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STIR FACILITY DECONTAMINATION AND DISPOSITION FINAL REPORT

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B. F. Ureda

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ABSTRACT

The decontamination and disposition (D&D) of Building 028, Shield Test Irradiation Reactor (STIR) facilities, are complete. The core tank, the activated concrete structures surrounding the core tanks, the thermal column, the reactor shield, the test vault carriage, the water cooling systems, and the water shield door were removed, and the facility exhaust system was partially dismantled. The facilities were decontaminated to levels which were as low as practicable, but in all cases to levels below the limits described as acceptable for future unrestricted use. The more significant D&D activities are summarized, and special techniques are noted. Results of the radiological monitoring in support of the D&D operations and of the final radiological survey are presented.

I. INTRODUCTION

The Shield Test and Irradiation Reactor (STIR) located at the AI Santa Susana field laboratories was a 1-Mwt pool-type reactor, used primarily to conduct basic shielding experiments. The reactor was operated with a 50-kwt capability between 1961 and 1964, and with a 1-Mwt capability between 1964 and 1972. The "Hazards Summary Report" and "Startup and Operation" reports[1,2] provide additional detail of the facility history. The fuel elements were removed and the pool water was drained in June 1973. The STIR facilities were declared excess, and the dismantling proceeded as described in the "Decontamination and Disposition (D&D) of Facilities Program Plan," PP-704-990-002. The actual dismantling of STIR began on September 24, 1975, and was completed March 26, 1976. Contaminated and irradiated components and structures associated with the reactor, water cooling system, thermal column, test carriage, and facility exhaust system were removed, packaged, and shipped to Beatty, Nevada for disposal by land burial. Nonradioactive peripheral equipment such as the cooling tower, shield door, and film conveyor were removed as salvage. Floor and wall openings resulting from the D&D operations were filled and covered with concrete as required to restore the facility to a safe condition.

The dismantling activities were conducted with a minimum of exposure to personnel, in keeping with "as low as practicable" (ALAP) principles. Upon completion of the facility decontamination and disposition, a radiological survey verified that the facility had been decontaminated to levels as low as practicable below the limits (Table 1) described as acceptable for future unrestricted use.

TABLE 1

CONTAMINATION LIMITS FOR DECONTAMINATION AND DISPOSAL OF BUILDING 028, STIR FACILITIES

	Total	Removable
Beta-Gamma Emitters	0.1 mrad/hr at 1 cm with 7 mg/cm^2 absorber	100 $dpm/100\ cm^2$
Alpha Emitters	100 $dpm/100\ cm^2$	20 $dpm/100\ cm^2$

This report summarizes the more pertinent decontamination and disposition activities, discusses special techniques used, and reviews major problems and their resolution.

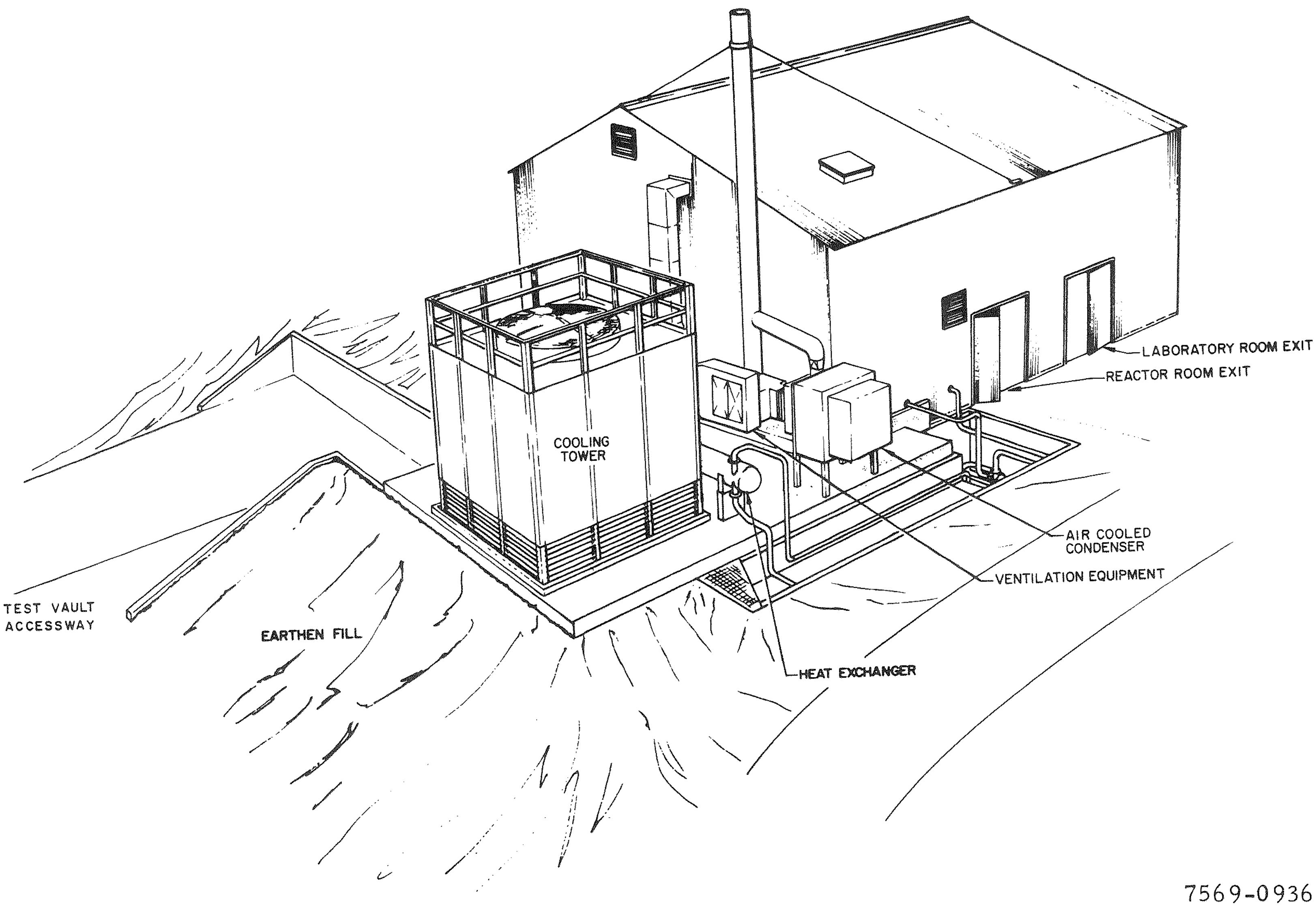

Figure 1. STIR Architectural Elevation

II. FACILITY DESCRIPTION

The STIR facility, shown in Figures 1 through 4, consisted essentially of a reactor core tank, control room, cooling system, test vault, graphite thermal column, fission plate, test carriage, and radiological shielding. The facility was deactivated in 1973, at which time the fuel and fission plate were removed and the reactor control room was dismantled.

A. COOLING SYSTEM

The reactor was cooled by natural convection flow of the pool water. There were two separate cooling systems for the pool water. The 50-kw auxiliary system consisted of a 15-ton capacity water refrigeration installation (Figure 5) and an airblast heat exchanger. For operations above 50 kw, a 1-Mw cooling system was used (Figure 6). The 1-Mw system consisted of a heat exchanger and a one-cell induced draft counterflow cooling tower. The water purification loop consisted of a particulate filter, a mixed-bed demineralizer, pumps, and control valves.

B. REACTOR

The reactor core was located at the bottom of a 5-ft diameter by 20-ft deep water-filled aluminum tank (Figure 4). Although the fuel elements had been removed in 1973, the grid plate and support structure remained in place. The tank sat in a concrete well, with a 6-in. annulus of pea gravel between the vessel and the concrete. The lower end of the tank mated with the thermal column which led to the test vault. A 7-in. lead shutdown shield filled with lead shot was located at the thermal column and tank interface. The center of the shield contained a 10 by 16 in. bismuth window. The thermal column was a 5-ft by 5-ft by 4-ft aluminum box, filled with 4-in. by 4-in. by 4-ft long graphite logs. Figure 7 shows the thermal column as viewed from the test vault. The wall immediately surrounding the thermal column was constructed of dense magnetite concrete.

C. TEST VAULT

The test vault contained a test carriage (Figure 8), upon which was mounted a concrete auxiliary shield also referred to as the "donut." A fission plate

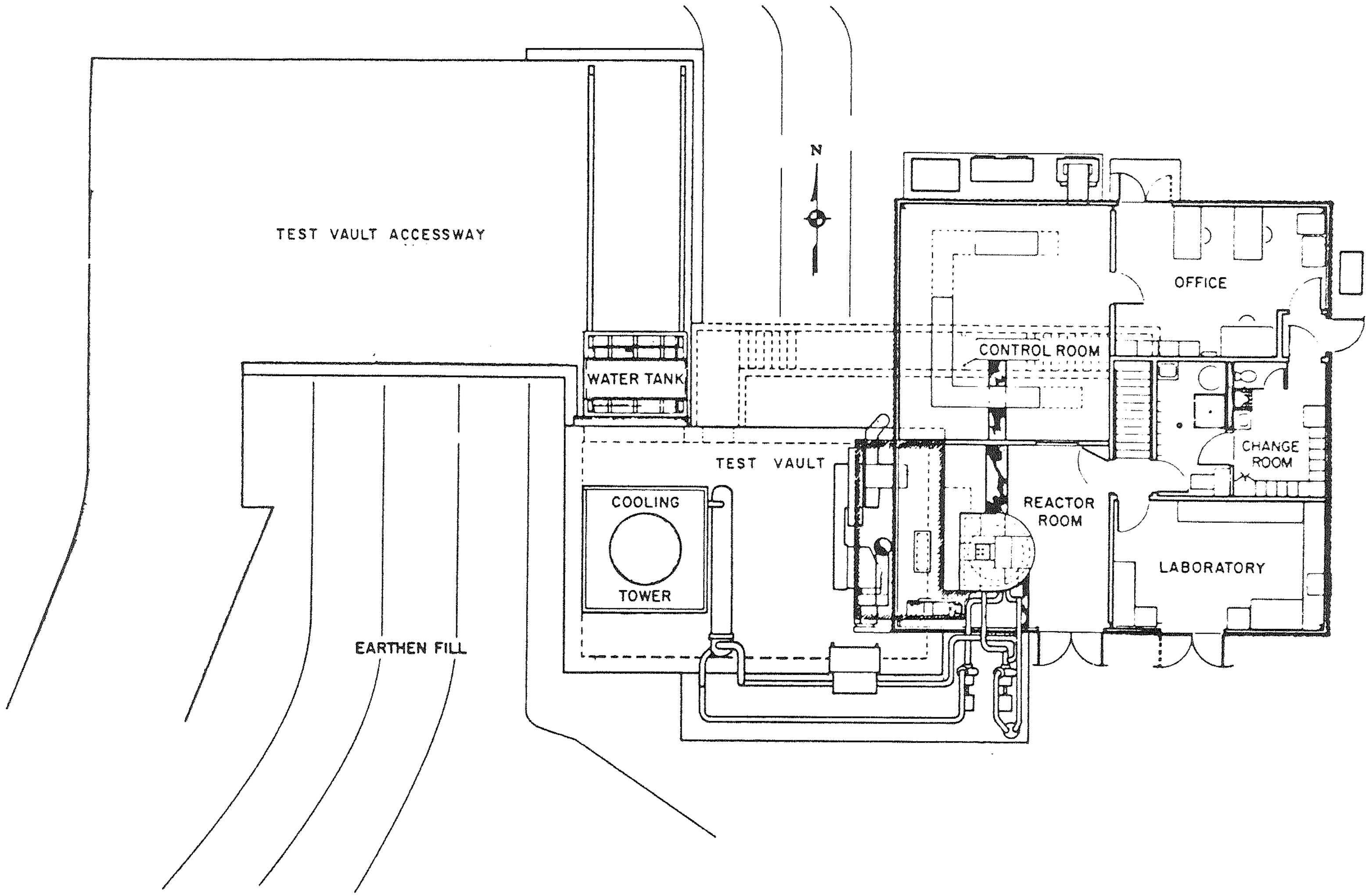

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Figure 2. STIR Architectural Floor Plan

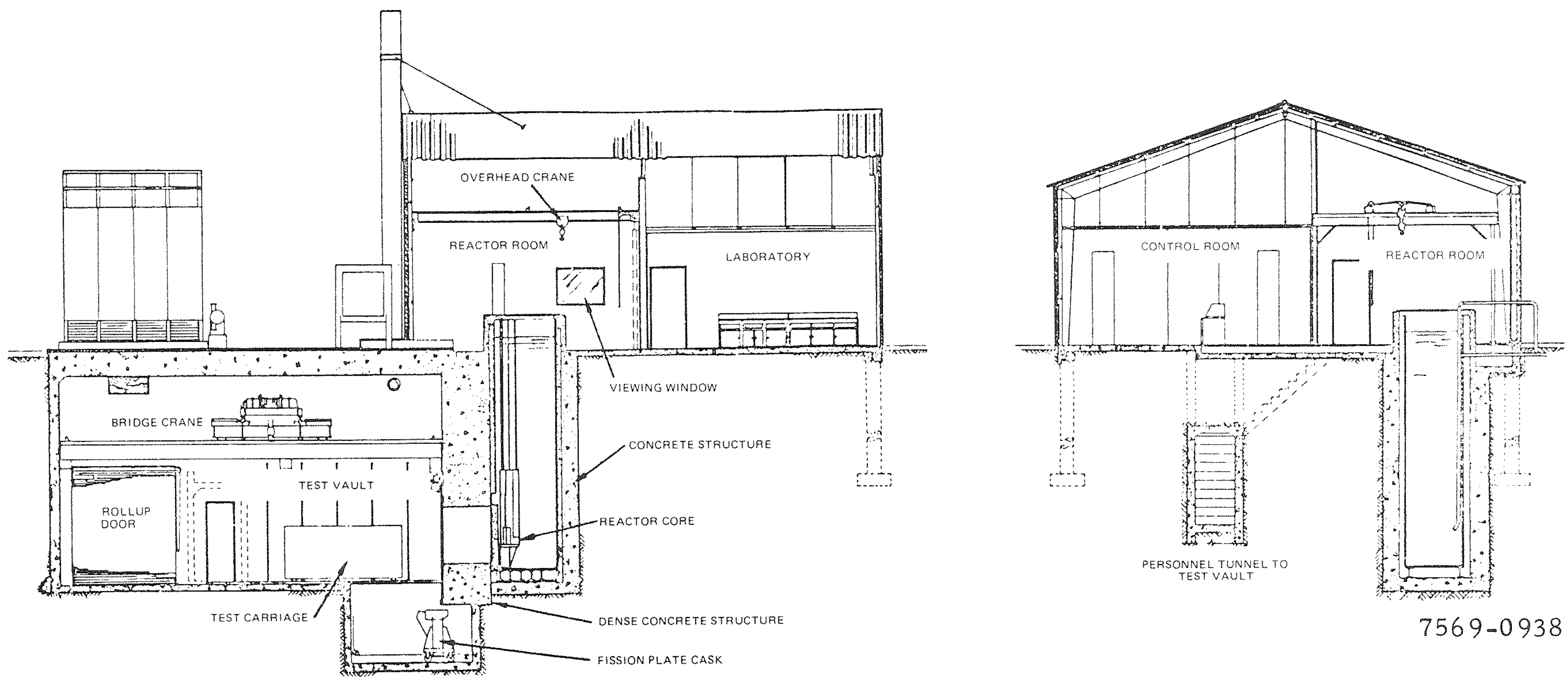

Figure 3. STIR Architectural Sections and Details

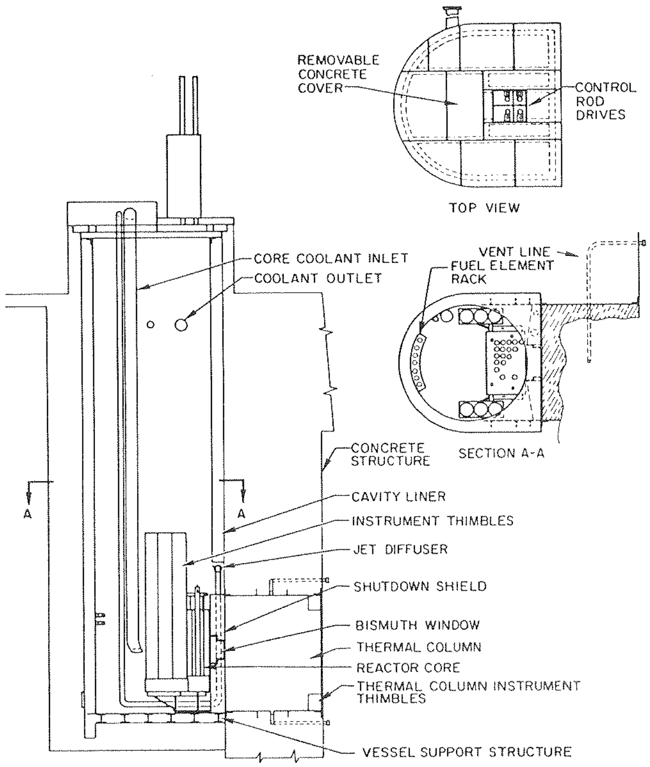

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Figure 4. Reactor Complex

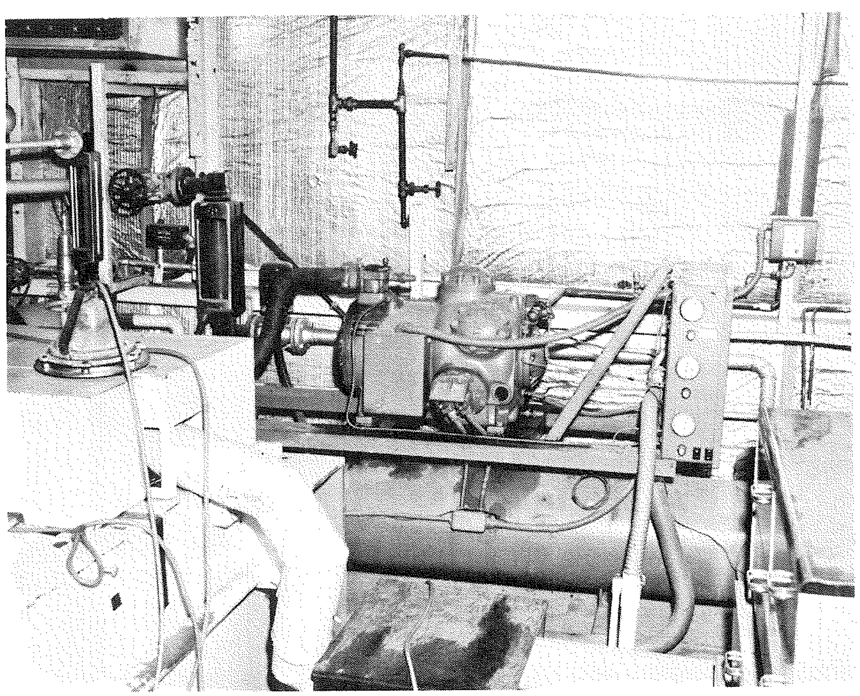

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Figure 5. 15-ton Refrigeration Water Cooling Unit

Figure 6. 1-Mw Cooling Tower and Heat Exchanger

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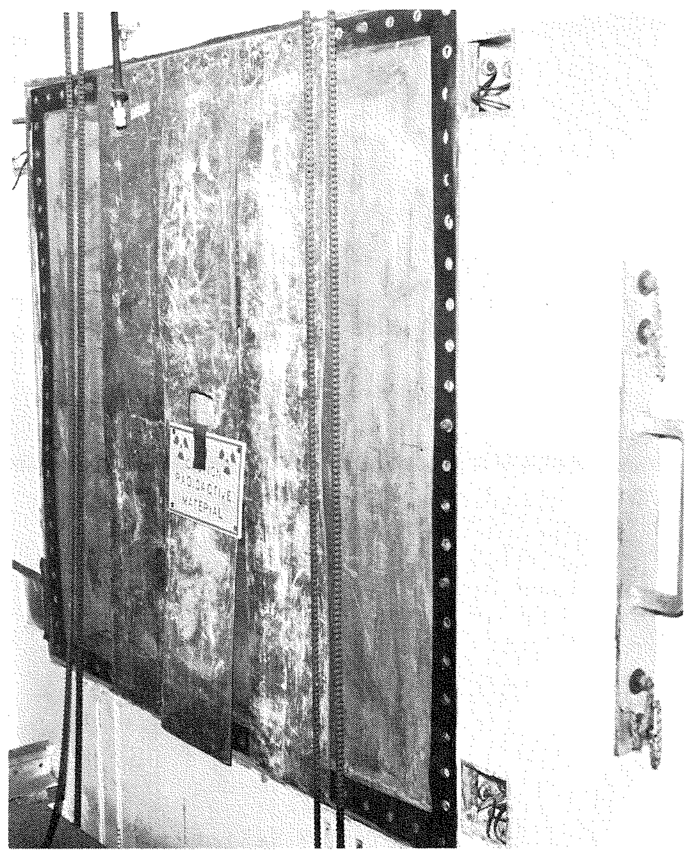

Figure 7. Thermal Column Face Viewed From Test Vault

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assembly, located in the pit directly below the thermal column area, provided a fission spectrum neutron flux source for shielding and irradiation experiments. A movable, water-filled steel tank (Figure 9) provided shielding at the overhead door of the test vault.

