RADIOACTIVE WASTE MANAGEMENT POLICY IN ROMANIA

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ABSTRACT

Radioactive waste management is a key issue of the environmental policy of our company. According to the Romanian Nuclear Act (Law 111/1996) and the Law of the Environmental Protection (Law 137/1996) the owner is responsible for the management of all radioactive wastes streams at the Nuclear Power Plant, including the technical and cost components. For radioactive waste disposal and plant decommissioning is under examination a new law setting up a National Fund paid by all users of nuclear energy which are producing radwastes.

To meet these legal provisions, NUCLEARELECTRICA developed a radioactive waste management policy, which incorporate the practice in the country of the plant supplier (Canada) and the recommendations of IAEA and European Commission. The policy established objectives and targets are accordance with the status of Cernavoda NPP project.

On short term, the priorities of our radioactive waste management policy are to extend the spent fuel storage capacity using the dry storage technology and to upgrade the LILW characterization process in order to provide necessary data for selection of treatment/conditioning technologies.

On long term our policy includes a facilities for LILW packaging for disposal in new surface repository to be built on the Cernavoda NPP site. For HLW the interim storage for about 50 years will provide the necessary time to select and implement the geological disposal, in accordance with the best international practice.

INTRODUCTION

The Romanian Electricity Authority (RENEL), the national supplier and distributor of electrical and thermal power was reorganized in 1998, in two companies. "Nuclearelectrica" National Company (SNN), a state owned company, was set up as the operator of the Cernavoda Nuclear Power Plant (NPP) and Fuel Manufacturing Plant Pitesti. The remaining part of the former company RENEL was reorganized as the National Electricity Company (CONEL) which keeps in one hand the bulk of the power producers (non-nuclear producers) and the entire distribution and commercial branches. The restructuring process of the electric power sector will continue aiming at the privatization of most power supply and distribution branches.
"Nuclearelectrica" National Company (SNN) is structured in three branches:

- Cernavoda NPP – Unit 1, which operates a CANDU-6 power reactor, in commercial operation since December 2, 1996;
- Cernavoda NPP – Unit 2, which is the investor for the second power reactor (about 40% completed);

- Pitesti Fuel Manufacturing Plant.

The Cernavoda project started in '70s and was planned to have five CANDU reactors. The first reactor covered over the last two years about 9% of the annual national electricity demand. Now efforts are made to set up a financing scheme for the completion of the second reactor that is about 40% already built. Even the national consumption of electricity decreased during the last years, plans are considered for future development of the entire power production system. Currently, the nuclear power project competes with projects for upgrading coal and gas fired power plants or new small hydro power plants.

According to the new Romanian Atomic Act (Law 1996), the responsibility for radioactive waste management rests with the waste producer. The "polluter pays" principle is, according to the Romanian law, the basis for financing radioactive waste management. Romania is party to the IAEA Joint Convention for Safe Management of the Spent Fuel and Radioactive Wastes. The national policy of accession in the European Union will require the harmonization of Romanian legal framework in the field of radioactive waste management with the Community's body of legislation (acquis).

RADIOACTIVE WASTE MANAGEMENT SYSTEMS

In Romania, radioactive wastes are managed through decentralized strategies. The radioactive wastes from small producers are collected and stored or disposed of by a central organization. Policies and strategies for the nuclear fuel cycle waste management including disposal are developed by the waste producers.

The Institutional Wastes

The use of radioactive elements in Romania was started by scientists, many of them trained in Western Europe and well informed about the worldwide radioactivity research. By the 50's the Romanian scientists began to do research in the field of peaceful use of atomic energy. In 1957, Romania commissioned a research reactor used for scientific activities and radioisotope production. Since 1961, the nuclear activities were subject to licensing based on a Nuclear Act adopted by Romanian Authorities. Since that time a national network for environmental radioactivity monitoring was established and continuously developed to cover the national territory. In 1974 a national system of guides and standards for nuclear safety, health physics, transportation, ore mining was adopted. Some of these guides are still in force. The radioactive wastes from research activities and industrial applications of nuclear energy were collected between 1957 - 1977 at Institute for Atomic Physics in Bucharest and stored in an improvised facility (a fort built before the First World War). During 1977 -1978 this facility was decommissioned and the radioactive wastes were transferred for treatment and conditioning in 220 l drums at the new Radioactive Waste Treatment Plant commissioned on the site of Institute for Atomic Physics. A disposal facility for the institutional low-level wastes was built in an old uranium mine (Baita) in the west part of the country. This facility was subject to IAEA-WAMAP and RAPAT missions, which recommended upgrading to improve safety and environmental protection (1). In 1971 was established in Pitesti the Institute for Nuclear Power Reactors, which operated a TRIGA reactor, hot cells, research laboratories and a waste treatment plant. The TRIGA spent fuel will be returned to the USA. The Fuel Manufacturing Plant operated by SNN shares the same site and the same radioactive waste treatment plant with the R&D institute.

