USE OF SEGREGATION TECHNIQUES TO REDUCE STORED LOW LEVEL WASTE

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Abstract

This paper describes the use of segregation techniques in reducing the stored Low Level Waste on Intermediate Waste Repository 1, at Angra Nuclear Power Plant Site, from 1701 to 425 drums of compacted waste.

1. INTRODUCTION

The Angra I Nuclear Power Plant, a Westinghouse Pressurized Water Reactor, two loops and 657 MWe nominal capacity, has been operating in commercial condition since 1985 and it has been using the Gaseous, Liquid and Solid Radwaste Processing Systems [1,6] in order to attend the Brazilian [4,5] and International Rules [3,7]. The low and medium solid Radioactive Waste, produced since 1982, has been placed in 0,208 m^3 drums and stored on the Intermediate Repository 1, at Angra Nuclear Site, and waiting the Final Radwaste Repository political definition, in terms of place, technical and operational characteristics. Up to 1994, an amount of 5,800 recipients were stored on the Intermediate Repository, it meaning 83% Repository's capacity, with perspective to have it full in one year and four months ahead, feeding the Repository with the same rate of recipients that were been produced. For about 40% of all stored recipients were compressed materials with very low activity: yellow plastic cover shoes, yellow plastic bags, yellow cotton coveralls, yellow rubber gloves, papers in general, etc. A second Intermediate Repository was empty and ready to receive just a new type of recipient: 1 m^3 Liners, for Evaporator Concentrate and Waste Resins. So, the plant owners would have the necessity to identify the best alternative to have more available space in the repository, in order to extend its life for some years more. Considering the Super-Compaction process and Segregation of materials inside the old stored drums, the second one were considered with better advantages in regard of: lower costs per recipient, possibility to reuse and recycle materials in good condition saving money, no investments in materials or equipment, immediate service start up, considering the available work force, and the possibility to remove non-contaminated material from the Repository, forever. Build a Incinerator or to erect a new Repository were rejected alternatives, considering the very high costs and spent time involved.[8]

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2. SEGREGATING THE CONTAMINATED MATERIALS INSIDE THE OLD DRUMS

2.1 Objectives and Goals

The job started at April 24th, 1995 and finished at January 10th, 1997. The initial objective was process 1800 recipients stored between 1982 and 1990 in the Repository I, considering the possibility of 30% volume reduction.

2.2 Human Resources, Materials And Equipment

A crew of 8 contracted experienced laborers, 2 Radiological Protection Technicians and one Radiological Protection Foreman, from Angra I NPP, working in average 40 hours per week, completed the job. Material resources used in the job: Consumables (Personal Safety Devices, decon detergents, rags and materials for general cleaning), Monitoring Instruments (portable, fixed and personal), and moving cargo equipment's (truck, loader, and handcar). As those material were still available, no additional expenses were done.

2.3 Procedures and Controls

A specific procedure was produced and included into the Plant Operation Manual [6], which described the operations and controls improved, in order to comply with the National Nuclear Energy Commission (CNEN) standards[4,5], Plant Radiological Protection Procedures[6] and preliminary Regulatory Authority inspections and requests performed.

2.4. Segregation

A Segregation Tent with 5 m x 3 m x 3 m was mounted inside the Repository 1, in a low radiation area (1.5 uSv/h), covered with plastics, and with two 0.48 m^3/s ventilation units provided with pre-filter and HEPA filter, allowing the personnel to open safely the 0,208 m^3 drums, remove the waste and place it above a metallic table. This table was specially mounted, made in steel, with identified circle holes over metallic drums covered by plastic bags, and each type of waste were sent to a specific drum, after segregation and decontamination. The workers who handled the waste were wearing protective clothes, glasses and respirators, avoiding radioactive intakes, external contamination and/or any contact with microorganisms (*bacteria and fungi*).

2.5 Initial Radiometry

After the segregation, the bags containing dry rags, plastics, plastic recipients, dry papers and other savable materials, were moved for a Monitoring Tent. The wet material, putrefactive or with doubts in its radioactive monitoring were pressed again in 0,208 m^3 drums using a 12,000 N baler. The Monitoring Tent, located on the Repository 2, was similar to the Segregation Tent but shielded with lead blankets to reduce background level and without forced ventilation. The monitoring process was performed by a Radiological Protection Technician using a Beta/Gamma proportional counter, with P-10 gas flow, four large area detectors, with set point for 0.85 Bq/cm^2, bellow the authorized limits established by CNEN [4,5]. All materials were individually monitored and if contaminated they were sent back into a drum. The non-radioactive materials, in this step, were cleaned with germicide and released for reuse or, if non-usable, send to final repository as conventional industrial waste.

