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DECONTAMINATION TECHNOLOGY OVERVIEW (U)

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ABSTRACT

This paper consists of an overview of the decontamination technology program being carried out at the Savannah River Site and discusses the use of state-of-the-art equipment and techniques for decontamination and removal (D&R) applications. The purpose of the program is to minimize personnel radiation exposure, minimize the potential for uptake of radioactive material, and reduce the volume of contaminated waste. Implementation of technology and the status of new applications are discussed.

INTRODUCTION

The Savannah River Site's program to investigate and implement state-of-the-art decontamination technology is composed of three parts: 1) Evaluation of existing technology, 2) Development of new technology, and 3) Providing technical assistance. Examples of the type of work being done are given below:

EVALUATION OF EXISTING TECHNOLOGY

Concrete Scabbling (Figures 1 and 2) In this operation the surface of contaminated concrete is removed. This is accomplished by both mechanical and super-high-pressure water techniques. Super-high-pressure water scabbling is more easily operated remotely.

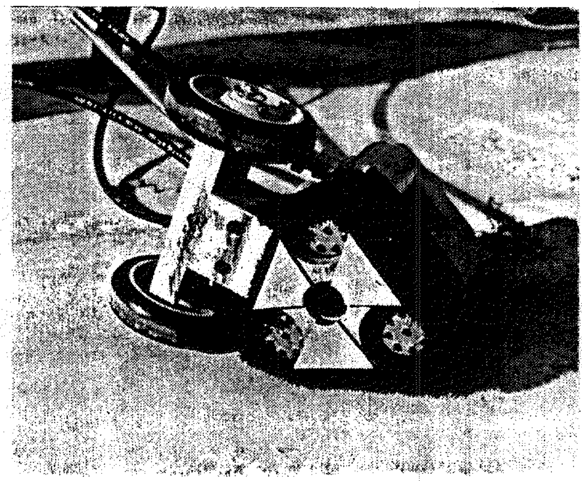

FIGURE 1. Mechanical Scabbler

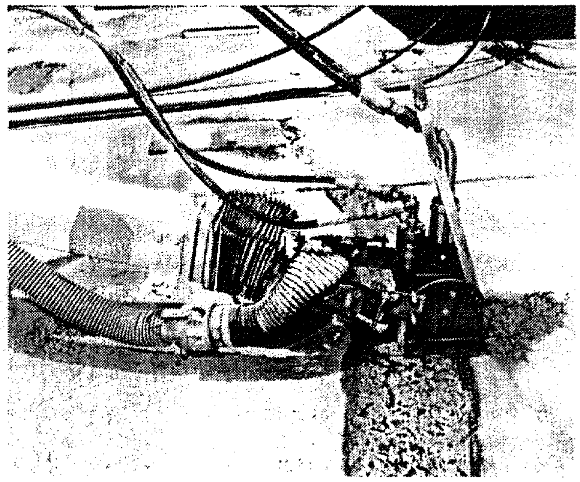

FIGURE 2. Scabbling Concrete with ADMAC

Decontamination Chemicals (Figures 3 and 4) A laboratory-scale evaluation of commercially available decontamination chemicals was conducted.[1]

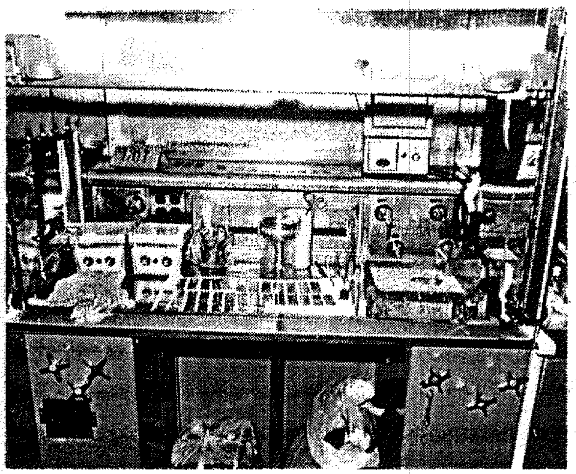

FIGURE 3. Equipment for Evaluating Decontamination Chemicals

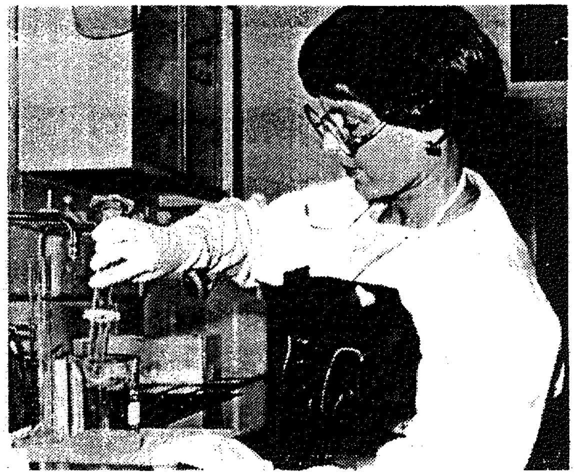

FIGURE 4. Evaluation of Commerically Available Decontamination Chemicals

Foam and Gel Decontamination Techniques (Figure 5) Foam and gel applicators produce solutions that adhere to the surfaces being decontaminated, and provide a means to clean surfaces where a soaking action is required.

