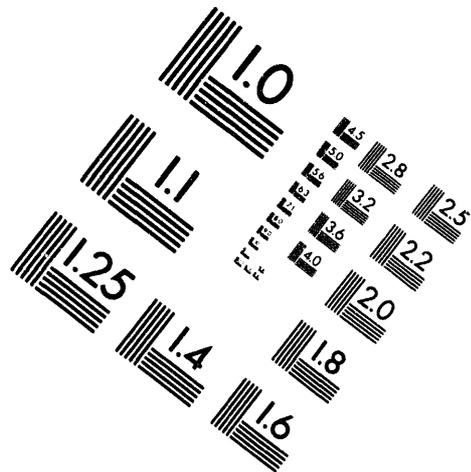
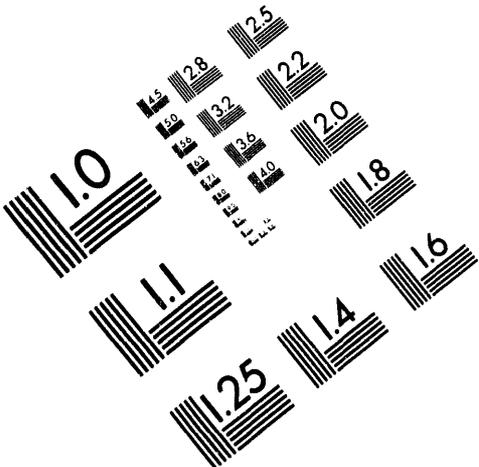




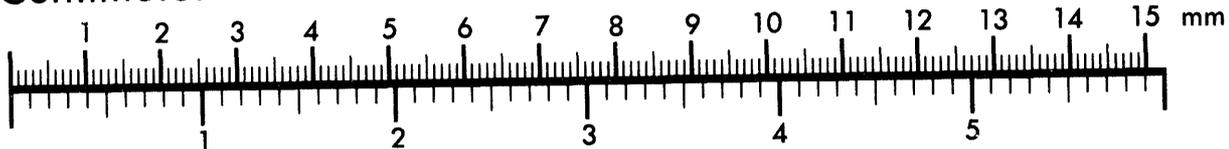
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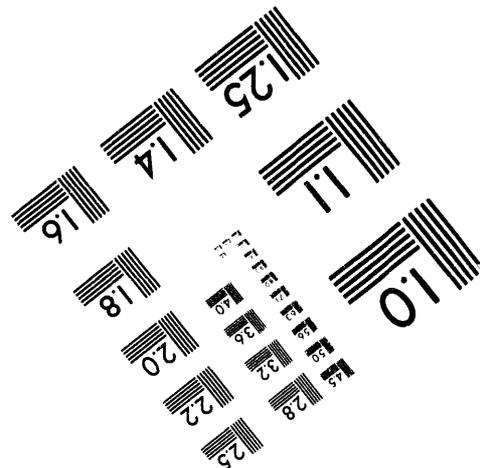
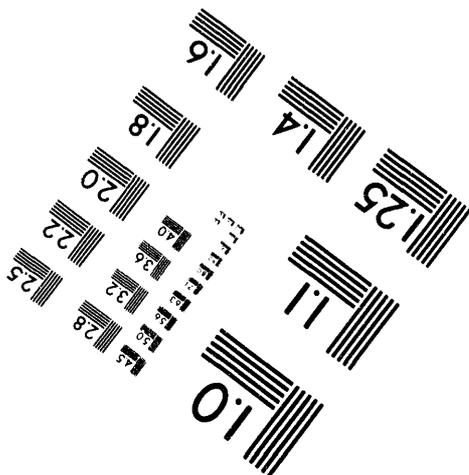
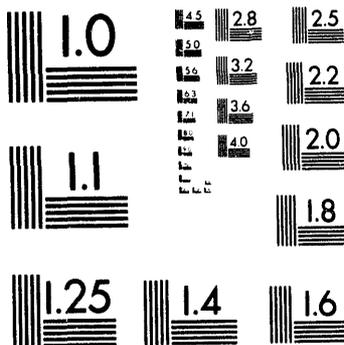
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CO₂ PELLET DECONTAMINATION TECHNOLOGY AT WESTINGHOUSE HANFORD

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INTRODUCTION

Experimentation and testing with CO₂ pellet decontamination technology is being conducted at Westinghouse Hanford Company (WHC), Richland, Washington. There are 1100 known existing waste sites at Hanford. The sites specified by federal and state agencies are currently being studied to determine the appropriate cleanup methods best for each site. These sites are contaminated and work on them is in compliance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).¹

There are also 63 treatment, storage, and disposal units, for example: groups of waste tanks or drums. In 1992, there were 100 planned activities scheduled to bring these units into the Resource Conservation and Recovery Act (RCRA) compliance or close them after waste removal. Ninety-six of these were completed. The remaining four were delayed or are being negotiated with regulatory agencies.¹ As a result of past defense program activities at Hanford a tremendous volume of materials and equipment have accumulated and require remediation.

BACKGROUND

To support WHC's mission of environmental remediation and restoration, the WHC ALARA (as low as reasonably achievable) Engineering group began evaluating a patented CO₂ pellet cleaning technology in January 1993. The CO₂ process is a unique dry process that uses dry ice as the exclusive decon medium, and does not use any hazardous chemicals, water, solid grit or aggregate materials. This process does not create costly secondary wastes and is a non-destructive surface cleaner.

A decision was made to test the technology on a variety of items at Hanford to gain first hand information about the efficacy of the CO₂ pellet decontamination methodology. Non-Destructive Cleaning, Inc. (NDC), is the vendor chosen to provide the demonstration of services contract at Hanford (Figure 1). The NDC mobile CO₂ decontamination unit is a stand alone, transportable, steel enclosure. No special mounting requirements are necessary and the unit can be placed on any firm flat surface, such as a paved lot or crushed stone. The unit is designed for cleaning items ranging in size from small hand tools to items up to twenty feet long with no weight limit.