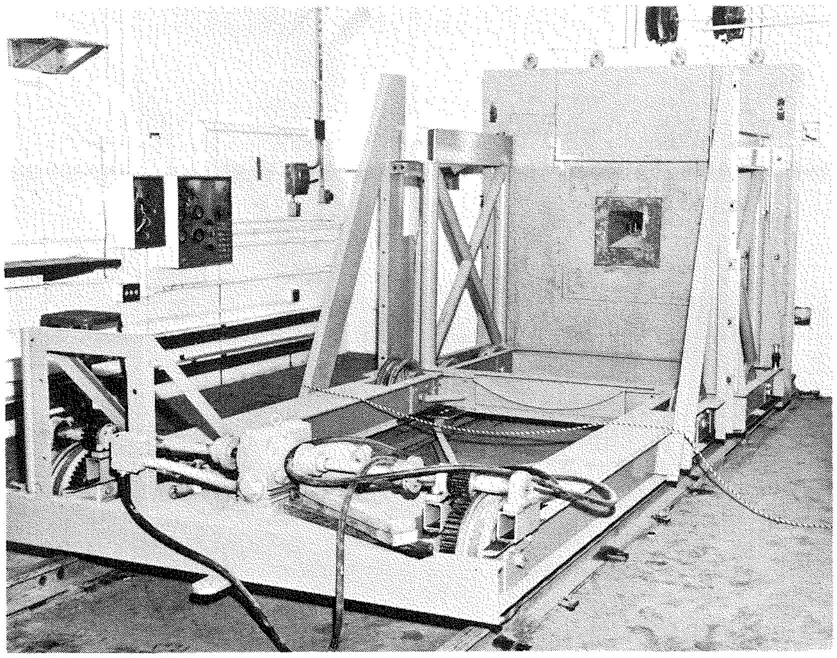

Figure 8. Test Carriage With "Donut" Positioned Against Thermal Column

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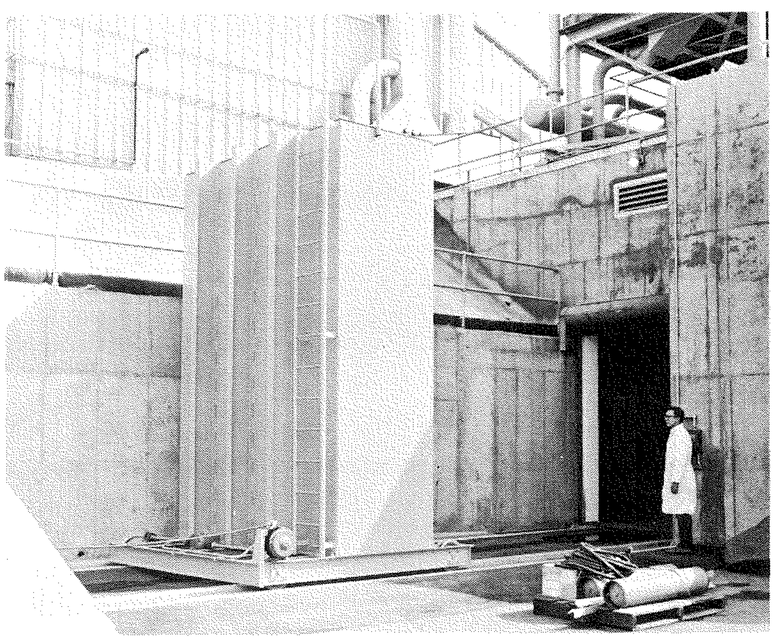

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Figure 9. Movable Water-Filled Shield Door

III. SUMMARY OF DISMANTLING ACTIVITIES

Physical dismantling of the STIR facility began on September 24, 1975, and was completed on March 26, 1976. The documentation prepared to support the dismantling activities was as follows:

1) Facilities Dismantling Plan for STIR, Building T028, FPD-704-990-004 (in Appendix)
2) Building T028 (STIR), Activity Requirement 001, Removal of Radioactive Components and Materials Excluding Concrete Structure, N704-ACR-900-001
3) Dismantling of Peripheral Equipment for STIR, Building T028, Detailed Working Procedure, N704-DWP-990-005
4) Radiological Survey Plan in Support of D&D Program Operations at Building T028 (STIR), N704-TP-990-004
5) Detailed Working Procedure for Decontamination and Dismantling for Shield Test Irradiation Reactor Building T028, Excluding Concrete Structures, N704-DWP-990-006
6) Building T028 (STIR) Activity Requirement 002, Removal of Activated Concrete, N704-ACR-900-002
7) Detailed Working Procedure for Removal of Activated Concrete and Associated Materials From Building T028 (STIR), N704-DWP-990-007.

The documents were reviewed and approved by Quality Assurance, Operating Groups, Health, Safety, and Radiation Services (HSRS), the D&D Program Office, and the Isotopes Committee of the AI Nuclear Safeguards Review Panel. The work was performed by the AI Remote Technology Unit, which includes personnel trained to handle radioactive materials. HSRS provided health physics and safety support. Industrial Engineering coordinated demolition and salvage contractors' work and arranged for plant maintenance assistance for utility disconnections. The demolition contractors' work included breakout and removal of the activated concrete, and backfilling and sealing the reactor enclosure. The salvage contractor removed peripheral systems. Health physics surveillance was continuous. All radioactive wastes were packaged and sent to the Radioactive Material Disposal Facility (RMDF), for shipment to Beatty, Nevada for burial.

TABLE 2

RADIOLOGICAL SURVEY OF BUILDING 028 FACILITIES BEFORE DISMANTLING

Facility	Sample Type	Maximum Specific Radiation
Floor Areas	Smear (100 cm^2)	<5 dpm α, 50 dpm β-γ
Reactor Control Room Office Area Change Room Laboratory		
Six Fuel Storage Cells	Smear (100 cm^2)	<20 dpm α, 60 dpm β-γ
Reactor Coolant in Pump Pit	Water	4.2×10^{-8} μCi/cc β
Leg of Cooling Tower	Filings	No activity detected
Cooling System Pipe	Filings	No activity detected
Test Carriage	Filings	25.0 pCi/gmβ
Tank-Concrete Enclosure Annulus	Pea Gravel (top surface)	24.1 pCi/gmβ
Core Tank Walls	Paint	289 pCi/gmβ
Manipulator	Smear (100 cm^2)	<50 dpm β-γ 1.0 mrad/hr
Reactor Grid Plate	Survey Meter (Jordan with Remote Detector)	1.2 rad/hr
Bismuth Window	Survey Meter (Juno)	430 mrad/hr

A. PREPARATIONS

The existing personnel change room in Building 028 was reactivated and resupplied. An HSRS work station was established in the office area, and equipped with radiation detection instrumentation. Personnel dosimeters, portable radiation survey instruments, respiratory protective devices, airborne particulate radioactivity samplers, and protective clothing were provided. A radiological survey of the facility was conducted before work was begun. The survey results (Table 2) show that the radiation sources were essentially confined to the reactor vessel internals and surrounding materials, thermal column, and test carriage.

Before beginning the dismantling, all personnel who were to be associated with the work were fully briefed by the unit manager on the scope of the work, the radiation hazards expected, and the precautions necessary to safely accomplish the dismantling tasks. A familiarization review of the Detailed Working Procedures, and the requirements for keeping the personnel radiation exposure levels as low as practicable, as defined in Reference 3, were also presented to the operating personnel by the unit manager.

A contract was issued to a salvage contractor for the removal of the peripheral nonradioactive equipment and materials which included the cooling tower, heat exchanger, water shield door, portions of the test carriage and associated piping.

B. PROCEDURES

The Detailed Working Procedures described the dismantling steps and delineated the activity sequence. When changes to the procedure were necessary, they were noted on the work copy of the procedure, and were instituted after review and approval. Separate procedures were prepared for removal of the peripheral equipment, the reactor systems, and the activated concrete.

A major activity in the STIR facility decontamination and disposition was the radiological monitoring and surveying of the total operation. Smear surveys, portable instrument surveys, air sampling, and radioanalyses of water, soil, and concrete were conducted.

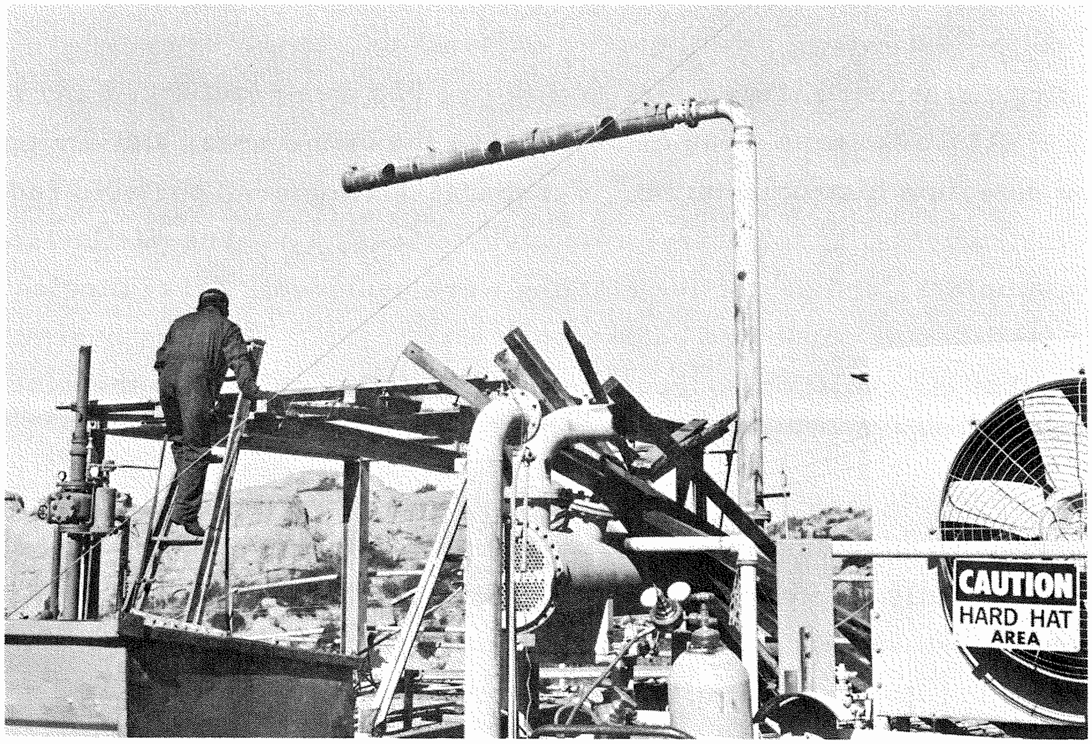

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Figure 10. 1-Mw Water-Cooling Tower and Heat Exchanger Dismantling

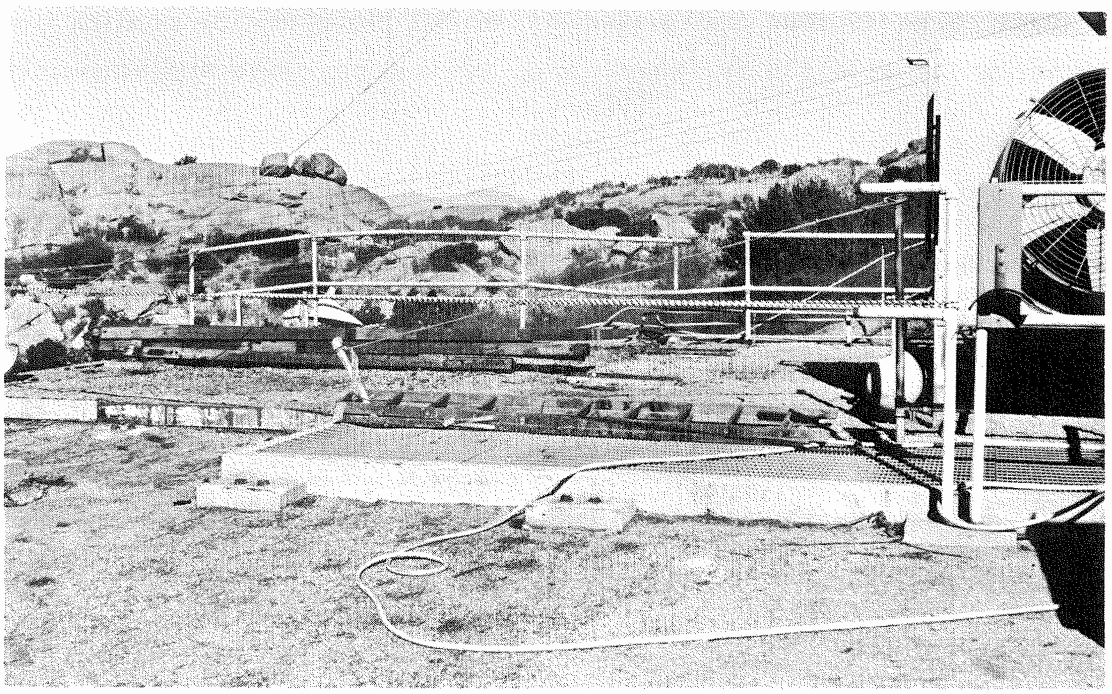

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Figure 11. Completion of Water Tower and Heat Exchanger Dismantling

1. Cooling System

The 50-kw reactor water cooling system and the primary (reactor side) of the 1-Mw reactor water cooling systems were dismantled. The secondary side of the 1-Mw system was removed by the salvage contractor. The piping, valves, and pumps were nonradioactive, and were disposed of as salvage. The 50-kw refrigeration water cooler was found to contain low levels of radioactivity in the water trapped inside the unit. The unit was removed from the facility and transferred to storage for possible reuse.

The water demineralizer and filters were cut out, packaged as radioactive waste, and sent to the RMDF for shipment to off-site burial. The nonradioactive 1-Mw water cooling tower and the 1-Mw heat exchanger and associated piping were dismantled and removed from the site by the salvage contractor. Figures 10 and 11 show stages of dismantling.

2. Reactor Vessel

The concrete shield blocks over the top of the reactor opening shown in Figure 12 were removed. These blocks were nonradioactive and were set aside for eventual burial in the reactor cavity.

Samples of the aluminum core tank walls were taken using a drill to produce metal shavings. Analysis of these samples revealed that the upper portion (11 ft) was not radioactive and that the radioactivity in the lower portion resulted mainly from neutron activation of the paint on the inside surface. Figure 13 shows the arrangement of the core tank internals: the grid plate at the right, six storage thimbles – three on each side, and coolant piping. The flexible duct at the right provided fresh air and air movement for personnel working in the tank.

The instrumentation thimbles, grid plate, and the core support structure were removed from the tank. These components were packaged as radioactive waste and sent to the RMDF for shipment to off-site burial.

Holes were sawed in the radiation shield, Figure 14, and the lead shot (about 3000 lb) was removed, placed in small drums, and sent to the RMDF for shipment to off-site burial. The annulus between the core tank and the concrete enclosure was opened and the pea gravel was removed by vacuuming and placing in 55-gal. drums. Figure 15 shows the removal technique. Radioactivity in the

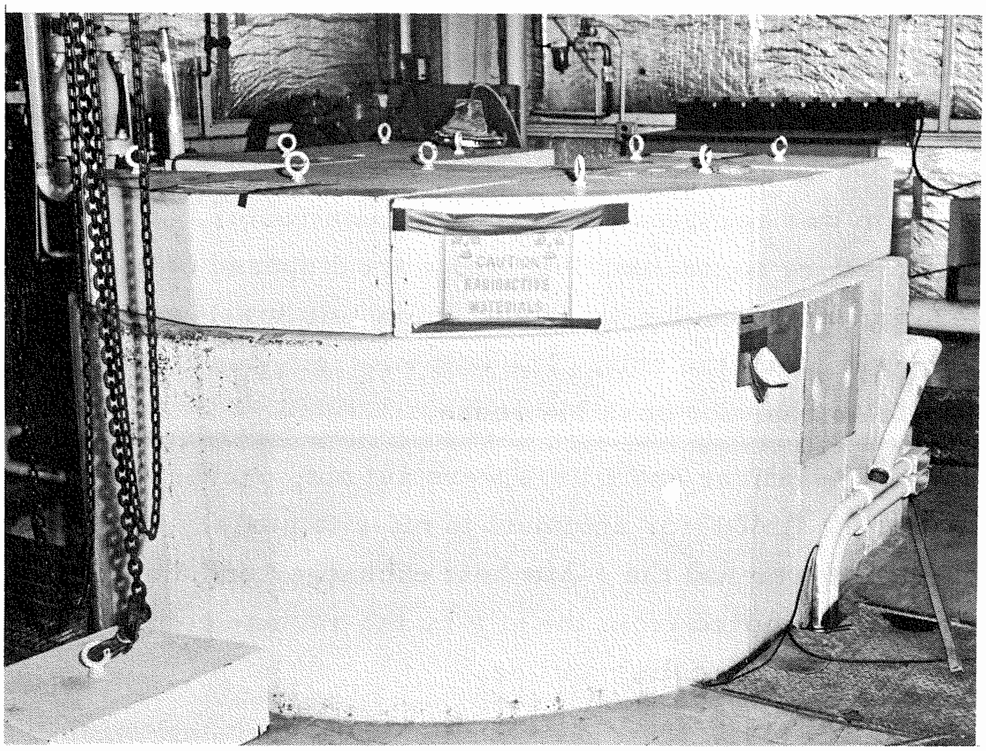

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Figure 12. Shield Blocks and Upper Reactor Opening

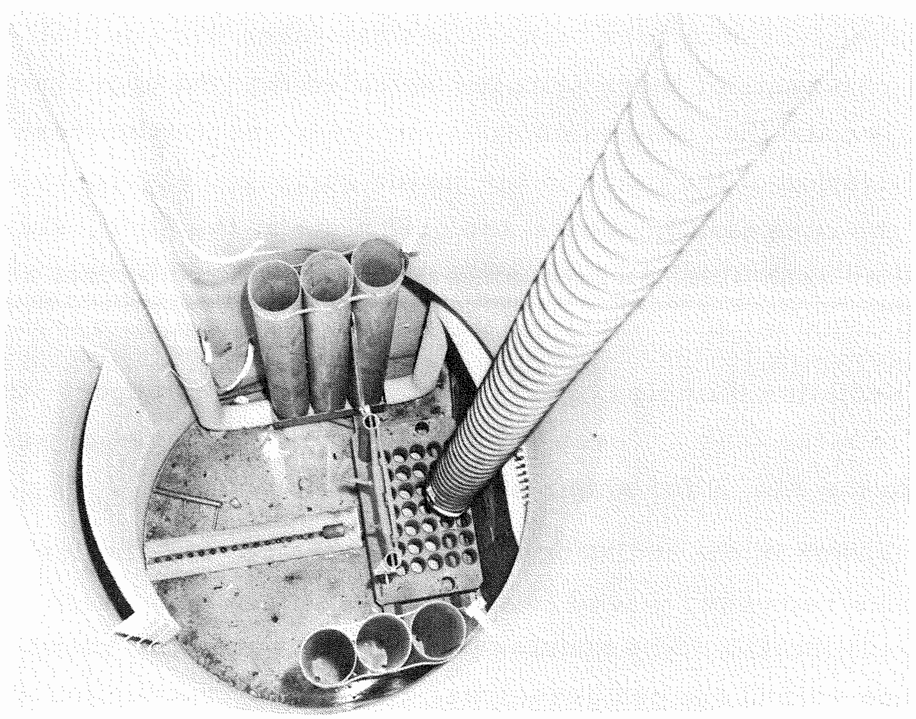

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Figure 13. Reactor Vessel Internals

