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DECONTAMINATION AND SIZE REDUCTION

OF PLUTONIUM CONTAMINATED

PROCESS EXHAUST DUCTWORK AND GLOVE BOXES

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ABSTRACT

The Los Alamos National Laboratory (LANL) Decommissioning Program has decontaminated and demolishing two filter plenum buildings at Technical Area 21 (TA-21). During the project a former hot cell was retrofitted to perform decontamination and size reduction of highly Pu contaminated process exhaust (1100 ft) and gloveboxes. Pu-238/239 concentrations were as high a 1 Ci per linear foot and averaged approximately 1 mCi/ft.

The Project decontamination objective was to reduce the plutonium contamination on surfaces below transuranic levels. If possible, metal surfaces were decontaminated further to meet Science and Ecology Group (SEG) waste classification guidelines to enable the metal to be recycled at their facility in Oak Ridge Tennessee. Project surface contamination acceptance criteria for low-level radioactive waste (LLRW), transuranic waste, and SEG waste acceptance criteria will be presented. Ninety percent of all radioactive waste for the project was characterized as LLRW. Twenty percent of this material was shipped to SEG. Process exhaust and glove boxes were brought to the project decontamination area, an old hot cell in Building 4 North.

This paper focuses on process exhaust and glovebox decontamination methodology, size reduction techniques, waste characterization, airborne contamination monitoring, engineering controls, worker protection, lessons learned, and waste minimization. Decontamination objectives are discussed in detail.

1.0 INTRODUCTION

The Los Alamos National Laboratory (LANL) Decommissioning Program has decontaminated and demolishing two filter plenum buildings at Technical Area 21 (TA-21). During the project a former hot cell was retrofitted to perform decontamination and size reduction of highly plutonium contaminated process exhaust and gloveboxes. Pu-238/239 concentrations were as high a 1 Ci per linear foot and averaged approximately 1 mCi per linear foot.

Decommissioning of the filter buildings involved removal of all hoods, gloveboxes, and process exhaust inside Buildings 3 and 4 North; removal of exterior ductwork and stanchions from Buildings 3 and 4 North and Building 21; decontamination and removal of the firescreen plenum and rotary filter plenums; dismantlement of equipment inside the filter buildings; and razing of the buildings.

The primary objective of decontaminating the process exhaust ductwork and gloveboxes was to reduce the plutonium contamination on surfaces below transuranic levels. If possible, metal surfaces were decontaminated further to meet Science and Ecology Group (SEG) waste acceptance guidelines to enable the metal to be recycled at their facility in Oak Ridge, Tennessee. Project scope included management of all waste generated, with considerable attention paid to decontamination and waste segregation in order to minimize waste, particularly transuranic (TRU) waste. Waste management activities included characterization, segregation, decontamination, packaging, and transportation to the Laboratory's waste management groups. This paper focuses on process exhaust ductwork and glovebox decontamination methodology, size reduction techniques, waste characterization, waste minimization, engineering controls, worker protection, and lessons learned.

2.0 SITE/FACILITY DESCRIPTIONS

The Laboratory's Technical Area (TA) -21, also known as "DP Site," is located on the northern edge of the laboratory, at an elevation of 7,140 ft. TA-21 centers on DP Mesa immediately east-southeast of the Los Alamos townsite. Figure 2-1 shows the project buildings and structures in relation to the DP West site.

(Figure 2-1: DP West Site)

DP West began operations in September 1945. Its main purpose was to provide the capability to produce metal and alloys of plutonium from the nitrate solution feedstock provided by other production facilities. This involved several acid dissolution and chemical precipitation steps to separate the plutonium and other valuable actinides from the feed stocks. A major research objective at DP West was the development of new purification techniques that would increase the efficiency of the separation processes. These separation techniques used a wide range of chemicals from the periodic table. In conjunction with improving purification techniques in the main process lines, research was conducted into reprocessing the waste produced to further enhance recovery. In addition, other operations, such as nuclear fuel reprocessing, were performed on occasion at DP West. Activities unrelated to plutonium processing also occurred at DP West.