The Front End Fuel Cycle Wastes

The uranium exploration and mining in Romania started in 1950 and was developed in three stages. In the first stage (1950-1961), the mining activities were done by a joint Soviet Union - Romanian Company (SOVROMKVARTIT) and the uranium ores were transported in Soviet Union. The mining activities were out of national regulatory control for 22 years. The uranium deposits situated in Banat Mountains and Apuseni Mountains (at that time known as the richest in the world) were fully exhausted. The exploration and mining activities, done in this period, have as result large polluted areas that need environmental restoration (2).
The second stage of uranium mining (1961-1989) was done by the Rare Metals Enterprise a state owned company, the uranium ores were processed as uranium concentrate and stored.
The third stage started in 1990 and the mining, milling and refining activities were done by a dedicated company named National Company of Uranium.
The radioactive wastes resulted from uranium mining and milling activities are:

- about 5 350 000 tones of sterile rocks,
- water contaminated with uranium from mining activities,
- water contaminated with uranium from milling activities,
- low grade uranium ores (0.02-0.05%) stored at mine site,
- spent ion resins from processing plant.

The environmental restoration program of uranium mining sites includes uranium recovery from low-grade ores, treatment of contaminated water and covering of sterile deposits with vegetal soil. This program approved by the Governmental Decision 400/1996 is financed from the national budget and is going to be completed in 2003.

Operational and Decommissioning Wastes

The significant portion of the fuel cycle radioactive wastes consists of the operational and decommissioning wastes from the nuclear power plant. The current radioactive waste management system at Cernavoda NPP is based on the experience and current approach in all CANDU plants. The Cernavoda NPP is provided with all facilities for propre management of gaseous, liquid and solid wastes.

The aqueous radioactive wastes are collected, decontaminated if necessary and released by dilution in the cooling water within the limits approved by the Regulatory Body. The gaseous wastes: noble gases, iodine, tritium and airborne particles, are collected by ventilation system, filtered and released through the ventilation stack under a tight control to minimize the environmental impact.

Thus, based on international agreed approach, aqueous and gaseous radioactive waste, after certain purification (if appropriate) are disposed of into the environment by an approved "dilute and disperse" solution.

The bulk of radioactive waste are safe managed within the plant facilities, designed and built to meet the internationally agreed safety standards.

The compactable and non-compactable radioactive wastes are packaged in stainless steel drums and stored in the concrete building of the Solid Radioactive Waste Intermediate Facility (SRWIF), located within the fence inner of the plant. The spent filters cartridges, spent filters and large metallic items are stored in concrete holes of a special concrete structure belonging to the SRWIF. The design capacity of the SRWIF is for 18 years/reactor. The spent resins are stored in two concrete vaults located in the service building. Each storage vault has a capacity of about 200 m^3, together covering 15-20 years of the plant operation lifetime. The organic liquids and other types of radioactive waste packaged in stainless steel drums are stored on the service building basement.

The spent fuel, treated as radioactive waste, is stored in a pool with enough capacity for 8-10 years of the NPP (80% availability).

According to IAEA Safety Series 111-F "The principles of Radioactive Waste Management", the waste management system of the plant addresses only the first step of the effective management: "the pretreatment". This initial step in waste management consists of collection, precompaction (if appropriate) and includes a period of interim storage. The other three steps of the radioactive waste management: treatment, conditioning and disposal were considered to define the SNN's policy in this field.

THE RADIOACTIVE WASTE MANAGEMENT POLICY

The radioactive waste management policy and strategy of the company are reviewed now (3). A document will be submitted for approval to the Regulatory Body in February 2000.

Target Objectives

The first target objective of the policy is an interim spent fuel dry storage facility.
The CANDU fuel has advantages and disadvantages for dry storage. The fuel contains natural uranium, has small weight and dimensions and is free from criticality hazard in low water. Also, the low burn-up characteristics (average burn-up is approximately 7400 MWd/tU), determine both low thermal power release and low specific activity. On the other hand the large quantity of spent fuel and the number of bundles to be transferred and prepared for storage require a special attention in the design process. A modular concept was considered for this facility, which provide more flexibility as regards the investment. The following dry storage technologies were considered:

- Dual purpose casks
- One piece flask (DSC flasks / Ontario-Hydro, CASTOR / GNS, TN / Transnucleaire)
- Canister in a concrete flask (TranStore / BNFL)
- Vaults
- Concrete monolithic module (CANSTOR / AECL)
- Modular concrete vault (MVDS / GEC-Alsthom, CASCAD / SGN)

The dry storage technologies developed in Canada and Europe were analyzed and compared. Four criteria were selected for comparing the solutions: costs, safety aspects, technical aspects, and interface with nuclear power plant. The nuclear safety criterion refers to the capability to fulfill the fundamental requirements: adequate containment, shielding for gamma and neutron radiation, heat dissipation, criticality and protection against external hazards. The basis for comparison from economical point of view is the price per kilo of uranium stored. The technical criterion refers to the technical aspects of the objective and takes into account the performances in operation, materials, tests and inspection during operation, systems redundancies, auxiliary systems, decommissioning, spent fuel removal. The Cernavoda NPP does not include a system to prepare the spent fuel for transfer to the dry storage facility. Therefore, it is important to take into consideration the interface between Dry Storage Facility and Cernavoda NPP. All the storage solutions considered require, more or less, modifications in NPP Cernavoda project, including new systems, modifications or linking with the existing systems, modifications of procedures. The interface with nuclear power plant criterion takes into consideration these aspects. As results from this multi-criteria evaluation, the monolithic concrete module was selected as the reference design for our interim spent fuel storage facility to be built on Cernavoda site (4).