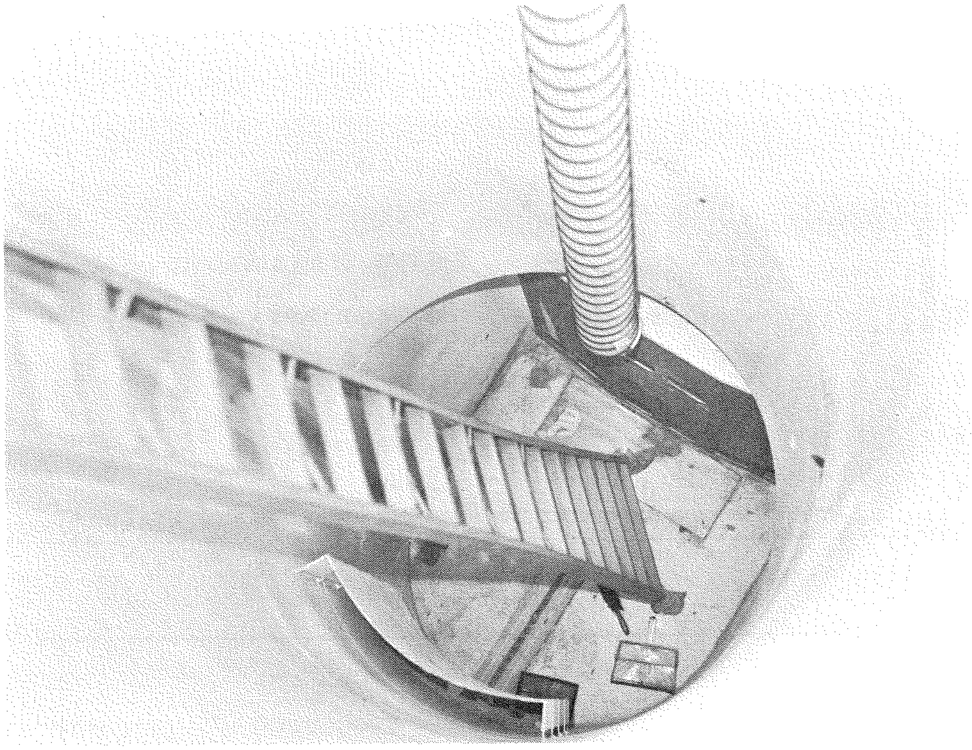

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Figure 14. Saw Holes in Shield for Lead Shot Removal

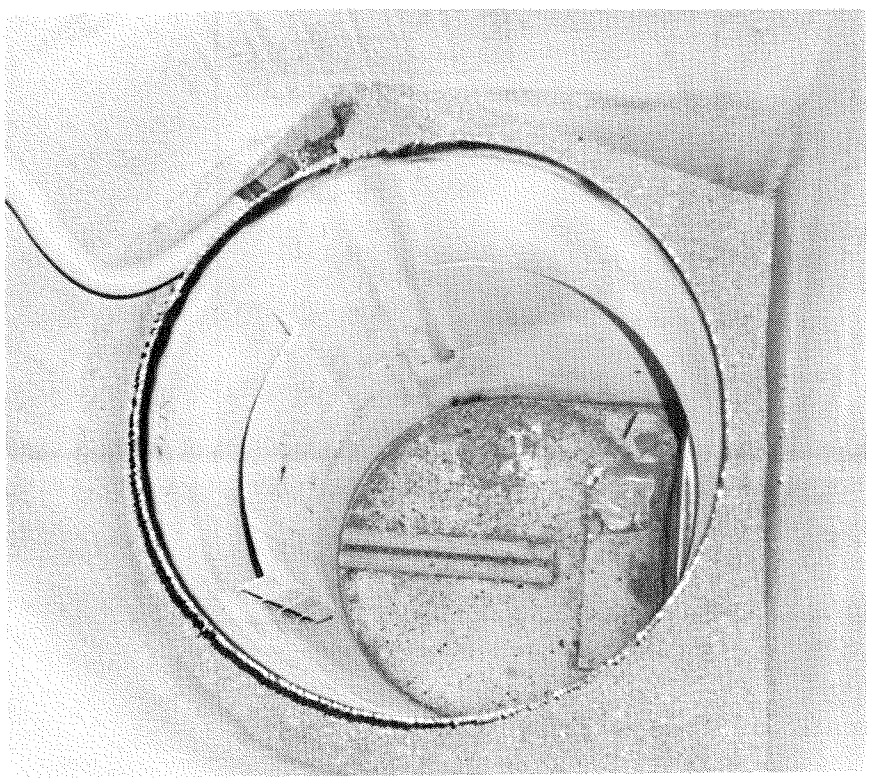

Figure 15. Pea Gravel Removal From Annulus

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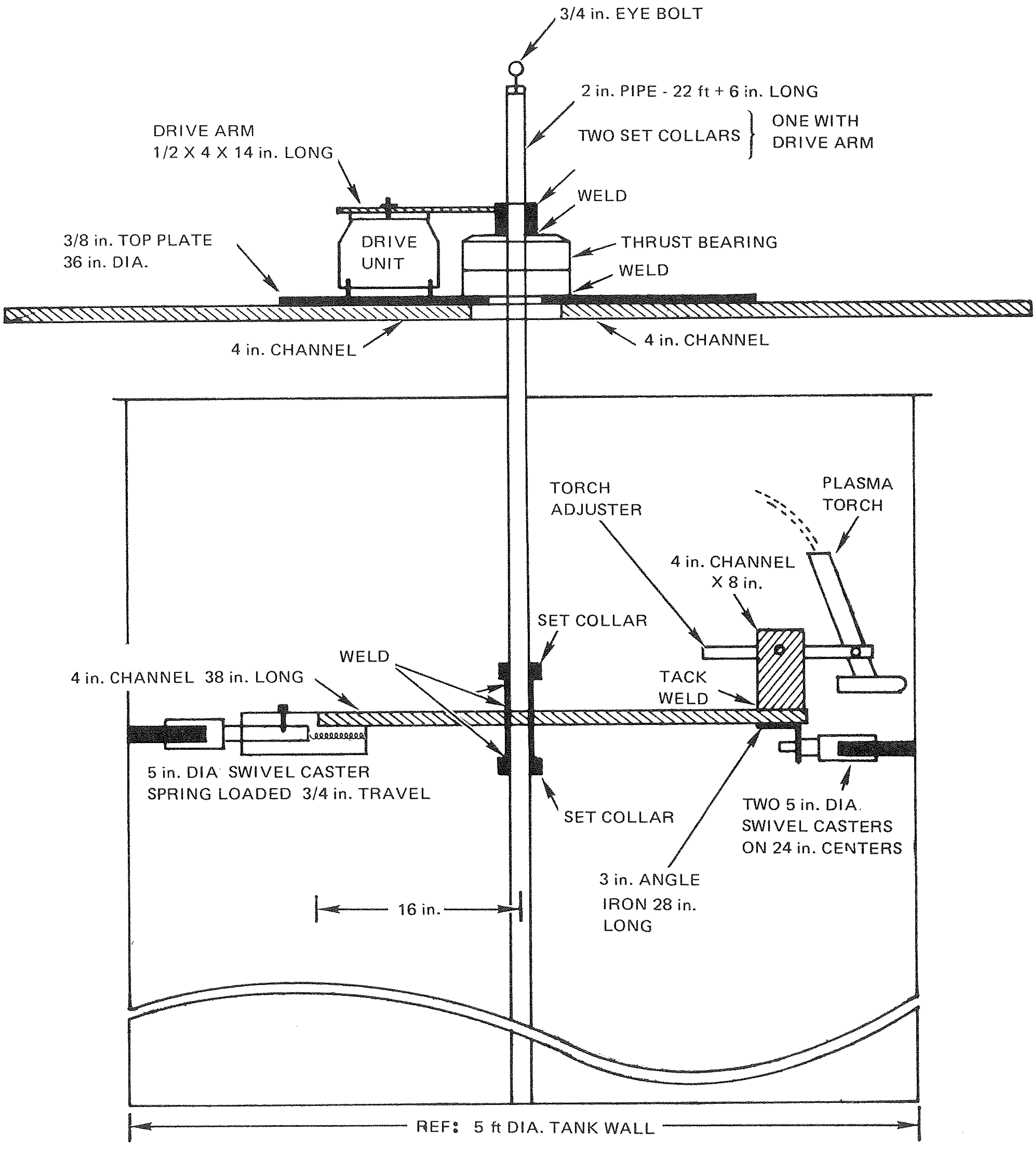

Figure 16. Schematic of Plasma Torch Cutting Tooling

pea gravel in the annulus for the first 10 ft below the tank top was limited to natural radioactivity: 24.1 pCi/gm. The gravel below 10 ft was determined to be neutron activated and was handled as radioactive waste. Radiation levels of up to 15 mrad/hr were measured at the surface of the drums of activated gravel.

To minimize the technician's working time inside the core tank, where the radiation was highest, and to facilitate the required vessel cutting operations, a special plasma torch cutting fixture, Figures 16, 17, 18, and 19, was assembled to cut the upper nonactivated portion of the core tank. Figure 16 is a schematic showing the general arrangement and operation of the special fixture. Figure 17 shows the plasma torch mounted on the radial arm inside the core tank. Figure 18 shows the support and drive structure at the top of the tank. Figure 19 shows the plasma torch power supply. Once the torch was set up, the 1/2-in. thick aluminum tank wall was cut in approximately 15 min for each circumferential cut. Three cuts were made. The three vessel sections shown in Figure 20 were disposed of as nonradioactive scrap.

The lower 9-ft radioactive portion of the tank was cut into two sections. The bottom section is shown in Figure 21 resting on the top of the reactor enclosure where it was placed after hoisting from below. A longitudinal cut of the section was made to facilitate packaging. Figure 22 shows the sections in the shipping box. The shutdown shield with the bismuth windows at the center was an integral part of the lower section of the tank. The radiation level at the bismuth window was 600 mrad/hr. In packaging the lower section of the tank for shipment, special shielding was placed over the bismuth window. The thermal column — core tank interface plate was sawed, removed, and placed in a shipping box. The tank support structure at the bottom of the reactor enclosure and the remaining pea gravel were removed. Figure 23 shows the reactor enclosure after the tank support structure and thermal column interface plate were removed. Figure 24 shows the thermal column liner.

3. Test Vault Dismantling

Test vault dismantling began with the removal of the test carriage. The test carriage concrete "donut" was removed from the carriage and stored in the rear of the vault. The test carriage (Figure 8) was disassembled and removed

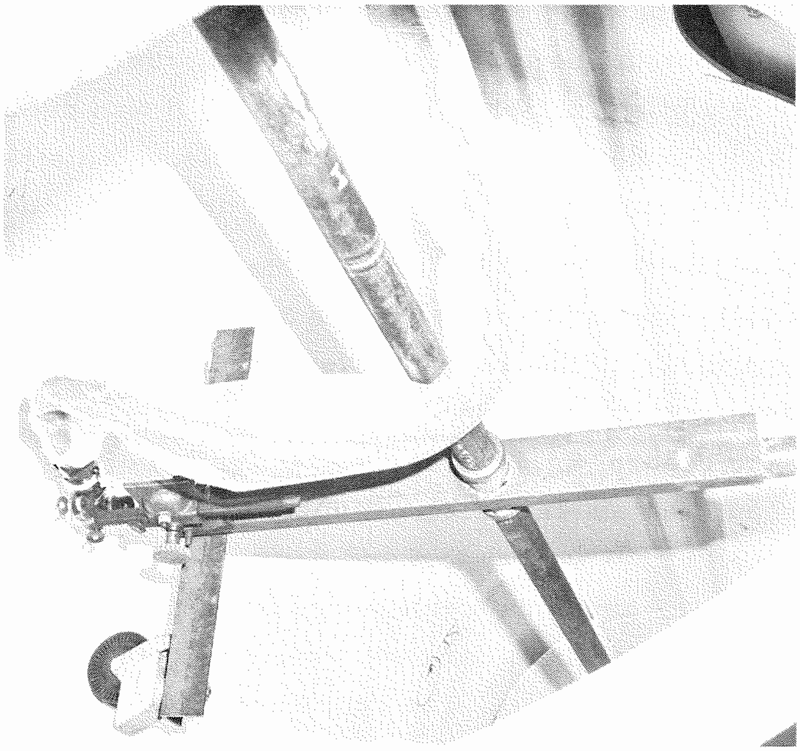

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Figure 17. Plasma Torch Cutting Fixture

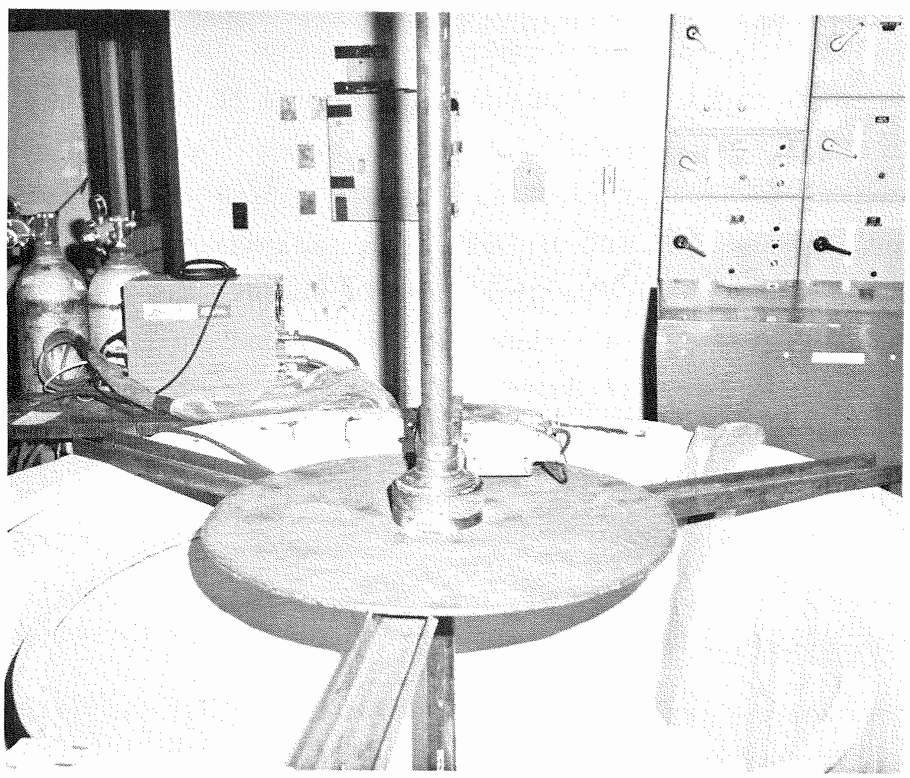

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Figure 18. Plasma Torch Support Fixture for Cutting Reactor Vessel

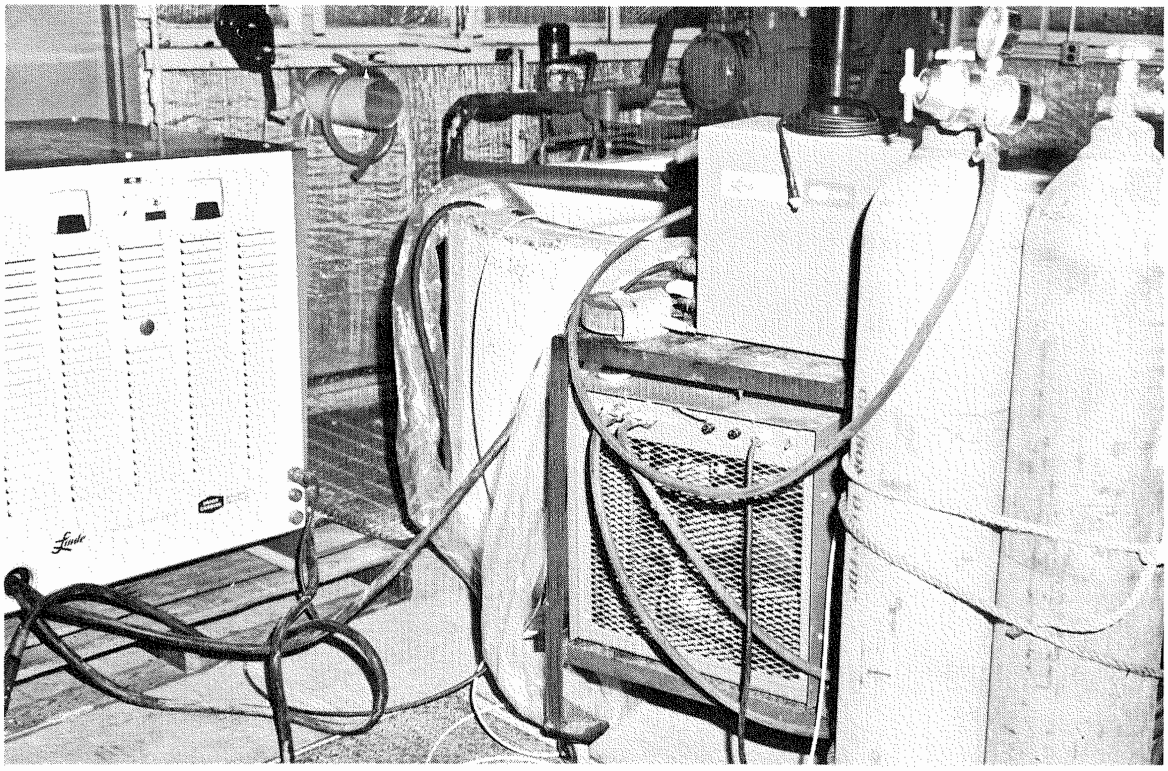

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Figure 19. Plasma Torch Power Supply and Gas Supply

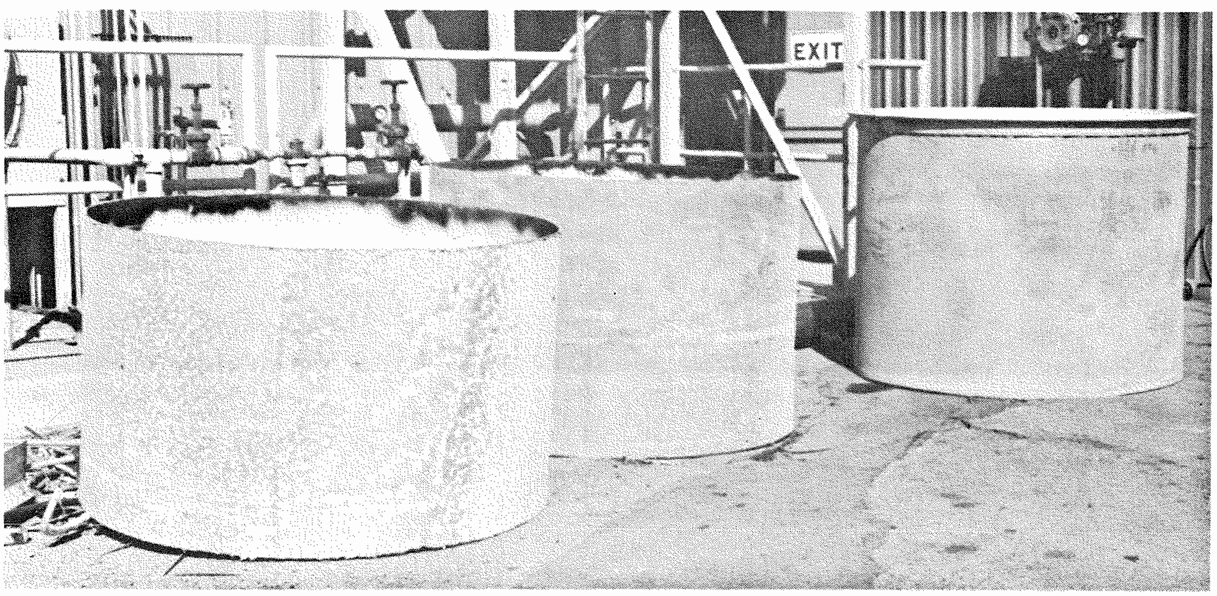

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Figure 20. STIR Reactor Vessel Sections Cut With Plasma Torch

