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Fission Product Development Laboratory Cell Decommissioning Project Plan

T. E. Myrick
R. W. Schaich
F. V. Williams

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(Activity AR 05 05 00 0, ONL-WD05)

FISSION PRODUCT DEVELOPMENT LABORATORY CELL DECOMMISSIONING PROJECT PLAN

T. E. Myrick
R. W. Schaich
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FISSION PRODUCT DEVELOPMENT LABORATORY CELL DECOMMISSIONING PROJECT PLAN

T. E. Myrick, R. W. Schaich, F. V. Williams

ABSTRACT

The Fission Product Development Laboratory (FPDL) at Oak Ridge National Laboratory (ORNL) was a full-scale processing facility for separating megacurie quantities of ^{90}Sr, ^{137}Cs, and ^{144}Ce for a variety of source applications, operating at full capacity from 1958 to 1975. Since facility shutdown, the inactive portions of the FPDL have been maintained in a protective storage mode as part of the ORNL Surplus Facilities Management Program (SFMP). Due to the significant radionuclide inventory remaining in the facility, the high surveillance and maintenance costs necessary to assure radionuclide containment, and the potential for reuse of the facility by other programs, the decommissioning of the inactive portions of the FPDL has been given a high priority by the SFMP. In response to this program direction, plans are being made for initiation of these activities in late FY 1983.

This project plan has been prepared to satisfy the program documentation requirements for SFMP project planning. The plan outlines the scope of the proposed effort, describes the proposed methods of project accomplishment, and provides estimates of the project resource needs and schedule.

---

1. INTRODUCTION

The Fission Product Development Laboratory (FPDL) is one of 46 ORNL facilities currently included in the Department of Energy's Surplus Facilities Management Program (SFMP). The purpose and objectives of this national program are set forth in the SFMP Program Plan[1] and include (1) the maintenance and surveillance of surplus radioactively-contaminated facilities prior to initiation of facility decommissioning activities, (2) planning for the orderly disposition of these facilities and (3) implementation of a program to accomplish the facility decommissioning in a safe, cost effective and timely manner.

The major portion of the FPDL has been maintained in a safe storage mode since facility shutdown in 1975. Because of the significant radionuclide inventory remaining in the facility, a comprehensive maintenance and surveillance program has been conducted since that time to adequately control the contained radioactivity. Due to the resulting high maintenance costs, the potential for facility reuse by other programs, and the current availability of experienced operating personnel, decommissioning of portions of the FPDL has been given a high priority by the SFMP. In response to this program direction, plans are being made for initiation of these activities in late FY 1983.

As outlined in the SFMP Program Plan, participating contractors are required to prepare a formal project plan that documents the objectives of the task, outlines the management approach to be utilized, presents a summary of the technical plan for decommissioning operations, and provides estimates of the project cost and schedule. This document has been prepared to satisfy this program need.

2. PROJECT OBJECTIVES

The primary objectives of the current decontamination and decommissioning (D&D) efforts at the FPDL are to (1) remove all excess contaminated process equipment from the unused portions of the facility, (2) decontaminate these areas to acceptable levels for reuse, and (3) place these portions of the facility in a standby mode, awaiting other applications. Since the FPDL is in an operable condition, with portions of the facility presently being utilized for radioactive processing and ORNL decontamination operations, no plans are being made for the complete decommissioning and dismantlement of the building. Such final facility disposition will be delayed until the end of the useful life of the facility (15-20 years).

3. FACILITY DESCRIPTION

3.1 PHYSICAL DESCRIPTION

3.1.1 Building

The Fission Product Development Laboratory[2] (Building 3517) is a concrete block and corregated aluminum-sided structure located in the Bethel Valley portion of ORNL (Figs. 1 and 2). The two main building levels consist of operating areas, service areas, offices and other personnel access areas arranged around a large concrete cell block containing some 20 separate cells (Fig. 3). A crane bay encloses the area over the tops of the cells. There are four additional underground cells located on the north side of the building.

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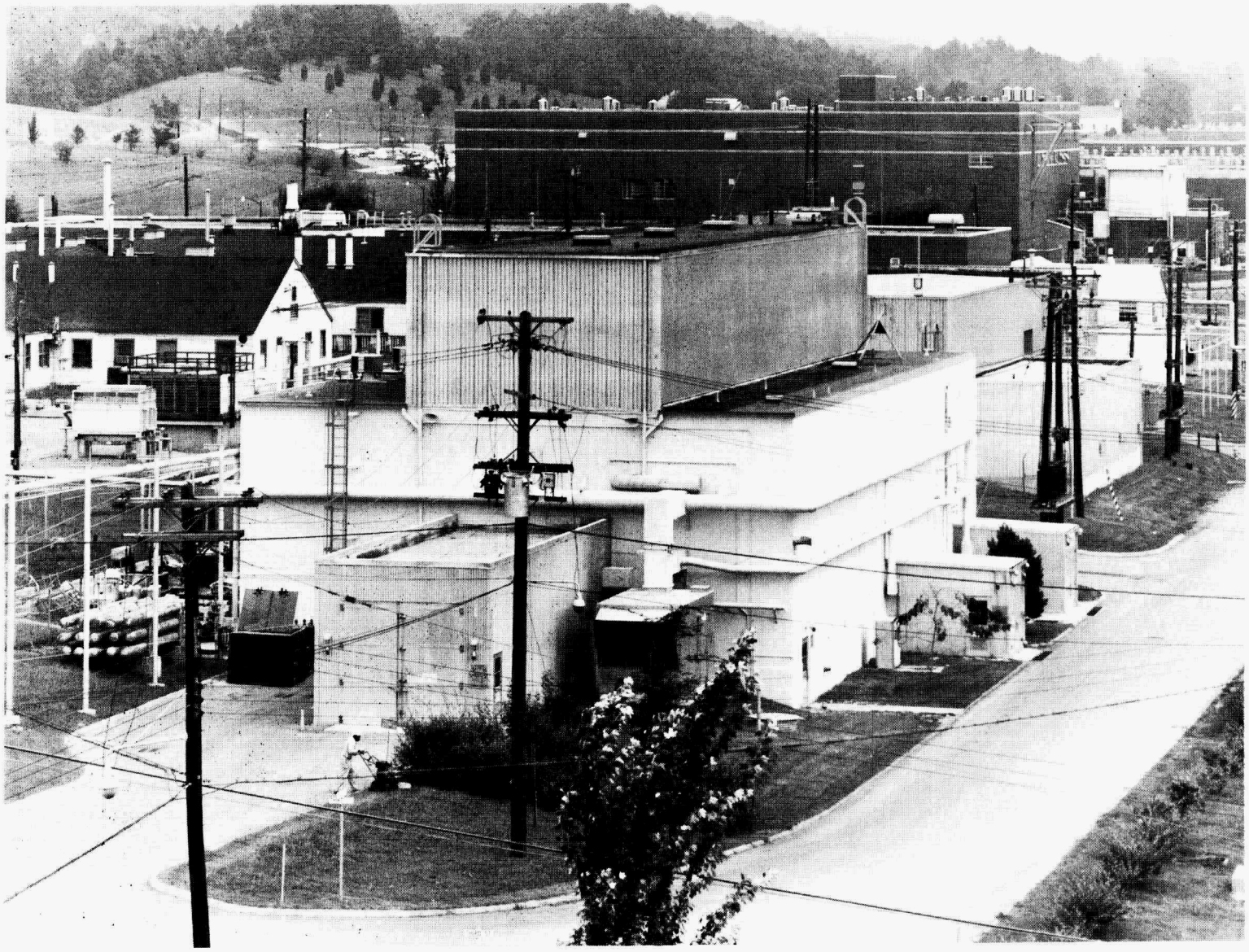

Fig. 1. Fission Product Development Laboratory.

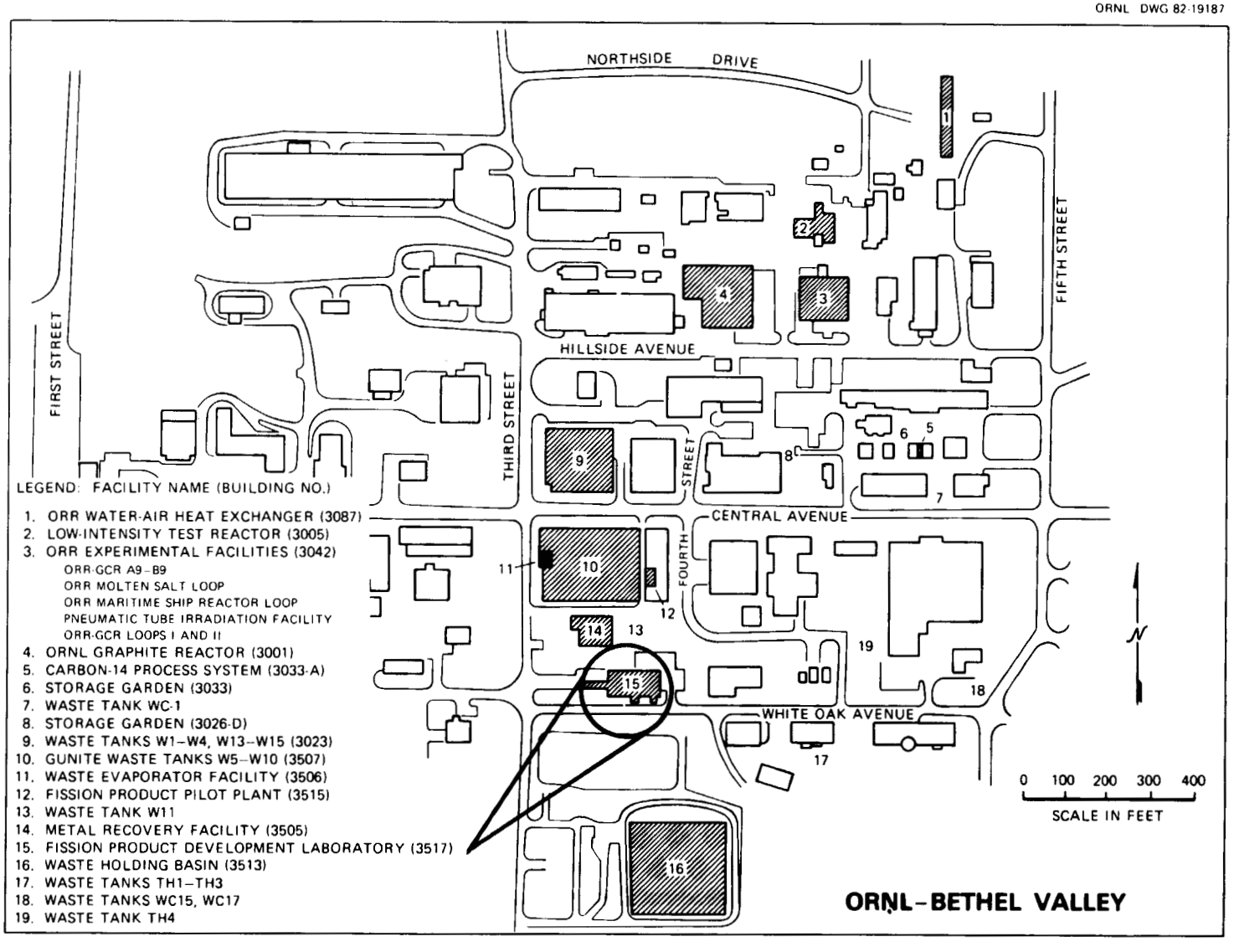

Fig. 2. Location map for the Surplus Facilities Management Program.

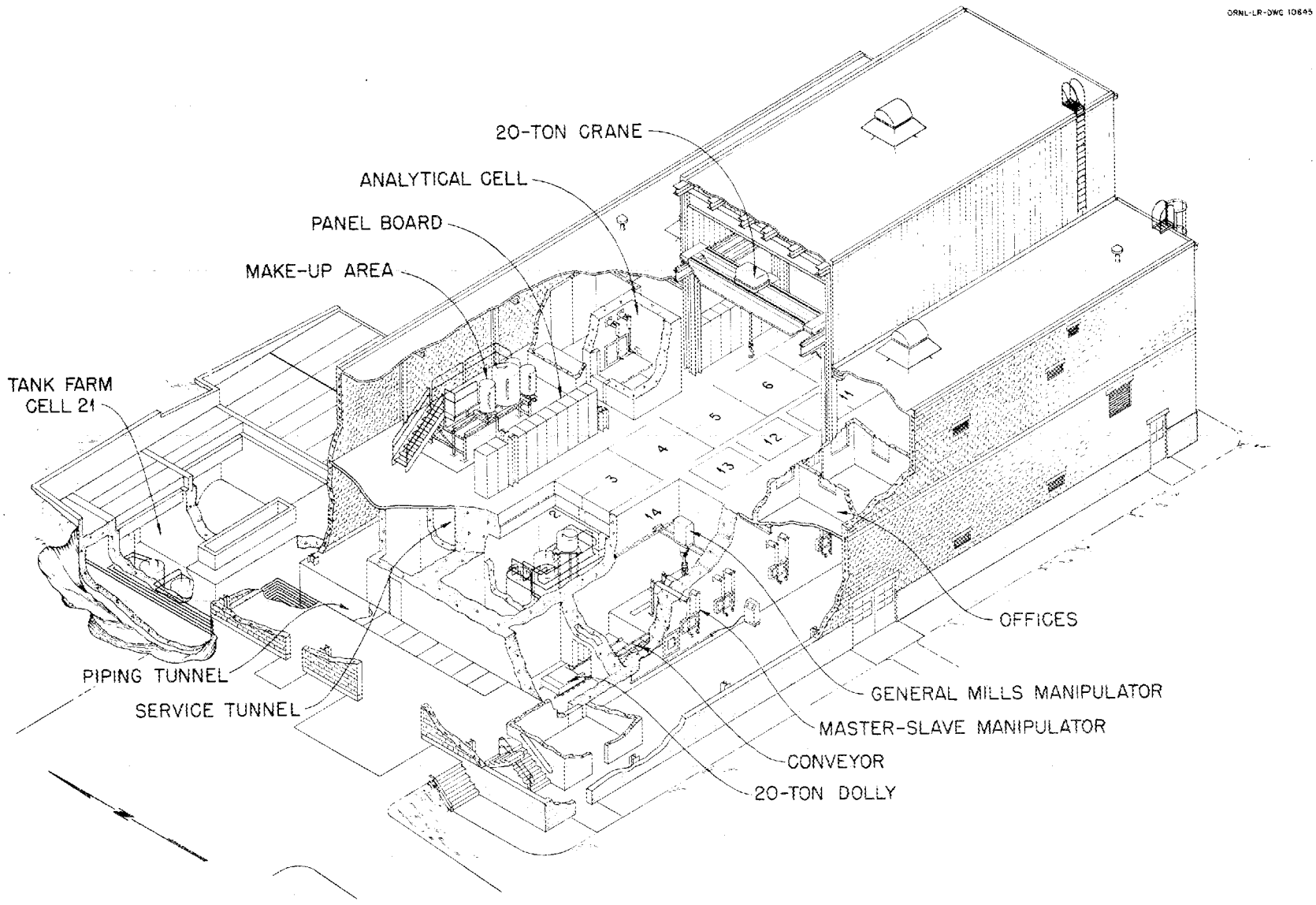

Fig. 3. Isometric view of the FPDL.

A controlled air-handling system provides ventilation and containment for the facility. All building air is exhausted through HEPA filters to the ORNL cell ventilation system. The building atmosphere is regulated at a negative pressure of approximately 0.35 in. of water and the cells are maintained at a negative pressure of 1.5 in. of water. Personnel entrances and equipment loading areas are airlocked to maintain atmospheric control.

Batch makeup tanks for process chemicals are located on the second level of the building. A makeup and storage area for large volumes of process chemicals is located outside the building. Chilled water for cooling the process vessels is provided by three compressor units on a recirculating water loop. A 20-ton bridge crane is used to handle shielded casks and to remove the top shield blocks from the cells to allow cell access.

3.1.2 Cells

A schematic of the FPDL cell arrangement and numbering system is provided in Fig. 4. The main cell block consists of process and manipulator cells 1 through 15. Connected to this main cell block on the first level are manipulator cell 16, service cells 17 and 20, and the service tunnel. Manipulator cell 18 and cell 19 (now removed) are located on the second level. The four storage cells 21-24 are underground adjacent to the building. The cell ventilation filter house is located on ground-level, east of the FPDL. A brief description of the design function of each of these cells is given as follows, with additional details provided in Appendix A.

1. Process Cells (1-9) - contain fixed equipment and are used for remote chemical processing. The cells are totally enclosed, having no viewing windows or manipulators, and are operated from remote panelboards.

2. High-Level Manipulator Cells (10-14) - are used for final processing of radioactive materials to product compounds. The majority of this processing is directed by master-slave manipulators from the manipulator operating gallery (Fig. 5).

3. Low-Level Manipulator Cells (15, 16, 18, 19) - are used for manipulator operations which require relatively little shielding. Typical operations are sampling, decontamination of small equipment, and solid waste removal.

4. Service Cells (17, 20, service tunnel and ventilation filter house) - contain service equipment such as steam supply valves, filters, scrubbers, pneumatic transmitters, and instrument piping. Since this equipment is directly connected to the process equipment, the areas in which it is installed are treated like other cells.

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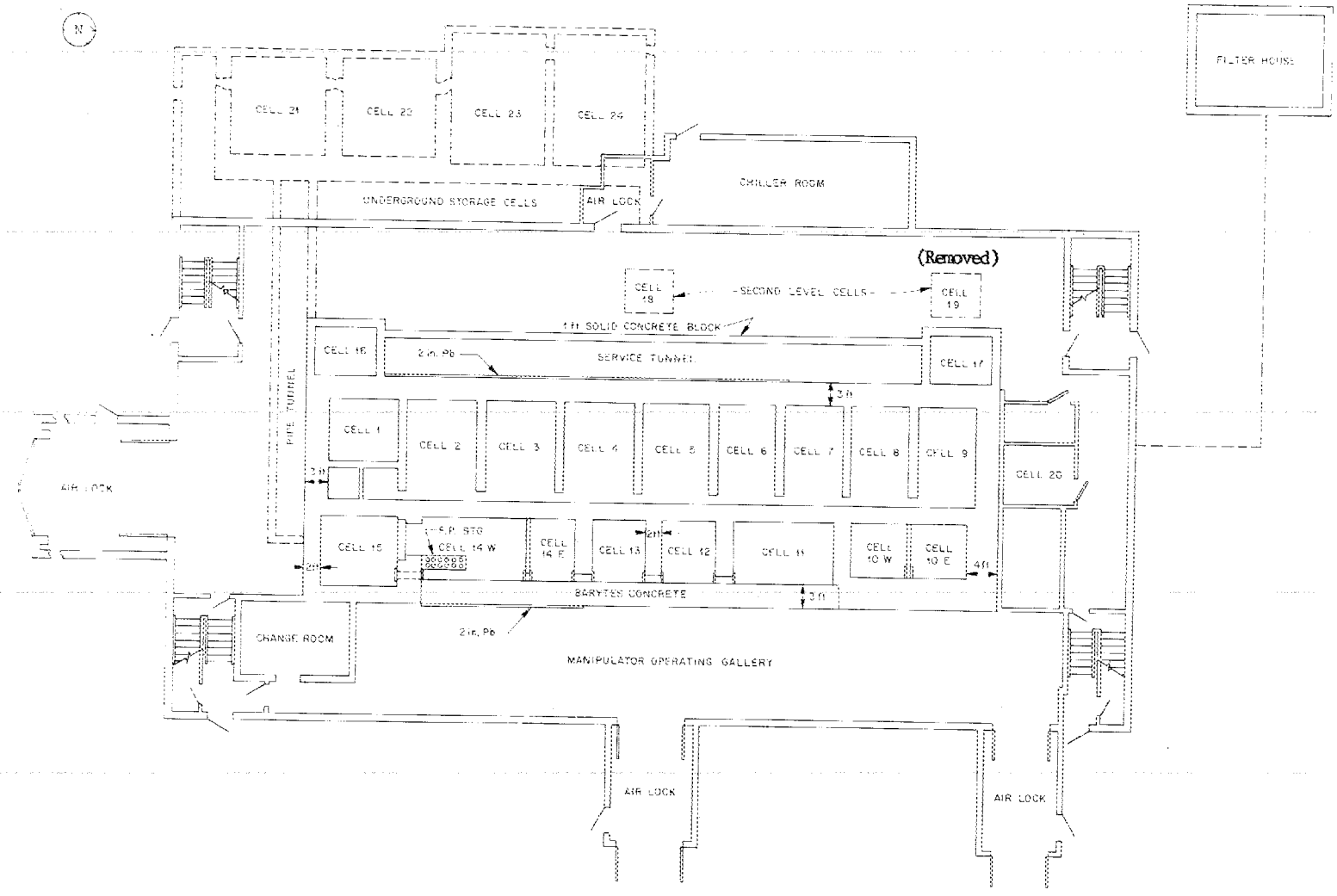

Fig. 4. Cell arrangement at the FPDL.

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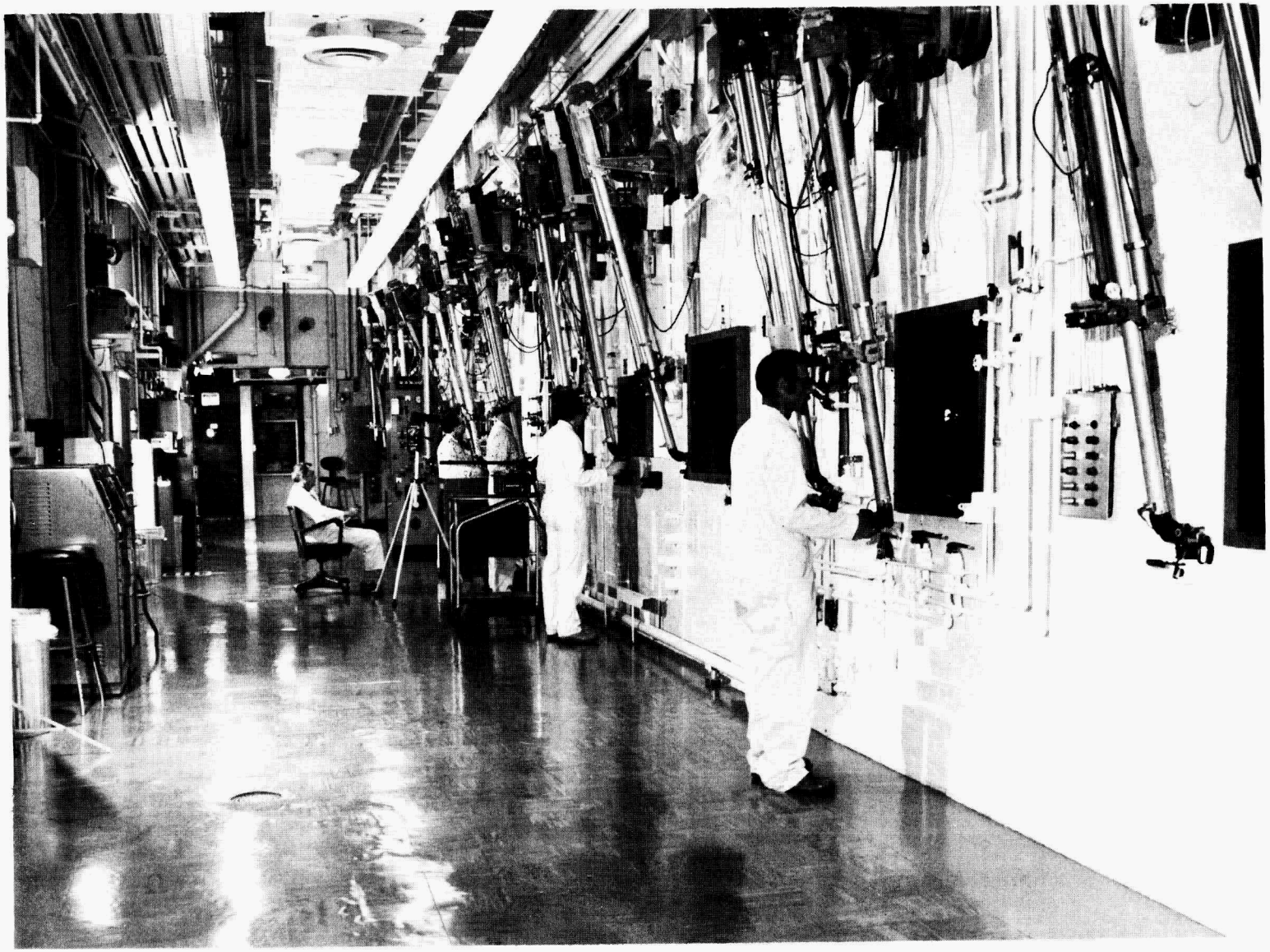

Fig. 5. Manipulator cells operating gallery.

5. Tank Farm Cells (21-24) - contain stainless-steel tanks for waste solution holdup and fission product solution storage. These cells are similar to the process cells except that the equipment they contain is designed simply for storage and transfers instead of for chemical processing.

Most of the cells are lined with stainless steel for ease of decontamination. They are provided with a variety of services, such as steam, chilled water, hot off-gas system, electrical supplies, cell ventilation, and instrumentation, as required. The process cells, storage cells, and high-level manipulator cells are shielded from the nearest accessible area by the equivalent of four feet of ordinary concrete; the low-level manipulator cells and service areas have less shielding. Personnel can gain entrance to the process, storage, or high-level manipulator cells only after removal of the concrete top plugs (Fig. 6). The entrances to low-level manipulator cells or service areas are equipped with interlock devices which prevent accidental entry into zones of potentially high radiation.

Process equipment permanently installed in the FPDL provided for the following operations:

1. elution of ion exchanger beds,
2. precipitation - centrifugation,
3. precipitation - filtration,
4. crystallization - filtration,
5. evaporation,
6. batch solvent extraction,
7. calcination and sintering, and
8. vacuum hot pressing.

All of the assorted tanks and process piping involved in these operations are of welded stainless steel. In addition to these operations, essentially any unit operation or process could have been carried out on relatively small scale in the manipulator cells with temporary equipment.

3.2 OPERATING HISTORY

As part of the fission product research and development work at ORNL, the Fission Product Development Laboratory went on-line in 1958 to separate kilocurie amounts of ^{137}Cs, ^{90}Sr, ^{144}Ce, and ^{147}Pm from Redox- and Purex-type waste streams. This program was successfully demonstrated during the first two years of operation, and kilocurie quantities were made available for worldwide distribution.

With the advent of the AEC's Systems for Nuclear Auxiliary Power (SNAP) program and increased demand for ^{137}Cs gamma sources, the requirements for ^{137}Cs, ^{144}Ce, and ^{90}Sr were increased to a level of megacuries per year. To meet this demand, concentrates of ^{137}Cs, ^{90}Sr,

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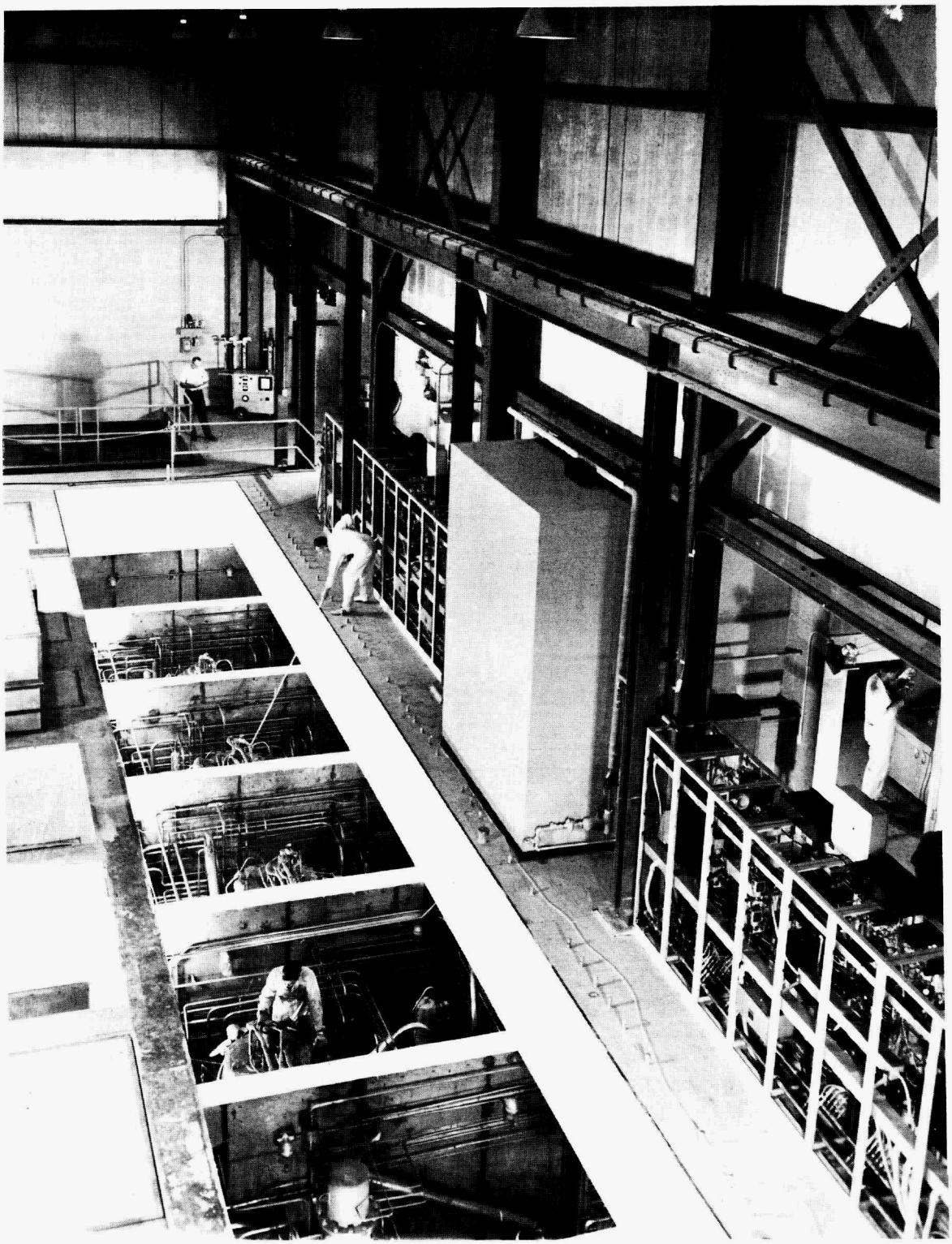

Fig. 6. View of process cells with top plugs removed.

and ^{144}Ce were shipped from the Hanford Atomic Products Operation (HAPO) to the FPDL for preparation of the fuel compounds used in the SNAP program. The FPDL facility was modified in 1963 to allow the continuous production of three product streams as follows:

1. A semi-pure fraction of ^{137}Cs from HAPO was chemically purified at the FPDL and converted to $^{137}CsCl$ powder. This powder was cold pressed into pellets which were doubly encapsulated in stainless steel; the capsules were tested for leaks, and then shipped to the customer.

