REPLACEMENT OF THE HIGH-LEVEL WASTE OFF-GAS FILTERS AT THE WEST VALLEY DEMONSTRATION PROJECT

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ABSTRACT

During high-level radioactive waste (HLW) vitrification processing at the West Valley Demonstration Project (WVDP), the two vessel off-gas high-efficiency particulate air (HEPA) filters became highly contaminated and developed very high dose rates after a prefilter failed. The off-gas filter system consists of two parallel trains, each with two HEPA filters located in series. The first filter in each train (64-T-009 A1 and 64-T-009 B1) was affected. Based on measured and calculated dose rates through the 152-millimeter (mm) (6-inch) thick steel shield doors, it was determined that the dose rate on the face of these filters was 47 R/hr and 25 R/hr, respectively. Functionally, both filters were operating properly. Differential pressure across each filter bank was well within limits and in-place filter test results were satisfactory. Environmental stack emissions confirmed that no federal regulatory standards or DOE guidelines had been exceeded. Based on future radiological concerns, it was determined that the filters should be replaced. Changing the filters later, when differential limits required, would likely result in higher dose rates thereby making the change that much more difficult.

This project contained several significant safety and environmental hazards that needed to be addressed. Based on the given physical parameters, it was determined that the filters would have to be removed from the filter housings manually by operators working in close proximity to the unshielded filters.

The plan was to conduct the filter replacements in four phases. Phase 1 was to remove a previously installed containment bag from the plenum opening. This phase of the project was expected to expose the operators to the highest dose and also be the most difficult with regard to the potential spread of contamination. After removal of the plenum bag, the A1 filter would be removed in Phase 2. Removal of the B1 containment bag in the same manner as the A1 bag was slated for Phase 3, while Phase 4 was to remove the B1 filter. Exposure during Phases 3 and 4 was expected to be much less than Phases 1 and 2, but the contamination potential still remained significant.

Although the operators would be working in close proximity to the filters, they would not have visual access for this hands-on activity. They would essentially be performing the filter removal “in the blind.” To address this issue, a full-scale mock-up was designed and constructed. The operators that were to perform the work in the field began training on the primary removal methodology. In addition, the necessary tooling was developed by Engineering. Operator involvement in the development and use of the mock-up was extremely beneficial.

Strict as-low-as-reasonably-achievable (ALARA) principles were incorporated into the scope of work. The key to minimizing exposure was rapid removal of the filters into a shielded box. Extensive mock-up use and training were utilized to develop methods that reduced the time spent in the area and minimized the spread of contamination. Although the ability to maintain distance from the source was limited, the operators were able to implement techniques that allowed them to avoid the direct dose paths as much as practical.

The mock-up efforts proved to be invaluable. Both filters were removed and replaced safely without incident. The total accumulated dose for the removal of both filters was less than 50 percent of the pre-job estimate.

This paper will discuss the significant challenges associated with the highly successful HLW vessel off-gas filter change; focusing on: project team involvement, ALARA concept implementation, mock-up preparation and use, and actual hands-on field activities and opportunities.
BACKGROUND

The West Valley Demonstration Project (WVDP) (the Project) is an environmental-management project located approximately 56 kilometers (35 miles) south of Buffalo, New York, at the site of a former nuclear fuel reprocessing plant. The site is owned by New York State. The U.S. Department of Energy (DOE) is conducting the Project in cooperation with the New York State Energy Research and Development Authority (NYSERDA). The management and operations contractor is West Valley Nuclear Services Co. (WVNS), a part of Westinghouse Government Services, a member of Washington Group International Inc.

In 1962, the Davison Chemical Company established Nuclear Fuel Services, Inc. (NFS) to construct and operate the first commercial nuclear fuel reprocessing plant in the United States at the Western New York Nuclear Service Center. NFS leased the land from the state, construction was completed February 1966, and fuel reprocessing began in April. NFS operated from 1966 to 1972, reprocessing about 640 metric tons (705 short tons) of spent nuclear fuel to recover usable uranium and plutonium. The plant was shut down in 1972 for modifications to meet new regulatory requirements and never reopened.