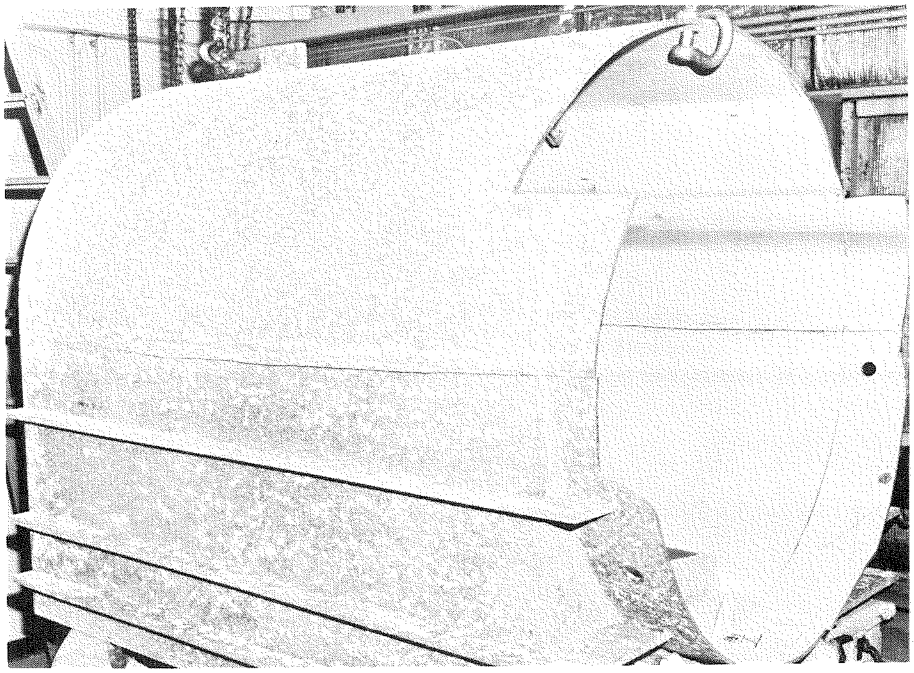

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Figure 21. STIR-Longitudinal Cut of Reactor Vessel After Removal From Pit

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Figure 22. STIR-Bottom Portion of Reactor Vessel Cut Longitudinally and Boxed for Shipment to Burial

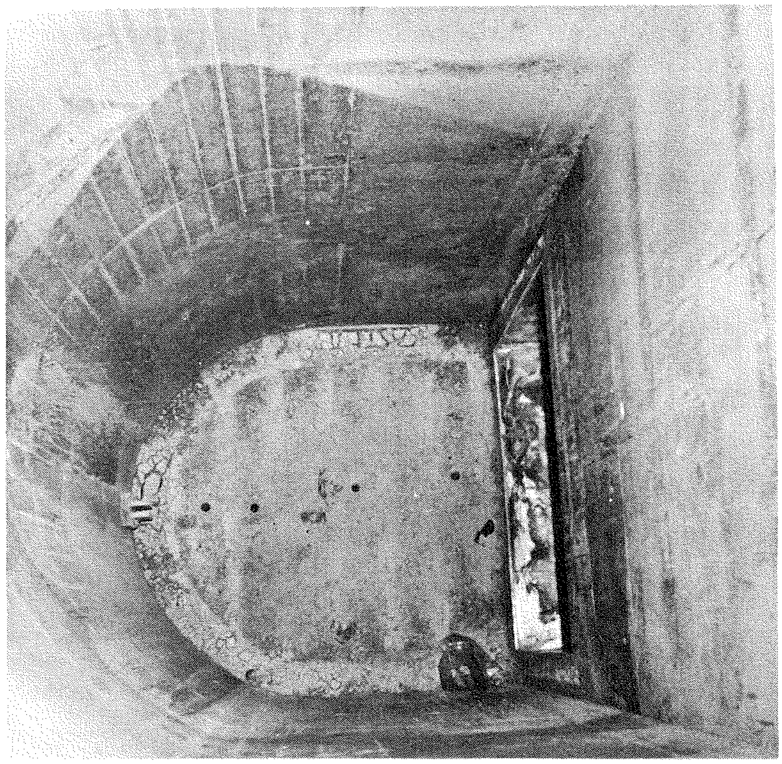

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Figure 23. STIR-Reactor Concrete Enclosure After Removal of Vessel, Shield and Bismuth Window

Figure 24.

Thermal Column Liner Looking Into Reactor Enclosure

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from the test vault. The salvage contractor cut up the noncontaminated portions of the test carriage, and removed them from the site. A radiological survey of the test carriage scrap material was made prior to release from the site. The forward end of the carriage that supported the "donut" was found to be neutron activated. This section was cut off, disassembled, and placed in boxes for shipment to the land burial site. The test carriage rails on the test vault were removed and disposed of as scrap.

The fission plate pit was opened, radiologically surveyed, and found to be free of radioactivity. The rails and structural support hardware were removed from the pit. The steel cover plates were disposed of as radioactive waste.

Plastic sheeting was spread over the floor area, directly in front of the thermal column, in preparation for disassembly of the thermal column. The lead shielding was removed from the thermal column front face (Figure 7). The boral sheet, which was nonradioactive, was then removed, exposing the graphite logs. Radiation levels associated with the graphite logs ranged from 15 mrad/hr at the ends exposed to the test vault to 50 mrad/hr at the ends nearest to the reactor. The graphite logs were removed, placed in shipping containers and sent to the RMDF for subsequent shipment to Beatty, Nevada for burial. Six thousand pounds of graphite logs were removed. The thermal column liner (Figure 25) was wiped down to remove loose contamination. The radiation level, after wiping, at the thermal column back wall was 500 mrad/hr in the center and 200 mrad/hr at the edges. The plastic sheeting on the floor was picked up and placed in the shipping boxes. The test vault area was then vacuumed.

a. Survey of Test Vault Before Activated Concrete Removal

A radiation survey of the test vault area, including the thermal column, reactor enclosure floor and walls, and the "donut" was performed prior to removal of the activated concrete. The survey was conducted using a Nuclear Chicago 2650 GM-type survey instrument with the beta shield open and readings taken at waist level. Radiation levels are shown in Tables 3 through 7. Figures 26 through 30 are schematics which show the locations in the STIR facility at which the radiation measurements were taken. All readings are total radiation readings including background radiation levels.

7704-62147

Figure 25. Thermal Column Liner After Removal of Graphite Logs

TABLE 3

RADIATION SURVEY OF TEST VAULT AREA
(Relating to Figure 26)

Survey Location	Radiation Level (mrad/hr)	Survey Location	Radiation Level (mrad/hr)
1	0.05	10	0.17
2	0.07	11	0.25
3	6.00	12	0.25
4	0.07	13	0.17
5	0.05	14	0.03
6	0.15	15	0.07
7	0.50	16	0.05
8	0.17	17	0.05
9	0.17	18	0.03

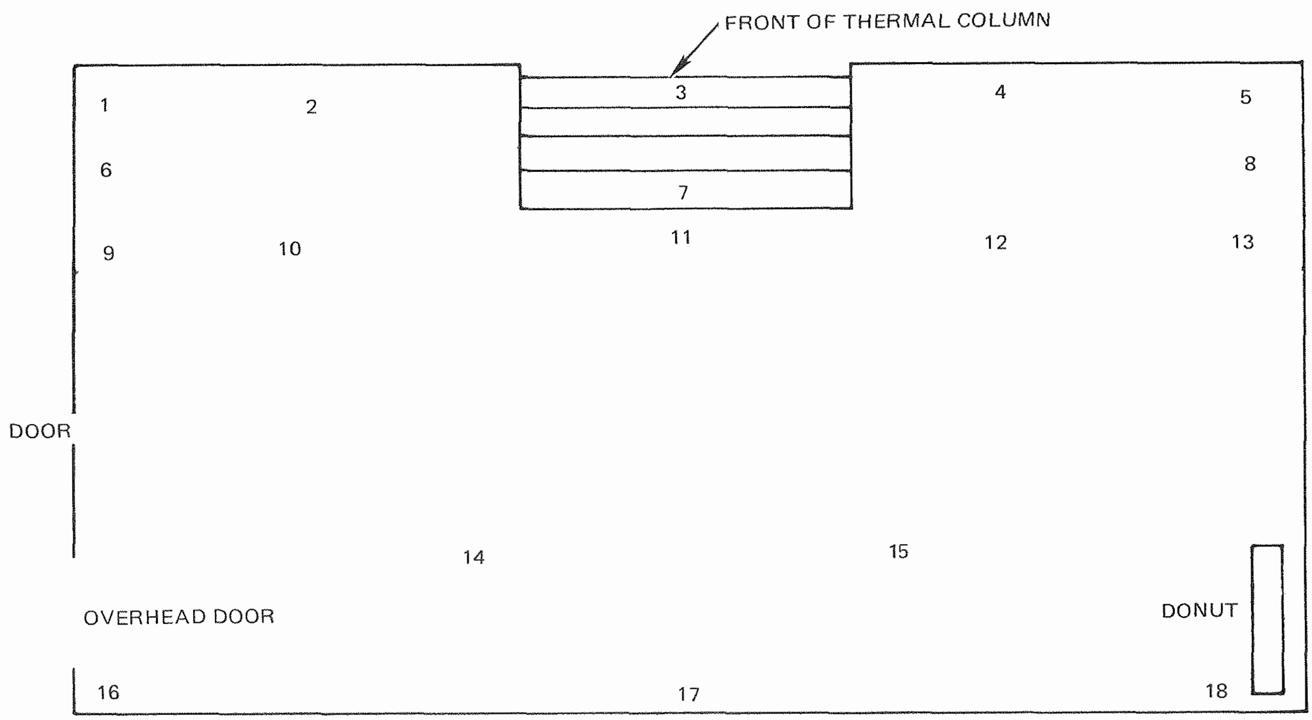


Figure 26. Radioactive Survey Locations in Test Vault Area (Table 3)

TABLE 4

RADIATION SURVEY OF DONUT
(Relating to Figure 27)

Survey Location	Radiation Level (mrad/hr)
1	0.10
2	0.10
3	0.10
4	0.10
5	0.10
6	0.05
7	0.05
8	0.05
9	1.0

Note: Reading 1-8 taken 1/2 in. from surface. Reading 9 taken inside donut opening.

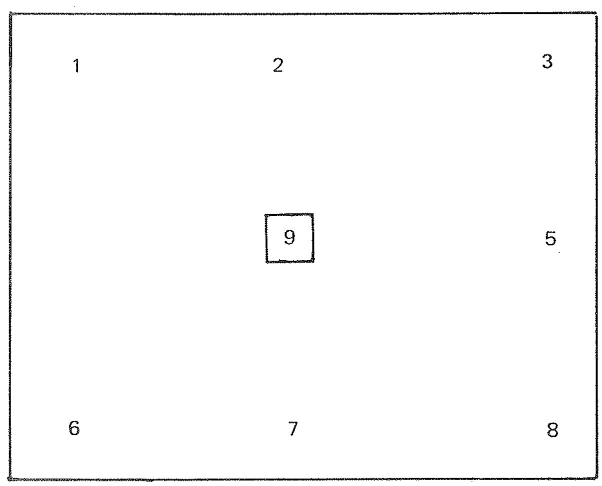


Figure 27. Donut Survey Locations (Table 4)

TABLE 5

RADIATION SURVEY OF THERMAL COLUMN WALLS
(Relating to Figure 28)

28a.		28b.		28c.	
Location	Radiation Level (mrad/hr)	Location	Radiation Level (mrad/hr)	Location	Radiation Level (mrad/hr)
1	7.0	1	15.0	1	15.0
2	10.0			2	10.0
3	15.0			3	5.0
4	7.0			4	32.0
5	15.0			5	12.0
6	33.0			6	5.0
7	4.0			7	15.0
8	8.0			8	8.0
9	12.0			9	3.0

Note: Readings in 28a. and 28c. taken 1/2 in. from surface. Reading in 28b. taken at center.

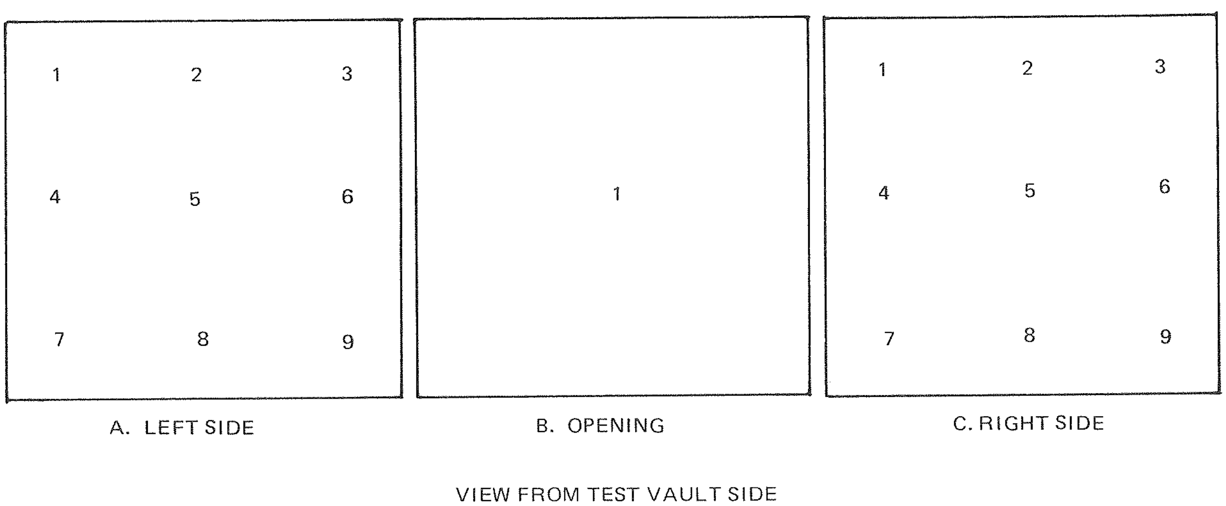


Figure 28. Reactor Thermal Column Survey Locations (Table 5)

TABLE 6

REACTOR CAVITY FLOOR RADIATION SURVEY
(Relating to Figure 29)

Location	Radiation Level (mrad/hr)	Location	Radiation Level (mrad/hr)
1	10.0	8	10.0
2	32.0	9	5.0
3	55.0	10	3.0
4	60.0	11	3.0
5	35.0	12	3.0
6	10.0	13	3.0
7	5.0	14	3.0
		15	3.0

Note: Readings taken 1/2 in. from surface

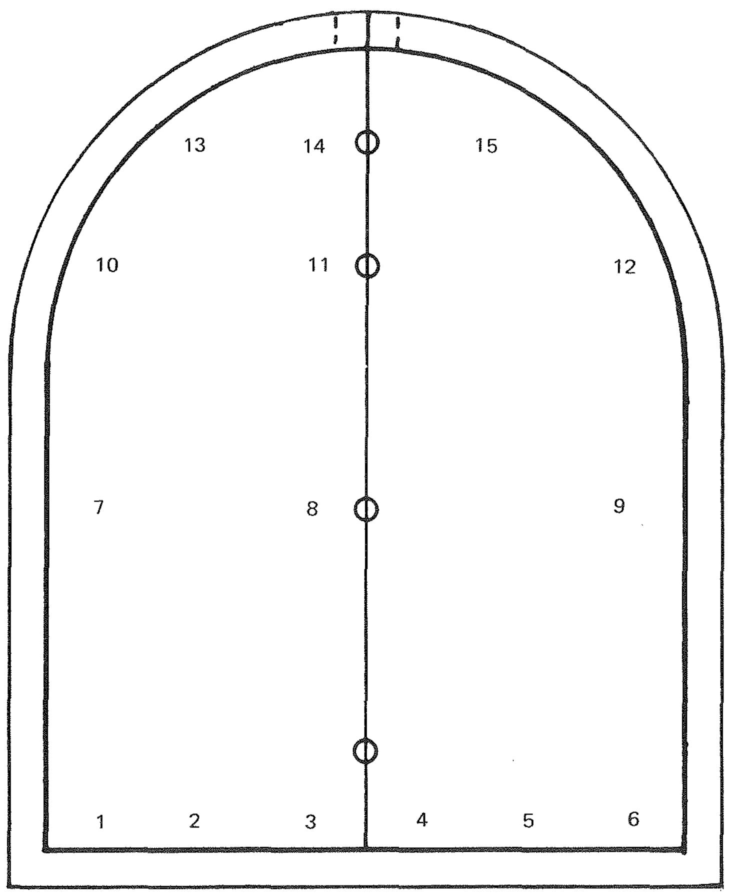


Figure 29. Reactor Cavity Floor Survey Locations
(Table 6)

TABLE 7

LOWER REACTOR CONCRETE WALL
(Relating to Figure 30)

Location	Radiation Level (mrad/hr)
A	35.0
B	8.0
C	1.5
D	1.7
E	3.5
F	50.0
G	6.0
H	4.0
I	1.2
J	1.6
K	2.0
L	4.0

Note: Readings taken 1/2 in. from surface

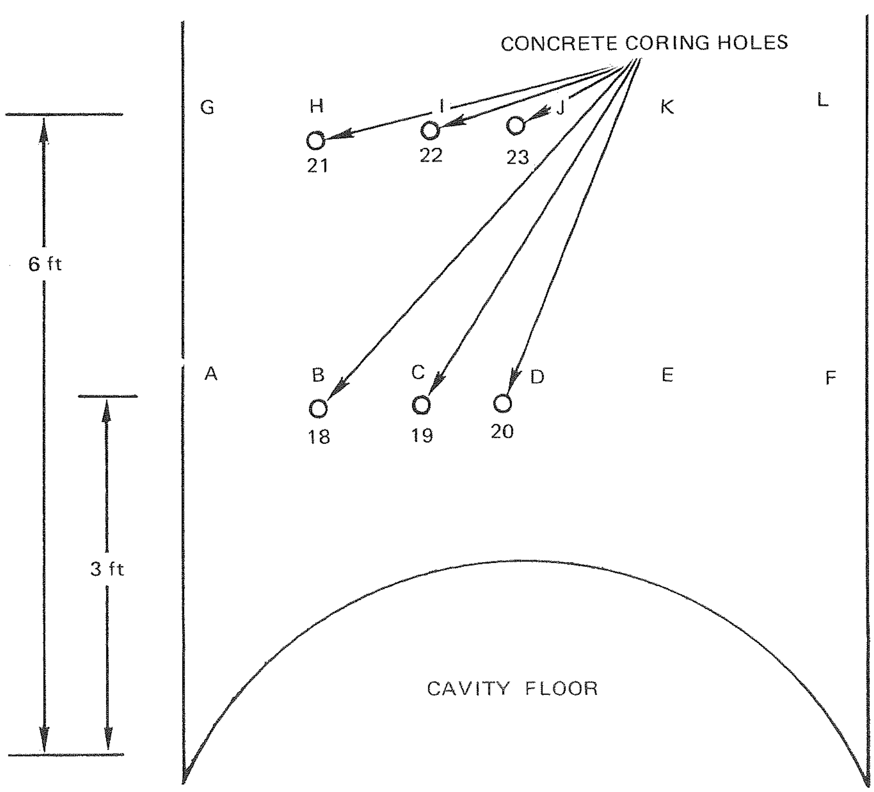


Figure 30. Lower Reactor Cavity Wall Survey Locations (Table 7)

b. Concrete Sampling

Removal of the concrete structures which were neutron irradiated during the reactor operations was a prime project requirement. Because of the accessibility of the activated concrete in the shield and the reactor enclosure structure, removal of all concrete containing statistically significant activity in excess of the natural radioactivity in the concrete was deemed practicable by the application of ALAP principles.

Before the extent of the concrete removal could be defined, it was necessary to determine the level of natural background radioactivity in the concrete structures. Nine concrete core samples (1 in. diameter by 18 in. long) were collected from the unirradiated concrete structures of the STIR facility for use as natural radioactivity standards. The 18-in. long cores were crushed and mixed, to make possible the collection of aliquots for radiometric analysis. Table 8 and the sample-identifying Figure 31 describe the results of this analysis. The mean concentration of the samples and the observed standard deviation of the data were calculated, to make possible an overall standard for the natural radioactivity in the concrete. Subsequent concrete samples were considered free of statistically significant activity, in excess of natural radioactivity, if they contained no radioactivity in excess of three times the standard deviation of the mean background radioactivity level, as established in the following listing.

mean	16.8 pCi/g
Standard deviation (σ)	1.4 pCi/g
3 (σ)	4.2 pCi/g
acceptable upper limit	21.0 pCi/g

Concrete core samples were taken from the irradiated concrete prior to initiating concrete demolition. Table 9 and the sample-identifying Figures 32, 33, and 34 describe the radiometric analyses of core samples taken from the irradiated concrete structures. Note that the samples were of various lengths, reflecting the thickness of the concrete at the sample location. Note also that the analyses were performed on segments of the samples, so that the depth of the irradiation could be assessed. The radioactivity level in the high-density (magnetite) concrete surround the thermal column (Sample 11) was lower than the level of the natural radioactivity standard for the ordinary concrete.