- Foam

  Foam is produced by a pressurized applicator. The solution is applied to the surface, and decontaminates it through contact and chemical removal. The units will be used to perform tests on the adherence properties and decontaminability using various chemicals.

- Gel

  The gel works using the same principles that the foam does, but the gel has the property of being able to adhere to the surface for a longer period of time then the foam. This will increase the decontaminability due to a longer soaking time.

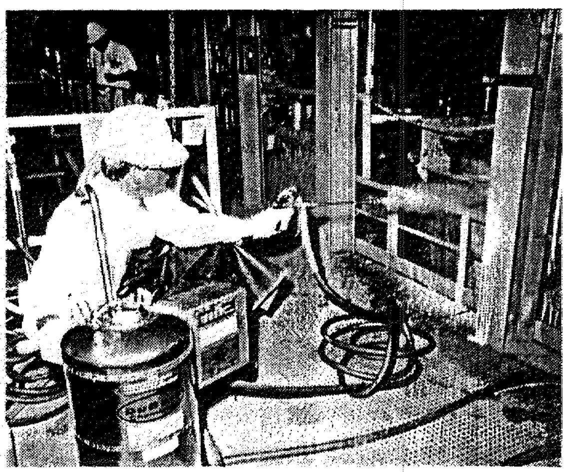

FIGURE 5. Evaluation of Foam

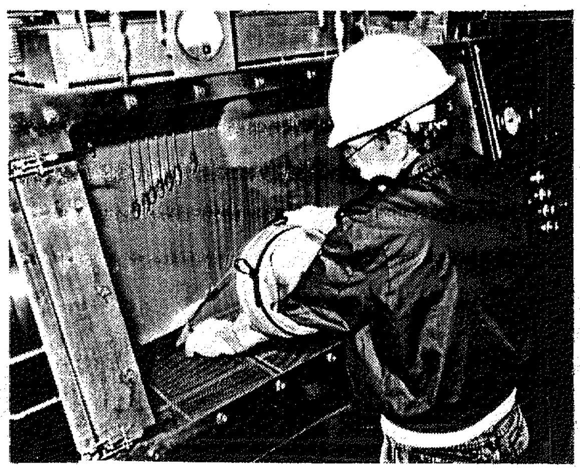

FIGURE 6. Freon Spray Chamber

Freon™ Spray Decontamination (Figure 6) A high pressure Freon™ spray is used to remove smearable contamination from small parts and tools.

Decontamination of Lead Technology is being developed to decontaminate lead for reuse.

- Chemical Techniques

  The effectiveness of chemical decontamination of lead was demonstrated in both lab-scale and larger-scale tests. There is a problem, however, in removing the lead from the used solution. Precipitation techniques are ineffective. Ion exchange techniques require an unreasonable amount of media. A decontamination technique with fewer waste disposal problems was desired.

- Abrasive Blasting Technique

  The effectiveness of this technique has been demonstrated on a wide variety of materials, including lead. There are fewer waste disposal problems than encountered with chemical decontamination techniques. Plans are to conduct a pilot-scale demonstration.