2.1 Filter Buildings 146 and 324

Filter Buildings 146 and 324 provided process exhaust ventilation for all plutonium processing and research activities at TA-21. At one point, Buildings 2, 3, 4, 5, 21, and 150 were tied into the system -- approximately 1100 linear feet of gloveboxes connected to the system.

Initial airflow from Buildings 3, 4 and 21 passed through the firescreen plenum into the Building 146 plenum. The plenum led to a large, drum-shaped HEPA filter system. The drum diameter was approximately 92 in. and length was 91.5 in. It contained a total of 24 filters—3 filters arranged along the 8-sided drum.

The ventilation flow entered the outer region of the filter housing, passed through the filters into the center of the drum, out the exhaust duct, and then was sent to Building 324. Building 324 acted as the second stage of filtration.

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The airflow into Building 324 passed through 20 parallel HEPA filters, split into 2 paths, each with an exhaust fan, and then recombined and exited the stack.

Approximately 300-ft. of stainless 16-gauge, 24-in.-diameter exhaust duct ran from Buildings 3 and 4 North, along elevated stanchions, to the firescreen plenum. Another 60-ft. of 16-in.-diameter galvanized duct ran from Building 21 to the firescreen. The interior of Buildings 3 and 4 North also contained ductwork of varying sizes, fume hoods and gloveboxes, all of which were tied into the process exhaust system.

2.2 Firescreen Plenum

As part of an interim upgrading project, the Firescreen Plenum (Structure 329), was constructed in 1972. The process airflow was rerouted to first enter the firescreen plenum, which housed a wall of metal screen filters which were designed to prevent fire from reaching the main filter plenums. The firescreen also equipped with an automatic sprinkler head and was intended to be connected to the main radioactive liquid waste system.

3.0 DECONTAMINATION OPERATION CONTAINMENT ENCLOSURES

3.1 Hot Cell Containment

The initial enclosure used to house decontamination operations was built in a decommissioned hot cell facility located in Building 4 North (figure 3-1). Usable floor space was approximately 10-ft. wide by 30-ft. long. Interior ceiling height was approximately 15-ft. The interior of the hot cell was framed with tube and clamp scaffolding to form the support for the containment. Six mil poly sheeting was then hung from the scaffolding to form the walls, ceiling and floor of the containment. Walls and ceiling were covered with two layers of poly, and the floor was covered with three layers. Seams were sealed with spray adhesive and duct tape. An airlock was constructed utilizing the four foot thick walls of the hot cell structure as the framework to support the doors. Airlock doors were constructed from three overlapping sheets of poly hung with spray adhesive and duct on either side of the hot cell door frame. This resulted in a 6-ft. wide, 8-ft. high, and 4-ft. deep airlock. Flexible duct was installed through an existing opening in the hot cell wall at the end opposite the airlock entrance. A 2000 cubic feet per minute (cfm) high efficiency particulate air (HEPA) filtered air handler was connected to the flexible duct to provide negative air pressure within the containment. Inside the containment, a flexible duct was routed along the wall approximately ⅓ the length of the containment. A second flexible duct was left long enough to reach almost the length of the containment. These flexible ducts were used as engineering controls to control airborne contamination at their source. Other flexible ducts were extended just through the wall of the containment to provide a general negative on the enclosure. Other items installed in the containment were a HEPA vacuum, low-volume continuous air samplers, an alpha continuous air monitor (CAM), work tables and tools. Consumable supplies were placed in clear plastic bags that were hung from the walls of the containment with duct tape.

(Fig. 3-1: *Hot Cell Containment*)

As the decontamination process evolved, several modifications were made to the containment. The first modification was the installation of an additional 2000 CFM HEPA negative air handler. This unit was attached to the flexible duct that had been installed earlier. The addition of the second negative air unit resulted in air exchanges in the containment approximately every two minutes and significantly improved airborne contamination control.

