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DISPOSITION OF TA-33-21,
A PLUTONIUM CONTAMINATED EXPERIMENTAL FACILITY

ABSTRACT

This report discusses the decontamination, demolition and disposal of a plutonium contaminated experimental physics facility which housed physics experiments with plutonium from 1951 until 1960. The results of preliminary decontamination efforts in 1960 are reported along with health physics, waste management, and environmental aspects of final disposition work accomplished during 1974 and 1975.

by

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*Work done under the auspices of

The Energy Research and Development Administration

July 21, 1975

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1. History

The facility described in this report was acquired by the U. S. Atomic Energy Commission in April, 1951, at a cost of $40,819.00. During the period from 1951 until 1960, it was used for numerous physics studies, some of which involved plutonium. Most internal surfaces of the building and surfaces of experimental equipment items became contaminated on April 13, 1960, following an accidental release of approximately 300 milligrams of plutonium (^{239}Pu) oxide powder from an experimental apparatus in the process section of the main building. Soon after this accidental release occurred, preliminary decontamination efforts were initiated. Removal of contaminated equipment items and materials, and repeated washing and painting of surfaces removed and/or fixed the plutonium contamination allowing release of the building for occupancy on May 2, 1960. Due to programmatic changes, the facility was not placed back into service and it remained an excess contaminated facility until October, 1974, at which time final decontamination and demolition work was begun. Final disposition of the facility was achieved in June, 1975.

2. Description of Facility

The facility which is referred to in this report as TA-33-21 was located in Technical Area No. 33 (TA-33). The main building was designated as Building 21 or Structure No. TA-33-21 for engineering and maintenance reference.

TA-33 is a remote technical area located along State Road 4 bordered by National Park Service Land, Indian Land, and by other LASL technical areas. The site, shown in Fig. 1, is approximately 9.6 kilometers southeast of the main Los Alamos Technical Area. TA-33-21 was located approximately 100 meters southwest of the main TA-33 office and Laboratory facilities. It was referred to as the "Cut Off Building" in early Laboratory communications and drawings.

In addition to Building 21, the facility included a small compressor shed, a septic tank, a manhole structure, and several hundred meters of underground drain lines and chain link security fences. These structures, identified in Fig. 2, are:

Structure No.	TA-33-32	Septic Tank
Structure No.	TA-33-55	Compressor Building
Structure No.	TA-33-74	Manhole
Structure No.	TA-33-83	Vacuum Pump Base

As shown in Figs. 3 to 6, Building 21 was a combination concrete and wooden structure with approximately 100 square meters of floor area. The concrete portion had approximate dimensions of 11 x 5.4 x 4.2 meters and was constructed of 0.2 meter thick monolithic reinforced concrete. It had a poured concrete floor with wire reinforcement. The wooden section had approximate dimensions of 8.7 x 3.9 x 3.0 meters and was constructed of frame with sheetrock paneling on the

