Cask Processing Enclosure Specification/Operation – 12231

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ABSTRACT

Following an evaluation of throughput rates in the Hot Cell at the Transuranic Waste Processing Center and considering the variability in the waste with respect to actual dose rates a new approach to processing transuranic waste was necessary. Compounding the issue was the remote equipment poor reliability and high down-time. After considering all the factors, the evaluation resulted in the design and construction of a new waste processing area for handling the concrete casks that predominately contain contact handled transuranic (TRU) waste. The area is called the Cask Processing Enclosure and essentially the Cask Processing Enclosure mimics the projects current process techniques used for processing Contact Handled -TRU waste in the existing Box Breakdown Area and Glovebox.

INTRODUCTION

At the TRU Waste Processing Center (TWPC), waste initially characterized as Remote Handled is received in thick walled concrete casks (10-cm, 15-cm and 30-cm thick walls). The concrete casks are normally mated to the Hot Cell to allow waste removal using a remote powered manipulator (provided by PaR Systems, Inc) and the waste is then sorted and processed using standard through-the-wall master-slave manipulators (provided by Central Research Laboratories). The Hot Cell was designed for processing remotely handled radioactive waste exhibiting contact dose rates in excess of 2.0 mSv/hr (milli-Sieverts/hr).

The basis for the change to the Cask Processing Enclosure approach for processing RH Concrete Casks includes:

- Lower dose rates than expected on waste contained in Remote Handled concrete casks
- Equipment reliability/wear in Hot Cell
- Reduce down time and complexity of repairs and maintenance
- Hot cell costs (per cubic meter processed) are high compared to Contact Handled processing
  - Hands-on processing faster/more predictable
  - Achieve higher drum loading efficiency (hand-load verses manipulator)
- Capability to load non RCRA Low Level Waste into empty cask (option not available for Hot Cell)
- Frees Hot Cell for actual high dose rate waste and special operations that must be done in Hot Cell

<u>Lower Dose Rates than Expected</u>

Dose rates on individual waste items contained the casks have shown to exceed 1.0 mSv/hr and some of the waste exhibits neutron dose rates in combination with the gamma component. It has been shown to date that a high percentage (if not all) of the

contents in the casks are less than 2.0 mSv/hr (i.e., waste consists of Contact Handled - TRU or Low Level Waste) resulting is large time delays as the waste is moved from the RH container to the Contact Handled waste drum out station.

Hot Cell Processing Costs

The waste items within the concrete casks typically consists of paint cans, 10 liter plastic buckets, poly bottles, small laboratory vials, plastic bags, and standard PPE. Taken independently, each of these are relatively easy to handle with the existing Hot Cell equipment. However, many items contained in the casks have been very difficult to process using the existing remote equipment. Many of the casks also contain groundwater making treatment for liquids slow and difficult. Hands-on processing in the Cask Processing Enclosure will be significantly faster and more predictable. Additionally, hands-on processing will enable us to achieve higher drum loading efficiency (hand-load verses manipulator). It is projected that for the same waste types the Cask Processing Enclosure will be at least 50% faster and with the increased efficiency will reduce project costs.

Equipment Reliability/Wear

Processing these items presented issues and stressed the delicate Hot Cell equipment to the point of premature and frequent failure. Master-slave manipulators (each costing nearly $100,000 euros) fail at a rate of one every other shift and the large bridge mounted crane has experienced extended periods of down-time (several days each event) to repair wrist functions, cameras, motor brakes and belt drives.

Capability to load non RCRA Low Level Waste into empty cask

One advantage gained in the Cask Processing Enclosure compared to Hot Cell processing is the capability to load waste designated as low level waste into emptied cask. This option was not readily available for casks that are removed after processing from the Hot Cell. Various physical and logistical constraints prevented the introduction of waste into the emptied cask. To date, the project has been shipping empty casks for burial to Nevada and the Cask Processing Enclosure will help in reducing the total waste volume shipped for burial.