2. Purified ^{90}Sr was received from HAPO and converted to ^{90}Sr titanate. This material was then compacted by vacuum hot press techniques to form a high density pellet. The pellets were encapsulated, usually in Hastelloy "C", and the capsules were tested for leaks and decontaminated before being loaded into a thermoelectric generator for shipment to the customer.

3. A mixed rare earth fraction was received from HAPO; the ^{144}Ce was separated by solvent extraction, and converted to ^{144}Ce oxide. The powder was cold pressed and sintered and then sealed in compatible containers for shipment to the customer.

A total of 10.0 MCi of fission product material was successfully processed at the FPDL during this operating period. At the conclusion of this program (1975), the majority of the facility was placed in standby and initial decontamination efforts undertaken. Only limited radioisotope processing has been conducted since that time.

Current operations at the FPDL consist of routine facility maintenance and surveillance, processing of ^{137}Cs and ^{90}Sr for commercial applications, and decontamination activities for other ORNL programs. A variety of maintenance and surveillance (M&S) tasks are conducted on a routine basis in order to maintain adequate control over the contained radioactivity. These activities are documented in the ORNL SFMP Maintenance and Surveillance Plan[3] in terms of frequency and resource requirements. Only a portion of the total M&S costs for the facility is borne by the SFMP, the remainder is provided by the operating programs occupying the building.

The current commercial radioisotope processing consists of (1) purification of cesium chloride feed material from the Hanford Waste Encapsulation Storage Facility (WESF) for conversion to various ^{137}Cs sources and (2) preparation of ^{90}Sr heat sources for thermoelectric generators from strontium fluoride feed, again provided by WESF. These operations are a continuation of the original FPDL processing mission, and are conducted in cells 10, 11, and 12. Decontamination services for the entire Laboratory are also provided at FPDL, including vibratory finishing, electropolishing, remote decontamination in process or manipulator cells (1 and 16), and hands-on decontamination of equipment in established contamination zones. Contaminated equipment for clean-up

is brought in on an as-required basis, and the appropriate decontamination technique used to clean the item to specified levels for reuse or disposal.

3.3 PREVIOUS FACILITY DECONTAMINATION

The FPDL was designed to be directly maintained. Before any equipment could be repaired, replaced, or revised, the equipment and the cell in which it was located had to be decontaminated. The decontamination consisted primarily of hot chemical flushes of cell piping and process equipment, followed by decontamination of exterior surfaces and cell walls by high pressure spraying. If necessary, shielding was then used to reduce radiation levels to acceptable limits for maintenance and equipment removal. During the main operating period from 1963-1973, in-cell maintenance requirements were at a minimum and only six cells were decontaminated for the installation of new equipment or for repairs to existing equipment. Of course, subsequent use of these cells after decontamination and maintenance resulted in re-contamination of process equipment and cell surfaces.

A comprehensive decontamination program was conducted in 1973-1975 to remove and encapsulate all remaining ^{90}Sr products and provide initial decontamination of the process, manipulator and tank farm cells, and the cell ventilation system.[4] Although subsequent funding restrictions limited the scope of this decontamination effort, a significant reduction in the radionuclide inventory of the facility was achieved. The primary accomplishments of this initial program are listed as follows:

1. The encapsulation and storage of approximately 500,000 curies of ^{90}Sr titanate powder was completed.

2. Three manipulator cells (10, 11, 19) were decontaminated to a level allowing direct personnel access; the remaining manipulator cells will require significant additional effort prior to in-cell maintenance and equipment removal.

3. Hot chemical flushes of process equipment and piping within all nine process cells were completed; comprehensive in-cell decontamination was conducted only in cells 8 and 9.

4. Initial decontamination of the tank farm cells and cell ventilation systems was completed.

Since 1975, decontamination of the FPDL has been conducted on an as-needed basis to provide a safe working environment for operating and maintenance personnel, or to allow the installation of new equipment. In 1979, further decontamination of manipulator cells 11 and 12 was initiated for installation of a new viewing window and the cutting of a transfer port between cells 10 and 11. These modifications were part of

the cell upgrading for start-up of the current ^{90}Sr and ^{137}Cs radioisotope work. In 1980-81, significant decontamination and decommissioning efforts were undertaken to prepare for installation of the ORNL electropolishing unit. As part of this project, cells 9 and 17 were decontaminated to allow for in-cell equipment removal and tie-in of the electropolisher off-gas system. Cell 19 had to be decontaminated and completely dismantled for actual placement of the electropolisher tanks and controls. All of these decontamination activities were funded by the supporting operating programs and were not associated with the SFMP. Finally, decontamination of the crane bay area (cell access area) is currently being completed to allow direct personnel access to the vibratory finisher and to the cell plugs. This decontamination effort will be conducted simultaneously with the initiation of SFMP decontamination of these cells.

3.4 CURRENT FACILITY CONDITIONS

The FPDL has been maintained in an operable condition since placed in standby in 1975. The building structure is sound and the supporting services fully functional. The facilities for operating personnel (offices, change rooms, operating galleries) have been well maintained and are available for use.

The conditions of the FPDL cells are generally known, although direct cell access has been limited over the past ten years. A summary of the current cell status and contents is provided in Table 1, with additional details presented in Appendix A. Of the 23 available cells, 8 are utilized on a part-time or full-time basis by operating programs. The operating cells are used for radioisotope processing and decontamination activities, as well as for transport, treatment or storage of operational waste streams. The inactive process cells contain a variety of tanks, piping, samplers, services, and instrumentation. The majority of this equipment is operable to the extent that solutions can be transferred through the piping and vessels. Inoperative valves and jets have been documented (see Appendix A). Background radiation levels in the inactive process cells are estimated to be in the range of 10-100 rad/h, with isolated hot spots of 100-1000 rad/h in transfer lines or pieces of equipment that could not be adequately cleaned during the previous hot chemical flushing efforts. The inactive manipulator cells contain a variety of solid wastes, obsolete equipment, and residual cesium and strontium powder. Due to the presence of this powder, radiation levels exceeding 10^6 rad/h are found in some of the cells.

As evidenced by the estimated radiation levels in the inactive cells, significant quantities of residual radioactivity remain in the facility. However, adequate controls have been provided to assure containment. Contamination external to the cells is minimal, and is controlled through proper zoning and periodic decontamination efforts.

Table 1. Summary of FPDL cell status - March 1983

Cell type	Cell No.	Cell contents	Radiation levels	Cell status
Process	1	1-125 gal. Tank Assorted piping and services Armor plate cell divider	20-100 mrad/h, North side <100 rad/h, South side	North side used for decontamination South side Inactive
	2	3-250 gal. tanks Centrifuge with motor Assorted piping and services	100 rad/h background 100-1000 rad/h hot spots	Inactive
	3	3-250 gal. tanks Centrifuge with motor Assorted piping and services	100 rad/h background 100-1000 rad/h hot spots	Inactive
	4	3-250 gal. tanks Centrifuge with motor Assorted piping and services	100 rad/h background 100-1000 rad/h hot spots	Inactive
	5	2-500 gal. tanks Centrifuge with motor Assorted piping and services	100 rad/h background 100-1000 rad/h hot spots	Inactive
	6	1-650 gal. tank Reflux condenser Assorted piping and services	100 rad/h background 100-1000 rad/h hot spots	Inactive

Table 1. (Continued)
Page 2

Cell type	Cell No.	Cell contents	Radiation levels	Cell status
	7	2-500 gal. tanks Assorted piping and services	10-20 rad/h background 100-1000 rad/h hot spots	Inactive
	8	2-125 gal. tanks 1-25 gal. tank Assorted piping and services	10-20 rad/h background 100 rad/h hot spots	Inactive
	9	All process equipment removed	< 1 rad/h background	Available for reuse
Manipu-lator	10	Curium storage equipment Cell load-out equipment	10 rad/h	Operating cell
	11	^{137}Cs purification equipment	10^7 rad/h	Operating cell
	12	^{90}Sr heat source fabrication equipment	10^7 rad/h	Operating cell
	13	Powder handling equipment	10^6 rad/h	Inactive
	14	Cs Precipitator Water-cooled storage wells Sr powder storage equipment Inoperative manipulator Miscellaneous solid wastes	$>10^6$ rad/h	Inactive

Table 1. (Continued)
Page 3

Cell type	Cell No.	Cell contents	Radiation levels	Cell status
	15	Waste transfer equipment	100 rad/h	Inactive
	16	Decontamination equipment	100 mrad/h	Operating cell
	17	Fission product Xe storage containers	100 mrad/h	Operating cell
Manipulator	18	Sampling and analytical equipment. Miscellaneous solid wastes	100 rad/h background 100-1000 rad/h hot spots	Inactive
	19	None	None	Cell removed in 1980
	20	Off-gas scrubbing system	1-100 rad/h	Operating cell
Tank farm	21	4-275 gal. tanks 2-520 gal. tanks Assorted piping and services. Instrument cubicle	10 rad/h background 100 rad/h hot spots	Inactive
	22	1-6000 gal. tank Assorted piping and services. Instrument cubicle	10 rad/h background 100 rad/h hot spots	Inactive

Table 1. (Continued)
Page 4

Cell type	Cell No.	Cell contents	Radiation levels	Cell status
	23	ILW tankage and transfer system	1000 rad/h	Operating cell
	24	Process waste tankage and transfer system	1000 rad/h	Operating cell
Service	Filter pit	Roughing ventilation filters	200 rad/h	Operating cell
	Filter house	HEPA filtration system	10-200 rad/h	Operating cell
	Service tunnel	Assorted valves, relays and piping	50-500 mrad/h background 5-100 rad/h hot spots	Inactive

4. CELL DECOMMISSIONING PLAN

As stated in Sect. 2, the objective of the current decommissioning efforts at the FPDL is to decontaminate the inactive portions of the facility in order to reduce the hazards associated with the residual radioactivity and make these areas available for potential reuse. Specifically, this task will involve (1) the decontamination of inactive process, manipulator and tank farm cells, service tunnel and associated in-cell equipment, (2) the removal of all surplus in-cell equipment for appropriate disposal, and (3) the placing of these portions of the facility in a standby mode, awaiting reuse applications. The cells to be included in this effort are the process cells 1-8, manipulator cells 13-15 and 18, tank farm cells 21 and 22, and the service tunnel behind process cells 1-8. The remainder of the FPDL facility is operational and will not be treated as part of this project.

4.1 GENERAL APPROACH

The decontamination and decommissioning activities proposed for the FPDL are similar in concept to the remote maintenance tasks carried out during facility operation. When equipment maintenance was required, or process alterations necessary, in-cell decontamination and equipment removal was performed. The proposed decommissioning project simply expands the scope of these routine maintenance functions to provide complete removal of all excess in-cell equipment, with subsequent decontamination of the bare cell walls to specified limits. The technical plan for cell decommissioning at the FPDL is outlined in Fig. 7 in a Work Breakdown Structure (WBS) format. Generic flowcharts of activities for each decontamination and decommissioning WBS (WBS 1.0-4.0) are provided in Figs. 8-11 and are briefly discussed in the following sections. Details of the proposed project management structure and requirements (WBS 5.0) are reserved for Sect. 5.

4.1.1 Manipulator Cells

Decommissioning the manipulator cells (Fig. 8) will involve removal of all excess equipment and residual waste materials present in the cells. The initial work will be conducted remotely from the manipulator gallery, using specially designed tools and high pressure sprays. Once radiation levels have been reduced sufficiently, direct access to the cells will be secured and high pressure spraying of cell walls and equipment performed. Solutions to be used include nitric acid, sodium hydroxide, oxalic acid and commercial decontamination agents. After each cell is decontaminated to an acceptable level for personnel entry, maintenance personnel will remove any excess piping or other equipment. Operating personnel will then decontaminate the cells to an acceptable level for reuse.

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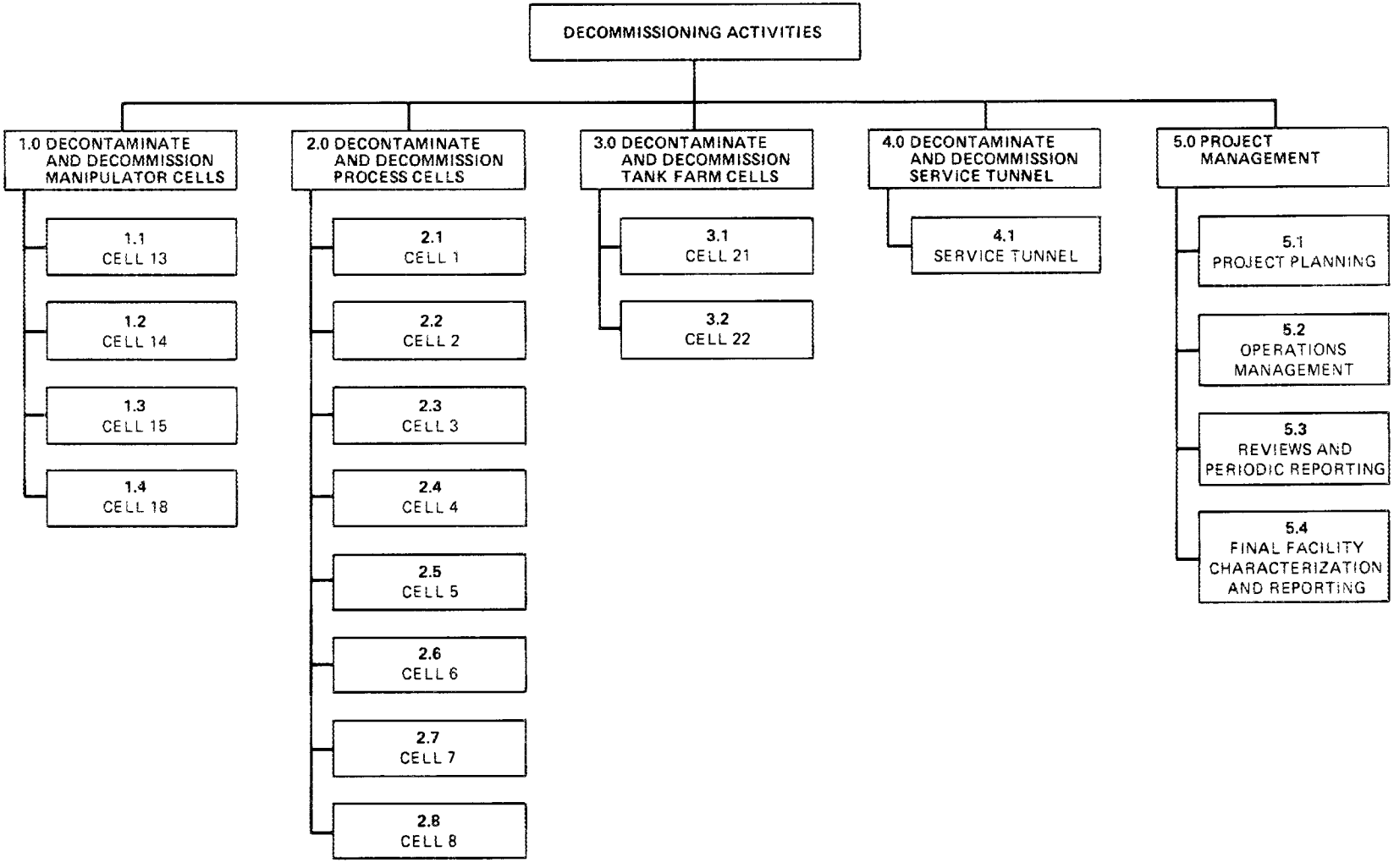

Fig. 7. FPDL cell decommissioning plan outline.

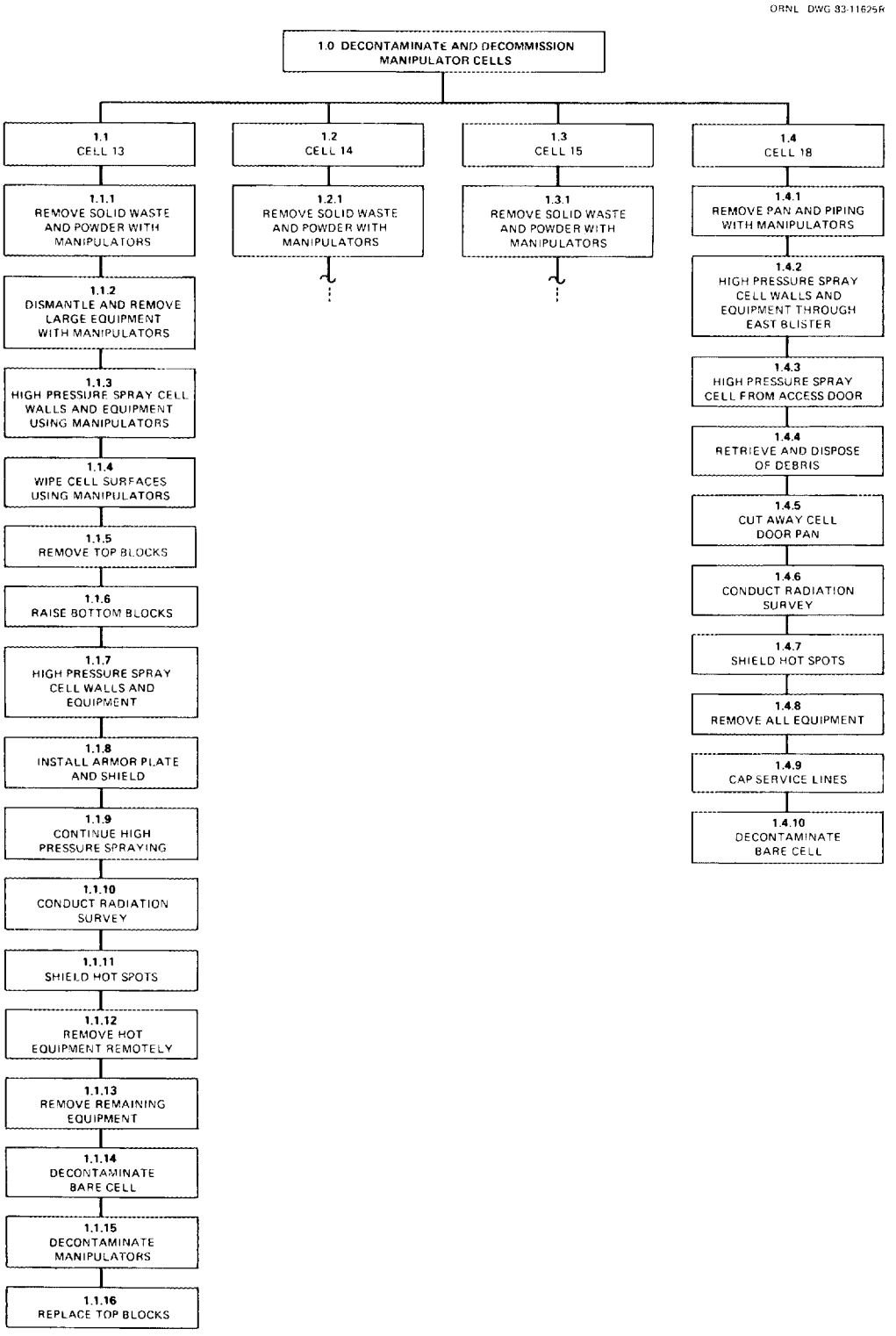

Fig. 8. Flowchart of D&D activities for the manipulator cells.

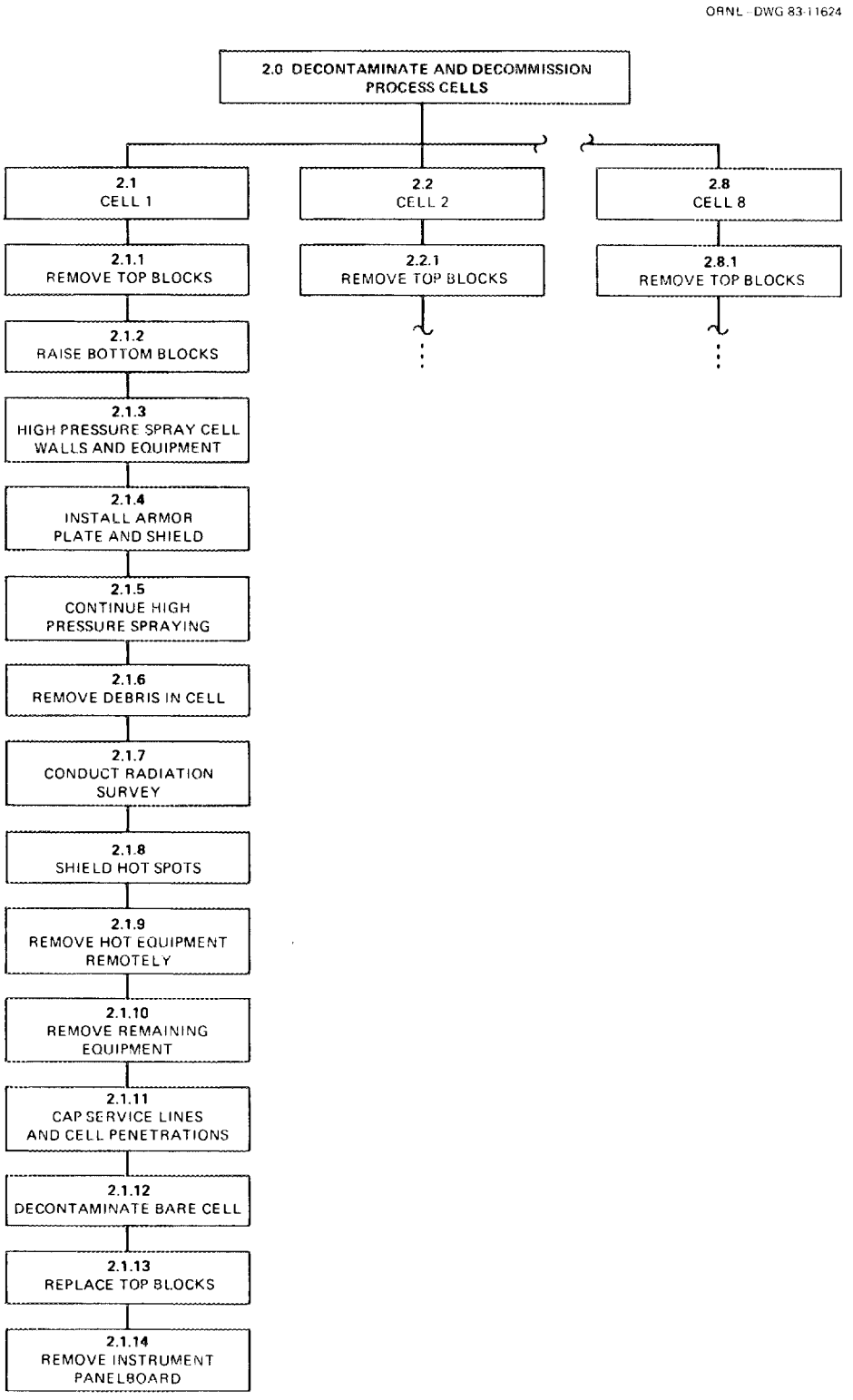

Fig. 9. Flowchart of D&D activities for the process cells.

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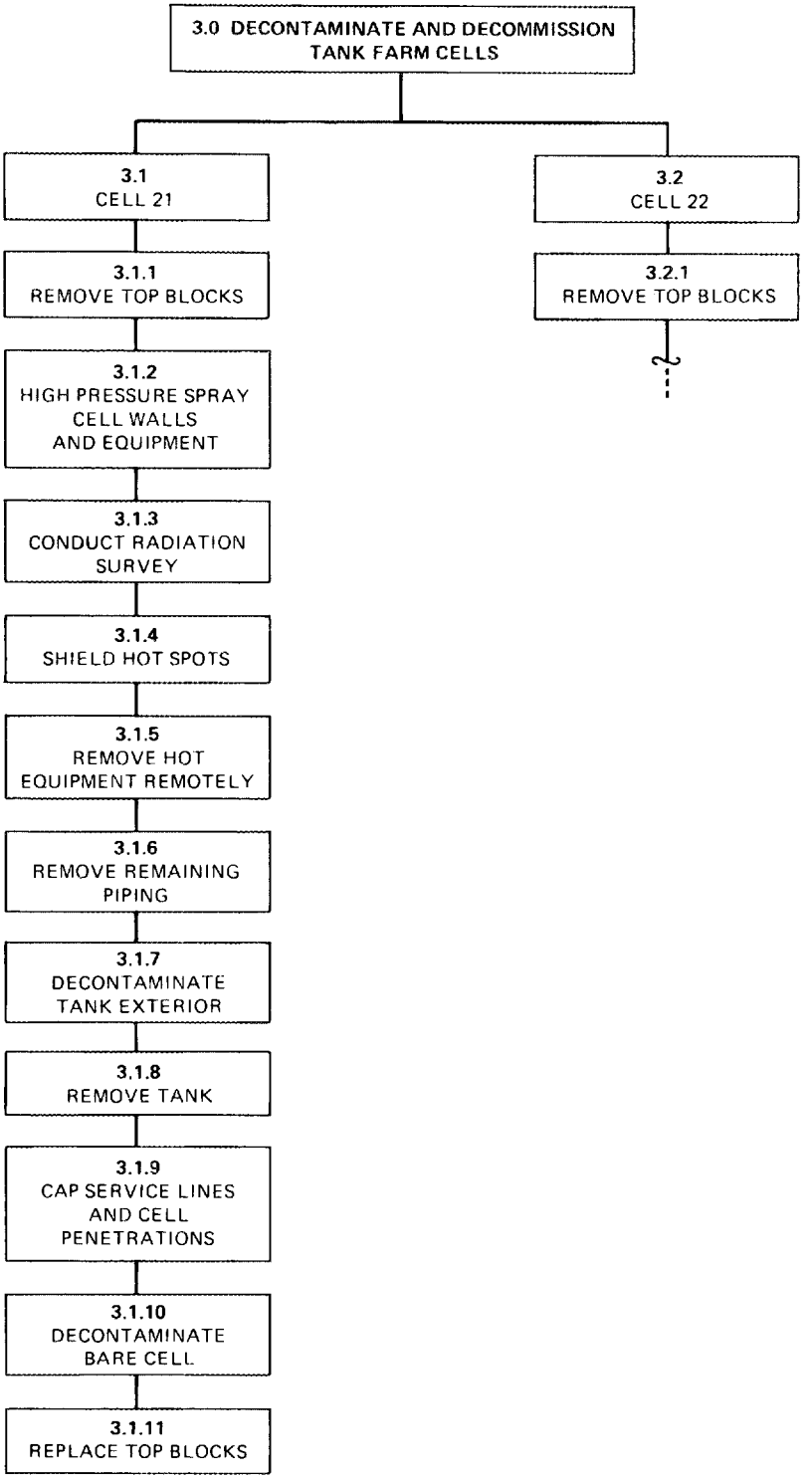

Fig. 10. Flowchart of D&D activities for the tank farm cells.

