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DUCT REMEDIATION PROGRAM
Engineered Access Research & Construction

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Abstract The Rocky Flats Plant, Duct Remediation mission concentrated on removing Plutonium Oxide from the process ductwork in the primary Plutonium processing facility. When possible, remediation took place from existing process gloveboxes. Fifteen locations were identified, however, that required accessing duct runs where no process gloveboxes existed. The building's second floor utility areas had many locations where long, inaccessible duct runs were prevalent. Consequently, an extensive program for design, procurement and construction was initiated to contain and isolate ducts for penetration when existing glovebox sites were not present.

Introduction Figure 1 shows the relationship between all the components of the engineered and installed "PermaCon® location." This paper outlines the design evolution of all the Duct Remediation Engineered Access Research & Construction effort components.

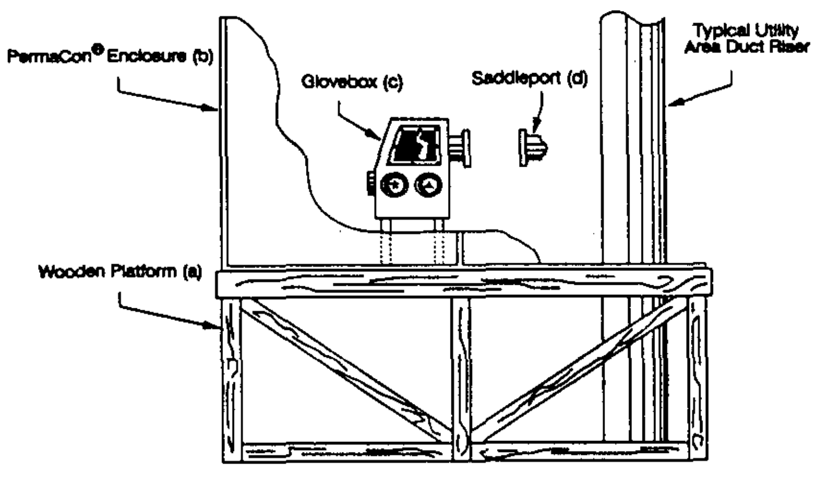

Figure 1. Schematic of engineered access to utility area duct.
(a) Platforms had location specific dimensions.
(b) PermaCon® modular panels formed HVAC Zone II enclosures.
(c) A uniquely designed glovebox served as a Zone I extension.
(d) The "saddleport" transition piece fit the glovebox to the duct.

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DISCLAIMER

The United States Department of Energy (DOE) Order 6430.1A, and 5480.11 provided the basis for the design and safety criteria utilized by the Duct Remediation Engineered Access Program. These criteria, as applied by the Program, were used in combination with several other restrictions: (1) building specific Operational Safety Requirements (OSRs) were to remain in effect; (2) implementation of remediation methods would not significantly affect the overall worker or public risk as defined in the Final Safety Analysis Report (FSAR); (3) qualitative methods were permitted initially, but deterministic or empirical methods and analysis were to be used to document the safety of intended operations; and (4) existing limits for transuranic (TRU), mixed hazardous, and low level waste storage would remain in effect. Within the boundary established by these requirements, the following pertinent engineering criteria were developed:

- Existing gloveboxes would be used to the maximum extent possible to provide access for duct remediation.

- DOE Orders and OSRs defining proper air flow and differential pressures would be followed in the design and operation of new access locations.

- Commercially available equipment would be used when possible. New equipment designs would comply with requirements governed by available space, nuclear safety issues, and ease of installation.

- All designs, regardless of the application, would be subjected to some form of peer or in-house review prior to release. Impact of the design upon safety or operations would determine the level of review.

- Modifications and other adjustments to building Vital Safety Systems (VSS) and Utilities would not compromise the systems' operational integrity at any time. Systems would function unimpeded by the presence of Duct Remediation modifications.

Contamination containment systems rely on a cascading flow concept to insure that all ventilation within a processing or handling area flows from least contaminated to most contaminated areas. To maintain proper flows, the most contaminated area of a building's ventilation system must be at a higher negative pressure (lower absolute pressure) than the next containment area. Ventilation systems are categorized, in order of decreasing contamination, as Zone I, Zone II, and Zone III areas. All new gloveboxes were procured and built to meet Zone I design and operational requirements. Likewise, the PermaCon® structure interiors were considered Zone II containment areas. In all cases, Zone III ventilation control was provided by existing building systems. Under provisions of the OSR document, all Zone I containments were expected to maintain a differential pressure relative to the adjoining Zone II containment. Also, Zone II containments were required to maintain an operating pressure relative to Zone III and the building external atmosphere to assure cascading air flow. Zone II differential pressures were maintained by installing airmover units specifically designed to evacuate and filter PermaCon® atmospheres. Extensive design work and analysis were required to maintain these conditions in the PermaCon® enclosure. Airlocks were designed into the PermaCon® structures to dampen out pressure fluctuations as workers entered and exited. Specific construction sequences were followed during installation, testing, and operations at each of the engineered access locations.

A survey of the commercially available containment structures revealed a product ideally suited to replace plastic tents traditionally used for containment "houses." The stainless steel PermaCon® system manufactured by General Dynamics Services Company was selected as an ideal containment structure. The PermaCon® structures allowed flexibility of installation. It was also fully compatible with associated support structures. The modular nature of the PermaCon® system eliminated the need for a completely new design for each location. Wooden support platforms were constructed below each PermaCon® enclosure. These platforms were designed to withstand loads from the gloveboxes and other equipment, plus the live loads of the operating crew.