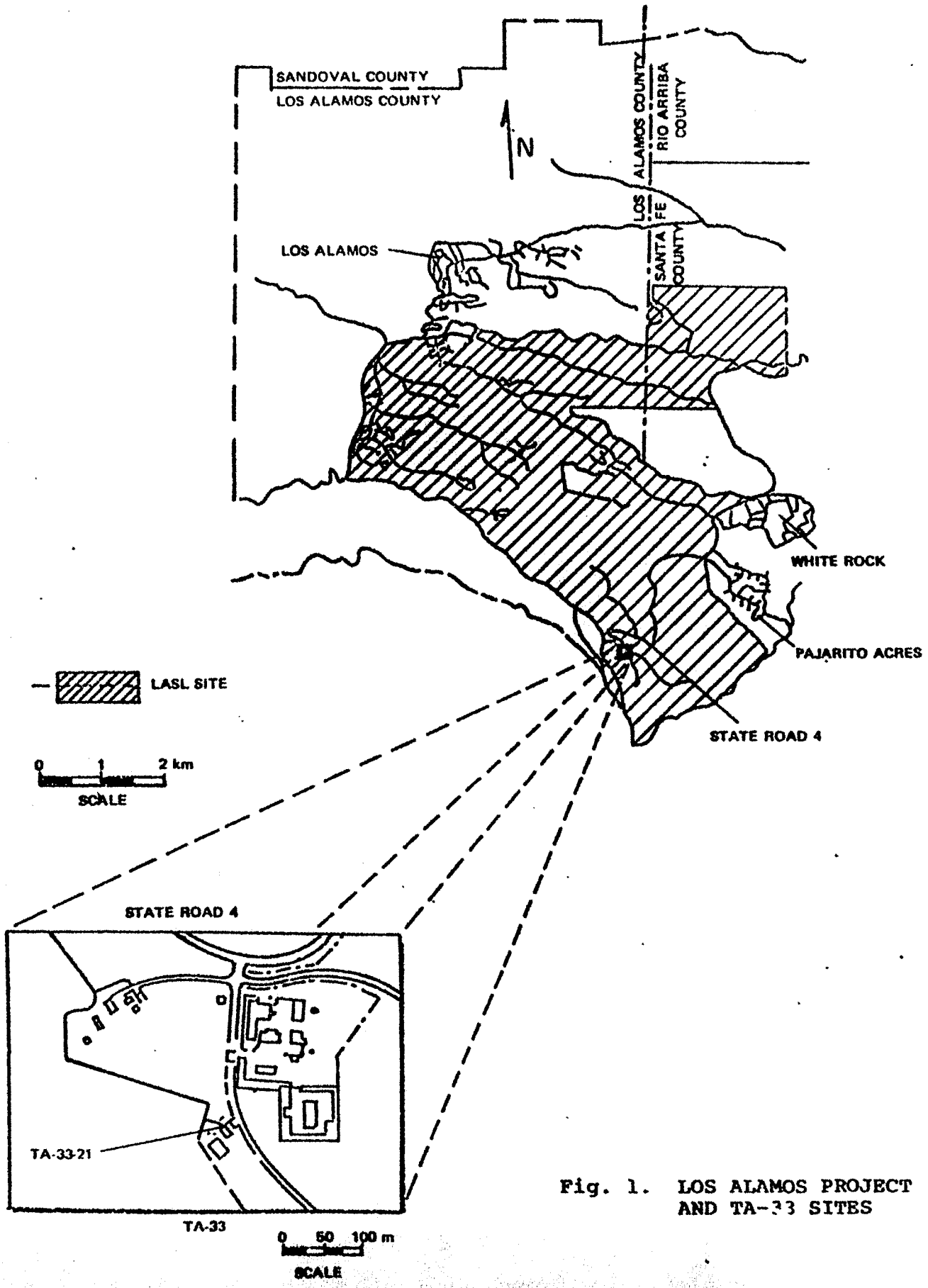

Fig. 1. LOS ALAMOS PROJECT AND TA-33 SITES

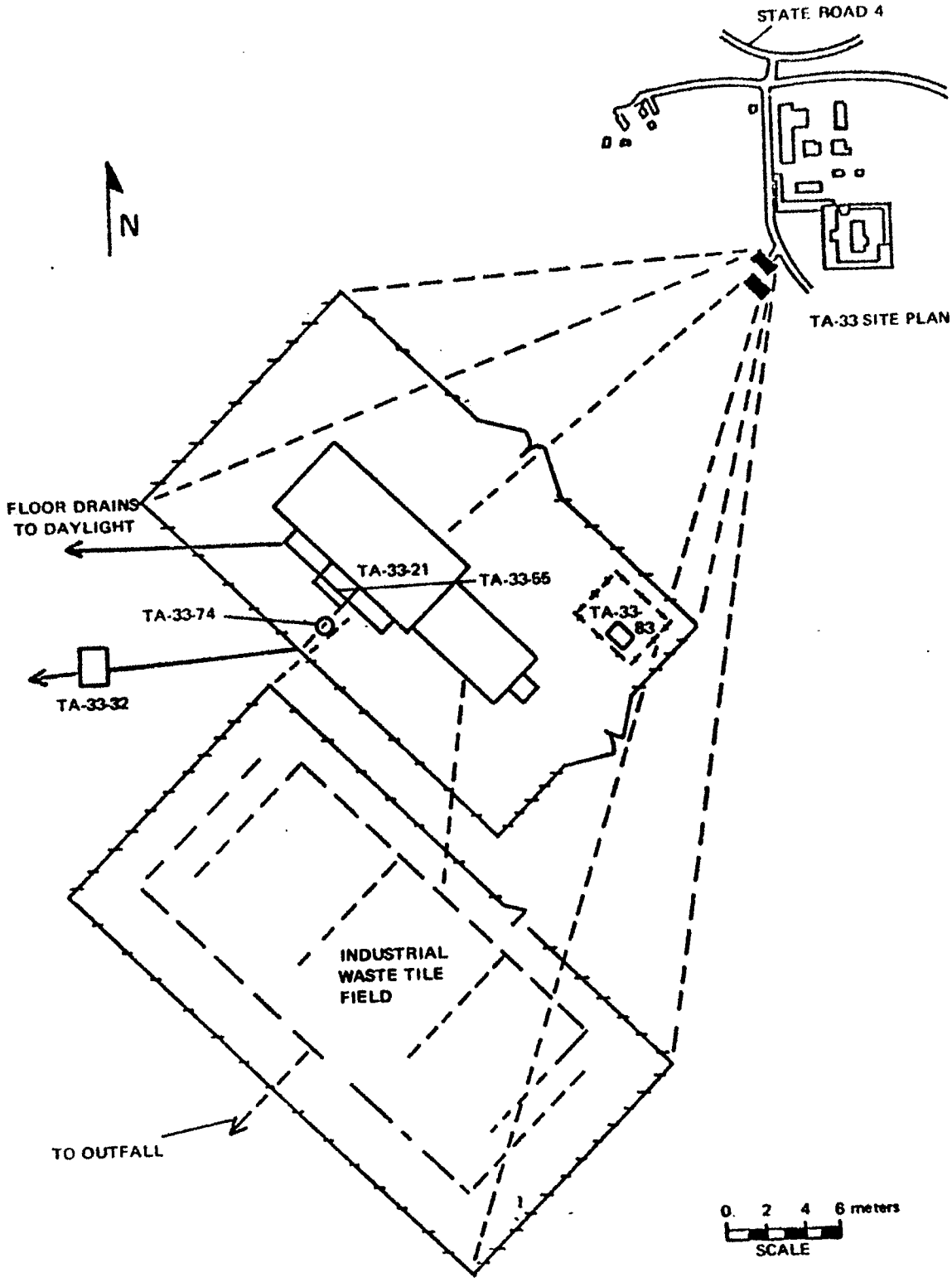