Frees Hot Cell

Moving waste that is predominantly Contact Handled to the Cask Processing Enclosure frees the Hot Cell for actual high dose rate waste and special operations that must be done in Hot Cell. It is anticipated that nearly 50% of the original Remote Handled waste may be able to be processed in the new Cask Processing Enclosure.

METHOD

Cask Processing Enclosure Description

The Cask Processing Enclosure is a metal enclosure capable of handling RH Concrete Casks which are nominally 137 centimeter (cm) in diameter and 216 cm in height. Drums of radioactive waste may also be processed. While the Cask Processing Enclosure has been designed to accommodate 10 cm and 15 cm thick Concrete casks inside a metal overpack, the 30 cm casks are not precluded and the Cask Processing Enclosure may also be used for the sorting, segregating, and repackaging of smaller drums as well. The containment accommodates only one cask at a time. Figure 1, General Layout of Cask Processing Enclosure, provides an overview of the Cask Processing Enclosure with associated airlocks.

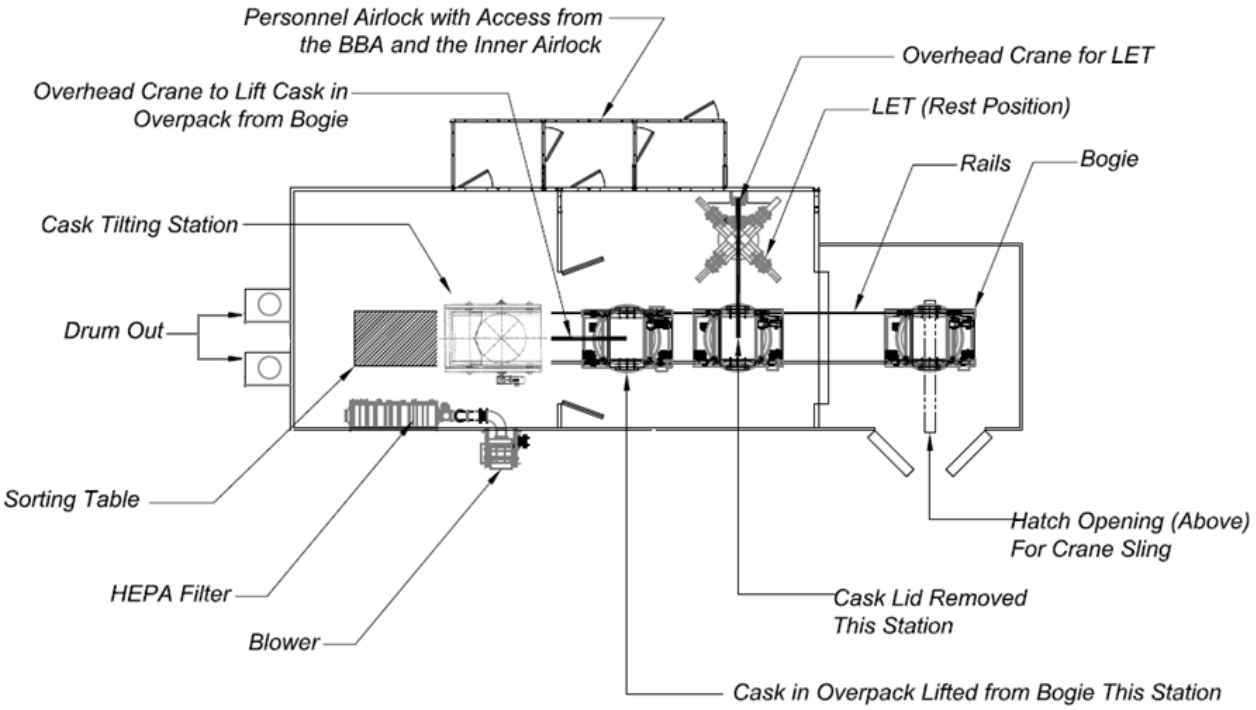

Fig. 1, General layout of the Cask Processing Enclosure

The Cask Processing Enclosure is constructed using 1.5 millimeter (16-gauge) stainless steel sheeting attached to a carbon steel frame coated with an industrial coating. The panel sections are bolted together and the seams sealed with silicon caulking and a layer of sealing tape. The steel shell incorporates clear transparent flame resistant polycarbonate panels for lighting. The floor in the inner airlock and the work area may be coated with a durable fire retardant strippable coating to aid in decontamination and disposable contamination control materials, when used. The enclosure has been designed to operate under a vacuum up to 0.00762 kgs/sq.cm.

