of LEPI facility are stored:

- Short lived radioactive waste with high activity (a few high activity spent sources);
- Long lived radioactive waste resulted from the reactor TRIGA.

4. IFIN-HH radioactive waste management facilities

a) Radioactive Waste Treatment Plant

The management of the non-fuel cycle radioactive wastes from all over Romania is centralized at IFIN–HH in the Radioactive Waste Treatment Plant (STDR). Final disposal is carried out at the National Repository of Radioactive Wastes (DNDR) at Baita Bihor.
Radioactive wastes, containing short lived radionuclides, including spent sealed sources are collected, treated and conditioned at IFIN–HH before final disposal, provided they are satisfying the maximum concentration of activity allowed for disposal at Baita Bihor repository. The long lived radioactive wastes including spent sources, are stored on site at STDR Magurele.

Radioactive wastes treated at STDR Magurele arise from three main sources:

1. Wastes originated from the VVR-S research reactor during operation and the future decommissioning works.
2. Local wastes from other facilities operating on IFIN–HH site. These wastes include the own wastes generated during the normal activities of the STDR.
3. Wastes from non-fuel cycle practices all over the country (i.e. medical, biological, research and industrial applications)

The radioactive wastes treated and conditioned at STDR Magurele are both liquid and solid wastes.

From the operation of the STDR, internal liquid effluents arise from drainage systems, from the individual protection equipment decontamination (laundry) and from equipment decontamination.

Solid wastes collected from the research reactor and other IFIN – HH departments as well as from off-site facilities and from the treatment plant are generated during the operation and routine maintenance and are classified as follows:

1. Combustible type: cloth, paper, wood, etc.;
2. Compactable, non-combustible type: glass, metal sheet, and plastic materials;
3. Non-compactable, non-combustible type: metal, ceramics, rubber, etc.:
4. Spoilage, putrefying type: dead animal bodies, plants, fruits, vegetables, etc;
5. Short-lived spent sources;
6. Long-lived spent sources and radioactive waste.

The Radioactive Waste Treatment Plant was commissioned in 1975 and it represents a fully import from FEL – England. Except the central building which contain the incinerator, the liquid effluents treatment installation, all the equipments for solid waste conditioning, the laboratories and the offices, the plant has in compound five interim storage repositories and a building for two 300 m^3 tanks in which are collected the contaminated waters from the nuclear research reactor, radioisotope production department and nuclear medicine department. The five cellular repositories are used for the interim storage of the conditioned drums until their transfer to Baita final repository.

The STDR basically consists of liquid and solid waste treatment and conditioning facilities, a radioactive decontamination center, a laundry and an intermediate storage area.

STDR Magurele has available the following facilities for the treatment and conditioning of radioactive wastes:

1. Installation for aqueous liquids treatment;
2. Installation for incineration of solid combustible radioactive waste;
3. Installation for solid non-combustible radioactive waste compaction;
4. Installation for cement conditioning;
5. Installation for decontamination of sub-assemblies and spare parts.

STDR Magurele has available a laundry for decontamination of individual protective clothes.

Collection of liquid effluents with an activity up to 3.7×10^7 Bq/m^3 (10^{-3} Ci/m^3) is provided by two 300 m^3 tanks with pipe connections to the radioactive waste discharge from Radiochemical Production Department the reactor building and reactor primary circuit, and four 10 m^3 tanks located in a Special Center. Inner discharge is collected in 2×3 m^3 tanks; the drain-off is collected too in a 3 m^3 tank.

A batch treatment system is employed. The basic treatment processes are: chemical precipitation treatment, evaporation and polishing through an ion exchange resin column.

Chemical treatment of liquid effluents is undertaken using flocculates (iron chloride, sodium phosphate, and copper ferrocyanide) in one of two identical 30 m^3 tanks.

The precipitate formed in each tanks settled and the supernatant is removed and passed either through a second stage treatment of evaporation, or direct to the final delay tanks according to the level of contamination in the effluent.

The sludge collected by this process is further dewatered and cemented in drums for final disposal. The supernatant from this step is returned to one-treatment tanks.

After sampling, the supernatant is discharged to the river if the radioactive concentrations are less than 14,800 Bq/m^3 (4×10^{-7} Ci/m^3).

The evaporator is a single-stage type with 1.14 m^3/h of treatment capacity. Distillate from the collecting tank may be either discharged directly to the final delay tanks or further treated in a non-regenerable ion exchange column to the final delay tank.

Evaporator of the STDR Magurele liquid waste treatment installation

The concentrate from the evaporator can be removed for mixing with cement and placement into drums.
The final stage consists of a non-regenerable ion exchange plant final treatment of a distillate from the evaporator if required. The plant was designed to treat the final full output from the evaporator should this be necessary.

The overall liquid effluent system was design to give complete flexibility in operation, so that any stage of treatment may be by-passed or re-cycled for additional processes if required.
Low level solid wastes are treated according to the initial waste form. Final conditioning is performed by cementation.

Solid waste cementation installation at STDR Magurele

Collection from the waste producers is made in 100 or 220-litter carbon steel painted drums fitted with removable lids. Activity introduced in each container should not exceed 3.7 MBq/m^3 ^{60}Co equivalent for low active wastes and the dose rate on the container wall should not exceed 2 mSv/h (200 mrem/h).

Combustible radioactive wastes are segregates and directed to the combustible waste treatment system to be burned followed be filtration of the exhaust gases before their discharge to the atmosphere.

The incinerator is a complex, automatic equipment fitted with special systems for handling the containers inside the Reception and Sorting-out Compartment (RSC). The incinerator itself has combustion chambers where a temperature of 850-900°C is required until the burning process is reached. The resulting ash is collected into two ash pans located under the burner grid. From here, it is transferred via a raking system to 100 litter drums and to the cementation plant.

The incinerator in STDR is not suitable for burning wastes containing ^{3}H, ^{14}C, ^{35}S and plastics with organic chlorine.

STDR Magurele has its own ventilation system. The releases into the environment pass through a filter battery for radioactive aerosols retention. The Installation for incineration of solid combustible radioactive waste has its own local ventilation system composed by 1 cyclone, 1 electrostatic separator, and a HEPA filter battery. The release from the incineration installation is monitored.

The non-combustible solid radioactive wastes are directed to the treatment system in order to reduce their volume. Reduction of volume is accomplished in two ways:

- By shredding of plastics into as small as possible pieces;
- By compacting in order to gets the smallest possible volume.

In case of wastes with higher activity, classified as intermediate active radioactive wastes such as filters, pre-filters, gamma ray sources for therapy, etc., they are treated in the STDR by processes which are adapted to each case separately.

ILW, spent sources and wastes containing ^{3}H, ^{14}C and ^{129}I are conditioned in shielded drums. The STDR is not licensed for the treatment or conditioning of alpha wastes, including smokes detectors and neutron sources.

The sludge resulting from the chemical treatment of radioactive liquid wastes, the concentrates resulting from evaporation and the ash resulting from incinerator are homogeneously mixed with cement and then concrete into drums of 220 litters.

The small amounts of liquid radioactive waste with activity greater than 3.7×10^{7} Bq/m^{3} (10^{-3} Ci/m^{3}) are directly conditioned without further processing by cementation into 220 litter drums.

The solid wastes should be introduced, if any, into drums of 100 litter, which will then be placed in drums of 220 litter or, alternatively, by direct cementation in drums of 220 litter.

The 220 litter drums are closed with metallic lids, marked with numbers, measured and then marked (the dose rate of each drums should be also marked) registered, transmitted to the temporary storage and then transported to the National Repository at Baita Bihor.

Conditioned drums waiting for transport at Baita Bihor Repository

At present the containers used at STDR for packaging radioactive wastes are stainless and normal painted carbon steel drums of 100, 220 and 420-litter capacity. The annual production of final packages after liquid treatment is 150-200 standard 220 litter drums with a surface dose rate up 2 mSv/h, an activity up 3.7×10^{13} Bq/m^3 and superficial contamination for γ and β emitters up to 3.7 Bq/cm^2.

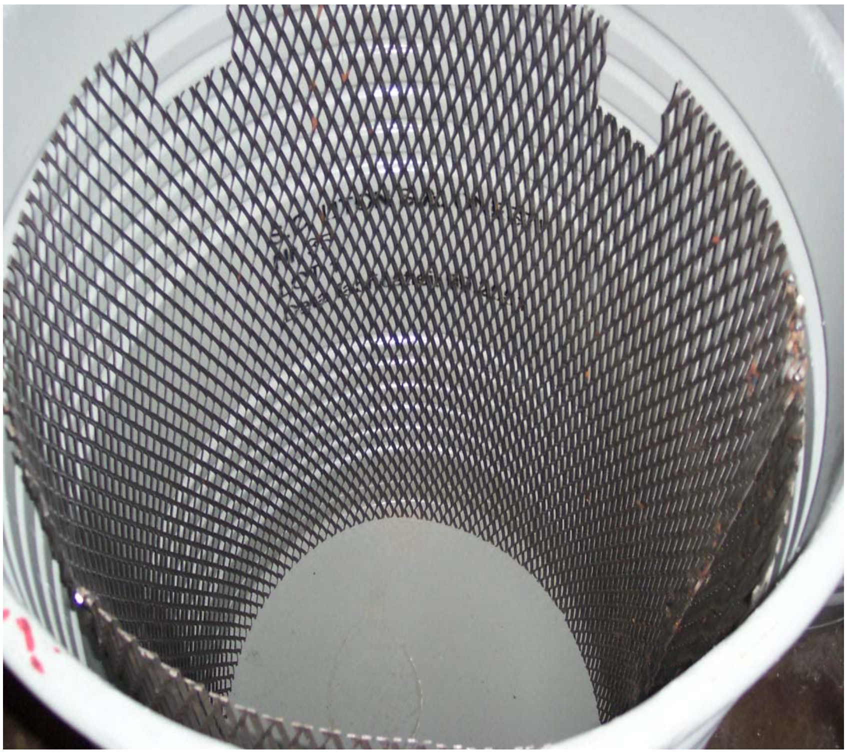
The annual designed capacity of the treatment plants is 1,500 m^3 Low Level Aqueous Waste (LLAW), 100 m^3 Low Level Solid Waste (LLSW) and shielded drums for Intermediate Level Waste (ILW). The normal present status of STDR concerning the buffer storage capacity radioactivity and annual arising are presented in Table 2.

From November 1974, when the STDR became operational, to December 2000, the plant has treated nearly 26,000 m^3 of LLAW, 2,100 m^3 of LLSW and 4,000 spent radiation sources, resulting in over 5,500 conditioned drums. The transfer of conditioned wastes from the STDR to the DNDR for final disposal started in 1987 with an annual rate of nearly 500 drums up to 1993 and than 150-200 drums yearly.

At IFIN-HH Magurele there is a temporary storage area. The facility is a ground floor building with a surface area of approximately 1000 m^2, divided into 5 rooms. The storage building is not fitted with either a ventilation system or special systems for handling the containers.

Temporary Storage Facility at STDR Magurele

The total storage capacity is about 3,000 drums. At present, there are approximately 800 drums some of which are up to 20 years old are damaged by corrosion. These 220-l drums will require repackaging in 420-l drums before being sent to the national repository. In some cases, the contents of the drums are uncertain and a program of characterization is required to determine the contents.



420 l drum for reconditioning 220 l corroded drums

Also, at STDR is a Used Filters Repository (DFU). This is a construction with 5860 mm × 5000 mm × 3000 mm dimensions done by heavy concrete, build in 1957-1958 having as destination the long term disposal of the filters from VVR-S research reactor, of damaged fuel assemblies and other materials resulting from reactor processes. In DFU were disposed aluminum devices with Pb used at radioisotope irradiation and irradiation devices from the reactor experiments. It was not disposed any used filters from primary cooling system (with ion exchange resins) either damaged fuel assemblies.

DFU is composed by a concrete platform on which are placed 4 closed wells with concrete corks.

Well no. 1, which was designed for disposal of solid wastes from hot cells, is lined on the whole internal surface with 5 mm thick iron plate.

Wells 2,3 and 4 were designated for disposal of filters from the primary cooling system and are lined also with 5 mm iron plate at the upper surfaces (1000 mm) and on the bottom part.

Initially, every well was connected to the reactor ventilation system by rubber hoses only when the cork is taken out. Also, DFU was equipped with a travelling crane, which is not in use anymore.

Thickness of the wall is 972 mm heavy concrete, of the bottom is 300 mm heavy concrete according to the Russian standards. The corks are also from heavy

concrete lined with 5 mm iron plate, with 1000 mm thickness and 1550 mm / 1400 mm diameters.
In present the wells are closed and are not in use for more than 25 years. The total disposed activity is not known. The area is under radiometric surveillance performed permanent by STDR and periodically by the Radiological Security Department from IFIN-HH.

b) National Repository for Low and Intermediate Level Wastes Baita - Bihor

In 1985 was built and given in operation the National Repository for Low and Intermediate Radioactive Waste (DNDR) – Baita, Bihor county, sited in Apuseni mountains, in an old exhausted uranium mine. The repository is dedicated to institutional waste. Using the existing concepts at ’80 years level concerning the final disposal of the low and intermediate level radioactive wastes, and, rely on internal standards and international recommendations the underground constructions were dimensioned to dispose about 21,000 standard drums.

DNDR entrance

The experience gained by the countries that developed nuclear programs, which shows that a proper modality for radioactive waste disposal are the underground facilities in geological formations without water table or infiltrations in the vicinity of the emplacement, was used to choose the emplacement of DNDR.
The site selection was based on preliminary studies concerning the geology, hydrogeology, seismic, meteorological and radioactivity of the area, and also on mining technical studies.

In present, in the DNDR galleries are finally disposed more than 6,000 standard drums, which means about 30 % of the repository capacity.

The region relief is mountainous, with big slopes, conditioned by the geological structure of the area. The mountainsides are covered with deciduous woods up to 900-1000 m altitude and up to 1500 m with coniferous.

Disposal and ventilation galleries are dug up in flyschoid formation which has maximum thickness in this zone. Is important to be mentioned that hydrothermal metamorphism processes lead to the decrease of the rock permeability and porosity, becoming a hard and compact rock. So, the main types of rock meet in galleries are characterised by low porosity and humidity, which practically means that are dry and compact. From the mechanical characteristics point of view, they have big resistance at compression (f =12,5). The cohesion is enhanced and in uncracking state is practically waterproof.
Thus, their natural stability leads that for almost 25 years from excavation, with small exceptions, the galleries maintain the initial profiles.

According to the existing macroseismic and instrumental data, the seismicity of the area is influenced by a weak local seismicity and by a higher seismicity activity induced by the Vrancea epicentral area located at a distance of approx. 700 km.

The main water leakage results form precipitation. This fact as well as the situation of the geologic basement eliminates the existence of a hydrostatic level. The absence of permanent water sources, assure a low flooding level, practically null, taking also in consideration that the above rock package has 160-180 m thickness.
The hydro-geologic prospective performed underground as well as the chemical analyse of the water conducted to the result that groundwater does not origin from underground springs. Hence the rainfall and melted snows infiltration water (through fractures) are the single sources of groundwater.

The Avram Iancu uranium deposit (which include galleries 50 and 53) is found by Russians in 1952 using gamma prospecting, being considered one of the most important uranium deposits form Romania. In time, the activity was diminished and now the exploitation is almost shut down. The repository area is totally exhausted with no economic potential and is planned to start a re-ecologisation and restoration project in the whole area.

The planning was carried out taking in consideration the total length of the galleries and the annually deposited drums, obtaining an optimum profile of 10.5 m^2. Locally the walls were catched with Portland cement selected concerning his small alkalinity aggressively to water. The same type of cement is now used in the radioactive waste conditioning process.

In the technological disposal process is used bentonite, wood and cement brick. Bentonite is used as backfilling material and engineered barrier, taking in consideration his very good plasticity and absorption capacity, which diminishes the radionuclide migration possibility from deposited drums. Between the drums ranges are placed wood shuttering. When a gallery is filled up, is tight with cement bricks. These materials are placed near the working area, inside the gallery.

Disposal Gallery at DNDR

5. National Uranium Company waste management facilities

The Uranium Milling Plant of the Feldioara Subsidiary is located at about 30 km from the Brasov town (250,000 inhabitants). Since the commissioning of the plant, the tailings resulted from the milling process were discharged in 2 special insulated tailings ponds, under a variable water strata, located at 600 m from the plant area.
The location and insulation system were realized taking into account the "National security standards for geological research, radioactive raw materials mining and milling", issued in 1975. The geographic criteria were the presence of a clay deposit within the area, enhancing the possibilities for a good insulation, and also the presence of the Cetãtuia natural valley, suitable for building a long and stable pond. The 2 tailings ponds are named Cetatuia II and Mittelzop.

The Cetatuia II have as aim the settling and storage of radioactive tailings, and was built in 3 pieces, due to high investment costs for insulation of the concerned surfaces. The present state of this pond is the following, in present:
- the first part, is now in a closing out process, being used for tailings discharging in the 1978 - 2001 period; the total estimated tailings discharged was about 4,500,000 tons; the total surface of this first part is 368,000 m^2; the closure of the pond will transform it in a repository, provided that the closure solution satisfies the regulatory safety requirements;

- the second part of the Cetatuia II pond was commissioned in October 2001, after completion of complex insulation works; the discharging capacity is estimated at 880,000 tones of tailings, on a 133,000 m^2;
- the third part of the Cetatuia II pond, located upside the two other parts on the Cetatuia valley, is planned to be commissioned after 2011, after the closing of the part II - Cetatuia pond.

The Mittelzop pond has as aim the final tailings settling of fines, receiving the inflow from the Cetatuia pond waters. This pond was commissioned in 1978, at the same date with Cetatuia pond and the milling plant. The volume is about 300,000 m^3, on an 87,000 m^2 surface. The dam of this pond has 5 m height. From the pond the clear waters are pumped to the decontamination plant (where the remaining trace of uranium are removed) and then to the Olt river.

After closure, all the tailing ponds will be transformed in repositories, provided that the closure solution satisfies the regulatory safety requirements.

For the ponds the main insulation works were as follows:
- the bottom of ponds was insulated with two layers, 30 cm thick, of clay.
- the right slope of the ponds was protected by two layers of polyethylene (plastic) foil, and a sandwich of special bitumen - rubber materials;
- the left slope, being located on a clay deposit;
- it was built a rain water drainage system used also for draining the surroundings of the ponds.

In 1996, a channel was built between the Cetãtuia and Mittelzop ponds, enabling the natural flowing of pond water, without using pumps, possible because of higher level of water and tailings.

Between the two mentioned ponds there is a radioactive solid material discharge area, composed by 2 old trench type storages and 1 new storage that is surrounded by concrete walls.

On a 3 km area around the plant and tailing ponds there are no inhabitants to be exposed to radiological hazard due to radioactive materials discharge.
The new storage for contaminated solids is located between two older trench type storage areas, which were used and authorized in past according to the former law for nuclear activities within the country.
Within these older storage surfaces the radioactive waste were buried into the existing clay layer and also were covered by clay. Around the surfaces was built a wire fence.

The new solid radioactive materials (wastes, scrap) storage facility was located, projected, built, according to the new 111/1996 Law establishing the nuclear activities security standards, according to new Radiological Safety Fundamental Norms - 2000 edition, and to the new Norms for Physical Protection in Nuclear Field - 2001 edition.

The new storage area for radioactive waste has a trapezoidal shape, the useful surface being 1,640 m^2 protected by 3 concrete walls, 5 m high. The maximum storage volume is 6,560 $m^{3.}$ The fourth wall will be built in future, ensuring larger storage capacity when needed.

Uranium mining and milling low level radioactive waste storage

iv. Radioactive waste inventory

The inventories of radioactive waste are presented in section L.

v. Decommissioning

In Romania there is only one nuclear facility under decommissioning, namely the VVR-S research reactor from IFIN-HH Magurele. The reactor was shut down in 1997, being in present under a conservation authorization.
According to IFIN-HH, which has submitted to CNCAN till now a preliminary decommissioning plan, the future strategy for VVR-S Research Reactor was defined as decommissioning to stage 2.
CNCAN did not approved the decommissioning plan submitted, asking for improvements.
According to the new “Norms for Decommissioning of Nuclear Objectives and Installations / 2002”, IFIN-HH has to submit till June 2003, a generic decommissioning plan for VVR-S reactor.
The actual start up of the decommissioning activities requires the completion of the detailed decommissioning plan for the Stage for which the authorization is required. In this moment, IFIN-HH considers that asking first a decommissioning authorization to stage 1 is the best solution, which will allow starting the clean-up activities; the authorization for stage 2 decommissioning will be required latter, during the clean-up activities.

SECTION E. LEGISLATIVE AND REGULATORY SYSTEM

Article 18. Implementing measures

Romania has ratified by the Law no. 105 / 1999 the Joint Convention on the safety of spent fuel management and on the safety of radioactive waste management.

In order to fulfill its obligations under the Joint Convention, Romanian Government issued the Governmental Ordinance no. 11 / 2003 on the management of spent nuclear fuel and radioactive waste, including final disposal.

By the provisions of this ordinance, it is established that the holder of authorizations for nuclear activities have the obligation to manage safely the spent fuel and the radioactive waste, in view of their final disposal, during all the useful lifetime of the nuclear installation and during its decommissioning.

The coordination at national level of the process of management of the spent fuel and of the radioactive waste and of their disposal shall be done by the National Agency for Radioactive Waste (ANDRAD), subordinated to the Ministry of Industry and Resources. The coordination shall be based on the National Strategy on Medium and Long Term for Management of Spent Nuclear Fuel and Radioactive Waste, Including Final Disposal and Decommissioning.

The above strategy shall be approved by National Council for Nuclear Energy, which is an interministerial board, including representatives of the Ministry of Industry and Resources, Ministry of Education and Research (through the National Agency for Atomic Energy - ANEA), Ministry of Waters and Environmental Protection (through the National Commission for Nuclear Activities Control – CNCAN), Ministry of Health and Family, Ministry of National Defense and Ministry of Foreign Affairs.

The ordinance, that entered into force and shall be endorsed by a law, establishes the attributions of ANDRAD and the obligations related to spent fuel and radioactive waste management of the holders of authorization.

The main tasks of ANDRAD are:

- to elaborate the National Strategy on Medium and Long Term for Management of Spent Nuclear Fuel and Radioactive Waste, Including Final Disposal and Decommissioning;
- to elaborate the Yearly Activity Plan and to establish the financial resources necessary for the coordination at national level of the management of spent fuel and radioactive waste;
- to create and maintain the national data base regarding the spent fuel and radioactive waste;
- to analyze the characteristics of spent fuel and radioactive waste in view of their management;
- to establish the spent fuel and radioactive waste inventory to be produced in each year, in view of elaboration of the Yearly Activity Plan;

- to elaborate technical standards and procedures for the management of the spent fuel and of the radioactive waste, including disposal and decommissioning
- to coordinate feasibility and siting studies, of design, construction, commissioning and operation of final disposals for spent fuel and radioactive waste;
- to coordinate the decommissioning process for the nuclear installations;
- to cooperate with similar foreign organization to assure the use of the best available technologies for spent fuel and radioactive waste disposal.

The National Commission for Nuclear Activities Control (the regulatory body) is in the process of establishing the new set of regulations related to spent fuel and radioactive waste management. This will strongly improve the regulatory process in the field of interest of the Joint Convention.

Article 19. Legislative and regulatory framework

19.1. Establishing and maintaining of legislative and regulatory framework

Romania has had laws in place governing nuclear activities since 1974. After the political changes occurred in December 1989, and subsequent to constitutional changes, the legislative system started to be revised. In December 1996 the new nuclear law was enacted (Law no. 111 / 1996 on safe conduct of nuclear activities).

Prior to December 1996, the regulatory activities were based on:
- Law no. 61 / 1974 for the development of nuclear activities in Romania;
- Law no. 6 / 1982 for the quality assurance of the nuclear facilities and nuclear power plants.

Besides the laws, regulations were in place starting with 1957. The first regulations were related to radiation protection. The system of regulations evolved and nuclear safety, radiation protection, quality assurance, physical protection, safeguards regulations were issued according to the provisions of the 2 laws.

Up to 1989, activities in nuclear area related to promotion, development, construction, commissioning, operation and regulation were performed by the State Committee for Nuclear Energy (CSEN).
The regulatory component was set up in 1972 as a division of CSEN, called State Inspectorate for Nuclear Activities Control (ISCAN). After 1982 the name of the regulatory component was changed in Inspectorate for Nuclear Activities Control and Nuclear Quality Assurance (ISCANACN). This lack of independence of the regulatory body has created problems as the authority of regulatory body was diminished.

However, in spite of the difficulties, the regulatory body started to issue nuclear safety regulations. The regulations were based on IAEA-NUSS series of standards, and on the provisions of the US 10 CFR regulations, adapted to the specifics of CANDU reactors. The NRS prescriptive approach was endorsed, and the regulatory body was deeply involved in all the phases of Romanian nuclear program.
After 1990, the regulatory activities were separated from promotion, development, construction, commissioning, operation, and a new regulatory body was set up:

National Commission for Nuclear Activities Control, under the Ministry of Waters and Environmental Protection.

The Romanian legislative framework that govern safety of spent fuel and radioactive waste management includes the following:

- Law no. 111/1996 on safe conduct of nuclear activities (as amended); the last amendment is in the final process of approval in the Parliament.
- Law no. 137/1995 on environmental protection (as amended)
- Law no. 98/1994 on public health
- Governmental Ordinance no. 47/1994 on defense against disasters, endorsed by the Parliament by law no. 124/1995
- Law no. 106/1996 on civil protection
- Law no. 105/1999 on ratification of Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
- Law no. 703/2001 on civil liability for nuclear damages
- Governmental Ordinance no. 11/2003 on the Management of Spent Nuclear Fuel and Radioactive Waste, including final disposal
- Governmental Ordinance no. 7/2003 on the peaceful use of nuclear energy

➢ Law no.111/1996 (as amended) establishes the regulatory framework for nuclear activities. According to this law the regulatory body, National Commission for Nuclear Activities Control (CNCAN), under the coordination of the Ministry of Waters and Environmental Protection is empowered with the regulation, authorization, and control of nuclear activities.

According to the law, any (non excepted) nuclear activity (including only possession) and any (non excepted) radiation source (within the activity) shall be authorized.

Beside the general requirements for nuclear safety, radiation protection, quality assurance, safeguards, physical protection, emergency planning, preparedness and implementation, Law no.111/1996 (as amended) has also specific requirements regarding radioactive waste management (as spent fuel is considered radioactive waste, these requirements apply also to spent fuel):

- The holder of authorization is responsible for the management of radioactive waste generated by his own activity;
- The holder of authorization shall bear the expenses related to the collection, handling, transport, treatment, conditioning, temporary storage and disposal of the waste produced in its activity;
- The holder of authorization shall pay the legal contribution to the Fund for management of radioactive waste and decommissioning;
- On discontinuation of the activity or decommissioning of nuclear installation, as well as in case of transfer of sources or installations, the holder of authorization shall obtain an authorization to hold, decommission or transfer them, as applicable;
- An authorization for a nuclear activity shall be granted only if the applicant disposes of material and financial arrangements adequate and sufficient for the collection, treatment, conditioning, and storage of radioactive waste generated from

his own activity, as well as for decommissioning the nuclear installation when it will cease its authorized activity, and has paid his contribution to the Fund for management of radioactive waste and decommissioning;

- The import of radioactive waste shall be prohibited, except situations in which import follows directly from processing outside Romanian territory of a previously authorized export of radioactive waste, including spent nuclear fuel;
- The Government shall introduce for adoption in Parliament the draft law on the Fund for the management of radioactive waste and decommissioning.

It has to be mentioned that till now the law on the Fund for the management of radioactive waste and decommissioning was not submitted to the Parliament.

According to the provisions of Law no.111/1996 (as amended), CNCAN issued a set of regulations and internal procedures regarding the regulation, authorization, control and enforcement process.
According to the provisions of the law, the nuclear system of regulations issued by CNCAN is under review.

Till now, the following new regulations were issued:

- Radiological Safety Fundamental Norms /2000 (transposing the Council Directive 96/29/EURATOM - the Romanian regulation has a supplementary chapter on the transfer in environment of the radioactive waste);
- Radiological Safety Norms on Operational Protection of Outside Workers /2001;
- Radiological Safety Norms – Procedures for Agreement of External Undertaking /2003
- Radiological Safety Norms –Authorization Procedures /2001;
- Norms for Designation of Notified Bodies in Nuclear Field /2000;
- Norms for Authorization of the Work with Radiation Sources Outside the Special Designated Precinct /2002
- Individual Dosimetry Norms /2002;
- Norms for Issuing the Work Permits for Nuclear Activities and Designation of Radiological Protection Qualified Experts /2002;
- Norms for Decommissioning of Nuclear Objectives and Installations /2002 (the regulation does not refer to NPPs);
- Radiological Safety Norms for Operational Radiation Protection for Uranium and Thorium Mining and Milling /2002;
- Radiological Safety Norms for Radioactive Waste Management from Uranium Mining and Milling /2002;
- Fundamental Norms for Safe Transport of Radioactive Materials /2002;
- Norms for International Shipments of Radioactive Materials Involving Romanian Territory /2002;
- Norms for International Shipments of Radioactive Wastes Involving Romanian Territory /2002;
- Norms for Transport of Radioactive Material – Authorization Procedures /2002
- Safeguards Norms for Nuclear Field /2001;
- Detailed List of Materials, Devices, Equipment and Information Relevant for the Proliferation of Nuclear Weapons and Other Explosive Nuclear Devices /2002;

- Norms for Physical Protection in Nuclear Field /2001;
- Norms on Requirements for Qualification of the Personnel that Ensures the Guarding and the Protection of Protected Materials and Installations in Nuclear Field /2002;
- Norms on Radiation Protection of the Persons in Case of Medical Exposures /2002;
- Norms on Radioactively Contaminated Foodstuff and Feeding stuff after a Nuclear accident or other Radiological Emergency /2002 (issued together with the Ministry of Health and Family);
- Norms on Irradiated Foodstuff and Alimentary Additives /2002 (issued together with the Ministry of Health and Family).