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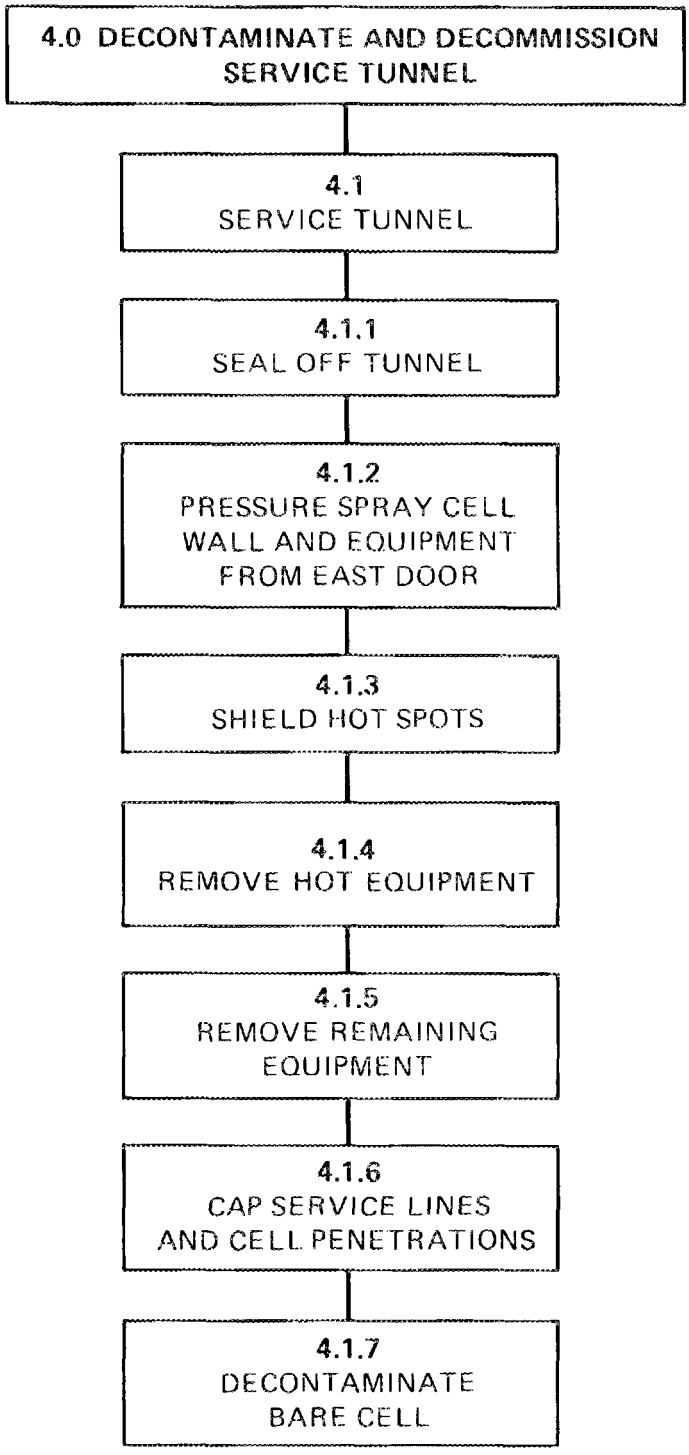

Fig. 11. Flowchart of D&D activities for the service tunnel.

4.1.2 Process Cells

The decommissioning efforts for the process cells (Fig. 9) will be similar to that for the manipulator cells. However, since no completely remote operations can be conducted for these cells, all decontamination and equipment dismantlement activities will require direct access through the cell roof plugs. High pressure sprays will be used to decontaminate the cells to allow maintenance personnel access. Equipment removal will then proceed until the cell is completely stripped and all service lines and cell penetrations capped. Decontamination of the bare cell will then be conducted to acceptable levels for reuse. As a part of this task, the instrument panel boards associated with these cells will also be dismantled.

4.1.3 Tank Farm Cells

Tank farm cell decommissioning (Fig. 10) will follow the same general procedures as for the process cells, including cell decontamination by high pressure spray techniques, in-cell removal of process piping and storage tanks, and final decontamination of the empty cells. Special consideration will be given to these cells due to the work location exterior to the building and the size of the tankage being removed.

4.1.4 Service Tunnel

The decommissioning of the service tunnel (Fig. 11) will involve spray decontamination and equipment removal procedures similar to those described previously. Final tunnel decontamination will be performed to levels that allow ready access to the cells for installation of new services for future cell reuse.

4.2 TECHNICAL PLAN

Technical descriptions of the proposed decontamination procedures have been prepared for each of the FPDL cells included in the scope of this project and are presented in Appendix A. These descriptions provide a step by step outline of the D&D activities for each cell and include estimates of the waste volumes to be generated, the maximum radiation exposures anticipated, and a breakdown of the manpower requirements by discipline. The activities described will be performed in strict accordance with the operating procedures for the FPDL. The procedures for in-cell maintenance and decontamination are well defined and have received extensive operational and safety reviews during the operating life of the facility. Detailed procedures have been developed to cover 46 separate activities at the FPDL and are documented in the Operations Division Operating Procedures Manual.[5] A listing of the FPDL procedures included in this manual is provided in Appendix B. These procedures meet the requirements of all applicable codes and standards governing these types of operations at ORNL. Additional guidance in

specific areas would be obtained from other appropriate ORNL operating procedures, including the Health Physics Procedures Manual, the ORNL Safety Manual, and the ORNL Radioactive Solid Waste Operations Manual.

Summaries of the performance criteria, health and safety considerations, operational requirements and estimated manpower needs for the conduct of the cell decommissioning at the FPDL are presented in the following sections. These summaries are based on the WBS activity descriptions provided in Appendix A, and the guidelines for operations at the FPDL. Presentation of the overall project costs and schedule is included in Sect. 6.

4.2.1 Performance Criteria

The acceptability of D&D activities at the FPDL will be measured by two general criteria, (1) that all excess equipment and waste materials are removed from the cells, and (2) that residual radioactivity remaining in the cells is at levels that permit direct personnel access. Equipment removal efforts must be sufficient to allow adequate room for installation of new equipment when other process applications arise for these facilities. Similarly, residual radiation and contamination levels must not prohibit the installation of equipment or other use of the cells by other programs. The guidelines proposed for this decontamination effort are that all cells must be cleaned to background levels of <1 rad/h total beta-gamma dose rate and <30,000 dpm/100 cm^2 beta-gamma transferable activity (smear). In some cases, cells may be decontaminated to 10 mrad/h and 1000 dpm/100 cm^2 background levels, if cell conditions or reuse potential warrants the effort.

4.2.2 Safety

All FPDL decommissioning activities will be performed in a manner that assures adequate protection of onsite personnel and the general public. The work procedures to be employed conform to applicable DOE guidelines for radiation safety, industrial safety and site security. Brief discussions of the safety controls to be employed in these areas are provided as follows.

4.2.2.1 Radiation Protection

Trained health physics personnel will provide radiation protection surveillance of all operations. This health physics surveillance will provide:

1. assurance that the decommissioning is carried out in accordance with the ORNL radiation protection standards, as specified in the FPDL operating procedures and the ORNL Health Physics Manual;

2. radiation surveys and evaluation of work procedures to ensure that personnel exposures and spread of contamination are maintained as low as reasonably achievable;

3. records of instrument and smear survey results, air sampling data, and personnel exposures throughout the life of the project; and

4. documentation of final in-cell radiation surveys for comparison with the project performance criteria.

To provide this required health physics coverage, a full-time health physicist from the ORNL Industrial Safety and Applied Health Physics (ISAHP) Division will be available at the facility. Adequate area and personnel monitoring instrumentation will be maintained in the FPDL. Personnel radiation protection will be assured through the routine establishment of radiation/contamination zones, the issuance of radiation work permits, the construction of containment shells during in-cell work, and the proper use of contamination clothing. The results of radiation surveys will be used extensively as decision points in the progression of work activities.

Based on the scope of decommissioning activities proposed for the FPDL, it is estimated that a total of about 190 man-rem dose equivalent will occur over a period of approximately 5 1/2 years. A breakdown of this exposure, by WBS Activity, is provided in Table 2. Individual exposures will be maintained below the guidelines of 5 rem per year of penetrating dose, and 15 rem per year of skin dose. All reasonable efforts shall be made to keep exposures of forearms and hands within the limit value for skin. Work assignments will be adjusted to provide the proper balance of in-cell exposure and non-exposure tasks (i.e., manipulator operation). No off-site exposure attributable to this decommissioning effort is anticipated.

4.2.2.2 Industrial Safety

The proposed decommissioning activities involve common construction and maintenance practices occurring in areas containing radiation hazards. As such, the safety concerns are for the most part identical to those in other industrial operations, with added emphasis on radiation protection, as discussed above. At ORNL, these types of operations have been conducted for many years, and comprehensive guidelines have been established to (1) conduct all activities to minimize the risk of personnel injury or property loss due to preventable accidents, (2) perform all work and maintain the working environment in accordance with applicable national codes and standards, and (3) investigate all significant accidents to determine their causes and then take steps to prevent recurrance of similar accidents.

Some 10 manuals specific to industrial safety concerns have been developed at ORNL, covering topics such as industrial hygiene, hazardous material control, quality assurance, and fire prevention. These procedures have been written to conform with recognized industrial and federal guidelines such as ANSI standards, DOE orders, and OSHA requirements, and represent ORNL management guidance in these areas. In keeping with this guidance, the guide-lines outlined in the FPDL operating

Table 2. Summary of estimated radiation exposures from FPDL cell decommissioning[a]

WBS No.	D&D activity	Dose equivalent (man-rem)
1.1	Manipulator cell 13	12.5
1.2	Manipulator cell 14	13.0
1.3	Manipulator cell 15	2.8
1.4	Manipulator cell 18	10.5
2.1	Process cell 1	5.2
2.2	Process cell 2	20.5
2.3	Process cell 3	20.5
2.4	Process cell 4	20.5
2.5	Process cell 5	20.5
2.6	Process cell 6	20.5
2.7	Process cell 7	20.5
2.8	Process cell 8	12.5
3.1	Tank Farm cell 21	5.5
3.2	Tank Farm cell 22	4.2
4.1	Service tunnel	2.1
	TOTAL	191.3

[a]See Appendix A for breakdown of exposure by personnel classification.

procedures and the individual safety manuals will be utilized as the industrial safety criteria for operations at the FPDL.

4.2.2.3 Site Security

As a restricted government installation, ORNL is provided with comprehensive safeguards, security and protection systems. These systems include exclusion fencing around the laboratory perimeter, continuously manned guard posts, controlled access for sensitive and hazardous areas, fire alarm and protection systems, a continuously manned and fully equipped fire department, and a routine security patrol. In addition to this plant-wide security system, individual facility access is further restricted by the facility operators who are required to minimize nonroutine personnel entry. At the FPDL, this is accomplished by providing entry restriction and radiation hazard posting for all accessible areas.

4.2.3 Waste Management

Significant quantities of radioactive waste will be generated by the decommissioning operations at the FPDL. The handling, packaging, and disposal of these wastes will be conducted according to the guidelines established for FPDL operations, as defined in the facility operating procedures. These procedures are based on the ORNL Waste Operations manuals for solid, liquid and gaseous waste disposal, which were developed according to the guidelines established by the appropriate state and federal agencies.

Solid radioactive waste will be kept segregated from noncontaminated wastes as they are generated, and will be further classified according to the characteristics of the waste. These classifications are defined in terms of gross activity levels, acceptable packaging types, and location of final disposal or storage. All solid radioactive wastes will be disposed of in the ORNL Solid Waste Storage Area (SWSA), and will be transported by appropriate in-plant waste transport vehicles. Consideration will be given to volume reduction of solid wastes on a case-by-case basis. Void volumes will be filled as appropriate to minimize the burial space utilized.

Liquid and gaseous radioactive wastes generated during decommissioning operations will be routed directly to the appropriate ORNL waste treatment system for subsequent treatment and disposal. Waste composition and flow-rates will be compatible with the individual system operating requirements. Liquid wastes will be collected in the FPDL process or ILW holdup tanks prior to transfer to the processing systems. Cell ventilation air flow will be filtered at the facility prior to transfer into the ORNL gaseous treatment system.

Approximately 71,000 gal of liquid waste and 8,000 ft^3 of solid waste are anticipated to be generated during FPDL cell decommissioning. A breakdown of these generation rates by WBS activity is provided in Table 3.

Table 3. Summary of estimated radioactive waste generation rates from FPDL cell decommissioning

WBS No.	D&D activity	Liquid waste (gal)	Solid waste (ft^3)
1.1	Manipulator cell 13	7,500	50
1.2	Manipulator cell 14	15,000	150
1.3	Manipulator cell 15	3,000	15
1.4	Manipulator cell 18	1,000	100
2.1	Process cell 1	3,000	100
2.2	Process cell 2	5,000	700
2.3	Process cell 3	5,000	700
2.4	Process cell 4	5,000	700
2.5	Process cell 5	5,000	800
2.6	Process cell 6	5,000	500
2.7	Process cell 7	5,000	900
2.8	Process cell 8	5,000	500
3.1	Tank farm cell 21	2,000	1,100
3.2	Tank farm cell 22	3,000	1,200
4.1	Service tunnel	1,000	500
	TOTAL	70,500	8,015

4.2.4 Special Facilities and Equipment

As discussed in previous sections, the proposed cell decommissioning activities at the FPDL are basically an expansion of routine maintenance efforts that have been conducted extensively in the past. Hence, the facilities and equipment that are needed for these types of operations are for the most part already on-hand. The primary items requiring special construction or fabrication are (1) the armor plate operator shield for over-cell activities, and (2) the various containment structures to be provided whenever cells are to be opened. The armor plate shield will be sized to fit the cell openings and will include a plexiglass viewing window. The specifications for this shield are readily available based on previous applications. Cell work space containment will be provided by temporary enclosures of plastic, wood or metal construction. These enclosures will provide adequate control over the spread of contamination when cell plugs are removed. Each containment will include areas for personnel access and dress out. Routine ORNL safety procedures will be followed in the construction and maintenance of these structures. For operations over the tank farm cells (21 and 22), additional requirements on structural integrity will be required since these cells open directly to the environment.

4.2.5 Manpower Requirements

Estimates of the technical manpower requirements for cell decommissioning have been developed by WBS activity in Appendix A and are summarized in Table 4. A total of approximately 250 man-months of technical effort are expected to be expended in placing the FPDL cells in a standby condition. This manpower will consist of chemical operators for decontamination operations, a health physicist for radiation exposure control, and a variety of crafts for equipment removal efforts. Supervisory personnel requirements are detailed in Sect. 5.

5. PROJECT MANAGEMENT

The FPDL cell decommissioning project is being conducted under the direction of the ORNL Surplus Facilities Management Program (SFMP). This program is part of the national SFMP, administered for DOE by the Richland Operations Office. Local DOE control and program administration is provided by the DOE Oak Ridge Operations Office. All major contractual, programmatic, technical and funding issues must be reviewed and approved through these DOE organizations.

The ORNL SFMP is administered through the Nuclear Waste Programs Office at ORNL by Operations Division staff (Fig. 12). Currently the SFMP staff consists of two full-time personnel, the Program Manager and an assistant, both of whom are members of the Radioactive Waste Management Section (Fig. 13). All program-related matters, including interaction with the DOE national program offices, are handled out of

Table 4. Summary of Estimated Technical Manpower Requirements for FPDL Cell Decommissioning

Personnel Category	Manpower Requirement by WBS Activity (Man-months)															
	1.1 Cell 13	1.2 Cell 14	1.3 Cell 15	1.4 Cell 18	2.1 Cell 1	2.2 Cell 2	2.3 Cell 3	2.4 Cell 4	2.5 Cell 5	2.6 Cell 6	2.7 Cell 7	2.8 Cell 8	3.1 Cell 21	3.2 Cell 22	4.1 Service Tunnel	TOTAL
1. Chemical Operator	12	15	5	5	5	9	9	9	9	9	9	4	5	5	10	120
2. Health Physicist	1	1.5	1	1	0.5	1	1	1	1	1	1	1	1	1	1	15
3. Pipefitter	0.5	2	0.5	2	3	4	4	4	4	4	4	4	3	2	5	46
4. Welder	0.5	0.5	0.5	0.5	0.5	2	2	2	2	1	1	1	1	1	2	17.5
5. Rigger, Operator	0.5	0.5	--	1	0.5	2	2	2	2	1	2	2	2	2	4	23.5
6. Electrician, Carpenter and all Others	0.5	1.0	0.5	1	1	2	2	2	4	2	3	3	2	1	2	27
TOTAL	15	20.5	7.5	10.5	10.5	20	20	20	22	18	20	15	14	12	24	249

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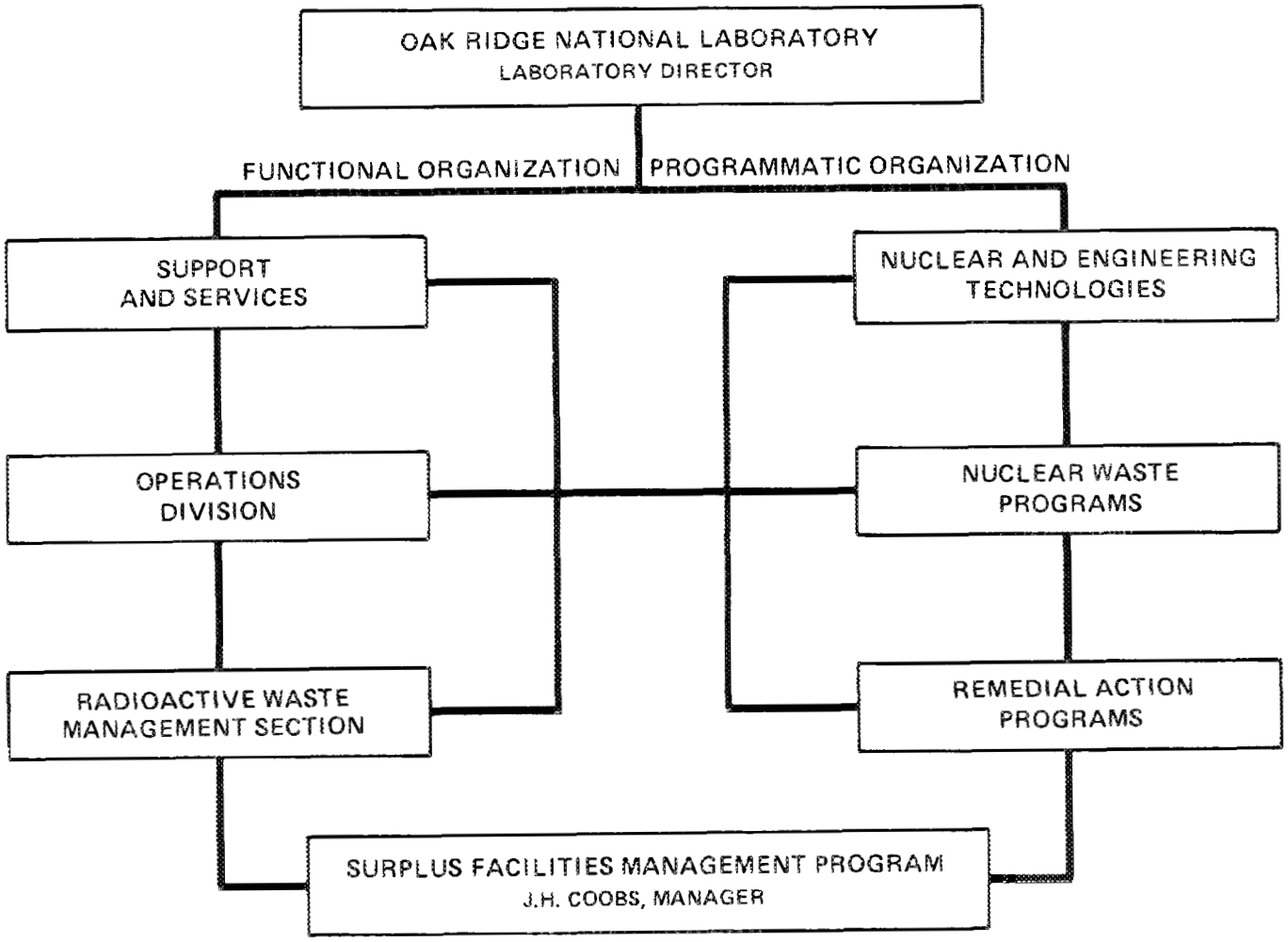

Fig. 12. ORNL organizational structure for the Surplus Facilities Management Program.

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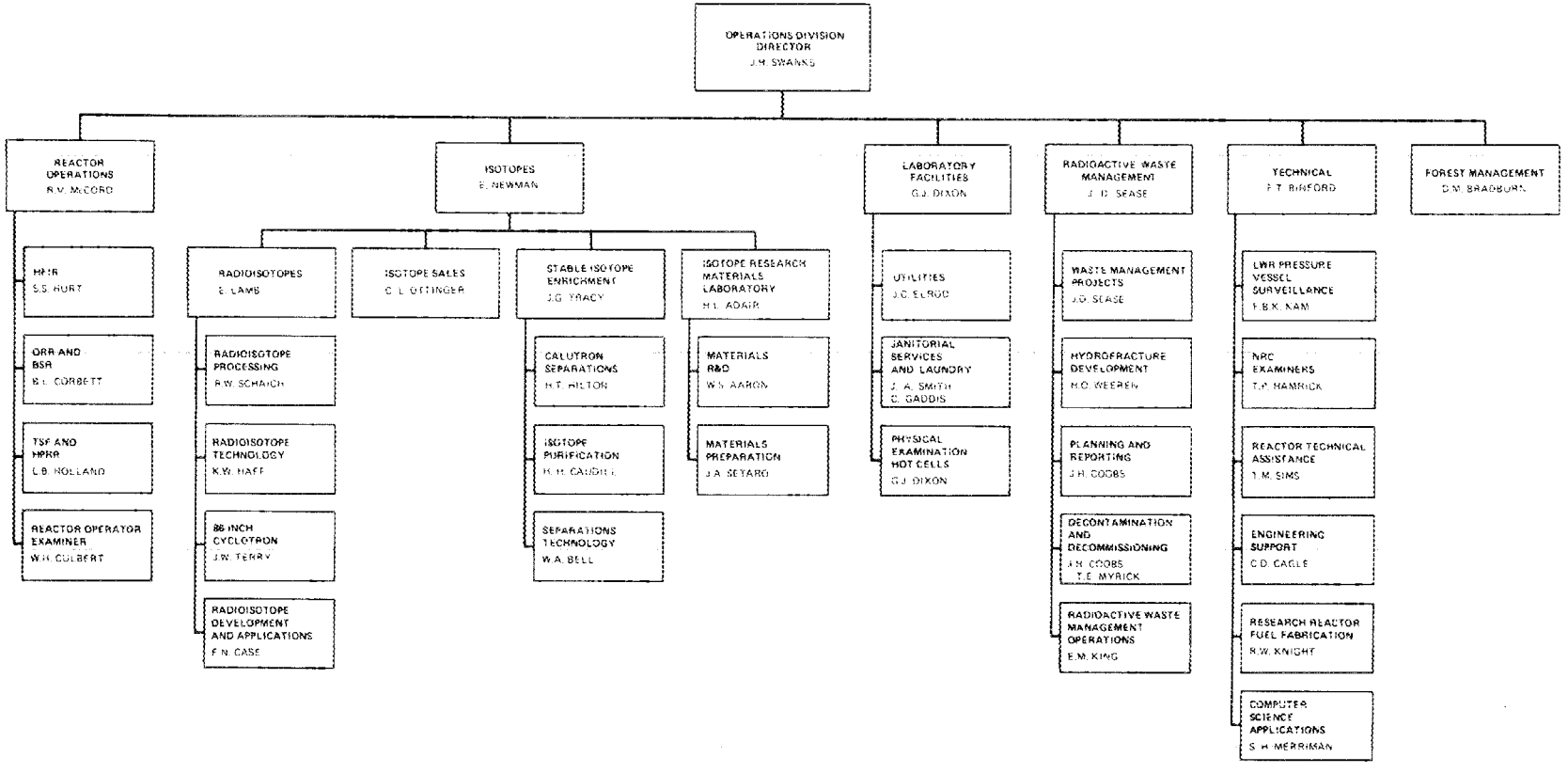

Fig. 13. Operations Division organizational structure.

this office. Operational control of the 46 individual facilities managed by the SFMP is maintained by three separate sections of the Operations Division. As detailed in Fig. 14, the Fission Product Development Laboratory is operated by the Isotopes Section.

An outline for project management of the FPDL cell decommissioning is presented in Fig. 7, according to the project activity Work Breakdown Structure (WBS) format. The WBS activities consist of project planning (WBS 5.1), Operations management (WBS 5.2), reviews and periodic reporting (WBS 5.3), and final facility characterization and reporting (WBS 5.4). Discussions of each of these activities are provided as follows.

5.1 PROJECT PLANNING

In preparation for the initiation of decommissioning activities at the FPDL, project planning efforts have been conducted in five areas:

1. preparation of the Project Plan, including details of the budget needs, an estimate of the project schedule, and an outline of the project management approach;

2. development of detailed decommissioning procedures for implementation of the project objectives, and review/update of existing operating procedures to accommodate any necessary revision or additions;

3. review and approval of safety documentation on FPDL operations;

4. review and approval of environmental assessment documentation on FPDL operations; and

5. review and approval of quality assurance documentation on FPDL operations.

Brief discussions of each of these project planning activities are provided as follows.

5.1.1 Project Plan

As outlined in Sect. 1, this project plan has been prepared to satisfy the program documentation requirements for project planning. The plan has been formulated by the ORNL SFM Program Office, with assistance from the Isotopes Section technical staff, to outline the scope of the proposed effort, provide estimates of the resource needs, and describe the proposed method of project accomplishment. Upon review and approval by ORNL and DOE management, this plan will form the basis for conduct of the FPDL cell decommissioning. Future budget requests and technical progress updates will reference this plan for project details. Updates of the project plan will only be provided upon request of the national SFMP, or if significant changes in the scope of the project occur.

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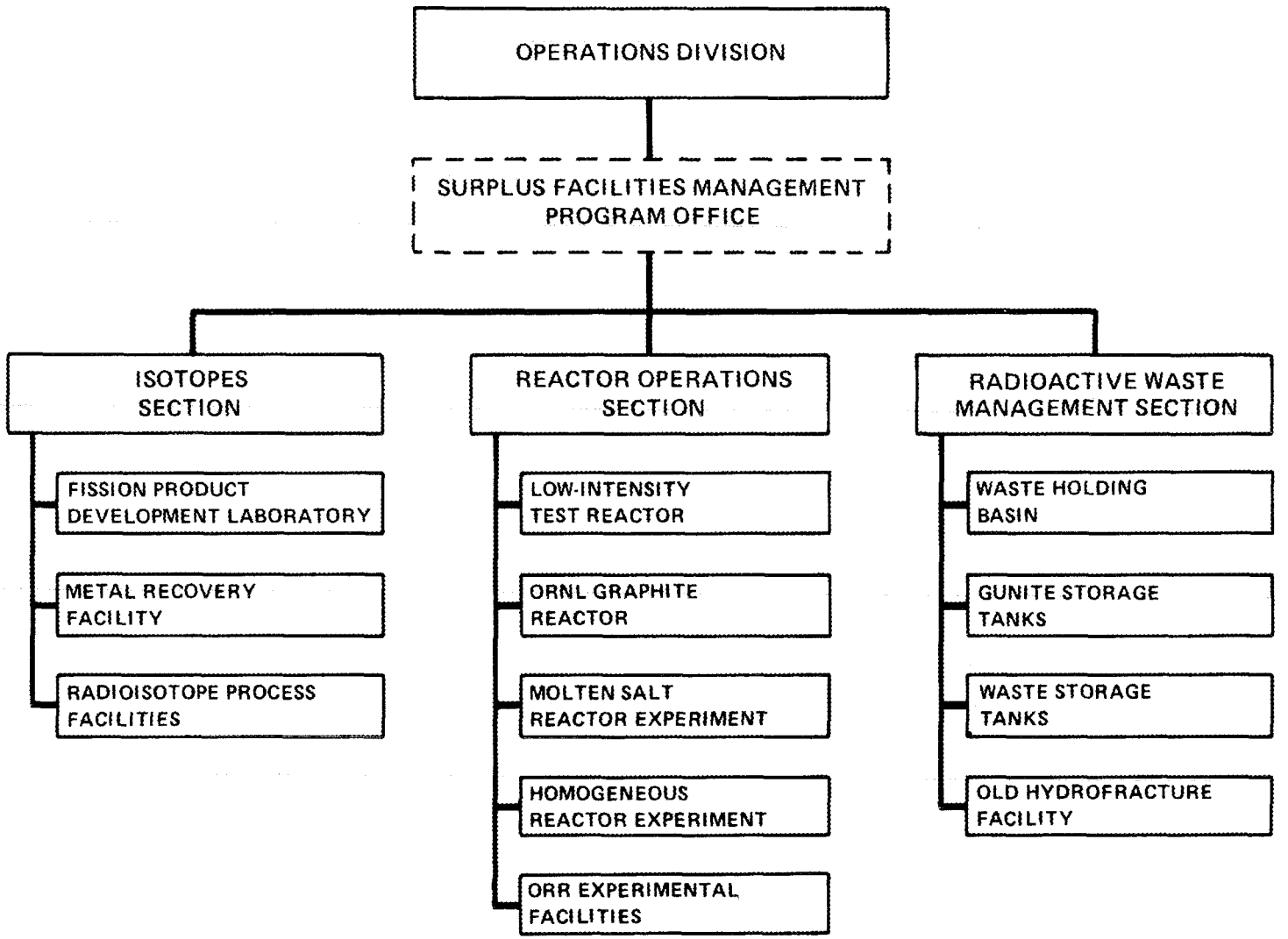

Fig. 14. Facility responsibilities in the ORNL SFMP.