Access for personnel is through a series of three airlocks. The concrete cask passes through two airlocks as is moves from the Crane Bay to the Process Area.

Outer Airlock

The Outer Airlock is nominally 5.18-metres (m) wide, 5.6-m long and 6.2-m tall. The roll-up between the Outer Airlock and Inner Airlock is approximately 3.6-m by 3.6-m. The Bi-fold into the Outer Airlock from the 30-Ton Crane Bay (RD1-36) is 10-ft wide by 10-ft tall, then tapers to full height of 6.2-m. The Outer Airlock door has provisions (slots or openings) to allow the hoist/crane to transition from the Crane Bay to the Outer Airlock.

The Outer Airlock is used to prepare the cask for lid removal in the Inner Airlock. It also serves as a transition space (for contamination control purposes) between waste in the Process Area and the Inner Airlock. The Outer Airlock also provides container staging area between the Inner Airlock and the Crane Bay.

Inner Airlock

The Inner Airlock (Room 192) is nominally 7.6-m wide, 7.0-m long and 6.2-m tall. The bi-fold doors between the Inner Airlock and Process Area (RD1-38) is approximately 3.6-m wide by 4.9-m tall. The Inner Airlock has breathing air capability for use of bubble suits as necessary and the Inner Airlock has ground water pumping capability. The Inner Airlock contains the hydraulically operated Cask Lid Extraction Tool and provides mechanism for ground water removal from the cask.

Process Area

The Process Area (Room 193) is nominally 6.7-m wide, 7.3-m long and 5.4-m tall. As with the Inner Airlock, the Process Area has breathing air capability. The Process Area contains the Cask Tilt Station, the sorting table, and drum out station.