From the old regulations, still in force till the new regulations will be issued, we mention, related to spent fuel and radioactive waste management:

- Republican Nuclear Safety Norms for Nuclear Reactors and Nuclear Power Plants /1975: part I: Safety Criteria for Nuclear Reactors and Nuclear Power Plants and part II: Authorization of Operator Personnel for Nuclear Reactors and Nuclear Power Plants
- Republican Nuclear Safety Norms – Working Rules with Nuclear Radiation Sources /1975
- Norms for Prevention and Extinguishing of Fire and for Providing Vehicles, Installations, Devices, Apparatus, Protection Equipment and Chemical Substances for Preventing and Extinguishing of Fires in Nuclear Field / 1978
- Republican Nuclear Safety Norms for Planning, Preparedness and Intervention for Nuclear Accidents and Radiological Emergencies /1993
- Republican Quality Assurance Norms: QA Requirements for the Project Management of the Nuclear Objectives and Installations /1991
- Republican Quality Assurance Norms: QA Requirements for the Design of the Nuclear Objectives and Installations /1991
- Republican Quality Assurance Norms: QA Requirements for the Procurement of the Products and Services of the Nuclear Objectives and Installations /1991
- Republican Quality Assurance Norms: QA Requirements for Manufacturing Products and Providing Services for the Nuclear Objectives and Installations /1984
- Republican Quality Assurance Norms: QA Requirements for Construction of the Nuclear Objectives and Installations /1991
- Republican Quality Assurance Norms: QA Requirements for the Commissioning of the Nuclear Objectives and Installations /1991
- Republican Quality Assurance Norms: QA Requirements for the Operation of the Nuclear Objectives and Installations /1991

Other regulations are issued by the Ministry of Health and Family:

- Norms for medical examination for hiring workers and for periodical medical examination / 2001;
- Norms for medical surveillance radiation workers / 2001.

It has to be mentioned that till now CNCAN has not issued specific regulations for siting, design, construction, operation, maintenance, inspection, and administration of spent fuel and radioactive waste management facilities nor for waste classification, treatment and disposal.

In order to fill the gap, CNCAN intends to issue in 2003-2004 a set of norms for radioactive waste management. For this purpose, in a PHARE project requested by Romania, was proposed a task for preparing this set of documents.

Till this moment, international regulations are used (e.g. AIEA regulations, Canadian Standards, and USNRC Regulatory Guides and NUREGs). The most recent case was the licensing of the siting and of the construction of NPP Cernavoda Spent Fuel Dry Storage (2001 and 2002), where the review of the Initial Safety Analysis (required for siting authorization) and of the Preliminary Safety Report (required for construction authorization) were performed using as a reference the applicable requirements of the following documents:

- Canadian Standard N292.2-96 Dry Storage of Irradiated Fuel
- 10 CFR 72 Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High Level Radioactive Waste
- Regulatory Guide 3.48 Standard Format Content for the Safety Analysis Report (Dry Storage)
- NUREG -1567 Standard Review Plan for Spent Fuel Dry Storage Facilities

Another example for using international regulations is the field of QA regulations, where supplementary requirements from ASME, Section V, NCA 3800 and 4000 are used.

Taking into consideration the complexity of the problems, and the fact that there are only a few spent fuel and radioactive waste disposal and treatment facilities, it is expected that even after issuing the set of norms for radioactive waste management, for detailing of the requirements, there will be used regulations of US and of other developed countries.

Regarding the design guides, it has to be mentioned that, when it is decided to construct an installation, the design guides and safety design guides of the foreign designer are endorsed by CNCAN.

For example, all AECL design guides and safety design guides for Candu-6 NPP were endorsed by CNCAN.
Most of applicable industry technical standards have been used during the licensing process of Cernavoda NPP Unit 1. CNCAN has endorsed the following number of technical standards:

- 98 for ASTM and ASME (sect. 2 for metallurgical items);
- 25 for chemical items;
- 341 for electrical and I&C items;
- 205 for mechanical items;
- 1 for nuclear fuel.

For pressure vessels, CNCAN and ISCIR (National Authority for Checking Approval for Pressured Vessels and Hoisting Equipment) have jointly established a set of

technical standards by adopting the most ASME relevant codes applicable to CANDU reactor.
For pressure tubes the Canadian standards were accepted. Consequently the following Romanian Nuclear Codes were published by ISCIR:

- Requirements for design, manufacturing, installation, operation, maintenance and control of the pressurized vessels belonging to safety related systems (NC 1-81)
- Requirements for design, manufacturing, installation, operation, maintenance and control of the pressurized pipes and pipe elements of safety related systems (NC 2-83);
- Requirements for design, manufacturing, installation, operation, maintenance and control of the pumps of safety related systems (NC 3-86);
- Requirements for design, manufacturing, installation, operation, maintenance and control of the valves of safety related systems (NC 4-88).

Supplementary, the Romanian industry has produced within the frame of Romanian Institute for Standardization a set of technical/industrial standards, which once approved by CNCAN have subsequently become mandatory.

A similar procedure has been followed for the electrical component standards, the result of which is very similar to American Standard IEEE 344.

➢ The Governmental Ordinance no. 11/2003 on the management of spent nuclear fuel and radioactive waste, including final disposal (to be endorsed by the Parliament) establishes the attributions of ANDRAD (see section: Article 18 Implementing measures).

The same ordinance establishes the following responsibilities of the holders of authorization:

- to report every year to ANDRAD the quantities and types of spent nuclear fuel and radioactive waste generated during the current year and those estimated to be produced in the next year, in order to allow the actualization of the data base for coordination at national level of the process of management of the spent nuclear fuel and of the radioactive waste, including final disposal and decommissioning;
- to bear (during entire lifetime and decommissioning of the installation) the direct responsibility for the management of the spent nuclear fuel and radioactive waste in view of their final disposal;
- to finance the own activities of collection, segregation, treatment, conditioning, intermediate storage and transport in view of final disposal of spent nuclear fuel and radioactive waste generated during operation, maintenance and repairing activities, including during decommissioning of the nuclear installation;
- to finance the own research and development activities regarding the management of the spent nuclear fuel and of the radioactive waste.

19.2. Provisions of legislative and regulatory framework

Analyzing in detail the existing legislative and regulatory framework, it can be clearly seen that it provides for:

i. the establishment of applicable national safety requirements and regulations for radiation safety (this is done by updating the existing system of regulations);
ii. a system of licensing of spent fuel and radioactive waste management activities (Law no.111/1996 requires the authorization of all nuclear activities);
iii. a system of prohibition of the operation of a spent fuel or radioactive waste management facility without an authorization (the system of sanctions establishes penal sanctions for such situations);
iv. a system of appropriate institutional control, regulatory inspection and documentation and reporting (Law 111/1996, as amended, establishes the regulatory inspection rules, while the regulations and authorization conditions establish the requirements for institutional control, documentation and reporting);
v. the enforcement of applicable regulations and of the terms of the authorizations (the CNCAN inspectors have the right to fill an inspection report and impose sanctions if they find violations of the legal requirements, in special cases CNCAN can suspend or withdrawn an authorization, and for some violations can ask the prosecution, as the violations are punished with imprisonment);
vi. a clear allocation of responsibilities of the bodies involved in the different steps of spent fuel and of radioactive waste management (Law no.111/1996 and Governmental Ordinance no.11/2003 establish the responsibilities of the bodies involved)

19.3. Consideration of the objectives of the Joint Convention

The provisions of Law 111/1996 (as amended) and of Governmental Ordinance no.11/2003, as well as the regulatory requirements established by CNCAN take due account of the objectives of the Joint Convention.

Thus it can be concluded that the obligations under article 19 of the Joint Convention are met by Romania.

Article 20. Regulatory body

20.1. Functions of National Commission for Nuclear Activities Control (CNCAN)

According to the provisions of Law no. 111/1996 (as amended) the regulatory body, empowered with the regulation, authorization, and control of nuclear activities, is the National Commission for Nuclear Activities Control (CNCAN), under the coordination of the Ministry of Waters and Environmental Protection.

The organizational diagram of CNCAN is presented at the end of this section.

According to the provisions of Law no.111/1996 (as amended), CNCAN is empowered to issue regulations for the specification in detail of the general requirements for nuclear safety, for protection against ionizing radiation, for quality

assurance, for controlling the non-proliferation of nuclear weapons, for physical protection and emergency plans for intervention in case of nuclear accident, authorization and control procedures inclusive, as well as any other regulations needed for the authorization and control activity in nuclear field.
CNCAN can also issue regulations, in consultation with ministries and other interested factors, according to their specific responsibilities.
Other ministries and special bodies of the central public administration that have responsibilities for authorization and control specified under the provisions of law no. 111/1996 (as amended), are empowered to issue regulations for their field of competency.
CNCAN, through the regulation issued and through the measures ordered within the framework of authorization and control procedures, shall ensure an adequate framework for natural and legal persons in order to safely conduct activities subject to the provisions of the law.
CNCAN shall revise the regulations whenever it is necessary for consistence with international standards and with ratified international conventions in the field, and shall order the measures required for their applications.

According to Law no.111/1996 (as amended), CNCAN issues authorizations for all activities with radiation (non excepted) sources. For activities with significant nuclear or radiological risk, the authorization phases are as applicable, the following: design, siting, production, construction and erection, commissioning, testing operation, operation and maintenance, repairing or modification, conservation, decommissioning.
The requirements for each authorization phase are established by CNCAN according to the applicable regulations, or in case that such Romanian regulations does not exist, according to regulatory dispositions that generally endorse some international or foreign regulations, and give the requirements for adapting those documents to Romanian framework..
The authorization process for starting the operation of spent fuel and radioactive waste management facilities includes four formal steps:

Siting authorization

The siting authorization is issued by CNCAN on the basis of an Initial Safety Analysis Report and of supporting documents. This document must ensure that the proposed site meets all safety and environmental requirements, and should include a description of facility design, and the assessment of site characteristics. The Initial Safety Analysis Report should include the estimation of radioactive releases and the radiological impact on the public and the environment in normal operation and in design basis accident conditions. A siting permit issued by the Public Health Authority is a prerequisite.

Construction authorization

The construction authorization is issued by CNCAN on the basis of Preliminary Safety Report and of supporting documents. This document should include a description of the design, including its major safety features, ant the operating characteristics. The report should contain a preliminary evaluation of the design and performance of the systems, structures and components of the facility, in order to assess the risk to public health and environment resulting from the facility operation. Other information required regards the quality assurance program, physical protection and safeguards. As prerequisite for this authorization, CNCAN require construction permits issued by the Environmental Protection Authority and by the Public Health Authority.

Commissioning authorization

The commissioning authorization is issued on the basis of the Final Safety Report, and of supporting documents.
The Final Safety Report should include:
- an updated technical evaluation performed in the Preliminary Safety Report
- the procedures for effluents and exposure control;
- organizational structures, responsibilities and personnel training;
- managerial and administrative controls;
- plans, programs and procedures for preoperational testing;
- emergency plans.

Operating authorization

The operating authorization is issued based on the revised Final Safety Report, which contains amendments derived from the results and conclusion of the commissioning period, and on the supporting documents.
As prerequisites for the operating authorization, CNCAN requires operating permit issued by and by the Public Health Authority.
An authorization has to be issued by the Environmental Protection Authority after the putting into operation of the facility.
It has to be mentioned that the operating authorization is granted by CNCAN only for a limited period of time (max. 2 years for spent fuel storage, maximum 5 years for radioactive waste management facilities). After this period the authorization shall be renewed. Periodically (generally at 10 years), the Final Safety report has to be revised.

For at reactor wet spent fuel storage, the operating authorization is part of the authorization of NPP or reactor. Also the waste management at NPP is performed based of the authorization of the plant.
For the Post Irradiation Examination facility, the operating authorization covers the storage of spent fuel elements and of fragments and of intermediate level radioactive waste.

CNCAN issues also work permits for the persons having responsibilities for the work with radiation sources, namely the reactor operators, and for the persons responsible for radiation protection (working permits are required for all the staff, but CNCAN issues only the mentioned ones, while the others are issued by the holder of authorization, in conditions described by specific regulations). Recently, CNCAN has established the rules for designation of radiation protection qualified experts. The process of designation by CNCAN of qualified experts shall start in 2003.

Law no.111/1996 (as amended) establishes the control rules. According to those rules, the preventive, current-operative and posterior control of the observance of the provisions of the law and regulations shall be carried out at the applicants or holders of authorization, by the specially empowered representatives of CNCAN. The control shall be performed before authorization, periodically or unannounced during the period of validity of the authorization, or based on notification of the holder of authorization.

During the control, CNCAN inspectors have the following rights:

- to have access to any place where nuclear activities are conducted;
- to carry out measurements and install the necessary monitoring equipment;
- to request sampling and to take the samples of materials and products directly or indirectly subject to the control;
- to force the controlled natural or legal person to ensure the fulfillment of the above provisions and to mediate the extension of the control to his supplier of products and of services or to their sub-suppliers;
- have access to all information, technical and contractual data , in any form, required for carrying out the objectives of control, with observance of confidentiality, if requested by the holder of authorization;
- to request the holder of authorization to transmit reports, information, and notifications in the form required by the regulations;
- to request the holder of authorization 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;
- to receive from the holder of authorization the necessary protective equipment and clothing.

CNCAN inspectors shall observe, during the whole period of control, the applicable authorization requirements, as they are imposed to the staff of the holder of authorization.

After the conclusion of the control, the representatives of CNCAN shall have the following powers:

- to draw up a written inspection report recording the findings of the control, the corrective actions ordered, and the term of their fulfillment;
- to propose the suspension or withdrawal of the authorization or work permits according to the provisions of the law;
- to propose the information of the prosecution bodies in the cases and for the facts provided by the law;
- to order the holder of authorization to apply disciplinary sanctions to the guilty personnel under the terms provided by the law;
- to apply the contraventional sanctions provided by the law to the holder of authorization through the natural persons that represent him in relation with public authorities, according to his status;
- to apply the contraventional sanctions provided under the law to the staff guilty for these contraventions.

In order to discharge its legal responsibilities for assuring the compliance of the holder of authorization with radiological and nuclear safety requirements, CNCAN has developed a set of inspection practices.

The objectives of the inspection activities are:

- to ensure licensee compliance with regulatory requirements;
- to ensure licensee compliance with quality assurance programs and procedures;
- to ensure that the licensee has personnel with adequate competence for commissioning, operation or decommissioning, respectively;
- to ensure that deficiencies and unplanned events are reported, investigated and corrected in a timely fashion.

In order to reach these objectives, CNCAN had to define in detail the inspection and enforcement responsibilities of its staff and to ensure the competence of that staff.
CNCAN inspections can be categorized in 4 types, according to their depth and detail:

- rounds, performed by the resident inspectors on a routine basis;
- operating practice assessments of particular aspects of the practice (these inspections are generally conducted by specialists of head office, according to pre-planned inspection guides, and their results are recorded in a report that is sent to the licensee for follow-up action, and retained on file);
- audits, that are formal in-depth and detailed examinations of one or more topics related to a specific aspect of the practice; these inspections are pre-planned in detail with the acceptance criteria spelled in advance, are announced in advance, and their results are recorded in a report that is sent to the licensee for follow-up action, and retained on file;
- system inspections, that are in-depth and detailed examinations of the status of a chosen system of the nuclear installation; these inspections are pre-planned in detail and are performed according to check sheets. Results are transmitted formally to the licensee by letter, and, if necessary, follow-up actions with target date are spelled out.

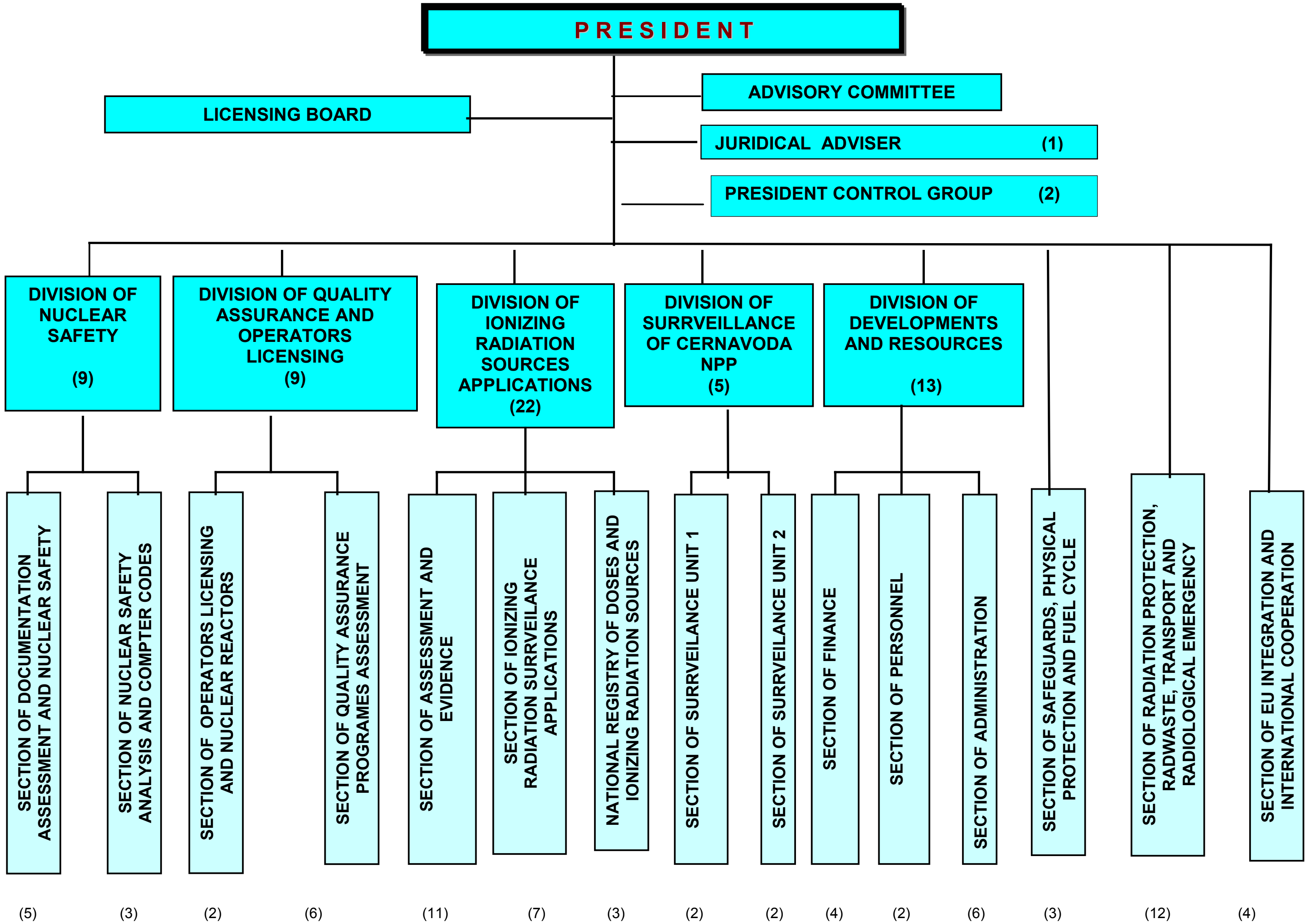
20.2. Independence of Regulatory Body

Law 111/1996 (as amended) and Governmental Ordinances no. 7 / 2003 and no. 11 / 2003 establish the roles of CNCAN, ANDRAD, and National Council for Nuclear Energy (the interministerial body for coordination of activities related to peacefull use of nuclear energy).

The above law and Governmental Ordinances ensure the independence of Regulatory Body (CNCAN).

Figure: The organizational diagram of CNCAN.

(Note: the numbers in the brachets represent the number of positions for each division or section)



SECTION F. OTHER GENERAL SAFETY PROVISIONS

Article 21. Responsibility of the license holder

According to the Romanian Law no.111/1996 on safe conduct of nuclear activities, the prime responsibility for the safety of a nuclear installation rests with the authorization holder. This general responsibility includes the responsibility for the management of the spent fuel and of the radioactive waste generated within the practice, and the responsibility for decommissioning of the facility. The main responsibilities of the authorization holder for any spent fuel or radioactive waste management facility are the following:

- ensure and maintain nuclear safety, protection against ionizing radiation, physical protection, emergency plans in case of nuclear accidents, quality assurance for the licensed activities, and records of nuclear and radioactive materials;
- observance of the technical conditions and limits included in the authorization and reporting of any violation, in accordance with specific regulations;
- development of its own system of requirements, regulations, and instructions ensuring the implementation of the licensed activities without unacceptable risks of any kind;
- bear the expenses related to the collection, handling, transport, treatment, conditioning, storage and disposal of its wastes;
- ensure adequate staff to carry on the licensed activities.

CNCAN carries out preventive and operative control on the observance of laws and regulations, at the authorization holder's facilities. Any failure of the authorization holder to follow the requirements is followed by corrective actions, which may include sanctions or even authorization suspension.

Other means to ensure that the authorization holder meets its responsibilities is the reporting system. For NPP Cernavoda, CNCAN includes specific reporting requirements in each authorization, such as:

- Quarterly Reports;
- Environmental Monitoring Reports
- Event Assessment Reports
- Reliability Reports.

Similar requirements regarding operation annual report, environmental monitoring annual reports and event assessment reports are established by CNCAN for the research reactors, including their spent fuel management facilities, for the nuclear fuel fabrication plant and for the radioactive waste management facilities. For the Uranium Milling Plant Feldioara and for uranium mining activities, CNCAN requires annual report for radiation protection, radioactive waste management and for the environmental monitoring.

According to the new Governmental Ordinance no.11/2003 on spent nuclear fuel and radioactive waste management, including final disposal, in case that a licensee cease to exist legally, or is unable to continue its activity, the responsibility for spent fuel and radioactive waste management rests with ANDRAD, till a new holder of authorization is established.

According to the Radiological Safety Fundamental Norms, for the activities from the past that have generated contamination or radioactive waste, CNCAN can dispose intervention measures. The owner of the site has the responsibility to implement these measures.

Article 22. Human and financial resources

According to the Romanian Law no.111/1996 the authorization for any facility is granted only if the applicant meets the following requirements:

- can prove the professional qualification for each position of its staff;
- has insurance or any other financial guarantee to cover his responsibility for nuclear damages;
- have financial arrangements for safe management of its own radioactive wastes and for decommissioning of its installation.

The law mentioned above imposed a system of individual permits for each person employed for works with radioactive materials or in radiation fields. The permits are issued based on training and examination by the competent authorities.

The Final Safety Report for Cernavoda NPP-Unit 1 which is periodically updated during plant lifetime must contains special provisions with respect to plant organizational structure, experience and training for the key plant personnel, assurance that minimum plant complement (operations, technical, maintenance, etc.) is always in place; the plant training programs are also extensively assessed by CNCAN through periodic audits / safety assessments.

Adequate human and financial resources to support the plant safety are prerequisites to obtain and maintain the operating authorization.

Similar requirements for getting an operation authorization are established by CNCAN for reactors and for other facilities, including spent fuel and radioactive waste management facilities.

i. Qualified staff availability as needed for safety related activities during the operating lifetime of a spent fuel and radioactive waste management facility

Romania has used nuclear energy well before starting the construction of its first Nuclear Power Plant; some regulations related to personnel Training, Qualification and Retraining have been in place since 1975. Those documents established the Training & Qualification Requirements for Licensed and Non-Licensed Nuclear Operators.

When Romania bought the CANDU technology, training issue was considered in early phase of the contract negotiators. 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 bought the NPP personnel training concept and training technology for licensed/unlicensed operation staff, fuel handling staff, maintenance staff and Radiation Protection staff as well. This technology has been adopted but continuously adapted 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's) Station Instruction (SI's) and Internal Department Procedures (IDP's) have been put in place to establish a structural Training Concept for NPP Personnel.

However, because the organisational structure and position responsibilities at Cernavoda NPP are similar to those used at other CANDU stations world-wide, training needs derived from these functions have been used to prepare standard training programs and courses. Each NPP department must document its training needs by preparing a generic Job Related Training Requirements (JRTR) for each position, or group of similar positions. At this time any training activity in the plant is based on positions Generic JRTR's and Generic Job Related Training Requirements (JRTR) have been developed for the NPP personnel which is involved in the activities related to the management of spent fuel and radioactive waste.

Currently, CNE PROD is under the process to define the generic Job Related Training Requirements (JRTR) for the personnel who will be involved in the operation of the Intermediate Spent Fuel Dry Storage Facility (ISFDS) in order to train and qualify personnel for these activities.
Training Objectives for each Training program have been produced by application of the second stage (Design) of the SAT system. The training objectives for activities related to the safe operation of spent fuel and radioactive management facilities were incorporated in the training and qualification programs for licensed and non-licensed operators, fuel handling operators, maintenance personnel and radiation protection technicians.

The third SAT stages have been applied (development) and training materials have been produced based on previous determined training objectives and the applied training methods are mainly simulator training, classroom training, mentoring and skill training.

Having the JRTR's for each position it allows to establish training objectives and to produce training materials. It also was possible to design and implements a career path for main positions.

A system for monitoring of training effectiveness has been established as well. Based on generic JRTR of each chart organisation position, a Training Qualification Index (TQI) can be calculated for each individual.

In addition to standard training described above, a non-standard training is considered for NPP personnel qualification. In this category all co-operation with other external organisations (IAEA, WANO, COG, Suppliers etc.) for personnel training is included. This is a very important part of key personnel development through courses, fellowships, workshop participation, and development programs participation, organised and sponsored by above-mentioned organisation.

In order to support the internal and external training activities and to ensure continue SAT application a Training Organisation has been established and a Training Centre with a full Scope Simulator has been constructed. The Full Scope Simulator has been made available prior to the plant criticality. The Training Department has 15 dedicated instructors, qualified according to IAEA / INPO - Guidelines. Considering simulator training of the licensed operators as a very important part of their development and for maintaining ability to fulfil their responsibilities dictated by their position the instructor simulator positions are filled with experienced operators. Also, Subject Matter Experts (SME) from Nuclear Power Plant Departments were involved in all of the SAT phase were their experience, knowledge and skills can be transferred to the personnel who are in the training and qualification process.
Regulator Authority is closely supervising the training activity in the plant and it is involved in evaluation of plant staff training and training policy as well. In this respect Regulatory Body is periodically auditing plant training activity and is directly involved in the licensing training programs approval and evaluation.

In this respect, CNCAN ensured that the utility allows only high qualified, competent staff to perform the following functions and tasks, which are critical to nuclear safety:

- Recognise if a proposed action, or any changes to equipment, procedures or staffing, is threatening a layer of defence;
- Monitor, operate and maintain safety and safety related systems;
- Identify incipient equipment failures, so that corrective action can be taken before catastrophic failures occur.
- Properly execute emergency response procedures to mitigate and accommodate consequences of potential accidents.

Based on the qualification, training and retraining requirements for all operation positions CNCAN required a similar training approach for the individuals performing tasks critical to nuclear safety and belonging to other plant’s departments. Those positions also have detailed qualification, training and retraining requirements, according to their duties.

Management Personnel must also be CNCAN authorised before they are fully appointed to the job, as follows:

- Station Manager
- Production Manager
- Technical, Safety & Compliance Manager
- Health Physics Manager
- Operation Superintendent
- Safety & Compliance Superintendent

Refresher training for any chart organisation position is also established or at least is counted that is necessary to be established. At this time refreshing training is for sure established for Licensed Operation Staff and the Full Scope Simulator is the main tool for retraining and maintaining their competence. The other personnel are in general under continuous training. Retraining for special skills or abilities is established and done as required.
Cernavoda-NPP Unit 1 has the nuclear world wide accepted training approach and standards, ensuring a qualified and competent staff for safety related activities during the operating lifetime of the nuclear power plant that includes spent fuel wet and dry storage facilities and collection and storage radioactive waste management facilities.

The shift supervisors (i.e. main reactor operators), reactor operators and the senior staff with responsibilities in radiation protection (i.e. the qualified experts) have to pass a CNCAN examination in order to receive the permit to operate the reactor, respectively the practice permit.

Regarding the research reactors, a training system that assures the safe management of reactors operation, including spent fuel management, is in place. The reactor main operators and operators, and the staff with responsibilities related to radiation protection, including the qualified experts, are tested by CNCAN, in order to get the permit to operate the reactor, respectively the practice permit.

For all other facilities, the qualified experts and the staff with responsibilities related to radiation protection have to pass CNCAN examination in order to get the practice permit.

ii. Financial resources for operation of spent fuel and radioactive waste management facilities

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

For the costs associated to the long term management: disposal of spent fuel and radioactive waste management including here decommissioning costs, SNN/CNE PROD will pay a tax to the Fund for Radioactive Waste Management and for Decommissioning, that will be established based on the Law no.111/1996 (as amended).

Regarding the funds for management of spent nuclear fuel of VVR-S research reactor and of institutional radioactive waste, in present they are assured by:

- a special fund created by the Ministry of Education and Research designated to support the operation of nuclear facilities of national interest;
- economic contracts with radioactive waste producers from all over the Romanian territory.