NDC was chosen through a sole-source justification based on the perfection of a patented process including ventilation control and containment. A number of vendors can generate and deliver CO₂ pellets, but the key to an effective and safe CO₂ decontamination practice is proper ventilation and containment during the actual work. NDC, Inc., has demonstrated technical expertise in the diverse applications of the process to a variety of materials within the commercial nuclear industry.

CO₂ PELLET PROCESS

The NDC patented process/facility² uses small, solid carbon dioxide particles propelled by dry compressed air. The CO₂ particles shatter upon impact with the surface of the material to be cleaned and flash into dry CO₂ gas. The cleaning is accomplished by the rapidly expanding CO₂ gas lifting and flushing the foreign materials out.

Microscopic sized particles are captured on high efficiency particulate air (HEPA) filters and larger materials are retrieved using HEPA-filtered vacuum cleaners. Therefore, the NDC mobile unit requires no drip pans or dikes or double walled leak protection designed to prevent leakage of radioactive liquids. Since no solid grit or aggregate is used, the CO₂ unit requires no bulk radioactive solid waste handling equipment. In addition, since no chemicals are required for the process no radioactive chemical processing or mixed waste handling facilities are needed. CO₂ levels have been demonstrated to remain below OSHA requirements and a CO₂ monitor verifies the levels during operation.

NDC had operated within the commercial nuclear industry for 9 equivalent operating years. Some examples of the items successfully decontaminated include: hand tools, power tools, pumps, tanks, glass, pipes (Figure 2), computer components and circuitry, manipulators, and lead shielding. The CO₂ pellets will clean metal objects, as well as softer objects like wood, plastics and rubbery materials without causing damage.

External Design of the CO₂ Unit

The main features of the CO₂ unit are designed to accommodate easy setup and tear down. Each facility arrives on site in three pieces that are simply joined together in place. The three pieces are two stand-alone, transportable, steel enclosure boxes and a flat bed containing the CO₂ tank and air compressor (Figures 3 and 4). All electrical interconnections are managed by a central power cable which is connected to a power control and distribution panel located within the mobile unit.

Internal Design of the CO₂ Unit

The CO₂ decontamination unit is designed with separate rooms: a machinery and electrical room, a large decontamination room, a decontamination cell room, and a count room where cleaned items are surveyed after cleaning (Figure 5). The unit has been designed with a complete HVAC system for "out of doors" operation in any environment. All floor and wall covering materials in the decontamination unit are specially selected and installed for ease of decontamination.

The decontamination room is completely lined with stainless steel, and includes a large entry door and an internal hoist that can handle up to two tons. The floor loading capacity is unlimited. The decon room ventilation system includes two pre-filters (Figure 6) and a HEPA filter system (Figure 7). The decontamination room is pre-piped for the use of supplied breathing air for worker safety. A special rolling lift table equipped with an air driven vise to hold items for cleaning has also been built in to the unit.

The decontamination cell room houses a unique cleaning cell equipped with CO₂. The design includes high capacity sweep air flow, a pull-out drawer in the decon cell and a foot pedal operated air vise inside the decon cell to hold items being cleaned. The delivery of the CO₂ pellets is also triggered by a foot pedal. The decon cell has been ergonomically engineered for ease of operation. The CO₂ pellets are produced by the pelletizer, which converts CO₂ gas to rice-sized pellets. The pelletizer is located in the machinery and electrical room (Figure 8).

DEMONSTRATION OF SERVICES

NDC has been operating their patented process and facility for the last 5 months. The intent of the WHC demonstration of services contract was to test the effectiveness of the CO₂ process on a variety of items within the Department of Energy complex. The CO₂ pellet decontamination unit has operated at Hanford's B-Plant, the 222S laboratory, the Hanford Central Waste Complex (CWC), and will support the mission to clean up equipment located in the 300 Area Nuclear Fuels Fabrication building.

CO₂ SUCCESSES

The CO₂ pellet decontamination activities being conducted and tested at WHC, have resulted in unprecedented accomplishments. The real success has been attributed to the three phase process used in the CO₂ unit. Phase I

is the cleaning, phase II is the ventilation control and containment as described in the process section, and phase III is the exhaust gas filtration. This third phase allows us to stay in compliance with environmental laws regulating the release of hazardous effluents to the environment.

B-Plant Demonstration

Successes at the B-Plant resulting from a three month demonstration of the CO₂ pellet decontamination technology included the free release of ten years accumulated materials and equipment. The efforts resulted in the elimination of thousands of cubic feet of radioactive waste as well as the decon of thousands of pounds of contaminated lead shielding for re-use. Items free released included (Figure 9) assorted hand tools, electric drills, squirrel cages, shafts and bearings, shelving, door stop carriers, fan blades, and metal collars. An example of the decontamination log sheet (Table 1) shows the initial smearable contamination in disintegrations/minute (dpm)/100 cm², final smearable, approximate cleaning times and the air pressure (psi).

222S Process and Analytical Laboratories Demonstration

The demonstration activities at the 222S laboratories have resulted, so far, in greater than 2700 cubic feet of material decontaminated. Most of the material was free released. Where free release is not achieved two other approaches are used: (1) reduction of dose rates (ALARA), or (2) reducing burial costs by converting high-level waste to low-level waste.

In addition, a number of chemical sampling hoods were decontaminated for reuse or excess using the CO₂ process (Table 2). Hepa filter housings and a variety of duct work were also cleaned to determine the CO₂ decon efficiency.