Fig. 2. TA-33 AND TA-33-21 PLANS

Fig. 3. NORTHEAST SIDE OF BUILDING 21

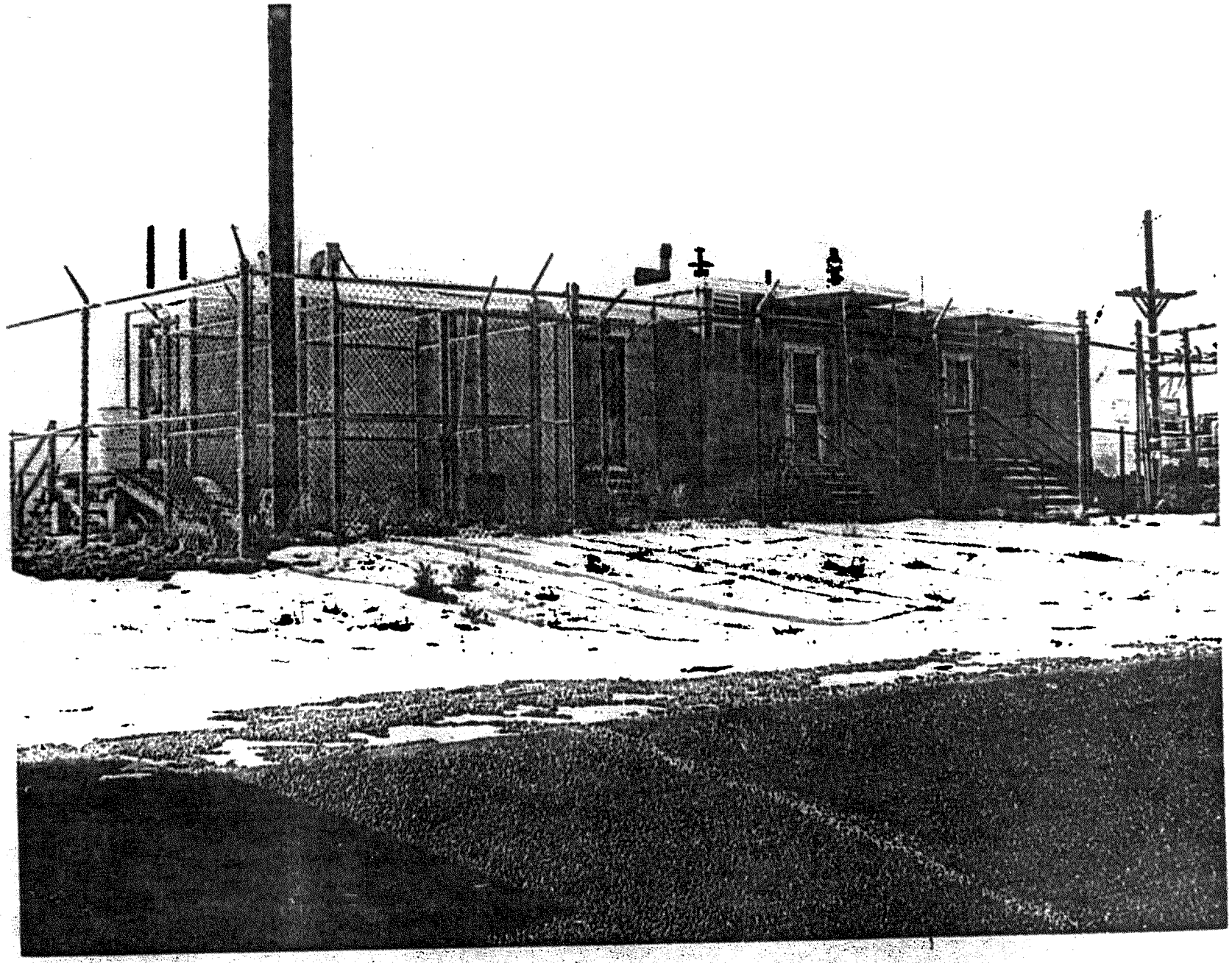

Fig. 4. SOUTHEAST SIDE OF BUILDING 21