The West Valley Demonstration Project Act was signed into law by President Carter in 1980. The Act authorized the U.S. Department of Energy to complete five specific actions at West Valley: solidify the liquid high-level radioactive waste stored in an underground tank into a solid form suitable for transport and disposal; develop containers suitable for the permanent disposal of the radioactive waste solidified; transport the solidified waste to a federal repository for permanent disposal; dispose of low-level radioactive waste and transuranic waste produced by high-level waste operations; and decontaminate and decommission the tanks, facilities, and material/hardware used in connection with the Project. In 1982, DOE and WVNS, the management and operating contractor, assumed operational control of the approximately 81-hectare (200 acre) facility. After a five-year testing program was completed in 1989, the Vitrification Facility was constructed and vitrification operations began in 1996. The first phase of vitrification operations was completed on June 9, 1998.

During the vitrification phase, off gasses are processed through the vitrification off-gas system.

FACILITY CONFIGURATION AND ESSENTIAL FEATURES

The Ex-Cell Off-Gas System provides essential services to the high-level waste vitrification system and the environment. This system provides the motive force to maintain a negative force on the In-Cell Vitrification process equipment. It has a series of filter banks that remove the radioactive particulate and provides for the destruction of acidic oxides of nitrogen generated during the vitrification process.

The Ex-Cell Off-Gas System was designed for maximum use of existing facilities and equipment. To this end, the previously existing high efficiency particulate air (HEPA) filters, filter housings, and building in which they were installed, the 01-14 Building, were included in the design.

The gases pass through one of two redundant off-gas preheaters to elevate the gas to a temperature well above its dew point to protect the subsequent HEPA filters from the deleterious effects of condensation.

The gases then pass through the HEPA filters. In each of the two parallel filter trains there are two HEPA filter elements connected in series. The gases pass through one filter train while the other remains available as an installed back-up. The purpose of the HEPA filters is to provide final atmospheric protection against dispersion of radioactive particulate. The integrity of the filter elements, and the seals between the elements and the housings, is verified by in-place leak testing.

Following HEPA filtration, the gases pass through previously existing but now empty filter housing. One housing is located immediately downstream from each HEPA filter train. These housings were retained for possible future use.
Following filtration, the gases pass through an off-gas blower. Three blowers are installed in parallel, one operating, and the others providing reliable, independent backup. The blower provides the motive force to maintain all the vitrification equipment upstream under a slight vacuum, maintaining contamination control. It also provides the motive force to discharge the treated gases to the atmosphere.

HEPA Filtration

The HEPA filter housing assembly 64-T-009 is "previously existing equipment" purchased around 1970 (as detailed in Fig. 4). Both parallel HEPA filter trains are contained in a common housing made from 6-mm-thick (1/4-inch) Type 304L SS plate. The housing accommodates filter elements 610 mm x 610 mm x 292 mm deep (24 inches x 24 inches x 11-1/2 inches deep). The filter elements are held in place by air piston-actuated, remotely operated, clamping devices. Gases enter from the bottom of the housing, pass horizontally through two filter elements, then exit from the top of the housing. HEPA Elements 64-T-009A1 and 64-T-009A2 are located in the top portion of Housing 64-T-009, and HEPA Elements 64-T-009B1 and 64-T-009B2 are located in the bottom portion of the housing. Access to the 64-T-009 filters is obtained from the third floor of the 01-14 Building in a room approximately 5 meters (m) x 5 m (16 feet x 16 feet).

To provide remote switchover, automated operators were added to the previously existing butterfly valves at the inlets to the HEPA filters and outlets of the filter housings (64-T-010A and 64-T-010B). Each filter element position has a bag-out port. Each of the bag-out ports is located behind a 152-mm (6-inch) thick carbon steel shield door. Each shield door is mounted on two steel wheels and can move along a horizontal rail by use of an air cylinder.

Empty Filter Housings

The filter housings (64-T-010A and 64-T-010B) are items of previously existing equipment purchased around 1970. The housings are made from 3-mm (11-gauge) thickness Type 304L SS and are designed to hold filter elements 610 mm x 610 mm x 292 mm deep (24 inch x 24 inch x 11.5 inch deep). The change-out ports are designed for "bag-in" and "bag-out."

THE PROBLEM

During routine radiological surveys of the 64-T-009 filter housings, a reading of approximately 3 mRem/hr was detected through the 64-T-009 A1, 152-mm (6-inch) thick steel shield door. Subsequent surveys and calculations indicated that a dose rate of approximately 47 R/hr and 25 R/hr existed at the face of HEPA Filters 64-T-009 A1 and 64-T-009 B1, respectively. Functionally both filters were operating properly. Differential pressure across each filter bank was well within limits and polyalthaolefin (PAO) test results were satisfactory.