The funds for the spent fuel and radioactive waste originated at SCN Pitesti are provided by the Ministry of Industry and Resources.

After the issuing of the Law establishing the Fund for Radioactive Waste Management and for Decommissioning, the financing of these activities will be regulated according to this law.

iii. Financial provision for institutional controls and monitoring arrangements after closure of disposal facility

After the issuing of the Law establishing the Fund for Radioactive Waste Management and for Decommissioning, the financing of these activities will be regulated according to this law.

Article 23. Quality assurance

According to the Law no.111/1996 (as amended), the authorization holder for spent fuel and radioactive waste management facilities should establish and implement quality assurance programs. The guidance for quality assurance in the nuclear field is provided in a CNCAN guidance, which covers all phases of a nuclear facility: design, procurement, construction, commissioning and operation. The plant owner have to demonstrate the effective fulfillment of quality requirements to the satisfaction of CNCAN, and on this basis a QA license will be issued by CNCAN.

Separate from the internal review and audits carried out by the plant owner, the CNCAN staff makes an independent review. When these are acceptable, CNCAN staff carries out audits to make sure that the licensee is meeting the requirements.

CNE PROD, Nuclear Fuel Plant, SCN Pitesti and IFIN-HH have implemented quality assurance programs.

It has to be mentioned that Nuclear Fuel Plant (FCN) Pitesti is in process to develop more specific procedures within the QA manual to address radioactive waste management activities including waste transfer to different waste operators for further treatment and conditioning or disposal and waste transportation.

A quality assurance program is developed also in Uranium Milling Plant Feldioara.

Implementation of the QA system at CNE PROD Cernavoda together with regulatory aspects are further presented. The QA system at SCN Pitesti and IFIN-HH are quite similar.

23.1. QA Policies

In 1982 under the directions of the former State Committee for Nuclear Energy (CSEN) the law regarding Quality Assurance for Nuclear Objectives and Installations (Law 6/82) was published. Law 6/1982 was replaced by the Law no.111/96 on safe deployment of nuclear activities.

The Romanian QA Standards have been developed based on Canadian Standards series N286 and Z299 and cover all of the phases of nuclear facilities, including design, procurement, construction, commissioning and operation.

Each participant in a nuclear project develops and implements a QA Program that must satisfy these standards.

In the Art. 8, Item 6) of the Law no.111/1996 is mentioned:
"The authorization phases of the nuclear facilities and plants shall, as applicable, be the following:

- *Designing*
- *Siting*
- *Production*
- *Construction and installation*
- *Commissioning*
- *Test operation*
- *Operation and maintenance*
- *Repair or modification*
- *Conservation*
- *Decommissioning"*

Also in Art. 18, item k) is mentioned that:
" Authorization provided under Article 8 shall be issued only if the applicant for an authorization fulfills the following conditions, as applicable, if he:
institutes and maintains an authorized system for the quality assurance in its own activity and makes sure that his suppliers of products and of services as well as their sub – suppliers institute and maintain their own controlled quality assurance system."

The Overall Quality Assurance Program represents the QA Program applied by the owner of nuclear facilities. It contains rules related to the owner responsibilities in coordinating and control of activities associated with all phases of the project from design to commissioning and operation; there are also included specific measures relating to managing all the QA activities associated with radioactive waste and spent fuel management.

CNE-PROD developed specific responsibilities in order to assure that all activities associated with spent fuel and radioactive waste management are proper controlled and performed in a safety and reliable manner.

As per CNE-PROD QA Manual there are set specific procedures (policy, administrative and work level procedures are prepared covering the following activities:

- control on whole operational fuel life-cycle (from fresh to spent fuel);
- fuel using in the reactor core;
- stored in the pool and at the Spent Fuel Dry Storage Facility;
- radioactive waste collection and segregation;
- radioactive waste temporary storage at the Interim Solid Radioactive Waste Storage Facility;
- radioactive waste inventory including volumes, contact gamma dose rates, mass, radionuclide content.

As per Law no. 111/1996 all activities performed for operation and decommissioning of an NPP should be based on a QA license issued by CNCAN.
The application for QA license was sustained by CNE-PROD Cernavoda QA Manual which described the current Quality Assurance Program applied during operational phase.
The CNE-PROD Cernavoda Quality Assurance license is renewed each two years.

The construction of the Interim Spent Fuel Dry Storage Facility on Cernavoda site is QA licensed.

23.2. Life-cycle application

In accordance with Law no.111/1996 any activities developed in relation with siting, design, procurement, construction, installation, commissioning operation and manufacturing and decommissioning of a nuclear installation shall be performed based on a quality assurance program.

The quality assurance program shall be developed in accordance with specific QA regulations, issued by CNCAN. The activity related to spent fuel and radioactive wastes are part of the QA program developed for operation and decommissioning of the NPP and are integrated in the specific QA requirements.

According to the present licensing practice, when an owner of a nuclear facility prepares the preliminary safety report for the nuclear facility, the CNCAN reviews it to determine which commitments the licensee is making regarding quality assurance during the life of the facility.

The expectation is that the owner will commit to meeting the requirements of the nuclear quality assurance standards for the work involved during each phase of the project.
The safety report should identify if the owner intends to meet these standards. In this way, all further work related to design, procurement, construction, commissioning, operation, and decommissioning will be governed by the corresponding QA standard.

CNCAN ensures that these commitments are identified when its staff reviews the Preliminary Safety Report (PSR). Later the CNCAN staff carries out reviews and audits to ensure that each participant in a nuclear project meet these commitments during each of the phases of application.

The CNCAN requires to all participants in a nuclear project and which are involved in activities related to nuclear safety to establish and implement quality assurance programs. These programs are applied during all phases of the facility life cycle from its design until it is decommissioned. Their main objective is to facilitate, support and preserve safety objectives in nuclear facility design, procurement, construction, commissioning, operation and decommissioning.

Quality assurance programs should focus on performance and emphasize the full responsibility of those who do the work, such as:

- designers
- installers/constructors
- manufacturers
- operators
- maintenance workers
- radiation protection personnel

The owner and the other organizations involved have to demonstrate the effective fulfillment of the quality assurance requirements to the satisfaction of the CNCAN and based on these, a QA license will be issued by CNCAN.

Nuclear safety is the fundamental consideration for identifying the items, activities and processes to which the quality assurance programs are to be applied during each stage of the life cycle of a nuclear project. CNCAN requires the owner to identify the safety-related systems, activities and processes to be subject to QA regime.

The quality assurance program includes the controls and details of how the participants will manage, perform and assesses the work they do in each life-cycle phase. This is fundamental since the life of projects crosses generations, making dependence on systematic processes for decisions, actions and results.

The quality assurance program informs everyone concerned on how the organization is structured, which are the functional responsibilities, levels of authority, the methods of communication and decision-making tools to be used by those managing, performing and assessing the adequacy of work.

It also includes management methods of control such as planning, training, resource allocations, and work instructions and practices. As the project progresses from one phase to another, the organization involved and the methods to be used to process and control the performance of work will change.

The owner must describe these variations and modify its management processes accordingly.

The owner, in accordance with the Romanian QA Standards, must perform oversight activities of various disciplines of the project and to retain responsibility in all circumstances.

The overall quality assurance program includes the controls and details of how the holder of authorization will manage, perform and assesses the work for which they receive responsibility on specific life cycle phase. This includes the work performed by organizations that have been delegated to implement part of the program for a certain phase. The quality assurance program ensures that the owner's ultimate accountability for safety is passed down the chain of command through senior managers and line managers to the working level.

Responsibilities at each level are developed, understood and exercised so that each individual takes responsibility for the quality of the work he or she performs. These arrangements must be in place through all phases of the project from design to decommissioning.

23.3. Methods used for implementation and assessment of QA programs

Separate from the internal reviews and audits carried out by the participants, the CNCAN staff reviews the QA documents of the authorized participants in a nuclear project. When these are acceptable, the CNCAN staff plans and carries out real-time audits to make sure that the licensee and other organizations are complying.

Relative to the impact on safety, they assess:
- work methods
- management processes and results
- compliance with QA Standards for each particular phase of work of the facility.

When deficiencies are detected, the owner and addressed organization are notified and they are required to correct them. The CNCAN staff produces detailed reports of the audit findings and forwards them to the owner and addressed participant for action and reply. The CNCAN may decide an enforcement action when is appropriate.

The participant's quality assurance programs are subjected to two levels of audit by its own management;

a) *The first level - Internal Audits* - oriented to assess the effectiveness of his own QA Program and compliance to the applicable standards requirements.
b) *A second level - External Audits* - oriented to assess the effectiveness and efficiency of the contractor's QA Program to which he delegated a part of the responsibilities.

When participants detect a deficiency, they must determine the extent of the problem, and the effect on safety. They must identify the breakdown in the management process that was the underlying cause of the problem and correct it.

Similarly, when the owner has to rely on other organizations to carry out work, the owner makes sure that quality assurance requirements are passed on to them and are met. The licensee ensures itself that these organizations have an acceptable and licensed QA program before work can be contracted to them. Then as the work progresses, the owner conducts real-time reviews, audits, and inspections to make sure that the work being done meets applicable requirements. Their frequency is determined by factors such as safety significance of the work and the performance records of the contractor.

Article 24. Operational radiation protection

24.1. Exposures of workers and public

i. Optimization of exposures

For operational radiation protection CNCAN issued the Radiological Safety Fundamental Norms. This regulation is a Romanian transposition of the Council Directive 96/29/EURATOM laying down basic safety standards for the protection of the health of workers and the general public against the danger arising from ionizing radiation.

CNE-PROD, FCN Pitesti, SCN Pitesti, IFIN-HH, and National Uranium Company have developed policies, regulations and procedures for operational radiation protection, based on Romanian regulations and ICRP / IAEA recommendations. The policy of these licensees is to keep the radiation exposure of workers and the public as low as reasonable achievable.

ii. Exposure limits

The legal effective dose limits for the workers and for the public are 20 mSv / year and 1 mSv / year, respectively. In order to minimize exposure, CNE-PROD established administrative dose limits, under the legal value (18 mSv / year). They also developed processes for dose control, using special work plans and procedures for high hazard works.

iii. Control of releases

Both CNE-PROD and FCN are implementing procedures to control the gaseous and liquid releases to the environment, based on emission limits approved by CNCAN.

Recently SCN-Pitesti and IFIN-HH have also established derived emission limits for their sites (previously such limits did exist only for the reactors at these sites); these derived emission limits are in the process of approval by CNCAN.

For liquid discharges, the uranium mining and milling facilities have to comply with limits set up in their authorization.

CNE-PROD, FCN Pitesti, SCN Pitesti, IFIN-HH, and National Uranium Company have established environmental monitoring programs, in order to assess the effect of their activities on the environment.

24.2. Discharges

i. Optimization of discharges

According to Fundamental Norms on Radiological Safety, derived emissions limits (DELs) approved by CNCAN shall be used to quantify the relationship between

releases of radioactivity and doses to critical groups (the most exposed) from the public.
Based on legal limit of 1 mSv/year for exposure of a member of general public, at CNE PROD Cernavoda (NPP-Unit 1) were calculated site specific DEL's for all representative radionuclides. These DEL's values both for liquid and gaseous emissions are presented in Section L. The values for either gaseous or liquid emissions are given in % DELs.
In order to assure optimization of discharges, CNE-PROD established an operational limit of 5 % DELs. These values assure a tight control of effluent releases. The results of the CNE-PROD effluent monitoring are also presented in Section L.

ii. Limitation of doses in normal situations

It has to be mentioned that in fact, a constraint of 0.5 mSv / year for members of critical group was established by CNCAN for Cernavoda site. As unit 2 is under construction, and a radioactive waste treatment and disposal facility will be added near this site, derived emission limits will be established for each installation. In this case, the limit for Unit 1 will be probably 0.1 mSv / year.

24.3. Control of releases and mitigation of consequences of unplanned and uncontrolled releases

According to the provisions of Law 703 / 2001 on civil liability for nuclear damages, the holder of authorization for a nuclear installation shall have an insurance policy covering the nuclear damages. This assures that in case of an unplanned or uncontrolled release funds are available for mitigate the effects.
In order to control the release, design features and emergency procedures are in place, according to the provisions of the regulations.

Article 25. Emergency preparedness

25.1. Emergency planning for Romanian facilities

The Cernavoda NPP spent fuel and radioactive waste management facilities are operated in an integrated manner with the nuclear power plant by CNE-PROD. The on-site emergency preparedness for these facilities was treated as a part of emergency planning for Cernavoda NPP Unit-1.

Similar on-site emergency plans are in place for the site of the research reactors (TRIGA at SCN Pitesti and VVR-S at IFIN-HH Magurele). These arrangements covers the spent fuel management and radioactive waste management facilities at these sites.

The of-site emergency plans of the local and central public authorities, regarding emergencies at NPP and reactors sites and the General Emergency Plan are in place, according to the provisions of Law no. 111/1996 on safe conduct of nuclear activities (as amended), the provisions of the Governmental Ordinance no. 47/1994 on defense against disasters, endorsed by the Parliament by law no. 124/1995, the provisions of the Law no. 106/1996 on civil protection, and the provisions of the

Radiological Safety Fundamental Norms /2000 and of Republican Nuclear Safety Norms for Planning, Preparedness and Intervention for Nuclear Accidents and Radiological Emergencies / 1993.

For the other radioactive waste management facilities, i. e. the National Repository for Radioactive Wastes Baita Bihor, the Nuclear Fuel Plant Pitesti, the Uranium Milling Plant Feldioara and for mining activities, specific on-site emergency plans are in place. These on-site plans are in accordance with the norms, and are dimensioned in accordance with the risks associated with the respective practice.

It has to be mentioned that recently the National Emergency Plan was supplemented with the emergency plan for transport of nuclear fuel.
For the scope of this report the Cernavoda NPP arrangements will be detailed bellow, together with information under the emergency national system.

a) Legal requirements for on-site and off-site emergency preparedness

"National Nuclear Safety Norms for Planning, Preparedness and Response to Nuclear Accidents and Radiation Emergencies" issued by CNCAN in 1993 are containing mainly the IAEA recommendations, included in documents such as "Preparedness of the Operating Organization (License) for Emergencies at Nuclear Power Plants" - IAEA Safety Guides no 50-SG-06 and "Preparedness of Public Authorities for Emergencies at Nuclear Power Plants" - IAEA Safety Guides no 50-SG-G6.
These norms are applied for planning, preparedness and intervention in the following cases:
- nuclear accidents at licensed installations;
- radiation emergencies as a result of authorized activities in nuclear field;
- radiological emergencies as a result of some transboundary effects or as a result of other cases, such as cosmic objects falling.

The norms provide that any nuclear facility has to make preparations, in conjunction with national, regional and local government and other organizations, to cope with nuclear accidents.

According to the norms, an Overall (General) Emergency Plan has to be prepared for any area, which may be threatened by a radiation emergency. This Plan cover all activities planned to be carried out by all authorities and organizations involved in case of an emergency situation leading to, or likely to lead to, a significant release of radioactivity beyond the boundary of the nuclear facility. This overall plan includes the co-ordinated emergency plans of the facility and of the public authorities.

The Cernavoda NPP - Unit 1 Overall Emergency Plan covers all the emergencies likely to appear during the operational lifetime of its facilities including spent fuel and radioactive waste management facilities.

CNCAN controls, evaluates and approves the emergency plans of the nuclear facilities.

The authority which controls, evaluates and approves the emergency plans of public authorities is The Central Committee for Nuclear Accidents and Cosmic Objects Falling, CCANCOC. CCANCOC is an interministerial committee which is led by the Ministry of Internal Affair and which also has the responsibility for controlling, evaluating and approving the Overall (General) Intervention Plan. The permanent working body of CCANCOC is the Civil Protection, which has Commandments in each county and locality.

b) The implementation of emergency preparedness measures, including the role of the Regulatory Body and other entities

b.1) Classification of emergency situations

According to the National Nuclear Safety Norms for Planning, Preparedness, and Response to Nuclear Accidents and Radiation Emergencies, the radiation incidents are classified as follows:
• station alert;
• station emergency;
• off-site emergency;
• general emergency.

The classification criteria are being revised under the Technical Co-operation Project co-ordinated by the IAEA in 1998, for harmonizing the emergency classification for CANDU 6 with the classification used in other plants across Europe.

b.2) Overall national emergency preparedness scheme

CNCAN has, in the field of preparing for radiation emergencies, the following responsibilities:
a) to review the conditions from nuclear facilities which may cause radiation emergencies;
b) to help public authority to elaborate intervention plans and to maintain their preparedness in co-operation with the nuclear facilities;
c) to determine the nuclear facilities to co-operate with public authority in establishing compatible intervention plans;
d) to analyze, to evaluate and to approve intervention plans elaborated by nuclear facilities;
e) to act as a technical counselor of nuclear safety and for radiation protection for public authority and for nuclear facilities during emergencies;
f) to analyze and to survey the actions proposed or performed by public authority or by the nuclear facilities during the emergency;
g) to inform the public about the emergency;
h) to give technical consultations regarding the end of emergency;
i) to analyze and to agree the protective measures for public;
j) to authorize the recovery or decommissioning of the installation which was affected by the accident.

The bodies of central and local public administration who will respond in case of a nuclear accident and take actions to protect the public in an area, which may be affected by a radiation emergency, have the following responsibilities:
a) to elaborate and maintain a proper updated intervention plan
b) to establish a proper body for intervention
c) to implement the emergency measures according to the intervention plan
d) to organize exercises, to prepare and to maintain an appropriate level of personnel's
preparedness and of the material means requested for intervention
e) to inform the public and to provide instructions on taking protective measures
f) to establish the alarming levels for transboundary radiological emergencies.

b.3) On-site and off-site emergency plans of nuclear installations

The Overall (General) Radiation Emergency Plan for an affected area first identifies the Emergency Planning Zones around a nuclear facility where advanced planning is needed to ensure that prompt and effective actions can be taken to protect the public in the event of a nuclear accident. There are two distinct zones: one for the short term "plume exposure pathway", and the other for the long term "ingestion exposure pathways". The size of the zones depends on the hazard posed by the nuclear facility.

Based on the Emergency Planning Zones, the Off-site Radiation Emergency Plan describes the external organizations and their responsibilities during an incident at nuclear facilities, which may have an off-site impact. This plan also contains a description of essential steps for off-site emergency response activation, the protective action levels, and the protective measures. The protective actions, and the organization in charge to implement these actions, are identified for each emergency-planning zone.

The Plan also contains a description of the protective actions for different stages of the emergency. In the final section, the Off-site Radiation Emergency Plan describes the recovery activities, the international assistance, the periodic exercises, and the up dating and revision of plans.

All the emergency response requirements of the plan are implemented by off-site emergency procedures, which describe detailed emergency actions.

The objective of an effective On-site Radiation Emergency Plan along with its supporting documents is to ensure effective emergency preparedness and response to emergency situations at the nuclear facilities in Romania.

The purpose of the On-site Radiation Emergency Plan is to identify the essential elements of a response to a radiological emergency and to describe in general terms the measures required to control and ameliorate the radiological accident consequences within the site and to minimize the off-site effects.

The On-site Radiation Emergency Plan emphasizes the immediate on-site response actions.

However, it does cover the off-site emergency for the first few hours of the radiation incident, which has an impact on the public and the environment. The length of time necessary to set up the off-site organization to function effectively is estimated to be 2-4 hours.

The document 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 organization 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.

b.4) Measures for informing the public during a nuclear emergency

The On-site Radiation Emergency Plan and the Off-site Radiation Emergency Plan for the nuclear facilities establish the responsibilities, the resources and the interfaces required for informing the public in case of a nuclear emergency. Joint information centers, staffed by representatives of the nuclear facility and of the public authorities, are established at the local and national levels.

c) Training and exercises

The effectiveness of the response is tested and enhanced through carrying out periodical radiation emergency exercises for all areas and facilities.

The general exercises will simulate an emergency, which results in radioactive releases outside the facility and which requires the intervention of county and / or national public authorities.

General exercises are organized by all nuclear facilities in collaboration with the public authorities and include mobilization of the emergency personnel and the appropriate resources and organizations in order to verify the response capability for an accident scenario.

The general exercises are organized, for example, at Cernavoda NPP at least once in three years and are based on various scenarios in order to verify and test various parts of the emergency plan.

The exercises are followed by a post-exercise report (Exercise Evaluation Report) in order to evaluate the ability of the various organizations involved and to recommend measures for improving the response. The nuclear facility organize annual exercises and quarterly drills in order to verify the on-site emergency plan.

25.2. Planning for radiological emergencies in the vicinity of Romanian territory

Romania is a signatory of the following international emergency response agreements:

- Convention on Early Notification of a Nuclear Accident
- Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency
- Convention Regarding the Liability for Nuclear Damages

Concerning the liaison across national borders, Romania has signed the Agreements for Early Notification of Nuclear Accidents with Russian Federation, Bulgaria, Greece, Hungary, Slovakia.
These agreements contain provisions for:
- taking all appropriate and effective measures to prevent, reduce and control adverse trans-boundary environmental impacts of major nuclear activities;
- ensuring that the Parties are notified in case of nuclear accidents which could affect them.

The Romanian General Emergency Plan includes provisions for transboundary emergencies according to the provisions of national norms.

Article 26. Decommissioning

26.1. General requirements related to decommissioning

According to the provisions of the Law no. 111/1996 (as amended) the licensee shall:
- elaborate a program for preparing the decommissioning and to present it for approval to CNCAN
- pay the contribution to the Fund for Radioactive waste Management and Decommissioning.

Based on these provisions of the law, CNCAN has issued till now the Norms for Decommissioning of Nuclear Objectives and Installations, that apply for decommissioning of: research reactors, subcritical assemblies, radioactive waste treatment installations, spent fuel intermediate storages, radioactive waste intermediate storages. The issuing of a norm for decommissioning of NPPs is expected latter.
According to the Norms for Decommissioning of Nuclear Objectives and Installations:
- for all future nuclear objectives and installations for which the regulation applies, the decommissioning plan shall be part of authorization documentation, starting with the siting authorization;
- for the nuclear objectives and installations for which the regulation applies that already are in the design, construction, or operation stage, the decommissioning plan (at various levels of detail, from conceptual to detailed) has to be submitted by the holder of authorization to CNCAN, in the next 3 years after the publication of the norms (norms were published in December 2002);
- for the nuclear objectives and installations for which the regulation applies that are under conservation, the detailed decommissioning plan has to be submitted by the holder of authorization to CNCAN, in the next 6 month after the publication of the norms.

26.2. Fulfillment of the requirements of article 26 of Joint Convention

All the requirements of Art. 26 of the Joint Convention are detailed by the Norms for Decommissioning of Nuclear Objectives and Installations:

i. Qualified staff and adequate financial resources

According to the Norms for Decommissioning of nuclear Objectives and Installations, in order to get the decommissioning authorization, the applicant shall prove in the decommissioning plan that qualified staff and adequate resources are available.
These requirements shall be mentioned in the following subparagraphs of the Decommissioning Plan:

- 1.2.2. “Cost Estimations”;
- 1.2.3. “Availability of Financial Funds”;
- 2.4. “Responsibilities for decommissioning”;
- 2.5. “Training program”;
- 2.6. “Assistance of the contractors”.

ii. Operational radiation protection, discharges, unplanned and uncontrolled releases

The requirements related to radiation protection shall be detailed in the Decommissioning Plan in Chapter 3 “Radiological Protection of Workers, Public and Environment”, according to the provisions of the above mentioned norms.

iii. Emergency preparedness

According to the provisions of the above mentioned norms, the applicant for a decommissioning authorization shall submit to CNCAN the emergency plan. If necessary, the General Emergency Plan and the local public authorities plans will take into consideration the decommissioning activities.

iv. Records of decommissioning operations

According to the provisions of the above mentioned norms the Decommissioning Plan shall present in Chapter 7 “Record keeping” the records to be kept related to decommissioning activities.

26.3. Design requirements related to decommissioning

The spent fuel and radioactive wastes facilities in operation or under construction of NPP owner (SNN) are designed taking into account recommendations for safe decommissioning.

26.4. NPP decommissioning plan

The preliminary decommissioning plan for NPP Cernavoda Unit 1 is under development.

The mains steps for development are as follows:
- Decommissioning concept study
- Unit 1 decommissioning strategy
- Define Unit 1 preliminary decommissioning plan
- Conservative decommissioning cost evaluation
- Unit 1 preliminary decommissioning plan development activities

The principal activity related to decommissioning of the spent fuel dry storage facility (under construction) is the fuel removal process. The removal of fuel baskets from the storage module is made using inverse operations to loading. The fuel basket would be directly loaded into the transportation cask at the site.

Once all the spent fuel has been removed from module, the internal cavities of the storage cylinders are verified for contamination and decontaminated as necessary.
The storage module materials are then verified to have activation levels lower than low-level waste standards. The storage module is then demolished using standard wrecking equipment.
The same principles are applied for the radioactive waste management facilities.

Decommissioning costs for NPP Unit 1, will be covered by the Fund for Radioactive Waste Management and for Decommissioning that will be established based on provisions of Law no.111/1996.

26.5. Status of VVR-S reactor decommissioning

At this moment the research reactor VVR-S of IFIN-HH Magurele is permanently shut down, under a conservation authorization.
According to IFIN-HH, which has submitted to CNCAN till now a preliminary decommissioning plan, not approved, the decommissioning strategy for VVR-S Research Reactor was defined as decommissioning to stage 2.

The preparation of the stage 2 detailed decommissioning plan of VVR-S research reactor is now ungoing, and CNCAN expects to receive it in the next few months for assessment.

SECTION G. SAFETY OF SPENT FUEL MANAGEMENT

Article 4. General safety requirements

i. Criticality and removal of heat

In the authorization process for siting, construction and operation of NPP and of research reactors, CNCAN pays special attention to:

- criticality control (not applicable for NPP Cernavoda, because fuel is made of natural Uranium);
- assurance of adequate heat removal;
- control of water parameters in wet storages, and control of confinement and of the isolating air parameters for dry storage, in order to ensure optimum storage conditions (control of corrosion) and control of radioactivity levels.

ii. Minimization of waste

The control of water parameters in wet storages, and control of confinement and of the isolating air parameters for dry storage minimizes the generation of radioactive waste associated with spent fuel management.

iii. Interdependencies among different management steps

The Romanian strategy for spent fuel management takes into consideration both the present and future storage capabilities, and the actual status of the fuel cladding. Efforts are made by the regulatory body to enforce the observance of the storage conditions for the VVR-S aluminum cladding fuel, in order to extend the storage period, waiting the transfer of the fuel to the country of origin.
In the licensing of the new NPP dry storage for spent fuel, the relations between the intermediate storage stage and the following stage, when the fuel will be removed for transfer in the geological repository, were taken into consideration.

iv. Effective protection of individuals, society and environment

In the authorization process, CNCAN pays due attention to the effective protection of workers, public and environment. The authorization is granted only if the internationally recognized criteria and standards are observed.
In order to protect adequately the public health and the environment during the normal operation of the spent fuel management facility, the offsite dose estimate and monitoring are based on the analysis of the external effective doses and of the (internal) committed effective doses for members of critical groups for all radiation pathways. These analyses are performed according to methods and procedures recommended in IAEA and in other western regulations, like US regulations. The result of the analyses leads to derived emission limits for the effluents, and the monitoring program of the environment shall demonstrate that the derived emission limits are observed both in normal operation and during events with relative high probability of occurrence.

Regarding the assumed accident scenario and the scope of the emergency plan it shall be mentioned that the Nuclear Safety Analysis, the Preliminary Nuclear Safety Report, and the Final Safety Report for a spent fuel or radioactive waste management facility have chapters regarding the assessment of natural effects (e.g. earthquakes, natural fire, flooding, snow) and of the man made effects (e.g. explosions, air plane crashes) and regarding the accident analyses, according to the requirements of the IAEA applicable recommendations and to the applicable requirements of the other international regulations that are used in the licensing process, like US Regulatory Guides and NUREGs, as well as to the supplementary requirements issued by CNCAN. For example CNCAN asked for the authorization of the construction of the Spent Fuel Dry Storage of NPP Cernavoda to be performed the analysis of air plane crash on the storage. For the Design Basis Accidents, the doses shall remain below specified values, while, in order to prepare the emergency plan, Beyond Design Basis Accidents are analyzed.

v. Biological, chemical and other hazards

The criteria and standards mentioned in paragraph *iv* take into consideration biological, chemical and other hazards that may be associated with spent fuel management.

vi. Impact on future generations

The authorization process for transport and storage of spent fuel, and, when it will be the case, for its geological disposal requires the demonstration that the impact on future generations will not be higher than it is now accepted for the current generation.

vii. Avoidance of undue burdens on future generations

Regarding the policy of avoiding undue burdens of spent fuel management on the future generations, it shall be noted that even though Romanian authorities, and particularly CNCAN, fully accept and promote this principle, for Romania this principle has some limitations. Law 111/1996 (as amended) asks for establishing of the Fund for Radioactive Waste Management and for Decommissioning, in order to be sure that at the costs for such activities, including spent fuel management, will be covered in future. At the present moment taking into consideration the development stage of the country, it can be concluded that technical and financial resources are limited, so the R&D program regarding radioactive waste management and decommissioning is restricted. Supplementary, it shall be noted that Romania is a country with a small program for nuclear energy, having only one NPP, with Unit 1 in operation and Unit 2 under construction (there are other 3 units planned, but their construction was stopped, and there are discussions to restart the construction only for Unit 3). In this case, the preliminary estimation of the costs for sitting and construction of a deep geological disposal for spent fuel and long lived waste in a national repository are extremely high. This is the reason for Romania to consider that deep geological disposal in an international repository could be a better solution for avoidance of leaving unfair burden for future generations, taking also into account the fact that the risks for safety and physical protection are also reduced.