2.5 Material Differentiation

The material made using yellow plastic (eg. booties, overshoes), not contaminated and non-usable, were differentiate using a special industrial plastic cutter machine, specially designed to cut plastics which have a grid of nylon fibers in its structure. Other yellow materials were manually differentiated

2.6 Radiometry Before Releasing Material as Conventional Industrial Waste

All non-usable materials were packed in waste bags, weighted and completely monitored, in a low background area, with a scintillator probe, type SPA-3, coupled to a ratemeter. A final survey were performed by counting samples, pressed inside a 1 liter Marinelli recipient, with cut out material from each waste bag, in a Multi-Channel Analyzer with hyper-pure Germanium detectors, located at the Radiological Protection Division Environmental Laboratory [9,10]. The authorized limit from CNEN used to characterize as radioactive waste was 74 Bq/g, and an operational limit or clearance level of 7,4 Bq/g (one tenth of regulatory limit) was established, assuring compliance to the CNEN standards [4,5], Administrative Limit [6,7] permitting to minimize the released activity.[2]

2.7 Re-compaction

The material which failed in any of the three monitoring steps and those putrescent, or those difficult to be monitored, were sent for to be re-compacted in the same metallic drums which were liberated during segregation phase. This 12,000 N baler had capacity three times more than the other one used in the 1982 to 1990 period.

2.8 Microbiological Controls

In order to attend the Industrial Hygiene requirements, in face of the stored material nature, it was established a microbiological control of the work environment and reused materials, by assessing air samples and floor, general surfaces and skin workers smears, each two months, that had been done by an accredited Biological Laboratory. Routine daily biological cleaning were performed on the floor and tents, by using a 2% hypochloride solution and an industrial germicide for material asepsis, and air cleaning was done by using a germicide spray.

2.9 Radiological Controls

All workers were using personal dosimeters in order to control individual and collective doses. The protective clothes were used inside of the tents and when handling the segregating material, intending to avoid radiological and microbiological contamination. Routine daily surveys, covering air sampling, loose contamination on surfaces and dose rate, were performed in the operating areas. Daily check tests were performed on the radiation monitors used, with the objective to assure the validity of their calibrations.

3. RESULTS

3.1 Recycled Material and Monetary Return

Considering all the material recovered and recycled (e.g: drums, wood pallets, booties, overshoes, plastic bags and cotton protective coveralls) an amount of U$ 359,759.52 were saved, and after removing the laborer payments and operational costs a financial return of U$ 19,228.29 was observed.

3.2 Packages Released As Ordinary Trash

A total of 10,119 waste bags, corresponding to 85,984 kg, were released as ordinary trash, after each one had bee monitored three times.

3.3 Individual and Collective Dose Follow Up

The job was performed with no abnormal doses. During the job period the highest individual dose was 7.52 mSv, the average dose was 1.15mSv/worker and the collective dose was 99.2 Man.mSv,13,8% below the initial estimated value.

3.4 Repository's Space Evolution

After finished the job, it was observed 50% of the Repository's space initially occupied by low level compacted waste was released to be filled with newer produced waste drums. A total of 1,701 old stored drums were segregated and only 425 drums were re-compacted, it meaning 75% drums were released after segregation performed.

4. CONCLUSIONS

The compacted radioactive waste, stored in Repository 1 during 1982 and 1990, showed radionuclides with short half-lives (less than 30 years), confirming no fuel failure happened in the period. The large quantity of recovered material was, primarily, in function of the practice used in the plant in its early years, considering all yellow material used inside radiological controlled area, as contaminated materials. The decontamination processes, radioactive decay since 1982 and higher compaction capacity, contributed greatly with those results. The resulting specific activities from released materials, well below compared to that required by Brazilian Regulator CNEN, confirmed as adequate the operational limits established at Angra Site. The optimization concept was attended, considering that no more non-radioactive material will occupy a space destined for radioactive material. The option to perform a segregation first, before choose another waste stored reduction alternative, was considered correct. Actually, Angra perform, in a routinely basis, the segregation of the waste produced inside the RCA. For the future, other option is being considered, again, to reduce the compressible waste stored into the Repository.

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