Challenges

The system was designed and built to perform with manual, hands-on, filter replacements thereby making this task a significant radiological challenge. The necessity to have personnel physically handle 47 R/hr and 25 R/hr filters at close proximity posed significant engineering and radiological issues. Complicating the upcoming filter change was evidence that the bag-out poly bags were in place over the plenum opening. High contamination levels were expected inside the plenum and on the poly bags. Based on expected high dose rates and the need for significant contamination controls, pulling the filters into the bags during extraction was deemed impractical.

A project team consisting of design, radiological, and system engineers was developed to evaluate various approaches to change out the filters. The hazards to be overcome included: the presence of high radiation fields, radioactive contamination including liquid contamination, mercury, work space constraints, ventilation control issues, and the need for hoisting and rigging.

Visual inspection of the 64-T-009 A1 plenum cover and direct dose rates were obtained behind the 152-mm (6-inch) thick shield door to help establish known parameters such as dose rates in the work area and initial contamination
levels. This was accomplished by opening the shield doors for a limited period of time and obtaining video and radiological surveys, focusing on the plenum cover. The initial inspection revealed that the poly bag, intended for filter bag-out, was in place as evident by the securing strap at the plenum opening behind the plenum cover. Dose rates at the surface of the plenum cover were approximately 3 R/hr, which was consistent with calculated rates based on readings through the 152-mm (6-inch) thick shield doors. No smearable contamination was detected on the outside surface of the plenum cover.

Based on the known physical parameters; including existing system design, radiological conditions, and facility configuration; the team developed initial methods and tooling concepts. A systematic and dynamic removal plan was designed that kept contamination control and minimization of exposure in the forefront.

Adding to these challenges were the site limits for individual personal exposures of 100 mRem/day and 500 mRem/yr. Preliminary dose estimates indicated that several individuals would be required to complete the task while maintaining personal exposure limits.

**Tooling**

The first challenge addressed was the need to access the housings and get close enough to extract the filters from the plenum. Issues that required consideration were: how to shield the operators once the 152-mm (6-inch) thick shield door was opened; what to grab the filter with; and how to control contamination while extracting the filter from the plenum.

The initial concept utilized a 76-mm (3-inch) thick steel wall shield box to reduce dose rates from the filter and remote tooling to grab and extract the filter. The operators would manipulate remote tooling from outside the shield box to grab the filter. To help control contamination, the filter would be pulled into a sheet metal containment box that was strategically positioned between the plenum and shield box. The containment box, with the filter inside, would then be pulled into the shield box and the shield box sealed. There was not a time during the evolution that the operators would be able to see the filter. Complicating the situation, the physical dimensions of the plenum left little room for the remote tooling, sheet metal containment box, and filter. The design of the tooling had to allow for positive acquisition of the filter while operating without visual access. Design drawings were developed and fabrication of the primary tooling was initiated.

A more difficult challenge, however, would be removing the poly bags from the opening of the plenum. The poly bags installed over the plenum opening, initially intended to be used in the filter removal process, first had to be removed to gain access to the filter. It was determined that utilizing the bags during the filter removal evolution was not practical for several reasons. The first of these was that although it was evident that the bags were present behind the plenum cover, it could not be determined what condition the bags were in nor what configuration the bags were in. The second was that the dose rates of the filters were so high that manually reaching into the plenum through the bag to grab the filter and pull it into the bag unshielded would expose personnel to unacceptable radiation levels. Initial concepts included a glove box configuration that would attach to the face of the plenum. Operators would reach into the glove box, while standing to the side of the plenum opening utilizing the plenum wall for shielding, and remove the poly bag from the plenum.

**Expanding the Team**

The known parameters and conditions were established and initial tooling and removal concepts developed. Although field personnel; including radiological technicians, operators, and supervisors; had been discussing the scope of the project with the engineering team during initial development, their involvement was minimal to this point. During the development of workable solutions it proved necessary to then add these disciplines to the team on a full-time involvement basis. The new project team mix of technicians, operators, engineers, safety professionals, and management would prove vital in developing viable solutions to the problems
posed during early development. The primary work groups responsible for the project continued to include Radiation Protection (RP), Decontamination and Decommissioning (D&D), and Industrial Hygiene and Safety (IH&S).

Full-Scale Mock-Up and Work Group Involvement

The initial tooling concepts were developed with as much simplicity as possible keeping in mind that the evolution must be executed in the field in restrictive and limiting physical and radiological conditions. However, extracting the high-dose, highly contaminated filter into a sheet metal containment box, without visual access and using remote tooling, required exacting dimensions and methods. The use of a full-scale mock-up was designed and constructed to help develop the tooling and methods to a point of perfection.