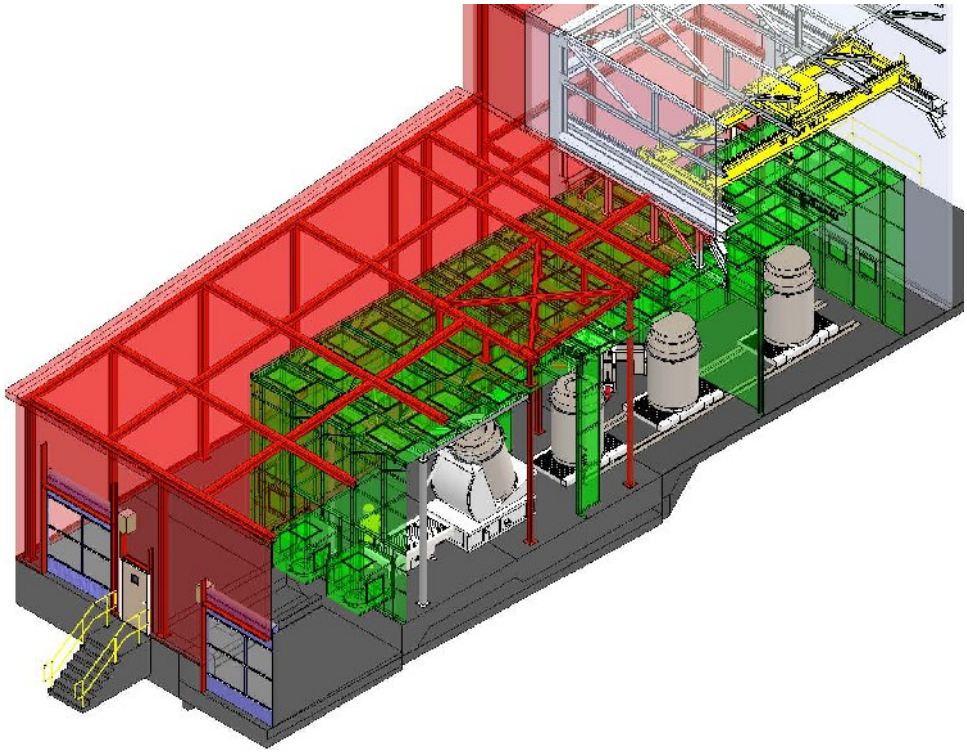

Figure 2, Cask Processing Enclosure

Equipment Overview

The key equipment designed to support Cask Processing Enclosure operations includes the cask bogie, Cask Lid Extraction Tool, Cask Tilt Station, sorting table, supply and exhaust ventilation, liquids pumping, and support systems such as breathing air and hydraulics.

The cask bogie (See Figure 3) is similar in design and construction to the plants existing concrete cask bogie (e.g., a neutron shield is not required) utilized to transfer casks from the Crane Bay to the RH Cask Airlock. Total weight of the cask and overpack is limited to 8400 kilograms. Each cask may contain up to 1.6 cubic meters (eight 55-gal drum equivalents).

The Cask Lid Extraction Tool (See Figure 4) is powered by a single hydraulic power unit located external to the Cask Processing Enclosure. Consistent with TWPC practice fire resistant hydraulic fluid is utilized.

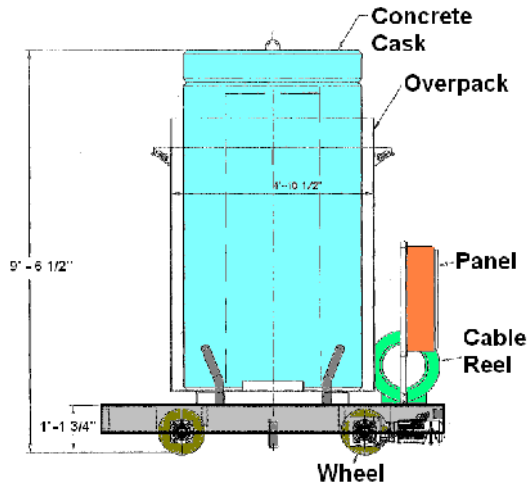

Fig. 3, Cask Bogie with Cask/Overpack

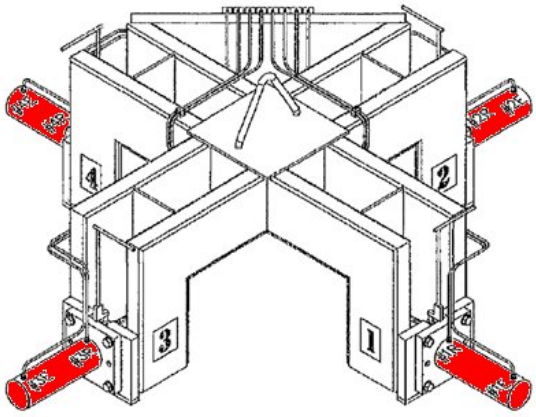

Fig. 4, Cask Lid Extraction Tool

Casks processed in the Cask Processing Enclosure may contain ground water. Many of the casks were buried and retrieved to allow processing.