FUTURE PLANS

Near Term Plans

Beginning in May, the Hanford Central Waste Complex and the 300 Area Nuclear Fuels Fabrication Building are scheduled for a 10 week and 6 week demonstration of CO₂ decontamination activities, respectively. Items to be tested for the CWC are materials, tools, and equipment scheduled for burial at Hanford. Expectations are to recycle and excess all the items and save 100% of the burial costs. The Fuels Fabrication Building has some specialized equipment and fuel carts contaminated with low level uranium scheduled for CO₂ decontamination testing.

Long Term Plans

CO₂ pellet decontamination technology will be used at Hanford in the years to come to assist the U.S. Department of Energy (DOE) contractors in completing their mission of environmental remediation. The long term plans are to, through the governmental competitive bid process, determine the appropriate vendor to continue the work demonstrated by NDC and their CO₂ process. Because of the successes with the demonstration of services with NDC, CO₂ pellet decontamination activities will continue at Hanford.

A workshop was held October 4-5, 1993, in Richland Washington. The workshop was sponsored by WHC Health Physics and supported a DOE Directive to form a CO₂ User's Group, and allowed 5 major DOE sites (7 contractors) who participated to utilize a savings through sharing concept. Eleven of the eighteen invited vendors attended the workshop.

COST SAVINGS

A cost savings of over 5 million dollars has been estimated for the term of the contract. Long term cost savings resulting from the use of CO₂ are estimated at over 50 million dollars.

CONCLUSION

CO₂ pellet decontamination technology will solve many of our decontamination problems. The technology is effective in solving these problems in terms of costs and performance. This state-of-the-art technology is revolutionary in terms of decontamination to ALARA, and in terms of waste management. CO₂ pellet technology will definitely enhance the public's image of Hanford by streamlining the mission of environmental restoration and remediation.

We have definitely learned that CO₂ technology doesn't end at CO₂ pellet delivery. The real technology includes the proper containment technology and the proper ventilation and filtration technologies because, without the entire package, CO₂ technology would be incomplete and unsuccessful.

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1. McMakin, A. H., "In Summary Environmental Report 1992," PNL-8682 Ex Sum, Pacific Northwest Laboratory, Richland, WA., September 1993.
2. Technical Bulletin, "Non-Destructive Cleaning Facility (NDC) Model 400," Non-Destructive Cleaning, Inc., Walpole, MA., April 1994.

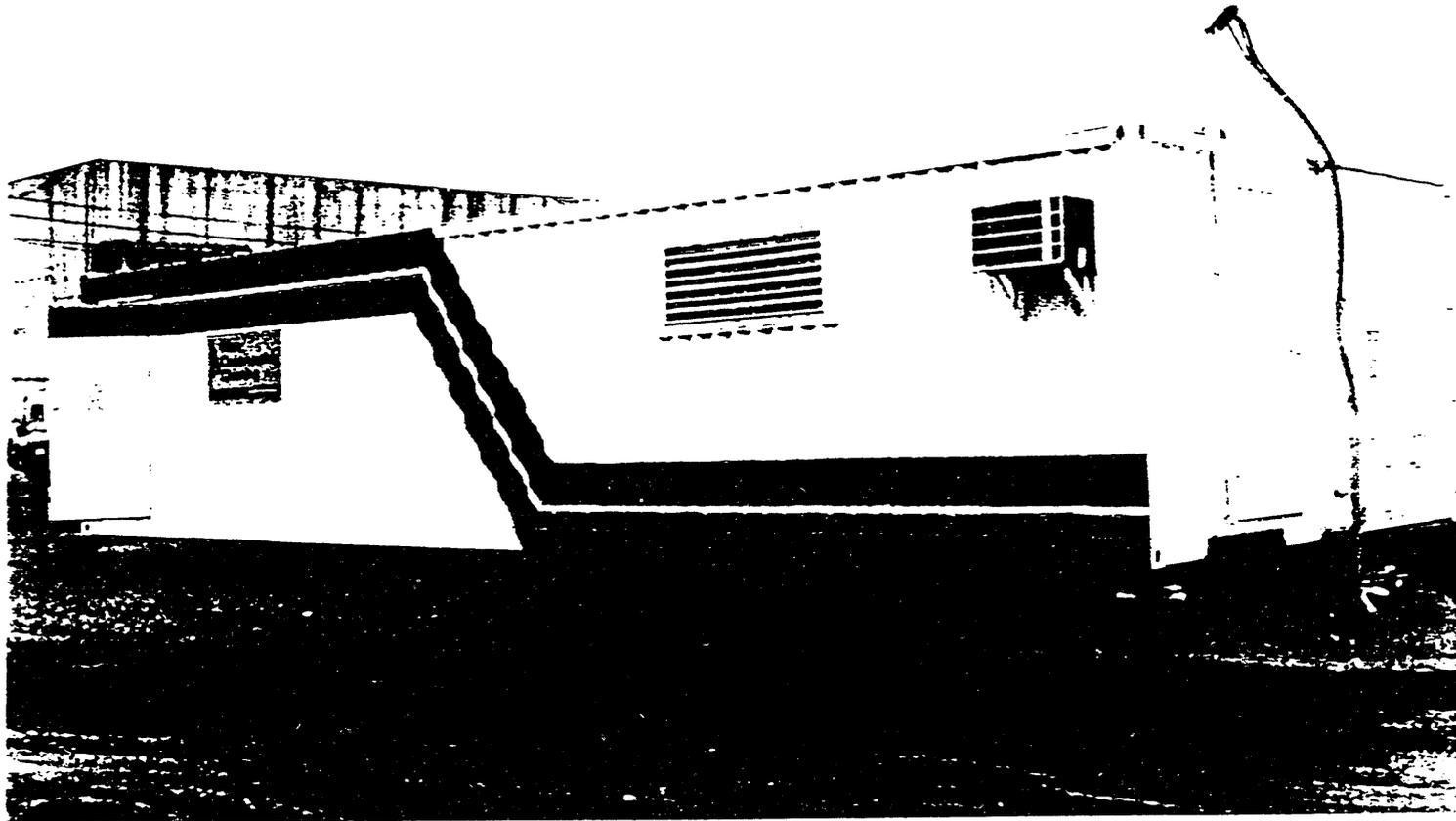


Figure 1. Non-Destructive Cleaning, Inc. Demonstration Facility at Hanford.