The mock-up served two specific and equally important functions. The first was to act as a device to help complete development of the tooling and methods for the poly bag and filter removal. Primary operators and technicians, as well as back-up personnel, were identified to perform specific tasks of the evolution. The operators began by utilizing the mock-up to perform several evolutions of both the poly bag removal and filter extraction, implementing the initial concepts developed by engineering as well as the ALARA principals. Each time the evolutions were performed, the operators and radiological technicians developed new and more efficient concepts for both tooling and methods for performing the tasks. These ideas were discussed and evaluated with the various groups and then were implemented as appropriate.

The second purpose of the mock-up was to provide a tool for the operators to perfect the methods of poly bag and filter removal as well as implementation of the tooling. It was during this segment of the project that methods for ventilation control were developed. As with the development of the tooling, the operators continually practiced the evolutions in an effort to understand exactly the positions and roles of everyone involved. With each evolution, operator proficiencies and efficiencies improved resulting in methods that would minimize time spent in the radiation area as well as minimize the spread of contamination.

Final Tooling and Method Configuration

After several evolutions of the mock-up, and significant input and contributions from the operators and technicians associated with the project, the tooling and methods took final form.

Removing the poly bag from the opening of the plenum employed a glove bag as opposed to the initial concept of a glove box (Figure 1). Handling the glove bag proved substantially more time efficient and easier to manipulate than a glove box. Power drill motors were used to remove the four swing bolts that held the plenum cover in place thereby greatly reducing time spent at the face of the plenum. The roller table assembly would be utilized as a work table to support the glove bag during the evolution.
The primary shield box for the filter removal was constructed of 76-mm (3-inch) thick stainless steel on all sides except the bottom which was constructed from 51-mm (2-inch) thick stainless steel (Figures 2 and 3). Based on calculations, this would provide enough shielding to reduce the calculated dose rate from a maximum of 47 R/hr on the face of the filter to approximately 700 mRem/hr on contact with the shield box when the filter was in the box. The door of the box was hinged and the inside perimeter contained a neoprene gasket to provide a seal when closed. The door was temporarily held closed with over-the-center pull clamps and permanently sealed closed with two swing bolts. The back of the box had two access ports, one above the other. The top port was the access port for controlling the sheet metal containment box. The bottom port was used to guide the remote tooling through the shield and containment box on the way to the filter. A pair of 25-mm (1-inch) thick carbon vent filters were installed on the top left corner of the shield box to help with air expansion during storage. The shield box weighed 1.4 metric tons (3,700 lbs.) and was lifted with a 1.8-metric ton (2-short ton) overhead crane.
Fig. 2. HEPA Filter Removal Tooling (Plan)
The box was placed on a roller cart assembly that was constructed of 6-mm (1/4-inch) thick stainless steel and six ball transfer units. The roller cart allowed the shield box to be moved towards and away from the plenum face on a roller table assembly. The roller table assembly was constructed of carbon steel and provided support for the shield box as well as a travel rail for the roller cart. The roller table assembly was temporarily fixed to the plenum face at one end, providing positive dimensional placement, and a removable leg assembly at the other.

The sheet metal containment box was fabricated from 3-mm (11-gauge) thickness stainless steel. The outside dimensions of 313 mm x 619 mm x 673 mm deep (12.31 inch x 24.38 inch x 26.50 inch) allowed the box to fit into the plenum, while the inside dimensions allowed room to fit the extracted HEPA filter measuring 292 mm x 610 mm x 610 mm deep (1.5 inch x 24 inch x 24 inch).

The containment box pull bar passed through the back of the shield box and attached to a threaded toggle pad at the back of the containment box. The pull bar was used to insert the containment box into the plenum in preparation to receive the filter.

The filter pull bar passed through the back of the shield box and through the back of the containment box. At the head of the filter pull bar was the filter removal clamp and shoe. The purpose of the shoe was to guide the clamp through the plenum and position the clamp against the filter. The purpose of the clamp was to grab the filter and positively lock the filter to the pull bar.
Ventilation Control

The presence of highly radioactive airborne particulate in the plenum posed the most significant contamination control issue. Although a tent was constructed around the work area and plenum face to provide containment, ventilation of the tent was required to ensure workers were protected against extreme airborne particulate and the work area in the tent remained radiologically uncontaminated.