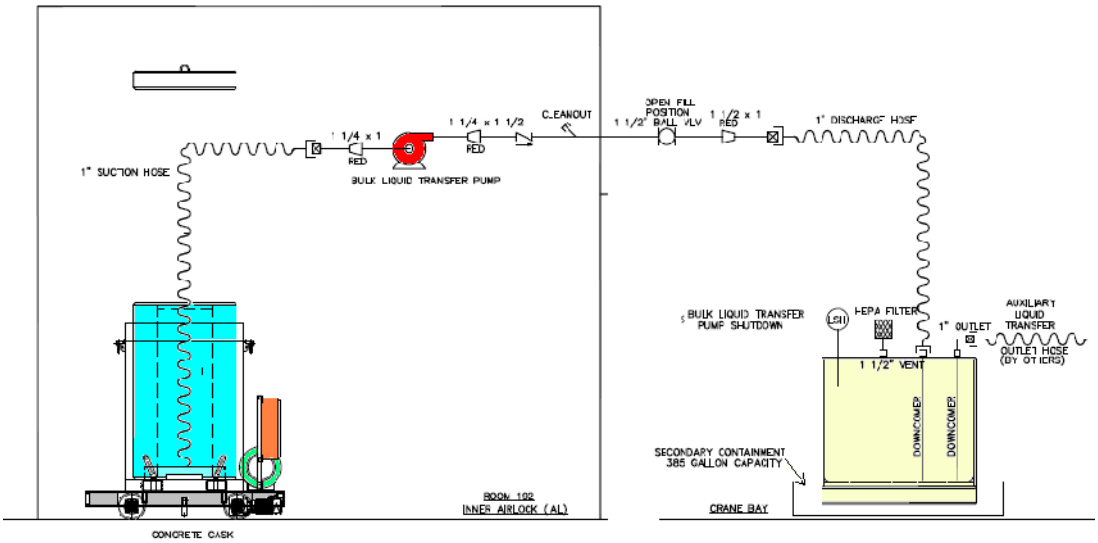

Fig. 5, Liquids Pumping System

The Cask Tilt Station is designed to handle the waste package consisting of materials inside concrete casks in conjunction with the down draft sorting table. Cask/overpack loading and unloading is accomplished on the side opposite the tilt pivot side. Cask/overpack is secured only by gravity during the tilt operation; and may be accomplished by a cradle extending 0.523 radians to 0.785 radians from the centerline of the cask/overpack. The Cask Tilt Station is an electric driven machine that inherently secures the load in any position on loss of power. The tilt cycle can move the cask/overpack 1.57 radians from vertical to horizontal. The Cask Tilt Station is capable of returning a fully loaded cask to the upright position in the event a cask needs to be removed from the Cask Processing Enclosure.

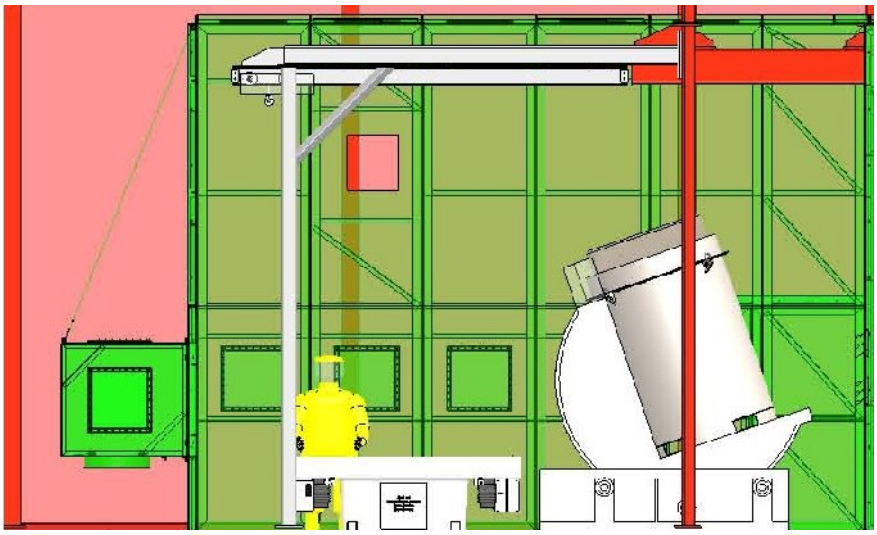

Fig. 6, Cask Tilt Station and Sorting Table in Process Area

Waste is removed from the cask, after tilting, and placed on the sorting table, nominally 100-cm wide and 250-cm long and includes liquid collection and downdraft capabilities. Waste sorting operations, including the treatment of containerized liquids, are conducted in accordance with the practices currently employed in the Hot Cell and Glovebox.