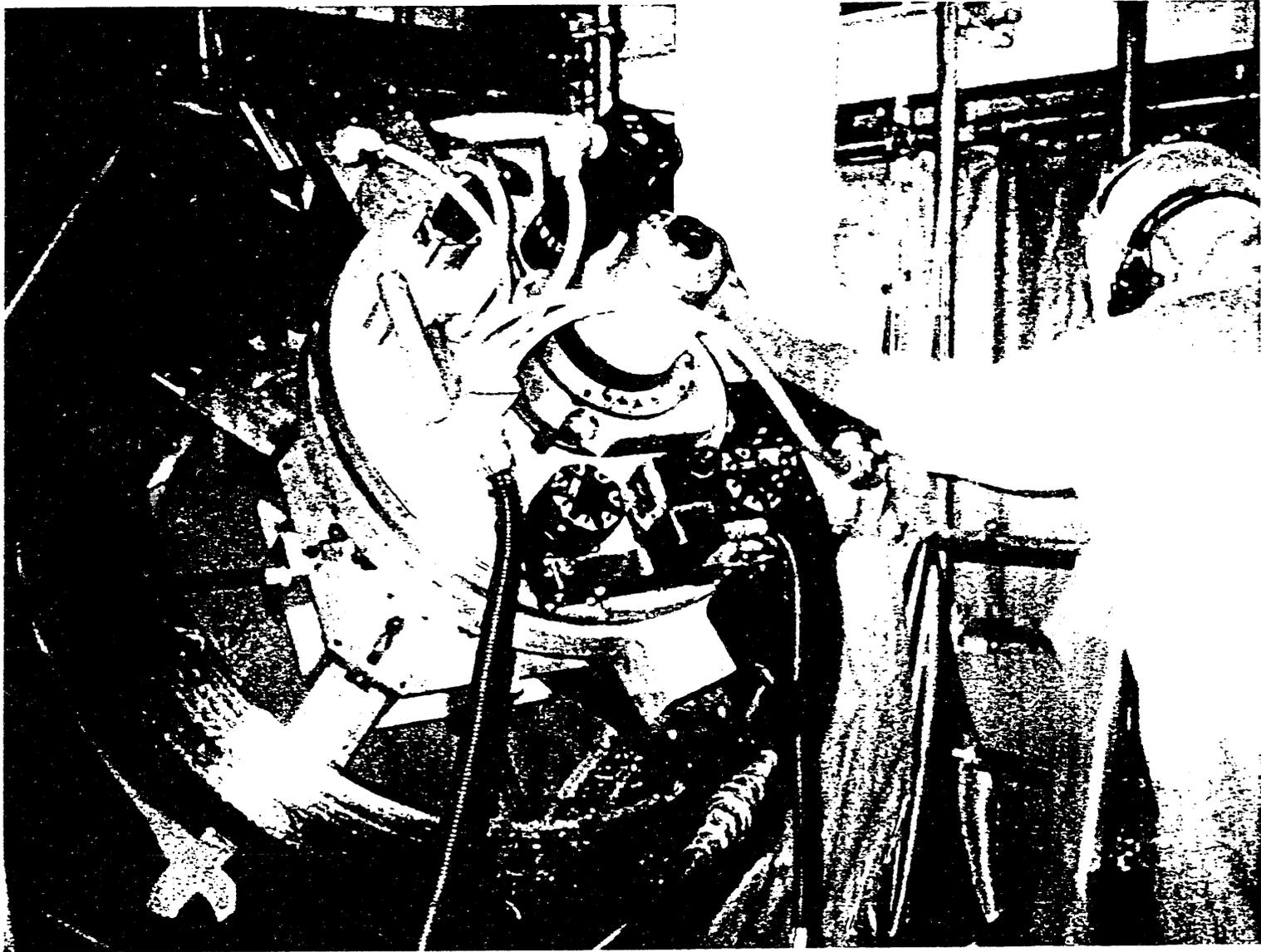


Figure 2. Pipe Decontamination.