5.1.2 Decommissioning Procedures

As documented in Appendix A, step-by-step procedures have been outlined for the proposed cell decommissioning activities. These procedures were developed based on previous operational experience at the FPDL and are consistent with the operating procedures currently in effect at the facility (Appendix B). No significant changes in the routine operations were identified.

5.1.3 Safety Review

The operation of the FPDL has been thoroughly analyzed from a safety standpoint and documented in the Hazards Report for Building 3517.[6] This report covers all of the processing operations conducted in the past, including routine in-cell maintenance. Hence, the proposed cell decommissioning activities are adequately addressed in that report since they are only an expansion of the routine maintenance tasks. An update of this report is scheduled for FY 1985 as part of the ORNL effort to meet the requirements of DOE Order 5480.1A.

In addition to the facility safety analysis report, the operations of the FPDL are reviewed on a bi-annual basis by the ORNL Radioactive Operations Committee (ROC) and the Office of Operational Safety (OOS). The last full review was conducted on July 2, 1981,[7] and concluded that the operations at the FPDL were being conducted safely and in accordance with applicable guidelines and regulations. The committee recommended continued approval of the FPDL operations, including routine decontamination and decommissioning. A more recent committee review was conducted in May 1983, resulting in similar recommendations.[8]

5.1.4 Environmental Assessment

An environmental analysis of the current ORNL operations has been completed.[9] Included in this analysis was the assessment of solid, liquid and gaseous disposal systems employed at the Laboratory. As all planned releases associated with the cell decommissioning at the FPDL will be directly into these waste disposal systems, the resulting environmental impacts would only be a small increment above the routine ORNL releases. Due to the fact that no new operations are to be conducted as part of this FPDL D&D effort, an additional environmental assessment was judged unnecessary.

5.1.5 Quality Assurance Assessment

A quality assurance assessment for the operations at the FPDL has been prepared, reviewed and approved.[10] This assessment documents the practices employed to assure quality control of the current operations, in terms of (1) operating personnel qualifications, (2) maintenance and inspection planning, (3) quality investigation reports, (4) deviation reports, (5) record keeping and storage requirements, (6) readiness reviews and (7) instrument calibrations. These same approved practices

will be employed throughout the conduct of the proposed decommissioning effort. A review of this QA assessment is currently scheduled for March 1984. Additional QA requirements associated with SFMP reporting and documentation needs are addressed under WBS 5.3 and WBS 5.4.

5.2 OPERATIONS MANAGEMENT

Operational control of the FPDL decommissioning activities will be provided by the facility supervisor, reporting directly to the group leader of the Radioactive Processing Group of the Operations Division. The supervisor will oversee the day-to-day operations, providing direction to the operating staff of chemical operators, maintenance personnel, safety personnel, waste disposal system operators, and engineering support staff (Fig. 15). The group leader (also designated as the project principal investigator) will provide project management control, in terms of project direction, budget tracking, project reporting and other administrative tasks.

The FPDL supervisor responsibilities for the D&D project include the following:

1. providing specifications, instructions, and detailed work procedures for all operating support staff;

2. providing adequate training for operating personnel;

3. assessing and documenting project progress against objectives and criteria;

4. assuring that the decommissioning activities are carried out in accordance with ORNL standards for radiation protection, industrial safety and waste disposal;

5. maintaining records of health physics surveys, air-sampling data, material release or disposal, daily work progress, and personnel exposures; and

6. documenting the final in-situ radiation surveys and sample analysis results for comparison to performance criteria and for final project reporting.

The supervisor's office will be located in Building 3517, where all operational records will be maintained on file throughout the project.

Technical support and services during the decommissioning operations will be provided by several support divisions at ORNL, including the Industrial Safety and Applied Health Physics Division for all safety related matters, the Plant and Equipment Division for maintenance activities, and the UCC/ND Engineering Division for engineering design support. Direct supervision of these support groups will be provided by

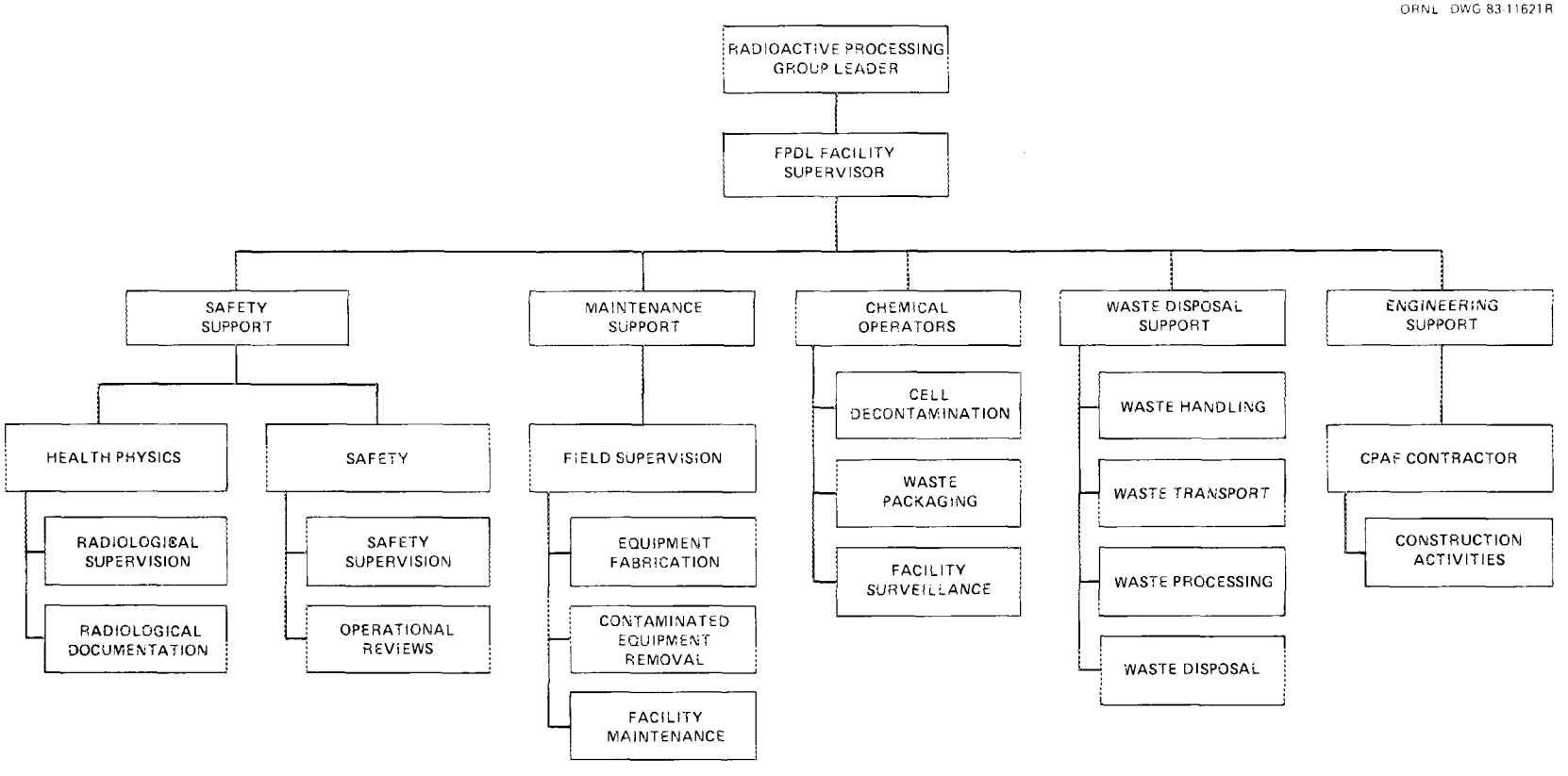

Fig. 15. Operations management structure for FPDL cell decommissioning.

the respective division management, with only technical direction dictated by the FPDL operations supervisor. Detailed designs, work procedures, and field supervision of any cost-plus-award-fee (CPAF) subcontractor activities would be the responsibility of UCC/ND Engineering. All Operations Division support will be field directed by the facility supervisor. This includes the use of chemical operators for decontamination efforts and the interactions with the waste disposal operations group.

The proposed operations management approach is identical to that currently employed for operations at the FPDL. Throughout the 25 years of facility operation, this concept has proven to be efficient, responsive and cost-effective. The many years of operational experience provided by the proposed facility supervisor and his support staff will help to assure project success.

5.3 REVIEWS AND PERIODIC REPORTING

Project reviews and reporting will be conducted on a periodic basis throughout the decommissioning operations. Monthly project status reports will be made by the project principal investigator to the ORNL SFMP office for inclusion in the program report to DOE. This report will provide information on the technical progress during the month, the planned activities for the coming month, and highlight project milestones completed or identify changes to the projected schedule. Quarterly project review meetings will be held by the SFMP staff to assess the overall project direction and identify any programmatic needs for the following quarter. An annual report summarizing the project accomplishments during each fiscal year will be prepared by the principal investigator during the last quarter of the year for issue early in the following year. This report will address the completed milestones, identify any changes in the project schedule, summarize the project budget, and provide to-date estimates of personnel exposures and waste disposal volumes.

Safety and quality assurance reviews of the decommissioning operations will be conducted according to the schedules established for the operating facility. Currently these assessments are performed on a bi-annual basis. Additional audits and reviews may be conducted by ORNL and DOE as part of their overall QA and safety audit programs.

5.4 FINAL FACILITY CHARACTERIZATION AND REPORTING

Upon completion of the scheduled decommissioning tasks at the FPDL, a final radiological survey will be performed and documented. The results of this survey will then be used as the basis for final reporting of the project, in a Final Project Report. This report will be prepared by the project principal investigator and will provide an overview of

the complete project activities, accomplishments, final facility status, and lessons learned. The report content will be consistent with the requirements set forth in the SFMP Program Plan.

6. PROJECT COST AND SCHEDULE

An overall project schedule, by work breakdown structure activity, has been developed for the FPDL cell decommissioning and is presented in Fig. 16. The project is estimated to take approximately 5 1/2 years to complete, with final facility characterization and project reporting provided in FY 1988. The decommissioning of the process and manipulator cells will be conducted simultaneously during the first 4 1/2 years of the project, followed by decontamination of the process cell service tunnel and the tank farm cells. In-cell decontamination work will be scheduled such that only one process or manipulator cell roof is open at any one time. Manipulator decontamination activities will be used in concert with the process cell D&D as non-exposure work for the operators. Management support will, of course, be provided throughout the project, with scheduled reviews and periodic reporting . Only the annual reports have been highlighted on this overall project schedule.

Project costs have been estimated based on the manpower and equipment requirements detailed in Sect. 4.2, Technical Plan. A summary of these costs, by work breakdown structure activity and fiscal year, is presented in Table 5. These estimated costs are escalated to the proposed year of expenditure. In addition to the decommissioning project costs, the costs for SFMP-related routine facility maintenance and surveillance (M&S) have been included in Table 5. The facility M&S requirements are described in the ORNL SFMP Maintenance and Surveillance Plan,[3] including details of the cost estimates for facility upkeep. The M&S budget is managed separately from the decommissioning projects, until the time that a project begins D&D operations. Combining the budgets at this point results in a more efficient use of the M&S funds. Including the M&S needs, the total estimated cost of the cell decommissioning at the FPDL is $3.8 million.

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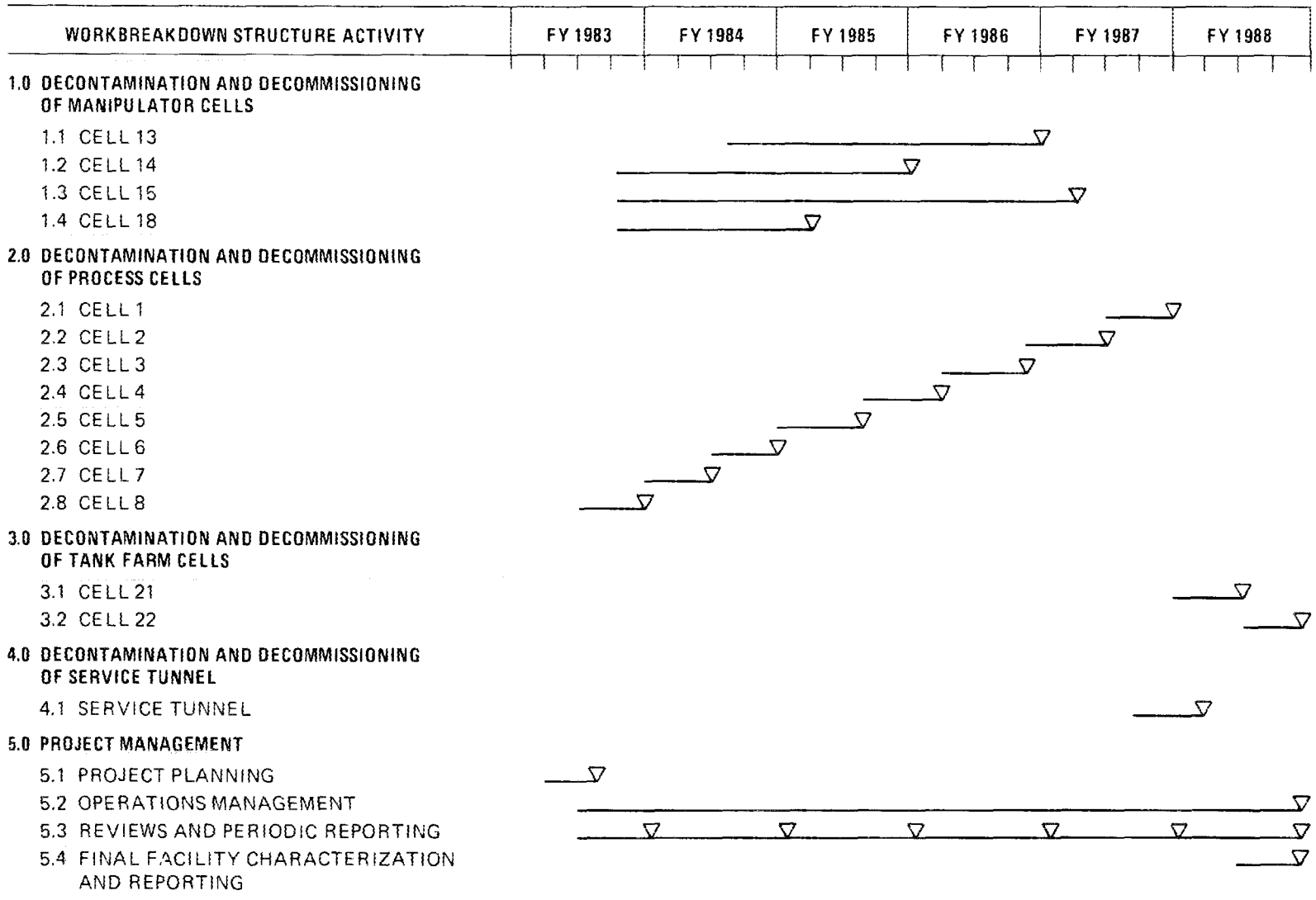

Fig. 16. Project milestone schedule for FPDL cell decommissioning.

Table 5. FPDL cell decommissioning project costs[a]

Work breakdown structure activity	Fiscal Year					
	1983	1984	1985	1986	1987	1988
1.0 Decontamination and Decommissioning of Manipulator Cells	20	50	150	170	80	
2.0 Decontamination and Decommissioning of Process Cells	40	100	300	320	340	
3.0 Decontamination and Decommissioning of Tank Farm Cells						250
4.0 Decontamination and Decommissioning of Service Tunnel					120	125
5.0 Project Management	40	50	50	50	50	75
DECOMMISSIONING TOTAL	100	200	500	540	590	450
Facility Maintenance and Surveillance[b]	270	270	320	350	140	60
PROJECT TOTAL	370	470	820	890	730	510

[a]Costs have been escalated to proposed year of expenditure.

[b]Costs are detailed in Ref. 3.

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APPENDIX A

FPDL CELL DESCRIPTIONS AND PROPOSED DECOMMISSIONING PLANS

CELL NUMBER 1

(WBS 2.1)

Cell Description

Cell 1 (Fig. A.1) is a stainless steel-lined unloading cell 9 ft wide by 12.5 ft long by 12 ft deep. The cell is shielded on the north and west sides by 3 ft of standard concrete. Additional shielding on the north side is provided by solid barytes concrete blocks on Cell 16 and the service tunnel. The cell is separated from Cell 15 on the south side by 2 ft of standard concrete. The east wall of the cell is a 1-ft thick divider which separates Cell 1 from Cell 2. A 1-ft slot, 12-ft deep, on the south side of the divider allows the passage of piping and services to the other process cells. In the southwest corner of the floor is a 4 ft by 4 ft opening which goes to the pipe tunnel beneath the first level west. This allows for passage of all piping from the process cells to the tank farm on the north side of the building. The drainage trough from the process cells terminates here and drains into a 4 inch stainless steel pipe which permits gravity flow to tank S523 in the FPDL tank farm. A 9.75 inch laminated armor plate divider was installed across the width of the cell 4 ft from the south wall to lower the working background in the north side of the cell. There are 6 cell blocks 2-ft-thick which supply 4 ft of standard concrete shielding for the top of the cell.

The cell contains one 304L stainless steel tank of 125 gallons capacity, located in the south section of the cell. This tank is connected by welded stainless piping to samplers, makeup lines, and instrumentation and transfer lines in the facility. The cell ventilation for this cell is supplied by a 12-inch duct in the north floor of the cell. A damper was installed to control the flow of air from the cell. The cell ventilation was not filtered due to the inaccessability of the duct work.

Solution addition lines penetrate the north side of the cell and terminate on the second level of the FPDL in Area 31.

Processing History

Cell 1 was used as an unloading cell for the STT, Gun Barrel, and HAPO shipping casks which were used to transfer cesium-137 and strontium-90 from Hanford, Washington. Flexible stainless steel lines were used to hook up to the cask to elute the material from the resin beds and transfer to storage tanks in Cells 2, 3, and 4, and tanks W19, W20, and S-122. Cell 1 has not been used since the early 1970's for radioactive transfer. Since 1974 the cell has been used occasionally for the decontamination of contaminated equipment.

The cell is considered a low-level cell and residual activity in the north part of the cell would be cesium-137 and strontium-90. Residual activity in the south part of the cell would be cesium-137 and strontium-90, which may have washed down the drainage trough which terminates in the southwest corner

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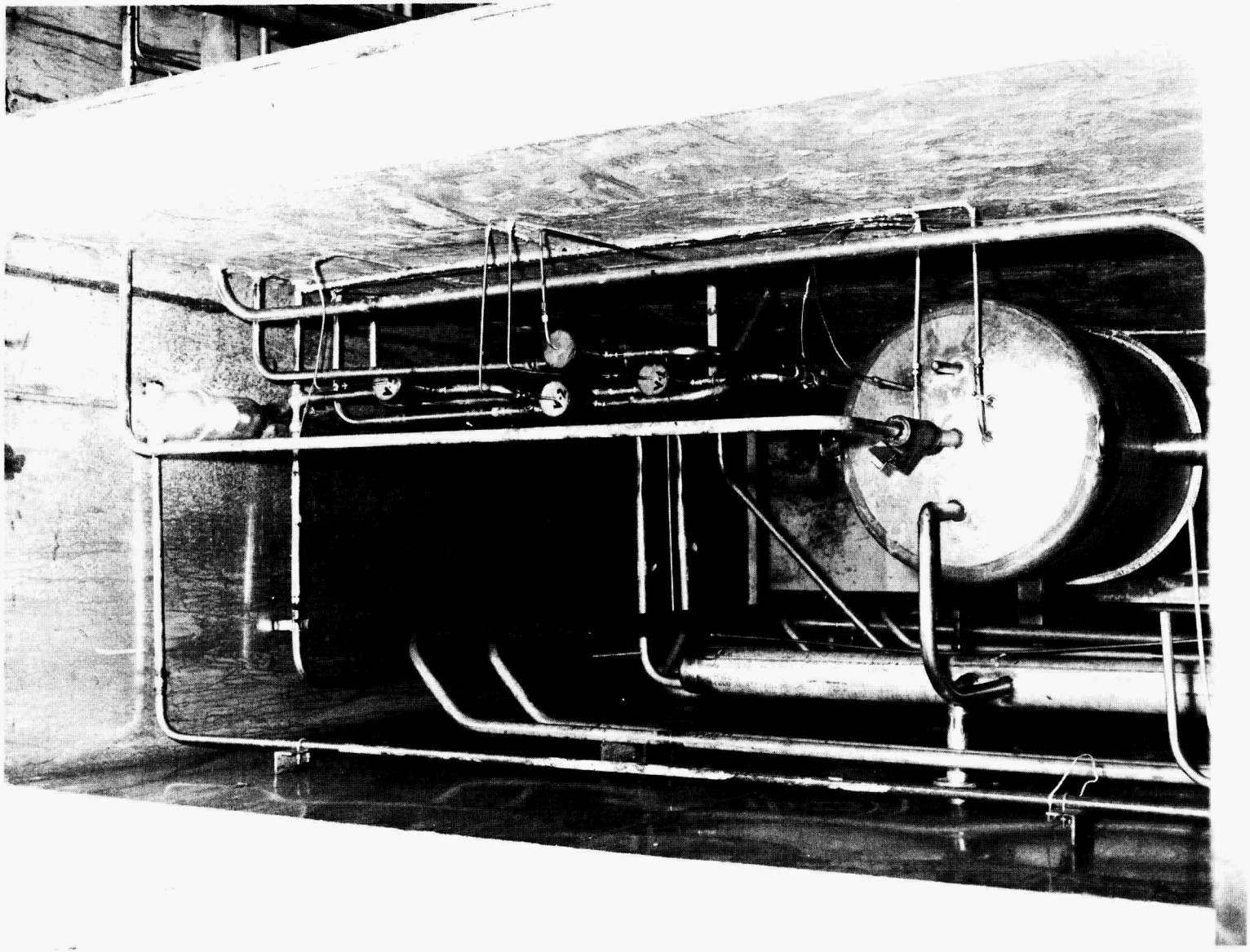

Fig. A.1. Interior view of Cell 1.

of the south part of the cell. The south part of the cell could be much hotter, radioactively, than the north part of the cell.

Decontamination

North Side

The north side of the cell is low-level and has a general background at floor level of 50 to 100 mrad/hr. The reading at the top of the cell is 20 to 30 mrad/hr. The top shielding blocks, however, are much hotter due to contamination from equipment decontamination over the past 8 or 9 years. After the top blocks have been removed and cleaned, one chemical wash of the cell walls and floor should be adequate to allow entry to start stripping the lines from the walls.

South Side

The south side of the cell has not been opened since about 1962. Extreme care should be exercised when removing the top blocks to obtain a survey. However, consideration should be given to the fact that all decontamination solutions used for decontamination of Cells 9 through 2 will have drained through the south side of Cell 1. Tank R11 has been decontaminated along with the other tanks in the process cells.

Proposed Decontamination

1. Remove the 3 top blocks and decontaminate to levels for storage outside the building.

2. Install plastic containment and remove the north and middle bottom blocks and decontaminate for storage.

3. Raise the south bottom block to a position to allow high pressure spraying of the walls, piping, and tank.

4. When the radiation level at the top of the cell reaches 1 rad/hr, stack the north and south bottom blocks on top of one another on the north side of the cell and install an armor plate shield with plexiglas shielding over the south side of the cell.

5. Working through the plexiglas shield to reduce exposure, remove all debris from the trough, using long tongs and lard cans. It may be necessary to use lead shielding arrangements to remove the debris which has accumulated in Cell 1 over the years.

6. Once the debris is removed, decontaminate the south side of the cell using gravity flow sprays of nitric acid, Turco, oxalic acid, and water.

7. By high-pressure spraying and the decontamination cycle in 6 above, continue decontamination until the reading at the top of the open cell is less than 500 mrad/hr. At this point get a good survey of the cell and submit a radiation map to supervision to determine additional decontamination steps.

8. Hot pipe, tank, or valves will be shielded with lead and will be cut loose by means of hydraulic pinchers, sabre saws, etc. The hot pieces will be removed to shielded boxes and sent to the SWSA for burial.

9. All piping and tanks can be removed from the south side of Cell 1 except the S-324 jet line. Before any electrical lines are cut they should be de-energized. All waste will be boxed and sent to the SWSA for disposal.

10. When the south side of the cell has been cleaned, clean the armor plate and move it to a storage area.

11. Remove the 2 bottom blocks, clean and move to a storage area.

12. Clean the north side of the cell as in step 6 above.

13. Because of the low radiation level on the north side of the cell it will be permissible to install a scaffold and strip the walls of piping and valves. All waste will be boxed and sent to the SWSA for storage.

14. All service lines will be capped inside the cell.

15. Operator will decontaminate the bare walls to less than 1 rad/hr general reading and less than 30,000 dis/min smear level.

16. The Cell 1 panelboards will be removed, sealed in wooden boxes and transported to the SWSA for disposal.

Manpower Requirements

Health Physics - 0.5 Man Month

Operations Division		Craft Support		
Operator Man Months for Decontamination	Operator Man Months for Observing	Pipefitter Man Months	Electrician Man Months	Carpenters Man Months
3	2	3	1	1

Total volume of solid waste to the SWSA - 100 cu. ft.

Estimated decontamination solution volume required - liquid waste	3000 gallons

Estimated radiation exposure:

Chemical Operators	2.0 rem
Health Physics	0.2 rem
Crafts	3.0 rem

CELL NUMBER 2

(WBS 2.2)

Cell Description

Cell No. 2 (Fig. A.2) is a stainless steel-lined process cell approximately 9.0 ft wide (E-W), 12.5 ft long (N-S), and 12.0 ft in depth. The cell is shielded on the north side with 3 ft of standard concrete. Additional shielding on the north side of the cell is supplied by the barytes concrete block wall of the FPDL service tunnel. The cell is separated from Cell 14 on the south side by 2 ft of standard concrete. Dividers on the east and west sides of Cell 2, containing 1.0 ft of standard concrete, separate Cell 2 from Cells 1 and 3. A 1-ft slot 12-ft deep on the south portion of the divider allows the passage of required piping from Cell 2 to the other FPDL process cells. There are four cell blocks 2-ft-thick supplying 4 ft of standard concrete shielding for the top of the cell.

The cell contains three 304L stainless steel tanks with a capacity of 250 gallons per tank and a 304L stainless steel centrifuge with an electrical motor-drive system. A precipitator tank has a motor driven agitator. All vessels are connected by welded stainless steel piping to samplers, services, off-gas, instrumentation, and transfer lines within Cell 2 and to other cells in the facility.

The cell ventilation for Cell 2 is supplied by a 12-inch stainless steel duct located on the north floor of the cell. A damper was installed to control the flow of air from the cell. The cell ventilation was not filtered in-cell due to the inaccessability of the duct work.

Solution addition lines penetrate the north side of the cell and terminate on the second level of FPDL in Area 31.

Processing History

Cell 2 was used to transfer strontium-90 feed materials shipped from Hanford, Washington. The maximum quantity of strontium-90 solution transferred through Cell 2 was 0.5×10^6 curies.

The feed material for the FPDL strontium-90 process was highly purified $^{90}SrCO_3$ received from the HAPO. This feed was radiochemically pure and contained a few percent of other alkaline earths (calcium, barium); no purification was done at the FPDL. The $^{90}SrCO_3$ was shipped to ORNL as a dry solid; it was removed from the shipping cask by water slurrying; and the slurry was treated with HNO_3 to yield a $^{90}Sr(NO_3)_2$ feed solution. At the FPDL there was storage capacity for 3 megacuries of strontium-90 in nitrate solution.