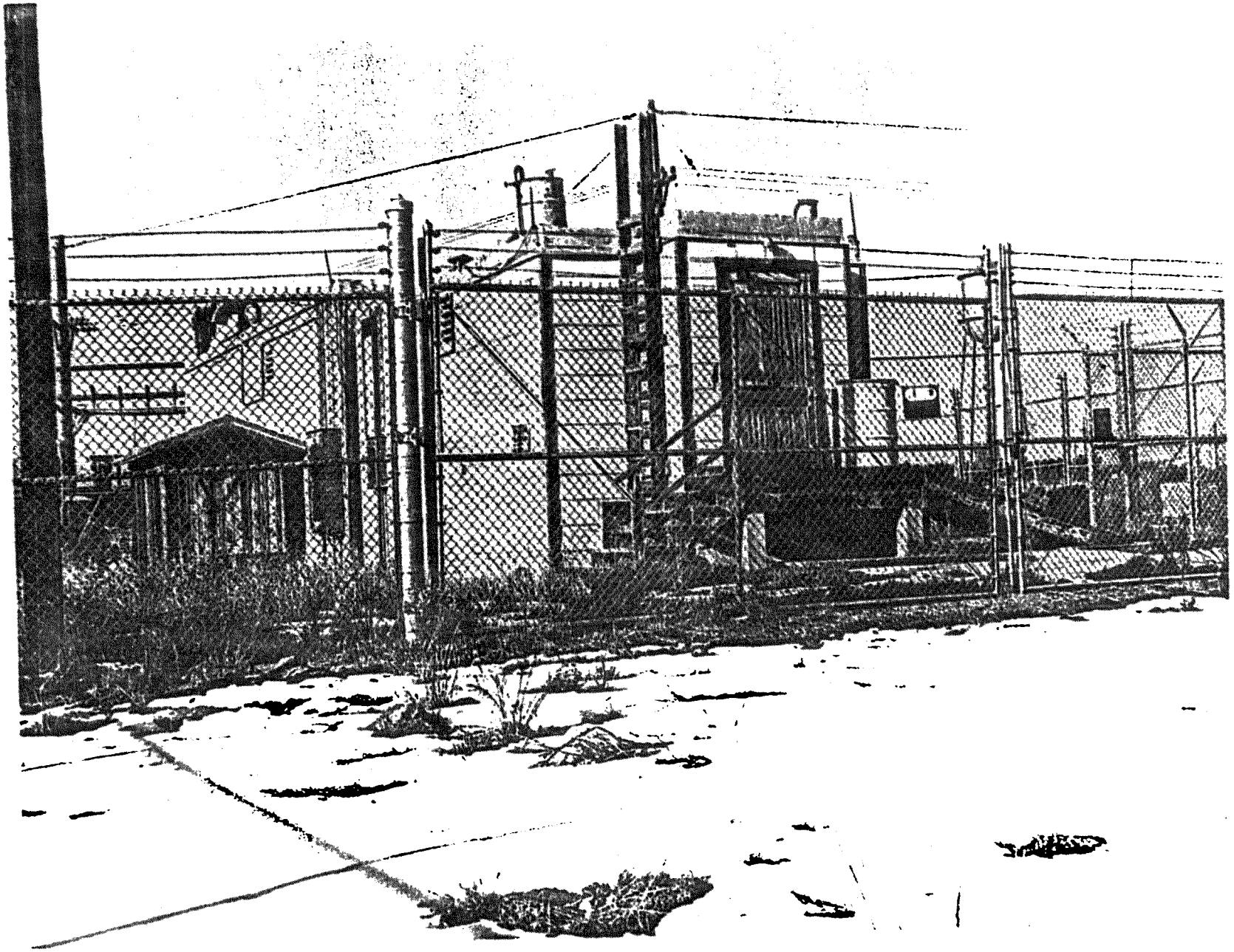

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Fig. 5. SOUTHWEST SIDE OF BUILDING 21