Liquids are collected in a small, less than 20-liter, sump mounted on the floor of the Cask Processing Enclosure, beneath the sorting table. Integral controls automatically cycle the pump transferring liquids to the liquid collection tote. Should the pump or level controls fail the price and size of the pump allow for disposal in a 208-liter drum; this item is considered a consumable.

The sorting table enclosure in conjunction with the downdraft through the surface of the table maximizes the flow of air away from the worker through the table and into the ventilation system. The enclosure allows for the worker to open only that portion of the enclosure needed to access the waste at any given time, thereby maximizing the efficacy of the downdraft feature and minimizing the spread of contamination in the area around the sorting table. By minimizing the contamination on the worker's air supplied (a.k.a. bubble) suit the potential for a skin contamination event during the doffing of the suit and subsequent Cask Processing Enclosure egress is greatly reduced.

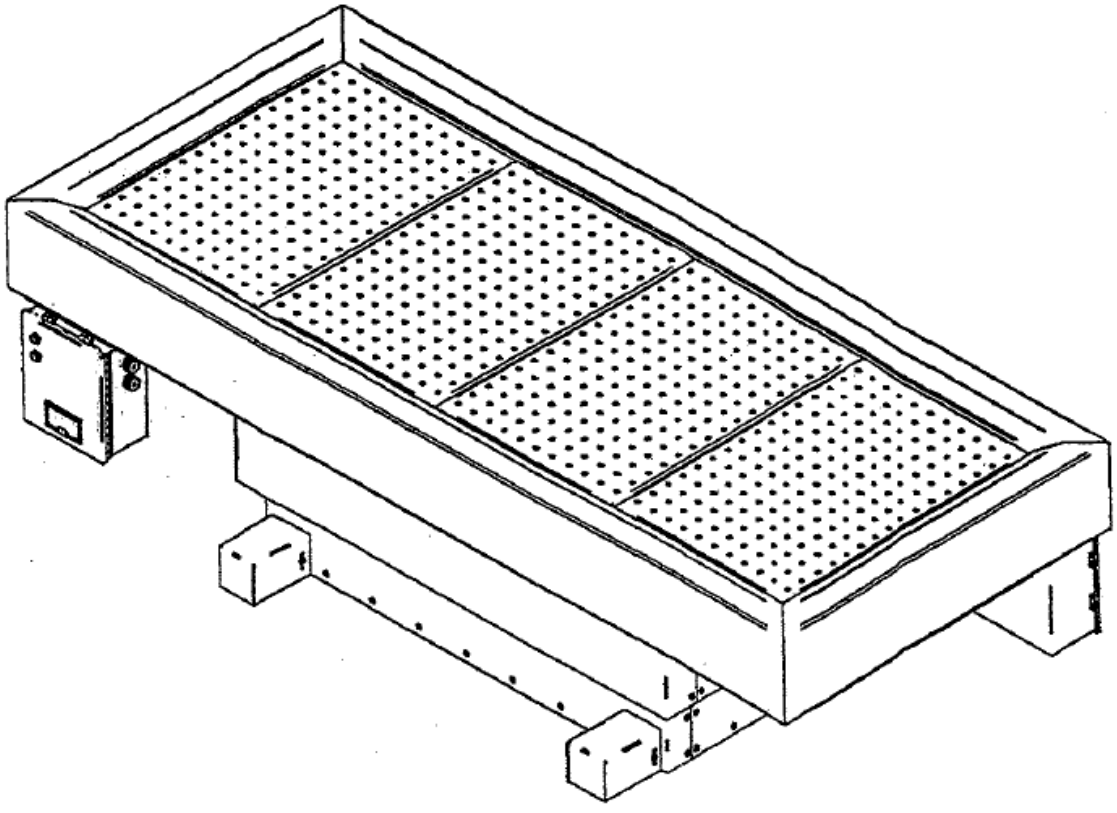

Fig. 7, Sorting Table

Ventilation System

Normal operations (e.g., handling/processing of contaminated material and objects) create airborne hazardous material (including radiological) contamination. The ventilation system is provided to ensure confinement of radiological material during normal operations and filtration of the exhaust for the enclosure prior to discharge into the main plant process ventilation system.

The ventilation system is designed to confine radiological material by maintaining the area at a negative pressure with respect to the atmosphere in the greater Crane Bay. This design ensures the airflow within the Cask Processing Enclosure directs any potential airborne contamination to the HEPA filters. A single stage of HEPA filtration with a removal efficiency of 99%; however, two stages of HEPA filtration in series are provided. Confinement is maintained by establishing differential pressure within the area with respect to the surrounding 30-Ton Crane Bay.

Safety Basis Approach

TWPC is a Hazard Category 2 Nuclear Facility. The Cask Processing Enclosure was not considered to be segmented from the Main Process Building since hazardous material in the area can interact with hazardous materials in the Process Building. In this case, the ventilations system and fire protection systems in the area are not independent from the existing systems and therefore interface with each other. Moreover, the existing ventilation system and fire protection systems are considered safety significant, structures, systems, and components as described in the facility Documented Safety Analysis. Thus, the Cask Processing Enclosure is considered part of the existing Hazard Category 2 Nuclear Facility (i.e., the Process Building).