Article 5. Existing facilities

5.1. Review of the safety of the wet spent fuel management facility of NPP Cernavoda

The general safety requirements implemented in design, construction and operation of the CANDU Nuclear Power Plant are applicable for the fuel handling system, including spent fuel bay of Cernavoda NPP. The safety assessment reports prepared for nuclear licensing of the Nuclear Power Plant include specific safety assessment for the spent fuel management.
During the licensing process, CNCAN paid a special attention to evaluation of the following safety and safety related functions of the spent fuel bay:

- removal of the residual heat generated by the spent fuel;
- control of water chemical and physical parameters, in order to ensure optimum storage conditions and radiation levels control.

The spent fuel bay of Cernavoda NPP was designed to meet adequate safety standards used in Canada and in other six countries.
The Spent Fuel Bay of Cernavoda NPP – Unit 1 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;
- provision 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 ensure required safety, it has to be noted that for the Unit 2, under construction, modifications for the fueling/defueling machine design were introduced by the designer, due to the application of new design requirements issued by Canadian Nuclear Safety Commission and endorsed by CNCAN, and due to feedback of operational experience. Part of these modifications was already implemented for Unit 1, and part of them will be introduced later for this Unit.

It has to 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. If the results of such analyses for Unit 2 will show that design changes are recommended, which is highly unexpected, an assessment of the status of these systems for Unit 1 will be initiated.
Also, in Task - 6 Evaluation of Adequacy of Engineered Provisions for Radiation Protection, it is recommended to review the suitability and application of the spent fuel pond surface finish and to consider the installation of a suitable metallic liner in lieu of concrete surface finish, to fulfill the secondary containment requirement. Even

though this recommendation is made for Unit 2, CNCAN have asked the utility to review the situation of the spend fuel pond finish for Unit 1, and to prepare a report on this issue, in order to see if any measures are necessary.

5.2. Spent Fuel Bay and dry storage of spent fuel elements and fragments at SCN Pitesti

The general safety requirements implemented in design, construction and operation of the TRIGA reactor are applicable for the spent fuel bay of SCN Pitesti. The safety assessment reports prepared for nuclear licensing of the TRIGA reactor include specific safety assessment for the spent fuel bay.
During the licensing process, CNCAN paid a special attention to evaluation of the following safety and safety related functions of the spent fuel bay:
- criticality control;
- removal of the residual heat generated by the spent fuel;
- control of water chemical and physical parameters, in order to ensure optimum storage conditions and radiation levels control.

The Final Safety Report of LEPI, (Post Irradiation Examination Facility), to be submitted to CNCAN in May 2003, shall include the review of the safety of the reactor spent fuel storage in the pool, that in fact is sited in LEPI building (actually the pool is sited between the reactor building and LEPI building, in an area belonging to LEPI). The new safety report shall improve the chapters related to accident analyses.
Also the Final Safety Report of LEPI shall include the review of the safety of storage of spent fuel elements and fragments that resulted from destructive examination.
Aspects related to criticality control and heat removal are requested by CNCAN to be addressed in the new report.

5.3. Spent fuel management at IFIN-HH Magurele

The spent fuel of IFIN-HH VVR-S reactor, under decommissioning, is actually stored in the four spent fuel storage ponds, except the last core that is still stored in the reactor cooling pool.
The spent fuel is old, and during the years, it was stored in conditions that were not fully observing the limits and conditions of the facility. Some Cs-137 activity was detected in the ponds, resulting either from a few dammaged fuel elements (damage occurred during handling of the spent fuel) or from corrosion. Till now, the real cause was not identified.
The manufacturer have specified the water conditions for the EK-10 and S-36 fuel assemblies, which they believe will avoid corrosion problems to be as follows:

Parameters	EK-10	C-36
- pH	5,5 – 7,5	5,5 – 6
- conductivity	5 μS/cm	2-3.3 μS/cm
- constant residuals	8 mg/l	1 mg/l
- corrosion products	-	1 mg/l
- Cl^-	-	0,02 mg/l
- O_2	-	8 mg/l

Of course, the most important factor in controlling corrosion of aluminum-clad spent fuel assemblies is maintaining high quality water chemistry in the fuel storage pools. Until recently, no special operational practices or techniques were applied to improve the water quality from the ponds. The distilled water produced at the site was used "as it is" without any serious concern regarding corrosion. In 1997 the first visual inspections were done to the reactor vessel and to the stored spent fuel revealing some corrosion traces on the external side of the cassettes. The external surfaces of 223 fuel assemblies were examined with an underwater camera and the information was recorded into a database. From that data, all the parameters regarding the fuel were reviewed and a special attention was given to water conditions and fuel state reevaluation. The Table below shows the evolution of the main water parameters during the last four years; the improving of the parameters is due to water replacing.

Nr. crt.	Date	Basin 2						Basin 3						Basin 4					
		Cond. [uS/cm]	pH	Activity Cs137[Bq/l]	Res.fix [mg/l]	Cl [mg/l]	O [mg/l]	Cond. [uS/cm]	pH	Activity Cs137[Bq/l]	Res.fix [mg/l]	Cl [mg/l]	O [mg/l]	Cond. [uS/cm]	pH	Activity Cs137[Bq/l]	Res.fix [mg/l]	Cl [mg/l]	O [mg/l]
1	30.09.99	17.82	7.01	288	8.8	0		15.84	7.15	20636	7.9	0		19.8	7.05	1561	6	0	
2	28.10.99	17.16	7.44	838		0		15.84	7.21	22617		0		19.47	7.37	1370		0	
3	29.11.99	4.95	6.52	235		0		15.84	7.18	21750		0		19.8	7.34	1275		0	
4	16.12.99	4.95	6.47	185	1.6	0		15.83	7.08	22105	7.2	0		19.47	7.37	1108	6.9	0	
5	24.01.00	3.7	6.56	304		0		15.18	7.01	22120		0		14.52	6.67	1853		0	
6	28.02.00	4	6.58	295		0		7.92	7.1	22105		0		13.2	7.09	1847		0	
7	27.03.00	9.5	6.82	290	3.9	0.05		5.36	6.7	3769	3.8	0.05		19.43	7.09	1850	6.5	0.05	
8	24.04.00	6	6.59	226		0.05		7.03	6.68	3807		0.05		18.76	7.04	2132		0.05	
9	29.05.00	6.86	6.88	723		0.05		6.7	6.75	4721		0.05		17.2	7.19	1028		0.05	
10	20.06.00	8.04	6.74	153	7	0.05	8	7.52	6.63	4759	3.8	0.05	8	23.76	7.1	1218	6.3	0.05	8
11	25.07.00	11.88	6.84	418		0.05		9.24	6.74	4530		0.05		10.56	6.71	266		0.05	
12	27.08.00	9.83	6.68			0.05		8.53	6.63			0.05		9.24	6.27			0.05	
13	15.09.00	9.24	6.73	107	5.3	0.05		7.78	6.59	6065	4.5	0.05		8.58	6.75	179	4.8	0.05	
14	23.10.00	6.65	6.84			0.05		8.64	6.63	5914		0.05		8.25	6.71	314		0.05	
15	27.11.00	8.37	6.76	190		0.05		7.5	6.88	8224		0.05		9	6.76	457		0.05	
16	30.12.00	1.67	5.79			0.05		2.4				0.05		2.25	6.2			0.05	
17	22.01.01	11.3	4.81	0		0.02		13.86	4.55	1048		0.02		11.88	4.64	0		0.02	
18	19.02.01	19.43	4.09	0		0.015		21.44	4.46	1321		0.02		16.75	4.59	0		0.02	
19	19.03.01	21.12	4.93	920	18.1	0.015		26.4	4.38	1635 Co60-1030	18.9	0.015		20.8	4.64	1125 Co60-359	14.3	0.015	
20	23.04.01	23.1	4.86					27.72	4.25					22.11	4.5				
21	21.05.01	26.4	4.87					28.71	4.26					24.04	4.48				
22	18.06.01	28.2	4.75			0.015		29.2	4.38	1675 Co60-355		0.015		23.8	4.54	278 Co60-1422	0	0.015	
23	23.07.01			-		0.015		7.53	5.9	559		0.015				Co60-2964		0.015	
24	17.09.01	25	4.75	-	54.2	0.015		14.57	5.55	2102	9	0.015		26	4.5	103 Co60-3004	20	0.015	
24	21.10.01	27,7	4.69					15.16	5.72					28.3	4.56				

Water parameters at VVR-S reactor spent fuel storage pools.

In order to control the corrosion of aluminum-cladded spent fuel, a program to improve the water quality was issued and the main parameters were improved, pH between 5.5 and 6 and conductivity below 5 μS/cm were obtained.
An optimum management of aluminum alloys in water environments can result in satisfactory durability of irradiated fuel cladding and the functionality of the storage pools could be further extended.

CNCAN has asked the owner to assess the status of the fuel, to improve the storage conditions and to find solutions for long term storage or transfer of fuel to country of origin. Till now, a system for water filtering was put in place, and discussions were initiated to allow transfer of the spent fuel back to Russia. It is generally accepted that, if the transfer will be performed in 2-3 years, the actual condition of the fuel shall not create any problem, provided that the water parameters be kept under control. However, the situation is closely monitored, and supplementary control measures will be decided if the storage will continue in the future.

Regarding the safety assessment of the spent fuel storage ponds, it has to be mentioned that during the last 10 years, the report was revised, more than once. The modifications, required by CNCAN, were related to water parameter limits and technical conditions, and to control of criticality.
The last revision was made in November 2002. The revised report contains information regarding:

- general presentation of the installation;
- characteristics of site;
- status of the storage pools;
- cooling system;
- instrumentation and control;
- dosimetric control and assurance of the biological protection;
- ventilation system;
- utilities for distilled (demineralized) water supply and discharge;
- auxiliary systems;
- fuel handling system;
- control of operation;
- emergency plan;
- accident analyses;
- criticality control;
- deviations from the requirements of Preliminary Safety Report
- quality assurance;
- limits and technical conditions;
- records and reports;
- records and documentation management;
- physical protection.

Meantime, as a new regulation on decommissioning of research reactors and other facilities was recently issued, requiring the review of the Final Safety Report for spent fuel storage at reactor site, it was requested that IFIN-HH review that report for its spent fuel storage ponds. The content required for the new report is similar to the content required in IAEA SS No. 118 “Safety Assessment for Spent Fuel Storage

Facilities". IFIN-HH is in the process of reviewing the report, according to CNCAN requirements.

Article 6. Siting of proposed facilities

6.1. Procedures for safety evaluation, public information and neighbor countries consultancy

i. Site related factors likely to affect the safety of the facility

As mentioned before, any proposed facility needs a siting authorization issued by CNCAN based on Law no. 111/1996 (as amended). The siting process for Cernavoda Interim Spent Fuel Dry Storage Facility was implemented based on IAEA guidance and NRC – 10 CFR Part 72.
The content of the Initial Safety Analysis Report is observing generally the requirements of US NRC Regulatory Guide 3.48 "Standard Format Content for the Safety Analysis Report", adapted for the siting stage.

The following issues were addressed in the report:
- General description
- Characteristics of the site (these includes: geography and demography, nearby human activities - including man made events -, meteorology, surface and subsurface hydrology, geology, seismology, ecology, use of land and waters)
- Design criteria
- Description of the project
- Description of the functioning of the installation
- Waste management
- Radiological and nuclear safety
- Accident analyses
- Decommissioning
- Conclusions

The Initial Safety Analysis Report and its supporting documents are evaluating all the relevant site factors likely to affect the safety of the Spent Fuel Dry Storage Facility and the likely safety impact of the facility on individuals, society and environment, as presented in the paragraph on article 4.

The siting authorization was issued by CNCAN in August 2001, and contains the conditions related to the constructive solution, the confirmation of seismic entry data, the completitude of list of Design Basis Accidents. It is also required for the future Preliminary Safety Report, requested in support of the application for construction authorization, to demonstrate the observance of dose constraint for the members of the public during normal operation (0.1 mSv/year) and to demonstrate the observance of Romanian regulations related to dose limits in case of Design Basis Accidents (the exclusion zone and the reduced population zone shall remain inside the area established for Cernavoda NPPs site). In the Preliminary Safety Report shall be presented also the doses for Beyond Design Basis Accident.

For future siting of reactors, if it will be the case, the siting authorization process will cover in a similar manner the spent fuel management, as the requirements for NPPs or research reactors siting are covering the field of spent fuel handling and storage.

The siting of spent fuel deep geological repository was not yet addressed by Romanian regulations, as the existing strategy does takes into consideration at least 50 years of dry storage. These can be changed in the future, as ANDRAD will elaborate the future strategy, taking also into consideration the future EU regulations.

ii. Safety impact of the facility on individuals, society and environment

The chapter on accident analyses of the Initial Safety Analysis addresses the safety impact of the facility on individuals, society and environment, in case of accident.
For normal operation, the safety impact is assessed in the chapter on radiological and nuclear safety.

iii. Public consultancy

When selecting a site, the future licensee has to consult the public. The Environment Agreement is issued by the Environmental Protection Authority, after analyse of the Environmental Impact Study. Public consultancy of this study is required, and the decision for issuing the Environment Agreement takes into account the opinion of the members of the public. The Environment Agreement is a prerequisite for issuing by CNCAN of the Construction Authorization. In fact, public consultancy starts at earlier stage, when the prefesability study is presented to the Environmental Protection Authority.

The above mentioned consultancy process is done based on the transposition of the Directive 85/337/EEC on Environmental Impact Assessment, amended by the Directive 97/11/EC. The transposition is realized through the Emergency Government Ordinance no. 91/2002 amending the Law no. 137/1995 on Environmental Protection, the Government Decision 918/2002, and the Orders of the Minister of Waters and Environment Protection no. 860/2002 and no. 863/2002.

iv. Consultancy of Contracting Parties in the vicinity of the spent fuel management facilities

Romania has ratified the ESPOO Convention. Consequently, any country (not only a Contracting Part), that could be affected by a spent fuel management facility sited on Romanian territory will be announced, and will receive, upon request, the general data relating to the facility to enable it to evaluate the likely safety impact of that facility upon its territory.

6.2. Avoidance of unacceptable effects on Contracting Parties in the vicinity of the spent fuel management facilities

The Initial Safety Analysis, as well as the latter Preliminary Safety Report and Final Safety Report, for any new nuclear facility (not only for spent fuel management facilities) shall prove that the national requirements, which are in line with the internationally endorsed criteria and standards, are met for individuals, society and environment, at the same level for national territory and for neighbor countries.

This requirement is obviously fulfilled for fuel handling and storage facilities. When siting a spent fuel deep geological repository, due consideration will be given to the assessment of the impact on neighbor countries.

Article 7. Design and construction of facilities

7.1. Construction of Spent Fuel Handling and Storage Systems at NPP Cernavoda Unit 2

The design and construction of the spent fuel handling and storage facilities at NPPs and research reactors is part of the design and construction of the plants, respectively of the reactors. As all of the requirements of Article 7 of the Joint Convention are required by the Romanian legislation for all nuclear installations (for all the installation, not only for spent fuel management systems), the authorization of construction of a NPP or research reactor is granted by CNCAN only if, inter alia:

i. the design and construction of the spent fuel handling and storage system provide for suitable measures to limit possible radiological impacts on individuals, society and environment;
ii. at the design stage, conceptual plans and, if necessary, technical provisions for the decommissioning of spent fuel management facility are taken into account;
iii. the technologies incorporated in the design and construction of spent fuel management facility are supported by experience, testing or analysis.

For NPP Cernavoda Unit 2, the construction was stopped in 1990, and the construction remained under conservation. The restart of the construction was decided in 2001.
As it was presented in the paragraph on article 6, the spent fuel system of Cernavoda NPP Units 1 and 2 were designed to meet adequate safety standards used in Canada and in other six countries.
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;
- provision 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 future Unit 2 ensure required safety, it has to be noted that in order to enhance safety, modifications for the fueling/defueling machine design were introduced by the designer, due to the application of new design requirements issued by Canadian nuclear Safety Commission 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 will show that design changes are recommended (at this moment important design changes are not expected). If the results of such analyses for Unit 2 will show that design changes are recommended, an assessment of the status of these systems for Unit 1 will be also initiated.

Also, in Task - 6 Evaluation of Adequacy of Engineered Provisions for Radiation Protection, it is recommended to review the suitability and application of the spent fuel pond surface finish and to consider the installation of a suitable metallic liner in lieu of concrete surface finish, to fulfill the secondary containment requirement. This design change was already initiated for the construction of Unit 2.

7.2. Construction of Cernavoda Interim Spent Fuel Dry Storage Facility (including handling systems at Unit 1

i. The design of Cernavoda Interim Spent Fuel Dry Storage Facility provides measures to limit the possible radiological impact on people and environment:

- double confinement barriers
- massive reinforced concrete construction
- low temperature on spent fuel cladding

ii. Decommissioning is adequately addressed by the Preliminary Safety Report.

iii. The Cernavoda Interim Spent Fuel Dry Storage facility use a well-proven technology that is in use since the mid 70's.

It has been licensed and is being used in Canada for the Whiteshell, Gentilly 1, Douglas Point, NPD (Chalk River), Point Lepreau and Gentilly 2 spent fuel storage needs. It has also been licensed in South Korea and is being used at the Wolsong 1 reactor.

The design of the Cernavoda facility specifically uses the best features of two operating dry storage facilities at Point Lepreau and Gentilly 2 in Canada. The dry storage system has proved to be safe, simple to use, and has successfully limited doses of radiation to workers to very low values at each of the above facilities.

No release of radionuclides has been observed up to now at operating facilities and no dose to the public has been measured.

The content of the Preliminary Safety Report is observing generally the requirements of US NRC Regulatory Guide 3.48 "Standard Format Content for the Safety Analysis Report", adapted for the construction stage. Physical protection and safeguards are addressed separately. Emergency planing is covered by the general NPP emergency plan, that will integrated emergencies related to dry storage activities.

The following issues were addressed in the report:

- General description
- Characteristics of the site (these includes: geography and demography,
nearby human activities -including man made events-, meteorology, surface and subsurface hydrology, geology, seismology, ecology, use of land and waters)
- Design criteria
- Description of the project
- Description of the technological flux
- Waste management
- Radiological protection
- Conduct of operation
- Accident analyses
- Technical limits and conditions
- Quality Assurance
- Decommissioning program
- Conclusions

The construction of the facility was done under 2 different authorizations issued by CNCAN.

First authorization was given in the form of a "Modification of Plant Approval" in the area of the Spent Fuel Storage Bay, including the construction of an extension of the building. The modifications related to this area were approved only after demonstration that construction work will not affect the safety of the operation of the plant.
The construction authorization of spent fuel dry storage was issued in May 2002, and contains conditions related to the constructive solution, and to the reconsideration of the air crash severe accident (it is requested that the Final Safety Report improve the scenario, justify the emission height, and presenting the support documentation for radionuclide concentrations and dose calculations, for all meteorological conditions and all distances and heights relevant for emergency planning).
Also it is requested to be analysed the situation of a critical group inside the exclusion zone, and to demonstrate that in normal operation, the dose constraint for members of the public is not exceeded, and, in case of Design Basis accidents, the doses for public will in principle not exceed the dose limits applicable for workers during normal operation).

Article 8. Assessment of safety of facility

i. Initial safety assessment

According to the Romanian laws and regulations, for sitting a nuclear facility, including a spent fuel management facility, a siting authorization shall be issued by CNCAN. This authorization is issued based on a Initial Safety Analysis, as it was presented in the paragraph related to article 6.

As it was presented in the paragraphs related to articles 6 and 7, before construction of any nuclear facility, including a spent fuel handling and storage facility, an environmental agreement issued by the Environmental Protection Authority and a construction authorization issued by CNCAN are required. The environmental agreement is issued based on an Environmental Impact Study while the authorization is issued on the basis of a Preliminary Safety Report.

ii. Updated and detailed safety assessment

According to the Romanian laws and regulations, for issuing by CNCAN of a commissioning authorization for a nuclear facility, including a spent fuel handling and storage facility, a Final Safety Report is required, while for issuing by CNCAN of an operation authorization, a revised Final Safety Report is required. These requirements will be presented in the paragraph on article 9.

Operation requires also the issuing by the Environmental Protection Authority of an operating authorization. This last authorization is issued after starting of the operation, based on Environmental Report, that includes measurements of environmental parameters.
The operating authorizations are issued by CNCAN and by the Environmental Protection Authority for a limited period of time and have to be renewed periodically. That requires the update of supporting safety and environmental assessments.

Systematic impact assessment according to internationally recognized criteria and standards are required for completion of the Environmental Impact Study and of the Environmental Report.

The Initial Safety Analysis, Preliminary Safety Report, Final Safety Reports and their supporting documents are containing systematic assessment of the nuclear safety and of the environmental impact, in accordance with the internationally accepted criteria and standards. This is obviously the case for the spent fuel facilities inside the NPP or reactors, where the safety of the handling and storage of spent fuel are assessed in the general context of the safety of the entire installation.
As it was presented in the paragraphs related to articles 6 and 7, the content of Initial Safety Analysis and of Preliminary Safety Report for the Spent Fuel Dry Storage Facility were realised following the guidance provided in USNRC NUREG Guide 3.48, adapted for the siting and construction phases, respectively. The Final Safety Report for commissioning authorization, which was recently submitted for assessment, and the revised Final Safety Report shall also follow the content of this guide.
In fact some simplifications are operated, taking into account the characteristics of CANDU fuel (natural uranium, low residual heat, geometry and mass of the fuel assembly, etc.), the geographic and climatic conditions and the .

CNCAN has and will continue to assess these authorization documents based on USNRC NUREG-1567 “Standard Review Plan for Spent Fuel Dry Storage Facilities”, adapted taking into account the characteristics of CANDU spent fuel, the local geographic and climatic conditions and the regulatory requirements. This approach was communicated to the utility from the beginning of the licensing process.

For the case of the VVR-S reactor under decommissioning, the content of the revised Final Safety Report as per November 2002 was presented in the paragraph

related to article 5. According to new regulation on decommissioning of research reactors and other facilities, recently issued, requiring the review of the Final Safety Report for spent fuel storage at reactor site, it was requested that IFIN-HH review that report for its spent fuel storage ponds. The content required for the new report is similar to the content required in IAEA SS No. 118 “Safety Assessment for Spent Fuel Storage Facilities”. IFIN-HH is in the process of reviewing the report, according to CNCAN requirements.
The handling of spent fuel in TRIGA pool, at SCN Pitesti, is covered in the Final Safety Report of TRIGA reactor. The revised Final Safety Report of LEPI, under completion, covers the storage of the spent fuel in the spent fuel storage pool of LEPI and of the spent fuel fragments and experimental fuel elements in the dry pits of LEPI hot cells. The report will cover handling and storage of spent fuel in LEPI, according to the requirements of IAEA SS No. 118.

Article 9. Operation of facilities

i. Licensing

The spent fuel bay operated by CNE-PROD Cernavoda is a nuclear power plant system. The Cernavoda NPP operation was licensed by CNCAN following the legal procedure and based on appropriate assessment of safety. All safety analyses to support the four-formal licensing stages (site license, construction license, commissioning license and operating license) were performed as parts of the safety analyses for U1.

The Operating License was issued on the basis of a Final Safety Report (FSR)-Phase II, including two successive steps:

- Probationary operating license;
- Operating license.

The Probationary Operating License is issued based on the revised FSR, which includes the commissioning test and control program results. For Cernavoda NPP, Unit 1 specifically, the probationary operating license was issued based on the Final Safety Report which was structured in accordance with the provisions of the NRC Regulatory Guide 1.70.

The Operating License was finally issued based on the revise FSAR, which contains amendments derived from the results and conclusions of the probationary operating period.
Every 2 years the operation authorisation is renewed, and appropriate assessments are requested in support of the application for issuing of the new authorization.

Similar processes were in place for authorization of operation of the 2 reactors. Also the authorization for operation of LEPI was issued in similar conditions.

As it was presented previously, the Final Safety Report for LEPI is under review, according to the CNCAN requirements.

For VVR-S spent fuel storage, the completion of a revised Final safety Report is ongoing. The decommissioning authorization for the reactor will include the spent fuel storage activities. Prior to get CNCAN authorization to start the decommissioning, IFIN-HH shall assess the impact of these activities on spent fuel management CNCAN also asked IFIN-HH to perform characterization of fuel cladding status and to take measures for upgrading measures for the spent fuel management, including for more strict observation of technical limits and conditions. Any modification of the spent fuel handling and storage systems shall be done only with the prior approval of CNCAN.

ii. Operational limits and conditions

CNE-PROD Cernavoda issued under CNCAN approval, the reference document "OPERATING POLICIES AND PRINCIPLES". This document describes how the utility operates, maintains and modifies the safety-related systems in order to maintain the nuclear safety margins and consequential risk to the public acceptably low. This document defines the specific operating limits for safety related systems, which must be maintained all the time to ensure that the plant always operates within its analysed operating envelope. Other key boundaries for operation of Spent Fuel Facilities are included in their Operating Manuals.
The safety 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.

A fundamental requirement of nuclear safety is to operate and maintain the spent fuel management facility within a defined "safe operating envelope" in accordance with the design intent and the licensing basis.

The "safe operating envelope" is defined by a number of safe operation requirements from which the most important are:

- Requirements on safety related systems or functions, e.g. set point or other parameter 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 spent fuel facility safety related systems or their stand-by equipment from service.

The technical basis for the safe operating envelope are found in the Final Safety Report which includes the description of the safety analysis that examines the facility response to disturbances in process function, system failures, component failure or human errors. Safety analyses predicts the consequences of the design basis accidents and compare them with the regulatory requirements.

In addition a set of nuclear safety topics are integrated into the assembly of the measures by which the station performance is to be judged. Safety performance shall be assessed against the safety-related topics. Where discrepancies are met, corrective actions shall be implemented.

For LEPI facility as well as for the spent fuel storage of the under decommissioning VVR-S reactor, technical (operational) limits and conditions are established, based

on assessments, tests and operational experience. These technical limits and conditions are revised as necessary.
As an example, below are presented the technical limits and conditions for the spent fuel storage pools of VVR-S reactor:

1. water level in the ponds: minimum 4.2 m
2. water temperature: 60º C
3. air depression (before removing the plugs of the ponds) minimum 5 mm water column
4. the ventilation of the building shall function minimum ½ h before the entering into the storage area, all the time during the presence of persons in the storage area, at least 6 h per working day and 30 h per week
5. a reserve of at least 10 m^3 of distilled water for compensating in case of water loss
6. water characteristics: pH = 5.5 – 6, conductivity 2 - 3.3 $\mu S/cm^2$ fixed residuum = 1 mg/l, Cl = 0.02 mg/l, O = 8 mg/l
7. maximum activity in the water 25,000 Bq/l

These values will be revised, as the filtering of water allows lover limit for water specific activity.
For the new Cernavoda Spent Fuel Dry Storage Facility, a set of technical limits and conditions, already proposed in the Preliminary Safety Report, will be finalised in the Final Safety Report, before the putting into operation of the facility.

iii. Operation, maintenance, monitoring, inspection and testing

As parts of CNE-PROD NPP, the spent fuel facilities operation, maintenance, monitoring, inspection and testing activities are performed according to Station regulations: Operating Policies and Principles, Maintenance Philosophy, Quality Assurance 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.
As these documents are sustaining the operating license, the compliance with their requirements is mandatory for the Station and any deviation must be reported to CNCAN.
Similar requirements does exist for LEPI spent fuel management facility and for VVR-S spent fuel storage facility.

iv. Engineering and technical support

The station organisation chart for CNE-PROD Cernavoda NPP documents the general areas of responsibility. The structure of the organisation considers the needs for engineering and technical supports and for this reason it includes a strong Technical Unit covering System Performance Monitoring, Design Engineering and Safety & Compliance.

Also, it should be mentioned that a strong link is maintained with Romanian research institutes and with designer of the plant, Atomic Energy Canada Limited, Romania being member of CANDU Owners Group.

SCN Pitesti and IFIN-HH consider also needs for engineering and technical supports. Their organizational chart include also staff for operation, maintenance, monitoring, inspection and testing of spent fuel handling and storage systems.

v. Incidents reporting to CNCAN

Incidents significant to safety are reported in a timely manner by the holder of the authorization to the regulatory body, according to established procedures. These reports and procedures are requested by CNCAN according to authorization conditions.

CNE PROD has to submit to the regulatory body the following types of reports:

- Abnormal Condition Reports are prepared to report those events that could have significant adverse impact on the safety of the environment, the public or the personnel, such as: serious process failures, violations of the Operating Policies and Principles, release of radioactive materials in excess of targets, doses of radiation which exceed the regulatory limits, events which interfere with the IAEA safeguards system.

For each reportable event a notification is made to the CNCAN immediately after the discovery of the reportable event or within one working day depending on the gravity of the event and a report is prepared to document the event. For the events that are significant or complex, more detailed reports are prepared as Abnormal Condition Reports and submitted to CNCAN within the required time period.