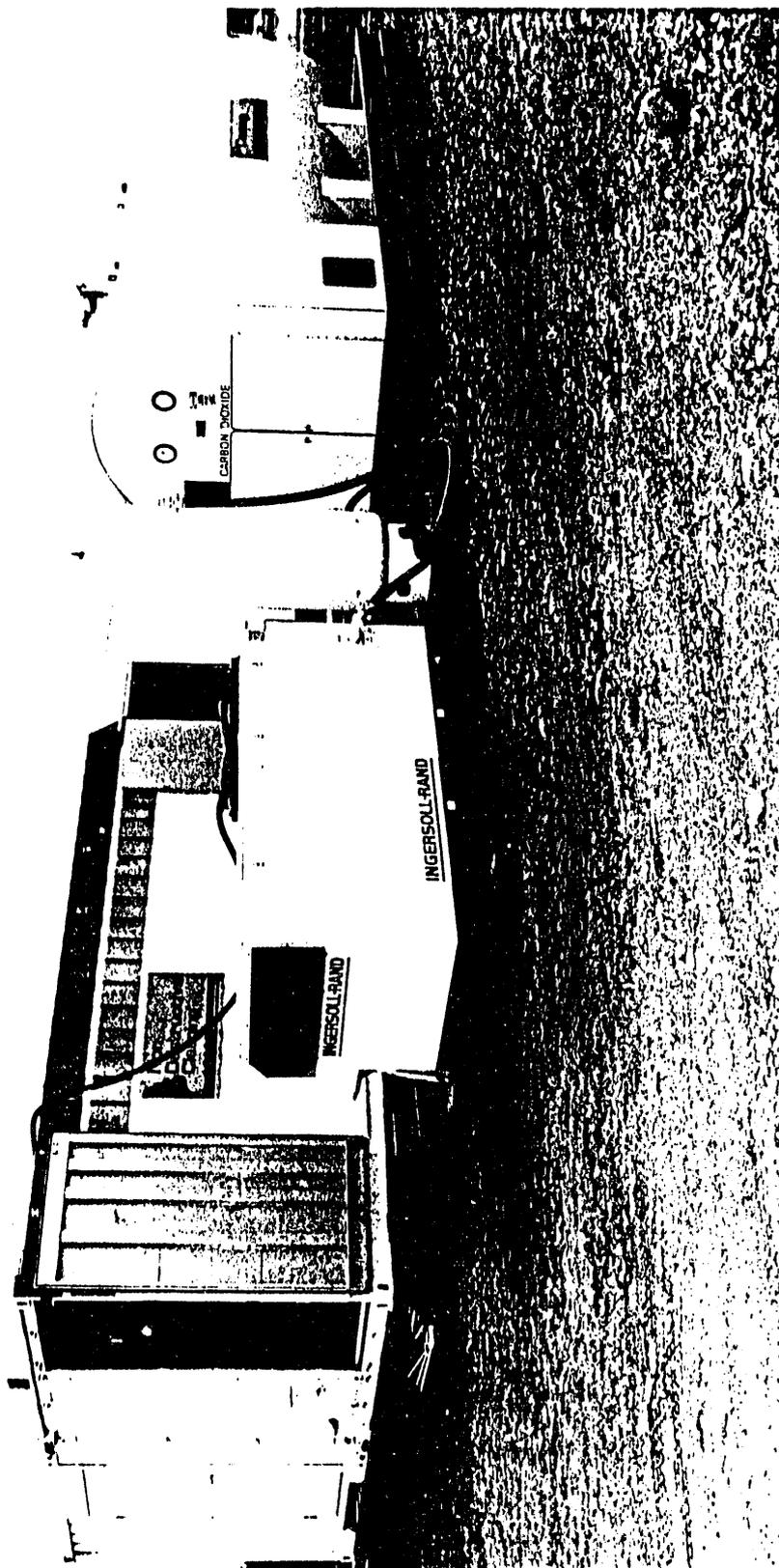


Figure 3. Three-Piece CO₂ Unit in Place.