The second major modification was the construction of a much larger airlock, approximately 10-ft. long by 10-ft. wide and 8-ft. high. This was framed from 1½ inch diameter PVC tubing and covered with two layers of 6 mil poly sheeting. The airlock inner and outer doors were again framed from PVC tubing, opening the full width of the airlock. Doors were hinged to open from the center with the hinges constructed from interlocking PVC "T" fittings on the door and airlock frames (figure 3-1). Construction of this enlarged airlock led to much better regulating of the airflow into the containment simply by opening or closing the doors. Movement of pieces of duct, gloveboxes, tool, supplies, and waste into and out of the containment was greatly enhanced. The large airlock also provided an egress area for all workers to doff personal protective equipment (PPE) in the event of an unplanned airborne contamination release.

3.2 Room 406 Containment

A second, larger containment, was constructed in an area adjacent to the hot cell to improve decontamination and size reduction output (figure 3-2). This containment was also framed with tube and clamp scaffolding and covered with a double layer of 6 mil poly sheeting. Large airlocks were constructed at each end of the containment, one primarily for crew entry/exit and the second for the movement of equipment and items in and out of the containment. These airlocks were constructed of tube and clamp scaffolding and covered in two layers of poly sheeting. Airlock doors were constructed of three overlapping sheets of poly sheeting. Three 1500 cfm HEPA negative air handlers were connected to the containment using flexible 8-in. duct. Several lengths of duct were run along the sides of the containment to enable the crew to place a negative air inlet at the work surface. The combined capacity of the negative air units resulted in an air change within the containment every two minutes. A low-volume continuous air sampler, a CAM, work tables, tools, and supplies were also installed in the containment.

(Fig. 3-2: Room 406 Containment)

4.0 DECONTAMINATION METHODOLOGY

4.1 Decontamination Methodology Evaluation

Evaluation of two separate decontamination methodologies were performed prior to the start of duct decontamination operations.

4.1.1 Brushing

The first decontamination method evaluated was brushing. A containment was prepared with HEPA filtered exhaust to provide negative air pressure within the containment. The operation was performed by personnel in two pairs of cotton coverall "anti-Cs", anti-C undergarments (surgeons scrubs), heavy latex gloves with a 15-in. cuff and skull cap. A final outer layer consisted of Tyvek coveralls with attached booties and hood, shoe covers, a final pair of heavy latex gloves and a full-face air purifying respirator with HEPA cartridge. All openings were taped. The stainless steel end-caps covering the duct ends were removed with a HEPA vacuum held at the work point. After both end-caps were removed, contamination levels were evaluated by the radiological control technician (RCT). Direct survey results at both ends of the duct indicated contamination levels excess of 4,000,000 dpm/100cm^2 alpha (saturation point of the instrument). Smears collected at the same locations indicated removable contamination levels of approximately 200,000 dpm/100 cm^2 alpha. Dose rates was indistinguishable from background. Decontamination was attempted using a wire brush (<$5.00 hand tool). An area 6-in. by 12-in. was brushed for 5 to 10 minutes using a HEPA vacuum to collect the dust. There was a visible difference in the appearance of the decontaminated area after the brushing. Evaluation of this area indicated that the contamination had been reduced from greater than 4,000,000 dpm/100 cm^2 to 200,000 dpm/100 cm^2. Airborne contamination levels reached a peak of 45 Derived Air Concentration (DAC) Pu-239.

4.1.2 Strippable Coatings

The second decontamination method evaluated was the use of strippable coatings. Two different coatings were evaluated, ALARA 1146 cavity paint, a commercially available product, and SensorCoat, a product developed and produced by LANL. SensorCoat is a water-based, nontoxic polymer strippable coating. The presence of contamination is indicated by a color change in the SensorCoat. The SensorCoat was evaluated in three different formulations, 4% glycerin, 8% glycerin and 12% glycerin. The higher the percentage of glycerin in the SensorCoat, the higher the viscosity and the better the adhesion. The item selected for the decontamination evaluation was the access hatch to a filter plenum, a piece of stainless steel 3-ft. wide by 6-ft. long. The hatch was placed flat on saw horses inside the containment and unwrapped. Contamination levels were evaluated with an alpha survey meter, a Ludlum Model 139 with an air proportional detector. Direct survey measurements indicated contamination levels in excess of 4,000,000 dpm/100 cm^2, spread uniformly over the hatch surface. The hatch was then divided into five equal sections. Sections were then brush painted with strippable coatings, ALARA cavity paint and the three formulations of the SensorCoat. The remaining section was left unpainted. After a 48 hour drying time (over a weekend), the ALARA paint and SensorCoat were removed and surface contamination levels re-evaluated. The results are as follows:

No coating or paint	>4,000,000 dpm/100 cm^2
ALARA cavity paint	600,000 dpm/100 cm^2
4% glycerin Sensor coat	320,000 dpm/100 cm^2
8% glycerin Sensor coat	220,000 dpm/100 cm^2
12% glycerin Sensor coat	160,000 dpm/100 cm^2

An evaluation of the results would indicate that the 12% glycerin SensorCoat provides superior decontamination.. In actual use the SensorCoat proved to be difficult to use on anything but horizontal surfaces, running down curved or vertical surfaces and proved to be more difficult to strip than the ALARA cavity paint. With further development, the SensorCoat may prove to be an extremely useful alternative to commercial products. Additional information on SensorCoat may be obtained from Betty Jorgensen, MST-7, Mail Stop E549, Los Alamos National Laboratory, Los Alamos, NM 87545; (505) 667-7059 or FAX (505) 667-8109.

4.2 *Process Exhaust Decontamination*

Brushing of the duct was selected over use of strippable coatings for decontamination of the process exhaust duct. Before decontamination work began, the brushing process was discussed in great detail with management personnel, craftsmen and the RCTs. A work package was developed to control work and to identify and mitigate hazards. The work package consisted of decontamination procedures, a task hazard analysis, and the radiological work permit. The basic brushing decontamination procedure consisted of driving a commercially available brush through the ductwork and capturing the radioactive contaminant in a HEPA vacuum cleaner. The main components for the process exhaust brushing operation consisted of the brush attachment, brushes, driver motors, shafts, HEPA vacuum cleaner, rolling platform, and glove bags (figure 4-1).

(Fig. 4-1: Brush Decontamination Method Setup)

The brush attachment assembly and end-cap were fabricated out of 22-gauge sheetmetal, approximately 1-in. greater in diameter than the duct being brushed.. A 1 1/2-in. shaft attachment was welded in the center of the brush attachment to pass the shaft driver in through the duct. The shaft was a 3/8-in. black piping salvaged from the scrap pile. The driver initially was a 1/2-in. drill motor. Brushing 24-in. diameter ductwork required 1/2-in. shafts and 3/4-in. drill motors. The brushes were purchased from a commercial dealer and were sized 1/2-in. bigger than the ductwork being decontaminated. Asbestos abatement glove bags were modified on location to accept the size of brush attachment and duct required. A rolling platform was fabricated with V attachments on each end to accept ductwork ranging from 12-in. to 36-in. in diameter.

The process exhaust decontamination operation consisted of the ductwork being placed on the platform and a glove bag attached to the out flow side of the duct. A HEPA vacuum hose was attached to the bag in order to draw the contaminant through the duct while the brushing operation was being performed. Another crew attached a glove bag to the intake side of the duct along with the brush attachment. The glove bags were tested for leakage by applying hand pressure and visual inspection. The vacuum cleaner was turned on which caused a negative on the ductwork. A 2-in. diameter plug was drilled on the duct at 4 different locations and direct readings were taken by the RCTs to determine the levels of fixed plus removable contamination. Plug locations were strategically chosen by knowledge of process, typically on the underside of the duct. If direct measurements exceeded predetermined values, the plugs were then bagged out of the containment area and analyzed specifically for Am-241 concentration by gamma spectroscopy . Gamma spectroscopy and/or direct measurement results were then conveyed to the decontamination crew. At this point, either the brush operation continued or, if the results were negative, the glove bags were removed, the ends of the duct capped, the duct wrapped with sheet plastic to control contamination and then the duct was removed from containment and staged for disposal. In the case of the radioactive contamination exceeding transuranic levels, the crew placed the first shaft on the brush along with the electrical drill and started brushing. An individual member of the crew was stationed on the end of the duct where the vacuum was attached and verified that the brush was performing the job as designed as well as monitoring the vacuum cleaner. Two passes were made with the brush depending on the length of the duct being cleaned, typically 19-ft. Once the crew believed the duct was cleaned another set of plugs were drilled and sampled. As soon as the samples proved acceptable, the glovebags and attachments were removed in reverse order of installation. If the brush had not worn to the point of being ineffective, it was retained, another glovebag fitted over the bag the brush was contained in , and re-used on the next duct. If the brush was worn out, it was discarded as TRU waste.