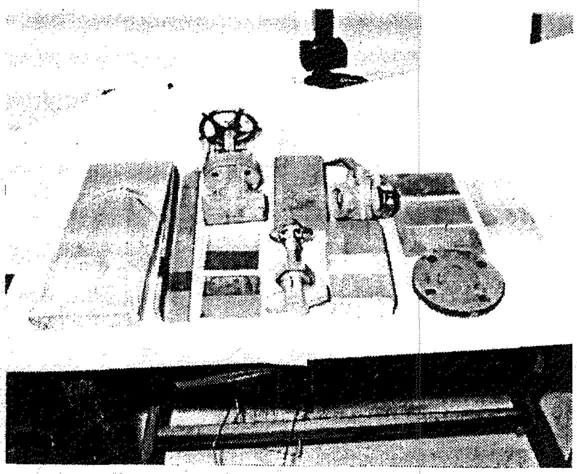

FIGURE 7. Abrasive Blasted Materials

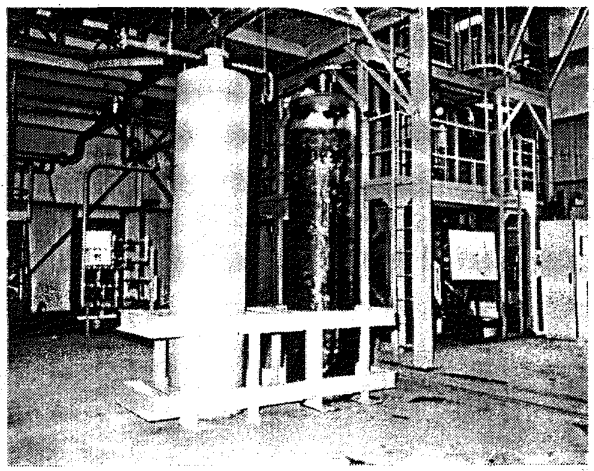

FIGURE 8. Waste Glass Canisters

Abrasive Blasting Decontamination (Figures 7 and 8) This technique removes both smearable and fixed contamination. The contaminated surface is mechanically removed by abrading it with a water slurry containing glass frit as the abrasive. All wastes from the process can be fed to a waste glass melter for disposal. This decontamination technique was developed to decontaminate the waste glass canisters in the Defense Waste Processing Facility (DWPF). Because the glass frit is needed to produce waste glass, this decontamination is effected with the generation of no additional radioactive waste.[2]

Kelly Machine (Figures 9 and 10) Superheated water chemically and mechanically removes smearable contamination. This equipment has performed well in a wide variety of applications at the Savannah River Site.

FIGURE 9. Kelly Machine Wall Tool

FIGURE 10. Training Class for Kelly Machine

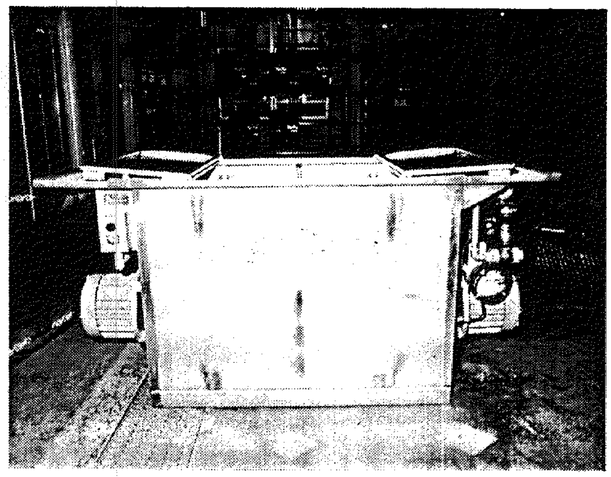

FIGURE 11. Turbulator Tank

Turbulator (Figure 11) Increased agitation of chemical solutions increases the removal rate of smearable contamination from small parts and tools. Four distinctive flow patterns allow the chemical solution to come in contact with all portions of the item being decontaminated. This unit will be used to conduct tests on how agitation increases the decontamination factors of certain solutions, as well as comparing the cleaning ability of various chemical decontamination agents.

Water-Jet Technology (Figures 12 and 13)

- Water-Jet

Water at 60,000 psi removes fixed contamination from concrete and asphalt surfaces by mechanically removing the top layer of the material.

• Abrasive Water-Jet

Water/abrasive slurry systems can be used to cut and clean surfaces. At pressures up to 60,000 psi this technology can be used to cut virtually any material; however, both time and cutting depth vary depending on the material being cut. This technology can be used for size reduction and waste minimization.

Size-Reduction and Decontamination of Decommissioned Waste Glass Melters Abrasive water-jet cutting of windows in the materials of construction of a melter shell has been demonstrated. The use of a Hydrex impact tool to dislodge the refractories is being investigated. This tool is charged with 50,000 psi water. When it is discharged it produces an impact of 40,000 ft-lb. This amount of energy applied to the refractories exposed by cutting windows in the melter is expected to break the refractories apart at the joints. They could then be removed and tightly packed in containers for disposal. After the refractories have been removed, the metal parts of the melter could be cut into small pieces for disposal using an abrasive water-jet.

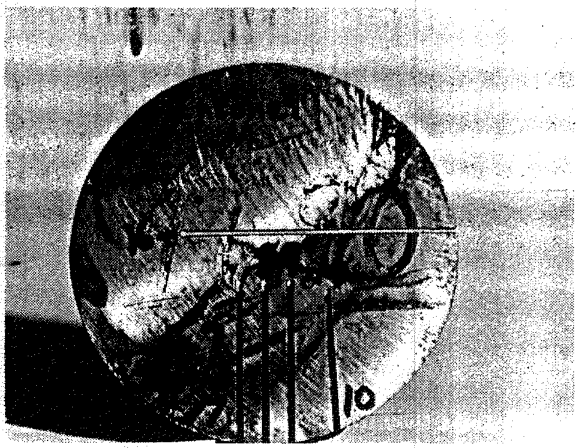

FIGURE 12. Inconel 690 Cut with Abrasive Water-Jet

FIGURE 13. Monofax K-3 Cut with Abrasive Water-Jet

Portable Heat-Sealers This hand-held device is used for heat-sealing plastic. It is being evaluated for use in sleeving techniques used to separate gloveboxes without breaking containment.