TABLE 8

STIR REACTOR CONCRETE ANALYSIS DATA
(Related to Figure 31)

Core Sample No.	Total Core Length (in.)	Sampled Core Segment Depth (in.)	Analysis (pCi/g β)
1	18	Composited	17.2
2	18	Composited	18.3
3	18	Composited	18.6
4	18	Composited	16.0
5	18	Composited	16.1
6	18	Composited	16.8
7	18	Composited	16.8
8	18	Composited	14.0
9	18	Composited	17.4

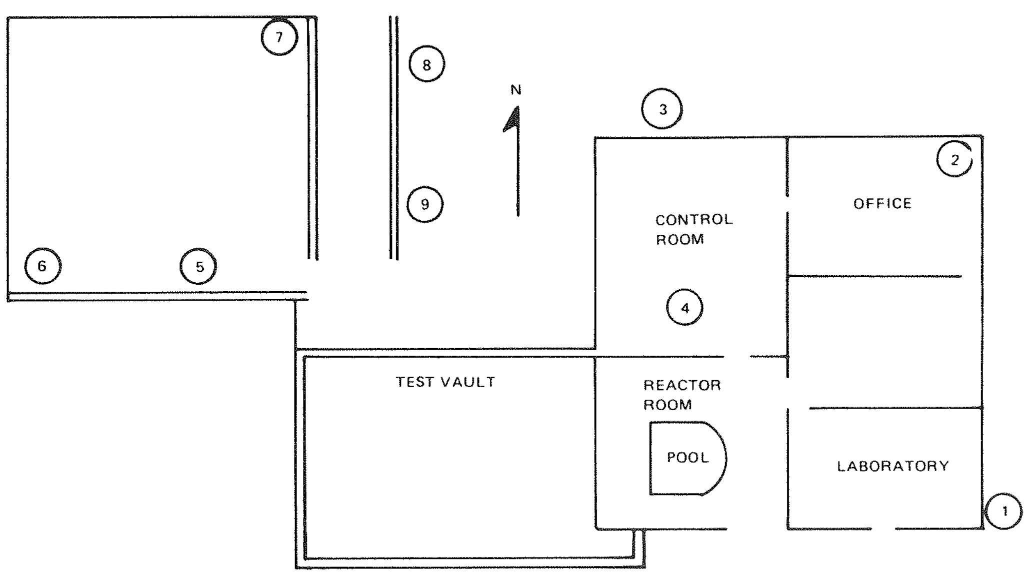


Figure 31. STIR Reactor Site Map Showing Core Sample Locations (Table 8)

TABLE 9

STIR IRRADIATED CONCRETE ANALYSIS DATA
(Related to Figures 32, 33, 34)
(Sheet 1 of 3)

Core Sample No.	Total Core Length (in.)	Sampled Core Segment Depth (in.)	Analysis (pCi/g β)
10-A	13	0-1	19.1
10-B		3-4	16.8
10-C		6-7	16.9
10-D		9-10	18.7
10-E		12-13	11.6
11-A	52	0-1	15.5
11-B		12-13	2.9
11-C		24-25	2.9
11-D		36-37	3.2
11-E		48-49	2.3
12-A	50	0-1	15.2
12-B		12-13	16.8
12-C		24-25	16.6
12-D		36-37	14.9
12-E		48-49	13.7
13-A	39	0-1	20.1
13-B		11-12	14.4
13-C		22-23	16.8
13-D		30-31	14.6
13-E		37-38	16.3
14-A	51	0-1	4904.1
14-B		12-13	21.4
14-C		24-25	25.3
14-D		36-37	17.8
14-E		50-51	16.5
15-A	36	0-1	308.8
15-B		10-11	30.0
15-C		16-17	19.4
15-D		24-25	14.3
15-E		35-36	16.6
16-A	28	0.1	24.6
16-B		6.7	18.7
16-C		12-13	13.0
16-D		18-19	10.5
16-E		27-28	16.0

TABLE 9

STIR IRRADIATED CONCRETE ANALYSIS DATA
(Related to Figures 32, 33, 34)
(Sheet 2 of 3)

Core Sample No.	Total Core Length (in.)	Sampled Core Segment Depth (in.)	Analysis (pCi/g β)
17-A	18	0-1	15.5
17-B		4-5	17.5
17-C		8-9	15.2
17-D		12-13	17.4
17-E		17-18	14.6
18-A	18	0-1	173.4
18-B		4-5	96.5
18-C		8-9	43.4
18-D		12-13	35.2
18-E		17-18	20.0
19-A	18	0-1	19.3
19-B		4-5	19.4
19-C		8-9	20.8
19-D		12-13	15.5
19-E		17-18	14.9
20-A	18	0.1	25.3
20-B		4-5	14.7
20-C		8-9	17.1
20-D		12-13	16.8
20-E		17-18	18.3
21-A	18	0-1	51.7
21-B		4-5	23.7
21-C		8-9	14.8
21-D		12-13	18.6
21-E		17-18	16.2
22-A		0-1	13.8
22-B		4-5	25.9
22-B	Duplicate Aliquot		28.4
22-C		8-9	20.2
22-D		12-13	18.0
22-E		17-18	16.4

TABLE 9

STIR IRRADIATED CONCRETE ANALYSIS DATA
(Related to Figures 32, 33, 34)
(Sheet 3 of 3)

Core Sample No.	Total Core Length (in.)	Sampled Core Segment Depth (in.)	Analysis (pCi/g β)
23-A	18	0-1	22.7
23-A	Duplicate Aliquot		18.4
23-B		4-5	12.2
23-C		8-9	24.3
23-D		12-13	17.1
23-E		17-18	14.3
24-A	18	0-1	14.2
24-B		4-5	14.8
24-C		8-9	16.3
24-D		12-13	17.1
24-E		17-18	16.0
25-A	18	0.1	16.2
25-B		4-5	18.9
25-C		8-9	14.7
25-D		12-13	15.2
25-E		17-18	13.3
26-A	18	0-1	12.1
26-B		4-5	15.5
26-C		8-9	18.6
26-D		12-13	16.0
26-E		17-18	28.3
26-E	Duplicate Aliquot		17.5

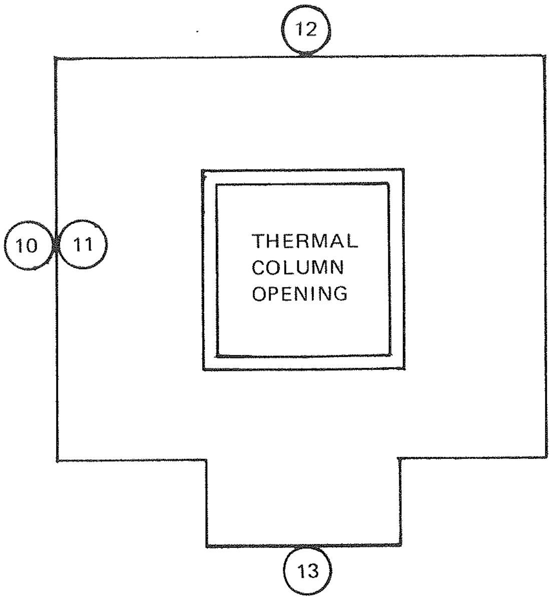
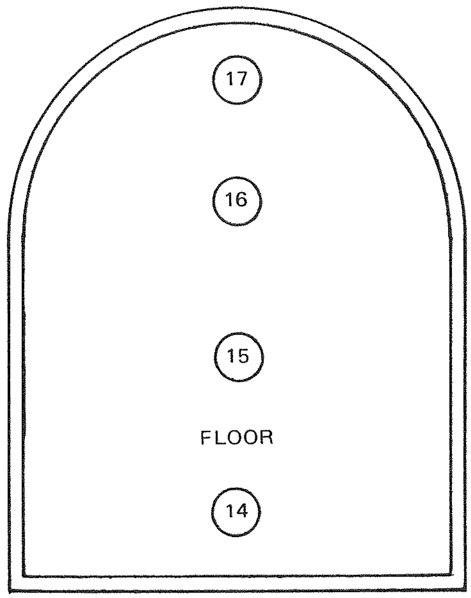


Figure 32. Thermal Column Core Sample Locations (Table 9)

Figure 33. Core Sample Locations Floor of Reactor Enclosure (Table 9)



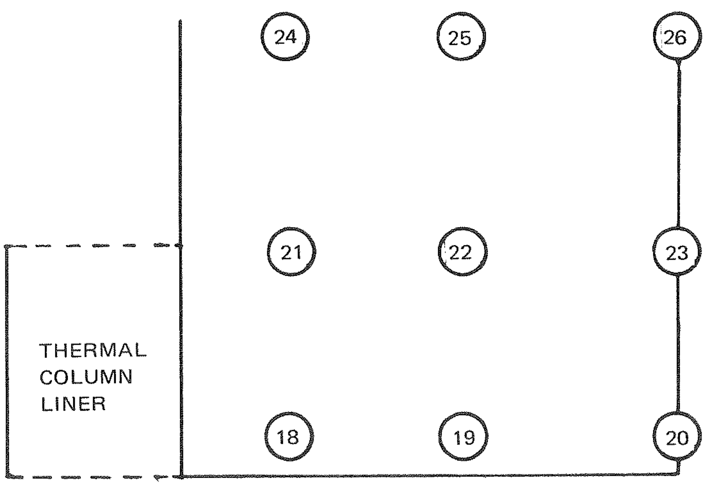


Figure 34. Cavity Wall Concrete Sample Locations (Table 9)

c. Removal of Activated Concrete

A specification defining the extent of the required activated concrete removal was prepared. Bids from demolition contractors were obtained and the contract was awarded to the lowest bidder. The activated concrete was broken out using an air driven, hydraulically positioned Hoe-Ram. The Hoe-Ram is a large jack hammer with a 4-in. diameter bit. Figure 35 shows the Hoe-Ram in action. Water was sprayed on the rubble to decrease the amount of airborne dust. Figure 36 highlights the personnel protective clothing and equipment required during the concrete removal. The concrete rubble was placed in boxes and sent to the RMDF for shipment to off-site burial. Sealed boxes of radioactive concrete rubble are shown in Figure 37. These boxes were later steel-banded prior to shipment. Figures 38, 39, 40, 41, and 42 are closeup views of the activated concrete excavation.

After removal of the thermal column liner, which was embedded 4 to 6 in. in the magnetite concrete, the side walls of the reactor enclosure were broken out. A wall area of 7 ft high and 3 ft wide was removed from each side. A radiological survey of the remaining exposed concrete and rebar revealed radiation levels in excess of 0.1 mrad/hr. Radiometric analysis of concrete samples from the remaining concrete indicated specific activities which were greater than the established limits. On the basis of the survey and sample analyses, the area of concrete excavation was widened an additional 2 ft, leaving a concrete wall 3 ft wide at the rear of the enclosure. The activity in this wall was below the established limits. The entire floor area of the reactor enclosure and the concrete pad directly below the floor area were removed. In addition, the concrete structure which supported the thermal column shielding and extended under the floor area was removed to a depth of 1.5 ft. Excavation of the floor area extended to a depth of 3 ft below the original floor level at the rear of the reactor cavity and 4.5 ft at the front. Radioanalysis of concrete samples taken from the concrete remaining in the wall and below the floor indicated a maximum specific activity of 19.0 pCi/g.

Removal of the concrete walls and floor exposed the surrounding fill soil. Results of the analysis of soil samples taken from this area are reported in

Figure 35. STIR-Excavation of Activated Concrete Near Thermal Liner and Reactor Enclosure

7704-62249

7704-62248

Figure 36. STIR-Hoe-Ram Crew Suited Up for Removal of Activated Concrete

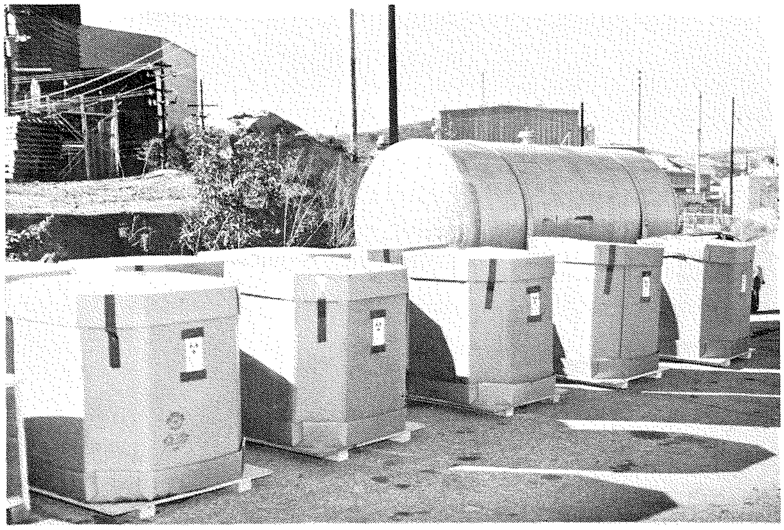


Figure 37.

Rubble Containers for Activated Concrete

7704-62247

Figure 38.

Activated Concrete Removal

7704-62246

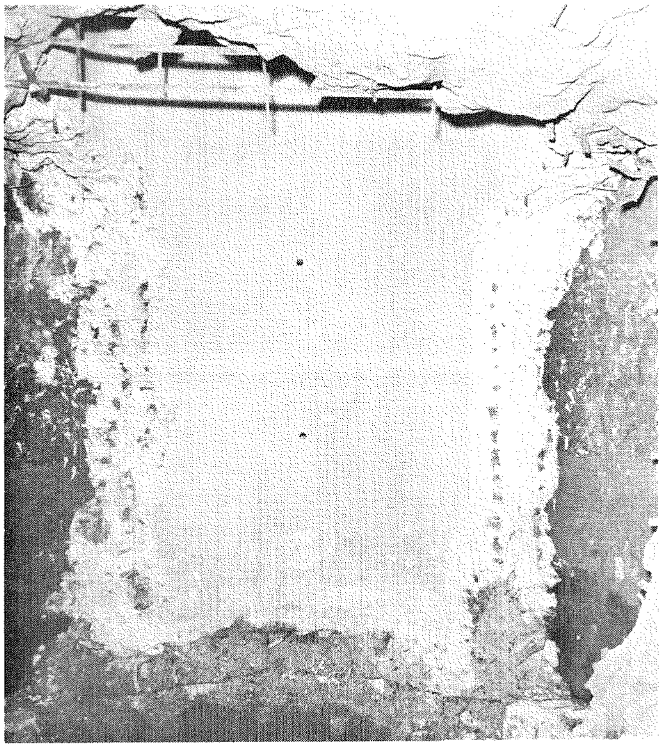


Figure 39. Excavation Showing Removal of Side Walls and Floor

7704-62359

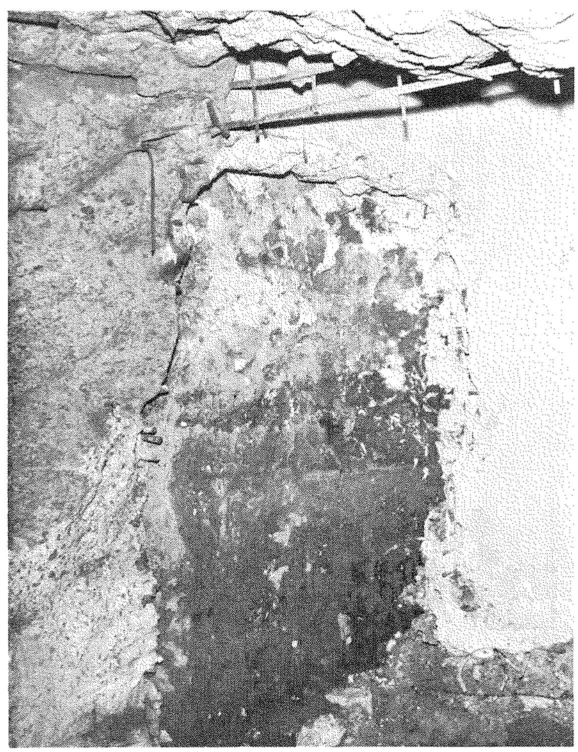
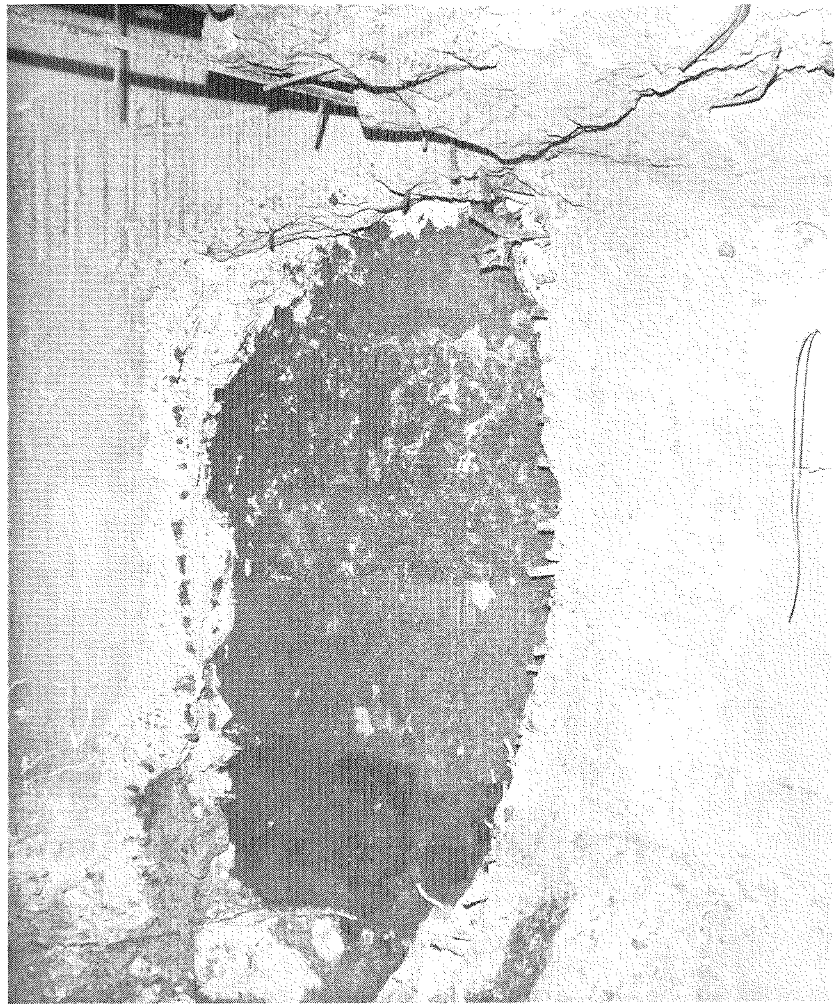


Figure 40. Excavation of Activated Concrete North Side of Enclosure

7704-62360

Figure 41. Excavation of Activated Concrete South Side of Enclosure



7704-62361

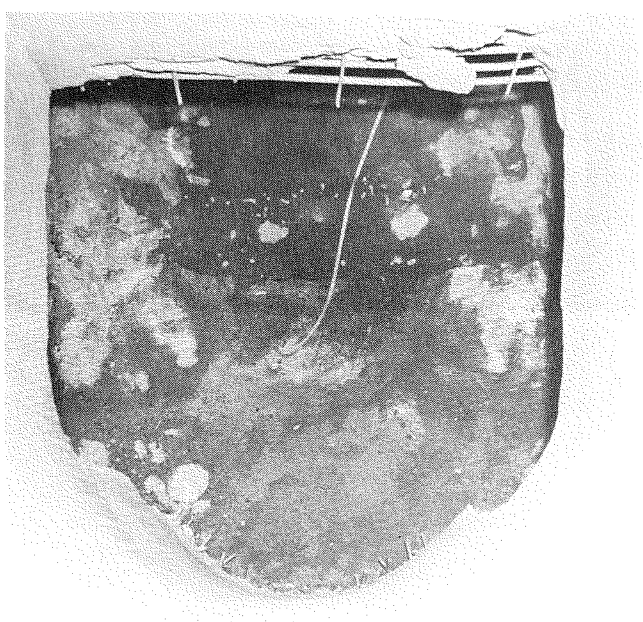


Figure 42. Excavation of Activated Concrete at Lower End of Enclosure

7704-62362

TABLE 10

RADIATION LEVELS OF SOIL SURROUNDING REACTOR CAVITY

Sample Number	Description and Location		Sample Weight (g)	Analysis (pCi/g β)
1	Soil, North Wall Reactor Cavity	West End	2.0	22.6
2	Soil, North Wall Reactor Cavity	West End	2.0	24.1
3	Soil, North Wall Reactor Cavity	West End	2.0	30.8
4	Soil, North Wall Reactor Cavity	West End	2.0	23.1
5	Soil, North Wall Reactor Cavity	Center	2.0	22.8
6	Soil, North Wall Reactor Cavity	Center	2.0	22.4
7	Soil, North Wall Reactor Cavity	Center	2.0	25.5
8	Soil, North Wall Reactor Cavity	Center	2.0	26.7
9	Soil, North Wall Reactor Cavity	East End	2.0	22.0
10	Soil, North Wall Reactor Cavity	East End	2.0	23.2
11	Soil, North Wall Reactor Cavity	East End	2.0	24.4
12	Soil, North Wall Reactor Cavity	East End	2.0	22.9
13	Soil, Floor of Reactor Cavity	North Side	2.0	19.5
14	Soil, Floor of Reactor Cavity	North Center	2.0	20.7
15	Soil, Floor of Reactor Cavity	Center	2.0	18.5
16	Soil, Floor of Reactor Cavity	South Center	2.0	14.4
17	Soil, Floor or Reactor Cavity	South Side	2.0	15.2
18	Soil, South Wall Reactor Cavity	West	2.0	23.8
19	Soil, South Wall Reactor Cavity	West	2.0	29.1
20	Soil, South Wall Reactor Cavity	West	2.0	27.9
21	Soil, South Wall Reactor Cavity	Center	2.0	20.8
22	Soil, South Wall Reactor Cavity	Center	2.0	21.7
23	Soil, South Wall Reactor Cavity	Center	2.0	25.0
24	Soil, South Wall Reactor Cavity	East	2.0	20.8
25	Soil, South Wall Reactor Cavity	East	2.0	26.1

Table 10. The natural background radioactivity levels of soil in the general environs of the AI Santa Susana site have historically measured from 20 to 30 pCi/g β. The data in this table show that the soil surrounding the concrete is at these background radioactivity levels. Surface radiation levels associated with the rebar projecting from the remaining concrete in all cases were below the 0.1 mrad/hr established limit.