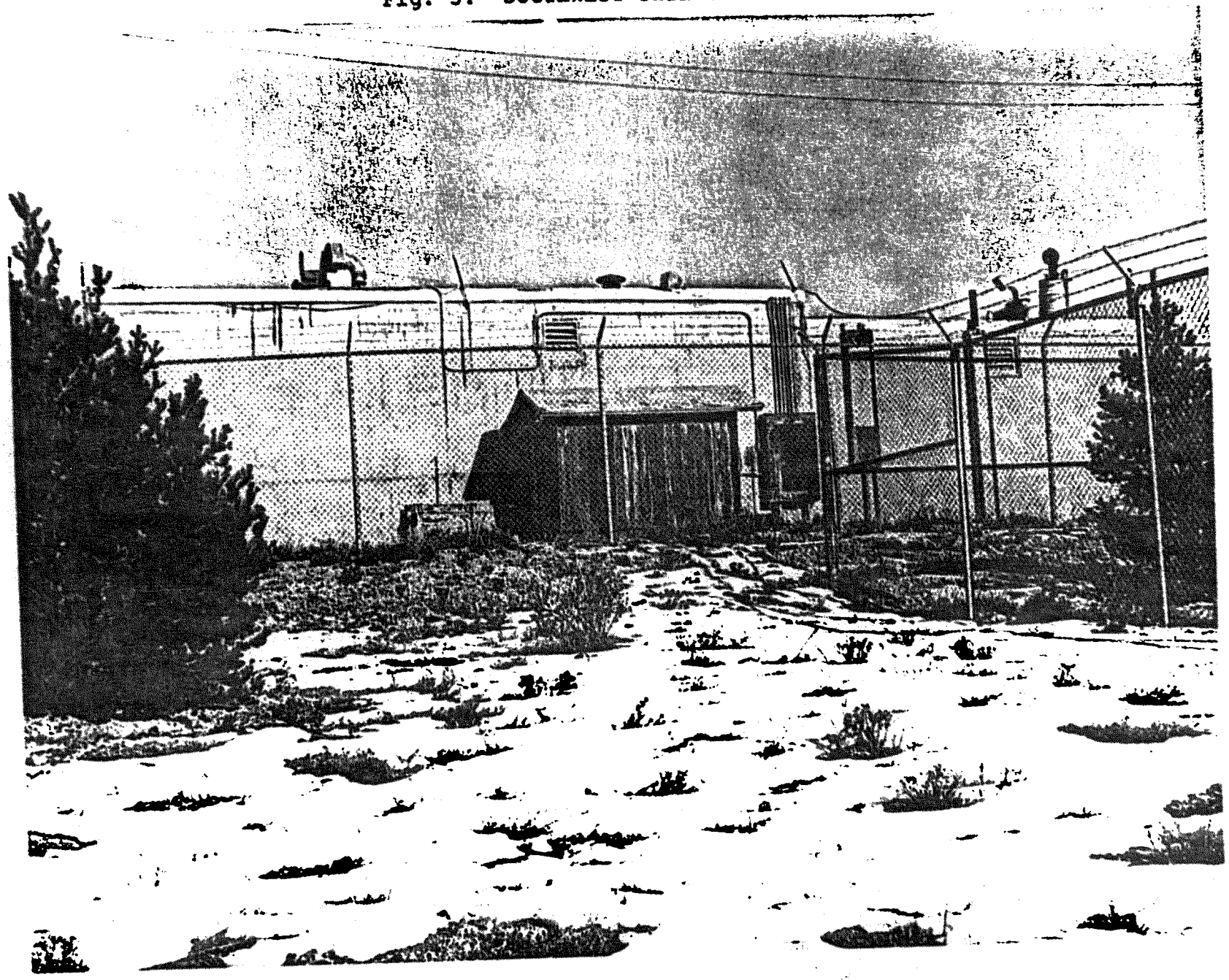