Electropolishing This electrochemical technique removes fixed contamination. In addition, it can be used to prepare a metal surface to minimize the sites where particles of contamination can become entrapped. Electropolished metal surfaces are easier to decontaminate. Electropolishing can be done through immersion or *in situ*(wand) techniques.

Alternative Steam Injector (Figure 14) A device was identified that the manufacturer claims is more efficient than the Sellers injector presently used sitewide for decontamination by washing. Evaluation is underway.

Robotic Decontamination (Figure 15) The use of robotic equipment in decontamination applications is being developed. This is a joint effort with SRS's Robotic Technology Division.

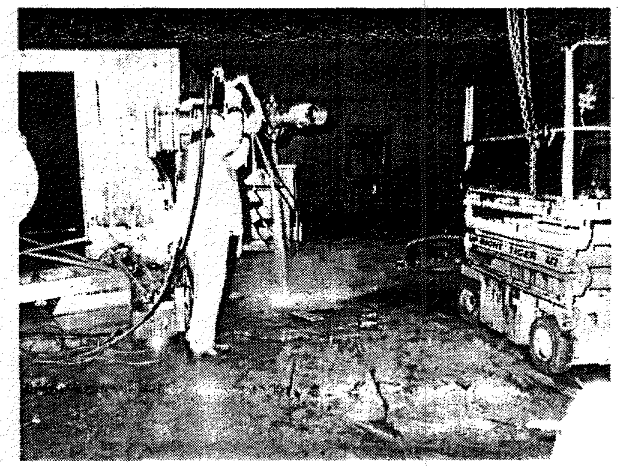

FIGURE 14. Sellers Injector

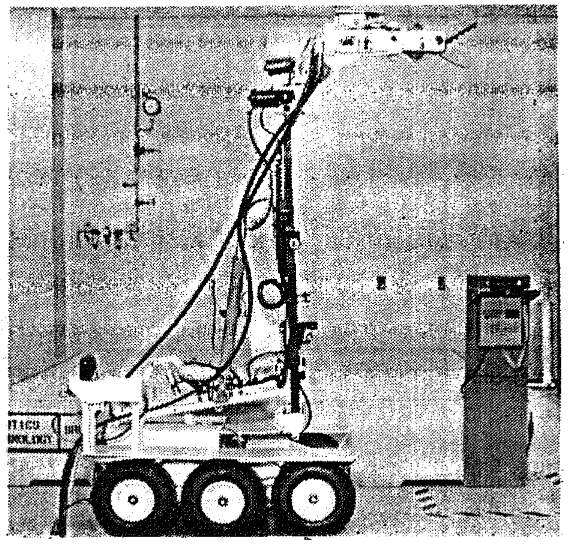

FIGURE 15. Robotic Decontamination

Polyurethane Foam The use of this material has two applications.

- Fixing Contamination (Figure 16 and 17)

  A device was developed that allows foam to be injected into pipes without breaking containment. The foam stabilizes any radioactive material inside the pipe. This minimizes the potential for airborne radioactive material when the pipe is cut during decontamination and removal (D&R) operations.

- Immobilization (Figure 18)

  In this application foam is used to stabilize equipment inside a glovebox in order to avoid shifting, which could cause a broken window and result in release of contaminated material during D&R operations.

Expandable Pipe Seals These devices are used to seal the ends of pipe removed during D&R operations. The seal prevents any radioactive material inside the pipe from escaping.

Personnel Mounted TV Camera A television camera was identified that is small enough to be mounted on a person. It would transmit a picture of what the person is looking at. It would be useful in critical quality assurance applications.

Heat-Shrinkable End Caps These devices are also used to seal the ends of pipes removed during D&R operations. The seal prevents radioactive material inside a pipe from escaping. In addition these devices protect workers from the rough edges of the pipe.

Penetration Sealing Several materials for sealing penetrations through walls were identified. The use of these materials will allow increased control of air flow in critical facilities.

