

STRATEGY IMPLEMENTED FOR A SAFE MANAGEMENT OF THE WASTE ARISING FROM THE GOIÂNIA ACCIDENT

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ABSTRACT

The radiological accident in Goiânia brought about an unexpected radioactive decontamination problem. The key to a straightforward management of waste arising from the decontamination work was the definition of a successful strategy to deal with it. In order to accomplish that, several aspects were taken into account, the most important being the properties of the waste, the available infrastructure for its collection, the decontamination logistics, the motivation and commitment of works from several organizations involved in the task and the politically sensitive definition of handling different waste as well as the administrative procedures to set up reliable records on the collected waste were also of great importance. The management of the waste after the accident became complex because of the delay in implementing a disposal facility. Four years after the accident, corrosion was detected in some packages and measures were taken to ensure safe interim storage until final disposal. These measures dealt mainly with waste reconditioning, development and implementation of waste data base related to the waste inventory information and development of a national safety evaluation procedure for the final disposal facility. This paper presents an overview of the Goiânia accident waste management and the solutions adopted for final disposal .

Key words: management, disposal of radioactive waste

INTRODUCTION

According to the Brazilian Legislation, the Brazilian Nuclear Energy Commission, CNEN, is the governmental body responsible for receiving and disposing radioactive waste in the whole country. The establishment of regulations concerning radiation safety, waste management and disposal is also a responsibility of CNEN.

During the accident in Goiânia, experts on radiological protection and waste management took the necessary actions to cope with several challenging situations in order to restore the city to its normal conditions. Decisions as to whether decontaminate and dispose of or to store had to be taken on the spot. As a result, different types of wastes were generated and needed to be classified according to its origins, physical-chemical properties and external dose rates.

It is worth mentioning that political and psycho-social aspects related to the

subject of radioactive waste contributed enormously to the difficulties faced by CNEN in selecting a suitable site for the storage of the waste produced in the decontamination process.

STRATEGY FOR WASTE MANAGEMENT

During the beginning of the decontamination work of several sites in Goiânia, it was found necessary to define a strategy aiming, basically, to segregate, identify, keep records and handle the wastes in a way that could make possible (i) interim storage for a reasonably long period, (ii) safe maintenance during the storage time and (iii) safe final disposal.

Another great difficulty which had to be dealt with by CNEN's staff was the strong opposition posed mainly by the general public and the politicians.

Three groups of wastes were generated following the decontamination activities:

- 1st group: soil, debris, metal scrap (85% in volume);
- 2nd group: waste paper, plastic material, clothes (11% in volume);
- 3rd group: animals, wood, plants (4% in volume).

These wastes were collected into four types of packaging that were available in Brazil at the time:

- 200-litre drums;
- 1.7m³ metal boxes;
- one drum concrete overpacks (VBA) and
- 32m³ shipping containers.

The waste from the first group was conditioned mainly in metal boxes and in 200 l drums, without immobilization. Most of the waste papers were wrapped in plastic and put either into shipping containers or in metal boxes. Plastic and clothes were conditioned in 200 l drums. The animal carcasses were conditioned in drums. Later, these drums were put into metal boxes. Other types of waste were conditioned either in drums or metal containers.

As a consequence of the accident, approximately 3.500 m³ of wastes were generated, with an estimated overall activity, in 1987, lying between 47.0 TBq (1270 Ci) and 49.6 TBq (1340 Ci).

The wastes were temporarily placed in an open air storage facility occupying an area of about 8.5 x 10 m² at a site near the village of Abadia de Goiás, 23 km away from the centre of Goiânia, a city with ca. 1 million inhabitants. For the further management of the waste generated during the accident and taking into account the decay period necessary for the contents of all packaging to reach a Cs-137 concentration level not greater than 87 Bq/g - a suitable value for landfill disposal^[1] - the waste was classified into 3 major groups, as described in Table I. It can be seen from Table Ia-Ic that approximately 33 % of the waste volume has specific activities not greater than 87 Bq/g. Although the specific activities of the waste were of the same order of the value established in the Brazilian regulation for landfill disposal by users of radioisotopes (74 Bq/g), this group, was not considered as exempt from control.

For the Brazilian Regulatory Body the mentioned exemption criteria is applicable only for solid wastes generated by facilities that handle small quantities of radioactive materials. Even considering the very low specific activity of this group of waste and its negligible impact predicted by means of a safety analysis, it was considered convenient to construct a specially designed disposal facility. Furthermore, most of the recovered activity was distributed over only 16.5 % of the total volume, requiring a decay period greater than 150 years to reach acceptable concentration levels. The remaining 40.8% of the waste needed to be reconditioned into concrete and metal containers to ensure the package integrity as well as to provide an additional engineered barrier in the near surface repository.