Non Destructive
Cleaning

Model 400
Patented

NON-DESTRUCTIVE CLEANING FACILITY (NDC)™

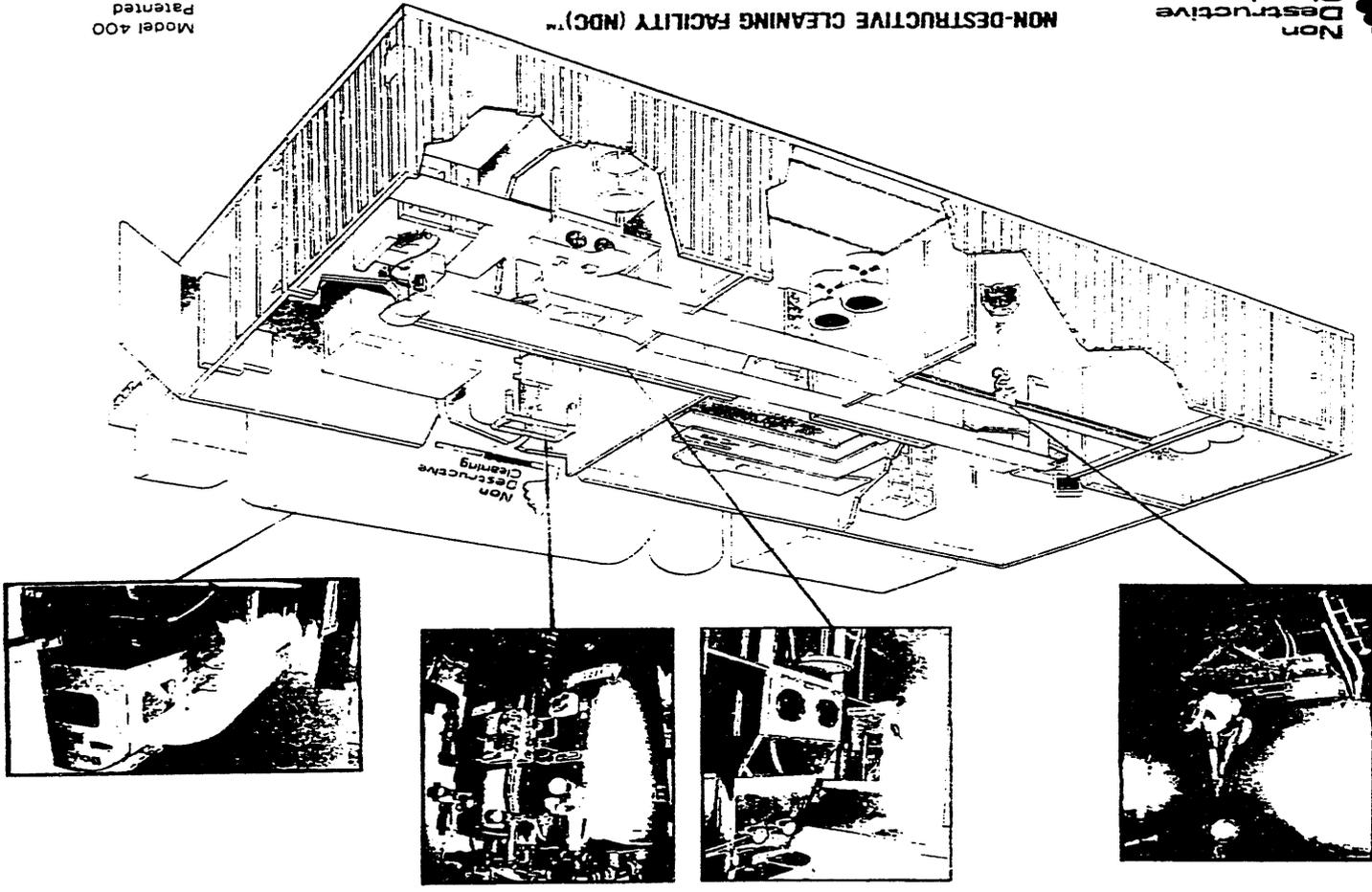


Figure 4. Facility Layout.

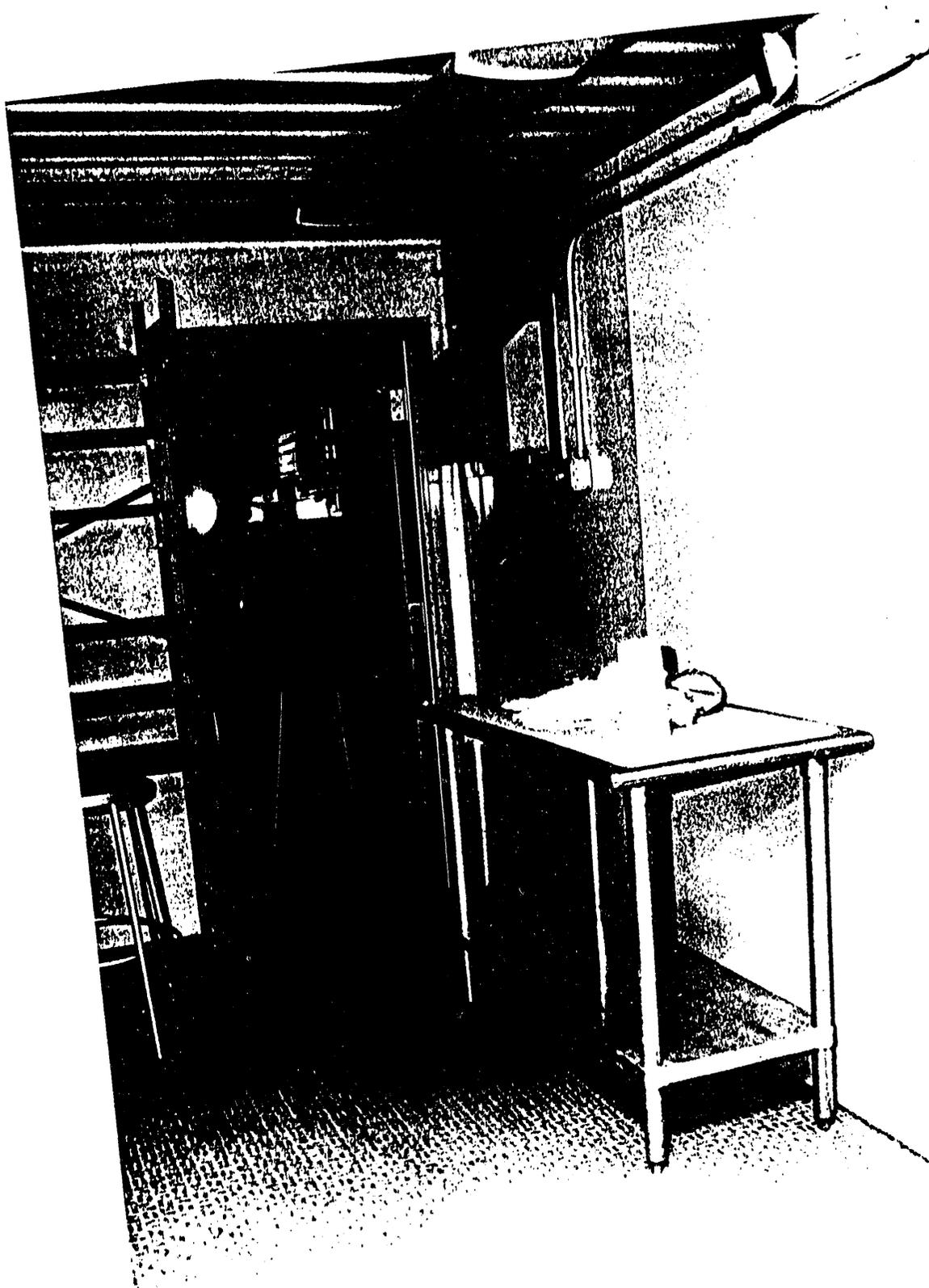


Figure 5. Count Room.



Figure 6. Decontamination Room Ventilation System Pre-Filters.



Figure 7. Decontamination Room Ventilation System HEPA Filters.

