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Low-Level Waste (LLW) Reclamation Program for the Point Lepreau Solid Radioactive Waste Management Facility (SRWMF)

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Abstract

Low level radioactive waste retrieved from intermediate storage vaults at Point Lepreau Generating Station has been sorted to remove the non-radioactive portion. The program began with trials to validate procedures and equipment, followed by a production run that is on-going. Waste boxes are opened and sorted at a ventilated sorting table. The sorted waste is directed to the station's free-release ("Likely Clean") waste stream or to the radioactive waste stream, depending on activity measurements. The radioactive waste content of the sorted materials has been reduced by 96% (by mass) using this process.

Introduction

For over 20 years waste from Zone 3 (radiological areas) at Point Lepreau Generating Station (PLGS) was considered to be radioactive, regardless of its actual activity content. This resulted in large volumes of non-radioactive waste being stored in the Solid Radioactive Waste Management Facility (SRWMF).

In 1998, PLGS staff visited the various Ontario Power Generation nuclear stations to learn from their experiences with the "Likely Clean" concept. This concept segregates non-radioactive materials being removed from radiological areas so that they may be disposed of via regular waste disposal methods and contractors, provided the materials meet accepted radiological clearance levels. The concept was adopted for PLGS and we began procuring the necessary equipment to perform the segregation of waste. During the procurement period, we decided to take the concept a step further, in that we would also look at waste already in storage at our SRWMF.

PLGS has undertaken the segregation of this waste for two reasons: to free up space in the SRWMF, and to reduce the volume of waste ultimately requiring disposal as radioactive.

Description of the Waste

The targeted waste was stored in cardboard boxes that were double-wrapped in heavy gauge plastic bags, sealed with duct tape. Plastic banding straps provided some reinforcement and included a lifting loop to allow handling of the package. Waste was either compacted in the box using a hydraulic compactor, or was placed in the box by hand (for non-compactable waste). Boxes weighed from 10 to 73 kg or more, depending on their contents.

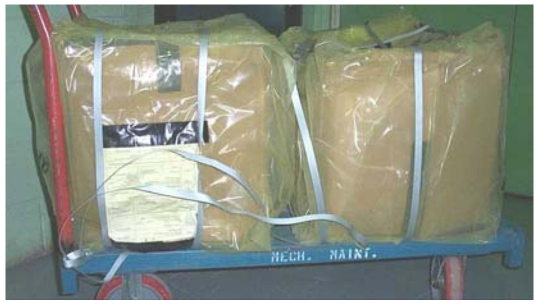

Figure 1 - Typical Boxed Waste

Waste was typically collected in polyethylene bags prior to processing. These bags were of various sizes, and labelled with a trefoil radiation symbol. The labelling also included one of the following phrases: “Radioactive Waste”, “Contaminated Equipment”, or “Laundry”. Various other radiation warning stickers may also be attached.

The waste we are currently processing has been in storage for approximately 20 years, so radioactive decay has had a chance to do its work. Initial gamma radiation surveys at the time of packaging were recorded for each package, and ranged from less than 10 μSv/h to 2 mSv/h. Current surveys show gamma fields to be typically less than 10 μSv/h.

Equipment and Process

A little-used Zone 3 room with a low radiation background (our D_2O Upgrader Loading Area) has been set up with a variety of equipment and instruments to allow us to perform the processing. The equipment is somewhat portable, so that we can quickly dismantle the set-up should the room be required for its original purpose.

Sorting Table
The main working area in the room is the ventilated sorting table. The purpose of the table is to provide protection from airborne particulate hazards. It is an enclosed unit, similar to a fume hood, constructed of stainless steel and Plexiglas. A series of holes in the work surface provide drop access to various waste containers for the sorted materials.

Airborne protection of the sorting area is provided by an Abatement Technologies HEPA-Aire 2000 model H2000A portable HEPA ventilation unit. The intake of the unit is connected to a plenum on the sidewall of the table enclosure. Exhaust from this unit is returned to the room, so it does not protect against tritium.

Figure 2 - The Waste Sorting Station

Radiation Monitors
A Nuclear Enterprises Technology model CM11 frisker unit is mounted inside the sorting table and is used to survey the materials for radiation.

Figure 3 – Frisker and

An Overhoff model 357RM bench top tritium in air monitor is mounted on top of the sorting table and is used to survey the waste boxes and bags for tritium.