The last strontium-90 transferred through Cell 2 was in June 1974. The residual contamination in this cell would be strontium-90 with a trace of

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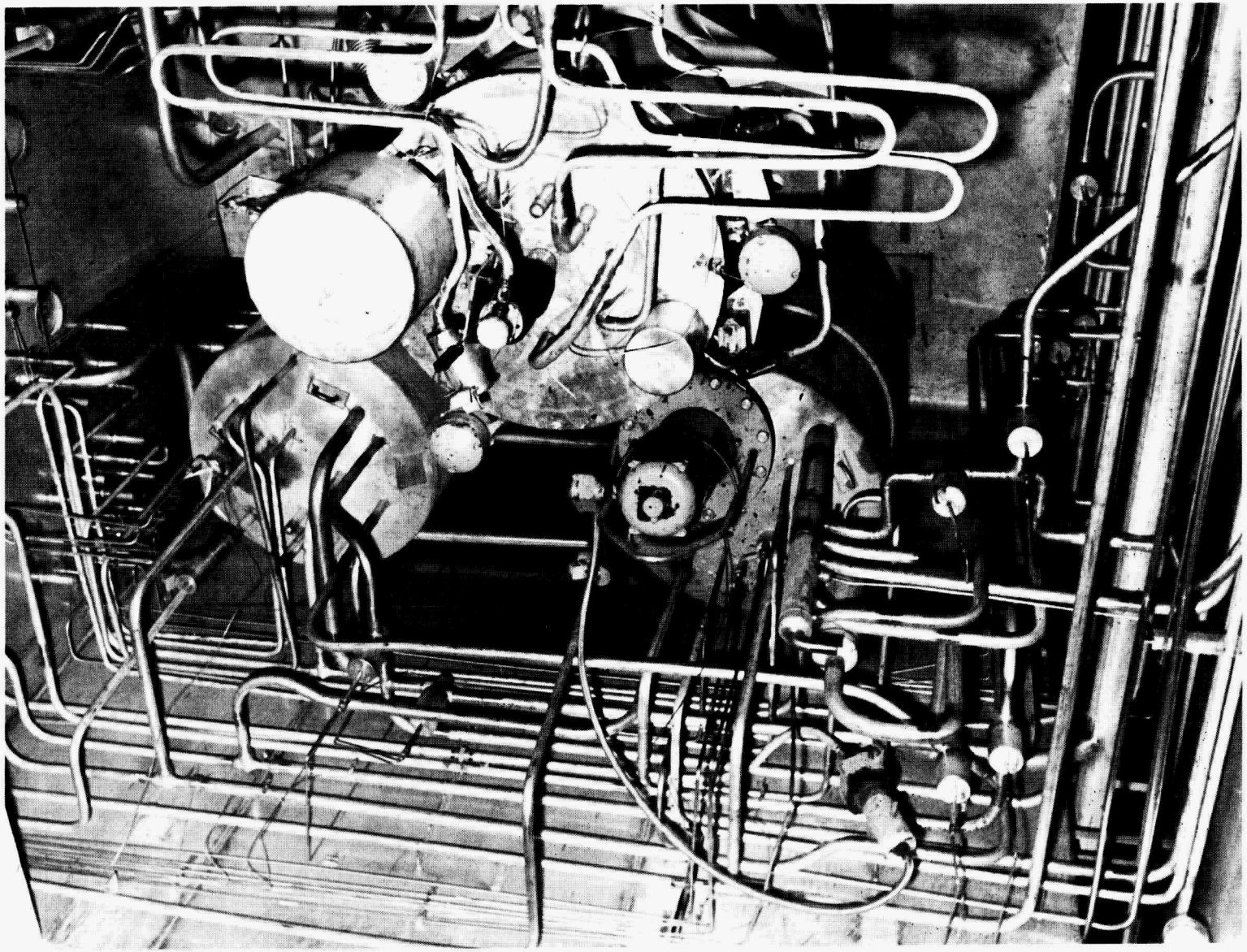

Fig. A.2. Interior view of Cell 2.

cesium-137 which was transferred from other FPDL cells or passed through the open pipe trench.

Decontamination

The process vessels and lines were flushed with caustic, nitric acid, Turco solution, oxalic acid, and water in 1975. Analysis of the last flush solutions indicated millicurie quantities of beta/gamma activity per 150-gallon batch. Two jet systems were found to be inoperative and the following lines have not been decontaminated:

F-12 to Feed Tanks

F-12 to S-122

Cell 2 sampler lines to Cell 18 were decontaminated in 1974. The Cell 2 blocks have not been removed to determine direct radiation readings. It is assumed that the cell background is approximately 100 rad/hr with hot spots on plugged lines reading >1000 rad/hr. The G-12 centrifuge will have readings up to 1000 rad/hr due to the inability to flush the inner walls of the centrifuge casing because the centrifuge motor is inoperative. Decontamination solutions will have to be overflowed from the H-12 tank and back up into the centrifuge housing to remove strontium-90 contamination. The G-12 oiling system will have to be capped in the service tunnel to prevent leakage of contamination through the bearing housing to the oil lube system.

Proposed Decontamination

1. Remove the top cell blocks and decontaminate the blocks for storage outside the FPDL.

2. Install plastic containment and raise the bottom south block to a position that allows the use of high pressure sprays on the tanks, piping, and cell walls.

3. Repeat step 2 with the north block.

4. When radiation level at the top of the cell reaches 1 rad/hr, remove the bottom south block, decontaminate it, and store.

5. Install an armor plate shield with a plastic shielded working area in the Cell 2 opening. This shield reduces exposure to personnel and holds the cell under negative pressure to reduce the leakage of contamination from the cell area.

6. Continue spraying cell walls, pipes, and vessels using gravity flow sprays of nitric acid, caustic, versene, Turco, oxalic acid, and water.

7. Repeat steps 4, 5, and 6, removing the bottom north block.

8. High-pressure spray the cell area and move all material from Cell 2 floor into drain trough and remove with long tongs. Force residual material in drain trough to Cell 1 using high-pressure spray.

9. Survey cell and submit radiation map to supervision to determine additional decontamination steps. Additional decontamination may be required on the G-12 centrifuge.

10. Shield hot pipe with lead and reduce general background to <500 mrad/hr.

11. Seal all service lines to Cell 2 and pull fuses on all electrical boxes to Cell 2.

12. All hot sections of piping will be removed from cell by remote cutting techniques, placed in wooden boxes, sealed, and transported to the ORNL SWSA.

13. After hot sections are removed, the remaining piping can be cut by hand and removed from the cell.

14. Vessels will be removed, sealed in wooden boxes and transported to ORNL SWSA. The G-12 centrifuge may have to be removed in an armor plate box.

15. The Cell 2 instrument panelboard will be removed, sealed in wooden boxes and transported to ORNL SWSA.

16. Operators will decontaminate the bare cell to <1 rad/hr general reading and <30,000 dis/min smear level.

17. All service lines will be capped on the inside of the cell. The off-gas for Cell 2 vessels will be capped at the off-gas header.

18. The remote service valves in the FPDL service tunnel will be removed under service tunnel decommissioning.

Manpower Requirements

Health Physics - 1 Man Month

Operations Division		Craft Support			
Operator Man Months for Decon.	Operator Man Months for Observing	Pipefitter Man Months	Welder Man Months	Rigger, Operator Man Months	Electricians, Carpenters, Others Man Months
7	2	4	2	2	2

Total volume of solid waste to SWSA - 700 cu. ft.

Estimated decontamination solution volume required - liquid waste	5000 gallons

Estimated radiation exposure:

Chemical Operators	10.0 rem
Health Physics	0.5 rem
Crafts	10.0 rem

CELL NUMBER 3

(WBS 2.3)

Cell Description

Cell No. 3 (Fig. A.3) is a stainless steel-lined process cell approximately 9.0 ft wide (E-W), 12.5 ft long (N-S), and 12.0 ft in depth. The cell is shielded on the north side with 3 ft of standard concrete. Additional shielding on the north side of the cell is supplied by the barytes concrete block wall of the FPDL service tunnel. The cell is separated from Cell 14 on the south side by 2 ft of standard concrete. Dividers on the east and west sides of Cell 3, containing 1.0 ft of standard concrete, separate Cell 3 from Cells 2 and 4. A 1-ft slot 12-ft deep on the south portion of the divider allows the passage of required piping from Cell 3 to the other FPDL process cells. There are four cell blocks 2-ft-thick supplying 4 ft of standard concrete shielding for the top of the cell.

The cell contains three 304L stainless steel tanks with a capacity of 250 gallons pwer tank and a 304L stainless steel centrifuge with an electrical motor-drive system. The precipitator tank has a motor driven agitator. All vessels are connected by welded stainless steel piping to samplers, services, off-gas, instrumentation, and transfer lines within Cell 3 and to other cells in the facility.

The cell ventilation for Cell 3 is supplied by a 12-inch stainless steel duct located on the north floor of the cell. A damper was installed to control the flow of air from the cell. The cell ventilation was not filtered in-cell due to the inaccessability of the duct work.

Solution addition lines penetrate the north side of the cell and terminate on the second level of FPDL in Area 31.

Processing History

Cell 3 was used to transfer strontium-90 feed materials shipped from Hanford, Washington. The maximum quantity of strontium-90 solution transferred through Cell 3 was 0.5×10^6 curies.

The feed material for the FPDL strontium-90 process was highly purified $^{90}SrCO_3$ received from the HAPO. This feed was radiochemically pure and contained a few percent of other alkaline earths (calcium, barium); no purification was done at the FPDL. The $^{90}SrCO_3$ was shipped to ORNL as a dry solid; it was removed from the shipping cask by water slurrying; and the slurry was treated with HNO_3 to yield a $^{90}Sr(NO_3)_2$ feed solution. At the FPDL there was storage capacity for 3 megacuries of strontium-90 in nitrate solution.

The last strontium-90 transferred through Cell 3 was in June 1974. The residual contamination in this cell would be strontium-90 with a trace of

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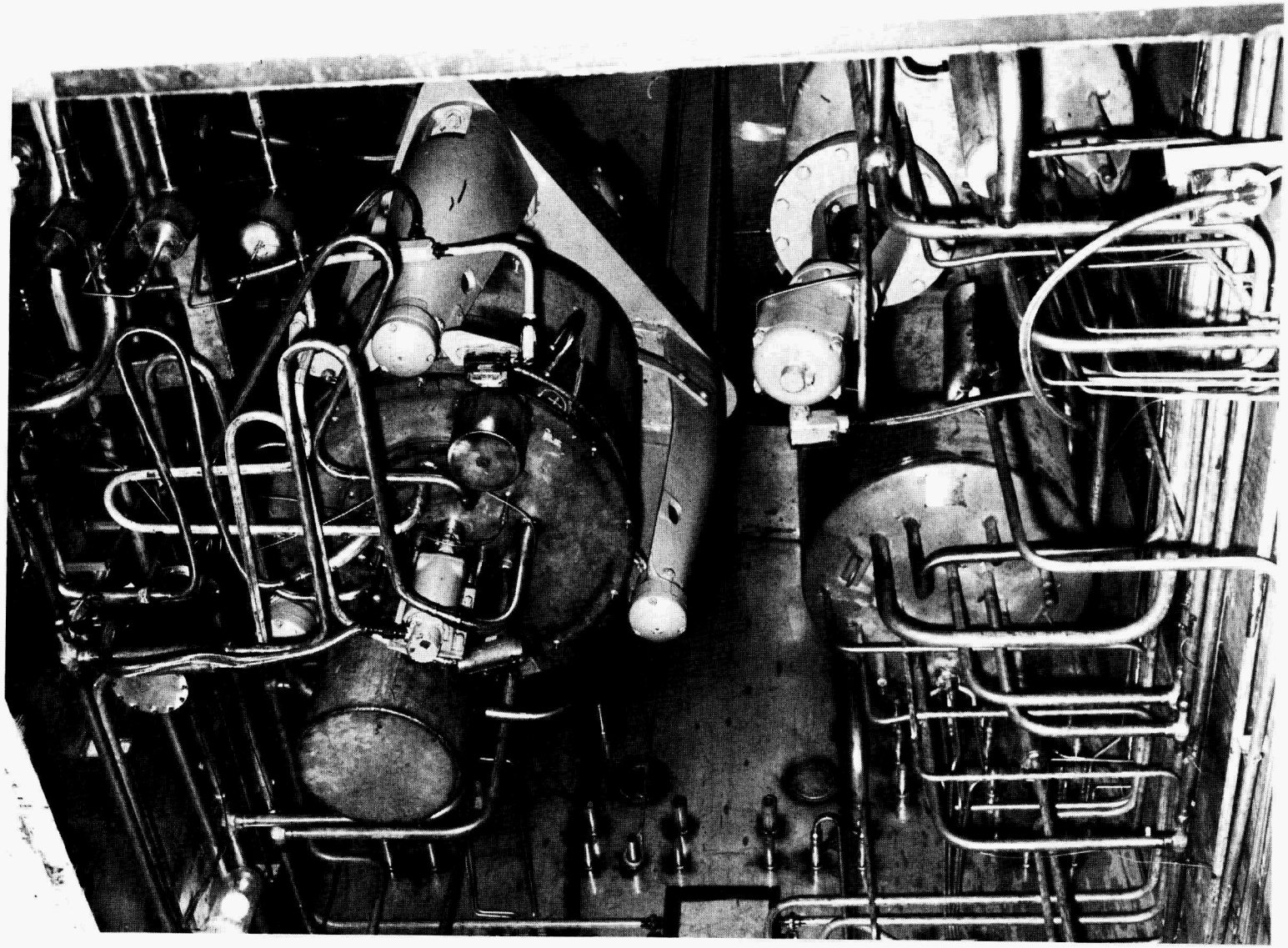

Fig. A.3. Interior view of Cell 3.

cesium-137 which was transferred from other FPDL cells or passed through the open pipe trench.

Decontamination

The process vessels and lines were flushed with caustic, nitric acid, Turco solution, oxalic acid, and water in 1975. Analysis of the last flush solutions indicated millicurie quantities of beta/gamma activity per 150-gallon batch. All jet systems were found to be operative and all lines have been decontaminated.

Cell 3 sampler lines to Cell 18 were decontaminated in 1974. The Cell 3 blocks have not been removed to determine direct radiation readings. It is assumed that the cell background is approximately 100 rad/hr with hot spots on some lines reading >1000 rad/hr. The G-23 centrifuge will have readings up to 1000 rad/hr due to the inability to flush the inner walls of the centrifuge casing because the centrifuge motor is inoperative. Decontamination solutions will have to be overflowed from the H-23 tank and back up into the centrifuge housing to remove strontium-90 contamination. The G-23 oiling system will have to be capped in the service tunnel to prevent leakage of contamination through the bearing housing to the oil lube system.

Proposed Decontamination

1. Remove the top cell blocks and decontaminate the blocks for storage outside the FPDL.

2. Install plastic containment and raise the bottom south block to a position that allows the use of high pressure sprays on the tanks, piping, and cell walls.

3. Repeat step 2 with the north block.

4. When radiation level at the top of the cell reaches 1 rad/hr, remove the bottom south block, decontaminate it, and store.

5. Install an armor plate shield with a plastic shielded working area in the Cell 3 opening. This shield reduces exposure to personnel and holds the cell under negative pressure to reduce the leakage of contamination from the cell area.

6. Continue spraying cell walls, pipes, and vessels using gravity flow sprays of nitric acid, caustic, versene, Turco, oxalic acid, and water.

7. Repeat steps 4, 5, and 6, removing the bottom north block.

8. High-pressure spray the cell area and move all material from Cell 3 floor into drain trough and remove with long tongs. Force residual material in drain trough to Cell 2 using high-pressure spray.

9. Survey cell and submit radiation map to supervision to determine additional decontamination steps. Additional decontamination may be required on the G-23 centrifuge.

10. Shield hot pipe with lead and reduce general background to <500 mrad/hr.

11. Seal all service lines to Cell 3 and pull fuses on all electrical boxes to Cell 3.

12. All hot sections of piping will be removed from cell by remote cutting techniques, placed in wooden boxes, sealed, and transported to the ORNL SWSA.

13. After hot sections are removed, the remaining piping can be cut by hand and removed from the cell.

14. Vessels will be removed, sealed in wooden boxes and transported to ORNL SWSA. The G-23 centrifuge may have to be removed in an armor plate box.

15. The Cell 3 instrument panelboard will be removed, sealed in wooden boxes and transported to ORNL SWSA.

16. Operators will decontaminate the bare cell to <1 rad/hr general reading and <30,000 dis/min smear level.

17. All service lines will be capped on the inside of the cell. The off-gas for Cell 3 vessels will be capped at the off-gas header.

18. The remote service valves in the FPDL service tunnel will be removed under service tunnel decommissioning.

Manpower Requirements

Health Physics - 1 Man Month

Operations Division		Craft Support			
Operator Man Months for Decon.	Operator Man Months for Observing	Pipefitter Man Months	Welder Man Months	Rigger, Operator Man Months	Electricians, Carpenters, Others Man Months
7	2	4	2	2	2

Total volume of solid waste to SWSA - 700 cu. ft.

Estimated decontamination solution volume required - liquid waste	5000 gallons

Estimated radiation exposure:

Chemical Operators	10.0 rem
Health Physics	0.5 rem
Crafts	10.0 rem

CELL NUMBER 4

(WBS 2.4)

Cell Description

Cell No. 4 (Fig. A.4) is a stainless steel-lined process cell 9.0 ft wide, 12.5 ft long, and 12.0 ft deep. The cell is shielded on the north side by 3 ft of standard concrete. Additional shielding on the north side is supplied by the solid barytes concrete block wall on the north side of the service tunnel. The cell is separated from Cells 13 and 14 on the south side by 2 ft of standard concrete. Dividers on the east and west sides of Cell 4, containing 1.0 ft of standard concrete, separate Cell 4 from Cells 3 and 5. A 1-ft slot, 12-ft deep, on the south side of the divider allows the passage of required piping and services from Cell 4 to the other process cells. There are four cell blocks 2-ft thick which supply 4 ft of standard concrete shielding for the top of the cell.

The cell contains three 304L stainless steel tanks with a capacity of 250 gallons per tank and a 304L stainless steel centrifuge with an electrical motor-drive system. The precipitator tank has a motor driven agitator. All vessels are connected by welded stainless steel piping to samplers, services, off-gas, instrumentation, and transfer lines within Cell 4 and to other cells in the facility.

The cell ventilation for Cell 4 is supplied by a 12-inch stainless steel duct located on the north floor of the cell. A damper was installed to control the flow of air from the cell. The cell ventilation was not filtered in-cell due to the inaccessability of the duct work.

Solution addition lines penetrate the north side of the cell and terminate on the second level of FPDL in Area 31.

Processing History

Cell 4 was used to transfer strontium-90 feed materials shipped from Hanford, Washington. The maximum quantity of strontium-90 solution transferred through Cell 4 was 0.5×10^6 curies.

The feed material for the FPDL strontium-90 process was highly purified $^{90}SrCO_3$ received from the HAPO. This feed was radiochemically pure and contained a few percent of other alkaline earths (calcium, barium); no purification was done at the FPDL. The $^{90}SrCO_3$ was shipped to ORNL as a dry solid; it was removed from the shipping cask by water slurrying; and the slurry was treated with HNO_3 to yield a $^{90}Sr(NO_3)_2$ feed solution. At the FPDL there was storage capacity for 3 megacuries of strontium-90 in nitrate solution.

The last strontium-90 stored in Cell 4 was in June 1974. The residual contamination in this cell would be strontium-90 with a trace of cesium-137

ORNL-PHOTO 42097

Fig. A.4. Interior view of Cell 4.

which was transferred from other FPDL cells or passed through the open pipe trench.

Decontamination

The process vessels and lines were flushed with caustic, nitric acid, Turco solution, oxalic acid, and water in 1975. Analysis of the last flush solutions indicated millicurie quantities of beta/gamma activity per 150-gallon batch. One jet was found to be inoperative.

Jet valve HX-J81-4 or block valve HX-10425 does not function (from P-34 to Cell 21 fraction tanks and F-12 and F-23).

Cell 4 sampler lines to Cell 18 were decontaminated in 1974. The Cell 4 blocks have not been removed to determine direct radiation readings. It is assumed that the cell background is approximately 100 rad/hr with hot spots on some lines reading >1000 rad/hr. The G-34 centrifuge will have readings up to 1000 rad/hr due to the inability to flush the inner walls of the centrifuge casing because the centrifuge motor is inoperative. Decontamination solutions will have to be overflowed from the H-34 tank and back up into the centrifuge housing to remove strontium-90 contamination. The G-34 oiling system will have to be capped in the service tunnel to prevent leakage of contamination through the bearing housing to the oil lube system.

Proposed Decontamination

1. Remove the top cell blocks and decontaminate the blocks for storage outside the FPDL.

2. Install plastic containment and raise the bottom south block to a position that allows the use of high pressure sprays on the tanks, piping, and cell walls.

3. Repeat step 2 with the north block.

4. When radiation level at the top of the cell reaches 1 rad/hr, remove the bottom south block, decontaminate it, and store.

5. Install an armor plate shield with a plastic shielded working area in the Cell 4 opening. This shield reduces exposure to personnel and holds the cell under negative pressure to reduce the leakage of contamination from the cell area.

6. Continue spraying cell walls, pipes, and vessels using gravity flow sprays of nitric acid, caustic, versene, Turco, oxalic acid, and water.

7. Repeat steps 4, 5, and 6, removing the bottom north block.

8. High-pressure spray the cell area and move all material from Cell 4 floor into drain trough and remove with long tongs. Force residual material in drain trough to Cell 3 using high-pressure spray.

9. Survey cell and submit radiation map to supervision to determine additional decontamination steps. Additional decontamination may be required on the G-34 centrifuge.

10. Shield hot pipe with lead and reduce general background to <500 mrad/hr.

11. Seal all service lines to Cell 4 and pull fuses on all electrical boxes to Cell 4.

12. All hot sections of piping will be removed from cell by remote cutting techniques, placed in wooden boxes, sealed, and transported to the ORNL SWSA.

13. After hot sections are removed, the remaining piping can be cut by hand and removed from the cell.

14. Vessels will be removed, sealed in wooden boxes and transported to ORNL SWSA. The G-34 centrifuge may have to be removed in an armor plate box.

15. The Cell 4 instrument panelboard will be removed, sealed in wooden boxes and transported to ORNL SWSA.

16. Operators will decontaminate the bare cell to <1 rad/hr general reading and <30,000 dis/min smear level.

17. All service lines will be capped on the inside of the cell. The off-gas for Cell 4 vessels will be capped at the off-gas header.

18. The remote service valves in the FPDL service tunnel will be removed under service tunnel decommissioning.

Manpower Requirements

Health Physics - 1 Man Month

Operations Division		Craft Support			
Operator Man Months for Decon.	Operator Man Months for Observing	Pipefitter Man Months	Welder Man Months	Rigger, Operator Man Months	Electricians, Carpenters, Others Man Months
7	2	4	2	2	2

Total volume of solid waste to SWSA - 700 cu. ft.

Estimated decontamination solution volume required - liquid waste	5000 gallons

Estimated radiation exposure:

Chemical Operators	10.0 rem
Health Physics	0.5 rem
Crafts	10.0 rem

CELL NUMBER 5

(WBS 2.5)

Cell Description

Cell No. 5 (Fig. A.5) is a stainless steel-lined process cell 9.0 ft wide, 12.5 ft long, and 12.0 ft deep. The cell is shielded on the north side by 3 ft of standard concrete. Additional shielding on the north side is provided by solid barytes concrete blocks on the north side of the service tunnel. The cell is separated from Cell 12 on the south side by 2 ft of standard concrete. Dividers on the east and west sides of Cell 5, containing 1.0 ft of standard concrete, separate Cell 5 from Cells 4 and 6. A 1-ft slot, 12-ft deep, on the south side of the dividers allows the passage of required piping and services to the other process cells and the Tank Farm. There are four cell blocks 2-ft thick which supply 4 ft of standard concrete shielding for the top of the cell.

The cell contains two 304L stainless steel tanks with a capacity of 500 gallons per tank and a 304L stainless steel centrifuge with a capacity of 26 gallons, and an electrical motor-drive system. The precipitator tank has a motor driven agitator. All vessels are connected by welded stainless steel piping to samplers, services, off-gas, instrumentation, and transfer lines within Cell 5 and to other cells in the facility.

The cell ventilation for Cell 5 is supplied by a 12-inch duct in the north floor of the cell. A damper was installed to control the flow of air from the cell. The cell ventilation was not filtered in-cell due to the inaccessability of the duct work.

Solution addition lines penetrate the north side of the cell and terminate on the second level of the FPDL in Area 32.

There is an opening on the north top wall of the cell which allows passage of sample lines from all cells to the sampling station in Cell 18.

Processing History

Cell 5 was used as a transfer station in the cesium-137 feed preparation and as a scavenge and sampling cell in the cesium-137 crystallization process.

The feed material for the FPDL cesium-137 process was received from the HAPO in Shielded Transfer Tanks (SST's) which contained one ton of an aluminosilicate ion exchanger. The cesium-137 was eluted from the ion exchanger by passing 5 *M* NH_4NO_3 at 80°C through the bed and routing the feed material to the storage tank (W-19, W-20 or S-122). Feed batches were then transferred to the cesium-137 process cells (Cells 5, 6, 7, and 8) where, through a process of co-crystallization with ammonium alum and scavenge crystallizations, the beds were accumulated to approximately 200,000 curies. The beds were then reduced and purified by water

ORNL-PHOTO 45862

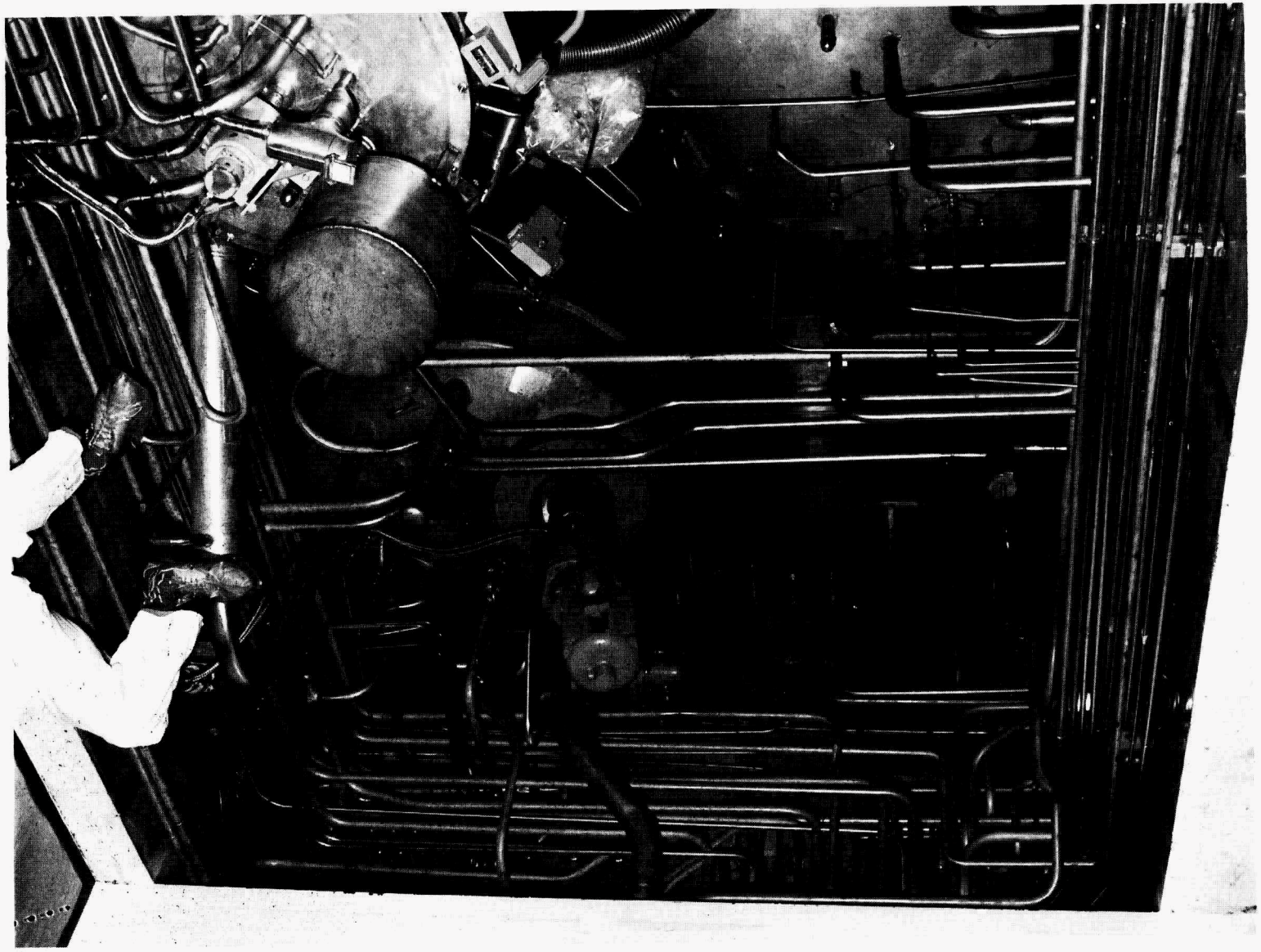

Fig. A.5. Interior view of Cell 5.

crystallization to reduce the bed size and remove the traces of rubidium and ammonium alum. The bed was then transferred to the concentrate crystallizer and, by the addition of oxalic acid, cesium tetraoxalate was formed. This material was then transferred to the manipulator cells for conversion to purified cesium chloride.

The last cesium-137 feed material was received from the HAPO in the summer of 1971 and the last batch was processed in March 1973.

The residual activity in Cell 5 would be cesium-137 with trace amounts of strontium-90 which may have migrated from the strontium storage cells through the pipe trench.

Decontamination

The cesium-137 process vessels and lines were thoroughly flushed with HNO_3 solution and water in the fall of 1973. Analysis of the last flush solutions indicated millicurie quantities of beta/gamma activity per 150-gallon batch.

All Cell 5 valves were found to be functioning. The Cell 5 sample lines were decontaminated in the above mentioned cleanout. The Cell 5 blocks have not been removed to determine direct radiation readings. It is assumed the cell background is approximately 100 rad/hr with hot spots on some lines >1000 rad/hr. The G-45 centrifuge will have readings up to 1000 rad/hr due to the inability to flush the inner walls of the centrifuge casing because the centrifuge motor is inoperative. Decontamination solutions will have to be overflowed from H-45 back into the G-45 housing to rinse out the cesium-137 contamination. The G-45 oiling system will have to be capped in the service tunnel to prevent leakage of contamination through the bearing housing to the oil lube system.

