Environmental Treatment of LLW and ILW at Almirante Álvaro Alberto Nuclear Power Station: A Proposal for a Waste Management Policy (Eletrobrás -Eletronuclear - Brazil) - 11150

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ABSTRACT

According to the best technique in the treatment and classification of the LLW and ILW produced in Almirante Álvaro Alberto Nuclear Power Station (Central Nuclear Almirante Álvaro Alberto - CNAAA), the CNEN (Comissão Nacional de Energia Nuclear - the Brazilian Nuclear Regulatory Authority) regulation standard for the Licensing of Radioactive Waste is similar in many points to the NRC (Nuclear Regulatory Commission) regulatons. This alignment of criteria should support wide acceptance of a *"state-of-the-art"* standard for radioactive waste repositories.

The three CNAAA initial radioactive depositories will be exhausted at the end of the next decade and, in order to deal with this deadline, ELETROBRAS-ELETRONUCLEAR, the owner utility of CNAAA, and CNEN, the Brazilian authority legally responsible for interim and final disposal of radioactive waste, are developing a joint program to establish a final disposal repository for low and medium level waste generated in the country.

Although the studies for selection of the proper sites for LLW and ILW repositories are in preliminary phase, there are some appropriate sites within 50 km radius of CNAAA (Rio de Janeiro State). CNEN intends to present other sites in Brazil.

INTRODUCTION

CNAAA, located at Itaorna beach, Angra dos Reis Municipality, 130 km from Rio de Janeiro, 220 km from São Paulo and 350 km from Belo Horizonte, encompasses Angra 1, Angra 2 and Angra 3 Nuclear Power Plants. Angra 1 and 2, currently in operation, supply 45% of energy demand of the Rio de Janeiro State. This capacity will increase when Angra 3 (under construction) is commissioned with an additional capacity of 1,350 MWe, to 75% of the state demand. Licensing activities for Angra 1, 2 and 3, as well any other additional nuclear power plants in Brazil, are controlled by CNEN (nuclear issues) and by IBAMA, the Brazilian Environmental Regulatory Authority (environmental issues).

Minimum LLW and ILW disposal requirements must be met by the selection process established in CNEN-NE-6.06 standard (Site Selection for Repository of Radioactive Waste Products), which proposes a methodology to recognize preliminary sites within the selected area, in order to find secure waste confinement for the required period of time to preserve and protect the public and the environment. Currently, a revision process for establishing new requirements and classifications regarding LLW and ILW products and repositories is being concluded, which will be issued in the new standard CNEN-NE-8.02, embodying the requirements of CNEN-NE-6.06.

PRESENT WORK

Site selection must follow some regulations such as safe distance from urban areas, highways, hydrographic and conservation areas, and easy access. In order to reach these objectives, besides the standard, studies involving structural geology, hydrogeology, pedology, seismology, climatology, biotic and socio-environmental aspects must be performed.

A CIS (Communication and Integration with Society) project lead by CNEN, with cooperation of ELETROBRAS-ELETRONUCLEAR, intends to follow the several licensing and building stages, subdivided into three items:

1. Site definition related to public participation and technical explanations;
2. Spontaneous candidatures to be considered in terms of site advantages and disadvantages, emphasizing aspects defined by Brazilian Law 10.308/2001, which provides for selection of locations, licensing, operation, inspection, costs, damages, liability and guarantees for deposits of radioactive waste and takes other measures, including the regulation about monetary compensations for the selected municipalities;
3. Participative process.

METHODOLOGY

Till 2020, CNAAA will produce 8,488 drums (0.25 m^3 each), 520 metallic boxes (1.15m^3 each) and 1,007 liners (1.5m^3 each), in a total of 10,015 containers, representing 4,351.76 m^3 of LLW and ILW. The Brazilian legislation (CNEN-NE-8.02) classifies the waste products according to radiation levels and its half-life into eight groups and three sub-classes. Table 1 presents the comparison between this classification and that one adopted by the American standards (10 CFR 61.55).

BRAZIL LEGISLATION (CNEN-NE-8.02)	**U.S. LEGISLATION (10 CFR 61.55)**
CLASSES OF WASTE	
Class 0 – Very low waste (lower or similar levels to exemption); Class 1 – Very short half-life (lower than 100 days and higher activity levels than exemption); Class 2 – Low and intermediate radiation levels (with activity levels higher than exemption levels and thermal capacity lower than 2 kW/m^3); Class 2.1 – Short half-life (low and intermediate radiation levels, beta/gamma-rays emission devices with half-life lower than 30 years and alpha long half-life emission radionuclide concentration limited to 3700 Bq/g);	Class A Waste – Waste that is usually segregated from other waste classes at the disposal site. The physical form and characteristics of Class A waste must meet the minimum requirements set forth in 10 CFR 61.56(a). It is not necessary to segregate the waste for disposal.

Class 2.2 – Natural radionuclides, derived from petroleum extraction and prospecting containing U-Th Series of radionuclides, in concentration above exemption levels; Class 2.3 – Natural radionuclides, with natural or industrialized raw minerals, containing U-Th Series of radionuclides, in concentration above exemption levels; Class 2.4 – Waste excluded from Classes 2.2 and 2.3, with long half-life radionuclide concentrations exceeding limitation for classification as short half-life waste); Class 3 – Waste of high radiation level, with thermal capacity over than 2 kW/m^3 and long half-life radionuclide concentrations exceeding the limitation for classification of short half-life waste.	Class B Waste – Waste that must meet more rigorous requirements on waste form to ensure stability after disposal. The physical form and characteristics of Class B waste must meet both the minimum and stability requirements set forth in 10 CFR 61.56. Class C Waste – Waste that not only must meet more rigorous requirements on waste form to ensure stability but also requires additional measures at the disposal facility to protect against inadvertent intrusion. The physical form and characteristics of Class C waste must meet both the minimum and stability requirements set forth in 10 CFR 61.56. • Classification determined by long-lived radionuclides. • Classification determined by short-lived radionuclides. • Classification determined by both long and short-lived radionuclides, if radioactive waste contains a mixture of radionuclides.

CONCLUSION

The comparison between these two classifications clearly shows the wide approach of the Brazilian standard, encompassing several waste materials and facilitating the understanding of the personnel who will utilize the radioactive repositories ruled by CNEN. Due to the delay in disposal site selection, it is important that the LLW and ILW waste products generated in CNAAA meet the standard criteria for near surface repositories.

REFERENCES

CNEN-NN-6.09 – Acceptance Criteria for Waste Disposal of Radioactive Waste of Low and Medium Level of Radiation. September 2002. 12p.

CNEN-NE 8.02 – Licensing of Radioactive Waste Deposits of Lower and Medium Level Radiation. 10p. Public Consultation – December 2010.

10 CFR 61.55 – U.S. Code of Federal Regulations (NRC) – Waste Classification.

10 CFR 61.56 – U.S. Code of Federal Regulations (NRC) – Waste Characteristics.