Figure 4 – Tritium Monitor

Two waste clearance monitors are available for processing bags of waste. The original Herfurth model H13600 waste bag monitor is being relocated to the sorting area. The newer Rados

RTM661C waste clearance monitor is located in the Service Building crane hall waste processing area, where routine day to day Zone 2 and Likely Clean waste is surveyed prior to release.

Figure 5 – Waste Clearance Monitors

An Eberline AMS[4] continuous air monitor provides indication of radioactive particulate in the room air, confirming that the ventilation unit is working properly and providing the desired protection. The room has an Area Alarming Tritium Monitor (AATM) installed to warn of tritium excursions.

Other Equipment

An electronic scale is used to weigh the retrieved waste boxes, and bags of the active portion of the retrieved waste boxes. A number of carts are used to transfer waste packages and the surveyed waste to and from various areas. Bulk storage of the waste to be processed is accomplished using a sea container located nearby the sorting room.

Figure 6 - Sea Container for Temporary Waste Storage

The Process

A box is selected from the stockpile and transferred to the sorting area. An initial gamma survey is completed to determine if there is any immediate hazard, followed by a tritium survey of the interior of the box. If the tritium is less than 10 µSv/h, the exterior plastic and banding is removed and frisked and the box is then opened for processing.

The individual bags of waste are removed from the box and surveyed for tritium. The bags are then cleared through one of the waste clearance monitors; alternatively, the bags may be opened and each piece of waste surveyed using the frisker.

Waste that passes the surveys is inspected for the presence of trefoils or other indicators of radioactive material ("Radioactive" or "Contamination" labels, stickers, trefoil symbols). These items are removed and the surveyed waste is placed into the Likely Clean waste stream. Items that fail, as well as the trefoils and labels, are segregated. The radioactive materials are transferred to the active waste stream and the non-active trefoils and labels are reserved separately.

As noted previously, the Likely Clean waste stream allows Zone 3 waste to be cleared from the station as non-radioactive, provided it passes further clearance checks for radioactivity. The cleared waste from the sorting table is thus checked for radioactivity three times prior to its release to an off-site landfill. Failure at the later stages returns the waste to the sorting area for further processing.

Sorting Criteria

The clearance monitors are set to alarm at 1000 Bq/kg for waste materials and at 300 Bq/kg for materials going to a recycler.

The tritium in air monitors are set to alarm at 10 μSv/h tritium. Bags of waste must sit sealed for a minimum of 2 hours before being surveyed to allow tritium to equilibrate within the bag.

The CM11 frisker on the sort table has an alarm set point of 10 cps above background.

On a practical note, we found that detectable activity on the frisker was usually good cause to discard an item to active waste, rather than letting it pass through, even if the frisker did not alarm. Similarly, bags with detectable tritium may be reprocessed after off-gassing.

Trial Results

The initial test runs were conducted in conjunction with our 2004 outage. Some 45 boxes were retrieved from the SRWMF prior to the outage and placed in the sea container. Of these, 44 were actually processed. The remaining box had much higher levels of tritium than were expected, so it was held until production processing was implemented. The boxes were taken in small lots (3 to 5 boxes at a time) from the container to the sorting area and processed. Total mass of the boxes processed was about 2125 kg, with an average box mass of about 48 kg. The mass of waste rejected to active waste was 142 kg, of which 15 kg was clean trefoils and labels. In terms of mass percentage, 93% of the waste was clean (i.e., not radioactive). The 7% of the waste that was radioactive was estimated to produce about 3 boxes of waste, based on the average box mass of 48 kg.

We originally hoped to retrieve more boxes from the facility and process them during the outage. This was not feasible for reasons related to the outage itself. Consequently, our rate of processing is not impressive: we averaged 1.2 boxes per day. Our main goal, at the time, was to support the outage. Secondary to that was to test the concept, tools, and procedures developed for this work. Consequently, despite a 24/7 staff availability, we were only able to sort retrieved waste for up to 6 hours per day, and on some days no retrieved waste was processed. Viewed in that light, the results were successful. The concept, equipment, and procedures were proven to be effective.