Proposed Decontamination

1. Remove the top blocks and decontaminate the blocks for storage outside the FPDL.

2. Install plastic containment and raise the south bottom block to a position to allow high pressure spraying of the walls, piping, and tanks.

3. Repeat step 2 on the north bottom block.

4. When the radiation level at the top of the cell reaches 1 rad/hr, remove the bottom south block and decontaminate for storage.

5. Install an armor plate shield with a plastic shielded working area in the Cell 5 opening. This shield reduces exposure to personnel and holds the cell under negative pressure to reduce the leakage of contamination from the cell area.

6. Continue spraying the cell walls, tanks, and piping, using gravity flow sprays of nitric acid, Turco, oxalic acid, and water.

7. Repeat steps 4, 5, and 6, removing the north bottom block.

8. High-pressure spray the cell area and move all material from the Cell 5 floor to the trough on the south side of the cell. Remove all debris from the trough with long tongs. Force residual material to Cell 4 using the high-pressure spray.

9. Survey cell and submit radiation map to supervision to determine additional decontamination steps. Additional decontamination may be required on the G-45 centrifuge.

10. Shield hot pipe with lead and reduce general background to <500 mrad/hr.

11. Seal all service lines and pull all fuses on all electrical services to Cell 5.

12. All hot sections of piping will be removed by remote cutting techniques to wooden boxes, sealed, and transported to the ORNL SWSA.

13. After the hot sections of piping have been removed, the remaining piping can be cut by hand and removed from the cell.

14. Vessels will be removed, sealed in wooden boxes, and transported to the ORNL SWSA. The G-45 centrifuge may have to be removed in an armor plate box.

15. The Cell 5 instrument panelboard will be removed, sealed in plywood boxes, and transported to the ORNL SWSA.

16. Operators will decontaminate the bare cell to <1 rad/hr general reading and <30,000 dis/min smear level.

17. All service lines will be capped on the inside of the cell. The off-gas for the Cell 5 vessels will be capped at the off-gas header.

18. The remote service valves in the FPDL service tunnel will be removed under service tunnel decommissioning.

Manpower Requirements

Health Physics - 1 Man Month

Operations Division		Craft Support			
Operator Man Months for Decon.	Operator Man Months for Observing	Pipefitter Man Months	Welder Man Months	Rigger, Operator Man Months	Electricians, Carpenters, Others Man Months
7	2	4	2	2	4

Total volume of solid waste to SWSA- 800 cu. ft.

Estimated decontamination solution volume required - liquid waste	5000 gallons

Estimated radiation exposure:

Chemical Operators	10.0 rem
Health Physics	0.5 rem
Crafts	10.0 rem

CELL NUMBER 6

(WBS 2.6)

Cell Description

Cell 6 (Fig. A.6) is a stainless steel-lined process cell 7.5 ft wide, 12.5 ft long, and 12 ft deep. The cell is shielded on the north side by 3 ft of standard concrete. Additional shielding on the north side is supplied by the solid barytes concrete block wall on the north side of the service tunnel. The cell is separated from Cell 11 on the south side by 2 ft of standard concrete. Dividers on the east and west sides of Cell 6, containing 1 ft of standard concrete, separate Cell 6 from Cells 5 and 7. A 1-ft slot, 12 ft deep, on the south side of the dividers allows the passage of piping and services to the other process cells. There are four cell blocks 2-ft thick which supply 4 ft of standard concrete shielding for the top of the cell.

The cell contains one 304L stainless steel tank with a capacity of 650 gallons. This tank is fitted with a reflux condenser. All equipment is connected by welded stainless steel piping to samplers, services, off-gas, instrumentation, and transfer lines within Cell 6 and to other cells in the facility. The cell ventilation for Cell 6 is supplied by a 12-inch stainless steel duct located on the north floor of the cell. A damper was installed to control the flow of air from the cell. The cell ventilation was not filtered in-cell due to the inaccessability of the duct work.

Solution addition lines penetrate the north side of the cell and terminate on the second level of the FPDL in Area 32.

Processing History

In the early days of the FPDL, Cell 6 was used as an evaporator cell to concentrate the mixed fission products from the purex feed product waste received from on-site installations. In the latter years the cell was used as a storage and holding cell for cesium-137 feed material received from the HAPO.

The last cesium-137 feed material was received from the HAPO in the summer of 1971 and the last batch was processed in March 1973.

The residual activity in Cell 6 would be cesium-137 with trace amounts of strontium-90 which may have migrated from the strontium storage cells through the pipe trench.

Decontamination

The cesium-137 process vessels and lines were thoroughly flushed with HNO_3 solution and water in the fall of 1973. Analysis of the last flush solutions indicated millicurie quantities of beta/gamma activity per 150-gallon batch. All Cell 6 valves were found to be functioning. The Cell 6 sample

ORNL-PHOTO 43976

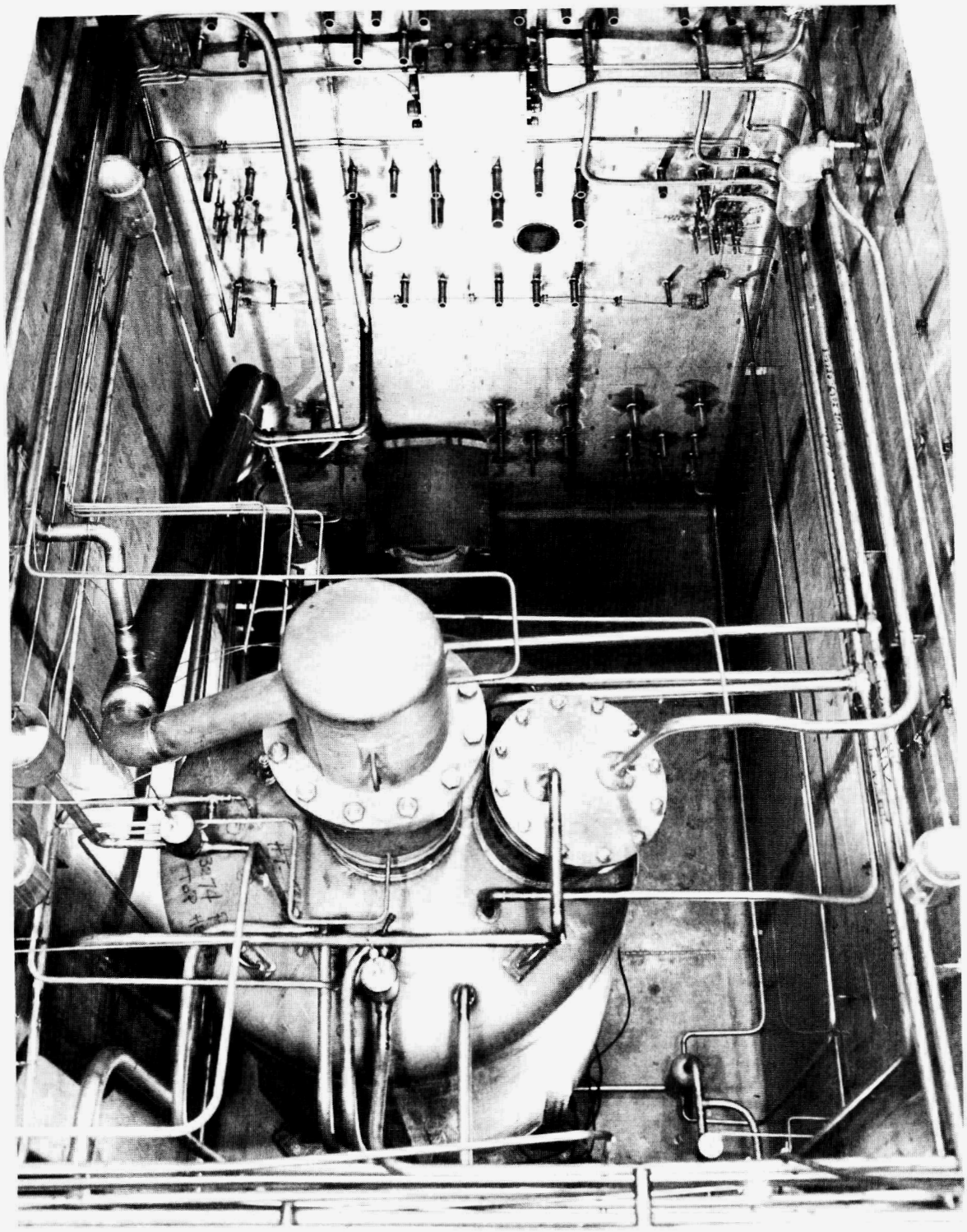

Fig. A.6. Interior view of Cell 6.

lines were decontaminated in the resultant cleanout. The Cell 6 blocks have not been removed to determine direct radiation readings. It is assumed the cell background is approximately 100 rad/hr with hot spots on some lines >1000 rad/hr.

Proposed Decontamination

1. Remove the top blocks and decontaminate the blocks for storage outside the FPDL.

2. Install plastic containment and raise the south bottom block to a position to allow high pressure spraying of the walls, piping, and tank.

3. Repeat step 2 on the north bottom block.

4. When the radiation level at the top of the cell reaches 1 rad/hr, remove the bottom south block and decontaminate for storage.

5. Install an armor plate shield with a plastic shielded working area in the Cell 6 opening. This shield reduces exposure to personnel and holds the cell under negative pressure to reduce the leakage of contamination from the cell area.

6. Continue spraying the cell walls, tanks, and piping, using gravity flow sprays of nitric acid, Turco, oxalic acid, and water.

7. Repeat steps 4, 5, and 6, removing the north bottom block.

8. High-pressure spray the cell area and move all material from the Cell 6 floor to the trough on the south side of the cell. Remove all debris from the trough with long tongs. Force residual material to Cell 5 using the high-pressure spray.

9. Survey the cell and submit a radiation map to supervision to determine additional decontamination steps.

10. Shield hot pipe with lead and reduce the general background to <500 mrad/hr.

11. Seal all service lines and pull all fuses on all electrical services to Cell 5.

12. All hot sections of piping will be removed by remote cutting techniques to wooden boxes, sealed, and transported to the ORNL SWSA.

13. After the hot sections of piping have been removed, the remaining piping can be cut by hand and removed from the cell.

14. The E-16 vessel and condenser will be removed, sealed in wooden boxes, and transported to the ORNL SWSA.

15. The Cell 6 instrument panelboard will be removed, sealed in plywood boxes, and transported to the ORNL SWSA.

16. Operators will decontaminate the bare cell to <1 rad/hr general reading and <30,000 dis/min smear level.

17. All service lines will be capped on the inside of the cell. The off-gas for the Cell 6 vessel will be capped at the off-gas header.

18. The remote service valves in the FPDL service tunnel will be removed under service tunnel decommissioning.

Manpower Requirements

Health Physics - 1 Man Month

Operations Division		Craft Support			
Operator Man Months for Decon.	Operator Man Months for Observing	Pipefitter Man Months	Welder Man Months	Rigger, Operator Man Months	Electricians, Carpenters, Others Man Months
7	2	4	1	1	2

Total volume of solid waste to SWSA - 500 cu. ft.

Estimated decontamination solution volume required - liquid waste 5000 gallons

Estimated radiation exposure:

Chemical Operators	10.0 rem
Health Physics	0.5 rem
Crafts	10.0 rem

CELL NUMBER 7

(WBS 2.7)

Cell Description

Cell 7 (Fig. A.7) is a stainless steel-lined process cell 7.5 ft wide, 12.5 ft long, and 12 ft deep. The cell is shielded on the north side by 3 ft of standard concrete. Additional shielding on the north side is provided by solid barytes concrete blocks on the north side of the service tunnel. The cell is separated from Cell 11 on the south side by 2 ft of standard concrete. Dividers on the east and west sides of Cell 7, containing 1 ft of standard concrete, separate Cell 7 from Cells 6 and 8. A 1-ft slot, 12 ft deep, on the south side of the dividers allows the passage of piping and services to the other process cells and to the Tank Farm. There are four cell blocks 2-ft thick which supply 4 ft of standard concrete shielding for the top of the cell.

The cell contains two 304L stainless steel tanks with a capacity of 500 gallons per tank. All vessels are connected by welded stainless steel piping to samplers, services, off-gas, instrumentation, and transfer lines within Cell 7 and to other cells in the facility. The cell ventilation for Cell 7 is supplied by a 12-inch duct in the north floor of the cell. A damper was installed to control the flow of air from the cell. The cell ventilation was not filtered in-cell due to the inaccessability of the duct work.

Solution addition lines penetrate the north side of the cell and terminate on the second level of the FPDL in Area 32.

Processing History

Cell 7 was used for the first crystallization in the scavenge crystallization of cesium-137 received from the HAPO. The cesium alum beds were accumulated through a process of co-crystallization with ammonium alum. The ammonium alum beds were then transferred to concentrate crystallizers in Cell 8.

The last cesium-137 feed material was received from the HAPO in the summer of 1971 and the last batch was processed in March of 1973.

The residual activity in Cell 7 would be cesium-137 with trace amounts of strontium-90 which may have migrated from the strontium storage cells through the pipe trench.

Decontamination

The cesium-137 process vessels and lines were thoroughly flushed with HNO_3 solution and water in the fall of 1973. Analysis of the last flush solution indicated millicurie quantities of beta/gamma activity per 150-gallon batch. The following valves were found inoperative:

ORNL-PHOTO 43982

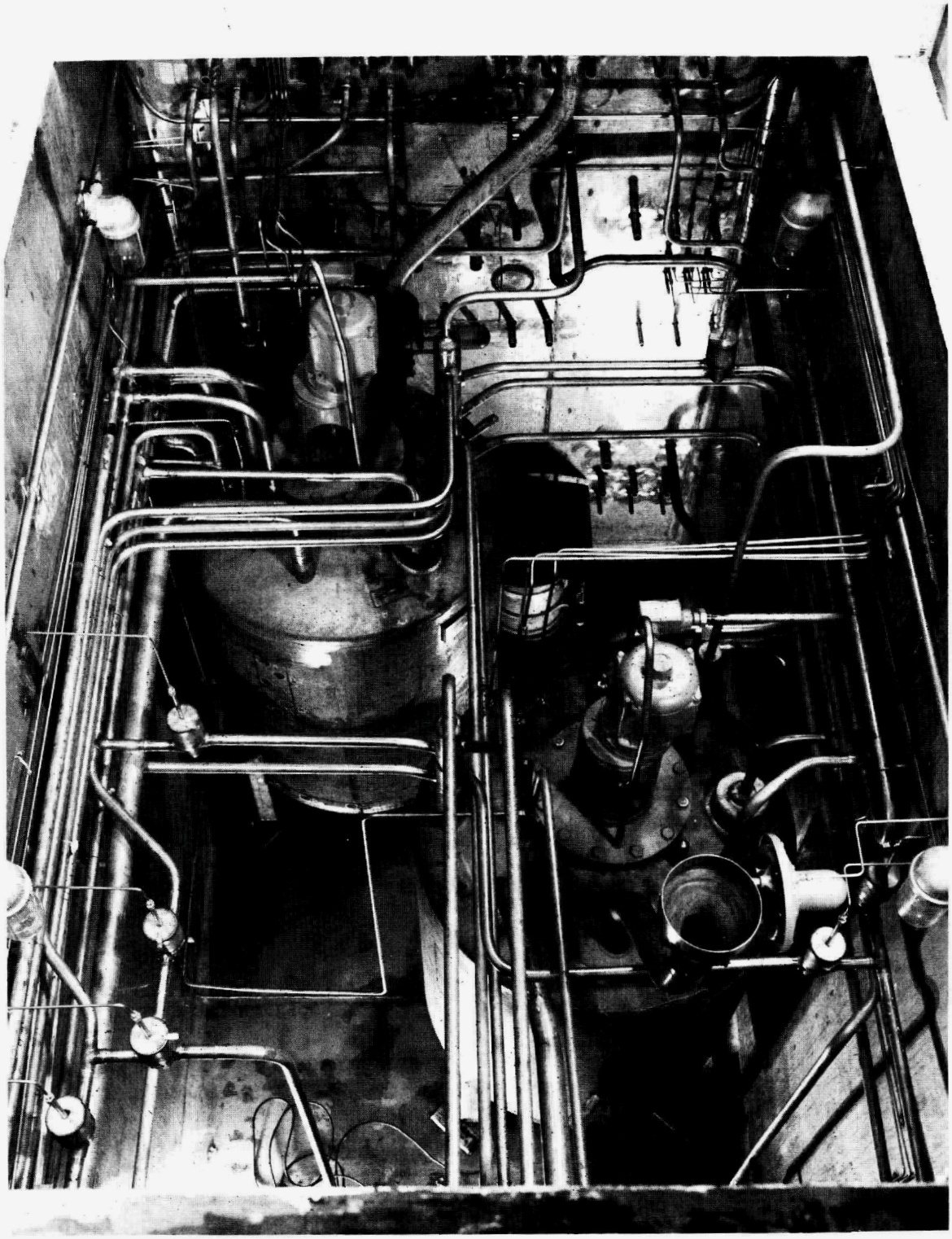

Fig. A.7. Interior view of Cell 7.

C-27 → S-324	Valve HX-10521 will not close
C-17 → S-122	Valve HX-1079 will not open
C-27 → C-17	Valve HX-1073 will not close
C-17 → S-324	Valve HX-10714 will not operate
C-17 → C-27	Jet HX-J-70-7 partially closed

The Cell 7 sample lines were decontaminated in the above mentioned cleanout. The cell blocks have not been removed to determine direct radiation readings. It is assumed the cell background is 10-20 rad/hr with hot spots on some lines >1000 rad/hr. Some Mason-Neilan valves will read >1000 rad/hr due to the inability to flush the lines because of stuck valves.

Proposed Decontamination

1. High-pressure spray the inside of the cell through the C-17 and C-27 solids addition holes through the top cell blocks.

2. Remove the top blocks and decontaminate the blocks for storage outside the FPDL.

3. Install plastic containment and raise the south bottom block to a position to allow high-pressure spraying of the walls, piping, and tanks.

4. Repeat step 3 on the north bottom block.

5. When the radiation level at the top of the cell reaches 1 rad/hr, remove the bottom south block and decontaminate for storage.

6. Install an armor plate shield with a plastic shielded working area in the Cell 7 opening. This shield reduces exposure to personnel and holds the cell under negative pressure to reduce the leakage of contamination from the cell area.

7. Continue spraying the cell walls, tanks, and piping, using gravity flow sprays of nitric acid, Turco, oxalic acid, and water.

8. Repeats steps 5, 6, and 7, removing the north block.

9. High-pressure spray the cell area and move all material from the Cell 7 floor to the trough on the south side of the cell. Remove all debris from the trough with long tongs. Force residual material to Cell 6 using the high-pressure spray.

10. Survey cell and submit a radiation map to supervision to determine additional decontamination steps.

11. Shield hot pipe with lead and reduce general background to <500 mrad/hr.

12. Seal all service lines and pull all fuses on all electrical service to Cell 7.

13. All hot sections of piping will be removed by remote cutting techniques to wooden boxes, sealed, and transported to the ORNL SWSA.

14. After the hot sections of piping have been removed, the remaining piping can be cut by hand and removed from the cell.

15. Vessels will be removed, sealed in wooden boxes, and transported to the ORNL SWSA.

16. The Cell 7 instrument panelboard will be removed, sealed in plywood boxes, and transported to the ORNL SWSA.

17. Operators will decontaminate the bare cell to <1 rad/hr general reading and <30,000 dis/min smear level.

18. All service lines will be capped on the inside of the cell. The off-gas for the Cell 7 vessels will be capped at the off-gas header.

19. The remote service valves in the FPDL service tunnel will be removed under service tunnel decommissioning.

Manpower Requirements

Health Physics - 1 Man Month

Operations Division		Craft Support			
Operator Man Months for Decon.	Operator Man Months for Observing	Pipefitter Man Months	Welder Man Months	Rigger, Operator Man Months	Electricians, Carpenters, Others Man Months
7	2	4	1	2	3

Total volume of solid waste to SWSA - 900 cu. ft.

Estimated decontamination solution volume required - liquid waste 5000 gallons

Estimated radiation exposure:

Chemical Operators	10.0 rem
Health Physics	0.5 rem
Crafts	10.0 rem

CELL NUMBER 8

(WBS 2.8)

Cell Description

Cell 8 (Fig. A.8) is a stainless steel-lined process cell 7.5 ft wide, 12.5 ft long, and 12 ft deep. The cell is shielded on the north side by 3 ft of standard concrete. Additional shielding on the north side is provided by solid barytes concrete blocks on the north side of the service tunnel. The cell is separated from cell 10W on the south side by 2 ft of standard concrete. Dividers on the east and west sides of Cell 8, containing 1 ft of standard concrete, separate Cell 8 from Cells 7 and 9. A 1-ft slot, 12 ft deep, on the south side of the dividers allows the passage of piping and services to the other process cells and to the Tank Farm. There are four cell blocks 2-ft thick which supply 4 ft of standard con0 crete shielding for the top of the cell.

The cell contains three 304L stainless steel tanks. Two tanks have a capacity of 125 gallons each and one tank has a capacity of 25 gallons. All tanks are connected by welded stainless steel piping to samplers, services, off-gas, instrumentation, and transfer lines within Cell 8, and to other cells in the facility. The cell ventilation for Cell 8 is supplied by a 12-inch duct in the north floor of the cell. A damper was installed to control the flow of air from the cell. The cell ventilation was not filtered in-cell due to the inaccessability of the duct work.

Solution addition lines penetrate the north side of the cell and terminate on the second level of the FPDL in Area 32.

Processing History

Cell 8 was used for the concentrate crystallization and the conversion to cesium tetraoxylate in the cesium-137 co-crystallization process of cesium-137 received from the HAPO.

The last cesium-137 feed material was received from the HAPO in the summer of 1971 and the last batch was processed in March of 1973.

The residual activity in Cell 8 would be cesium-137 with trace amounts of strontium-90 which may have migrated from the strontium storage cells through the pipe trench.

Decontamination

The cesium-137 process vessels and lines were thoroughly flushed with HNO_3 solution and water in the fall of 1973. Analysis of the last flush solution indicated millicurie quantities of beta/gamma activity per 150-gallon batch. The following jet system is inoperative:

R-18 → C-48 or S-324 HX-J123-8 does not function

ORNL-PHOTO 58639

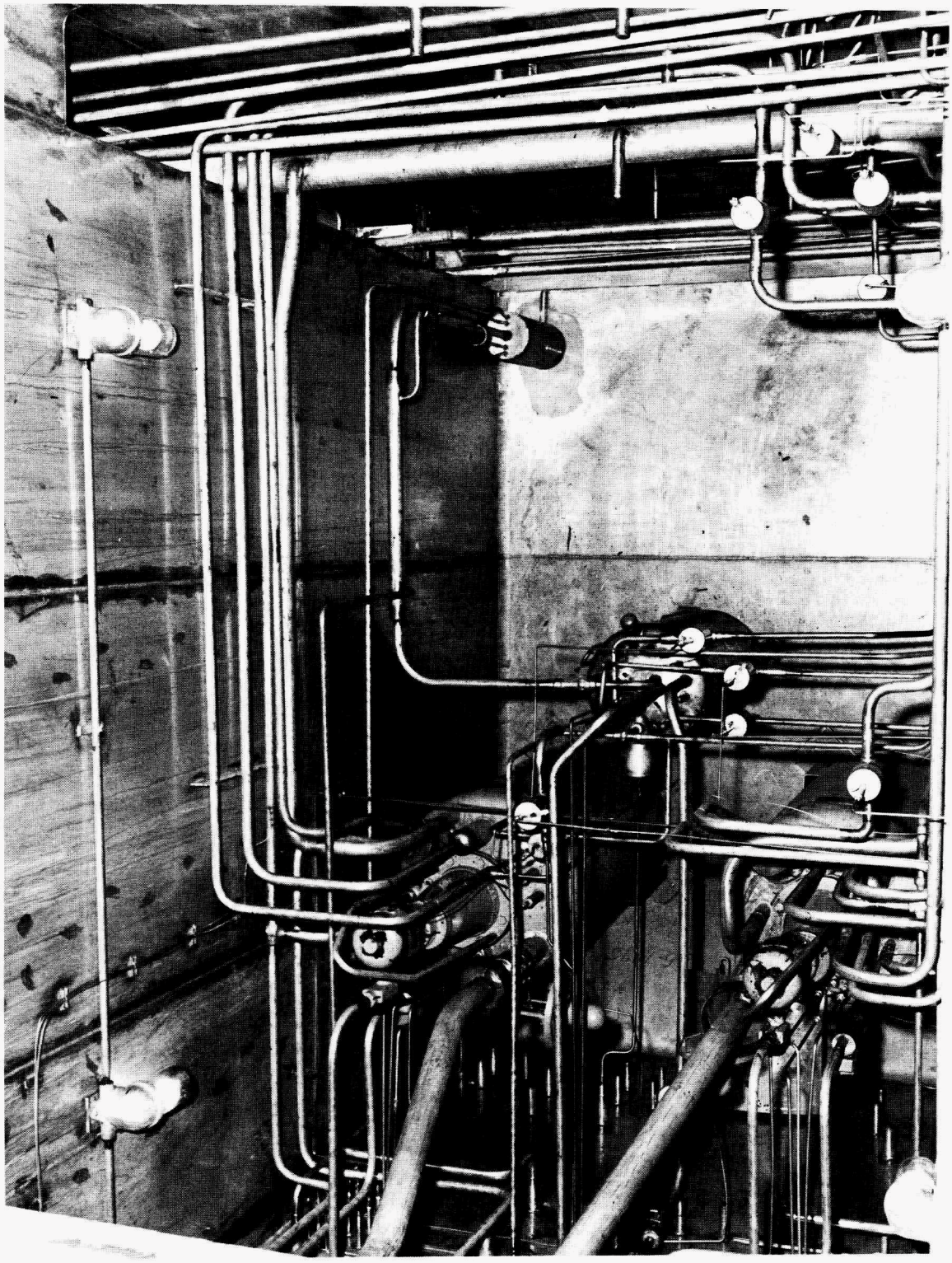

Fig. A.8. Interior view of Cell 8.

The Cell 8 sample lines were decontaminated in the above mentioned clean-out. The cell blocks were removed in 1982 and direct radiation readings have been taken. The cell background is 10-20 rad/hr with hot spots on some lines reading >100 rad/hr.

Proposed Decontamination

1. Remove the top block and decontaminate the blocks for storage outside the FPDL.

2. Install plastic containment and raise the south bottom block to a position to allow high-pressure spraying of the walls, piping, and tanks.

3. Repeat Step 2 on the north bottom block.

4. When the radiation level at the top of the cell reaches 1 rad/hr, remove the south bottom block and decontaminate for storage.

5. Install an armor plate shield with a plastic shielded working area in the Cell 8 opening. This shield reduces exposure to personnel and holds the cell under negative pressure to reduce the leakage of contamination from the cell area.

6. Continue spraying the cell walls, tanks, and piping, using gravity flow sprays of nitric acid, Turco, oxalic acid, and water.

7. Repeat Steps 4, 5, and 6, removing the north bottom block.

8. High-pressure spray the cell area and move all material from the Cell 8 floor to the trough on the south side of the cell. Remove all debris from the trough using long tongs. Force residual material to Cell 7 using the high pressure spray.

9. Survey the cell and submit a radiation map to supervision to determine additional decontamination steps.

10. Shield hot pipe, etc., with lead and reduce general background to <500 mrad/hr.

11. Seal all service lines and pull all fuses on all electrical service to Cell 8.

12. All hot sections of piping will be removed by remote cutting techniques to wooden boxes, sealed, and transported to the ORNL SWSA.

13. After the hot sections of piping have been removed, the remaining piping can be cut by hand and removed from the cell.

14. Vessels will be removed, sealed in wooden boxes, and transported to the ORNL SWSA.

15. Cell 8 instrument panelboard will be removed, sealed in wooden boxes, and transported to the ORNL SWSA.

16. Operators will decontaminate the bare cell to <1 rad/hr general reading and <30,000 dis/min smear level.

17. All service lines will be capped on the inside of the cell. The off-gas lines for the Cell 8 vessels will be capped at the off-gas header.

18. The remote service valves in the FPDL service tunnel will be removed under service tunnel decommissioning.

Manpower Requirements

Health Physics - 1 Man Month

Operations Division		Craft Support			
Operator Man Months for Decon.	Operator Man Months for Observing	Pipefitter Man Months	Welder Man Months	Rigger, Operator Man Months	Electricians, Carpenters, Others Man Months
2	2	4	1	2	3

Total volume of solid waste to the SWSA - 500 cu. ft.

Estimated decontamination solution volume required - liquid waste 5000 gallons

Estimated radiation exposure:

Chemical Operators	2.0 rem
Health Physics	0.5 rem
Crafts	10.0 rem

CELL NUMBER 13

(WBS 1.1)

Cell Description

Cell 13 (Fig. A.9) is a stainless steel-lined manipulator cell 7 ft wide (E-W), 8 ft long (N-S), and 11 ft deep. The cell is shielded from Cells 4 and 5 on the north side by 2 ft of standard concrete. It is shielded on the east and west sides by 2 ft of standard concrete. It is shielded on the south side, which is the manipulator operating gallery, by 3 ft of barytes concrete. There is one block of standard concrete, 2-ft thick, which covers the top of the cell. The top block is 7 ft, 7.5 inch by 6 ft, 1.5 inch. Beneath the top block is an angle iron frame of the same dimensions as the top block. This frame replaces the bottom 2-ft thick concrete block which was disposed of approximately 10 years ago. There is an airlock, 15 inch in diameter, on the east side of the cell which allows access to Cell 12. There is an airlock approximately 12 ft wide by 13 ft high in the southwest corner of the cell which allows access to Cell 14E. There is a floor drain in the rear center of the cell which drains to tank S-523. Cell ventilation is furnished to the cell through a duct in the northwest corner of the cell which contains two 8 inch HEPA filters.