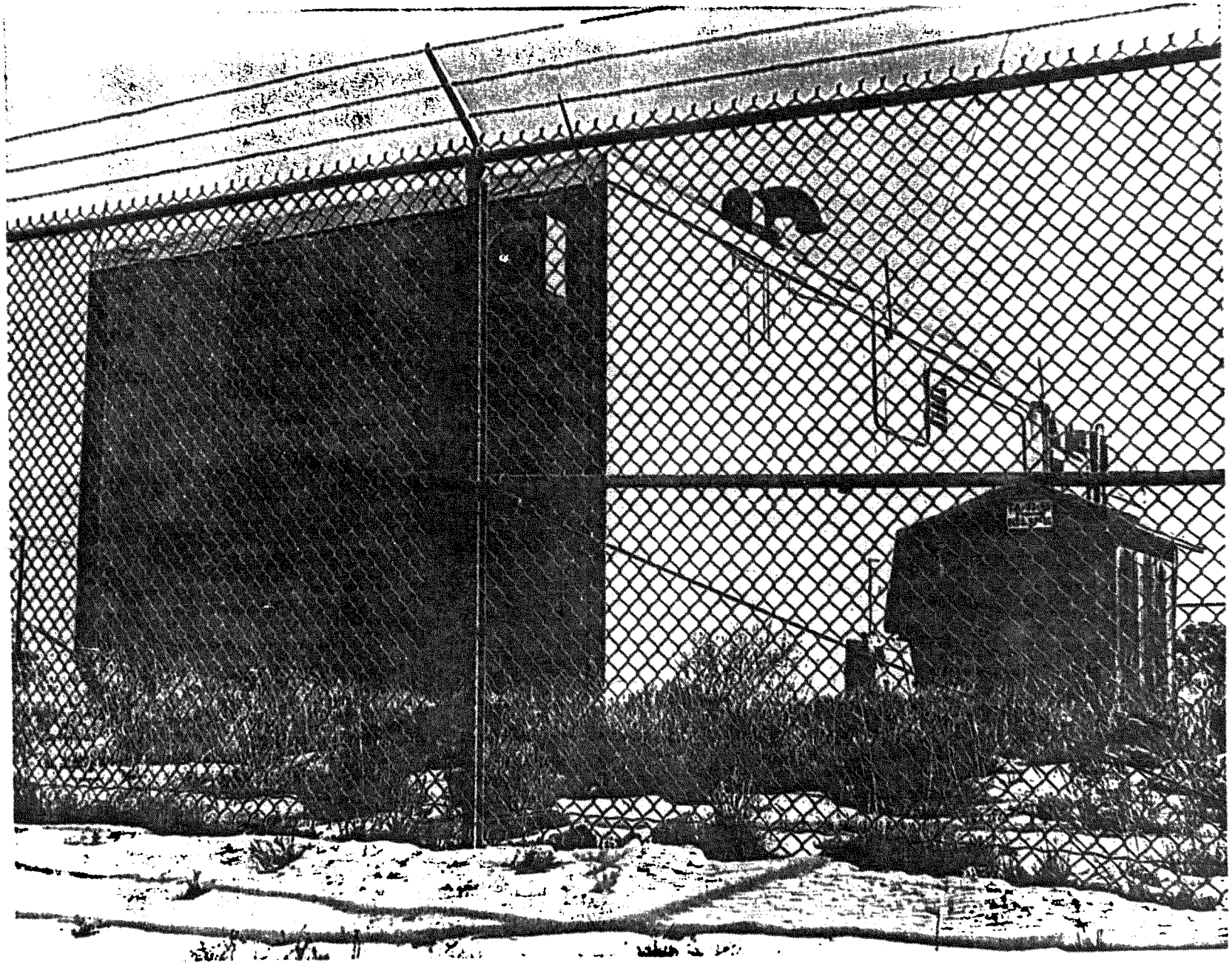