- Quarterly reports are to be prepared to provide information regarding the safety systems reliability performance, dose statistics and radioactive emission, 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 result of the chemistry control, radiation control, a review of the emergency planning a reactor core safety assessment, etc.
- Safety report updates should analyse the design and procedural changes and include the new safety analysis. These updates should be submitted to CNCAN each two years from the last update, excepting the case when CNCAN takes an other decision.
- Annual radiological environment monitoring reports are to be prepared to provide information on the off-site radiological environmental monitoring program, the individual doses that are calculated as doses to critical group, a review of the radiological environmental monitoring quality assurance program, and any unusual event during the calendar year.
- Annual research and development reports should describe the planned research and development programs that address the unresolved safety questions.
- Periodic inspection reports are to be prepared to describe the results of any subject inspections in compliance with applicable standards.
- Annual reliability reports should include an evaluation of systems that has specific reliability requirements given in the licensing documentation. A review of updated documents should be provided with the focus on the design changes and their impact on the analysis results.

Similar reporting systems are established in the authorization conditions and are precised in internal procedures of the licensee, in the case of SCN Pitesti and of IFIN-HH.

vi. Collection and analysing of relevant operating experience

For CNE-PROD Cernavoda NPP the station goal for operating experience is to effectively and efficiently use lessons learned from other plants and station operating experience to improve plant safety and reliability.

Station events and human performance problems often 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 CNE-PROD Cernavoda NPP consider, as the main topic of the Operating Experience Program, 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 external information regarding 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 basis for Operating Experience Program was set in place since the early stage of the commissioning phase (1993), with the objective to ensure:

- the reporting, reviewing, assessing of the station abnormal conditions and establishing of the necessary corrective actions;
- information exchange within CANDU Owner Group (COG), regarding abnormal conditions, technical problems, research and development projects, etc.

As a result, all the activities related to this topic were assigned to a new structure, an Operating Experience Group was created, and the program based on the ASSET philosophy-*"prevention of incidents - the path to excellence operational safety*" - is now developed in an integrated and centralised manner.

For this reason, the abnormal conditions assessment programs includes low level events analysis as precursors of the major events. The new created group together with technical units specialists analyses, using ASSET methodology, the external and internal abnormal conditions, and proposes to the station management an action plan, to improve the plant safety and to avoid the events reoccurrence.

For the information exchange program, the relation between CNE-PROD Cernavoda NPP and COG is covered by a COG contact officer, appointed by the station management, with the following general responsibilities:

- serving as a liaison between COG and the station;

- reviewing the incoming messages and distributing them to the appropriate persons;
- ensuring the transmittal of the required information/reports to COG;
- ensuring optimum participation by the station personnel.

Programs to collect and analyse relevant operating experiences are established also for SCN Pitesti and IFIN-HH.

vii. Decommissioning plans for spent fuel management facilities

According to the provisions of Law no. 111/1996 (as amended) any NPP or research reactor needs to prepare decommissioning plans. This is valid also for the spent fuel management facilities that in Romania are sited at reactor sites. The requirements related to decommissioning plans from the design and construction phases are applied for the Spent Fuel Dry Storage Facility at Cernavoda site, as presented before.

Article 10. Disposal of spent fuel

After six years of cooling in the Spent Fuel Bay, the spent fuel generated in operation of Cernavoda Nuclear Power Plant will be stored on site for 50 years in the Interim Spent Fuel Dry Storage Facility. The capacity of this interim storage is adequate for lifetime operation of two CANDU plants.

The geological disposal of spent fuel will be addressed later, when the technology will be commercially available.

The financial arrangements for disposal of spent fuel will be legally solved in a new national regulation.

For the spent fuel of research reactors, the preferred strategy is to return the fuel in the country of origin. If this will not be possible, co-disposal with the NPP spent fuel will be taken into consideration.

SECTION H. SAFETY OF RADIOACTIVE WASTE MANAGEMENT

Article 11. General safety requirements

i. Control of criticality and heat generation

The requirements regarding the control of criticality and heat generation during radioactive waste management are generally related, in Romanian case, to the spent fuel management (spent fuel being considered as radioactive waste, no reprocessing is foreseen). The CNCAN requirements and the measures taken by the licensees were presented in Section G.

Regarding the sealed sources of high activity, the storage authorization requirements take into consideration heat dissipation. When the sources are stored in the dedicated transport, storage or operation container, the conditions related to heat removal are mentioned also in the type approval of the equipment.

ii. Minimization of waste

Waste minimization is considered by CNCAN as an important issue, having important impact on radioactive waste management, especially on the associated costs.
This is obvious especially for decommissioning activities. In this respect, even though not explicitly present in the existing Romanian regulations, the applicant of a decommissioning authorization is requested by CNCAN to justify how it is observed the principle of control of radioactive waste generation presented in IAEA SS No.111-F. The future set of radioactive waste management norms will include a regulation on the principles of radioactive waste management that will include explicitly the requirement of minimization of the radioactive waste generation.

A main mean for reduction of the amount of the radioactive waste generated is the clearance of the waste. The Radiological Safety Fundamental Norms/2000 states that CNCAN shall establish, based on the EC regulations, clearance levels for each specific case.
The future set of radioactive waste management norms will include a regulation regarding clearance levels, both for conditional and free release of solid materials from radiological zones.

iii. Interdependencies among different management steps

In the regulatory process, CNCAN requires that due attention be given to interdependencies among the different steps in radioactive management. The future set of radioactive waste management norms will include a regulation on the principles of radioactive waste management. This regulation, probably entitled "Fundamental Norms for Radioactive Waste management" will establish that interdependencies among all steps in radioactive waste generation shall be appropriately taken into account. The fulfillment of this condition will be checked by CNCAN while authorizing radioactive waste management activities. Also, while assessing the regulatory compliance of the national radioactive waste management strategy to be elaborated by

ANDRAD, CNCAN shall verify if the interdependencies among different radioactive waste management strategy were correctly taken into consideration.

iv. Effective protection of workers, public and environment

In the authorization process of radioactive waste management facilities, CNCAN pays due attention to the effective protection of workers, public and environment. The authorization is granted only if the internationally recognized criteria and standards are observed.

In order to protect adequately the public health and the environment during the normal operation of the facility, the offsite dose estimate and monitoring are based on the analysis of the external effective doses and of the (internal) committed effective doses for members of critical groups for all radiation pathways. These analyses are performed according to methods and procedures recommended in IAEA and in other western regulations, like US regulations. The result of the analyses leads to derived emission limits for the effluents, and the monitoring program of the environment shall demonstrate that the derived emission limits are observed both in normal operation and during events with relative high probability of occurrence. Of a particular interest is the assessment (based on the FEPs list) and the monitoring of the doses resulted from a repository during both the operation and the post closure (institutional control) period. For this purpose, depending on the characteristics of the radioactive waste, the immobilization matrix, the engineered barriers of the facility, and of the surroundings of the facility (near field and far field) various monitoring activities for radioactivity of air, water, soil, vegetal and animal organisms are performed. For a surface repository, accepting short lived radionuclides, the institutional control period is considered 300 years.
Regarding the radiation protection criteria for the workers and for the public, they are similar to the criteria defined in the 1990 publication of ICRP 60, as the Radiological Safety Fundamental Norms are transposing the Council Directive 96/29/EURATOM.
In the case of the radioactive waste disposal facility, altered evolution scenarios, including the intrusion scenarios are considered, according to IAEA recommendations. Also operation and transport accidents are considered for such facilities. The loose and the theft of radioactive waste are also considered. The emergency plan is dimensioned according to the maximum credible accident.

For the low level radioactive waste treatment plants and for the low and intermediate level radioactive waste and spent sources storages the operation and transport accident scenarios, including loose and the theft of radioactive waste, are also considered.

v. Biological, chemical and other hazards

The internationally accepted criteria and standards used for assessing and authorizing the radioactive waste management facilities take into consideration biological, chemical hazards.

vi. Impact on future generations

The authorization process for pretreatment, treatment and storage of spent fuel, and, when it will be the case, for its geological disposal requires the demonstration that the impact on future generations will not be higher than it is now accepted for the current generation. This is done for long term storage and disposal by requiring that the dose be assessed both for normal and altered scenarios of evolution of the facility, including the intrusion in the repository, for all the period of time for which the waste has significant radioactivity. The results shall be below the constraints established by CNCAN, that are expressed in terms of yearly dose, or dose/event, that are the same as for the current generation.

vii. Avoidance of undue burdens on future generations

Regarding the policy of avoiding undue burden of radioactive waste management on the future generations, it shall be noted that Romanian authorities, and particularly CNCAN, fully accept and promote this principle. Law 111/1996 (as amended) asks for establishing of the Fund for Radioactive Waste Management and for Decommissioning, in order to be sure that all the costs for such activities will be covered in future.
The future norms on the principles of radioactive waste management will require the radioactive waste to be managed in such a way that will not impose undue burdens on future generations. The radioactive waste management strategy to be issued by ANDRAD shall observe this principle. However, due to the reasons previously presented when analyzing the application of the principle for the spent fuel management, it shall be noted that difficulties does exist for its application for long lived radioactive waste disposal.

Article 12. Existing facilities and past practices

i. Safety of radioactive waste management

a) Safety of radioactive waste management at CNE-PROD

The review of the safety of radioactive waste management systems at Cernavoda NPP is done periodically, as the authorization of the plant is renewed every 2 years.

The Cernavoda Nuclear Power Plant is provided with facilities for safe management of all radioactive waste arising from plant operation, from maintenance period, or from abnormal reactor operation.

The generation of radioactive waste resulting from plant operation is kept to the minimum practicable, both in activity and in volume. Station references documents and procedures are focused on waste minimization. Operational target for waste volume is 30 m^3 per year except spent resins.

Radiation exposure of the operating staff and members of public during processing and storage is maintained as low as reasonably achievable – ALARA (social and economic factors taken into account).

The contamination control, temporary accumulation and storage of radioactive waste within the plant are avoided by proper planning and scheduling. Temporary accumulations are prohibited except at locations designed for that purpose.

The whole set of procedures dealing with waste generation and waste management is under regulatory control.

Qualified and trained personnel operate facilities. Training is subject to periodically refreshment.

The plant has the capabilities to control, collect, handle, process, interim store wastes that may contain radioactive materials and are produced as a consequence of plant operation.

The design of the radioactive waste management facilities is such that radiological exposure of operating staff and the public is well within the limits recommended by the International Commission on Radiological Protection.

The solid radioactive wastes which result from either normal or ab-normal operation of the nuclear power plant are stored for a limited period of time. The wastes will be transferred for disposal at the moment when the disposal facility will be available.

The radioactive waste management facilities are located within Cernavoda NPP exclusion zone and security fence, with easy access of vehicles transporting radioactive wastes, minimizing the need for additional security mechanism to assure its integrity. No any off-site transportation is involved.

The origin of the radionuclides contained in the radioactive wastes from the CANDU NPP is the as follows:

- Fuel fission products
- System material activation products
- System fluid activation products

Radionuclides in all these categories remain predominantly at their place of origin, but may be transported and ultimately reach one or more parts of the radioactive waste management system.
The fission products, which may escape from defective fuel while in the core or in the fuel handling equipment, are filtered, trapped or removed in the heat transport system and its auxiliary systems. This leads to accumulation of the majority of the fission products in spent resin or filter elements as solid wastes. Radionuclides, which escape from the heat transport system boundary reach the building atmosphere. They are collected into the active ventilation ducts in the gaseous radioactive waste management system. If deposited and washed, down they reach liquid radioactive waste facilities thorough the active drainage system.
Similarly, and as a specific feature of the CANDU pressurized heavy water plant, the tritium produced by activation of the heavy water in the heat transport system and moderator D_2O circuits may escape as DTO or T_2O. Unless retained in the D_2O collection or D_2O vapor recovery systems, it ultimately arrives in the liquid or gaseous radioactive waste management systems.

Components being serviced are subjected to decontamination procedures, either in-situ or in special decontamination facilities, for the removal of fission products or activation products. The residues from these activities are directed to the applicable radioactive waste management system.

Pre-treatment of waste is the initial step in waste management that occurs after waste generation. It consists of collection, segregation and includes a period of interim storage. This initial step assures a segregation of waste streams and also a segregation of radioactive waste from the non-radioactive ones.

Treatment of radioactive waste is the next step and consists at this moment only of a volume reduction by pressing waste inside drums using a Hydraulic Press with a volume reduction factor of 4:1. Detailed description of these steps and interdependencies between them are presented in section D.

The conclusions of the review of the safety of radioactive waste management at Cernavoda NPP are that the requirements of the Joint Convention are met. However, CNCAN asked for supplementary work, in order to characterize in detail the radioactive waste produced in the plant. This requirement is important, as it is intended to construct a surface repository for NPP radioactive waste, and it shall be clear what wastes can be accommodate in this repository, and what will be the maximum committed doses for the critical group.

b) Safety of radioactive waste at FCN Pitesti

The review of the safety of radioactive waste management at Fuel Fabrication Plant (FCN Pitesti) is done periodically, as the authorization of the facility is renewed. The description of radioactive waste management at FCN Pitesti is done in Section D.
The conclusions of the review of the safety of radioactive waste management at FCN Pitesti are that this is done properly, in accordance with the requirements of the Joint Convention. However, improvements are performed permanently. The last safety improvements are related to the internal contamination and external dose monitoring systems.

c) Safety of radioactive waste management at SCN Pitesti

The review of the safety of radioactive waste management facilities at SCN Pitesti is done periodically, as the authorization of this facilities is renewed.
STDR Pitesti is provided with installations for safe management of all short lived radioactive waste arising from the operation of the institute facilities, including of the TRIGA reactor. Also there are installations for uranium recovery from the liquid and burnable solid wastes produced in the Fuel Fabrication Plant Pitesti.
LEPI facility is used for storage of long-lived radioactive waste and off the highly active short lived radioactive sources.

The generation of radioactive waste resulting from STDR and LEPI operation is kept to the minimum practicable, both in activity and in volume.

Radiation exposure of the operating staff and members of public during processing and storage is maintained as low as reasonably achievable – ALARA (social and economic factors taken into account).

The contamination control, temporary accumulation and storage of radioactive waste within the STDR are avoided by proper planning and scheduling. Temporary accumulations are prohibited except at locations designed for that purpose. The conditioned solid radioactive wastes are transferred to IFIN-HH for disposal at Baita-Bihor repository.

The whole set of procedures dealing with waste treatment and conditioning is under regulatory control.

Qualified and trained personnel operate facilities. Training is subject to periodically refreshment.

The design of the radioactive waste management facilities is such that radiological exposure of operating staff and the public is well within the limits recommended by the International Commission on Radiological Protection.

d) Safety of radioactive waste management at IFIN-HH

The review of the safety of radioactive waste management at STDR Magurele is done periodically, as the authorization of this facilities is renewed.
STDR Magurele is provided with installations for safe management of all short lived radioactive waste arising from the operation of the institute facilities, including the former VVR-S reactor, under decommissioning, as well as of the institutional radioactive waste produced in the country. The radioactive waste, including spent sources, are treated at STDR. Here are stored also long lived spent sources, waiting for treatment, in view of long term storage.
Due to ageing of the installation, problems are encountered regarding the liquid treatment. Also the solid radioactive waste treatment has some problems, for example the incineration installation. CNCAN has required a program for refurbishment of STDR Magurele, as well as for creation of technologies for long term storage of long lived radioactive waste. Also it is requested that the 800 existing corroded drums, containing historical waste, be reconditioned and disposed at Baita-Bihor repository. The new created agency ANDRAD that shall establish the future radioactive waste management strategy, shall propose the solution for future improvements at STDR Magurele.

The DNDR Baita-Bihor (the short lived radioactive waste national repository for institutional waste) was put in operation in 1985. Following the evolution of radioactive waste disposal concept, CNCAN has asked IFIN-HH to perform an Initial Safety Analysis, followed by a Preliminary Safety Report, and a Final Safety Report.
The first step was achieved in 2002, based of know-how transfer through a PHARE project. A continuation of the PHARE project is conducted in 2003-2004. As result, the Preliminary Safety Report will be produced at the end of 2004. In parallel, a feasibility study for upgrading the repository will establish the improvements that will be done at this repository. The content and conclusions of the first PHARE project, and the content

of the second are presented in the paragraph related to article 15, on assessment of safety of facilities.

e) Safety of radioactive waste management at National Uranium Company

As it was presented in Section D, National Uranium Company has 2 tailing ponds, and 3 solid waste storages (2 old, trench type, and 1 new, with concrete walls, realised according to a safety assessment approved by CNCAN.). After filling, the tailing ponds and the storages will be transformed in radioactive waste repositories, provided that they satisfy the CNCAN requirements.
The 2 tailings ponds are named Cetatuia II and Mittelzop.
The Cetatuia II have as aim the settling and storage of radioactive tailings, and was built in 3 pieces, due to high investment costs for insulation of the concerned surfaces. The present state of this pond is the following, in present:
- the first part, is now in a closing out process, being used for tailings discharging in the 1978 - 2001 period; the total estimated tailings discharged was about 4 500 000 tons; the total surface of this first part is 368,000 m^2; the closure of the pond will transform it in a repository, provided that the closure solution satisfies the regulatory safety requirements.

In present, gathering and storage of solid radioactive waste is done according with a specific procedure, agreed by the CNCAN authority, covering the following aspects:
- gathering radioactive waste from the Feldioara plant, sorting, transport for final storage;
- intervention in case nuclear accident during gathering radioactive waste from the Feldioara plant, sorting, transport for final storage;
- recording the radioactive waste stored, reporting of the stored quantities.

There are just a few personnel involved in the mentioned activities, a driver, dose measurement person, person for discharge and storage; all these persons are radiological monitored during their work with radioactive waste and medical controlled in accordance with the settlements of the Health and Family Ministry.
The radiological safety manager within the Feldioara branch is a person agreed by the CNCAN authority, to ensure the following activities:
- radiological protection of the exposed workers, of the population and environment;
- the management in safe conditions of the radioactive waste; registered as quantity, type, storage location, activity, level of surface contamination);
- planning of urgent intervention in case of radiological accident occurring during storing of radioactive waste (as mentioned in procedures “Urgent intervention plan at radioactive waste storage facilities”).

In accordance with the new norms issues by CNCAN the Feldioara branch has decided new safety measures for the radioactive waste management:
- the entire area around both new and old radioactive waste storage surfaces was surrounded by wire fence to avoid people’s access;
- the surrounding area is radiologicaly monitored and ground and underground water samples are taken and analyzed within the plant laboratory;
- to avoid radionuclides migration around the storage area the stored radioactive waste is compacted and covered by a 10 cm thick layer of clay (according to the

procedures “Location and storage of low activity radioactive waste” and “Conditioning of radioactive waste material easily removed by wind”).

Having as aim the increasing of radioactive waste safety management, for the near future the Feldioara branch foreseen the following:
- improvement of the access road at the radioactive waste storage facility;
- supplementary drillings around the radioactive waste storage facility in order to ensure more underground water samples for contamination assessment;
- radiometric monitoring of the access road to the radioactive waste facility.
Remote access will be ensured to the storage area.

The storage activity at the mentioned site is estimated during a 10 years period.
After filling completely the radioactive waste storage facility, the stored material will be leveled and covered by a 50 cm thick compacted clay to avoid any radioactive contamination of the surrounding environment (according to the procedure “Insulating the area of the full capacity storage facility“). In this way, the storage will be transformed in a repository.

If required, a higher storage capacity may be developed in future, within the same area, after obtaining the necessary CNCAN authorization. For the first two solid radioactive waste storage areas that are closed and covered, it is also necessary to assess the safety prior to get the authorization for transforming the storage areas in repositories.

ii. Past practices

a) Former radioactive waste storage “Magurele Fort”

Regarding the past practices, it should be mentioned the Magurele fort, where IFIN-HH have stored in the past untreated radioactive waste. The fort, sited near the Magurele site of IFIN-HH, was closed at the beginning of eighties, the waste was recovered and treated, part of it was disposed at Baita-Bihor repository and part of it is stored at Magurele site. The waste that remained at Magurele needs to be repacked before being sent at the repository. The closure of the repository was realised as required at that moment, and the site remained under control. Recently the clean up of the site was realized by IFIN-HH, and the institute required the release from authorization. CNCAN is still assessing the clean up results and shall give a decision during this year.

b) Sterile rock and low radioactive rock dumps resulted from geological research and mining activities for uranium ores production within the National Uranium Company sites

The uranium geological research and mining activities have produced sterile rock and radioactive rock dumps. This deposits shall be assessed, and where necessary, intervention shall be applied, in order to reduce the radiological risks. The sites and their actual status are presented below.

- *Objective MILOVA - Arad county*

The geological objective is located at 12 km from the nearest village, Milova, Arad county. The geological activities were completed 12 years ago.
A number of 9 dumps are located on slopes, in front of 9 adits digged for geological purposes, as follows :
- 6 dumps have a total volume of 73,090 m^3 on a total surface of 16,850 m^2, with a low radioactive elements content ;
- 3 dumps have a total volume of 31,400 m^3 on a total surface of 6,400 m^2, without radioactive rocks ;
All the dumps have a height under 30 m each, being located on slopes with an inclination higher than 20 degrees, at distance of about 100 m are flowing small brooks.
Studies for mine site closing out and environmental assessment will be completed until the fourth quarter of 2003. In field radiometric measurements will be carried out during the spring of 2003. The works for closing out and for environmental restoration will begin probably in the third quarter of 2005.

After completion of all environment restoration works very low radiological hazard will remain for the population living in Milova village.

- *Objective GRADISTE DE MUNTE - ALBA county*

The geological objective has 5 sterile and low grade ore dumps, located in front of 5 adits on slopes. The geological activities were completed 15 years ago.
The 5 dumps have a total volume of 182,700 m^3 on a surface of 40,000 m^2.
The land under the dumps has a 20 ^{0} slope and the dump surface has 10 - 25 ^{0}.
The gradient of dumps is between 30 - 45 ^{0}.
In present there are no detailed gamma dose measurements at the surface of the 5 dumps. During 2004 is planned to order studies like the closing out plan, the radiological risk assessment and the environment assessment. The restoration necessary works will be presented within these studies. The in field works may be carried out in the 2006 - 2007 period.

- *Objective Valea ZIMBRU - Bihor county*

The geological objective is located at 5 km from the Zimbru village.
2 sterile dumps are located on dumps in front of the adits. The total sterile rock volume is about 70 000 m^3. The no. 1 main dump has a 3 – 10 m height and a 300 m length. On a small surface of 1,600 m^2 can be found some low grade ore which will be removed. A natural re-vegetation process is going on the dump's surface. In present there is a very low radiological hazard for the nearest population group, which will be even lower after completion of the environment restoration works. Studies for mine closing out and environment restoration will be completed until 2005.

- *Objective PIETROASA - PADIS - Bihor county*

The geological objective is located at about 12 km of the nearest village, 2 km from a vacation camp.
Small volume mining works for uranium ore research were carried out during the fifties and sixties. The total volume of the 4 dumps is about 17,200 m^3.
3 dumps have small quantities of low radioactive rocks. One dump is completely re-vegetated. There is no detailed radiometric measurements at the surface of the dumps, but few old data showed no radioactive ore on these dumps.
Studies for mine site closing out, environmental assessment and restoration plan will be completed until the fourth quarter of 2003. Priority will be given to the restoration works because the increasing tourist activities within the area, ensuring no radiological hazard for population and tourists.

- *Objective Valea LEUCII - Valea VACII - BIHOR county*

This geological objective is located at about 12 km from the nearest village, Leuca, within a mountain area. The objectives has 5 sterile rock dumps with a total volume of 250,000 m^3 and a surface of 43,400 m^2, located along a valley, on mountain slopes. The geological works ended 10 years ago. The average gamma dose rate measures at 1 m height from the dump's surface is 0.09 – 0.18 µSv/h.
Radon exhalation was measured and found to be 5 - 30 Bq/m^3.
Mine waters flowing from the adits have a uranium concentration between 0.005 – 0.015 mgU/l, under the allowed limit for drinking water. The flowing brooks downside the mining works have uranium and radium concentration under the Romanian standard allowed limits for drinking water.
The height of the mentioned dumps vary from 6 to 40 meters.
One dump, G 7 Valea LEUCII, is naturally re-vegetated on more than 60 % of its surface. In present the radiological hazard for critic group population is very low.
There is no detailed radiometric measurements at the surface of the dumps, but few old data showed no radioactive ore on these dumps.
Studies for mine site closing out ,environmental assessment and restoration plan will be completed until of 2005. Priority will be given to the restoration works, re-vegetation and surface covering by forests, ensuring finally no radiological hazard for local population. In present the radiological hazard for critic group population is very low.

- *Objective RANUSA - ALBA county*

Mining works at the geological objective lead to 5 dumps having a total volume of 283,000 m^3 and covering a surface of 37,600 m^2.
The main dump, P1, has a low radioactive level, having an average uranium grade of about 100 g/t.
Mine waters are removed from underground adits, having an average of 0.10 mgU/l.
Other mine waters flows through 2 slope adits, having less than 0.05 mgU/l and a flow of 12 - 25 l/min.
Studies for mine closing out are already completed. Use of a sterile rocks volume is foreseen for capping the mine shaft and adits. Stabilization of the main dump and concrete walls for the new brook valley will be provided. No mine water treatment will

be required. Some of these works are planned to be undertaken during the third quarter of 2003. In present there is a very low radiological hazard for the critic population group. After closing out and environment restoration the affected surfaces will be reforested. About two years will be needed for completion of the restoration works, activities being undertaken each year from April to October.

- *Objective ARIESENI - BIHOR county*

The geological objective is located on the Aries River valley, at 5 km from the Arieseni village. Four sterile rock dumps resulted from digging four adits on the mountain slopes. The dumps total volume is 29,000 m^3 on a 6,395 m^2 surface.
The gamma dose rate at 1 m high from the dump surface is 0.33 - 1 μSv/h and radon exhalation between 20 - 104 Bq/ m^2.
The mine waters flowing from adits into the Aries river have an uranium concentration varying from 0.024 to 0.200 mgU/l, but after dilution the downside river waters has only 0.010 – 0.014 mgU/l, under the present allowed limits.
Mine closing out works and environment restoration will include capping adits on slopes, dump stabilization, soil recovering for the dumps, re-vegetation, new forest surfaces. The present affected surfaces will have mainly new forests.
Studies for mine site closing out, environmental assessment and restoration plan will be completed until the end of 2004. Environment restoration works will finally ensure no radiological hazard for local population and future tourist activities. In present the radiological hazard for critic group population is very low.

- *Objective BICAZU ARDELEAN - NEAMT county*

This geological objective is located at 1 km from the Telec village (one adit on slope, having one sterile rock dump). There are 6 dumps on slopes, at elevations between 700 – 820 m.
The total dump volume is about 62,900 m^3 on a 20,932 m^2 surface.
The main sterile dump is the no. 5-Telec dump, having a 42,000 m^3 volume.
The gamma dose rate is about 0,24 μSv/h with a maximum of 1,40 μSv/h. the rock from dumps have between 23 - 100 mgU/kg. Mine waters flowing from the 5 Telec adit have a 5 - 20 l/min flowrate and low uranium concentration, in average 0.039 mgU/l. Downside the adit the water in Jidanul brook have a very low uranium and radium concentrations, 0.005 mgU/l and 0.023 Bq/l respectively.
The critic group is represented by the Telec village population. The radiological hazard due to the dump and mine water is low. Special attention is given to closing out and restoration works, in order to ensure a minimum of radiological hazard for the future. Some low grade material may have to be relocated to avoid the natural uranium solubilization by rain waters and dump surface will be fully covered with natural soil.
Monitoring is carried out by taking water samples from 10 locations, soil and vegetation from 8 locations.
The mine closing out study will be soon completed.

- *Objective MEHADIA - CARAS SEVERIN county*

The geological objective is located at 5 km from Mehadia village and also 5 km from Iablonita village.
There is a single dump with a volume of 12,750 m^3 and a surface of 5,000 m^2 surface. The dump is located on slope, on the Sfârdin brook.
From the adit a very low flow of mine water is flowing through a pipe to the Sfârdin brook. Low contents of uranium and radium were analysed in water samples, 0.082 mgU/l and 0.080 Bq/l respectively. The waters are flowing into the Belarece river, which have a maximum uranium content of 0.022 mg/l.
There a very low radiological hazard due to the existing sterile dump. For the mentioned objective was completed the closing out plan, which requires capping the adit with sterile material, on 150 m long, removing of the low grade ore, works for increasing the stability of dump, reshaping de dump. Finally, the affected surfaces will be covered by forest.

- *Objective ILISOVA - MEHEDINTI county*

This geological perimeter is located near the Dunãrea River, within Almas mountain, at 10 km from Svinita village, 55 km from the Orsova town.
The geological adits are located within 4 areas, Strenac - Staristea Valley, Dunãrea River - Staristea Valley, Gabretina - Ilisova Valley, Ilisova area. There are 18 sterile dumps having a total volume of 12,750 m^3 .
The 2 dumps in the Strenac - Staristea Valley area, have together a volume of 16 000 m^3 material on a surface of 8,500 m^2 .
The 5 dumps of the Dunãrea River - Staristea Valley area have together a volume of 16,500 m^3 material on a surface of 7,000 m^2 .
The 5 dumps of the Gabretina - Ilisova Valley area have together a volume of 56 500 m^3 material on a surface of 43,500 m^2 .
Small flows of mine waters are flowing to the Dunãrea River. The uranium content in such mine waters is in the allowed limits for drinking water.
The gamma dose rate at 1 m of the dump's surfaces is in the 0.11 – 0.15 μSv/h with maximum values of 0.43 μSv/h.
For this geological objective, early in 1999 was completed a study for closing out of the mining works and an Environment Assessment study.
There is no radiological hazard due the dumps within this areas.