FIGURE 16. Foam Injection Clamp

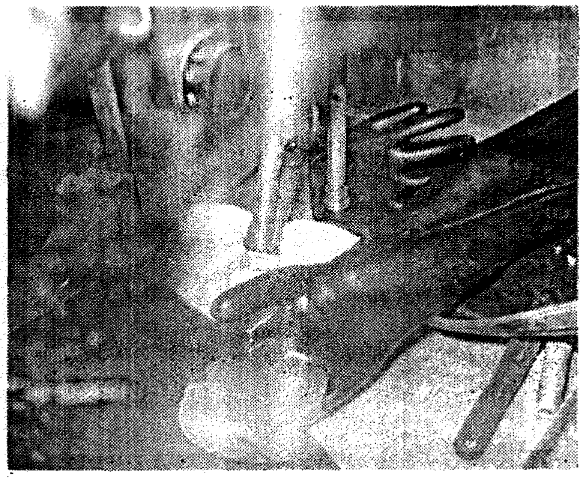

FIGURE 17. Fixing Contamination with Foam

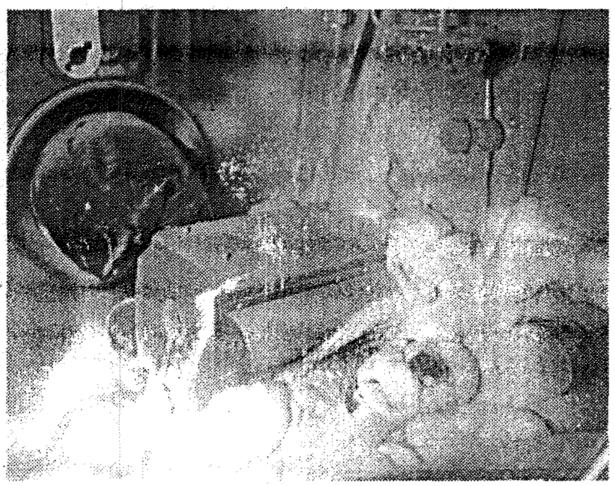

FIGURE 18. Stabilized Equipment using Foam

Ultrasonic Ranging and Data System This equipment provides a documented, reproducible survey of radioactive contamination within an area. An onsite demonstration is planned.

Evaluation of Laydown Materials (Figures 19 and 20) Blotting paper was evaluated as an alternative to kraft paper for laydown applications.

Evaluation of Strippable Coatings These materials were evaluated for both decontamination and surface protection applications.

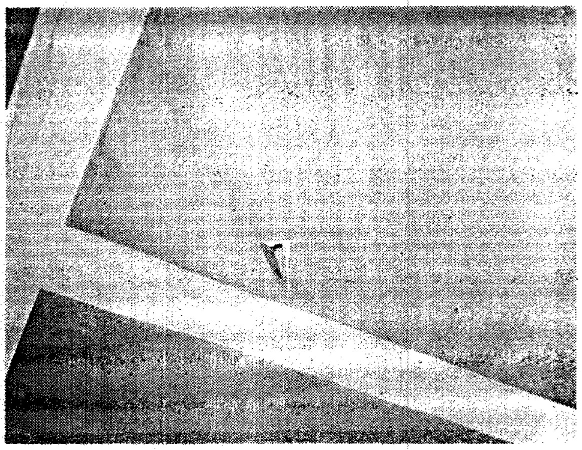

FIGURE 19. Evaluation of Kraft Paper

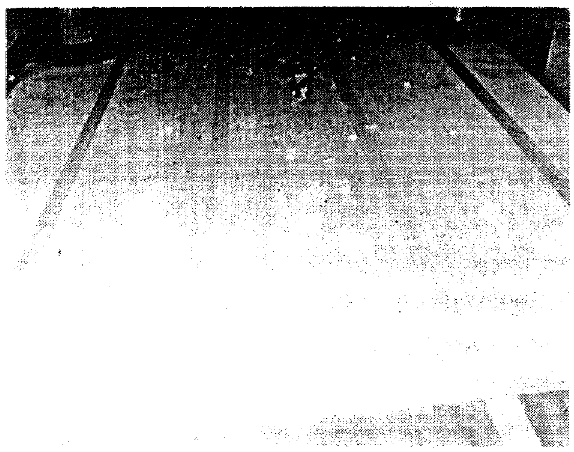

FIGURE 20. Evaluation of Blotting Paper

DEVELOPMENT OF NEW TECHNOLOGY

Low Pressure Sprayer (Figures 21 and 22) This equipment is used for applying strippable coatings. It is safer, less expensive,and increases the application rate by more than a factor of 10 over the application equipment recommended by the coating manufacturer and used at other sites. This equipment was designed, fabricated, and evaluated in nonradioactive and radioactive applications. Patent rights are being investigated.