RECONDITIONING OPERATION

After four years in open air storage, it was verified that corrosion had developed in some packages, especially in the 200 l drums. To ensure a safe storage for a longer period, that is, until final disposal, some measures were implemented. The objective was to make the product adequate to attend the interim storage and disposal requirements, established in Brazilian regulations. These measures were mainly related to waste reconditioning. For the operations, three types of packaging were designed and manufactured:

- concrete overpack capable of holding 14 drums of 200 litres;
- metallic cylindrical container capable of holding 14 drums of 200 litres;
- metallic cylindrical container for the remaining cesium source.

The proposed interim storage and disposal strategy was based on the decision of having two disposal facilities at the Abadia de Goiás site.

The first repository (CGP) was constructed in 1995 for all the waste with specific activity below the 87 Bq/g limit. The second one, for the radioactive waste with activities greater than the above mentioned value was concluded in 1997.

LICENSING PROCEDURE FOR WASTE DISPOSAL

A Safety Analysis Report (SAR)^[2] was prepared and submitted for approval, for the first repository, a large storage capacity concrete container - (CGP) designed to dispose of wastes with activities below 87 Bq/g, based on a simple and robust model, which shows that the radiological impact due to this disposal was negligible. This report was submitted to the Brazilian Organization responsible for the environmental licensing (IBAMA), to obtain exemption from the environmental licensing process and, consequently, from submission of an Environmental Impact Report (EIR). Table II shows the inventory of the waste in this repository.

An environmental radiological protection programme specially elaborated for monitoring the disposal site has been performed.

The licensing process, from site selection until final disposal involved the evaluation of the Safety Analysis Report (SAR) in the following main topics:

- Facility Description
- Site Characterization
- Design and Construction
- Acceptance Criteria, Requirements and Operational Procedures for the Repository
- Closure
- Environmental Radiological Protection
- Occupational Radiological Protection
- Institutional Control Period
- Protection Against Intrusion
- Quality Assurance

The second repository was built in the same site of the first one. For this facility, the State of Goiás submitted an Environmental Impact Report to the Brazilian Environmental Regulatory Body, IBAMA, for approval. A special Safety Analysis Report was prepared by a consultant organization and was submitted to CNEN for evaluation of the radiological impact. After the issue of the pertinent licences, the disposal work was performed and the repository concluded.

Table III presents the inventory of the waste disposed of in this repository.

CONCLUSIONS

Due to the unusual aspects related to waste management arising from an accident, the establishment of a strategy at the beginning of the decontamination operations is fundamental, to ensure that all steps taken will lead to the final disposal of the radioactive wastes arisen in the process.

Even considering the complex technical aspects related to the management of wastes generated following an accident, in special, the safety evaluation of disposal facilities, it should be considered that psychosocial aspects were the major difficulties met to find a temporary storage solution as well as a final disposal site for the collected wastes.

A previously established policy, by the Competent Authority, regarding wastes arising from accidents, if available, would facilitate the work that must be performed to safely keep the radioactive waste from the period of temporary storage until final disposal.

TABLE Ia - Goiania's Waste Inventory
Metal Boxes (Ref. March 92)

Decay time (years)	Quantity	Volume (m ³)	Activity (TBq)
t = 0	388	659.6	0.037
0 < t ≤ 150	658	1,118.6	1.736
t > 150	305	518.5	34.946
Total	1351	2,296.7	36.719

TABLE Ib - 200 litres Drums (Ref. March 92)

Decay time (years)	Quantity	Volume (m ³)	Activity (TBq)
t = 0	2,731	546.2	0.024
0 < t ≤ 150	1,268	253.6	0.225
t > 150	216	43.2	0.730
Total	4,215	843.0	0.979

TABLE Ic - Other Packages (Ref. March 92)

Type	Decay Time (years)	Quantity	Volume (m ³)	Activity (TBq)
Shipping containers	t = 0	10	320.0	0.011
One drum overpacks	t > 150	8	4.0	0.722
Cesium source container	t > 150	1	2.0	4.477

Table II - Inventory of the waste disposed in the first repository -CGP -(Activity - March 95)

Package Type	Quantity	Volume (m ³)	Activity (TBq)
200 l drum	2741	548,2	2,24 x 10 ⁻²
Metal box	368	625,6	3,54 x 10 ⁻²
Shipping container	10	320,0	1,0 x 10 ⁻²
Total	-	1493,8	6,78 x 10 ⁻²

Table III - Inventory of the waste disposed in the second repository (Activity - March 95)

Package Type	Quantity	Volume (m ³)	Activity (TBq)
Metal container (FT-01) with the recovered source	01	4,1	4,11
Concrete container (VBA)	08	10,8	6,73 x 10 ⁻¹
Concrete container (CB)	90	855,0	2,04 x 10 ⁻¹
Metal container (CM)	16	91,2	5,04 x 10 ⁻¹
Metal Box	989	1677,9	3,46 x 10 ⁻¹
Total	1104	2639,0	4,01 x 10 ⁻¹

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