- *Objective STOENESTI - DAMBOVITA county*

The geological objective is located at 4 km from the Stoenesti village, on the Badeasca Valley, near the Dâmbovita river. There are 19 relatively small dumps, 14 of them with less than 1,000 m^3 each; together the dumps have a total volume of 43,640 m^3 material. The largest dumps are G2 Badeanca with 16,900 m^3 material, G 5 Danis with 5,546 m^3 material, G9 Danis with 5,856 m^3 material.
In present there are no detailed in field measurements for the gamma dose rate at 1 m high from the dumps surface. There a very low radiological hazard due to the existing sterile dumps. For the mentioned objective yet there is no completed a closing out plan, which however will require capping the adits with sterile material,

works for increasing the stability of dumps and also reshaping of these dumps. Finally, the affected surfaces will be covered by forest.

- *Objective BRATEI - DÂMBOVITA county*

This geological objective is located at 20 km distance from the Pietrosita town. The geological works were ended in 1980.
There are 6 sterile rock dumps having a total volume of 21,000 m^3 material. In present no detailed data concerning gamma dose rate at the surface of dumps exists, neither data concerning analysis of water streams.
These data will be gathered when completed the mine closing out plan and the environment assessment study.

- *Objective TULHGES - GRINTIES, Neamt county*

This objective has 3 areas were geological works were carried out, including digging of slope adits, 30 years long. These areas are named Primatar, Prisecani, and Bradu, and are located on a 20 km^2 area.
The nearest village is Grinties, at 5 km distance from the Primatar area.
The Primatar area has 15 sterile dumps, covering a total surface of 46,300 m^2 and having a total volume of 160,370 m^3.
The Prisecani area has 5 sterile dumps, covering a total surface of 21,588 m^2 and having a total volume of 89,990 m^3.
The Bradu area has 6 sterile dumps, covering a total surface of 28,290 m^2 and having a total volume of 122,463 m^3.
All the sterile dumps are located on mountain slopes, in forest covered areas.
For all 3 area was completed in 2001 a study having the aim of assessment the hazards due to supplementary gamma doses received by critical population group.
At 1 m height from the surface, the gamma dose rate is 0.30 μSv/h with peaks to
0.70 μSv/h the mine waters flowing from few adits shows low concentration from uranium and radium, within the drink water range, except one adit which has low water flowrate and concentration up to 2 mg/l. The mine waters are flowing to brooks having variable flowrates, higher during spring and summer.
Water samples from taken each year from these brooks shows uranium and radium contents within the drink water standard.
Within the 3 areas there are many small surfaces with natural radioactive anomalies, showing gamma dose rates higher than those found on dump's surfaces.
The larger dumps are G24, G26 and G27 in the Primatar area.
Thus the G24 Primatar dump has a 3,900 m^2 surface and has a 20 ^{0} inclination, being located on slope at 1055 elevation.
The gamma dose rates vary from 0.10 to 0.60 μSv/h.
The G26 Primatar dump has a 12,000 m^2 surface and has an inclination angle of about 30 ^{0}. The measured gamma dose rates have 0.16 – 0.30 μSv/h.
The G27 Primatar dump has a 7,740 m^2 surface and has an inclination angle of about 30 ^{0}. The measured gamma dose rates have 0.10 – 0.35 μSv/h.
The population critic group is in fact represented by the inhabitants of the Grinties village, some 800 people.
There a very low radiological hazard due to the existing sterile dumps and mine waters.

Closing out these works will require capping all the adits, reshaping the affected surfaces, increasing the stability of the dumps, covering with natural soil and trees, collecting the higher mine water flows, building concrete works to separate, where necessary, the brooks from dumps.

- *Objective BAITA PLAI , Bihor county*

The Baita Plai open pit was the first mine in Romania for uranium ore exploitation. The open pit is located at 17 km far from the Stei town. In present some exploitation activities are still carried out, on a small scale, and also some radiometric sorting out is done on old low grade dumps, resulted during the exploitation of rich uranium ore, during the 1954 - 1962 period.
There 3 dumps of sterile and low grade rocks, having a total volume of 2,800,000 m^3 on a surface of 135,000 m^2. These dumps are located on low slopes and have a height of 20 to 100 m. The gamma dose rate measured at 1 m height from the soil is 0.26 – 0.46 μSv/h. Radon exhalation was measured being 20 - 60 Bq/ m^3.
The population from the critical group has about 80 persons living at 100 m downside the controlled perimeter, in he Baita Plai small village. To avoid local inhabitants contamination on along period basis, the closing out plans have to include the relocation of these persons, possible to the Nucet town, and demolishing of the few existing buildings. There is controlled access to this area in order to avoid population and animals possible contamination.
Relocation of one dump is undertaken in present, the material being radiometrically sorted out and moved downside on a 400 m far location, compared to the former location.
Closing out plan shall is foreseen after ceasing of all exploitation activities within the open pit area. Monitoring in ensured with water and sediments sampling. After dilution outside the open pit area, the water streams and brooks have uranium contents near the allowed limit.

- *Objective AVRAM IANCU - Bihor county*

The objective was an underground mine for the 1962 - 1998 period.
There are 9 sterile rock dumps having a total volume 1,245,500 m^3 on a 116,950 m^2.
One dump is located across a valley and the other 8 are located on slopes. The dumps contains hard rocks, 8 have a height under 30 m and 1 dump has 100 m. All the these dumps are located near forest of 30 - 60 years old.
The gamma dose rate, measured at 1 m from the soil, is 0.05 – 0.31 μSv/h.
The radon exhalation is 15 - 30 Bq/m^3.
Continuous monitoring for water and sediment samples is ensured for the affected surfaces and mine waters.
Two dumps are already partially covered by young forests.
There is completed a study for mine closing out, including works for the restoration of dumps and affected surfaces.
The critical group population is located at about 3 km and 7 km downside the area of this mine, in the Poiana and Sãliste villages, and in the Baita village at about 6 km north of the same mine site.
There is a very low radiological hazard for the inhabitants of the mentioned villages.

After the environment restoration almost all the former dumps will be covered by forests.

- *The mines within the Banat area : Ciudanovita, Lisava, Natra*

These three mines are located a 12 km far from the Oravita town, at elevations between 300 - 1100 m. The exploitation of uranium ores lasted from 1956 to 2002.

- *The Ciudanovita mine*

The mine is without mining activity since 1998. In this area are 7 sterile and low grade dumps, located on slopes, having a height between 3 - 25 m. The dumps have a total volume of 564,500 m^3 on a 82,000 m^2 surface.

Gamma dose rate at 1 m height from the soil has value of 0.10 – 0.60 μSv/h, the highest values being found on areas with low grade material.
The mine waters pumped from underground have uranium concentration between 0.9 – 1.6 mgU/l and radium between 0.1 – 0.4 Bq/l. The flowrate is in average 1000 m^3 / day. All the pumped waters flows through a decontamination plant, where the uranium content is lowered to 0.100 mg/l, and then discharged to the Jitin river. The water samples from this low flowrate river contain 0.020 to 0.029 mgU/l, with highest values in summer, of 0.039 mgU/l. Sediments from the river have a radium content of 44 - 110 Bq/kg dry material.

- *The NATRA mine*

The 2 dumps have a total volume of 223,500 m^3 on a 14,500 m^2 surface and are more than 20 years old.
Gamma dose rate at 1 m height from the soil has values of 0.11 – 0.20 μSv/h.
The mine waters flowing out from an adit have low flowrate, about 3 l/s, and an average uranium content of 0.032 mg/l.
The closing plan foreseen reshaping of these dumps, covering with natural soil and forests.

- *The DOBREI mine*

Within this mine there are 6 dumps having a 1,269,000 m^3 on a 81,800 m^2 surface.
Gamma dose rate at 1 m height from the soil has an average value of 0.25 μSv/h.
Higher values are found for the low grade material at Dobrei South dump, where maximum concentration of 300 gU/t was measured.
Mine waters is pumped from the underground at a daily flowrate of 1,500 m^3 .
A water decontamination plant removes the uranium, the residual concentration in effluents being about 0.100 mgU/l, for mine water having an average of 2 mgU/l.
This plant must work at least 20 years after closing out the mining works and flooding this mine. Dobrei brook is flowing through a concrete tunnel, under the Lisava dump. The Natra brook flows in present through the Natra dump, but it will have a new channel from 2004.

The critical group population is located at about 4 km downside the area of this mine, in the Brãdisor village. At the entrance of the Brãdisor village the water from Lisava river has less than 0.020 mgU/l for the average flowrate of 330 l/s.
There is a very low radiological hazard for the inhabitants of the mentioned villages, as long as the 2 decontamination plants are working.
After the environment restoration almost all the former dumps will be covered by forests.

Mine closing out and environment restoration at the Ciudanovita, Dobrei and Natra mines, Banat county, is high priority project in present.

- *Objective RAPSAG - Caras Severin county*

Within this mine, closed for 30 years, there is 1 dump having a 6,500 m^3 on a 700 m^2 surface and a 9 m height.
Gamma dose rate at 1 m height from the soil has an average value of 0.12 µSv/h.
The environment restoration works will ensure the stability of the dump, concrete walls between the Lisava brook and the dump, covering by forest.
There is no radiological hazard for the inhabitants living in the area.

- *Objective PUZDRA - LESU, Suceava county*

The geological objective is located at 36 km distance from Vatra Dornei town.
There are here 3 sterile rock dumps having a total volume of 95,600 m^3. The largest dump has 78,000 m^3 on a surface of 10,050 m^2 and a height of 15 – 50 m.
The average gamma dose rate, measured at 1 m from the soil, is 0.070 – 0.150 µSv/h. A very low mine water flowrate is present, with an average of 0.3 l/s. Downside the dumps, the waters from brooks have very low U concentration, 0.004 mg/l respectively. The rock samples had only 2 - 30 gU/kg. At the bottom of the main dump, is a natural spring having 1 l/s flowrate.
The surface of Ostra dump is already covered by young trees.
There is no radiological hazard for inhabitants due to these dumps.

- *Objective HOJDA - MAGURA, Suceava county*

This former geological objective is located at 5 km from the Stulpicani village.
There are 2 series of small dumps, having a total volume of 87,000 m^3 on a 15,600 m^2 surface. The height is 10 - 35 m and the G 16 Hojda dump is in contact with a brook on 200 m long.
The average gamma dose rate, measured at 1 m from the soil, is 0.070 – 0.120 µSv/h. For closing out and environment restoration are foreseen works for capping the old adits, reshaping the dumps, protection of the brook's valley, re-vegetation, covering with trees.
There is no radiological hazard for inhabitants due to these dumps.

- *Objective REPEDEA - POIENILE, Maramures county*

This former geological objective is located at 12 km from the Repedea village, the geological activities being ended before 1979.

There are 3 small dumps, having a total volume of 11,250 m^3 on a 2,600 m^2 surface. The height is 3 - 5 m. From one adit a minewater flowrate of 10 l/s was measured in 2002.
The average gamma dose rate, measured at 1 m from the soil, is 0.150 – 0.290 µSv/h. For closing out and environment restoration are foreseen works for capping the old adits, reshaping the dumps, protection of the brook's valley, re-vegetation, covering with trees. Water samples from the Repedea river, downside the old dumps, gave uranium concentration of 0.005 mgU/l. An old forest is all around the former adits and dumps, on both sides of the Repedea valley.
There is no radiological hazard for inhabitants due to these dumps.

- *Objective Venetia Persani, Brasov county*

This former geological objective is located at 2 km from the Venetia de Sus village. There are three sterile dumps having a total volume 14,345 m^3 .
There are no detailed gamma dose measurements made at the surface of these dumps. Few data showed maximum values of 0.120 µSv/h.
Comparing to similar other small geological works, one may consider that the radiological hazard for the inhabitants of the nearest village is very low. However a closing out plan and environment restoration study are foreseen for the 2004 - 2005 period.

- *Objective BARZAVA, Arad county*

The objective is located at about 0.5 km from the Bârzava village. One sterile rock dump having 20,000 m^3, 3,000 m^2 and a maximum height of 13 m is near a former shaft. Some 3000 m^3 of low grade material were removed from this area in 1993.
The gamma dose rate at 1 m from the soil is 0.20 – 0.67 µSv/h. The radon exhalation is 36 - 110 Bq/m^3, compared to 0.12 – 0.15 Bq/m^3 for the background. Water samples taken from the Bârzava river, flowing at 15 m from the old dumps, showed values of 0.008 mgU/l and 0.04 Bq/l Ra. Other samples of drink water presents the same values for uranium and radium.
In order to avoid the radiological contamination by the dust from this dump, urgent covering is necessary.
A closing out plan and environment restoration study were accomplished. Using of the material from dump to cap the shaft and underground works is foreseen, together with reshaping, covering and re-vegetation of the remaining material.
These studies have as aim ensuring no radiological hazard for the inhabitants of the Bârzava village, after completion of the closing and restoration works.

- *The CRUCEA - BOTUSANA mines, Suceava county*

This underground mining site is located at 30 km from Vatra Dornei town.
These mines are exploited from 1983, but mining works having geological purposes were done 10 years earlier.
There 14 sterile rock dumps, 4 being active ones. The total volume is 524,183 m^3 on a 113,636 m^2 surface. The average height of these dumps, located on mountain slopes, is 13 – 40 m. The mining activity of these important mines concerns the

underground uranium ore exploitation, transport on road and by railways of the sorted industrial ore, without processing of these ones.

The gamma dose rate at 1 m from the soil is 0.11- 0.80 μSv/h. Low uranium concentration were measured in these dumps, 3 - 25 gU/t .

The 14 closed dumps are covered by natural vegetation, on 15 - 70 % of their surface. All the surface is delineated and the access for persons is controlled. Two main areas are outlined around the dumps:

- the control area;
- the supervised area.

About 2000 m^3 / day mine water flows outside the adits of these 2 mines. 500 m^3 / day of the most contaminated minewaters flows through a decontamination plant, working on ion exchange basis for uranium removal. Commissioning of a new decontamination plant is foreseen for the second quarter of 2003.

The Bistrita river is the receiver for all waters flowing within the mining area. A monitoring programme allows water analysis for uranium and radium. Measured values are under the allowed limits for drink water.

c) Sterile rock and low radioactive rock dumps resulted from geological research and mining activities for thorium ores production within GEOLEX S.A.

The Jolotca objective is sited at approximately 3 km distance from the village Jolotca.

The mining works were digged for research of rare earth mineralization associated with thorium.

During approximately 40 years, a number of around 40 galleries were digged, most of them of small dimensions.

The works, stopped more than 10 years ago, have produced approximately 40 rock dumps, most of them of small dimensions. From these dumps, only on 4 were found some areas where the dose rate measured at 1 m height was around 2 microSv / h. These dose rates are produced by rocks with a content of maximum 0.02 % thorium. The thorium content in the mine waters is below 0.04 mg/l.

The radiological risk for the critical group is not significant. The approximately 300 m3 of rocks with higher content of thorium will be used for filling the mine shaft.

Article 13. Siting of proposed facilities

13.1. Procedures for safety evaluation, public information and neighbor countries consultancy

i. Site related factors likely to affect the safety of the facility

As mentioned before, any proposed facility needs a siting authorization issued by CNCAN based on Law no.111/1996 (as amended).

Till now CNCAN did not issued the set of regulations regarding radioactive waste management It has to be mentioned that till now, the siting of radioactive waste treatment, conditioning and temporary storage plants was realised according to the

requirements for the siting of NPP or research reactors. This is coherent with the fact that actually, STDR Magurele, STDR Pitesti, LEPI Pitesti are sited at the NPP or reactors site, so the requirements for reactor siting are covering the requirements for radioactive waste management facilities. Also the Fuel Fabrication Plant Pitesti was sited at the TRIGA reactor site.
For the siting of future treatment and conditioning plants, and for surface repositories, the new norms, to be issued till the end of 2004, will be in place.

It has to be mentioned that the siting process for a surface repository of short lived radioactive waste from Cernavoda NPP started in 1992. CNCAN asked that the requirements of 10 CFR Part 61 "Licensing requirements for land disposal of radioactive waste" be observed, with modifications related to dose constraints.
The new regulation regarding siting of near surface repositories, to be issued by CNCAN, intends to endorse the IAEA requirements no. WS-R-1 "Near surface disposal of radioactive waste" and the IAEA safety guides no. 111-G-3.1 "Siting of Near Surface Disposal Facilities" and no. WS-G-1.1 "Safety assessment for near surface disposal of radioactive waste". According to these documents, the site characteristics shall be taken into account in the safety assessment and in the repository design. In determining the site characteristics that are important to the assessment of the site design and safety, the following shall be considered as a minimum: geology, hydrogeology, geochemistry, tectonics and seismicity, surface processes, meteorology, climate and impact of human activities. As the process for siting of the NPP short lived radioactive waste repository is continuing, the Initial Safety Analysis to be submitted as support for the application for siting authorization, shall observe the requirements of IAEA documents.

Also it has to be mentioned that CNCAN already issued in 2002 the Radiological Safety Norms for Radioactive Waste Management from Uranium Mining and Milling. These norms have requirements for siting radioactive waste management of radioactive waste originated from uranium mining and milling activities. It is required to be analysed the characteristic factors related to structural geology, geochemistry, mineralogy, geography and geomorfology, hydrography and hydrogeology of surface and underground waters, climatology, demography and use of land, flora and fauna, archeological aspects and cultural heritage, local population accept. It is stated that the characteristics of the site shall assure the confinement and retention of the radioactive waste.

ii. Safety impact of the facility on individuals, society and environment

The Initial Safety Analysis shall assess the likely safety impact of the repository on individuals, society and environment at any moment in time, till the radioactive waste will decay to a radioactivity that shall not put any significant radiological risk (both for normal and altered scenarious, including intrusion).

Siting process for a new near surface repository

The detaliation of siting activities for the surface repository for NPP short lived radioactive waste is presented below.

Since 1992 an investigation program have been started to select an appropriate site for a future near surface repository for disposal of LILW generated by Cernavoda NPP, both operational and decommissioning waste.
The siting process started with an area survey stage. The region of interest was Dobrogea, a large zone including the NPP site. It is an old historical region with a geological zoning and a semiarid climate, suitable for siting a surface repository. Almost 40 potential sites in Dobrogea region were evaluated. The screening phase reduced the number of candidate sites to two: Cernavoda at 2.5 km from NPP and Saligny situated in the exclusion zone of the power plant.

The criteria for geology, tectonics, seismicity, surface processes and protection of the environment were considered at that stage. IAEA recommendations and its technical support provided to our specialists, enabled us a proper approach of the siting process and assured the suitability of the selected sites.

Even if Cernavoda site seemed to be geologically adequate for a surface repository, social, economical and public acceptance factors prevailed in selection of Saligny site as favorite.
It has been considered that the Saligny site characteristics along with a proper design, waste packages, other engineered barriers and institutional control, would provide radiological protection in compliance with national requirements and taking into account IAEA standards and international recommendations and guidance.

The main geological characteristics of the site according to the investigation done by GEOTEC a geological company is the presence of a deep crystalline fundament consisting of a top layer of silty loess followed by three alternative layers of different qualitative clays.

The area is drained by the Danube river which flows at 10-11 meters above Black See level.

The hydrogeological zoning indicated a large unsaturated zone over the watertable. The site is located in an area with low tectonic and seismic activity.

Relevant data to describe site population, industrial activities, water and land transportation, air traffic, etc., have been developed for the Cernavoda NPP with a component of provisions for a longer period, since such a facility was considered for an institutional control period of 300 years.

Currently, field studies and preliminary safety assessments are performed by companies outside of SNN.

As described within the Project PH4.10/94 “Technical basis and methodological approach for waste acceptance criteria”, the conceptual design of the waste disposal repository involved the following evaluations:

- *The waste characterization*
The anticipated activity concentration of the waste was the first step to be considered during the conceptual design of the disposal site. Based on waste characteristics of

L/ILW resulting from CANDU reactor operation and decommissioning, the fully engineered shallow land disposal concept was selected. At the same time, the necessary specification of the engineered barriers were prepared using as reference design the El Cabril repository.

- The volume of waste and radionuclide inventory to be disposed of
On the basis of waste generation forecasts made by the generators, the quantity of waste packages to be received is used to determine the following:

- the total capacity of the repository: 65,000 m^3;
- the total volume of each type of waste with associated packaging;
- the rate of receipt of packages: 1,500 m^3/year.

To establish the total capacity of the repository, it was considered that Cernavoda NPP will operate five CANDU reactors and volume of decommissioning waste would double the operational waste volume.
The area required for the whole disposal facility with auxiliary installations was evaluated at about 20 hectares. The site should be capable of encompassing this area, around a regular perimeter. The operating period of the repository (including NPP decommissioning) was determined to be 60 years.
The total radioactive inventory estimation was based on literature data measured in other similar CANDU - 6 plants. The value should be confirmed after implementation of a characterization program of raw wastes at Cernavoda NPP.
The safety - critical radionuclides for Saligny repository are H-3 and C-14.

- The expected lifetime of the repository
The lifetime of the disposal facility was set as 10 times the half-life of the major radionuclides present in the wastes, i. e. 10 $\times$ 30 years = 300 years. All the engineered structures (the barriers, the cover cap and the water collection system) are designed for a lifetime not less than 300 years.

- The disposal concept
The disposal concept is based on the “zero-release” principle by using a water collection system that prevent contamination of the aquifer, at least during the institutional control period of 300 years.

iii. Public consultancy

When selecting a site, the future licensee has to consult the public. The Environment Agreement is issued by the Environmental Protection Authority, after analyse of the Environmental Impact Study. Public consultancy of this study is required, and the decision for issuing the Environment Agreement takes into account the opinion of the members of the public. The Environment Agreement is a prerequisite for issuing by CNCAN of the Construction Authorization. In fact, public consultancy starts at earlier stage, when the prefesability study is presented to the Environmental Protection Authority.

The above mentioned consultancy process is done based on the transposition of the Directive 85/337/EEC on Environmental Impact Assessment, amended by the Directive 97/11/EC. The transposition is realized through the Emergency Government Ordinance no. 91/2002 amending the Law no. 137/1995 on

Environmental Protection, the Government Decision 918/2002, and the Orders of the Minister of Waters and Environment Protection no. 860/2002 and no. 863/2002.

iv. Consultancy of Contracting Parties in the vicinity of the radioactive waste management facilities

Romania has ratified the ESPOO Convention. Consequently, any country (not only a Contracting Part), that could be affected by a radioactive waste management facility sited on Romanian territory will be announced, and will receive, upon request, the general data relating to the facility to enable it to evaluate the likely safety impact of that facility upon its territory.

13.2. Avoidance of unacceptable effects on Contracting Parties in the vicinity of the radioactive waste management facilities

The Initial Safety Analysis, as well as the latter Preliminary Safety Report and Final Safety Report, for any new nuclear facility (not only for radioactive waste management facilities) shall prove that the national requirements, which are in line with the internationally endorsed criteria and standards, are met for individuals, society and environment, at the same level for national territory and for neighbor countries.

This requirement is obviously fulfilled for radioactive waste handling and storage facilities. Also, for surface repositories for short lived radioactive waste, it is relatively easy to demonstrate the fulfillment of the requirement. When siting a radioactive waste geological repository, due consideration will be given to the assessment of the impact on neighbor countries.

Article 14. Design and construction of facilities

The design and construction of a radioactive waste management facility at NPPs and research reactors is part of the design and construction of the plants, respectively of the reactors. As all of the requirements of Article 14 of the Joint Convention are required by the Romanian legislation for all nuclear installations, the authorization of construction of a NPP or radioactive waste management facility is granted by CNCAN only if, inter alia:
i. the design and construction of the spent fuel handling and storage system provide for suitable measures to limit possible radiological impacts on individuals, society and environment;
ii. at the design stage, conceptual plans and, if necessary, technical provisions for the decommissioning of radioactive waste management facility other than a disposal facility are taken into account;
iii. at the design stage, technical provisions for the closure of a disposal facility are prepared;
iv. the technologies incorporated in the design and construction of spent fuel management facility are supported by experience, testing or analysis.

For NPP Cernavoda Unit 2, the construction was stopped in 1990, and the construction remained under conservation. The restart of the construction was decided in 2001.
It has to be mentioned that the radioactive waste management systems of Cernavoda NPP Units 1 and 2 were designed to meet adequate safety standards used in Canada and in other six countries.

As it was presented in the paragraph related to article 13 on siting of proposed facilities, for the construction of the future NPP short lived radioactive waste surface repository, a Romanian regulation will be in place, transposing the IAEA requirements no. WS-R-1 “Near surface disposal of radioactive waste” and the IAEA safety guides no. 111-G-3.1 “Siting of Near Surface Disposal Facilities” and no. WS-G-1.1 “Safety assessment for near surface disposal of radioactive waste”. The Joint Convention obligations presented in Article 14 will be fulfilled also for the associated treatment plant, as the IAEA requirements no. WS-R-2 “Predisposal management of radioactive waste, including decommissioning” will be also transposed in a Romanian regulation.

Regarding the construction of a radioactive waste management facility for waste originated from uranium mining and milling, it has to be mentioned that the recently issued regulation “Radiological Safety Norms for Radioactive Waste Management from Uranium Mining and Milling” has a chapter with requirements related to design and construction, covering the requirements of the Joint Convention.

In conclusion, as it was previously explained, the construction authorization for any radioactive waste management facility will be granted by CNCAN based on the Preliminary Safety Report, that shall demonstrate, inter alia, the fulfillment of the requirements of the Joint Convention presented in Article 14.

Article 15. Assessment of safety of facilities

i. Initial safety assessment

According to the Romanian laws and regulations, for sitting a nuclear facility, including a radioactive waste management facility, a siting authorization shall be issued by CNCAN. This authorization is issued based on a Initial Safety Analysis, as it was presented in the paragraph related to article 13.

As an example, CNCAN requirements regarding the Initial Safety Analysis related to the repository and the associated treatment and conditioning plant for NPP radioactive waste are presented below.
a) It is not solved the problem of organic liquid wastes (and, also, for the flammable solid wastes) which could result from Cernavoda NPP operation. It is necessary to establish the solution for the treatment of these wastes and to present the support documents in order to demonstrate the applicability of the solution proposed (in accordance with international experience).

b) The document does not specify anything about the hazardous conventional waste (e.g. PCB, heavy metals, so on), and about the wastes which is no possible to be included in cement.
c) In Chapter 2, "Waste characteristics", there are no information about all long-lived radionuclides (e.g. Nb-94, Zr-93). For all radionuclides to be disposed it is necessary to present the maximum values for their total activity and specific activity, according to an appropriate criterion. The above requested values must be in accordance with the international values for this kind of repositories, especially according with the recommendation of US NRC Standards. Also, it is necessary to demonstrate that the declared values for radionuclide activities are in accordance with real waste composition from Cernavoda NPP operation and decommissioning.

d) In Chapter 2 also, there are incomplete assertions and errors about Pu and C-14.

e) It is necessary, also, to make a general presentation of all options taken into account to choose the site, specifying the motivation of the solution chosen (considered as optimal solution).

f) In Chapter 3, "Site Description", in geological description of site, we have following comments:

f1) There are no data about the dynamic of aquifers (no hydrodynamic model). Generally speaking, it is necessary to present or to complete the data about hydrogeology, geochemistry and geomorphology.

f2) There are no sufficient data about the presence of aquifer in the D horizon of geological strata (in accordance with the presence of sandy lens from D horizon).

f3) The irrigation water is no taken into account (it could have important effects).

f4) There is no reference about the local variation of geological strata (position, location). These variations could be unfavorable for environmental radionuclide dispersion. Also, it is necessary to mention the measures to minimize this unfavorable effect.

f5) In the section of radionuclide migration in the environment, the evaporation-perspiration process is no mentioned.

f6) In the section of radionuclides migration in the environment, there are no data about the migration of other interim and long lived radionuclides like C, Cs, Nb, Pu, Sr, Zr, their migration characteristics, and their entrance in trophic chains (there is presented only one diagram for tritium). Also, for tritium, there are no data on its entrance in the trophic chain.

f7) The main geological barrier, C horizon, has 5 m thickness, (including some layers of gravel). It is necessary to explain more detailed the follows:

- how is assured the function of barrier for other 60 m of geological strata, which is considered also as a barrier; the existing explanations in the Preliminary Safety Analysis must be completed. It is also necessary to ascertain that it does not exist water communication between sandy lens or if not possible, to exclude this supposition.

- furthermore, if C horizon is a barrier, it must isolate an aquifer, but the aquifer doesn't exist (or it is not presented).

f8) Because the host rock of repository (dirty loess) is favorable of subsidence, it is necessary to demonstrate the choose of the solution of compacted loess (with additives), against red clay, like montmorillonit.

f9) The document doesn't specify the loading and discharge for all aquifers.

g) About seismic design data, it is necessary to specify the signification of the two design earthquakes (maximum and extremal) from point of view of conditions which must be met by the components of the repository, taking into account the differences existing between a NPP and a repository (the duration for the required barrier function of the repository is higher for the repository, and after an extremal earthquake the barrier function shall be maintained, while a NPP is supposed to be shut down.

h) It does not exist a chapter with external events (man induced events) and the actions to be performed in order to mitigate their effect. It is necessary to specify and to demonstrate all the evaluations about the safety distance between the Final Repository and external event location, and to present the approval for the restrictions granted by railway company, fire authority and local authorities.

i) In the chapter 4, the description of the Waste Treatment Station is not correct, because it does not consider the treatment of liquid wastes and of burnable wastes.

j) Seismic Qualification of buildings and installations (both for Treatment Station and Final Repository) is not specified (including drainage system qualification).

k) The fire protection measures are not specified (the presence of burnable and hazardous waste shall be considered).

l) The description of drainage networks both for Treatment Station and Final Repository must be clarified. The description shall be coherent and shall contain all the drainage networks, their function, monitoring possibilities, discharge pathway. Especially, it is necessary to clarify the management for all liquid wastes (including secondary wastes from Treatment Station and infiltration water collected from disposal vaults), for all the life stages of the Final Repository. We mention that the free discharge of liquid wastes into environment is not acceptable. It is necessary to have a special chapter to demonstrate the observance of limit values for liquid effluent discharge. These values must be in accordance with national limits and with the constraints established by the Regulatory Body for doses for the critical group. These constraints will be: an individual dose of 0.05 mSv/year, for a person of the critical group (in the case of Waste Treatment Station operation), and 0.01-0.02 mSv/year, for institutional control period of the Repository.