4.3 Glovebox Decontamination

Gloveboxes were introduced into the Room 406 containment by setting it on either a crank-up table or pallet dolly and moved to the end of the containment where the negative air inlets were located (figure 4-2). Next, a negative air flexible duct was attached to the glovebox, at the pan (bottom) level so air could be drawn from the cleanest part, i.e., the top and sides across the bottom and out. Most of the gloveboxes had ports at both ends which made this task easier. In some cases a glove port was used. Many of the gloveboxes still had their make-up HEPA filtered air systems intact and were uncovered after the flexible duct was attached. Once the negative air was connected and functional, an entry on the top opposite end of the glovebox was opened up, by either unbolting or cutting a panel. Nibblers were use primarily to cut up the gloveboxes (and ducts), reciprocating saws and portable band saws were also used. Tools were selected for effectiveness and to be non-spark producing. Direct measurements for alpha were made to determine their levels and the gradient of contamination from top to bottom. ALARA cavity paint was then applied, allowed to dry and stripped, then bagged out near the negative air end of the box. This process was repeated until no appreciable loose contamination could be removed and contamination levels were below TRU and if possible within SEG waste acceptance criteria. Asbestos "lockdown" was then sprayed on the interior surfaces of the glovebox. On some of the gloveboxes the strippable ALARA cavity paint was used and then a commercial cleaner such as Fantastic was used to finish removing the loose contamination.

(Fig. 4-2: Glovebox Decontamination Setup)

Using survey information performed after decontaminating the glovebox, disassembly was started at the top opposite end, away from the negative air connection. The reason for this is to disassemble towards the negative air flow to pull the contaminated metal flakes away from the workers and facilitate keeping the containment as clean as possible. Depending on the gauge of the glovebox metal a nibbler was used, and on thicker materials a reciprocating saw had to be used. Cordless drills and basic hand tools were used to remove bolts, screws, glass and gasketing. The only pieces that could not be decontaminated down below TRU were the bottom pans and occasionally the bottom pan and 6 to 8 inches of the bottom sides. The pieces were strategically cut, wrapped and stacked to take the maximum advantage of space within the waste boxes.

As gloveboxes were being size reduced, the pieces were wrapped and marked as to their radiological levels and color coded. The color code was magenta for TRU and yellow for low-level waste. The waste packages were then wiped down and staged near the airlock farthest away from the negative air inlets. When the waste was removed from the containment, one laborer entered into the airlock and one was in the containment. The person in the airlock had "clean" bags and would double bag the waste from the person in the containment. The person in the airlock never stepped into the containment, nor did the containment laborer step into the airlock. Once the waste was double bagged and marked, it was put in either the TRU waste or low-level waste containers.

4.4 Process Improvements

Early on during the duct decontamination operation, saw horses were used to support the duct. These proved to be too low to work comfortably and allowed the duct to roll. The saw horses were replaced by adjustable height "V" stands that cradled the duct. This was a tremendous improvement, however, the duct still had to be manhandled into and out of the containment. The decommissioning contractor craftsmen designed and fabricated a rolling 3-ft. x 5-ft. cart with "V" shaped duct support arms. A forklift was used to load the cart with duct and the cart was then rolled into the containment. The duct was then decontaminated to acceptable levels, capped, and the exterior surfaces of the duct and cart decontaminated to allow them to be removed from the containment. After the duct and cart were removed from the containment, the duct was then unloaded from the cart with a forklift. The use of this cart eliminated manhandling the duct and placed the duct at a comfortable work height. Turn around time between pieces of duct was reduced, increasing productivity.