Table 11 represents the results of radiological survey of the test vault area upon completion of the activated concrete removal.

d. Air Sampling

Continuous air sampling was conducted by HSRS whenever the potential for airborne radioactivity existed, e.g., when using the Hoe-Ram for removing the activated concrete, which generated considerable dust. Control of the dust was effected by use of a water spray and by sealing the test vault area with plastic sheeting, taped at all openings, i.e., the stairway opening, the upper end of the reactor enclosure, and the roll-type door. Two air samplers were operated continuously during these operations and no significant airborne contamination was found. The data obtained from these samplers are reported in Table 12.

e. Contractor's Equipment

A contamination survey of the contractor's equipment following decontamination revealed that the equipment was not contaminated and could be released. Removable contamination levels on all equipment released were <30 dpm β-γ/100 cm^2.

4. Facility Exhaust System

Upon completion of the concrete removal, the facility exhaust system was radiologically surveyed. Only in one location, the grille opening directly over the thermal column area in the test vault, was measurable radioactivity detected. The exhaust system ducts directly associated with the grille were removed and sent to the RMDF. Radiological surveys of the entire remaining exhaust system were performed, and no radioactivity levels above the established limits were found. Table 13 presents the survey data for the exhaust system. The filters in the exhaust system were removed and packaged for disposal as radioactive waste.

TABLE 11

SMEAR SURVEY OF TEST VAULT
AFTER CONCRETE REMOVAL
(Sheet 1 of 3)

Sample Number	Description and Location	Analysis (dpm α/100 cm^2)	Analysis (dpm β-γ/100 cm^2)
1	Floor Area — T-028 Test Vault	0	30
2	Floor Area — T-028 Test Vault	0	30
3	Floor Area — T-028 Test Vault	0	30
4	Floor Area — T-028 Test Vault	0	30
5	Floor Area — T-028 Test Vault	0	30
6	Floor Area — T-028 Test Vault	0	30
7	Floor Area — T-028 Test Vault	0	30
8	Floor Area — T-028 Test Vault	0	30
9	Floor Area — T-028 Test Vault	0	30
10	Floor Area — T-028 Test Vault	0	30
11	Floor Area — T-028 Test Vault	0	30
12	Floor Area — T-028 Test Vault	0	30
13	Floor Area — T-028 Test Vault	0	30
14	Floor Area — T-028 Test Vault	0	30
15	Floor Area — T-028 Test Vault	0	30
16	Floor Area — T-028 Test Vault	0	30
17	Floor Area — T-028 Test Vault	0	30
18	Floor Area — T-028 Test Vault	0	30
19	Floor Area — T-028 Test Vault	0	30
20	Floor Area — T-028 Test Vault	0	30
21	Floor Area — T-028 Test Vault	0	30
22	Floor Area — T-028 Test Vault	0	30
23	Floor Area — T-028 Test Vault	0	30
24	Floor Area — T-028 Test Vault	0	30
25	Floor Area — T-028 Test Vault	0	30
26	Floor Area — T-028 Test Vault	0	30
27	Floor Area — T-028 Test Vault	0	30
28	Floor Area — T-028 Test Vault	0	30
29	Floor Area — T-028 Test Vault (Change Area Temporary)	0	30

TABLE 11

SMEAR SURVEY OF TEST VAULT
AFTER CONCRETE REMOVAL
(Sheet 2 of 3)

Sample Number	Description and Location	Analysis (dpm α/100 cm^2)	Analysis (dpm β-γ/100 cm^2)
30	Floor Area — T-028 Test Vault (Change Area Temporary)	0	30
31	Stair Well to T-028 Test Vault	0	30
32	Stair Well to T-028 Test Vault	0	30
33	Stair Well to T-028 Test Vault	0	30
34	Stair Well to T-028 Test Vault	0	30
35	T-028 Test Vault Walls - South Wall - East Corner	0	30
36	T-028 Test Vault Walls - South Wall - East Corner	0	30
37	T-028 Test Vault Walls - South Wall - East Corner	0	30
38	T-028 Test Vault Walls - South Wall - East Corner	0	30
39	T-028 Test Vault Walls - South Wall - East Corner	0	30
40	T-028 Test Vault Walls - South Wall - East Corner	0	30
41	T-028 Test Vault Walls - South Wall	0	30
42	T-028 Test Vault Walls - South Wall	0	30
43	T-028 Test Vault Walls - South Wall	0	30
44	T-028 Test Vault Walls - South Wall	0	30
45	T-028 Test Vault Walls - South Wall	0	30
46	T-028 Test Vault Walls - West Wall	0	30
47	T-028 Test Vault Walls - West Wall	0	30
48	T-028 Test Vault Walls - West Wall	0	30

TABLE 11

SMEAR SURVEY OF TEST VAULT
AFTER CONCRETE REMOVAL
(Sheet 3 of 3)

Sample Number	Description and Location	Analysis (dpm $\alpha/100\ cm^2$)	Analysis (dpm $\beta-\gamma/100\ cm^2$)
49	T-028 Test Vault Walls - West Wall	0	30
50	T-028 Test Vault Walls - West Wall	0	30
51	T-028 Test Vault Walls - West Wall	0	30
52	T-028 Test Vault Walls - West Wall	0	30
53	Roll-Up Door - North Wall	0	30
54	Roll-Up Door - North Wall	0	30
55	North Wall	0	30
56	North Wall	0	30
57	North Wall	0	30
58	North Wall	0	30
59	North Wall	0	30
60	North Wall	0	30
61	T-028 Test Vault Walls - North Wall	0	30
62	T-028 Test Vault East Wall	0	30
63	T-028 Test Vault East Wall	0	30
64	T-028 Test Vault East Wall	0	30
65	T-028 Test Vault East Wall	0	30
66	Weather Proof Work Lights (North Wall)	0	30
67	Weather Proof Work Lights (North Wall)	0	30

TABLE 12

AIR SAMPLING DURING CONCRETE REMOVAL

Sample No.	Sampler Location No.*	Date of Sample	Immediate Count ($\mu Ci/cm^3\ \beta$)	Delay Count Date	Delay Count ($\mu Ci/cm^3\ \beta$)
1 (Background)	1	1-14-76	2.03×10^{-12}	1-15-76	8.0×10^{-13}
2 (Background)	2	1-14-76	2.42×10^{-12}	1-15-76	2.6×10^{-13}
3 (Max for Date)	1	1-15-76	4.67×10^{-11}	1-16-76	2.56×10^{-12}
4 (Max for Date)	2	1-15-76	5.18×10^{-11}	1-16-76	7.04×10^{-12}
5 (Max for Date)	1	1-16-76	8.26×10^{-12}	1-19-76	2.93×10^{-12}
6 (Max for Date)	2	1-16-76	9.07×10^{-12}	1-19-76	1.73×10^{-12}
7 (Max for Date)	1	1-19-76	4.13×10^{-12}	1-20-76	3.73×10^{-12}
8 (Max for Date)	2	1-19-76	8.00×10^{-12}	1-20-76	5.60×10^{-12}
9 (Max for Date)	1	1-20-76	3.48×10^{-11}	1-21-76	3.73×10^{-13}
10 (Max for Date)	2	1-20-76	4.18×10^{-11}	1-21-76	2.67×10^{-13}
11 (Max for Date)	1	1-21-76	1.29×10^{-11}	1-22-76	1.85×10^{-13}
12 (Max for Date)	2	1-21-76	1.69×10^{-11}	1-22-76	2.62×10^{-12}
13 (Max for Date)	1	1-22-76	3.22×10^{-11}	1-23-76	1.33×10^{-12}
14 (Max for Date)	2	1-22-76	2.88×10^{-11}	1-23-76	2.67×10^{-13}
15 (Max for Date)	1	1-23-76	1.78×10^{-11}	1-26-76	5.66×10^{-12}
16 (Max for Date)	2	1-23-76	1.78×10^{-11}	1-26-76	3.94×10^{-12}
17 (Max for Date)	1	1-26-76	3.13×10^{-12}	1-27-76	3.80×10^{-13}
18 (Max for Date)	2	1-26-76	2.66×10^{-12}	1-27-76	3.60×10^{-13}
19 (Max for Date)	1	1-27-76	1.35×10^{-12}		
20 (Max for Date)	2	1-27-76	5.37×10^{-12}		

*Location 1 - Test Vault Exit Door
Location 2 - Near Thermal Column Opening

TABLE 13

EXHAUST SYSTEM RADIOLOGICAL SURVEY REPORT

Sample Number	Description and Location	Analysis (dpm β-γ/100 cm^2)	Analysis (dpm α/100 cm^2)
1	Back Side of Fume Hood Inside Panel (R) Side	<50	<5
2	Back Side of Fume Hood Inside Panel (R) Side	<50	<5
3	Back Side of Fume Hood Inside Panel (R) Side	<50	<5
4	Back Side of Fume Hood Inside Panel (L) Side	<50	<5
5	Back Side of Fume Hood Inside Panel (L) Side	<50	<5
6	Back Side of Fume Hood Inside Panel (L) Side	<50	<5
7	Back Side of Fume Hood Inside Panel Top (Exhaust Opening)	<50	<5
8	Back Side of Fume Hood Inside Panel Top (Exhaust Opening)	<50	<5
9	Back Side of Fume Hood Inside Panel Top (Exhaust Opening)	<50	<5
10	Back Side of Fume Hood Inside Panel Top (R) Side	<50	<5
11	Back Side of Fume Hood Inside Panel Top (L) Side	<50	<5
12	Test Vault (L) Wall Exhaust Opening	<50	<5
13	Test Vault (L) Wall Exhaust Opening	<50	<5
14	Test Vault (L) Wall Exhaust Opening	<50	<5
15	Duct/Exhaust Reactor Room	<50	<5
16	Duct/Exhaust Reactor Room	<50	<5
17	Duct/Exhaust Reactor Room	<50	<5
18	Duct/Exhaust Reactor Room	<50	<5
19	Facility Exhaust Stack (Top End of Stack)	<50	<5
20	Facility Exhaust Stack (Top End of Stack)	<50	<5

5. Facility Repairs

The demolition contractor filled the reactor cavity with fill dirt and non-radioactive rubble. The opening in the test vault was sealed with a 6-in. thick concrete-steel reinforced wall. The reactor cavity opening in the reactor room was paved with concrete. Other pits and trenches deemed unsafe were also filled and paved. Included were the storage pit in the laboratory room, the shield door rail excavations, and the pipe pits near the reactor cavity. Figure 43 shows the concrete forming for the test vault wall repair. Figure 44 shows the completed wall. Figure 45 shows the reactor room floor after paving.

6. Disposal of Radioactive Waste

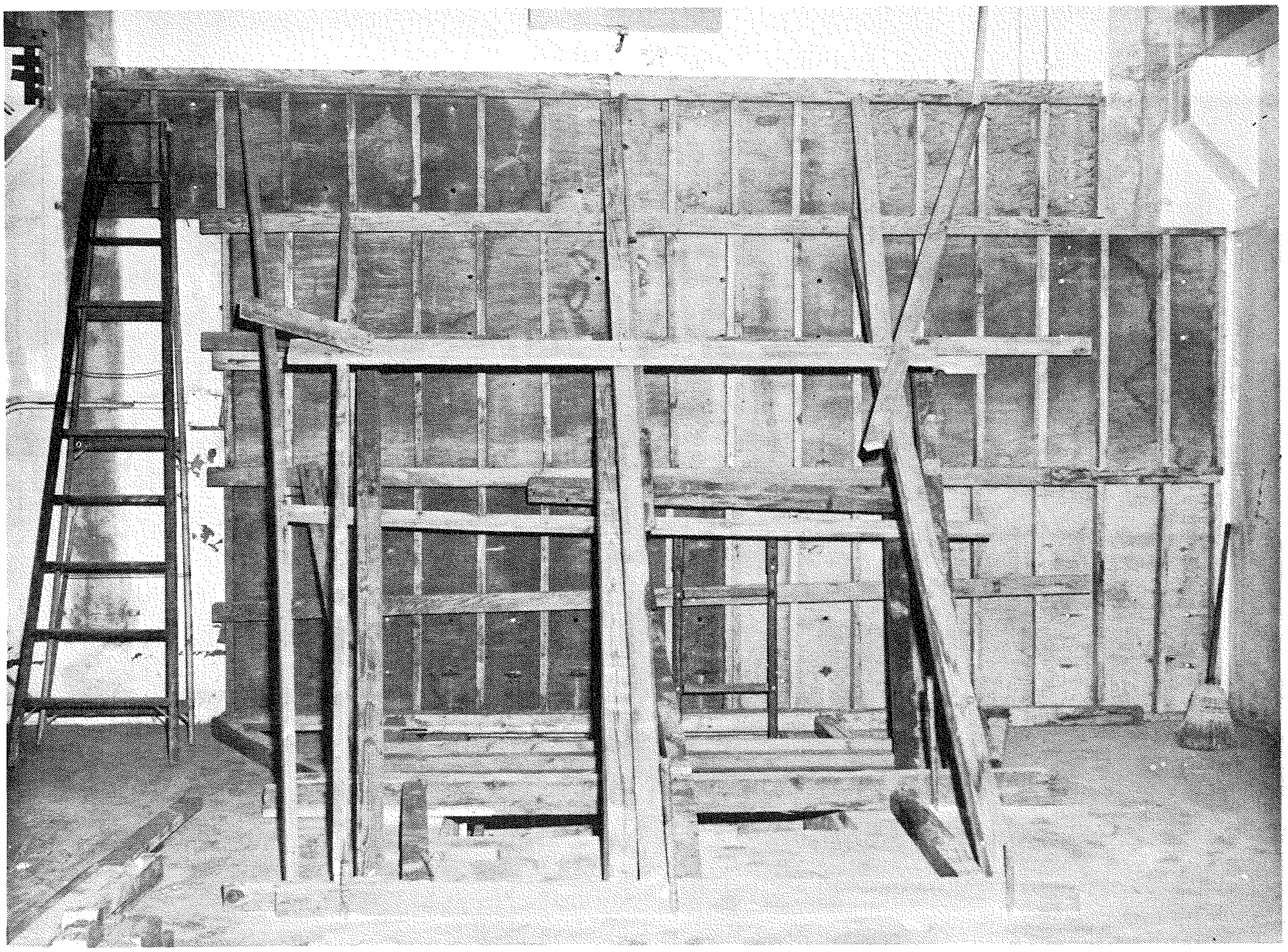
All radioactive waste generated from the STIR D&D activities was sent to the RMDF. Contaminated water from the concrete coring and Hoe-Ram operations was evaporated. Solid waste was packaged in containers and shipped in three shipments to Beatty, Nevada for land burial. A total of 1500 ft^3 of waste was shipped.

7. Personnel Dosimetry

Monitoring of internal and external radiation exposure to personnel, as prescribed in the Operational Safety Plan, was conducted throughout the STIR dismantling operations.

Personnel were periodically evaluated, by urinalysis, for internal exposure to mixed fission products, activation products, and nonspecific gross alpha emitters. All results were at or below the appropriate minimum detection limits for the analysis performed.

The external radiation exposure of the nine persons directly associated with the dismantling operations, during the period of September 24, 1975 through January 31, 1976, when the reactor internals, reactor vessel, and reactor shielding were removed, averaged 193 mrem, with a maximum individual exposure of 420 mrem. The entire operation was performed with a total radiation exposure of 1.7 man-rem.

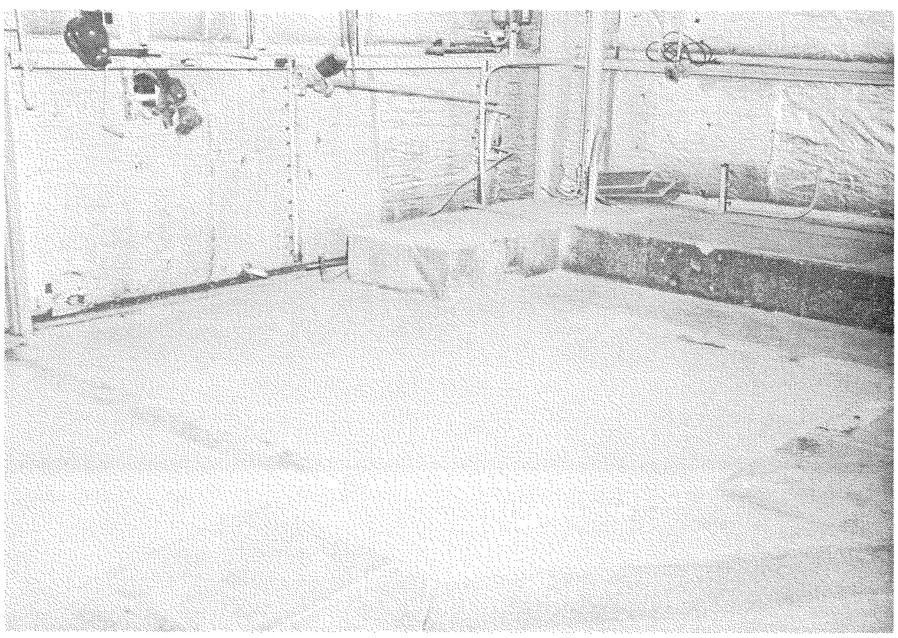


7704-62389

Figure 43. STIR-Concrete Forming in Repair of Excavation in Test Vault

7704-62442CN

Figure 44. Repaired Wall in Test Vault



7704-62470CN

Figure 45. Repaired Floor in Reactor Room

8. Final Survey of the STIR Facility

A final survey of the total facility was conducted to verify that the radiation levels in the facility have been reduced to <0.1 mrad/hr. The radiation survey was conducted in the interior spaces of Building T028, with a Technical Associates PUG-1 thin-window GM survey instrument and an Eberline E-510 GM survey instrument equipped with a 7 mg/cm^2 absorber over the detector window. The radiation levels measured throughout the building with the 7 mg/cm^2 absorber detector ranged from 0.02 to 0.05 mrad/hr above background. The maximum level measured with the 7 mg/cm^2 absorber detector was 0.07 mrad/hr at the west end of the thermal column in the test vault. The radiation levels on the reactor cavity excavation ranged from 0.02 to 0.04 mrad/hr. The radiation levels in the fission plate storage pit directly below the thermal column ranged from 0.02 to 0.05 mrad/hr above background. The surveys were conducted throughout the interior of Building 028 and throughout the fenced-in area surrounding the building.