Fig. 6. NORTHWEST AND SOUTHWEST SIDES OF BUILDING 21



inside and gypsum board siding on the outside; this section was supported on wooden beams. The foundation consisted of concrete piers reinforced with heavy steel bars and was insulated with rock wool. As shown in Fig. 7, Building 21 consisted of six rooms: a counting room, a process room, shower and clothes change areas; a restroom, and a utility room. The counting room was equipped with laboratory benches located around the exterior walls. The process room housed two single gloveboxes and a sink. These rooms were ventilated by two once-through forced air heating systems located in the utility room. There were also several exterior wall exhaust louvers. The building was enclosed in its own perimeter security fence.

Building 21 was served by three liquid waste drain systems: 1) a contamination free drain line that served a sink, a floor drain and a safety shower in the counting room; 2) a sanitary sewer system that served restroom and change room lavatories, urinals, and commodes; and 3) a contaminated industrial waste system that served the sink, shower, and glovebox drains in the process room and an adjacent hot change room. The industrial waste system drained to a drain field located approximately 16 meters south of Building 21. The sanitary sewer system drained to a drop manhole, TA-33-74, which drained to a septic tank, TA-33-32. Overflow from the septic tank surfaced a few

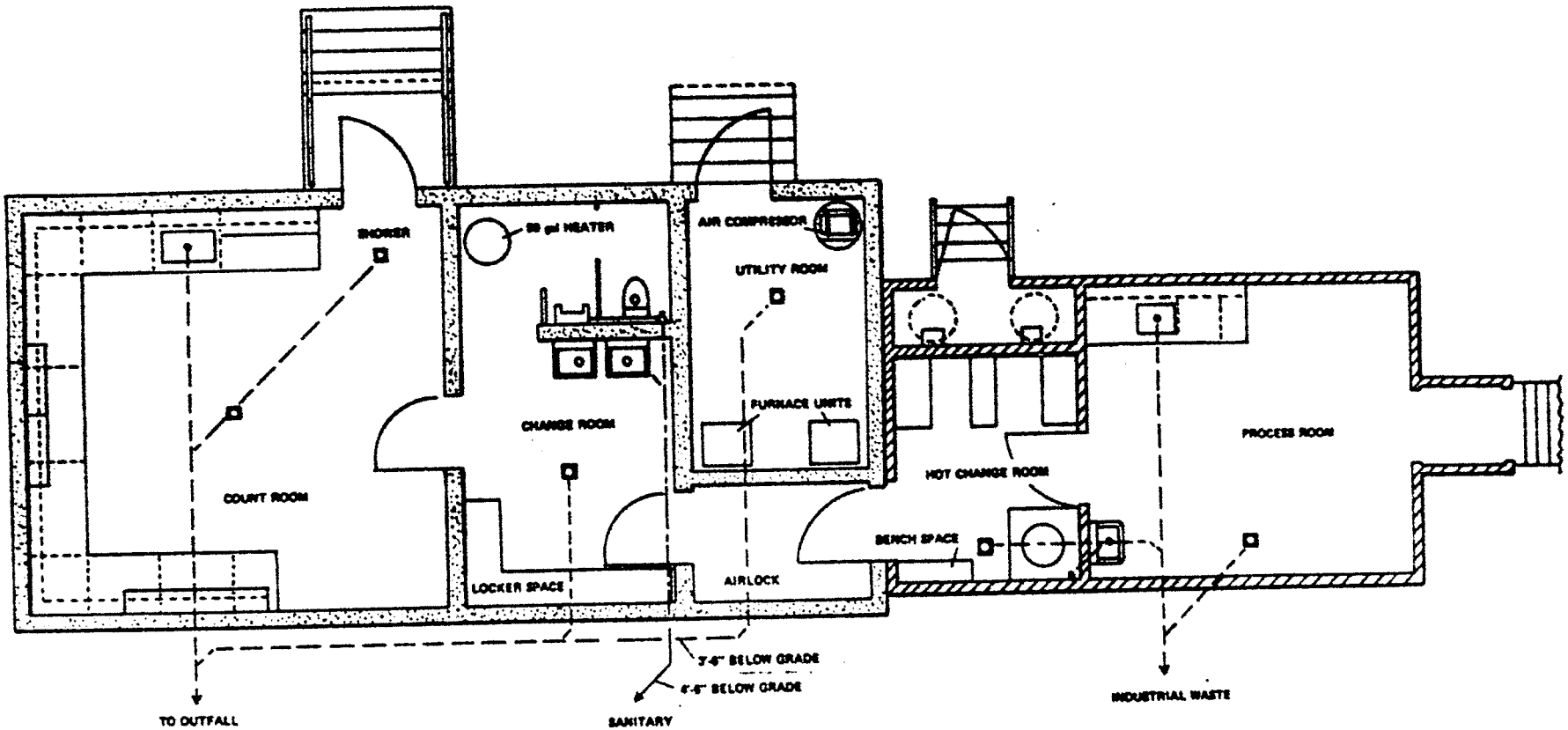


Fig. 7. BUILDING TA-33-21 FLOORPLAN

meters southwest of the septic tank. Figure 8 shows the manhole, a section of the security fence around TA-33-21, and the fenced industrial waste drain field area.

3. Decontamination of Building 21

Following the accidental plutonium release which occurred on April 13, 1960, decontamination efforts were begun to allow personnel occupancy and beneficial use of the building. The general sequence of this decontamination effort was:

1) Removal of most material and equipment items from the process room.
2) Removal of material and equipment from the other rooms.
3) Scrubbing of surfaces in the process room.
4) Sealing of duct openings and outside door from process room and removal of all remaining movable items from process room.
5) Final scrubbing of rooms and equipment surfaces.

Decontamination efforts terminated on May 2, 1960. Removable contamination remained on the cracked and buckled linoleum flooring and in inaccessible ducts and cracks. All other surfaces were free of removable contamination. Several small areas of fixed contamination (<400 dpm/60cm^2) remained on the west wall of the process room. Surfaces not entirely accessible for decontamination were painted.