Two 0.06 m$^3$/sec (125-cfm) HEPA vacuums were selected to provide ventilation on the plenum during both poly bag removal and filter extraction (Figure 4). The plenum required isolation from the system ventilation supply. This would be obtained by closing upstream and downstream isolation valves. The two HEPA vacuums were connected to the isolated plenums through the empty filter housings (64-T-010A and 64-T-010B) located one floor above the Filter Room. Ventilation was controlled by a manifold that was connected to both vacuums. The manifold consisted of a series of blast gates that were manually operated to control volume and velocity at the plenum face.

Instrumentation was developed to confirm that the plenum was isolated and the system negative pressure could be relieved from the isolated plenum when desired. This was important to determine because it would not be possible for operators to remove the 0.19 m$^2$ (2 ft$^2$) plenum covers from the plenum opening by hand with 20.4 kPa (82 in.) H$_2$O negative on the cover, yet it was desired that the system negative be applied between phases of the evolution.
Field Operations

Field preparations for the project began by inspecting and conducting maintenance on all mechanical equipment involved with the evolution. Shield door cylinder actuation valves were replaced and tested. The 1.8-metric tons (2-short tons) hoist was inspected and load-tested, and the filter clamp cylinders were cycled to check their function. A containment tent was constructed around the face of the plenum encompassing 90 percent of the Filter Room. A remote-controlled video camera was installed in the tent to aid with communications, specifically with operators and engineers controlling ventilation on the upper floor.

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Staging of support equipment such as the roller table, roller cart, shield box, and remote tooling was performed prior to opening the shield door to take advantage of the radiologically clean area with zero radiological dose.

The upper filter, 64-T-009 A1, was selected to be changed first for two reasons: the physical constraints of the room and tent made work on the upper filter ergonomically more practical; and removing the highest source of dose first would lead to reduced dose rates during the lower filter (64-T-009 B1) change.

Each filter replacement was performed in two phases. The first phase was to remove the bag-out poly bag that was in place over the plenum opening behind the plenum cover. It was during this phase that operators were expected to receive the highest dose based on the requirement to perform the task in front of the unshielded plenum. It was also the performance of this phase that posed the greatest risk of loss of contamination control. Precautions were required when removing the plenum covers in expectation that contaminated condensate could be present. The system negative was relieved while two D&D operators and a radiological technician opened the shield door and removed the plenum cover. The operators then removed the poly bag and placed it in the plenum. Ventilation was controlled by D&D operators and engineers, monitoring the evolution from the floor above via the remote camera system. The blast gates of the vacuum system manifold could be operated and coordinated at specific times to provide the appropriate volume and velocity at the face of the plenum based on where in the process the operators at the plenum were at the time. Once the poly bag was placed in the plenum the glove bag was placed over the plenum rim and secured in place with a nylon strap. Ventilation was reduced to a minimum at this point to prevent collapse of the glove bag. The poly bag was then pulled into the glove bag, simultaneously increasing ventilation. The glove bag was removed from the plenum rim and sealed. A temporary cover was placed over the plenum opening and the shield door closed.

The second phase removed the highly contaminated HEPA filter and installed a new HEPA filter. The shield box, roller cart, sheet metal containment box, and remote tooling were staged in position on the roller table while the shield door was closed. Three D&D operators and a radiological technician opened the shield door and removed the temporary cover. Again, ventilation was controlled and coordinated from the floor above. The shield box was slid forward on the roller table to the face of the plenum as close as possible to minimize the dose path and aid in ventilation control. The containment box was inserted into the plenum at a predetermined distance to maximize contamination control at the plenum opening and the roller cart was locked in place. Operators clamped on the filter with the remote tooling, as practiced and developed in the mock-up, and extracted the filter into the sheet metal containment box. Ventilation was at a minimum at this point to prevent the sheet metal containment box from collapsing and preventing the filter from fitting into the containment box. The filter and containment box were then extracted from the plenum into the shield box. Ventilation was increased as the containment box exited the plenum. A guillotine gate was inserted into the opening of the shield box providing contamination control while the shield box was being pulled away from the face of the plenum and the source of ventilation. The remote tooling was removed from the shield box. Radiological surveys were conducted and the shield box was lifted with the overhead crane and transported to shielded waste boxes in preparation for long-term storage. The replacement HEPA filter and permanent plenum cover were installed and the shield door was closed.