Tables 14 and 15 describe the final radiation survey meter measurements at specific interior and exterior locations shown in Figures 46 and 47 respectively. Table 16 summarizes the final radiological survey, including radiation and removable contamination measurements.

TABLE 14

T028 STIR INTERIOR FACILITY SURVEY
(Refer to Figure 46)

(mrad/hr)

1.	0.03	26.	0.04	51.	0.03	76.	0.04
2.	0.04	27.	0.04	52.	0.04	77.	0.07
3.	0.03	28.	0.03	53.	0.03	78.	0.05
4.	0.03	29.	0.04	54.	0.03	79.	0.04
5.	0.04	30.	0.04	55.	0.04	80.	0.05
6.	0.03	31.	0.03	56.	0.04	81.	0.07
7.	0.04	32.	0.03	57.	0.04	82.	0.04
8.	0.03	33.	0.03	58.	0.03	83.	0.04
9.	0.03	34.	0.03	59.	0.03	84.	0.04
10.	0.04	35.	0.03	60.	0.03	85.	0.04
11.	0.03	36.	0.03	61.	0.04	86.	0.04
12.	0.03	37.	0.03	62.	0.04	87.	0.04
13.	0.04	38.	0.03	63.	0.03	88.	0.04
14.	0.04	39.	0.03	64.	0.03	89.	0.04
15.	0.04	40.	0.04	65.	0.03	90.	0.04
16.	0.04	41.	0.03	66.	0.04	91.	0.04
17.	0.03	42.	0.03	67.	0.04	92.	0.04
18.	0.04	43.	0.03	68.	0.04	93.	0.04
19.	0.04	44.	0.03	69.	0.03	94.	0.04
20.	0.04	45.	0.04	70.	0.03	95.	0.04
21.	0.03	46.	0.04	71.	0.03	96.	0.04
22.	0.03	47.	0.03	72.	0.04	97.	0.04
23.	0.03	48.	0.03	73.	0.04	98.	0.04
24.	0.04	49.	0.03	74.	0.04	99.	0.04
25.	0.04	50.	0.03	75.	0.04	100.	0.04

NOTE: Background of 0.03 - 0.04 mrad/hr included in radiation measurements.

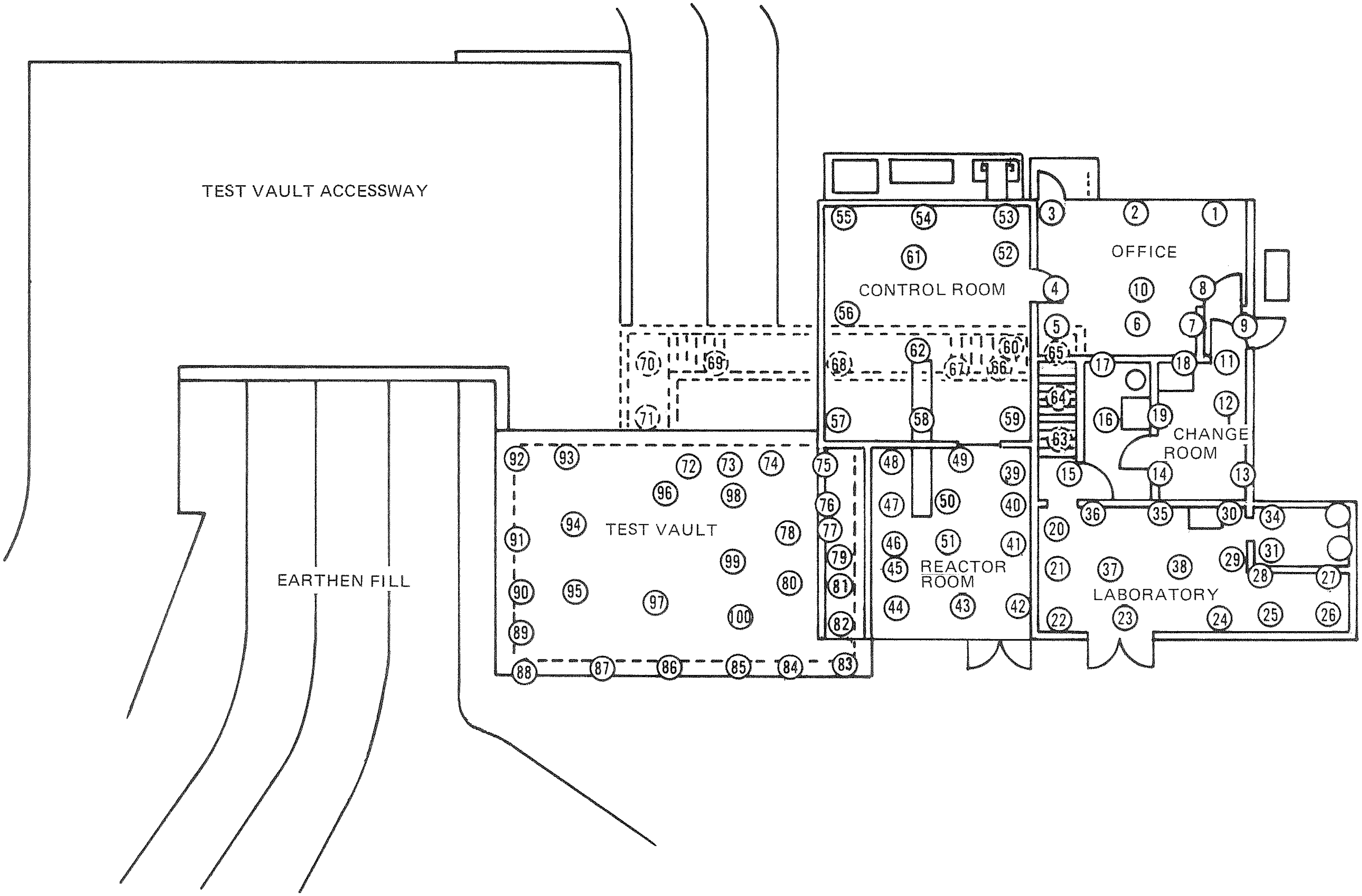


Figure 46. STIR – T028 Interior Radiation Survey

TABLE 15

T028 STIR EXTERIOR FACILITY SURVEY
(Refer to Figure 47)

(mrad/hr)			
1. 0.03	21. 0.06	41. 0.04	61. 0.03
2. 0.03	22. 0.05	42. 0.04	62. 0.03
3. 0.03	23. 0.05	43. 0.04	63. 0.03
4. 0.02	24. 0.04	44. 0.04	64. 0.04
5. 0.02	25. 0.04	45. 0.04	65. 0.04
6. 0.02	26. 0.04	46. 0.03	66. 0.04
7. 0.02	27. 0.04	47. 0.03	67. 0.04
8. 0.02	28. 0.04	48. 0.03	68. 0.03
9. 0.02	29. 0.04	49. 0.03	69. 0.03
10. 0.02	30. 0.03	50. 0.04	70. 0.04
11. 0.03	31. 0.04	51. 0.04	71. 0.04
12. 0.03	32. 0.04	52. 0.04	72. 0.04
13. 0.03	33. 0.03	53. 0.03	73. 0.04
14. 0.02	34. 0.03	54. 0.03	74. 0.04
15. 0.02	35. 0.03	55. 0.04	75. 0.04
16. 0.03	36. 0.03	56. 0.04	76. 0.04
17. 0.03	37. 0.03	57. 0.04	77. 0.04
18. 0.04	38. 0.03	58. 0.04	78. 0.03
19. 0.04	39. 0.03	59. 0.03	79. 0.04
20. 0.08	40. 0.04	60. 0.03	80. 0.04

NOTE: Background of 0.02 - 0.04 mrad/hr included in radiation measurements

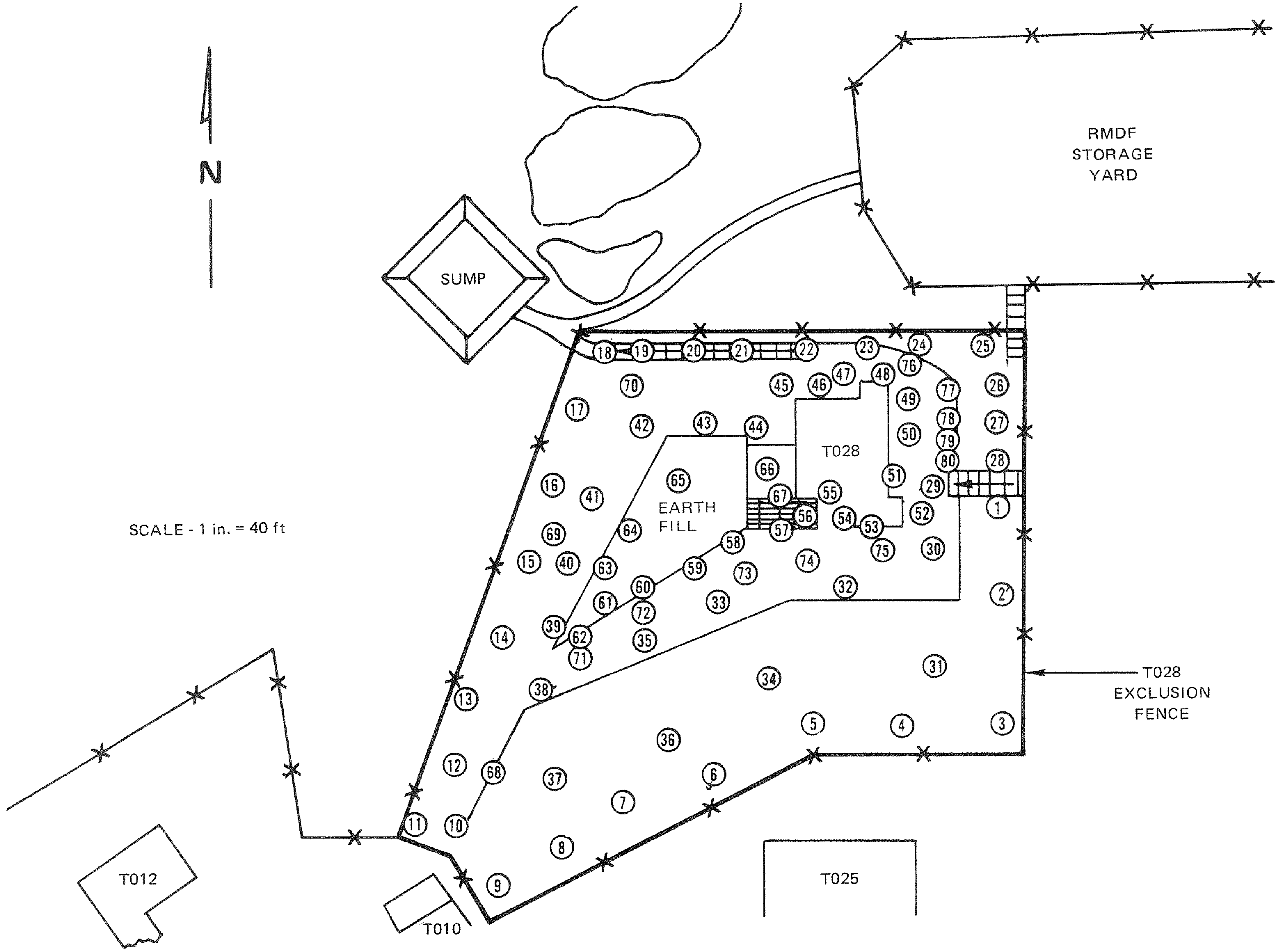


Figure 47. STIR — T028 Exterior Radiation Survey

TABLE 16

T028 STIR FINAL RADIOLOGICAL SURVEY SUMMARY

Location	Survey Type	Total Smears	Maximum Removable Contamination Level	Maximum Radiation Level* (mrad/hr)
1. Office Area	A&B	250	0 dpm/100 cm^2 α <30 dpm/100 cm^2 β-γ	0.04
2. Control Room	A&B	270	0 dpm/100 cm^2 α <30 dpm/100 cm^2 β-γ	0.04
3. Change Room	A&B	160	0 dpm/100 cm^2 <30 dpm/100 cm^2 β-γ	0.04
4. Darkroom	A&B	120	0 dpm/100 cm^2 α <30 dpm/100 cm^2 β-γ	0.03
5. Laboratory	A&B	265	0 dpm/100 cm^2 α <30 dpm/100 cm^2 β-γ	0.04
6. Reactor Room	A&B	280	0 dpm/100 cm^2 α <60 dpm/100 cm^2 β-γ	0.04
7. Stairway and Tunnel	A&B	95	0 dpm/100 cm^2 α <30 dpm/100 cm^2 β-γ	0.04
8. Test Vault	A&B	760	0 dpm/100 cm^2 α <50 dpm/100 cm^2 β-γ	0.07
9. Exhaust System	A&B	100	0 dpm/100 cm^2 α <30 dpm/100 cm^2 β-γ	0.04
10. Cooling System Area	B			0.04
11. Blacktop Surfaces	B			0.04
12. North Perimeter Stairway	B			0.08
13. Reactor Cavity and Thermal Column	C		23.7 ± 2.6 pCi/g β(Soil) 19.0 pCi/g β(Concrete)	

A — Smear
B — Survey Meter (PUG-1)
C — Radiometric
* — Total radiation reading with E-510 and 7 mg/cm^2 absorber detector
NOTE: General background level of 0.02 to 0.04 mrad/hr included in radiation measurements.

IV. STIR FACILITY D&D COSTS

The total costs for the STIR D&D are presented in Table 17. The major cost is represented by AI labor.

Nuclear Engineering Company was the contractor for burial of the radioactive waste material. Lester Cushing Company was employed as the demolition contractor and United Scrap Metals as the salvage contractor.

TABLE 17

STIR FACILITY D&D COSTS

Total Labor Costs	
AI	$ 88,442
Rocketdyne	710
Subcontracted Costs	
Nuclear Engineering Corp.	$ 6,908
Lester Cushing	18,370
Other Costs	
Materials	$ 4,104
Miscellaneous	
a. G&A	7,749
b. Fee	8,639
Total D&D Costs	$134,922

REFERENCES

1. "Hazards Summary Report, STIR Modifications for 1-Megawatt Operation, NAA-SR-MEMO-9129 (December 15, 1963)

2. "Startup and Operation of the 1 Megawatt STIR," NAA-SR-11175 (March 25, 1966)

3. Operational Safety Plan for the AI Decontamination and Disposition of Facilities Program, SRR-704-990-001, Rev. B (October 21, 1975)

APPENDIX

Atomics International Division
Rockwell International

SUPPORTING DOCUMENT

NUMBER	FDP-704-990-004
REV LTR/CHG NO.	SEE SUMMARY OF CHG
DOCUMENT TYPE	Facilities Dismantling Plan
KEY NOUNS	Dismantling Plan
ORIGINAL ISSUE DATE	5-28-75
GO NO.	09070
S/A NO.	15100
PAGE 1 OF TOTAL PAGES	14
REL. DATE	5-29-75

PROGRAM TITLE

Decontamination and Disposition of Facilities Program

DOCUMENT TITLE

Facilities Dismantling Plan for STIR, Building 028

PREPARED BY/DATE	DEPT	MAIL ADDR
V. A. Swanson	713-540	T093

IR&D PROGRAM? YES ☐ NO ☒ IF YES, ENTER TPA NO. ______

APPROVALS — DATE

W. Heine *W. Heine* M. Remley *M. Remley 28 May*
P. Higgins *P. Higgins 5-28-75* B. Ureda *B. Ureda 5-28-75*
A. Graves *A. Graves 5-28-75*

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ABSTRACT

The Shield Test Irradiation Reactor (STIR) will be dismantled, and materials and components disposed of to the extent necessary to allow unrestricted use of the remaining facilities. All contaminated or radioactive materials, equipment, and facility structures will be decontaminated or removed, packaged and shipped for burial. Utilities, ventilation systems, hoist, and other items which would have future general use will not be removed. Items that will be removed include: the reactor tank, thermal column, activated concrete, cooling systems, water purification system, water door, and test carriages. The reactor tank cavity will be filled with sand and topped with concrete flush with the reactor floor.

FORM 734-C REV. 2-74

I. OBJECTIVE

The Shield Test and Irradiation Reactor (STIR) facility is shown in Figures 1-3. The reactor was operated with a 50 kwt capability between 1961 and 1964 and with a 1 Mwt capability between 1964 and 1972. The MTR type fuel elements were removed and the pool water drained in June 1973. The maximum radiation level observed in the facility in a February 1975 survey was ~800 mR/hr on the core grid plate next to the lead gamma shield.

A. DESCRIPTION OF THE STIR FACILITY

1. Reactor

The reactor core was located at the bottom of a 5 ft diameter x 20 ft deep, water-filled aluminum tank. The fuel elements have been removed but the grid plate and support structure are still in place. The tank sits in a concrete well with a 6-inch annulus of pea gravel between the concrete and the tank. The west side of the tank near the bottom was modified to mate to the thermal column leading to the test vault and to provide a lead and bismuth gamma shield between the core and the thermal column. The control rods and drives, and the exposure thimbles and neutron detectors have already been removed. A 2000-lb capacity, manually operated chain hoist is provided in the reactor room.

2. Thermal Column and Test Vault

The 5 ft x 5 ft x 4 ft thermal column interfaces with the reactor tank on the east side and with the test vault on the west side. It consists of an aluminum box filled with graphite logs of 4-in. x 4-in. cross section. The wall immediately around the thermal column is dense concrete.

The test vault is 20 ft x 33 ft x 17 ft - 8 in. high. A 7.5 ton bridge crane with a remotely operated manipulator attached to it services the area. Access to the test vault is through a 9 ft x 10 ft freight door or through a stairwell leading to the main floor of the building. An electrically driven, 5 ft thick, water-filled tank can be moved into a position just outside the freight door for radiation shielding. An electrically driven test carriage runs on rails in an east-west direction inside the vault. A 5 ft x 10-1/2 ft x 6 ft - 10 in. deep pit in the floor of the vault served to hold a fission plate and its shield cask. The plate and cask have been removed.

3. Cooling System

Cooling for the reactor was provided by two systems; a 50 kw refrigeration unit and a 1 Mw cooling tower. The refrigeration system consists of a freon-to-water heat exchanger in the reactor room, an airblast heat exchanger outside the reactor room, and the associated pump and plumbing. The 1 Mw cooling system consists of a cooling tower, on the secondary side, and a 4-pass, tube and shell type heat exchanger located on the roof of the test vault. Two pumps are used to circulate water through the cooling tower and a single pump, located in a trench outside the reactor room on the south side, is used to circulate water through the primary side. The water purification system, valves and piping are also located in the trench outside the reactor room. A 1000 gal distilled water make-up tank is located just south of the building.

4. Support Facilities

Located on the same level as the reactor room are the control room, office area, change room and laboratory as shown in Figure 2. The laboratory has been extended 12 ft to the south since the figures were drawn. A fume hood is provided in the laboratory area.

The ventilation system maintains the reactor room and test vault at a negative pressure relative to surrounding areas. Exhausted air passes through a particulate air filter bank before being released through the building ventilation stack.

B. DISMANTLING AND DISPOSITION

All contaminated or radioactive materials, equipment, and facility structures will be decontaminated or removed, packaged and shipped for burial. All areas of the facility and all material and equipment released for unrestricted use will be decontaminated to levels which are as low as practicable but in all cases to levels below those in Table 1. Acceptable specific activity levels for the concrete biological shielding remaining in place following completion of the dismantling operations will be developed in the Activity Requirements for the concrete removal.

TABLE 1

Contamination Limits for Decontamination and Disposition of the STIR Facility

	Total	Removable
Beta-Gamma Emitters	0.1 mrad at 1 cm with 7 mg/cm^2 absorber	100 dpm/100 cm^2
Alpha Emitters	100 dpm/100 cm^2	20 dpm/100 cm^2

The facility will not be completely dismantled. Utilities, ventilation system, hoists, and other items that might be of general use to some future project will not be removed. Items that will be removed include the reactor tank, the thermal column, the two cooling systems, the water purification system, the water shield for the test vault freight door, the test carriage and miscellaneous items which are not generally useful. The control room instrumentation and equipment, most of the laboratory equipment, and miscellaneous hardware were removed in June 1973.