During brushing operations, increased contamination levels were noticed in the containment by the RCT performing direct measurements of the containment floor and work tables. Operations were halted until the source of contamination was identified and controls put in place. Investigation indicated that a partial blockage in the HEPA vacuum hose reduced the negative air flow on the interior of the duct. This allowed a large amount of airborne contamination into the containment through the make-up air holes in the wire brush shroud. The corrective action was to provide HEPA filtered make-up air to the interior of the duct being decontaminated. Short pieces of tubing were welded over the make-up air holes in the brush shroud. Vacuum cleaner hose was attached to this tubing and routed to a HEPA filter. A metal adapter was fabricated to connect the (four) vacuum cleaner hoses to a standard 2' x 2' HEPA filter. This simple solution prevented any further releases during duct decontamination using wire brushes. This contingency plan eliminated any contaminant release from the inside of the duct to the containment, when the vacuum ceased due to electrical power loss, equipment failure, or employee error. An alpha CAM was introduced into containment and was set to alarm at 15 DAC-hrs. This gave a real time warning of increased airborne contamination concentrations in containment and personnel could then evacuate to the airlock immediately on a CAM alarm.

The use of hand held electrical tools worked well on the smaller ductwork, but the use of free form fitting glove bags with the use of negative air trunk lines had to be employed to complete the cutting operation. This process was successful but time consuming and therefore most of the smaller duct and fittings were relocated and down sized in a modified glove box.

Because of the extent of the initial alpha contamination on much of the ductwork, the standard configuration of the direct alpha measuring equipment caused saturation of the instrument at around 4,000,000 dpm/100 cm^2. This was corrected two ways. One solution was to cover 90% of the active area of a Ludlum 44-3 ZnS probe with duct tape (figure 4-3). The active probe area was reduced to a 2.8 cm diameter circle. A reduced efficiency for alpha was then established using a 2.8 cm diameter Pu-239 check source. This allowed a somewhat more accurate way of measuring alpha contamination to levels approaching 6,000,000 dpm/100 cm^2. A second solution was to work with the instrument manufacture to modify a Ludlum 2350 (data logger) count rate meter/scaler to increase its maximum range to greater than 10,000,000 dpm/100 cm^2.

(Fig. 4-3: Ludlum 44-3 Probe Modification)

6.0 WASTE MANAGEMENT

Waste minimization was a significant project goal. Particular attention was paid to decontaminating TRU waste to low-level waste. Initially, TRU waste constituted 120 m^3 of the total. This amount was reduced to 20 m^3 of TRU waste through decontamination and compaction of the remaining fraction. Likewise, low-level waste was compacted on-site. Contaminated metal was recycled with two different companies, SEG in Oak Ridge, TN, and the Savanna River Plant. A considerable amount of steel was surveyed and free-released. Lastly, decontaminating a portion of the building structures enabled free release of all demolition debris. This material was crushed and recycled. Waste acceptance criteria for the project was as follows:

Table 6- 1: Project Waste Acceptance Criteria

	1/4" Steel (dpm/100cm^2)	16 Gauge Steel (dpm/100cm^2)	Heavy Plastic (dpm/100cm^2)
LLRW	<88,000,000	<26,800,000	<26,000,000
Transuranic	≥88,000,000	≥26,800,000	≥26,000,000
SEG Recycle	<880,000	<268,000	NA

Note: Total fixed plus removable surface contamination

The ductwork was reduced in size and packaged in two major methods - telescoping and cutting (nibblers, reciprocating saws, and shears). Telescoping the smaller ducts into larger ducts increased the density of the transportainers (8' X 8' X 20' sea/land container) used to ship to the low level radioactive disposal site. Each piece of duct was sprayed with asbestos lock down material (a very inexpensive asbestos fixadent) prior to inserting the smaller duct into the larger. The difficulties encountered were during the insertion process due to insufficient negative air flow on the bigger size duct. The remedy was to place a poly liner on the outer diameter of duct and allow the smaller duct to seal against the poly as the duct was manually pushed in. The poly end cap on smaller duct was cut and the vacuum hose attached before the next piece of duct was inserted.