Review and completion by SNN of the initial safety assessment report in order to comply with CNCAN's conditions and requirements was considered at that time to be available only after additional site and technical studies would be elaborated.

As it was presented in the paragraphs related to articles 13 and 14, before construction of any nuclear facility, including a radioactive waste management facility, an environmental agreement issued by the Environmental Protection Authority and a construction authorization issued by CNCAN are required. The environmental agreement is issued based on an Environmental Impact Study while the authorization is issued on the basis of a Preliminary Safety Report.

ii. Updated and detailed safety assessment

According to the Romanian laws and regulations, for issuing by CNCAN of a commissioning authorization for a nuclear facility, including a radioactive waste management facility, a Final Safety Report is required, while for issuing by CNCAN of an operation authorization, a revised Final Safety Report is required. These requirements will be presented in the paragraph on article 16.

Operation requires also the issuing by the Environmental Protection Authority of an operating authorization. This last authorization is issued after starting of the operation, based on Environmental Report, that includes measurements of environmental parameters.
The operating authorizations are issued by CNCAN and by the Environmental Protection Authority for a limited period of time and have to be renewed periodically. That requires the update of supporting safety and environmental assessments.

Systematic impact assessment according to internationally recognized criteria and standards are required for completion of the Environmental Impact Study and of the Environmental Report.

The Initial Safety Analysis, Preliminary Safety Report, Final Safety Reports and their supporting documents are containing systematic assessment of the nuclear safety and of the environmental impact, in accordance with the internationally accepted criteria and standards. This is obviously the case for the spent fuel facilities inside the NPP or reactors, where the safety of the handling and storage of spent fuel are assessed in the general context of the safety of the entire facility.

For NPP radioactive waste management systems, the Initial Safety Analysis, of Preliminary Safety Report and the Final Safety Report are realised for the whole facility.

As it was presented in the paragraphs related to articles 13 and 14, the content of Initial Safety Analysis and of Preliminary Safety Report for future radioactive waste management facilities will reflect the content of IAEA requirements and guides. The same is true for the Final Safety Report.

Requirements related to the content of the radioactive waste management facilities from uranium mining and milling are included in the “Radiological Safety Norms for Radioactive Waste Management from Uranium Mining and Milling”.

For the case of existing radioactive facilities STDR Magurele, STDR Pitesti and LEPI Pitesti, periodical review of the safety assessment of the facilities are required. In fact the LEPI Final Safety Report is under revision. A revised safety report will be required soon for STDR Magurele will be soon required by CNCAN for STDR Magurele, in order to establish refurbishment measures.

For DNDR Baita Bihor, it has to be mentioned that the siting and construction authorization, as well as the latter operation authorization were issued based on a documentation that was not at the level required by the new IAEA regulations. CNCAN required IFIN-HH to perform a new Initial Safety Analysis, that was submitted in 2002. A Preliminary Safety Report will follow before the end of 2004, to establish the construction improvements and higher activity concentration limits. At a latter stage a Final Safety Report will be submitted to CNCAN.

Article 16. Operation of facilities

i. Licensing

The radioactive waste management systems operated by CNE-PROD Cernavoda are nuclear power plant systems. The Cernavoda NPP operation was licensed by CNCAN following the legal procedure and based on appropriate assessment of safety. All safety analyses to support the four-formal licensing stages (site license, construction license, commissioning license and operating license) were performed as parts of the safety analyses for U1.
The Operating License was issued on the basis of a Final Safety Report (F.S.R.) - Phase II, including two successive steps:

- Probationary operating license;
- Operating license.

The Probationary Operating License is issued based on the revised FSR, which includes the commissioning test and control program results. For Cernavoda NPP, Unit 1 specifically, the probationary operating license was issued based on the Final Safety Report which was structured in accordance with the provisions of the NRC Regulatory Guide 1.70.

The Operating License was finally issued based on the revised FSR, which contains amendments derived from the results and conclusions of the probationary operating period.
Every 2 years the operation authorisation is renewed, and appropriate assessments are requested in support of the application for issuing of the new authorization.

For any radioactive waste management facility the authorization to operate the facility is based on the Final Safety Report and is conditional on the completion of the commissioning programme demonstrating that the facility, as constructed, is consistent with design and safety requirements.

ii. Operational limits and conditions

CNE-PROD Cernavoda issued under CNCAN approval, the reference document "OPERATING POLICIES AND PRINCIPLES". This document describes how the utility operates, maintains and modifies the safety-related systems in order to maintain the nuclear safety margins and consequential risk to the public acceptably low. This document defines the specific operating limits for safety related systems, which must be maintained all the time to ensure that the plant always operates within its analysed operating envelope. Other key boundaries for operation of radioactive waste management systems are included in their Operating Manuals.
The safety 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.

A nuclear safety requirement is to operate and maintain the radioactive waste management systems within a defined "safe operating envelope" in accordance with the design intent and the licensing basis.

The "safe operating envelope" is defined by a number of safe operation requirements from which the most important are:

- Requirements on safety related systems or functions, e.g. set point or other parameter 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 safety related systems or their stand-by equipment from service.

The technical basis for the safe operating envelope are found in the Final Safety Report which includes the description of the safety analysis that examines the facility response to disturbances in process function, system failures, component failure or human errors. Safety analyses predicts the consequences of the design basis accidents and compare them with the regulatory requirements.

In addition a set of nuclear safety topics are integrated into the assembly of the measures by which the station performance is to be judged. Safety performance shall be assessed against the safety-related topics. Where discrepancies are met, corrective actions shall be implemented.

For FCN Pitesti, STDR Pitesti, LEPI facility, STDR Magurele and DNDR Baita Bihor, technical (operational) limits and conditions are established, based on assessments, tests and operational experience. For DNDR Baita Bihor the limits and conditions include that waste acceptance criteria.
The technical limits and conditions are revised as necessary.

iii. Operation, maintenance, monitoring, inspection and testing

As parts of CNE-PROD NPP, the radioactive waste management systems' operation, maintenance, monitoring, inspection and testing activities are performed

according to Station regulations: Operating Policies and Principles, Maintenance Philosophy, Quality Assurance 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.
As these documents are sustaining the operating license, the compliance with their requirements is mandatory for the Station and any deviation must be reported to CNCAN.

As an example is presented the Cernavoda NPP radioactive waste systems' monitoring programs, which are part of NPP monitoring program

The Solid Radioactive Waste Interim Storage Facility monitoring program includes:

- Ground water sampling for beta-gamma and tritium activities
- Atmospheric radiation surveys including air samples and gamma dose rate at the site boundary
- Contamination surveys of the entire site and structures
- Structures watertight surveys surface run-off analyses for beta-gamma and tritium activities

Status of constructions during operations is monitored as follows:

- by current observations, visualizing the general status of the three concrete structures;
- by special observations performed precision measurements on fixed points with the intent of survey external platform and buildings status;

Monitoring of radioactive organic liquids waste storage spaces is performed by means of gamma monitoring systems and monitoring of air contamination in accordance with radiation protection procedures.
Monitoring of spent resins storage vaults, as well as detection of excessive radiation levels in the room located in the neighborhood of the vaults is performed by means of gamma monitoring systems and monitoring of air contamination.

Similar requirements does exist for FCN Pitesti, LEPI and STDR Pitesti, STDR Magurele, DNDR Baita Bihor.

iv. Engineering and technical support

The station organisation chart for CNE-PROD Cernavoda NPP documents the general areas of responsibility. The structure of the organisation considers the needs for engineering and technical supports and for this reason it includes a strong Technical Unit covering System Performance Monitoring, Design Engineering and Safety & Compliance.
Also, it should be mentioned that a strong link is maintained with Romanian research institutes and with designer of the plant, Atomic Energy Canada Limited, Romania being member of CANDU Owners Group.
FCN Pitesti, SCN Pitesti and IFIN-HH consider also needs for engineering and technical supports. Their organizational chart include also staff for operation,

maintenance, monitoring, inspection and testing of radioactive waste management facilities.

v. Procedures for characterization and segregation of radioactive waste

As it was presented in a previous paragraph of the section B "Policies and Practices" the radioactive waste are categorized and segregated at all radioactive waste management facilities. It shall be mentioned that at STDR Magurele and STDR Pitesti all radioactive waste conditioned packages are measured to comply with waste acceptance criteria at Baita Bihor. At NPP Cernavoda, based on origin, a radionuclide composition matrix is assigned for radioactive wastes. Special requirements for more detailed radioactive waste characterization and activity measurements were formulated by CNCAN. This process is required also in support for the Initial Safety Analysis for the siting of the future NPP short lived radioactive waste repository.

vi. Incidents reporting to CNCAN

Incidents significant to safety are reported in a timely manner by the holder of the authorization to the regulatory body, according to established procedures. These reports and procedures are requested by CNCAN according to authorization conditions.

CNE PROD has to submit to the regulatory body the following types of reports:

- Abnormal Condition Reports are prepared to report those events that could have significant adverse impact on the safety of the environment, the public or the personnel, such as: serious process failures, violations of the Operating Policies and Principles, release of radioactive materials in excess of targets, doses of radiation which exceed the regulatory limits, events which interfere with the IAEA safeguards system.

For each reportable event a notification is made to the CNCAN immediately after the discovery of the reportable event or within one working day depending on the gravity of the event and a report is prepared to document the event. For the events that are significant or complex, more detailed reports are prepared as Abnormal Condition Reports and submitted to CNCAN within the required time period.

- Quarterly reports are to be prepared to provide information regarding the safety systems reliability performance, dose statistics and radioactive emission, 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 result of the chemistry control, radiation control, a review of the emergency planning a reactor core safety assessment, etc.
- Safety report updates should analyse the design and procedural changes and include the new safety analysis. These updates should be submitted to CNCAN each two years from the last update, excepting the case when CNCAN takes an other decision.
- Annual radiological environment monitoring reports are to be prepared to provide information on the off-site radiological environmental monitoring program, the individual doses that are calculated as doses to critical group, a review of the

radiological environmental monitoring quality assurance program, and any unusual event during the calendar year.

- Annual research and development reports should describe the planned research and development programs that address the unresolved safety questions.
- Periodic inspection reports are to be prepared to describe the results of any subject inspections in compliance with applicable standards.
- Annual reliability reports should include an evaluation of systems that has specific reliability requirements given in the licensing documentation. A review of updated documents should be provided with the focus on the design changes and their impact on the analysis results.

Similar reporting systems are established in the authorization conditions and are precised in internal procedures of the licensee, in the case of FCN Pitesti, SCN Pitesti and of IFIN-HH.

vii. Collection and analyze of relevant operating experience

For Cernavoda NPP the station goal for operating experience is to effectively and efficiently use lessons learned from other plants and station operating experience to improve plant safety and reliability.
Station events and human performance problems often result from weaknesses or breakdowns in station processes, practices, procedures, training and system or component design that were not previously recognized or corrected. This is the reason why Cernavoda NPP consider, as the main topic of the Operating Experience Program, 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 external information regarding 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 organizations.

The basis for Operating Experience Program was set in place since the early stage of the commissioning phase (1993), with the objective to ensure:

- the reporting, reviewing, assessing of the station abnormal conditions and establishing of the necessary corrective actions;
- information exchange within CANDU Owner Group (COG), regarding abnormal conditions, technical problems, research and development projects, etc.

As a result, all the activities related to this topic were assigned to a new structure, an Operating Experience Group was created, and the program based on the ASSET philosophy "*prevention of incidents - the path to excellence operational safety*" is now developed in an integrated and centralized manner.

For this reason, the abnormal conditions assessment programs includes low level events analysis as precursors of the major events. The new created group together with technical unit's specialist's analyses, using ASSET methodology, the external and internal abnormal conditions, and proposes to the station management an action plan, to improve the plant safety and to avoid the events reoccurrence.
For the information exchange program, a COG (CANDU Owner Group) contact officer, appointed by the station management, with the following general responsibilities covers the relation between CERNAVODA NPP and COG:

- serving as a liaison between COG and the station;
- reviewing the incoming messages and distributing them to the appropriate persons;
- ensuring the transmittal of the required information/reports to COG;
- ensuring optimum participation by the station personnel.

Programs to collect and analyse relevant operating experience are in place also at FCN Pitesti, SCN Pitesti and IFIN-HH.

viii. Decommissioning plans for radioactive waste management facilities

According to the provisions of Law no.111/1996 (as amended) any nuclear installation needs to prepare decommissioning plans. This is valid also for the radioactive management facilities, other than repository. The new Norms for Decommissioning of Nuclear Objectives and Installations require that for any radioactive waste treatment and conditioning facility, as well as for any radioactive waste intermediate storage, decommissioning plans be prepared and updated.

ix. Plans for closure of disposal facilities

Till now there were not issued the specific norms for repositories, except the "Radiological Safety Norms for Radioactive Waste Management from Uranium Mining and Milling" that have provisions regarding the closure of the waste management facilities for uranium mining and milling. The new norms will include requirements related to plans for closure of disposal facilities, from the design and construction stage.

Article 17. Institutional measures after closure

As presented above, except the closure of uranium mining and milling repositories, for other repositories there are not yet issued specific norms. However the authorization process for siting of the new surface repository requires demonstration of the post closure evolution of the repository. The new regulation for radioactive waste short lived repositories will require, inter alia, that:

i. records of location, design and inventory of the repository be preserved;
ii. active or passive institutional controls such as monitoring or access restrictions are carried out;
iii. in case of unplanned release during institutional control period, intervention measures be implemented, if necessary.

It has to be mentioned that for the uranium mining and milling repositories, such requirements are already implemented by the new "Radiological Safety Norms for Radioactive Waste Management from Uranium Mining and Milling".

SECTION I. TRANSBOUNDARY MOVEMENT

Article 27. Transboundary movement

27.1. Steps to ensure that transboundary movements are undertaken in a manner consistent with the Joint Convention and binding international instruments:

i. Authorization of transboundary movement

According to Law no. 111/1996 (as amended), import, export, and transit of radioactive materials, including spent fuel and radioactive waste, shall be authorized by CNCAN. It shall be noted that according to the above mentioned law, the import of radioactive waste (including of spent fuel, as Romania considers spent fuel to be radioactive waste) is prohibited. The only exception is when the import follows directly from the processing outside Romanian territory, of a previously authorised export of radioactive waste (including spent fuel), on the basis of the provisions of international agreements or of contracts concluded with commercial partners, under the terms of Law no. 111/1996 (as amended).

According to the Romanian Norms for Transport of Radioactive Material – Authorization Procedures, the international shipment of radioactive materials can be performed only if the carrier possess a transport authorization issued by CNCAN, and the carrier or consignor possess a shipment authorization issued by CNCAN for that particular shipment.

Supplementary, for the shipment of radioactive waste, the Norms for International Shipments of Radioactive Wastes Involving Romanian Territory are also applicable. These norms are transposing the Council Directive 92/3/EURATOM on shipment of radioactive waste between Member States and into and out of the Community.

By the conditions stated in the authorization, CNCAN asks to be notified before the entry on Romanian territory of radioactive materials, including radioactive waste. For spent fuel transport special requirements for notification are in place as escort and emergency planning special arrangements are required. The transit or export can actually be conducted only if the licensee has all the authorizations from the countries involved, including of the country of destination.

ii. Subject of transit to relevant international obligations

As stated above in general for the transboundary movement, the transit on Romanian territory of radioactive waste and spent fuel is subjected to Romanian regulations, that are endorsing the IAEA regulation and international modal regulations (Fundamental Norms for Safe Transport of Radioactive Materials are endorsing IAEA TR-S-1 regulation, except that the authorization requirements, presented in the Norms for Transport of Radioactive Material – Authorization Procedures, are more stringent). It has to be noted that in Romania the modal regulations for transport of dangerous goods (RID, ADR, ICAO, IMDG) are in force.

As it was explained above, all international shipments of spent fuel/radioactive waste involving Romanian territory needs to be authorized by CNCAN. Also the transport package for fissile materials, and the Type B (U) or B (M) packages need to receive Romanian validation of type approval. Supplementary, the transporter needs a general practice authorization, covering also the transport (specially dedicated) vehicle. Insurance up to maximum level stated in Paris Convention on Third Part Liability in the field of Nuclear Energy, and Brussels Convention Supplementary to the Paris Convention, and arrangements for technical intervention following an accident are prerequisites for granting the Romanian shipment authorization for spent fuel.
In the authorization process, conditions are stated for presenting all the authorizations of the countries involved in the transport, and for harmonization of emergency plans and of escort arrangements of the countries involved in transport of spent fuel.

iii. Consent of transboundary movement by the State of destination

As presented above Romania does not allow the import of radioactive waste or spent fuel, so the requirement related to acceptance by the State of destination of the transboundary movement only if it has the administrative and technical capacity, as well as the regulatory structure, needed to manage the spent fuel or radioactive waste in a manner consistent with the convention is not applicable.

iv. Authorization of transboundary movement by the State of origin

According to the provisions of the Norms for International Shipments of Radioactive Wastes Involving Romanian Territory, CNCAN shall not authorize radioactive waste shipments to a country which, in the opinion of CNCAN, does not have the technical, legal or administrative resources to manage radioactive waste safely.
As Romania considers spent fuel to be radioactive waste, the requirement is applicable also for spent fuel.

v. Re-entry into the territory of the country of origin in case the transboundary movement is not or cannot be completed in accordance with safety requirements

According to the provisions of the Norms for International Shipments of Radioactive Wastes Involving Romanian Territory, when an international shipment of radioactive materials (or spent fuel) cannot be performed, or the shipment does not fulfill the requirements imposed for the authorization (approval) of the shipment, the radioactive material (spent fuel) shall be returned to the initial holder.

27.2. Shipment of spent fuel or radioactive waste to a destination south to latitude 60º South for storage or disposal

According to the provisions of the Norms for International Shipments of Radioactive Wastes Involving Romanian Territory, CNCAN shall not authorize radioactive waste shipments to a destination south of latitude 60º south.

As Romania considers spent fuel to be radioactive waste, the requirement is applicable also for spent fuel.

27.3. Rights of contracting parties

As presented before, Romania has a legislative framework in accordance with international agreements and recommendations.

i. The Romanian transport regulations do not affect the exercise by ships and aircrafts of foreign countries, of maritime, river and air navigation rights and freedoms, as provided by international law.

ii. As presented above, import of radioactive waste shall be allowed, when the import follows directly from the processing outside Romanian territory, of a previously authorised export of radioactive waste, on the basis of the provisions of international agreements or of contracts concluded with commercial partners, under the terms of Law no. 111/1996 (as amended).

iii. At this moment, Romania does not intend to export spent fuel for reprocessing. However, the Law no. 111/1996 (as amended) establishes that this is allowed.

iv. If export of spent fuel for reprocessing will be performed, the radioactive waste and other products resulting from reprocessing will be allowed to be returned, according to the provisions of the Law no. 111/1996 (as amended), presented above.

SECTION J. DISUSED SEALED SOURCES

Article 28. Disused sealed sources

28.1. Safe possession, remanufacturing or disposal of disused sealed sources

According to Romanian regulations, the radiation practices, including those involving sealed sources, shall be authorized. Excepted practices involve very low activity sources in consumer products, e. g. ^{241}Am smoke detectors of 1 µCi. According to Radiological Safety Fundamental Norms, even these excepted sources are required to be disposed as radioactive waste.

The authorization of a practice does include the list of radiological installations, and the list of sealed sources contained in these installations. Actually only the sources with half lives greater than one year are recorded. For the sources with shorter half lives, the internal system of recording of the transfer of the sources kept by the licensee and by the company which take the source for replacement, allows CNCAN to keep control of movement. For the sources with longer half lives, the transfer of the sources (used or not) requires modification of the authorization of the previous holder. If the radiological installations and/or the radioactive sources with half lives greater than one year are transferred to a new holder of authorization, a transfer authorization is also required.

The transfer of sources for remanufacturing is also performed according the above mentioned requirements.
The transfer of sources for treatment, conditioning and long term storage or disposal is performed according to the same requirements presented above, except the fact that a transfer authorization for the sources is not required. In this case, the sources are transferred to STDR of IFIN-HH Magurele. STDR has procedures for receiving the sources and for keeping records. Of course, if the source was recorded in the authorization of the user (i.e. the source has a half-live longer than one year), or if the source is transferred to STDR together with the radiological installation, the modification of the authorization of the previous holder is necessary.

Generally, CNCAN requires that the sources that are no longer used, be transferred to STDR Magurele, or to another user, if they are still able to be used.

The storage of the disused sources is inspected by CNCAN, and if the conditions are not acceptable, CNCAN can take actions to enforce observance of regulations. This is done also at STDR Magurele, where corrective action were recently required by CNCAN for the conditions of long term storage of long lived sealed sources, and for the speeding of the treatment and disposal process for the other sources collected at STDR Magurele.

28.2. Reentry into the territory of Contracting Party of disused sealed sources

As presented before, according to Law no. 111/1996 (as amended), Romania does not allow the import of radioactive waste, i.e. reentry on Romanian territory of disused sealed sources is not allowed.

SECTION K. PLANNED ACTIVITIES TO IMPROVE SAFETY

1. As presented in the section B “Policies and Practices”, a main issue is the set up of the National Agency for Radioactive Waste (ANDRAD) as a competent authority for coordination, at national level, of the safe management of spent fuel and radioactive waste.
The Governmental Ordinance no. 11/2003, now discussed by the Parliament for approval, establishes the attributes of ANDRAD and the responsibilities of the radioactive waste producers. After the setting up of ANDRAD, this agency shall establish the strategy for the spent fuel management and for radioactive waste management, including their final disposal.

2. Also a main issue is the establishing of the Fund for Radioactive Waste Management and for Decommissioning, in order to assure financial resources for spent fuel and radioactive waste management.

3. In order to improve safety of radioactive waste management ANDRAD shall establish and update the Yearly Activity Plan. Main issues to be addressed at this moment are:

a) The refurbishment of the Radioactive Waste Treatment Plant (STDR) Magurele and the establishing of technologies for long term storage of long lived radioactive waste, especially for long lived spent sealed sources. It has to be mentioned that an EC project for the investigation of STDR Magurele was performed in 2000. However, due to ageing, the liquid treatment installation needs at this moment major replacements of equipment and pipes, that were not recommended in the previous project.

b) The realization of the Preliminary Safety Report, followed by the upgrading of the Baita Bihor short lived radioactive waste repository. An Initial Safety Analysis for Baita Bihor repository was performed in 2002, based on the results of a Phare project entitled Preparatory Measures for the Long Term Safety Assessment of the Low-Level Radioactive Waste Repository Baita-Bihor. At this moment a PHARE project, continuing the previous one is undergoing. The project, entitled Preliminary Safety Analysis Report for Low –Level Radioactive Waste Repository Baita Bihor. The project purpose is the performance of the Preliminary Safety Analysis and the drawing up of a report under international expertise. Another purpose is the adaptation of existing western methodology and knowledge on safety assessment of radioactive waste repositories to Romanian case, and to transfer them to Romanian specialists involved ion performing the safety assessment.

c) Another safety issue is the decommissioning of the VVR-S research reactor Magurele, to be realized to stage 2. In order to assist this decommissioning, the IAEA project ROM/4/024 “Strengthening the Infrastructure for the Decommissioning of the Research Reactor at Magurele-Bucharest” is undergoing. Also cooperation with US DOE is started in order to establish a set of projects related to Magurele reactor decommissioning and to the management of spent fuel at this reactor.

d) Regarding the spent fuel, the main issue is related to the corrosion of the old Aluminum cladded spent fuel of VVR-S reactor Magurele. Romania hopes to get assistance through the regional co-operation project, RER/9/058 "Safety Review of Research Reactor Facilities" for returning in Russian Federation the spent fuel of Magurele reactor.

e) Finalising the Initial Safety Analysis for siting the new surface repository for Cernavoda short lived radioactive waste is also necessary. The issue of siting a surface repository for radioactive waste will be however reconsidered by the strategy to be elaborated by ANDRAD.

f) Closure of the first part of Cetatuia II tailing pond of the Uranium Milling Plant of the Feldioara Subsidiary of the National Uranium Company is also an issue to be addressed in the future. The solving of this issues shall require important financial resources.

g) Rehabilitation of the sites with sterile rock and low radioactive rock dumps resulted from geological research and mining activities for uranium ores production within the National Uranium Company shall be assessed and performed under intervention principles.

SECTION L. ANNEXES

a) List of Spent Fuel Management facilities

a1) List of Nuclearelectrica spent fuel management facilities

- CNE - PROD Cernavoda - Spent Fuel Bay
- CNE-PROD Cernavoda – Interim Spent Fuel Dry Storage

a2) List of SCN Pitesti spent fuel management facilities

- The Spent Fuel Storage Pool;
- The Dry Storage Pits.

a3) List of IFIN-HH spent fuel management facilities

- The Spent Fuel Cooling Pool;
- The Spend Fuel Storage Pools.

b) List of Radioactive Waste Management Facilities

b1) List of Nuclearelectrica radioactive waste management facilities

- CNE-PROD Cernavoda – Solid Radioactive Waste Interim Storage
- CNE-PROD Cernavoda - Spent Resins Handling System
- CNE-PROD Gaseous Radioactive Waste System
- CNE-PROD Liquid Radioactive Waste System
- Nuclear Fuel Plant Gaseous Radioactive Waste System
- Nuclear Fuel Plant - Liquid Waste Temporary Storage Tanks
- Nuclear Fuel Plant – Temporary Storage Platform for Low Contaminated Solid Waste

b2) List of SCN Pitesti radioactive waste management facilities

- Radioactive Waste Treatment Plant
- Post Irradiation Examination Facility

b3) List of IFIN-HH radioactive waste management facilities

- Radioactive Waste Treatment Plant
- National Repository for Low and Intermediate Level Wastes Baita - Bihor

c) List of nuclear facilities in process of being decommissioned

- VVR-S research reactor of IFIN-HH Magurele

d) Inventory of spent fuel

d1) Cernavoda NPP –Unit 1 spent fuel inventory

Year/Month	Type	Number of fuel bundles	Mass (kg U)
2002/October	CANDU-37 elements	29 360	551 475

d2) SCN Pitesti spent fuel inventory

The TRIGA storage pool contains:
- 106 TRIGA – HEU - type elements,
- 1 TRIGA – LEU - type element,
- 3 CANDU - type bundles,
- 1 CANDU - type experimental element.

The storage pits at the LEPI hot cell includes:
- approximately 20.77 kg uranium in LEU spent fuel elements and fragments, including approx. 0.1 kg unirradiated fuel,
- approximately 0.321 kg uranium in HEU spent fuel and fragments, including a few grams of unirradiated fuel,
- approximately 5.32 kg natural uranium in spent fuel elements and fragments, including 0.128 kg unirradiated natural uranium.

d3) IFIN – HH spent fuel inventory

The total inventory of spent fuel in storage pools and cooling pool of IFIN-HH consists in:
- 153 EK-10 type assemblies (10% initial enrichment) containing in total approximately 195.84 kg uranium
- 70 S-36 type assemblies (36% initial enrichment) containing in total approximately 27.09 kg uranium.

e) Inventory of radioactive waste

e1) CNE-PROD (Cernavoda NPP–Unit 1) radioactive waste inventory

e1.1) Solid radioactive waste volumes segregated as compactable and non – compactable.

Cernavoda NPP. Compactable and non-compactable solid radioactive waste volumes generated between 1996-2002.

Year	Solid radioactive waste			
	Compactable (m^3)	Non – compactable (m^3)		Total (m^3)
		Drums (m^3)	Spent filters (m^3)	
1996	2.86	0.44	0.01	3.31
1997	9.46	1.98	0.43	11.87
1998	14.96	1.32	0	16.28
1999	16.5	4.84	0.01	21.35
2000	12.1	3.96	0.26	16.32
2001	14.96	9.24	0.02	24.22
2002 (Oct.)	16.94	8.58	0	25.52
Total	87.78	30.36	0.73	117.87

e1.2) Solid radioactive waste volumes segregated by types: T1, T2 and T3.

Cernavoda NPP. Solid radioactive waste segregated by contact gamma dose rate.

Year	**Type T1** (m^3)	**Type T2** (m^3)	**Type T3** (m^3)
1996	3.31	0	0
1997	11.73	0.14 (non-compactable, spent filters, 12 mSv/h)	0
1998	16.28	0	0
1999	20.91	0.44 (compactable, drums, 8.5 mSv/h)	0
2000	16.23	0	0
2001	24.21	0.01 (non-compactable, spent filters, 3.8 mSv/h)	0
2002 (October)	25.52	0	0
Total	118.19	0.59	0
Maximum contact gamma dose rates	100 µSv/h.	as specified above	N/A

e1.3) Spent resins volumes segregated by system source

Cernavoda NPP spent resins volumes generated between 1996-2002.