II. SCOPE OF PLAN

The Dismantling Plan delineates the activities necessary to realize the objectives stated above. These activities have been categorized as follows:

1. Planning, monitoring, and control
2. Radiological survey
3. Tooling and support equipment procurement
4. Dismantling and disposal
5. Documentation

III. PLANNING, MONITORING, AND CONTROL

A schedule listing the detailed tasks and the sequence of performance has been prepared (see Figure 4). The level of manpower requirements for these activities are also shown in Figure 4.

Specific tasks will be initiated and monitored by the Program Office. The work authorizations, work releases, and progress report issuance will generally follow the format and guidelines set out in the Decontamination and Disposition of Facilities Program Plan. Quality Assurance and Health Safety and Radiation Services actions will be governed by the Quality Assurance Plan and the Operational Safety Plan, respectively. The schedule and manpower loading charts and the cost records will serve as the overall criteria to measure progress and accumulated costs.

IV. RADIOLOGICAL SURVEY

An initial radiological survey will be made to determine the extent of radioactivity present in the facility. An assessment of the probable levels of radioactivity are as follows:

A. REACTOR TANK

The highest observed radiation level as of February 1975 was 800 mR/hr measured at the top of the core grid plate next to the lead gamma shield. Most of this radiation is due to activated impurities in the 6061 T6 aluminum structure but some is probably due to Po-210 generated in the bismuth shield and activation of the gravel and concrete around the pool tank.

B. THERMAL COLUMN

The maximum radiation level at the test vault side of the thermal column is about 3 mR/hr. This is probably due to a combination of activated structural material and activated samarium oxide contamination in the graphite.

C. TEST VAULT

The concrete around the thermal column is probably activated. The rest of the vault structure indicates acceptable radiation levels. Parts of the test carriage structure and the shield mounted on it indicate radiation levels as high as 1 mR/hr.

D. COOLING SYSTEM

No radiation was detected external to the cooling system piping, heat exchangers, pumps, etc. This was true of the water purification system also. There may be some low level internal contamination.

V. TOOLING AND SUPPORT EQUIPMENT PROCUREMENT

No special tooling requirements are anticipated. Handling equipment, containers and packaging materials required for radioactive waste will be procured from the Radioactive Materials Disposal Facility (RMDF) at AI. Cranes and rigging needed for lifting and moving heavy equipment will be provided by AI Maintenance or an outside contractor.

VI. DISMANTLING AND DISPOSAL

Activity Requirements and detailed Working Procedures will be written to guide the dismantling and disposal operations. A brief description of the principal tasks are as follows.

A. PREPARATION FOR DISMANTLING AND DISPOSITION

A change area and a radiological survey station will be set up. Health and Safety equipment, instrumentation, and materials will be made available. A radiological survey will be made of all areas.

B. PERIPHERAL SYSTEMS REMOVAL

A Salvage Contractor will be used to remove non-radioactive equipment. Items such as the water door, cooling tower, and associated piping will be removed by the contractor. To facilitate his removal of the non-radioactive equipment, possibly contaminated equipment physically near will be removed early in the STIR dismantling.

and disposed of accordingly. The 50 Kw cooling system will likewise be checked for contamination and removed and disposed of accordingly. All signal cables will be removed and all electrical wiring will be removed back to the circuit breakers.

C. DISMANTLING OF TEST VAULT AREA

The water tank shield outside the freight door and the rails on which it runs will be removed. The channels provided for the rails in the concrete will be filled with concrete.

The concrete shield will be removed from the test carriage and broken up into pieces of manageable size for disposal. The test carriage and rails will be dismantled and disposed of as necessary. The drive mechanism and coolant hoses for the fission plate will be removed. The conveyor system in the stairwell and vault will be dismantled and removed. Miscellaneous hardware and equipment will be disposed of. The rails in the fission plate pit will be removed, but cleanup of the pit will be deferred until after the thermal column and pool tank have been removed.

D. REACTOR TANK - THERMAL COLUMN DISMANTLING

The grid plate, detector thimbles and internal piping will be removed from the reactor tank. The gravel in the annulus between the tank and the concrete liner will be taken out. The lead shot and bismuth "window" in the gamma shield will be removed. The aluminum tank will be cut into small sections and removed. The I-beam supports for the tank will be removed.

The cover plate on the test vault side of the thermal column will be taken off and the graphite logs removed. The aluminum liner will be removed.

The concrete around the reactor tank and around the thermal column will be checked for radioactivity and will be jackhammered or blasted out where necessary and disposed of. The concrete tank liner extending above floor level in the reactor room will be removed down to floor level. The storage wells in the reactor room floor will be decontaminated or removed for disposal. The gamma counter pit will be surveyed and decontaminated if radioactive.

E. FINAL CLEANUP

All debris from the dismantling work will be cleaned up and disposed of. A radiological survey will be made of all areas and a final cleanup will be done in those areas which are above permissible levels.

The filters in the building exhaust system will be removed and disposed of and ducting and stack checked for contamination. Any part of the exhaust system which is contaminated will either be cleaned or disposed of.

The thermal column will be plugged with concrete on the test vault side flush with the east wall of the test vault. The reactor tank cavity will be filled with sand and the top capped with concrete, flush with the reactor room floor.

VII. DOCUMENTATION

A. PROCEDURES

As indicated above, Activity Requirements and Detailed Working Procedures will be written to guide the decontamination and dismantling operations. Specific radiological and industrial safety hazards and the means for working with and elminating these hazards will be identified. The procedures will be consistent with the requirements of the Operational Safety Plan, and compliance with these requirements will be monitored by Quality Assurance and Health,Safety and Radiation Services. Detailed procedures will be released and controlled by the AI Engineering Data Release System.

B. REPORTING

Progress on the STIR D&D activities will be reported to ERDA in the Decontamination and Disposition of Facilities Program Monthly Report.

C. RECORD INFORMATION

The results of radiological surveys of the areas, materials, and equipment will be recorded. A complete accounting of all radioactivity disposed of by RMDF will be maintained. Photographic coverage of the more significant phases of dismantling will be obtained in still photos.

D. FINAL REPORT

The final report will describe the dismantling and decontamination activities. Problem areas and the subsequent solutions will be highlighted. Shipping records, showing quantities of material and the level of associated radioactivity, will be included. The report will contain the QA and HSRS records certifying the reported status of the STIR area upon completion.

REFERENCES

1) PP-704-990-002, Decontamination & Disposition of Facilities Program Plan, January 23, 1975

2) PP-704-990-001, Quality Assurance Program Plan for the Decontamination and Disposition of Facilities, Revision A, January 16, 1975

3) SRR-704-990-001, Operational Safety Plan for the AI Decontamination and Disposal of Facilities Program, Revision A, February 17, 1975

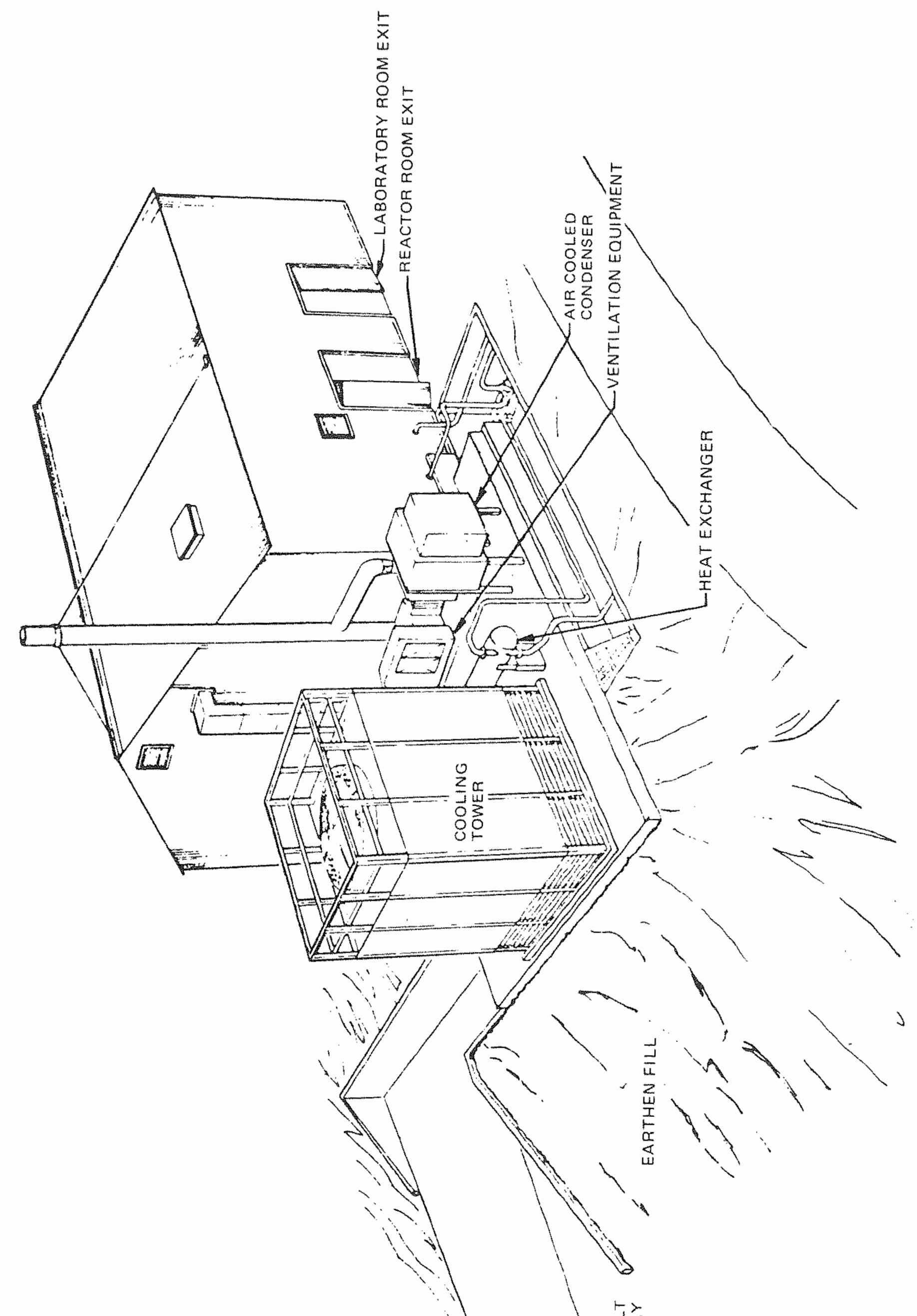

Figure 1. STIR Architectural Elevation

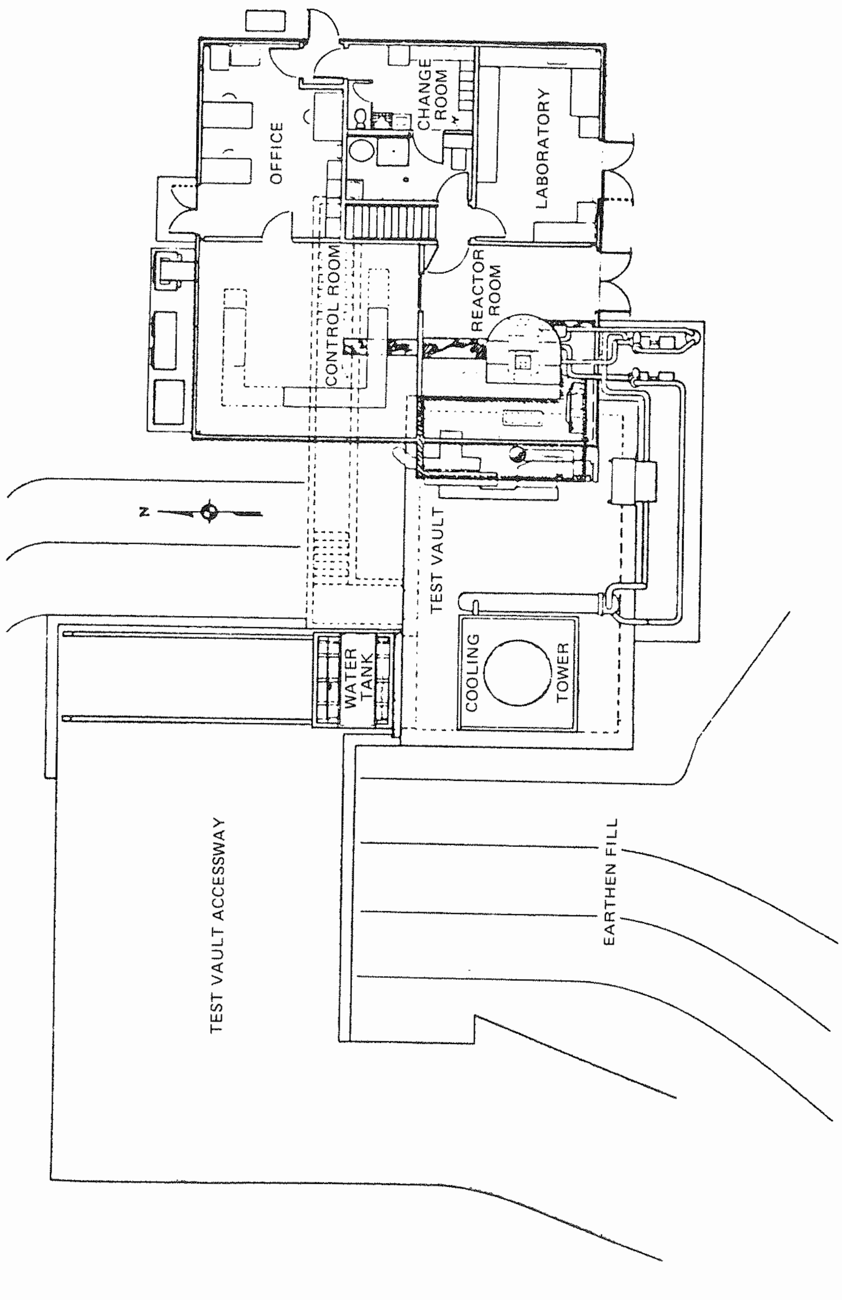

Figure 2. STIR Architectural Floor Plan

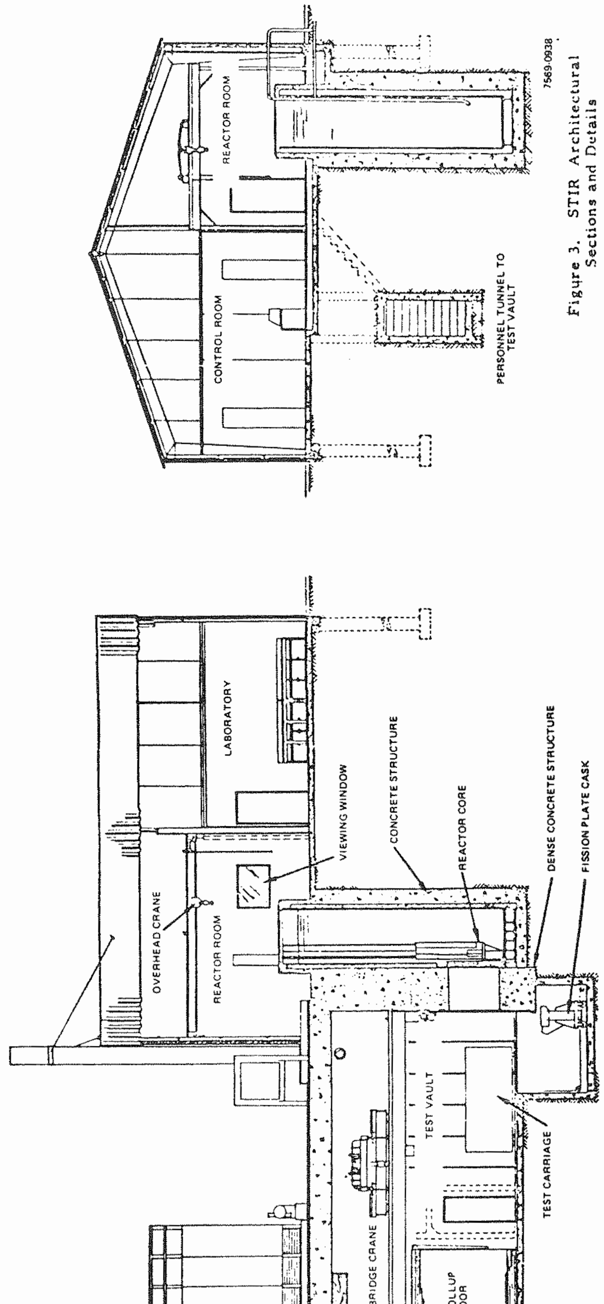

Figure 3. STIR Architectural
Sections and Details

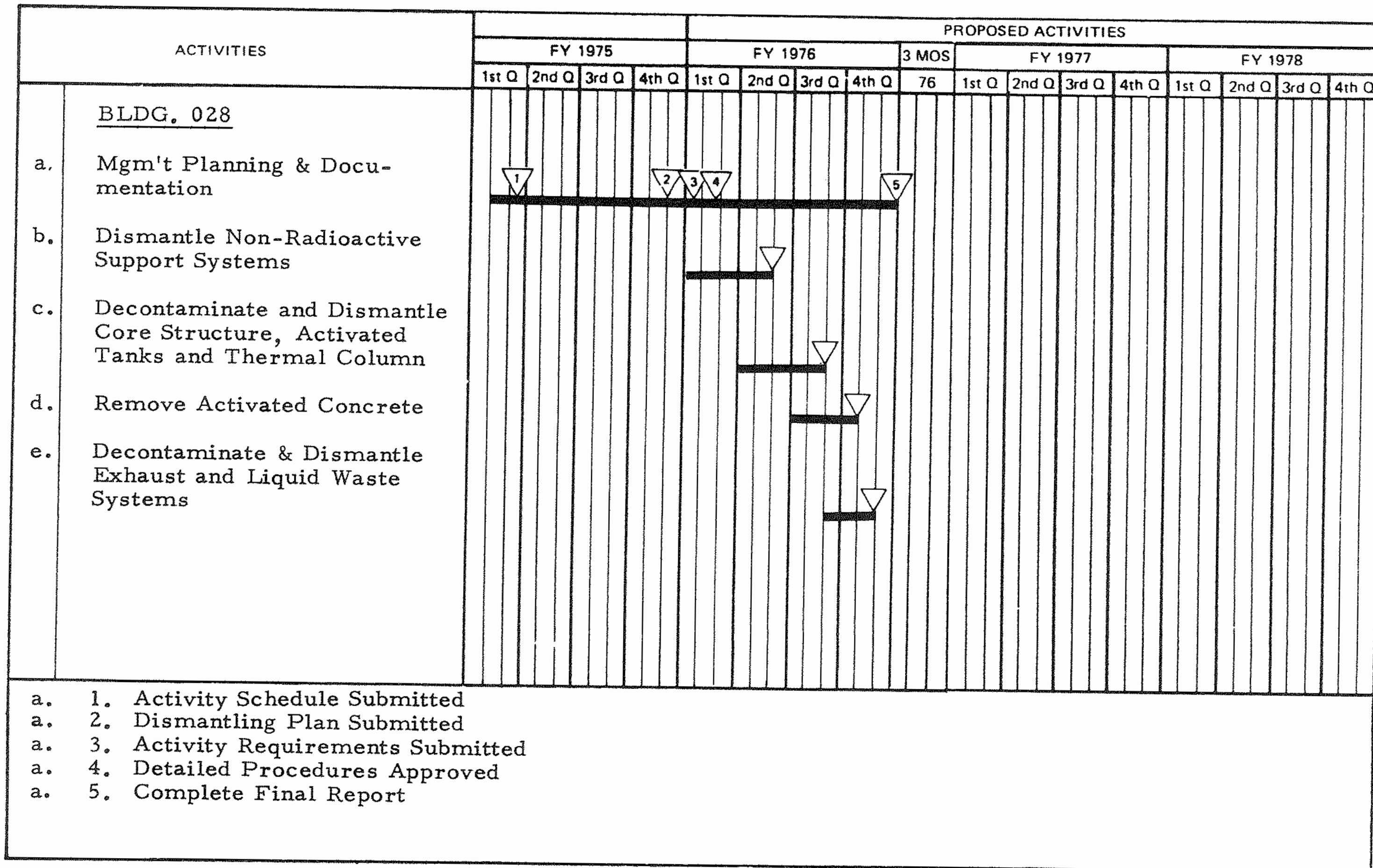

Figure 4. Decontamination and Disposition of Facilities Program, Program Activity Network, STIR Facilities