7.0 LESSONS LEARNED

Duct decontamination proved very difficult. Decontamination processes evolved continuously with airborne emissions and production concerns being the major drivers. Initially, strippable fixatives were sprayed inside a removed section of duct, the duct was cut in half, and the fixative peeled off. This practice resulted in airborne emissions that would have required supplied-air respiratory protection if performed for a full day. Such operations are more costly and greatly increase the risk of worker contamination. Instead, the duct was brushed out, with many engineering barriers to control the airborne radioactive emissions. Since TRU waste must be size reduced to drums or standard waste boxes, disposal alone can also be difficult. Gloveboxes proved easier to decontaminate and size-reduce.

All but one of the gloveboxes were contaminated with Pu-239, with the exception of one that contained Pu-238. The Pu-238 glovebox had to be treated differently, after it was found that the Tyvek material used for the outer layer of anti-C protective clothing was permeable to Pu-238 contamination. Common practice was to have the RCTs "frisk" the workers' anti-Cs as they doffed. It was discovered that the contamination had somehow wicked its way through the outer layer of Tyvek on to the inner layer of cloth coveralls. On further investigation of the contaminant, it was found to be Pu-238. Pu-238 has a higher dispersion coefficient than Pu-239, due to its higher specific activity. As a result, decontamination of this glovebox required more restrictive engineering and handling controls. Increased handling time on this glovebox was approximately 30% more than the Pu-239 gloveboxes.

Other lessons learned included the importance of verifying all systems being operational prior to start of process, contingency plans in case of equipment or electrical power failure, and employees staying focused on the task at hand. In one particular case the vacuum cleaner failed during the operation and negative to the duct was lost. Investigation after the incident proved that only the individual who had plugged the unit in had knowledge of the power source. This caused concern and a contingency plan was established and implemented to let all employees working the process to verify the location of all power sources for each piece of equipment being used. The decontamination of the ductwork lasted approximately 2 months and it was difficult to keep individual team members always on the same crew, therefore additional training was required each time a new member entered the operation. Keeping this concentrated focus was difficult. Initially we were entering the containment 3 times in a 10 hour shift, but as the ductwork pieces became larger and harder to handle the shift was restricted to 2 entries. The remaining time was concentrated on other tasks to maximize cost effectiveness on the project.

8.0 CONCLUSIONS

Relying on the project plan, the site specific health and safety plan, and individual task work packages, as the authorization basis proved efficient and cost effective. Augmenting critical operations with risk management experts also avoided unnecessary documentation and concentrated attention on important risks. The Project's safety record was very good, there were no radiological incidents, reportable occurrences, or worker injuries. Many factors contributed to this record. Active involvement of the entire project team, and particularly decommissioning workers, resulted in thorough requirement identification, and appropriate hazard analysis and communication. Worker input into procedures ensured efficient, safe work packages. Also, daily safety meetings introduced and reinforced safety topics.

It is possible to decontaminate and size reduce highly contaminated (transuranic) process exhaust and gloveboxes safely and economically. The size reduction efforts on this project (this includes the entire system) resulted in a waste cost savings of 3.3 million dollars. The knowledge and expertise gained will be a major factor of cost savings in future decontamination and decommissioning projects.

Goals and objectives to decontaminate the ductwork by brushing were established. All of the ideas and techniques were generated by personnel scheduled to perform the job and incorporated into the work procedures after conducting several brainstorming sessions. First, the idea to fabricate the end-cap came from our sheet metal foreman. Second, an RCT recognized the need for filtered air make up to eliminate any release of contaminants. Third, the glovebags were fabricated on site using commercially available asbestos bags for each particular application. Fourth, since the designated team placed the work package in motion, every one knew their key roles and responsibilities.

9.0 ACKNOWLEDGEMENTS

Dan Stout, TA-21 Decommissioning Project Leader, LANL.

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