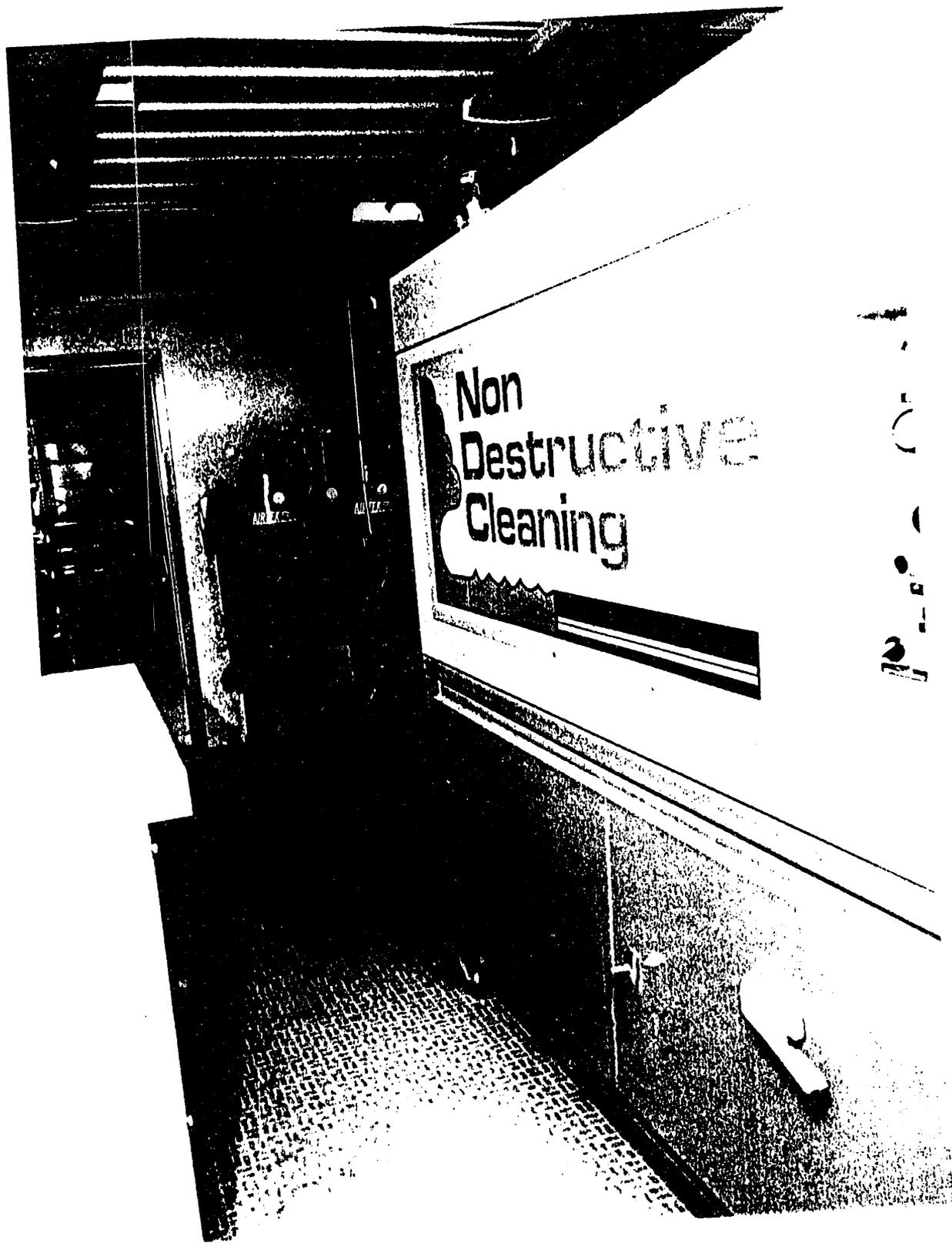


Figure 8. CO₂ Pelletizer.