Concrete casks introduced into the area will be screened such that a major portion of the waste processed will meet Contact Handled waste disposal criteria to protect the design scope of the facility and the safety basis strategy.

Casks that meet the Contact Handled waste processing criteria are also determined to contain inventories of radiological material such that total Plutonium Equivalent Curie (PE-Ci) inventories in the casks are low. Therefore, in addition to the screening process to verify Contact Handled waste processing criteria are satisfied, an initial condition supporting safety basis analysis will be established to limit the total inventory of radiological material permitted in the Cask Processing Enclosure. This approach ensures that material processed in the Cask Processing Enclosure will remain within the design scope.

Operationally, the Cask Processing Enclosure is expected to be managed as a separate inventory control area apart from the Process Building inventory control area, with defined inventory limits. Specifically, the area will be subject to the existing cumulative inventory limit of 2,500 PE-Ci maintained outside of the Process Building and inclusive within the existing Crane Bay, Drum Aging Criteria and Drum Venting Building combined inventory control area limit.

RESULTS

The results expected by implementing the Cask Processing Enclosure waste processing approach for RH waste casks include:

- Higher throughput rates for waste.
- Reduced waste processing costs
- Higher loading rates per drum
- Cost savings in Hot Cell equipment upkeep and maintenance
- Reduce down time in the Hot Cell
- Reduction in repairs and maintenance time
- Implement capability to load non RCRA Low Level Waste into empty cask (option not available for Hot Cell)
- Frees Hot Cell for actual high dose rate waste and special operations that must be done in Hot Cell

DISCUSSION

The Cask Processing Enclosure approach was developed based on a review of the RH processing throughput rates in the Hot Cell. As the process was reviewed consideration was given to the variability in the waste with respect to actual dose rates and the lack of equipment reliability and high wear in the Hot Cell. Based on that review, a new contact handled processing area for handling the concrete casks is being constructed and startup is expected shortly following WM2012. The Cask Processing Enclosure essentially mimics the projects current process techniques used for processing Contact Handled waste in the existing Box Breakdown Area and Glovebox and the design takes into consideration six years of operational experience.

REFERENCES

None Noted