System / volumes / m^3	**1996**	**1997**	**1998**	**1999**	**2000**	**2001**	**Sept. 2002**	**Total / system**
Moderator System	3.00	2.800	1.200	1.400	1.800	2.000	1.200	13.4
Heat Transport System	0.00	2.080	0.000	2.120	2.160	2.160	2.000	10.52
Fuelling Machine D_2O System	0.000	0.000	0.200	0.200	0.400	0.000	0.600	1.4
D_2O Clean-up System	1.200	2.330	1.800	1.800	1.400	0.600	0.600	9.73
End Shield Cooling System	0.00	0.200	0.200	0.000	0.200	0.200	0.000	0.8
Spent Fuel Bay	0.00	2.260	2.260	0.000	2.260	0.000	2.260	9.04
Liquid Zone Control	0.00	0.400	0.200	0.200	0.200	0.400	0.000	1.4
Liquid Radioactive Waste	0.025	-	-	0.040				0.065
Total / year/ m^3	4.225	10.07	5.86	5.76	8.42	5.36	6.66	46.355

e1.4) Organic Liquid Radioactive Waste: spent oils

Year	**Spent oils (m^3)**
1996	0.66
1997	0.22
1998	1.54
1999	4.18
2000	4.62
2001	0.44
2002 (oct)	0.22
Total to date	11.88
Maximum contact gamma dose rate	$\leq$3 μSv/h

Distribution of spent oils based on the order of magnitude of tritium content:

Tritium content (Bq/l)	10^3	10^4	10^5	10^6
Volumes (m^3)	1.1	1.1	8.8	0.88

e1.5) Organic liquid radioactive waste: spent solvent

Year	Spent Solvent (m^3)	Tritium Bq/l
1997-1998	0.66	10^5
2000	0.22	10^6
2002 (oct)	0.22	10^6
Total to date	1.1	
Maximum contact gamma dose rate	$\leq$3 µSv/h	

e1.6) Organic Liquid Radioactive Waste: liquid scintillator

Volume to date: 0.66 m^3

Contact gamma dose rates: < 3 µSv/h.

Maximum tritium content: 10^8 Bq/l.

Anticipated tritium content after liquid scintillator segregation by tritium content:

Sources	Dozimetry Lab. liquid effluents samples	Chemistry Lab. moderator and PHT samples	Chemistry Lab. other samples
H-3 (Bq/l)	10^2 - 10^3	10^9 - 10^{10}	10^4

e1.7) Organic Liquid Radioactive Waste: radioactive sludge

Year	Volume (m^3)
1997	0.44
2000	0.22
2002	0.22
Total to date	0.88
Maximum contact gamma dose rate	(40-110) µSv/h

e1.8) Flammable solids (solid –liquid mixture)

Year	Volume (m^3)
1996	0.44
1997	1.10
1998	1.98
1999	1.10
2000	1.54
2001	1.54
2002 (oct)	1.10
Total to date	8.80
Maximum contact gamma dose rate	(50-200) μSv/h

e1.9) Derived Emission Limits for airborne releases and liquid releases

Derived Emission Limits for Airborne Releases		Derived Emission Limits for Liquid Releases	
Radionuclide/ Radionuclide Group	DEL (GBq/week)	Radionuclide/ Radionuclide Group	DEL (GBq/month)
H-3 (oxide)	1.01E+06	H-3	6.06E+06
C-14 (gaseous)	2.11E+03	C-14	2.45E+05
I-131 (mfp)	6.62E+00	Cr-51	2.26E+06
Noble Gases*(GbqMeV×week^{-1})*	4.15E+05	Mn-54	1.01E+04
		Fe-59	1.92E+04
Particulate*	1.33E+00	Co-58	2.55E+03
Cr-51	2.69E+04	Co-60	5.72E+02
Mn-54	2.96E+02	Zn-65	5.75E+03
Fe-59	1.08E+02	Sr-89	1.98E+04
Co-58	9.54E+00	Sr-90+	1.83E+02
Co-60	8.84E+00	Zr-95+	1.53E+04
Zn-65	3.20E+01	Nb-95	1.27E+04
Sr-89	6.01E+01	Ru-103	9.03E+04
Sr-90+	2.77E+00	Ru-106+	1.33E+04
Zr-95+	3.04E+02	Sb-124	1.89E+04
Nb-95	6.29E+01	Sb-125	6.09E+03
Ru-103	6.47E+02	I-131 (mfp)	2.90E+03
Ru-106+	4.99E+01	Cs-134	1.47E+03
Sb-124	1.75E+02	Cs-137	4.63E+02
Sb-125	1.94E+02	Ba-140	5.99E+04
Cs-134	6.65E+00	Ce-141	2.08E+05
Cs-137+	1.33E+00	Ce-144	2.36E+04

Ba-140+	5.88E+02	Eu-152	5.79E+02
Ce-141	6.90E+02	Eu-154	4.37E+02
Ce-144+	6.43E+01	Gd-153	7.64E+04
Eu-152	2.68E+01		
Eu-154	1.95E+01		
Gd-153	1.09E+03		

* - the value is given for the most restrictive beta – gamma radionuclides.

- mfp: indicates that for conservatism, it will be assumed that at the recipient I-131 is an equilibrium mixture with the other fission radioiodines in a certain ratio.

e1.10) Gaseous Emissions for the period April 1996 – December 2001

Isotope	Annual DEL	%DEL					
	(kBq)	1996	1997	1998	1999	2000	2001
C-14 (gas)	1.1E+11	3.21E-02	1.63E-01	2.64E-01	1.55E-01	2.12E-01	1.50E-01
Cr-51	1.4E+12	-	-	-	-	4.33E-08	
H-3 (oxide)	5.3E+13	2.61E-03	4.88E-02	9.67E-02	1.62E-01	3.97E-01	3.42E-01
I-131 (mfp)	3.44E+08	-	2.05E-03	2.19E-04	-	-	4.14E-04
Nb-95	3.3E+09	-	-	-	-	2.40E-06	
Noble Gases *	2.2E+13	2.79E-01	2.05E-03	8.12E-02	9.89E-02	3.22E-02	1.26E-01
Total Releases		3.14E-01	5.00E-01	4.42E-01	4.17E-01	6.41E-01	6.18E-01

* Noble Gases annual DEL are in kBq MeV

- mfp: indicates that for conservatism, it will be assumed that at the recipient I-131 is an equilibrium mixture with the other fission radioiodines in a certain ratio.

e1.11) Liquid Emissions for the period April 1996 - 31 December 2001

Isotope		Annual DEL (kBq)	% DEL					
			1996	1997	1998	1999	2000	2001
H-3	D	7.3E+13	1.6E-02	1.6E-02	1.1E-01	2.21E-02	7.59E-02	1.09E-01
	C	7.3E+13	-	5.8E-04	1.9E-04	7.39E-03	3.07E-03	-
Cr-51	D	2.7E+13	3.0E-08	2.6E-07	4.2E-09	2.96E-07	3.54E-07	2.21E-08
	C	2.7E+13	-	4.0E-09	-	2.93E-07	3.89E-09	-
Mn-54	D	1.2E+11	-	-	5.0E-07	1.41E-06	-	-
	C	1.2E+11	-	-	-			
Fe-59	D	2.3E+11	1.5E-06	-	-	2.11E-06	-	-
	C	2.3E+11	-	-	-			
Co-60	D	6.9E+09	-	1.3E-04	-	1.01E-04	3.62E-04	1.07E-04
	C	6.9E+09	-	-	-			
Zn-65	D	6.9E+10	1.4E-05	5.9E-06	-	-	--	-
	C	6.9E+10	-	-	-			
Zr-95+	D	1.8E+11	-	2.4E-04	1.7E-04	6.46E-04	3.45E-04	4.63E-05
	C	1.8E+11	-	7.9E-06	-	1.08E-04	1.78E-05	-
Nb-95	D	1.5E+11	-	4.7E-04	5.2E-04	1.48E-03	9.92E-04	1.39E-04
	C	1.5E+11	-	2.3E-05	-	2.38E-0	4.42E-05	-
Ru-103	D	1.1E+11	2.1E-07	3.4E-07	1.2E-07	-	-	-
	C	1.1E+11	-	-	-			
Sb-124	D	2.3E+11	7.5E-07	3.1E-04	1.9E-04	9.61E-06	2.33E-05	4.41E-06
	C	2.3E+11	-	2.4E-05	-	1.44E-07	2.37E-07	
Sb-125	D	7.3E+10	-	-	1.8E-05	-	3.29E-07	-
	C	7.3E+10	-	-	-			
I-131	D	3.5E+10	1.1E-03	4.3E-02	1.8E-03	1.27E-05	-	-
	C	3.5E+10	-	8.1E-05	-	1.73E-05		
Cs-134	D	1.8E+10	-	2.6E-05	3.7E-06	2.72E-06	-	-
	C	1.8E+10	-	-	-			
Cs-137	D	5.6E+09	-	6.0E-04	3.1E-04	3.00E-04	1.30E-04	2.52E-05
	C	5.6E+09	-	5.7E-05	-			-
Ce-141	D	2.5E+12	6.1E-08	4.2E-08	-	-	-	-
	C	2.5E+12	-	-	-			
Ce-144	D	2.8E+11	-	6.2E-06	6.0E-06	1.27E-05	6.81E-07	-
	C	2.8E+11	-	-	-	1.97E-06		
Gd-153	D	9.2E+11	-	-	-	-	6.54E-07	2.50E-07
	C	9.2E+11						-
Total Releases	D		1.7E-02	6.1E-02	1.16E-01	2.47E-02	7.78E-02	1.09E-01
	C			7.7E-04	1.93E-04	7.75E-03	3.13E-03	-

Released in Danube (D)

Released in Danube – Black Sea Channel (C)

e2) Fuel Fabrication Plant radioactive waste inventory

- 9 m^3 combustible liquid waste

e3) SCN Pitesti radioactive waste inventory

- long lived radioactive waste:

- 4000.56 kg depleted uranium (from ^{60}Co therapy units of hospitals);

- 0.4 m^3 solid radioactive waste (from post irradiation examination and TRIGA reactor maintenance activities);

- 0.2 m^3 metallic radioactive waste (fragments of irradiation devices and of sample holders activated in TRIGA reactor, fragments of fuel cladding and of CANDU pressure tubes samples irradiated in TRIGA reactor)

- 9 ^{60}Co sources with activities between 15.5 TBq and 75.4 TBq (6 in hot cells and 3 in LEPI precinct)

e4) IFIN – HH radioactive waste inventory

e.4.1) Sealed radioactive sources collected at STDR Magurele from 1987.

Radionuclide	Number of sources	Activity (mCi)	Disposed	Stored
Co-60	1397	531100,00	1023	374
Cs-137	124	236247,00	61	63
Ra-Be	10	72,55	1	9
Kr-85	313	4316,27	289	24
Po-210	18	0,00	18	0
Po-Be	31	0,00	28	3
Ir-192	100	100,00	67	33
Ra-226	105	367,65	93	12
Sr-90	59	729,60	23	36
Am-241 industrial	171	22078,00	3	168
Am-241 from smoke detectors	25037	100,15	119	24918
Am-Pu from smoke detectors	4406	2203,00	0	4406
Am-Be	42	8100,00	3	39
H-3	57	52000,00	0	57
Ru-106	1	10,00	0	1
I-131	8	5,00	0	8
Cs-134	4	3,20	0	4
Cr-51	2	1,60	0	2
Ce-144	2	35,00	0	2
C-14	27	6,10	0	27
Ba-133	4	0,11	0	4
Ag-110m	17	980,00	0	17
Co-57	3	185,00	0	3
Eu-154	1	1,00	0	1
Pu-239	19	610,10	0	19
Pu-238	2	20,00	0	2

Pu-Be	1	7,00	0	1
Cd-109	1	10,00	0	1
Fe-55	1	40,00	0	1
Eu-152	5	1,80	0	5
Pm-147	4	0,10	0	4

The existing inventory at STDR Magurele is according to column 5. The inventory presented in column 4 represents sources disposed at Baita Bihor repository. Supplementary to this inventory, at STDR Magurele, there are approximately 800 corroded drums containing historical waste, including spent sources.

e.4.2) Solid radioactive wastes collected at STDR Magurele starting with 1994.

Radionuclide	**Qantity (kg)**	**Disposed**	**Stored**
I-131, Au-198, Tc-99m, P-32	5483,0	5478,0	5,0
U, Th-232	124,3	124,3	
I-131, Au-198, I-125,Tc-99m,Na-22	656,5	628,5	28,0
Co-60, Zn-65	70,0	70,0	
Na-24,I-131	3,0	3,0	
I-131, Cr-57, Br-82, Co-60	14,0	14,0	
Cr-51, I-131, Zn-65, Tc-99m	78,5	78,5	
Ba-131,Np-252	0,5	0,5	
Co-60, Am-241	2,0	2,0	
Zn-65, Co-60	100,0	100,0	
I-131,Au-198	504,0	504,0	
Am-241	15,0	15,0	
Ba-131, Zn-65	2,0	2,0	
Fe-55, Fe-59,Zn-65	4,5	4,0	0,5
I-125, Tc-99m,Se-75	75,0	70,0	5,0
Cs-137, Sr-90, Co-60	26,0	26,0	
I-125, Au-198, P-32	166,0	166,0	
C-14, H-3	5,0	5,0	
I-131, Tc-99m, Cs-137, Re-188	135,5	70,0	65,5
Ir-192, Co-60, Au-198,Cs-137	120,9	117,5	3,4
I-131, Au-198, Tc-99m, P-32, Co-60, Cs-137,Cs-134, Sr-90	742,0	512,0	230,0
H-3	57,0	57,0	
I-131, S-35, Au-198, Tc-99m, I-125	423,0	370,0	53,0
Te-131, I-131, Au-198, Sb-122	228,0	228,0	
C-14, Sr-90, Co-60	40,5	30,0	10,5
Co-60, Cs-137, Ra-226, Th-232	123,0	123,0	
Co-60, Cs-137, Zn-65	50,0	50,0	
I-125, H-3, Na-24, Co-60, Cs-137	36,0	2,0	34,0
Co-60, Ag-110	715,0	15,0	700,0
Ir-192, Mo-99, Tc-99m,I-131, In-113m	459,0	65,0	394,0
Na-22, Sc-46, Mn-54, Co-60, Zn-65, Cs-	5,4	5,4	

134, Eu-152			
Sr-90, Ca-45, Fe-55, Fe-59, Co-60	1,4	1,4	
Tc-99m	2446,0	72,0	2374,0
Tc-99m, H-3, I-125	9,5	9,5	
Tc-99m, I-131, Au-198, Cs-137, Co-60	15,0	15,0	
Am-241,Co-60,Te-123m, Cs-134, Sr-90	91,0		91,0
Am-241,Co-60, Ir-192, Cs-137, I-131	371,0		371,0
Ho-166m, Co-60	10,0	10,0	
Sb-124, Ag-112, Zn-65, Co-60	10,0		10,0
Th-232, I-131, Au-198, Co-60, Cs-134, C-14, H-3, Ra-226, Sr-90	10,0	10,0	
Am-241, Co-60, I-131, Cs-137, Sc-46, Na-22, Ir-192, Zn-65, Fe-59	167,0		167,0
Cs-137, Co-60, Ag-108m, Eu-152, Eu-154	2,0		2,0
V-48, Ga-67	2,0		2,0
Ir-192, I-131, Cs-134, Co-60, Fe-59, Sb-124, Eu-152, Cs-137, Am-241	4,3		4,3

Supplementary to this inventory, as mentioned for the previous table, at STDR Magurele there are approximately 800 corroded drums containing historical waste, including spent sources (see same comment in the previous table).

e.4.3) Radioactive liquid wastes collected from IFIN-HH (VVR-S Research Reactor, Radioisotope Production Dept., Nuclear Medicine Center, others, starting with 1987):

Radionuclide	**Quantity Collected (l)**
I-131, Cr-57, Br-82	1,0
Ba-131, Np-252	2,0
Ba-131, Zn-65	2,0
U, Th-232	3,0
H-3	83,0
Ba-131	0,5
Cs-137, Co-60	30130,0
Sr-90	5,0
I-131	43000,5
Ag-110, Au-198	80,0
I-131, Au-198, Tc-99m	263003,5
I-131, Sb-124, Sb-122, Te-131, Te-127	399265,0
Tc-99m, Au-198, Sb0122	66007,0
I-131, Tc-99m, Sb-122	233197,5
I-131, Co-60, Tc-99m, Cr-51	103585,9
I-131, Tc-99m	38508,5
Mo-99, Tc-99m, I-131	3506,6
I-131, Cr-51	17500,0
I-129, Sb-122, Te-131	8,0

I-131, Sb-122, Tc-99m, Te-129	203,5
I-131, Te-123	11,5
Tc-99m, I-129, Sb-122, Te-127	7,0
Tc-99m, Au-198, Sb-122	10,5
I-131, Te-131, Sb-122	6,5
I-125	53,5
I-125, Co-60, Cs-137	17,5
Na-24, I-125	5,0
I-131, Ru-108, Zr-95, Ag-110m	0,4
Ni-63, Na-22, Zn-65, Eu-152	0,0
Tc-99m, I-131, Re-188, I-125	0,5
V-48,Ga-67	2,0

The total liquid radioactive waste collected and treated at STDR from the beginning of operation of STDR is more than 26000 m^3. The sludge resulted from treatment was collected in approximately 900 drums of 220L capacity, disposed at Baita Bihor repository.

e.4.4) Estimated radioactive inventory for National Repository for Low and Intermediate Level Radioactive Waste – Baita-Bihor, according to the Preliminary Safety Assessment Analysis.

Nuclide	Activity (Bq) disposed at DNDR			% A_{tot}	Activity $_{med/drum}$			$A_{lim/drum}$ (Bq/drum)	$A_{lim/m3}$ (Bq/m^3)
	From IFIN-HH	From SCN	Total		IFIN-HH	SCN	DNDR		
H-3	2.20+09	8.16+12	8.16+12	7.46	6.47+07	2.00+09	1.03+09	2.20+09	1.00+10
C-14		8.16+11	8.16+11	7.46E-1		2.00+08	2.00+08	2.20+08	1.00+09
Co-60	8.44+13	1.95+12	8.64+13	78.93	1.65+10	3.39+08	8.41+09	2.20+10	1.00+11
Sr-90	3.05+11	5.60+12	5.91+12	5.40	1.55+07	9.76+08	4.96+08	1.10+09	5.00+09
Tc-99	2.99+09		2.99+09	2.73E-3			2.96+05	2.20+07	1.00+08
Cs-137	2.57+12	5.60+12	8.17+12	7.47	4.65+08	9.76+08	7.20+08	2.20+08	1.00+09
TOTAL			1.09+14						

The activity is not corrected for decay.

e.4.5) Conditioned drums disposed at DNDR from 1985 to 2002.

	From	Disposal years																		Total
		1985	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	
Total	IFIN	202	310	336	554	326	621	417	264	498	574	103	173	40	131	68	0	42	62	4721
	SCN	0	0	69	131	214	0	150	185	118	100	134	72	99	59	55	0	0	143	1529
Total per year	IFIN + SCN	202	310	405	685	540	621	567	449	616	674	237	245	139	190	123	0	42	205	6080
Cumulated	IFIN + SCN	202	512	917	1602	2142	2763	3330	3779	4395	5069	5306	5551	5690	5880	6003	6003	6045	6250	6250

e5) National Uranium Company radioactive waste inventory

- Tailing pond Cetatuia II (first part, to be closed and transformed in repository): approx. 2 300 000 m^3 (approx. 4 500 000 tons) radioactive wastes containing around 2000 Ci Ra-226.
- Tailing pond Cetatuia II (second part): approx. 38 500 m^3 (approx. 74 000 tons) radioactive wastes containing around 11 Ci Ra-226.
- Solid wastes:

- two old trench storages (closed, to be authorized as repositories): approx. 17 827 tons radioactive wastes;

- new storage: approx. 214 tons (approx. 640 m^3) radioactive wastes.

f) References to national laws, regulations, requirements, guides, etc.

Laws:

- Law no. 111/1996 on safe conduct of nuclear activities (as amended); the last amendment is in the final process of approval in the Parliament.
- Law no. 137/1995 on environmental protection (as amended)
- Law no. 98/1994 on public health
- Governmental Ordinance no. 47/1994 on defense against disasters, endorsed by the Parliament by law no. 124/1995
- Law no. 106/1996 on civil protection
- Law no. 105/1999 on ratification of Joint Convention on the Safety of Spent Fuel Management and on the Safety of Radioactive Waste Management
- Law no. 703/2001 on civil liability for nuclear damages
- Governmental Ordinance no. 11/2003 on the Management of Spent Nuclear Fuel and Radioactive Waste, including final disposal
- Governmental Ordinance no. 7/2003 on the peaceful use of nuclear energy

Regulatory Documents

New regulations related to spent fuel and radioactive waste management:

- Radiological Safety Fundamental Norms /2000 (transposing the Council Directive 96/29/EURATOM - the Romanian regulation has a supplementary chapter on the transfer in environment of the radioactive waste);
- Radiological Safety Norms on Operational Protection of Outside Workers /2001;
- Radiological Safety Norms – Procedures for Agreement of External Undertaking /2003
- Radiological Safety Norms –Authorization Procedures /2001;
- Norms for Designation of Notified Bodies in Nuclear Field /2000;
- Norms for Authorization of the Work with Radiation Sources Outside the Special Designated Precinct /2002

- Individual Dosimetry Norms /2002;
- Norms for Issuing the Work Permits for Nuclear Activities and Designation of Radiological Protection Qualified Experts /2002;
- Norms for Decommissioning of Nuclear Objectives and Installations /2002 (the regulation does not refer to NPPs);
- Radiological Safety Norms for Operational Radiation Protection for Uranium and Thorium Mining and Milling /2002;
- Radiological Safety Norms for Radioactive Waste Management from Uranium Mining and Milling /2002;
- Fundamental Norms for Safe Transport of Radioactive Materials /2002;
- Norms for International Shipments of Radioactive Materials Involving Romanian Territory /2002;
- Norms for International Shipments of Radioactive Wastes Involving Romanian Territory /2002;
- Norms for Transport of Radioactive Material – Authorization Procedures /2002
- Safeguards Norms for Nuclear Field /2001;
- Detailed List of Materials, Devices, Equipment and Information Relevant for the Proliferation of Nuclear Weapons and Other Explosive Nuclear Devices /2002;
- Norms for Physical Protection in Nuclear Field /2001;
- Norms on Requirements for Qualification of the Personnel that Ensures the Guarding and the Protection of Protected Materials and Installations in Nuclear Field /2002;
- Norms on Radioactively Contaminated Foodstuff and Feeding stuff after a Nuclear accident or other Radiological Emergency /2002 (issued together with the Ministry of Health and Family);

Old regulations related to spent fuel and radioactive waste management, still in force till the new regulations will be issued:

- Republican Nuclear Safety Norms for Nuclear Reactors and Nuclear Power Plants /1975: part I: Safety Criteria for Nuclear Reactors and Nuclear Power Plants and part II: Authorization of Operator Personnel for Nuclear Reactors and Nuclear Power Plants
- Republican Nuclear Safety Norms – Working Rules with Nuclear Radiation Sources /1975
- Norms for Prevention and Extinguishing of Fire and for Providing Vehicles, Installations, Devices, Apparatus, Protection Equipment and Chemical Substances for Preventing and Extinguishing of Fires in Nuclear Field / 1978
- Republican Nuclear Safety Norms for Planning, Preparedness and Intervention for Nuclear Accidents and Radiological Emergencies /1993
- Republican Quality Assurance Norms: QA Requirements for the Project Management of the Nuclear Objectives and Installations /1991
- Republican Quality Assurance Norms: QA Requirements for the Design of the Nuclear Objectives and Installations /1991
- Republican Quality Assurance Norms: QA Requirements for the Procurement of the Products and Services of the Nuclear Objectives and Installations /1991

- Republican Quality Assurance Norms: QA Requirements for Manufacturing Products and Providing Services for the Nuclear Objectives and Installations /1984
- Republican Quality Assurance Norms: QA Requirements for Construction of the Nuclear Objectives and Installations /1991
- Republican Quality Assurance Norms: QA Requirements for the Commissioning of the Nuclear Objectives and Installations /1991
- Republican Quality Assurance Norms: QA Requirements for the Operation of the Nuclear Objectives and Installations /1991

Regulations issued by the Ministry of Health and Family:

- Norms for medical examination for hiring workers and for periodical medical examination / 2001;
- Norms for medical surveillance radiation workers / 2001.

g) References to official national and international reports related to safety

- Convention on Nuclear Safety – Romanian National Report, First Revision, August 2001

h) References to reports on international review missions performed as a request of a contracting party

- Report of OSART mission in May 1993 with the follow – up in September 1994.
- Report of ASSET mission in 1994.
- Report of ASSET mission in 1998.
- Report of WANO peer review mission in August 1997.
- Report of WANO peer review mission in July 2000.
- Report of IRRT mission in February 1998.
- Report of IRRT full scope mission in May 2002.

i) Other relevant material

IAEA documents:

- IAEA, TRS 101 “Standardization of Radioactive Wastes”, 1970.
- IAEA SS-79 “Design of Radioactive Waste Management System at NPP”, 1986.
- IAEA SS-69 “Management of Radioactive Waste from NPP”, 1985.
- IAEA 50-SG-011 “Operational Management for Radioactive Effluents and Wastes Arising in NPP”, 1986.
- IAEA SS no. 111-F “The Principles of Radioactive Waste Management”, 1995.
- IAEA SSS no. WS-R-2 “Predisposal Management of Radioactive Waste, Including Decommissioning”, 2000.
- IAEA SSS no. WS-R-1 “Near Surface Disposal of Radioactive Waste”, 1999.
- IAEA SSS no. GS-R-1 “Legal and Governmental Infrastructure for Nuclear, Radiation, Radioactive Waste and Transport Safety”, 2000.
- IAEA SS no. 111-G-1.1 “Classification of radioactive Waste”, 1994.

- IAEA SSS no. WS-G-2.3 "Regulatory Control of Radioactive Discharges to the Environment", 2000.
- IAEA SS no. 116 "Design of spent fuel storage facilities", 1994.
- IAEA SS no. 117 "Operation of spent fuel storage facilities", 1994.
- IAEA SS no. 118 "Safety assessment for spent fuel storage facilities", 1994.
- IAEA SS no. 111-G-3.1 "Siting of Near Surface Disposal Facilities", 1994.
- IAEA SS no. 111-G-4.1 "Siting of Geological Disposal Facilities", 1994.
- IAEA SSS no. WS-G-1.1 "Safety Assessment for Near Surface Disposal of Radioactive Waste", 1999.

International Commission on Radiation Protection documents

- ICRP no. 60 "1990 Recommendations of the International Commission on Radiological Protection".
- ICRP no. 61 "Annual Limits on Intakes of Radionuclides by Workers Based on the 1990 Recommendations".
- ICRP no. 63 "Principles for Intervention for Protection of the Public in a Radiological Emergency"
- ICRP no. 66 "Human Respiratory Tract Model for Radiological Protection"
- ICRP no. 56 "Age-dependent Doses of the Public from Intake of Radionuclides: Part 1".
- ICRP no. 67 "Age-dependent Doses of the Public from Intake of Radionuclides: Part 2".
- ICRP no. 69 "Age-dependent Doses of the Public from Intake of Radionuclides: Part 3".
- ICRP no. 71 "Age-dependent Doses of the Public from Intake of Radionuclides: Part 4".
- ICRP no. 72 "Age-dependent Doses of the Public from Intake of Radionuclides: Part 5".
- ICRP no. 68 "Dose Coefficients for Intakes of Radionuclides by Workers".
- ICRP no. 75 "General Principles for the Radiation Protection of Workers".
- ICRP no. 77 "Radiological Protection Policy for the Disposal of Radioactive Waste".
- ICRP no. 78 "Individual Monitoring for Internal Exposure of Workers".

SNN documents:

- Strategy for Radioactive Waste Management at Cernavoda NPP – January 1998

CNE-PROD Cernavoda documents:

- 79-79140/67914-DM-001 - Design Manual Spent Resin Handling System
- RD-01364-RP1 Solid Radioactive Waste Management Concept for Cernavoda Nuclear Power Plant
- SI-01365-RP7 Radioactive Waste Management at Cernavoda NPP.
- RD-01364-RP9 Radiation protection regulations for Cernavoda Nuclear Power Plant

- RD – 01364 – TR 01 – Station Training Program
- SI – 01365 – TR 09 – Cernavoda NPP Operator Selection, Authorization and Post – Authorization Training Program
- CNE-PROD Cernavoda – Quality Assurance Manual: MAC 01.02
- RD-01364-RP3 Radiation safety policies and principles
- RD-01364-RP9 Radiation protection regulations for Cernavoda Nuclear Power Plant
- RD-01364-RP4 Derived Emission Limits for Cernavoda Nuclear Power Plant
- RD-01364-RP5 Radiation Safety Training and Qualification Program
- RD-01364-RP6 Personal Dosimetry Program
- RD-01364-RP7 Environmental Monitoring Program
- RD-01364-RP8 – On-Site Radiological Emergency Plan
- RD-01364-RP10 – Contingency Plan for Cernavoda Nuclear Power Plant U1
- RD-01364-RP11 – ALARA Program for Cernavoda Nuclear Power Plant
- RD-01364-RP14 – Accident Management Policy
- SI-01365-RP10 – Emergency Training Response for Cernavoda NPP Personnel
- SI-01365-RP12 – Control of the Exclusion Zone
- SI-01365-RP13 – Post-Accident Recovery Phase