Perhaps the single most important piece of equipment housed within the PermaCon® was the Glovebox (GB) appliance. Through a very rigorous construction sequence, the GB was installed, tested and put into operation at each of the new remediation locations. The GB design process utilized the following criteria:

- The design needed to be standardized for ease of fabrication and modification.
- The design needed to incorporate both present and future material removal tool technology. The design had to insure that everything placed in the box for remediation fit logically and efficiently and within specific spacial limitations.
- Each box needed to fit its intended PermaCon® in such a way that operators could move about and within the box efficiently and safely.
- All the boxes would use materials and techniques of fabrication which would allow for decontamination, long term box storage and potential reuse of each box.
- Layout and materials of construction considerations were the primary parameters used to satisfy box removal, decontamination and storage requirements.

The Airmover which provided Zone II differential pressures and flows had to conform to several demanding design criteria as well:

- The machine itself had to physically fit into the building using service elevators and passage ways for access.
- Two internal High Efficiency Particulate Air (HEPA) filters required

independent testing ports to insure filter certification.

- The filter and airmoving chambers were constructed of Stainless Steel in order to facilitate decontamination in the event that the interior became exposed to plutonium dust.
- The unit required flow control to throttle air for PermaCon® pressure control.
- All wiring, both power and control, had to be accessible in order to interface with an external control and monitoring scheme.
- The unit had to be portable so that after use at a particular location it could easily be made available elsewhere in the building.
- Allowance had to be made for filter changes during operation. This requirement would insure preservation of a Zone II containment pressure even if a clogged or malfunctioning filter required replacement.
- Noise limitations were specified in the procurement documents to design away an inordinate increase in background noise at each remediation location.
- Each unit, aside from power and instrumentation wiring and piping, had to be self-contained.

Eventually, 8 units were purchased to support simultaneous operations at all of the remediation locations. The stringent design requirements and versatility of the Duct Remediation Airmover redefined the plant standard for evacuating a controlled environment.

The PermaCon® platform designs were often very challenging. Of several PermaCon® structural designs, the most unique and complex was the "flying" platform. This operating deck was planned for an elevation above an HVAC Plenum. The requirement to 'fly' over the top of the Plenum created a load transfer scheme which called for the platform to transfer loads upwards to a roof girder and downward to the second floor. The tensile loading half of the platform design used threaded rods (3) combined with clevis' and compression screwjacks to suspend the platform from one overhead double-tee concrete girder. The threaded rods carried the -Y load while the compression jacks served to steady the two legs of a sew-saw designed overhead beam. The beam was single point attached to an overhead double-tee girder. On the other end of the platform a conventional built-up wooden substructure was used to transfer load to the floor. Thus one side of the platform derived its load transfer capability from compression members while the other side was in tension. At another location an entirely different challenge existed. Directly in the path of the proposed platform sat two large cabinets which housed instruments to detect and control the Oxygen content of a normally inert (Nitrogen) system. The original design called for temporary relocation of these O_2 Analyzers out of the way of the platform. The technical and operational difficulty associated with making this relocation warranted keeping the cabinets in place and building around them. In effect, major, post-commissioning internal platform modifications were made without loosing pressure within the PermaCon®. New formats had been prescribed for all construction tests and all operating procedures. The first location installed was in fact characterized & contracted as an *in situ* research and development project to prove these techniques. Also debugged at this location was the overall PermaCon® room layout of equipment and systems. The test procedures for construction acceptance were also subjected to extensive development at this first location. Perhaps the most creative PermaCon® design on the project occurred at a Plenum Demister entry location. This location called for the use of PermaCon® airlocks (a total of 3) in lieu of a GB to preserve Zone I containment during an operationally complex entry. Eventually the access plan was modified to include a soft-sided containment glovebag large enough to fit over the Demister door. This chamber design did prove invaluable in providing flow and pressure control capability for Demister access. The pressure control scheme eventually utilized two Airmovers and five Photohelic instruments to preserve proper pressures and flows.

The Program design process was continuously evolving to increase design rigor through incorporation of more structured and detailed design procedures. These procedures called for more extensive documentation, organizational interfaces and archival requirements. The Conduct of Engineering Manual (COEM) and Configuration Change Control Program (CCCP) were implemented during the final phase of the design effort. These documents were written to comply with NQA-1 standards established through DOE Orders and the Secretary of Energy requirements for implementation of "Conduct of Operations" at DOE facilities. A partial implementation of new, stricter requirements was provided to maintain consistency in the development of construction packages. The Program became fully compliant with the new criteria on July 15, 1992. The hierarchy of design documents which now govern our engineering efforts is shown in Figure 2.

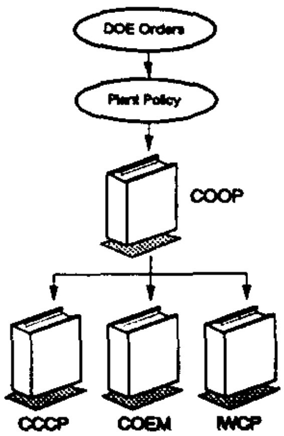

Figure 2. Standards Hierarchy

COOP - Conduct of Operations Procedure

CCCP - Configuration Change Control Procedure

COEM - Conduct of Engineering Manual

IWCP - Integrated Work Control Procedure

<u>Conclusions</u> **The Duct Remediation Engineered Access Program has provided** the DOE with a benchmark success for *in situ* remediation of processing facilities. There is no question that the technologies and methodologies developed in this program will be utilized in the future at Rocky Flats and at other DOE facilities.