CONCLUSIONS

The dose rate calculations on the face of Filters 64-T-009 A1 and 64-T-009 B1 of 47 R/hr and 25 R/hr, respectively, proved to be very accurate. The 64-T-009 A1 shielded waste box read 700 mRem/hr on contact and the 64-T-009 B1...
shielded waste box read 230 mRem/hr on contact. The measured dose rates correlate well with the calculated rates used to estimate the expected dose to personnel. The actual accumulated dose received by personnel was 228 person mRem. This compares to the pre-job estimate of 517 person mRem. The early involvement of the D&D operators and RP technicians was key to the implementation of excellent ALARA methods that were vital to minimizing exposure. Among these methods were the extensive use of mockups, shielding, and power tools, all which resulted in reduced stay times and ultimately reduced exposure.

Contamination levels were kept to a minimum throughout both filter removals. Levels in the tent and on the tooling/equipment were less than 200 dpm alpha/beta smearable. The shield doors did get contaminated during the B1 filter removal to levels between 236 dpm and 3,808 dpm alpha/beta smearable. The doors were decontaminated in two attempts.

SUMMARY

Replacing the 64-T-009 A1 and B1 filters proved to be an extremely physical and radiologically challenging task. This project contained the following several significant hazards that required consideration: extremely high dose rates, high contamination levels, ventilation issues, the presence of mercury vapors, contaminated liquid (water), heavy equipment/tooling, hoisting and rigging heavy loads, and work space constraints.

Based on measured and calculated dose rates, it was determined that the dose on the 64-T-009 A1 and 64-T-009 B1 filters was 47 R/hr and 25 R/hr, respectively. No other filter at the WVDP has ever been manually pulled with dose rates of this magnitude by operators working in close proximity [as close as 76 mm (3 in.) and no further than 762 mm (30 in.) at any given time] to the filters themselves. Each filter change was conducted in two phases. The first phase removed the poly bag from the plenum opening. This phase, as expected, exposed the operators to the highest dose of the project as well as being the most difficult in regard to the potential spread of contamination. The second phase removed and replaced the HEPA filter. Although the operators were closest to the filter during this evolution, shielding would limit exposure to something less than half that of the first phase.

The development of a project team including all work groups involved with the execution of this significantly challenging project proved to be an invaluable approach to successfully and safely completing the filter change outs. Involving the work groups early in the development of the project, specifically the operators and technicians, expanded the experience and knowledge base required to perfect the details required to execute the project. Beginning with the planning and design stages of the tooling and mock-up, the operators and technicians took ownership and responsibility of the job. Throughout the development process the operators and technicians continually contributed to and participated in the engineering of the project. The use of the full-scale mock-up enabled the operators and technicians to exercise several evolutions of the various aspects of the project incorporating all ALARA principles in the process. As a result of each run through the specific task of the project, an improved method was developed, a new more efficient tool design was incorporated, and the amount of time spent in the work area was reduced until each task was performed as efficiently and proficiently as possible.

The 76-mm (3 in.) thick shielded box significantly reduced the working area dose rate of Filter 64-T-009 A1 from 47 R/hr to 700 mRem/hr on contact. Remote tooling was utilized to maintain as much distance from the filters as possible given the physical constraints of the work area. Time spent in the work area was kept to approximately two minutes for each phase. The operators took full advantage of the plenum wall for shielding when working in front of the plenum and when extracting the high-dose HEPA filters. Contamination was minimized primarily through ventilation control.

The work group involvement and mock-up efforts proved to be extremely valuable. Both filters were removed and replaced without incident. A total accumulated dose of 228 person mRem/hr was received in contrast to the pre-job-estimate of 517 person mRem/hr. The maximum individual dose received was 46 mRem (Phase 1 of Filter 64-T-009 A1) with an average of 15.2 mRem per individual. There were no personnel contaminations or permanent facility contaminations. The work groups’ involvement in the development and execution of the project was extremely essential. The involvement of the operators and technicians in the development of the project gave them a
thorough understanding and knowledge of the details and logistics of the process as well as the radiological and industrial implications, enabling the operators to competently assess field conditions and react to unforeseen circumstances in a time-efficient manner. Furthermore, engineering and management were able to take advantage of the additional knowledge and experience that operating and technical personnel had to offer to execute the project in the most effective and safe manner possible. The success of this project hinged on the ability and willingness of the operators to participate and contribute to the development and execution of the project. The operators and technicians were able to perform at an unexpectedly high level due to their participation in the development and planning of the project. This project is an excellent example of teamwork. Getting essential personnel involved up front and working together was key to the success of the 01-14 Off-Gas Filter Change-Out.