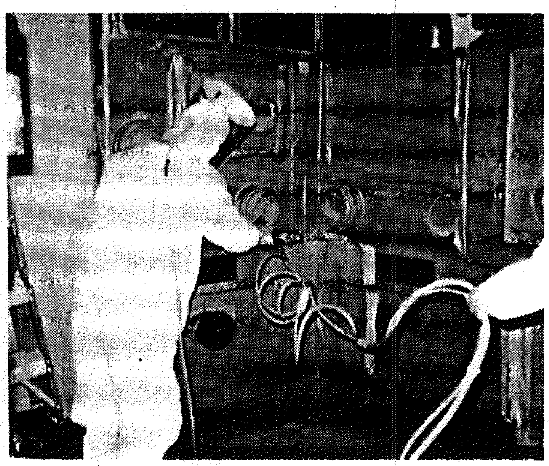

FIGURE 21. Spraying Alara using SRS Low Pressure Sprayer

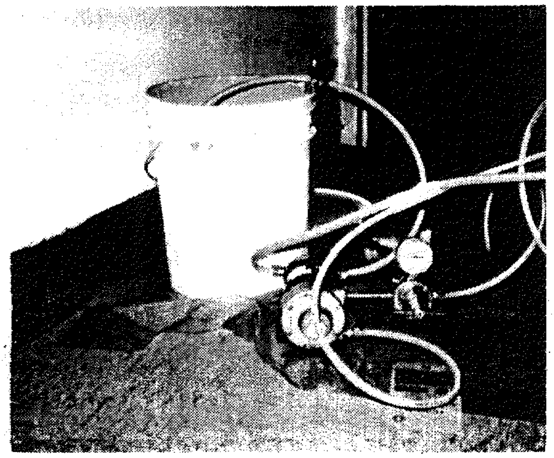

FIGURE 22. SRS Low Pressure Spray Equipment

Coating of Lead (Figure 23) Technology is being developed to coat lead for use as shielding in contaminated areas to prevent it from becoming contaminated.

Treated Polyester Wipes (Figure 24) These wipes are treated by a textile chemistry process to increase the sorption of the fiber. They are being investigated as an alternative to "atomic wipes" for decontamination by wiping and sorption. The advantages are: 1) Compatible

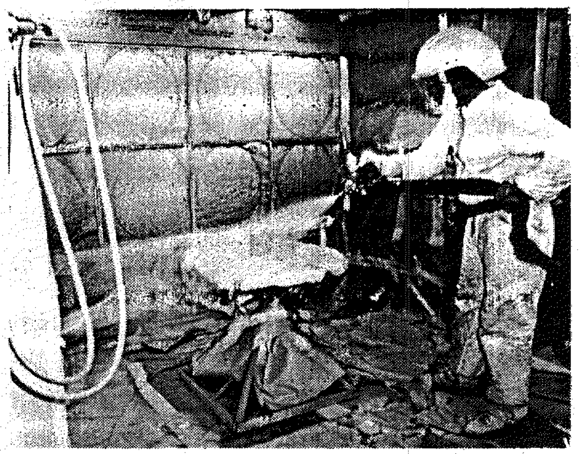

FIGURE 23. Coating Lead Brick

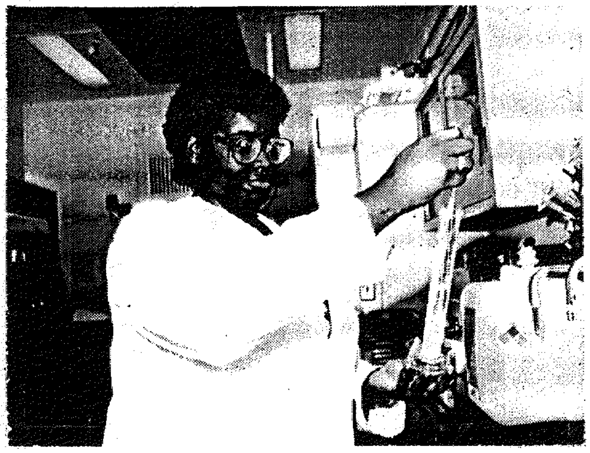

FIGURE 24. Evaluation of Sorbents

with nitric acid, 2) More fire resistant, 3) Less volume of radioactive waste generated, and 4) Recovery of product possible.[3]

Small Critically-Safe Solvent-Assisted Vacuum Cleaner (Figure 25) This device uses a liquid spray to dislodge particulate contamination. Then the liquid plus the radioactive material can be collected in a critically-safe sump. This material could be processed to recover product.

Atomic Wipe Holder (Figure 26) This device was developed to improve the effectiveness of "atomic wipes" in decontamination by wiping.