Production Results

Our production run began sporadically in November, with more consistent support received from January onward. As of February 21, 2005, we have processed 65 boxes of waste weighing 2665 kg, with an average weight of 41 kg/box. This has produced 2570 kg of clean waste and 95 kg of radioactive waste. In terms of mass percentage, 96% of the waste was clean (i.e., not radioactive). The 4% of the waste that was radioactive was estimated to produce about 2.3 boxes of waste, based on the average box mass of 41 kg.

Processing rates have improved significantly. Specific targets were set beginning in January and the team has consistently produced the desired results. Since January, we have averaged 1.7 boxes per day, based on a 5 day work week with a nominal 8 hour work day.

Problems Encountered

As can be expected, a number of surprises were discovered during our trial run. In hindsight, we probably should have expected these anomalies, since our waste processing standards were different in the early days of the plant operations.

Probably the biggest surprise was that boxes were found containing significant levels of tritium (as high as 150 μSv/h, in one case). Since the ventilation scheme used does not protect against tritium, fume hoods were initially used to allow the waste to off-gas. We quickly used up available fume hoods, requiring that we develop an alternative. Our solution was to modify a wheeled security cage to act as a temporary fume hood. A security cage is essentially a wire frame cage with a lockable door and shelves inside, usually used to securely store materials on the plant floor. We covered one with plastic and attached ventilation trunking connected to a contaminated exhaust system intake. The result was that air was drawn into the cage and then out through the vent trunk. Tritiated waste was spread on the shelves and allowed to sit for at least two hours (usually four or more hours and often overnight). After this the waste was re-bagged, allowed to sit for two hours and then retested for tritium.

The discovery of sharps (sampling syringes with needles) was also surprising. These were used to obtain samples from various systems in the plant, and were discarded as rad waste. We quickly procured puncture-resistant gloves from Warwick Mills (brand name – TurtleSkin gloves). These gloves are quite tough and reasonably comfortable to wear but do reduce dexterity somewhat. We also obtained proper sharps disposal containers, and the segregated sharps are sent to a bio-waste handler for incineration after the radiation checks confirm the activity levels are acceptable.

Figure 7 – Off-gas Cage

Figure 8 – TurtleSkin Gloves

Some packages retrieved were damp from minor leakage of the storage structure. Questions were raised about the presence of mould. Discussions with our occupational health and safety staff concluded that the HEPA filtration unit should mitigate this threat, but, as an extra precaution, a particulate filter half face mask should also be worn.

Perhaps the biggest non-safety issue that has developed is determining a disposal method for the clean trefoils and labelling removed from the various packages. To date, the only solution we have come up with is to manually cut them out and shred them using scissors. We have no shredder on-site capable of destroying them satisfactorily. The discovery of several boxes containing nothing but empty, clean rad waste bags requiring this treatment has not raised our spirits!

Future Direction

Minor adjustment of procedures is on-going. For example, we discovered packages containing metal, glass, and, more recently, empty bioassay sample bottles. As we encounter these surprises, the team works with the technical support group to refine our process and develop specific protocols for the various wastes encountered.

There are two major problems we need to resolve: efficient tritium removal from apparently dry or damp waste, and the removal and disposal of trefoils and labels.

Although the off-gas cages seem effective in some cases, there are some bags containing persistent levels of tritium that require days of off-gassing to reduce the levels to acceptable limits. Further work is obviously indicated in this area

The removal and destruction of radiation warning labels sounds like a trivial exercise, yet in practice, this has not been the case. Removal of the labels is manpower-intensive, but a unit that suitably shreds plastic film does not appear to be readily available. We are making enquiries and have some leads to follow up with manufacturers of recycling equipment.

Conclusion

The concept of segregating and sorting waste from radiological areas to remove the non-radioactive portion has been applied to waste retrieved from intermediate storage. PLGS has successfully processed over 4.5 tonnes of waste and reduced the radioactive portion of this waste to less than 250 kg.

Problems encountered include tritium, sharps, and other unexpected wastes stored in these packages. Most of these are the result of processing practices that were acceptable at the time of packaging (up to 20 years previously), and were remedied by minor tweaking of the process. Tritium content of some of the packages remains a difficulty and we are pursuing options for processing this waste. Similarly, the destruction of radiation warning labels has not been a trivial exercise.

Acknowledgement

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Reference

M. Mersereau and K. McIntyre, "Waste Management Operations - Outage 2004, IR-79100-01", Point Lepreau Generating Station Information Report number 0087-79100-0001-001-IR-A-00 (2005)