The dry storage project is now under implementation and is scheduled to be operational by mid of 2003. The design lifetime of the new facility is 50 years.

The second target objective of the radioactive waste management policy is a near surface repository planned for the next decade. The new repository will be designed according to the multibarrier concept, using as reference design the El Cabril repository in Spain. The repository will accommodate low and intermediate level waste arised from the plant operation as well as the plant decommissioning. Significant steps were already performed for this project.
Started in 1992, the siting process for this facility is now in the final stage. Recognizing the siting as a difficult and complex task, the company financed an R&D program, which aimed at selection and characterization of an acceptable site according to the IAEA Safety Guides 111 – G – 3.1 "Siting of a near surface disposal facility".

The siting process started with the area survey stage. The region of interest was Dobrogea, the district including the NPP site. It is an old historical region with available data for geological zoning and a semiarid climate, suitable for siting a repository. An "ideal" site was the target of the investigations made by geologists. Almost 40 potential sites in Dobrogea region were evaluated. The screening phase reduced the number of candidates to two sites: Cernavoda at 2.5 km from NPP and Saligny situated in the exclusion zone of the NPP. The criteria for geology, tectonics, seismically, surface processes and protection of the environment were considered at that stage. In fact, due to the vicinity of the two candidate sites, the geological characteristics are similar. An important moment of the siting the process was the year 1996 when significant data were available for:

- the radioactive waste inventory assessed on CANDU Owners Group (COG) data;
- the conceptual design of the disposal facility.

Even if Cernavoda site seemed to have better geological characteristics, the social, economical and public acceptance factors prevailed for choosing the Saligny site as the favorite. This was an approach recommended also by IAEA: the clear aim remained to have an acceptable solution with sufficient safety reserves instead a single "best solution".
The main geological characteristics of the site are the presence of a green schist fundament covered by precuaternary sediments. The quaternary deposits cover the whole area and have two components: an unsaturated loess layer of 35-40 meters and an impermeable redclay layer of 5-10 meters. At the surface the site consists of a silty loess layer the natural bearing capacity is not satisfactory and the erosion potential is increased. A compacted process to improve the geotechnical performance of the loess layer was considered and an on site tests provided good results (5). The IAEA expert's missions agreed that Saligny site along with a proper design would provide radiological protection in compliance with national requirements and international standards. At the end of 1998, the available data enabled the owner of the power plant to submit a preliminary safety assessment for the siting license to the Regulatory Body.
A significant step was registered at the end of 1999, when the chosen site as well as the approach of the new repository was confirmed in good terms within the framework of a project financed by European Union through the PHARE projects. Within this project, preliminary waste acceptance criteria were established for the near surface repository. Mainly, the project recommended as we were expected, to upgrade the level of safety assessment and to establish a methodology in order to characterize the plant operational waste.

Radioactive Waste Management Program

The current radioactive waste management program covers those measures established to reach the following radioactive waste management objectives:
-to promote the new investment of the interim spent fuel dry storage facility;
-to establish a methodology for the characterization of the raw waste;
-to license the site of the new near surface repository.

"Wait and See" Strategy

Except the storage of the organic liquids and flammable solid waste, enough storage capacity for more than 15 years is provided on the NPP site for all types of radioactive waste. A new disposal facility for LILW seems, according to some opinions, not to be an urgent task within the next 10 years. This controversial issue has to be carefully considered. The practice of the early conditioning, especially of the solid waste and spent resins, is largely used in many countries. It was proven that higher cost in economical and dose terms were involved when the raw waste are temporary stored waiting for future treatment and/or conditioning. In our case the Regulatory Body imposed the use of stainless steel drums for temporary storage of raw solid wastes. On the other hand, the extended storage of raw wastes allows the radioactivity do decay and as a consequence to lower the cost of treatment and disposal. For low and intermediate level operational wastes the "wait and see" approach seems not to be the best solution because the treatment, conditioning and disposal technologies are commercially available at competitive cost. In addition, the extended storage of raw wastes could induce increased costs of waste management due to the potential future public opposition.

As concern the disposal of the spent fuel, the "wait and see" strategy seems to be the only sound approach for small countries. The future dry storage facility offers sufficient reserve time to define an option. As disposal of high level waste has not yet been performed or approved anywhere, the high costs cause us to wait and see the progress of the process in developed countries.

CONCLUSIONS

The policies and strategies for radioactive waste management currently implemented in Romania are decentralized and established and by waste generators (producers or owners of waste).
The institutional wastes are treated, conditioned and disposed of in an old uranium mine (Baita). A new near surface repository is planned for waste streams from the operation and decommissioning of the Cernavoda NPP.

A spent fuel dry storage facility, scheduled to be in operation in 2003, is now under implementation. For high level waste including spent fuel a "wait and see" strategy is considered.

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