FIGURE 25. Small Solvent-Assisted Vacuum Cleaner

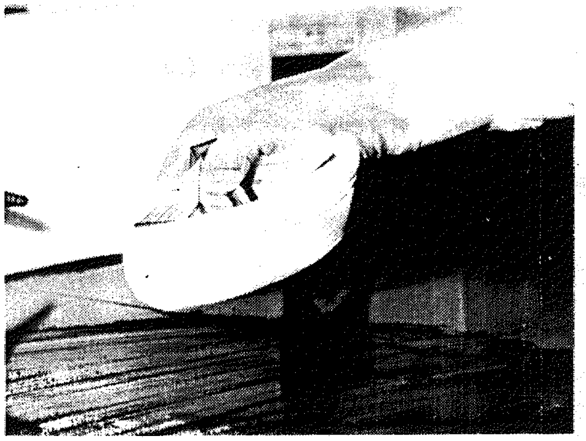

FIGURE 26. "Atomic Wipe" Holder

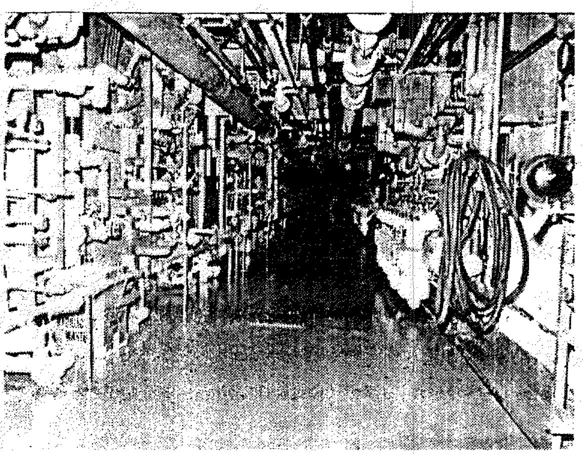

FIGURE 27. Hot Gang Valve Corridor

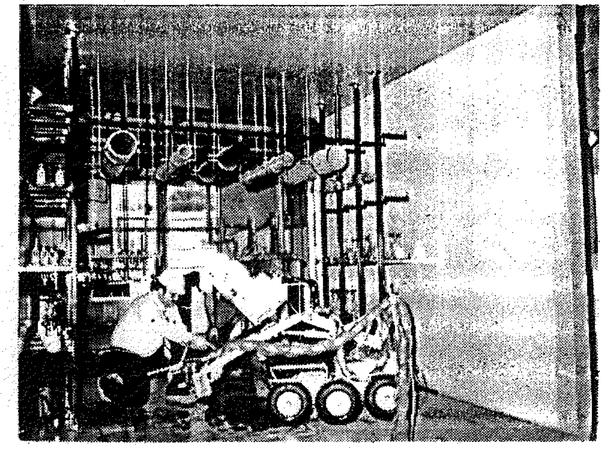

FIGURE 28. Mockup of Hot Gang Valve Corridor

PROVIDING TECHNICAL ASSISTANCE

Two divisions of the Savannah River Site, Interim Waste Technology and Robotics Technology, combined their expertise to provide technical assistance in two applications where robotic decontamination techniques were required to minimize personnel exposure.[4]

221-F Hot Gang Valve Corridor (Figures 27 and 28) Radioactive liquid migrated into the 221-F Hot Gang Valve Corridor (HGVC). The valves in this area are used to control canyon processes. Radiation levels up to 1000 rad/100 R/hr resulted. Equipment maintenance under these conditions was impossible. The Kelly spray/vacuum decontamination equipment was recommended for this application. A Pedsco robot was modified to remotely operate both the spray wands and the spray/vacuum tools. A full-size mockup of a portion of a HGVC was constructed. First, the ability to perform all operations in the mockup facility was demonstrated. Then operations were started in the contaminated area. Results were that radiation levels were reduced by a factor of 10. Personnel exposure of 1.65 rem resulted. The robot received an exposure of 37 R gamma, 113 rad beta.

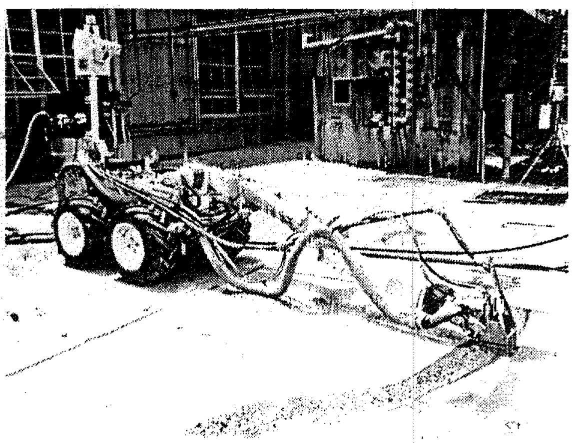

FIGURE 29. Mockup of Tank 13

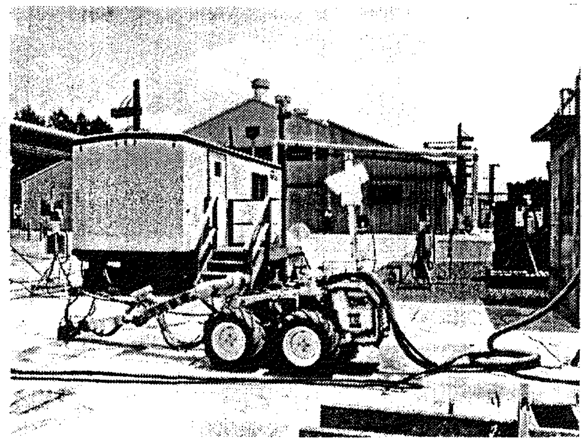

FIGURE 30. Control Trailer

Robotic Decontamination of Tank 13 (Figures 29, 30 and 31) Radioactive liquid spread across a portion of the top of Tank 13 (an 85-ft-diameter, high-level liquid waste tank) and into the soil. Radiation levels on the tank top were several hundred mR/hr and the severity of the soil contamination was unclear. Decontamination techniques involved scabbling the surface of the concrete to remove the contaminated portion using Admac ultra-high-pressure water equipment.