Processing History

In the late 1950's and early 1960's Cell 13 was used as a purification cell for the cesium-137 process. At that time the cell was 15-ft deep and contained a glassware setup for the cesium-137 recovery. In 1965 the cell was refurbished and the bottom 4 ft of the cell was filled with concrete and a stainless steel pan was installed. The cell was still used for the recovery of the cesium-137 tetraoxylate which was crystallized in Cell 8 and transferred to tank P-513 (in Cell 13) and filtered through a porous stainless steel filter. After completion of the cesium-137 processing in 1974 the cell was again decontaminated and tank P-513 was removed and sent to the SWSA for burial. It was at this time also that the bottom block was buried. In the decontamination process in 1974 cracks were discovered in the pan weld with readings to 750 rad/hr. Because of this and the high readings, the lighting system in Cell 13 was not refurbished at this time. Temporary lighting was installed through plug holes in the face of the cell. Since 1975 the cell has been used for the purification of cesium-137 chloride from WESF cans received from Richland, Washington. The cell is also used for pressing cesium-137 chloride pellets and capsule loading.

Decontamination

Decontamination was performed on the off-gas line which runs through the cell in 1974. No further decontamination has been done since the cell was closed in 1975.

ORNL-PHOTO 87588

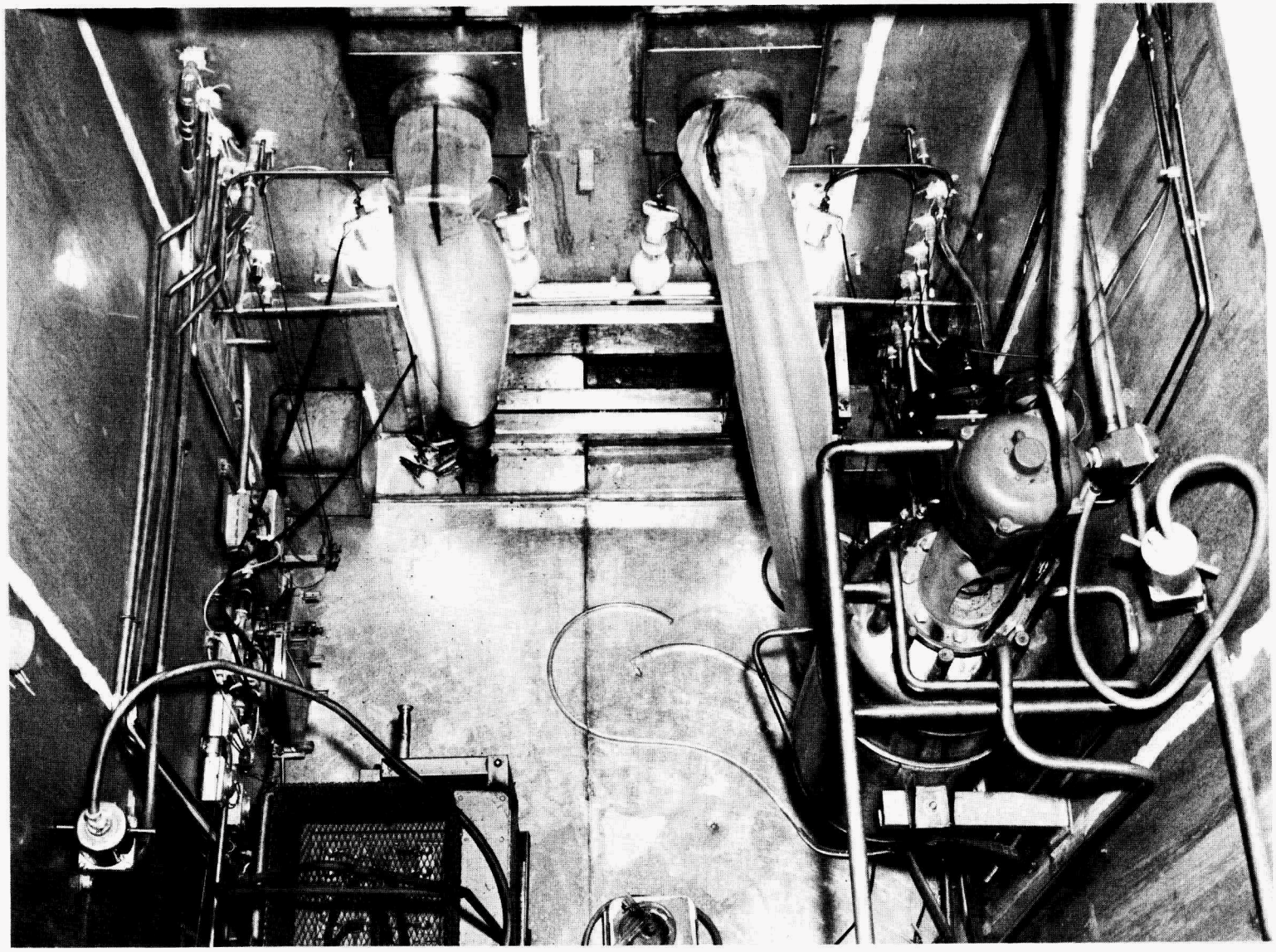

Fig. A.9. Interior view of Cell 13.

Proposed Decontamination

1. Decontaminate and remove all equipment from the cell through the airlocks. Decontamination will be accomplished by high-pressure spray and chemical washing. Equipment to be saved will be transferred to Cell 11. Equipment to be thrown away will be transferred to Cell 14 for transfer to the SWSA for burial.

2. Seal off both airlocks with lead bags or lead blocks.

3. Decontaminate the cell by high-pressure spraying, chemical washes, and wiping. Since there is no plug hole in the top block through which radiation probes can be inserted, decontamination should continue until the walls and pan are smearing <50 mrad/hr.

4. Install a plastic containment over Cell 13.

5. Slowly raise the top block, washing the sides of the block as it is removed. Move the block to approximately 1 inch above the bay floor. Move the block in different directions to allow for a radiation survey. Clean the cell from the top using high-pressure spray, chemical washes (Turco, oxalic acid, and HNO_3), and wiping as necessary to remove the top block and the angle iron frame from the cell.

6. Install an armor plate shield over the top of the cell. This shield reduces exposure to personnel and holds the cell under negative pressure to reduce the leakage of contamination from the cell.

7. Continue cleaning the cell from the top and with manipulators until wipes or smears are reading <1 mrad/hr.

8. Probe the pan to determine the area of high radiation around the cracks in the pan welds at the rear of the cell.

9. Using manipulators and a skill saw with a carborundum blade, cut out the pan area of high radiation.

10. Chip out any concrete under the pan to reduce the radiation reading to <1 rad/hr.

11. Cut out the off-gas line at the east and west walls and cap weld. Remove the off-gas line to a plywood box and ship to the SWSA for burial.

12. Remove any waste from the cell to plywood boxes and ship to the SWSA for disposal.

13. Final decontamination will be to <30,000 dis/min smears and 1 rad/hr background.

Manpower Requirements

Health Physics - 1 Man Month

Operations Division		Craft Support			
Operator Man Months for Decon.	Operator Man Months for Observing	Pipefitter Man Months	Welder Man Months	Rigger, Operator Man Months	Electricians, Carpenters, Others Man Months
10	2	0.5	0.5	0.5	0.5

Total volume of solid waste to SWSA - 50 cu. ft.

Estimated decontamination solution volume required - liquid waste 7500 gallons

Estimated radiation exposure:

Chemical Operators	10.0 rem
Health Physics	0.5 rem
Crafts	2.0 rem

CELL NUMBER 14

(WBS 1.2)

Cell Description

Cell 14 (Fig. A.10) is a stainless steel-lined cell comprising of 3 sections - Cell 14E, Cell 14M, and Cell 14W. The overall length of the cell is 19.5 ft. Each cell is 6.5 ft wide and 8 ft long. Cells 14E and 14M are 12 ft deep, and Cell 14W is 15 ft deep. Cell 14E is separated from Cell 14W by a 3-inch thick armor plate wall. There is an airlock to Cell 13 in the southeast corner of the cell which is approximately 12 inch by 13 inch. There is an airlock to Cell 14M in the southwest corner of the cell which is approximately 20 inch high by 36 inch wide. All ventilation is furnished to Cell 14E by a duct in the northeast corner which contains four 8-inch by 8-inch HEPA filters. There is one tank in the cell, P-114, which has a capacity of approximately 45 gallons. In the rear center of the cell is a water-cooled storage well which is 36.25 inch long by 8.125 inch wide by 33 inch deep. The manipulator cell off-gas line runs through the back of the cell. This is a 4-inch stainless steel line and is covered with 2 inch of lead. There are other lines which go to the process cells. Cell 14E is shielded from Cells 3 and 4 on the north side by 2 ft of normal concrete. It is shielded from Cell 13 on the east side by 2 ft of normal concrete. It is shielded from Cell 14M on the west side by 3 inch of armor plate, and on the south side, which is the manipulator operating gallery, by 3 ft of barytes concrete. There is one 3-ft thick normal concrete block on the top of the cell which measures 9 ft, 9.5 inch by 3 ft, 7.5 inch. There is a 10 ft OD plug in the south end of the block. Atop the cell on the east side of the cell in the bay area is an instrument cubicle to handle the instrumentation and services to the cell. Cells 14M and 14W are not separated by a wall. Cell 14W is a deep cell and the cell ventilation for this area is located in the northwest corner of the cell and contains four 8-inch by 8-inch HEPA filters. There is a floor drain in Cell 14W which drains to tank S-523. There is an airlock to Cell 15 in the southwest corner of the cell which is approximately 12 inch by 12 inch. There is a large transfer door in the lower west wall of Cell 14W which opens into Cell 15. This door is approximately 36 inch by 48 inch and is raised by use of the 26-ton crane in the bay area. There is one block of 3-ft thick standard concrete on top of the cell. In the center of this block is a 10-inch OD plug. There is a General Mills remote operated manipulator in the cell which has been inoperative since the early 1960's. On the south side of Cell 14W is a lead shielded barricade containing 3 turret type storage wells which were used to store strontium-90 powder cans in the late 1950's and 1960's. There are no powder cans remaining in the storage wells.

Cell 14M is similar to 14E except for the P-114 tank. There is a water-cooled storage well in the rear center of the cell of the same size as the storage well in Cell 14E. The off-gas line covered with lead continues into Cell 14M and terminates here. There is one block of 3-ft thick standard concrete on top of the cell and in the center of this block is a

ORNL-PHOTO 44304

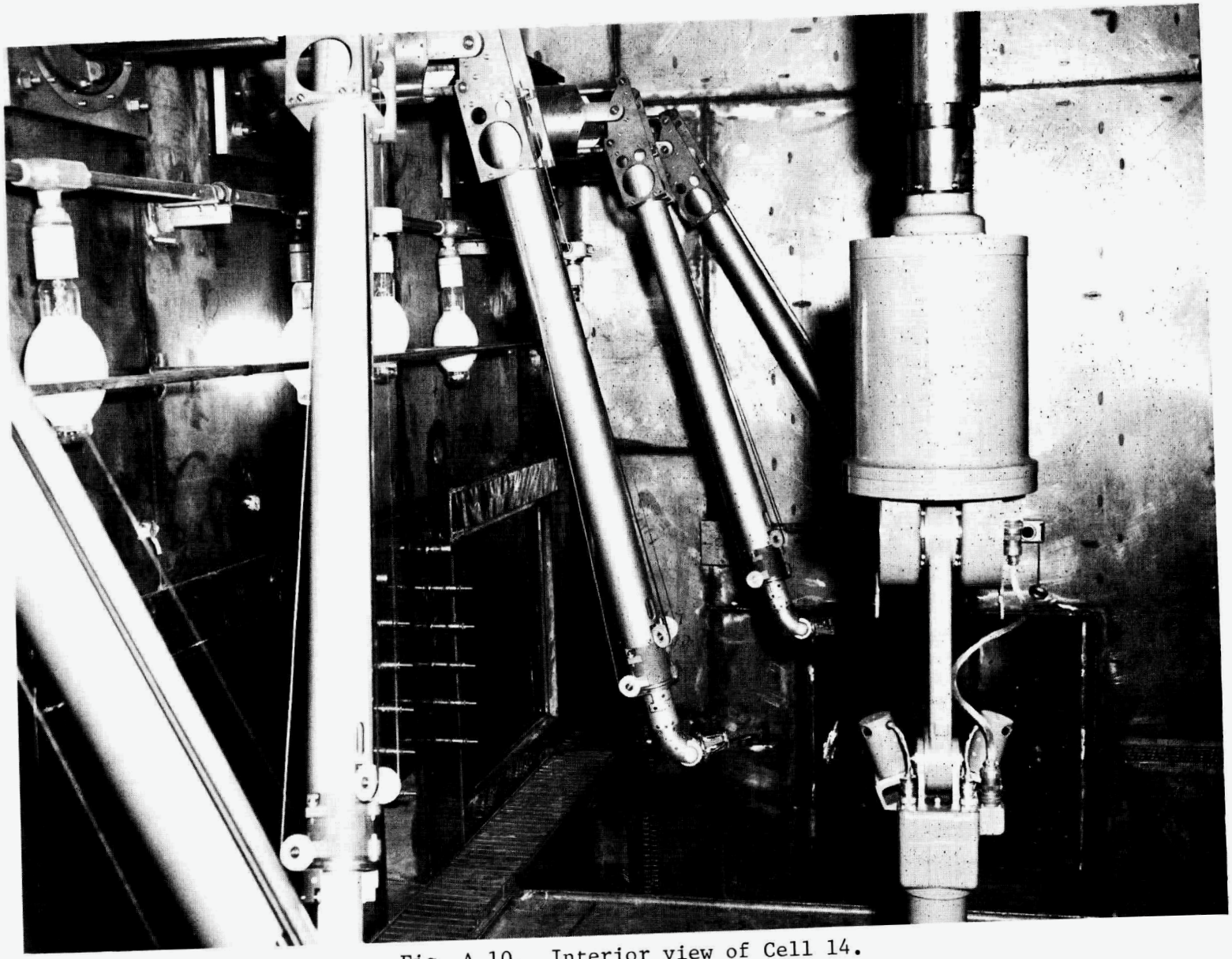

Fig. A.10. Interior view of Cell 14.

10 inch OD plug. This block is 9 ft, 9.5 inch by 3 ft, 7.5 inch. Cells 14M and 14W are separated from Cells 2 and 3 on the north side by 2 ft of standard concrete, and on the east side by the 3 inch armor plate wall. They are separated from Cell 15 on the west side by 3 ft of standard concrete and the large lead-filled door. The south wall is 3 ft of barytes concrete which separates the cells from the manipulator operating gallery. There are three viewing windows in Cell 14, one each for Cell 14E, 14M, and 14W. There are two manipulators at each viewing window. The left manipulator in Cell 14E is out of use, highly contaminated, and will have to be disassembled and pushed into the cell during decommissioning.

Processing History

Cell 14, Cells 14E, 14M, and 14W, has been used for powder storage, powder handling, source pelletizing, and source loading since processing began in the late 1950's. Tank P-114 in Cell 14E was frequently used to receive the cesium-137 tetraoxylate from Cell 8 and subsequently filtered through a porous stainless steel filter. Since processing was completed in 1974 the tank and lines were decontaminated and have not been used since. Routine cell operations have continued, such as powder handling and source loading. Residual contamination within Cell 14 would be strontium-90 and cesium-137.

Decontamination

Other than decontamination of the process lines and off-gas line in 1974, there have been no recent decontamination activities in Cell 14.

Proposed Decontamination

1. Using sabre saws, hammer and chisel, etc., cut and remove any covering over pipes, instrument lines, or any other equipment which can be cut up remotely. Can up the waste in lard cans and remove via the Drum Waste Carrier in Cell 15.

2. Pressure spray the cell with the high-pressure spray using the manipulators. Extreme care should be taken not to pressure spray towards the manipulator sleeves. Some boots are off and some boots have been taped to the manipulators because the boot adapters have rusted and fallen off the cell walls.

3. Through the three plug holes in the blocks, wash the cell with chemicals (Turco, oxalic acid, and HNO_3). Close surveillance should be maintained in the manipulator area around the manipulators for any leakage from the cell.

4. Repeat steps 2 and 3 six times.

5. Through the plug holes in the blocks, survey the cell with the 5-ft cutie pie probe. If the cell probes <25 rad/hr, remove the 5-ft probe and insert an in-cell probe with a 50-ft line. Probe the cell and identify hot spots. While probing the cell rotate

the turret storage wells and check each hole. Check both storage wells in 14E and 14M. If the cell probes more than 25 rad/hr, check with supervision for further chemical decontamination and pressure spraying.

6. Continue working on the hot spots remotely. It may be necessary to use lead shielding to lower the readings sufficiently to remove the top blocks.

7. When the reading through the plug hole is <1 rad/hr, build a plastic containment to cover the Cell 14 area.

8. Pull the Cell 14E block and install the armor plate shield over the hole. Clean the block and store.

9. By use of electric saws, hydraulic jaws, and other mechanical means, cut loose and remove tank P-114, the off-gas line, and service and transfer lines.

10. Box the waste in 9 above and ship to the SWSA for burial.

11. Reinstall the block in 14E.

12. Remove the block in 14M and install the armor plate shield over the hole.

13. As in 9 above, cut and remove all piping.

14. Box the waste and ship to the SWSA for burial.

15. Reinstall the block in 14M.

16. Remove the block in 14W and install the armor plate shield over the hole.

17. Remove the General Mills manipulator. Box up and send to the SWSA for burial.

18. The turret storage well will either be removed or sealed over.

19. Final decontamination of the bare cell will be <1 rad/hr probe and <30,000 dis/min smear level.

20. All service lines will be capped on the inside of the cell.

21. The off-gas line will be capped and welded at the cell walls.

22. The instrument cubicle atop the east side of Cell 14E was not included in this procedure since it will most likely be removed in the near future to facilitate the bay area cleanup.

Manpower Requirements

Health Physics - 1.5 Man Months

Operations Division		Craft Support			
Operator Man Months for Decon.	Operator Man Months for Observing	Pipefitter Man Months	Welder Man Months	Rigger, Operator Man Months	Electricians, Carpenters, Others Man Months
12	3	2	0.5	0.5	1

Total volume of solid waste to SWSA - 150 cu. ft.

Estimated decontamination solution volume required - liquid waste 15,000 gallons

Estimated radiation exposure:

Chemical Operators	8.0 rem
Health Physics	1.0 rem
Crafts	4.0 rem

CELL NUMBER 15

(WBS 1.3)

Cell Description

Cell 15 (Fig. A.11) is a stainless steel-lined cell located in the southwest corner of the cell bank. The cell is 16 ft deep by 10 ft wide and 9 ft long. It is separated from Cell 1 on the north side by 2-ft of standard concrete and on the west side by 2-ft of standard concrete from the first level west. The south wall, which is the manipulator operating gallery side, is 2-ft of standard concrete. The east wall, which separates Cell 15 from Cell 14W, is of 3-ft thick standard concrete and the large lead-filled door which opens into the Cell 14W deep well (see Cell Number 14). The top block is 2 ft of standard concrete and measures 7 ft, 7.5 inch by 7 ft, 7.5 inch. There is a large offset plug in the middle of this block which is 4 ft, 3.5 inch by 3 ft, 11.5 inch in diameter. In the middle of the large plug is a smaller plug which measures 10 inch in diameter. Drainage from the cell is by a trough on the north side of the floor and drains to tank S-523. There is a viewing window in the east side of the south wall. There are two manipulators which service this window. In the southwest corner of the cell is a walk-in door which opens to the manipulator operating gallery. In the southeast corner of the cell is an airlock approximately 12 inch by 12 inch which allows passage to Cell 14W. In the northwest corner of the floor is an opening approximately 24 inch by 24 inch which allows passage to the pipe tunnel. This opening is presently covered with a concrete plug and lead shielding. An extra row of solid concrete block has been added to the shielding in front of the cell and a 4-inch thick lead glass window has been added to the viewing window to reduce background radiation.

Processing History

Cell 15 has been used as a loadin and loadout cell. The cell is empty except for a few transfer lines which were used to hook up for unloading solutions to the process cells. Residual activity in Cell 15 would be cesium-137, strontium-90, and promethium-147.

Decontamination

Cell 15 has been decontaminated several times in the past for walk-in entry but no decontamination has been done in the past few years except for routine decontamination to keep the contamination levels acceptable for loadin and loadout operations.

Proposed Decontamination

1. Wash the walls and floor using the high-pressure spray.

2. Spray the cell from the top plug hole with hot chemical solutions (Turco, followed by oxalic acid, water rinse, then HNO_3 solution and water rinse).

ORNL-PHOTO 85187

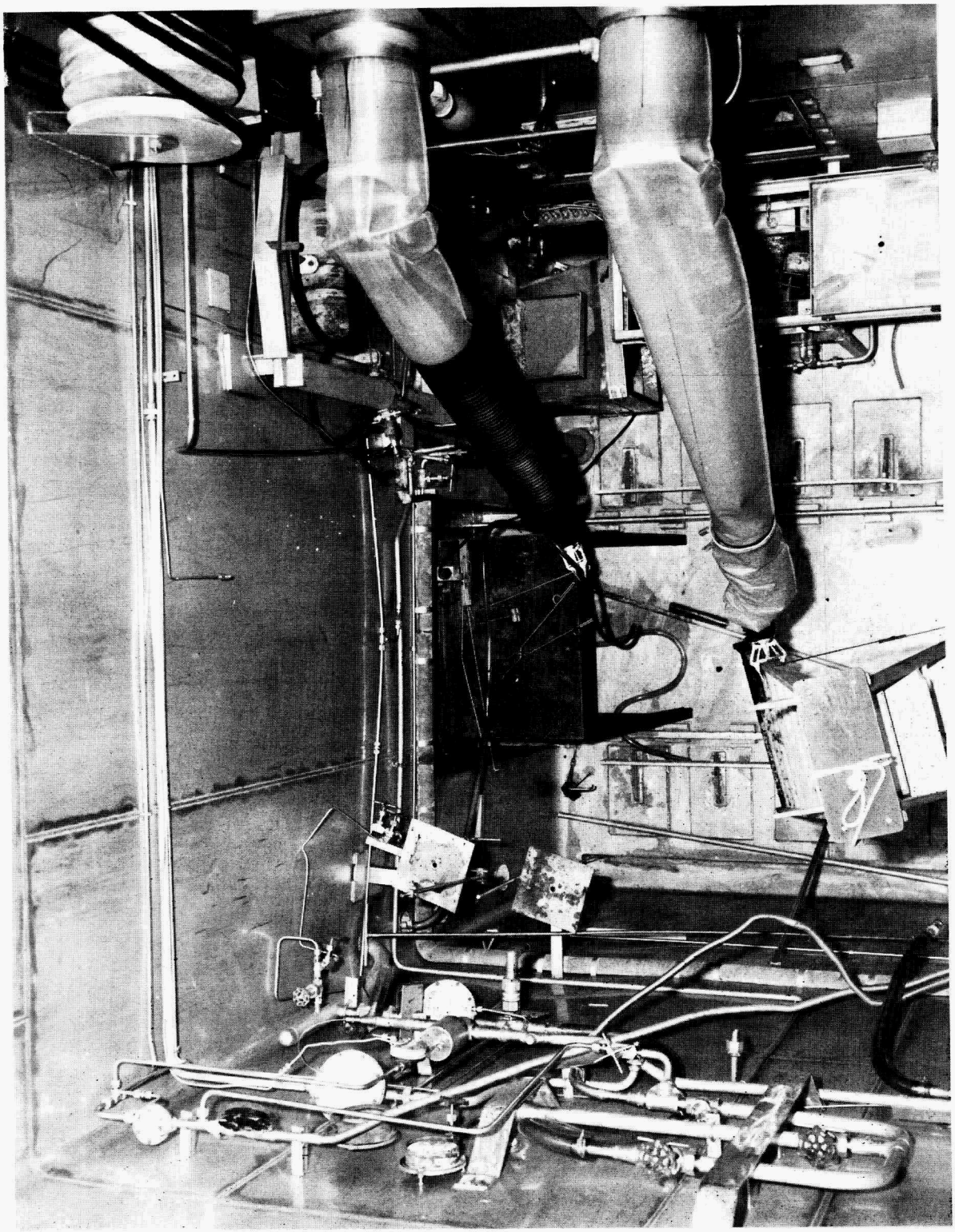

Fig. A.11. Interior view of Cell 15.

3. Any debris in the cell will have to be picked up with long tongs and removed from the cell.

4. Continue with 1 and 2 above until the reading at the plug hole is 50 mrad/hr.

5. Install a plastic containment over Cell 15 and Cells 14W and 14M.

6. Remove the top block and plugs and store outside the containment.

7. Remove and cap all unnecessary piping.

8. Clean the cell walls and floor to 10 mrad/hr probe and <1000 dis/min smear.

Manpower Requirements

Health Physics - 1 Man Month

Operations Division		Craft Support		
Operator Man Months for Decon.	Operator Man Months for Observing	Pipefitter Man Months	Welder Man Months	Electricians, Carpenters, Others Man Months
4	1	0.5	0.5	0.5

Total volume of solid waste to the SWSA - 15 cu. ft.

Estimated decontamination solution volume required - liquid waste 3000 gallons

Estimated radiation exposure:

Chemical Operators	2.0 rem
Health Physics	0.3 rem
Crafts	0.5 rem

CELL NUMBER 18

(WBS 1.4)

Cell Description

Cell 18 (Fig. A.12), which is a sampling and analytical cell, is located on the second level north over the service tunnel and just north of Cell 5. The cell is 6 ft wide, 6.5 ft long, and 10.5 ft deep. The cell is enclosed by 1.5 ft of standard concrete. There is a sampling blister on the east side of the cell for removing samples to transfer carriers. The sample blister is enclosed by 4 inches of lead shielding. Entrance to the cell is through an armor plate door on the west side of the cell. The cell is lined with stainless steel and has a lead glass viewing window on the north side of the cell. There are two manipulators on the north side of the cell which are fitted with CRL Model 8 manipulators. Cell ventilation is supplied by an 8-inch duct in the southwest corner of the cell. There is an opening in the southeast corner of the cell which allows passage of sample lines to the process cells through Cell 5.

Processing History

Cell 18 was used as a sampling and analytical cell for the cesium-137, strontium-90, and other fission product process cells. The last processing and sampling was completed in June 1974.

Decontamination

Cell 18 was decontaminated along with the cleanout of the cesium-137 and strontium-90 process cells in 1973 and 1974. All lines were flushed with nitric acid solution, Turco, oxalic acid, and water. Several cans of solid waste were removed from the cell, but there is still much solid waste on the floor of the cell. Residual contamination in the cell would be cesium-137, strontium-90, with trace amounts of cerium-144 and other fission products. Readings within the cell are most likely from 10 rad/hr to 100 rad/hr with possible spots to 1000 rad/hr.