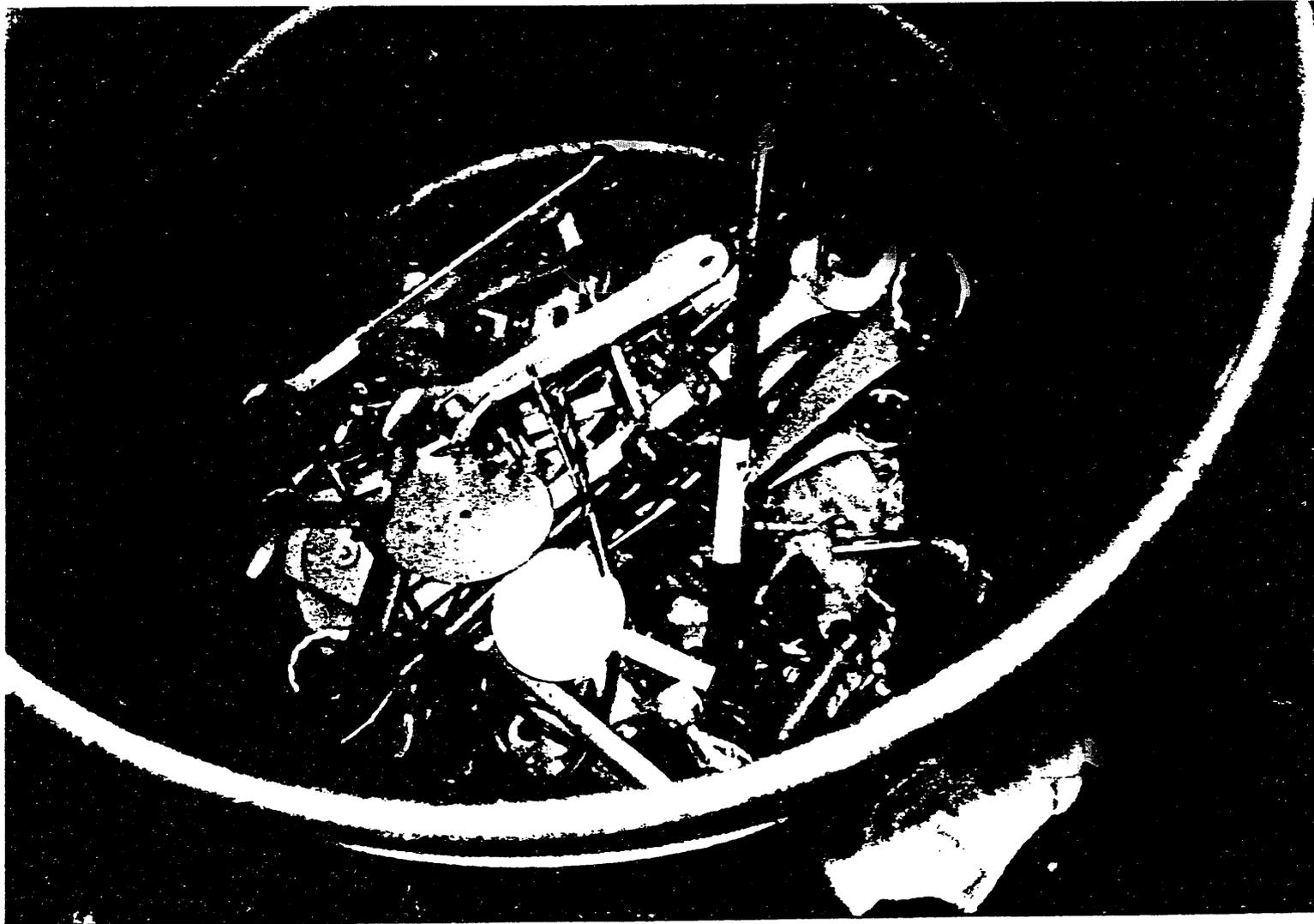


Figure 9. Example of the Free-Released Equipment.

Table 1. B-Plant Non-Destructive Cleaning, Inc. Decontamination Log Sheet.

Completed By: _____

Date of Test: 12-16-93

NDC DECONTAMINATION LOG SHEET

SECTION #	INITIAL SMEARABLE DPM/100CM ²	FINAL SMEARABLE DPM/100CM ²	D/F SMEARABLE	INITIAL RAD LEVEL	FINAL RAD LEVEL	D/F RAD LEVEL	CLEANING TIME MINUTES	CLEANING AIR PRESSURE	COMMENTS
SQUIRREL CAGE #1	500 CPM	LD		L1MR	LD		20	120	FREE RELEASED
SQUIRREL CAGE #2	500 CPM	LD		L1MR			20	120	RE SHOOT
SHAFT + BEARINGS #1	500 CPM	LD		L1MR	L1MR LD		15	120	FREE RELEASED
SHAFT + BEARINGS #2	500 CPM	LD		L1MR	LD		15	120	FREE RELEASED
SHELVING	700 CPM	LD		L1MR	LD		10	120	FREE RELEASED
DOOR STOP CARRIERS ⑦	LD	LD	N/A	LD	LD	N/A	10 MIN EA	120	Cleaned for 40% Technical Inspection
4-2X2 LEAD SHEETS	20,000 DPM	LD		L1MR	LD		15 MIN EA	120	FREE RELEASED
DOOR STOP CARRIERS	LD	LD	N/A	LD	LD	N/A	10 MIN EA	120	CLEANED FOR TECHNICAL INSPECTION
6-2X2 LEAD SHEETS	2K-20K	LD		L1MR	LD		15 MIN EA	120	FREE RELEASED
FAN BLADES (SCRAP)	2K-5K	LD	N/A	L1MR	LD	N/A	10 MIN EA	120	FREE RELEASED (10 PIECES)

Table 2. 222-S Laboratory Non-Destructive CO₂ Decontamination Log Sheet.

NON-DESTRUCTIVE CO₂ DECONTAMINATION LOG

DATE	ITEM DESCRIPTION	INITIAL ACTIVITY DPM/100cm ²		DOSE RATE	FINAL ACTIVITY DPM/100cm ²		CLEANING		COMMENTS RELEASED
		SMEARABLE	FIXED		SMEARABLE	FIXED	TIME (MIN)	AIR PRES PSIG	
3/14/94	6 @ 10" Ø DUCT 3'-4' Long	1K	0-1K	2.5	LD	LD	90	120	FREE RELEASED
3/14/94	LEAD BRICKS 16	10K	10K-200K	2.5	2K	2K	90	120	FREE RELEASED
3/14/94	40# ↑ LEAD BRICKS	21K	10K-200K	2.5	21K	10-200K	10	120	COND RELEASE.
3/15/94	Chem Sampling Hood (bottom)	1K	0-1K	2.5	21K	21K	30	90-120	FREE RELEASE
3/15/94	HEPA FILTER HOUSING DOOR	1K	0-1K	2.5	21K	21K	10	60	FREE RELEASE
3/15/94	HEPA FILTER HOUSING & ACCS	1-2K	0-1K	2.5	21K	21K	15	60-130	Free Release
3/15/94	SAW'S All POWER TOOL	21K	10K	2.5	21K	2K	15	130	Reshoot
	① Saw's All	21K	2K	2.5	21K	21K	15	130	Free Release
3/15/94	Butter fly valve	1K	N/A	2.5	21K	21K	5	130	Free Release
3/16/94	HEPA FILTER HOUSING & ACCS	1K	N/A	2.5	21K	21K	30	130	Free Release
3/16/94	Chem Sample Hood (top)	4K	N/A	2.5	21K	21K	30	60-130	Free Release
2/17/94	Chem Sample Hood	1K	N/A	2.5	21K	21K	30	60-130	Free Release
3/17/94	Chem Sample Hood	1K	N/A	2.5	21K	21K	30	60-130	Free Release
3/17/94	Chem Sample Hood Glass door	8-15K	8K-25K	2.5	21K	5K	20	130	NOT Released.
3/17/94	SS. Sample Hood	12K	N/A	2.5	21K	21K	30	130	Free Released

DATE

FILMED

7/28/94

END