FIGURE 31. Control Trailer

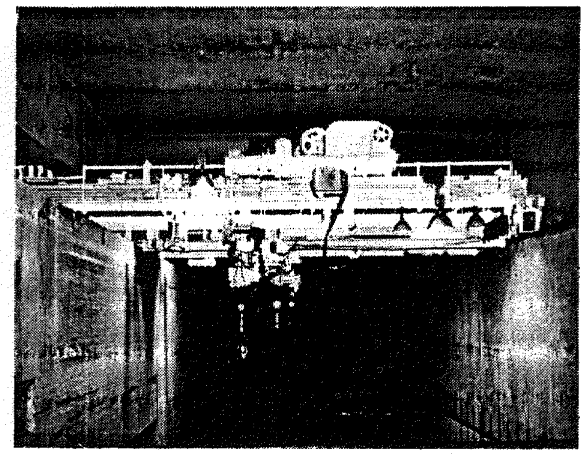

FIGURE 32. 221-H Hot-Canyon Crane

The cutting head was shrouded to minimize airborne contamination. A Wasp mobile robot was used to manipulate the scabbling head. A radio-controlled BOBCAT 743 skid-stear loader was readied to excavate the soil surrounding the tank top. A trailer was outfitted with a control panel for a multiple TV camera surveillance system used to position the robot. First, the ability to scabble concrete on an uncontaminated concrete pad was demonstrated. Then operations were started in the contaminated area. Results were that radiation levels were reduced 50%. Personnel exposure of 1.7 rem resulted.

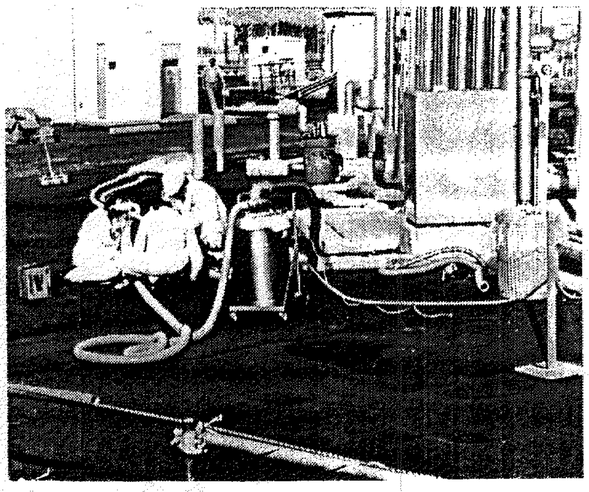

FIGURE 33. Kelly Machine in Tank Farm

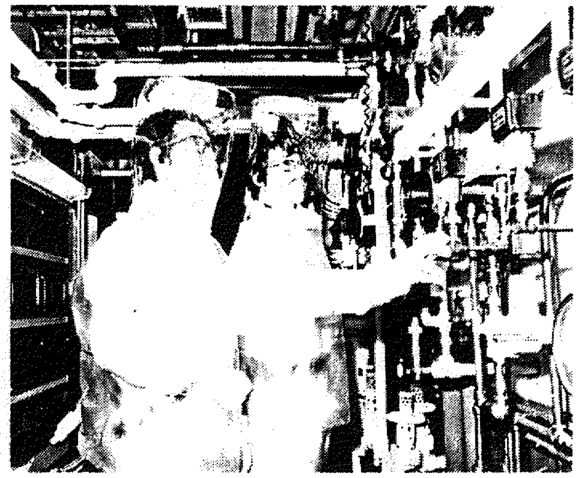

FIGURE 34. Communication in Hazardous Environments

H-Area Hot-Canyon Crane (Figure 32) Freon™ spray techniques were used to decontaminate this crane.[5]

Decontamination in Tank Farm Operations (Figure 33) The Kelly machine is used almost daily in tank farm operations.

Communications in Hazardous Environments (Figure 34) State-of-the-art radios were identified and evaluated in sitewide applications.[6]

FUTURE OUTLOOK

Future demand for the technology being investigated is expected to increase.

- There has been an increase in the site's desire to decontaminate using state-of-the-art rather than 20-year-old techniques.
- Maintenance requirements of existing facilities will increase as they continue to age. Decontamination before maintenance reduces personnel exposure, reduces the potential for uptake, and increases safety.
- Decontamination and Removal (D&R) of existing site facilities is expected to increase. In the 1984 Long Range Plan, D&R projects were identified that total approximately $400 million over the next 10 years. SRS needs to be in a position to provide technical assistance in planning and implementing this work so that it will be done in the most cost effective manner.

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ACKNOWLEDGMENT

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