Proposed Decontamination

1. Using electric power tools, saw out the pan and piping which can be reached by using manipulators.

2. Decontaminate pan and piping pieces to <1 rad/hr and remove from cell.

3. Insert pressure spray through the east blister and high-pressure spray the cell.

4. Install plastic containment over the walkin door on the west side the cell.

ORNL-PHOTO 54762

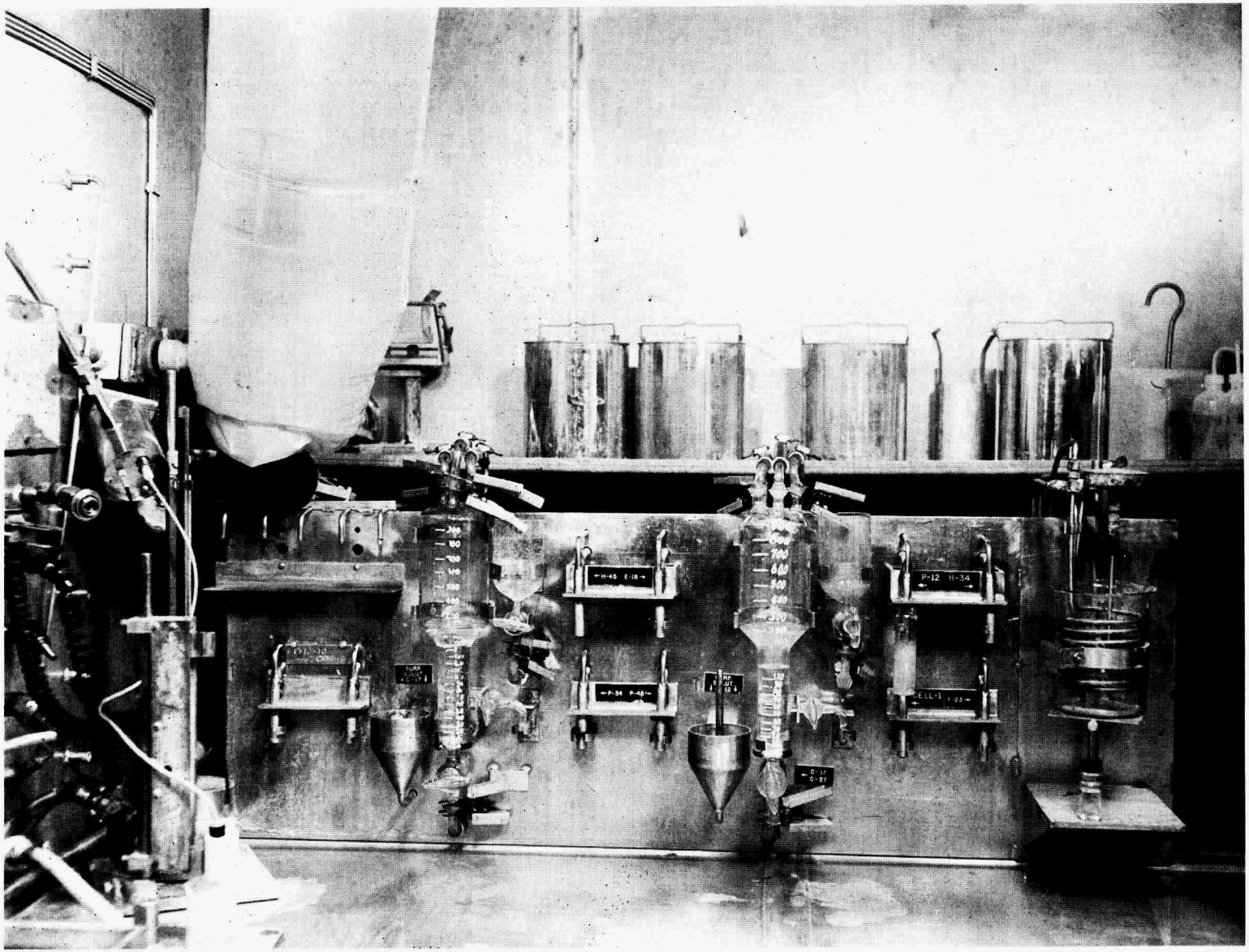

Fig. A.12. Interior view of Cell 18.

5. Standing outside the open door, high-pressure spray the inside of the cell and retrieve all debris with long tongs and place in one gallon cans for disposal to Cell 15 if >1 rad/hr.

6. Cut away pan from cell door entrance.

7. Survey cell and submit radiation map to supervision to determine additional decontamination steps.

8. Shield hot pipe with lead to reduce background to <500 mrad/hr.

9. Cut out all piping and bare the cell of all framework.

10. All piping and framework will be removed from the cell, sealed in plywood boxes, and transported to the ORNL SWSA for disposal.

11. Remove all bantam valves on top of the cell and all lines leading into the cell. These will be sealed in plywood boxes and transported to the ORNL SWSA for disposal.

12. All service lines and penetrations will be capped and welded on the inside of the cell.

13. Operators will decontaminate the cell to <1 rad/hr radiation and <30,000 dis/min smear level.

Manpower Requirements

Health Physics - 1 Man Month

Operations Division		Craft Support			
Operator Man Months for Decon.	Operator Man Months for Observing	Pipefitter Man Months	Welder Man Months	Rigger, Operator Man Months	Electricians, Carpenters, Others Man Months
4	1	2	0.5	1	1

Total volume of solid waste to the SWSA - 100 cu. ft.

Estimated decontamination solution volume required - liquid waste 1000 gallons

Estimated radiation exposure:

Chemical Operators	5.0 rem
Health Physics	0.5 rem
Crafts	5.0 rem

CELL NUMBER 21

(WBS 3.1)

Cell Description

Cell 21 (Fig. A.13) is an underground cell in the FPDL tank farm located at the northwest corner of the building. The cell is 12 ft wide, 25 ft long, and 10 ft deep. The cell is covered by 9 blocks of standard concrete which are 4 ft thick. The walls on the west and east side are 2 ft of standard concrete and on the south side a 3 ft thick wall of standard concrete. The north wall is 1 ft thick of standard concrete. The floor of the cell is concrete. A sump is located in the southeast corner of the cell for removing inleakage to the cell.

The cell contains six 304L stainless steel tanks. Four tanks have a capacity of 275 gallons and two tanks have a capacity of 520 gallons. All tanks are connected by stainless steel piping to samplers, services, off-gas, instrumentation, and tracers for lines within Cell 21 and to other tanks within the building process cells.

An instrument cubicle is located above the cell on the south side. This cubicle contains the relays and transmitters for the instrumentation in Cells 21 and 22.

Processing History

Cell 21 was used for the storage of strontium-90 during the 1960 to early 1970 period. Any residual activity would be strontium-90.

Decontamination

The six tanks in Cell 21 were decontaminated along with the process cell tamls in 1974. There were two or three problem valves encountered during the decontamination process and these may present areas of high radiation when the cells are opened. However, the strontium-90 activity should be easily shielded.

Proposed Decontamination

1. Remove the middle block, carefully, and survey with a fish pole probe. If the reading is greater than 2 rad/hr, contact supervision before continuing. If the reading is less than 2 rad/hr, replace the middle block and pull the south block. Probe the cell and replace the block. Pull the north block and probe the cell. Reinstall the block.

ORNL-PHOTO 44307

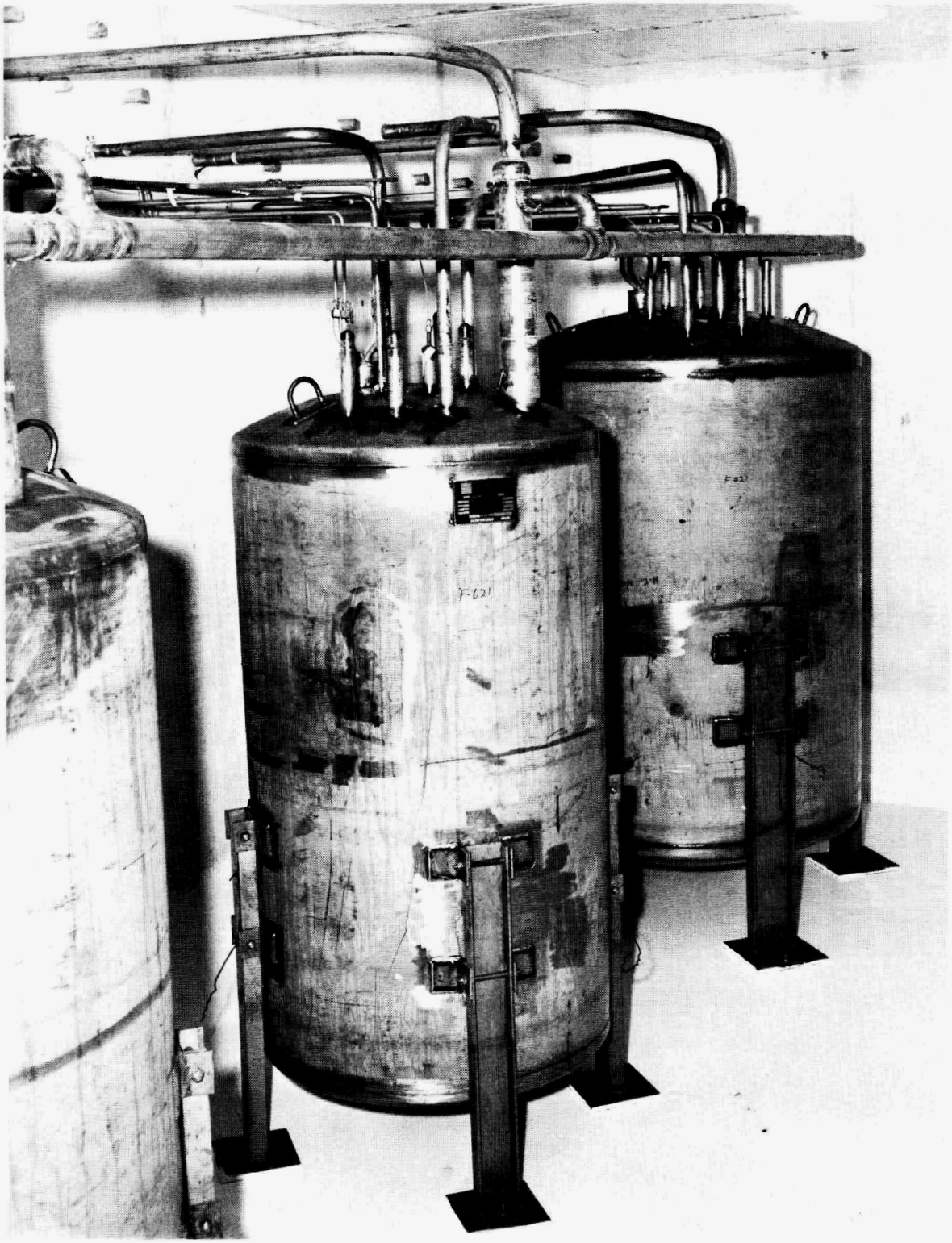

Fig. A.13. Interior view of Cell 21.

2. If all readings are less than 2 rad/hr, fabricate a containment shell to cover the nine cell blocks and the instrument cubicle. The shell should be wide enough to cover approximately one-half of the width of Cell 22 blocks. The shell should be 8 ft high and the top braces should run north and south. There should be a 4 ft opening on the top on the west side, 2 ft from the west edge. This should be covered with a foldable plastic sheet which can be rolled back when tanks or equipment are to be removed from the cell. An egress door should be located on the east side.

3. Remove the three south blocks, decontaminate and store.

4. Install the shell over the cell.

5. Pressure spray the cell and sump pump the waste to S223.

6. Survey the cell and identify and place lead shielding over all areas greater than 10 rad/hr.

7. Cut and isolate all tanks and piping on the south side of the cell for removal.

8. Remove and box all equipment and ship to the SWSA for disposal.

9. Remove the three middle blocks, decontaminate and store. It may be be necessary to remove the shell temporarily in order to remove the blocks.

10. Repeat steps 5, 6, 7, and 8 for the middle section of the cell.

11. Remove the three north blocks from the cell.

12. Repeat steps 5, 6, 7, and 8 for the north section of the cell.

13. When all tanks and piping have been removed, plug and weld all open pipes.

14. Pressure spray and clean the cell walls and floor to less than 1 rad/hr probe and less than 30,000 dis/min smear.

15. Reinstall cell blocks.

Manpower Requirements

Health Physics - 1 Man Month

Operations Division		Craft Support			
Operator Man Months for Decon.	Operator Man Months for Observing	Pipefitter Man Months	Welder Man Months	Rigger, Operator Man Months	Electricians, Carpenters, Others Man Months
3	2	3	1	2	2

Total volume of solid waste to the SWSA - 1100 cu. ft.

Estimated decontamination solution volume required - liquid waste	2000 gallons

Estimated radiation exposure:

Chemical Operators	2.0 rem
Health Physics	0.5 rem
Crafts	3.0 rem

CELL NUMBER 22

(WBS 3.2)

Cell Description

Cell 22 (Fig. A.14) is a large underground cell located in the FPDL tank farm on the northwest side of the building. The cell is 12 ft wide, 25 ft long, and 10 ft deep. The cell is shielded on the west side from Cell 21 and on the east side from Cell 23 by 2 ft of standard concrete. It is shielded on the south side from Cell 25 by 3 ft of standard concrete. Shielding on the north side is approximately 1 ft of standard concrete. The cell is covered by nine plugs of standard concrete 4-ft thick.

Cell 22 contains one 304L stainless steel tank which is 16 ft, 1 inch long and is 8 ft in diameter. It has a capacity of 6,000 gallons. The tank sits on two saddles and is anchored to the saddles by use of straps over the top of the tank. The tank is connected by welded stainless steel piping to other tanks within the tank farm system, to instrumentation, off-gas, and to other tanks in the process cells inside Building 3517. Instrumentation lines penetrate the top of the cell in the southwest corner and terminate in the instrument cubicle which covers a small section of the southwest corner of the cell. There is a sump and jet line in the southeast corner of the cell floor for removing inleakage to the cell.

Processing History

Tank S-122, the only tank in Cell 22, was used for the storage of cesium-137 for processing until 1974, when all processing was completed at FPDL. Residual activity should be only cesium-137.

Decontamination

The tank and lines were decontaminated by chemical and water rinses after the completion of chemical processing in 1974.

Proposed Decontamination

1. Remove the middle block, carefully, and survey with a fish pole probe. If the reading is >2 rad/hr, contact supervision before continuing. High readings from the cell may indicate the need for additional chemical decontamination within the tank and lines before proceeding. A very close check should be made to determine the source of the high radiation. If the readings are as stated below, continue.

   If the reading is <2 rad/hr, replace the middle block and pull the south block. Probe the cell and replace the block. Pull the north block and probe the cell. Reinstall the block.

ORNL-PHOTO 44332

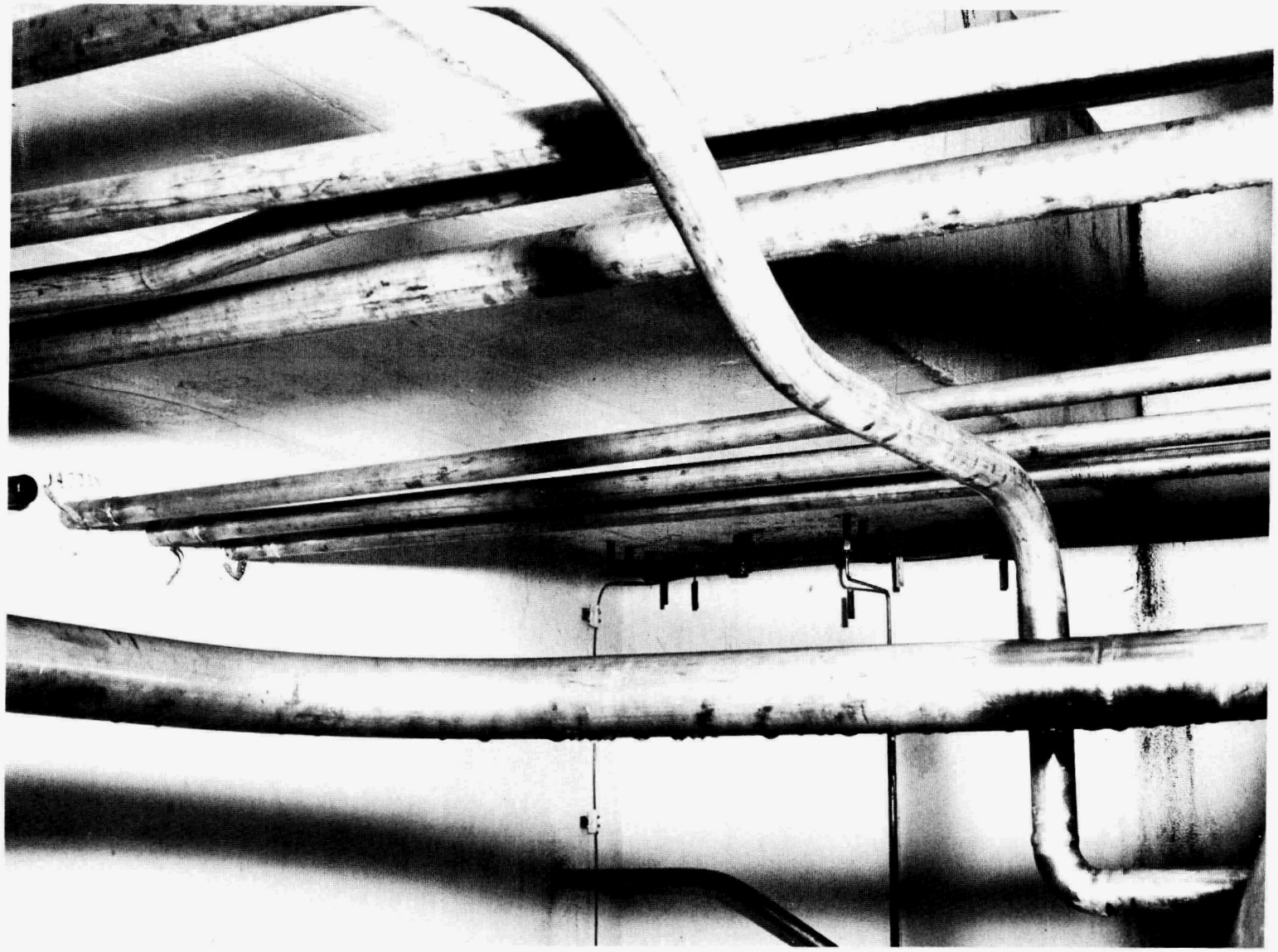

Fig. A.14. Interior view of Cell 22 (tank in lower right).

2. If all readings are <2 rad/hr, fabricate a containment shell to cover the nine cell blocks and the instrument cubicle. The shell should be wide enough to cover approximately one-half of the width of Cell 23 blocks. The shell should be 8 ft high and the top braces should run north and south. The shell from Cell 21 decommissioning can be used for Cell 22. An egress door should be located on the east side.

3. Remove the nine blocks, decontaminate, and store.

4. Install the shell over the cell.

5. Pressure spray the cell and sump jet the waste to S223.

6. Survey the cell and identify and place lead shielding over all areas >10 rad/hr. Cut out all leaded hot spots and remove to shielded boxes and transfer to the SWSA for disposal.

7. Cut and remove all piping; box and ship to the SWSA for disposal.

8. Remove the tie-down straps from the tank.

9. Pressure spray and smear the tank. Clean the outside of the tank to <25,000 dis/min smear. Remove the shell from the top of the cell.

10. Attach chokers and lift the tank to the top of the cell.

11. Wrap the tank in plastic and tape all seams and seal all pipe outlets.

12. Move the tank to the SWSA for disposal.

13. Trim all pipe ends close to the wall, plug and weld all openings.

14. Pressure spray and clean the walls and floor to <1 rad/hr probe and <30,000 dis/min smear.

15. Reinstall the cell block.

Manpower Requirements

Health Physics - 1 Man Month

Operations Division		Craft Support			
Operator Man Months for Decon.	Operator Man Months for Observing	Pipefitter Man Months	Welder Man Months	Rigger, Operator Man Months	Electricians, Carpenters, Others Man Months
3	2	2	1	2	1

Total volume of solid waste to the SWSA - 1200 cu. ft.

Estimated decontamination solution volume required - liquid waste	3000 gallons

Estimated radiation exposure:

Chemical Operators	2.0 rem
Health Physics	0.2 rem
Crafts	2.0 rem

SERVICE TUNNEL

(WBS 4.1)

Cell Description

The service tunnel (Fig. A.15), located on the north side of the process cells, is an area 69 ft long, 4.5 ft wide, and 12 ft high. The north, east, and west walls of the service tunnel consist of 1-ft thick solid barytes concrete blocks. The south wall is 3-ft thick concrete. The service tunnel contains numerous valves, relays, and piping which furnish the necessary services to Cells 1 through 9. Also, it contains numerous lines which go to the panelboards which operate these cells. There is an open slot along the top of the service tunnel to allow passage of the lines to the panelboard.

Cell ventilation to the service tunnel is furnished by two 12-inch ducts, one at the east end and one at the west end. These ducts are filtered. Two doors on the north wall of the service tunnel allow entry into the service tunnel.

Two floor drains 18 ft from each end allow drainage to Tank S-523.

Processing History

The service tunnel, which provides the services for Cells 1 through 8, is a medium-level radiation zone with background radiation readings of from 50 mrad/hr to 500 mrad/hr. It has been entered many times in the past few years to change out diaphragms, make piping changes, and to add equipment.

Backup through some malfunctioning valves in the cells has caused readings of from 5 rad to 100 rad/hr in the Cell 7 and 8 area and the Cell 4 and 5 area. One area in the Cell 1 section reads from 10 rad/hr to 25 rad/hr. The service tunnel has been decontaminated and cleaned out several times over the past 15 to 20 years, but has remained idle since the last strontium-90 processing in 1974, and the subsequent cleanout and decontamination of the process cell lines and tanks. Most of the south wall of the service tunnel has been covered with 2-in.-thick lead brick for additional shielding from the strontium-90 which was stored in Cells 3 and 4, and the high-level cesium-137 processing carried on in Cells 7 and 8. In the Cell 3 and 4 area, the lead brick have complicated the contamination problem by solution leakage between the lead brick and the wall, making decontamination in the past impossible without removing the lead brick shielding. This is the cause of the present high reading in the Cell 3 and 4 area.

Decontamination

There has been no decontamination in the service tunnel since 1973-1974.

ORNL-PHOTO 42091

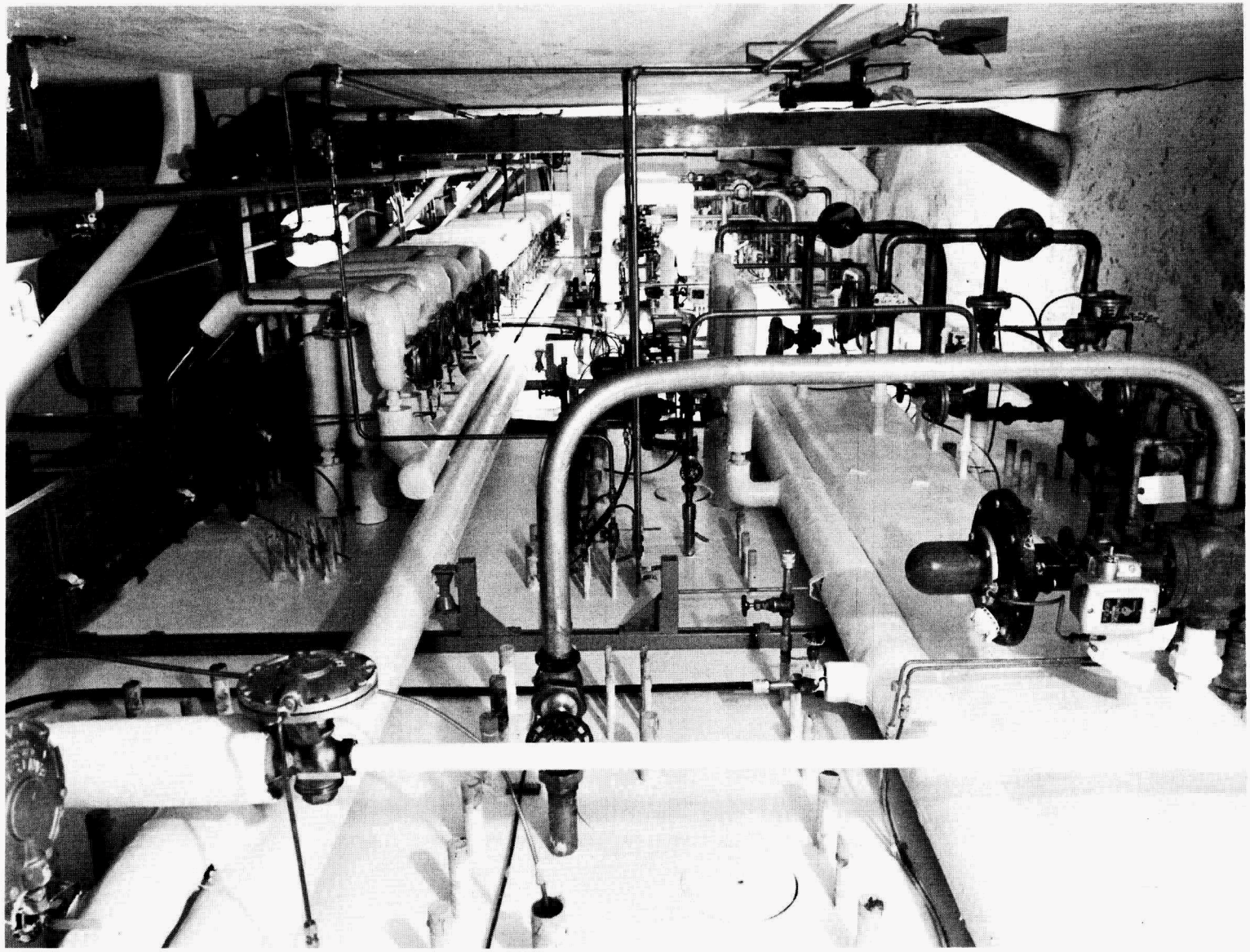

Fig. A.15. Interior view of service tunnel.

Proposed Decontamination

1. Build a plastic containment 6-ft wide and 12-ft long over the east door to the service tunnel.

2. Seal off the openings in the top of the service tunnel which allow passage of air and instrument lines to the panelboard areas.

3. Pressure spray the walls, piping, floor, and equipment.

4. Remove all insulation from the steam and chilled water lines, cut all plastic and copper tubing into garbage can lengths, and can up the debris for removal to the SWSA.

5. Remove all valves and relays and can up for removal to the SWSA.

6. Pressure spray the service tunnel to control the spread of loose contamination.

7. Remove all service lines by sawing the pipe into 6-ft lengths for removal to plywood boxes. All boxes will be sealed and removed to the SWSA.

8. Remove all lead brick shielding from the south wall. The brick will be canned, sealed, and transported to the SWSA.

9. In the areas of high radiation it will be necessary to use lead shielding to lower the reading to working background. After removal of highly contaminated pieces it will be necessary to pressure spray and clean the area before continuing with piping removal. This will particularly hold true in the removal of the lead brick in the Cell 3 and 4 area where solution has leaked between the wall and the brick.

10. All hot sections of pipe, valves, and lead brick will be removed by remote cutting techniques and be boxed up in plywood boxes, sealed, and transported to the SWSA.

11. All cell penetrations will be cleaned, sealed, and welded.

12. All service lines to the service tunnel will be capped on the inside of the service tunnel.

13. After all piping, valves, brick, etc., have been removed, the service tunnel will be cleaned by operators to <10 mrad/hr reading and <1000 dis/min smear level.

Manpower Requirements

Health Physics - 1 Man Month

Operations Division		Craft Support			
Operator Man Months for Decon.	Operator Man Months for Observing	Pipefitter Man Months	Welder Man Months	Rigger, Operator Man Months	Electricians, Carpenters, Others Man Months
8	2	5	2	4	2

Total volume of solid waste to SWSA - 500 ft^3

Estimated decontamination solution volume required - liquid waste 1000 gallons

Estimated radiation exposure:

Chemical Operators	1.0 rem
Health Physics	0.1 rem
Crafts	1.0 rem

APPENDIX B

LISTING OF FPDL OPERATING PROCEDURES - 1983

OPERATIONS DIVISION - RADIOISOTOPE DEPARTMENT
FPDL OPERATING PROCEDURES (RD-P-0-2-6)

Procedure No.	Content	Revision Date
1	General Procedure	4/16/81
2	Emergency and Evacuation Procedure	3/7/78
3	Safety Regulations	3/7/78
4	Zoning Procedures	3/7/78
5	Radioisotope Department Zoning Procedures	3/7/78
6	Contaminated Solid Waste Handling Procedure	12/11/79
7	Off-Gas Procedure - Operation	4/16/81
8	Off-Gas Procedure - Filter Change	3/7/78
9	Cell Ventilation -Operation	3/7/78
10	Cell Ventilation - Filter Change House	3/7/78
11	Cell Ventilation - Filter Change Pit	3/7/78
12	Cell Ventilation - Filter Change - By Pass	3/7/78
13	Manipulator Cells - Operation Procedure	3/7/78
14	Manipulator Cells - Boot Change and Repair	3/7/78
15	Manipulator Cell Decontamination	3/7/78
16	Vacuum Hot Press Operation	7/2/81
16A	Addendum to Vacuum Hot Press Operation	7/10/81
17	Cesium-137 Purification Procedure	8/23/79
18	Calorimeter Operation	3/7/78
19	Blender Operation	3/7/78
20	Chemical Makeup	3/7/78
21	Miscellaneous Decontamination	3/7/78
22	Cell Decontamination - Process	3/7/78
23	Cell 12 - Cell and Vacuum Hot Press (VHP) Decontamination Procedure	3/7/78
24	Solid Waste Disposal	3/7/78
25	Liquid Waste Disposal	3/7/78
26	Drum Waste Carrier Procedure	3/7/78
27	Manipulator Cell Airlock Operation	3/7/78
28	Service Tunnel Entry	3/7/78
29	Argon Truck Unloading Procedure	9/1/80
30	Chilled Water Operation	3/7/78
31	Helium Leak Test	3/7/78
32	20-Ton Crane Operation	3/7/78
33	High-Level Transfers	3/7/78
34	Shutdown Procedure	3/7/78
35	Observer Procedure	3/7/78
36	Cell Danger Zone Entry Procedure	3/7/78
37	Cell 10 Storage Well Operation	3/7/78
38	Dress Out Procedure	3/7/78
39	Lift Truck Procedures and Operation	3/7/78
40	Control of Toxic Chemicals (in use at FPDL)	8/29/78
41	Iridium-192 Process Procedure	2/8/80
42	Cesium-137 Pollucite Processing	8/18/78
43	Econolift Operation Procedure	3/28/80
44	Manipulator Boot Change Procedure	1/12/81
45	Strontium-90 Processing	3/3/82
46	Vacuum Hot Press - Hydraulic Ram Change Out	9/3/82

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