Fig. 8. SANITARY SEWER MANHOLE AND INDUSTRIAL WASTE DRAIN FIELD

Although the building could be occupied by personnel following this preliminary decontamination effort, it was abandoned due to progra.. redirection. The doors were secured to prevent unauthorized access and the facility became an excess contaminated facility awaiting final disposition.

An extensive survey was conducted on July 18, 1972, to re-establish contamination levels on accessible surfaces in Building 21. Results of this survey are listed in Table 1. No attempt was made to survey inside ducts and drain lines. Results of the July 18, 1972 survey indicated that some recontamination of interior surfaces had occurred since 1960. There was also evidence that the building was deteriorating structurally making final decontamination and disposal desirable, primarily to prevent accidental plutonium dispersal in the event of a fire or natural disaster.

In October, 1974, final decontamination efforts were begun with special program funding from the ERDA Division of Waste Management and Transportation. The following decontamination efforts were initiated to reduce the potential for plutonium dispersal during subsequent demoliton phases:

1) Removal of gloveboxes, equipment items and miscellaneous materials remaining in Building 21.
2) Removal of some contaminated air ducts and fixtures.
3) Resealing of duct openings.
4) Scrubbing of floors and bench tops.

Table 1

Building TA-33-21 Survey Results 18 July 1972

Room	Location	Maximum Contamination Levels: Direct α (dpm/60cm²)	Maximum Contamination Levels: Removable α (dpm/100cm²)
Process Room	Outside airlock floor	3,000	90
Process Room	Floor under glovebox	>40,000	29,000
Process Room	Water pipe, south wall	2,000	500
Process Room	Floor, center	2,000	180
Process Room	Floor, under sink	1,500	269
Process Room	Floor, under bench	1,000	150
Hot Change Room	Top of door	20,000	160
Hot Change Room	Steam pipes	10,000	110
Hot Change Room	Floor	10,000	550
Locker Room	Light switch	1,000	70
Locker Room	Floor	2,000	90
Restroom	Steam pipes	1,000	60
Restroom	Floor	1,600	240
Count Room	Floor	1,000	100
Count Room	Floor	3,000	170
Utility Room	Pipes	36,000	1,000

Figure 9 shows the sink unit and a portion of the process room prior to final decontamination. Surface contamination levels following final decontamination work were significantly less than levels measured in 1972.

During the period from October 1974 until March 1975, final demolition and disposal plans and work orders were developed to accomplish final disposition.

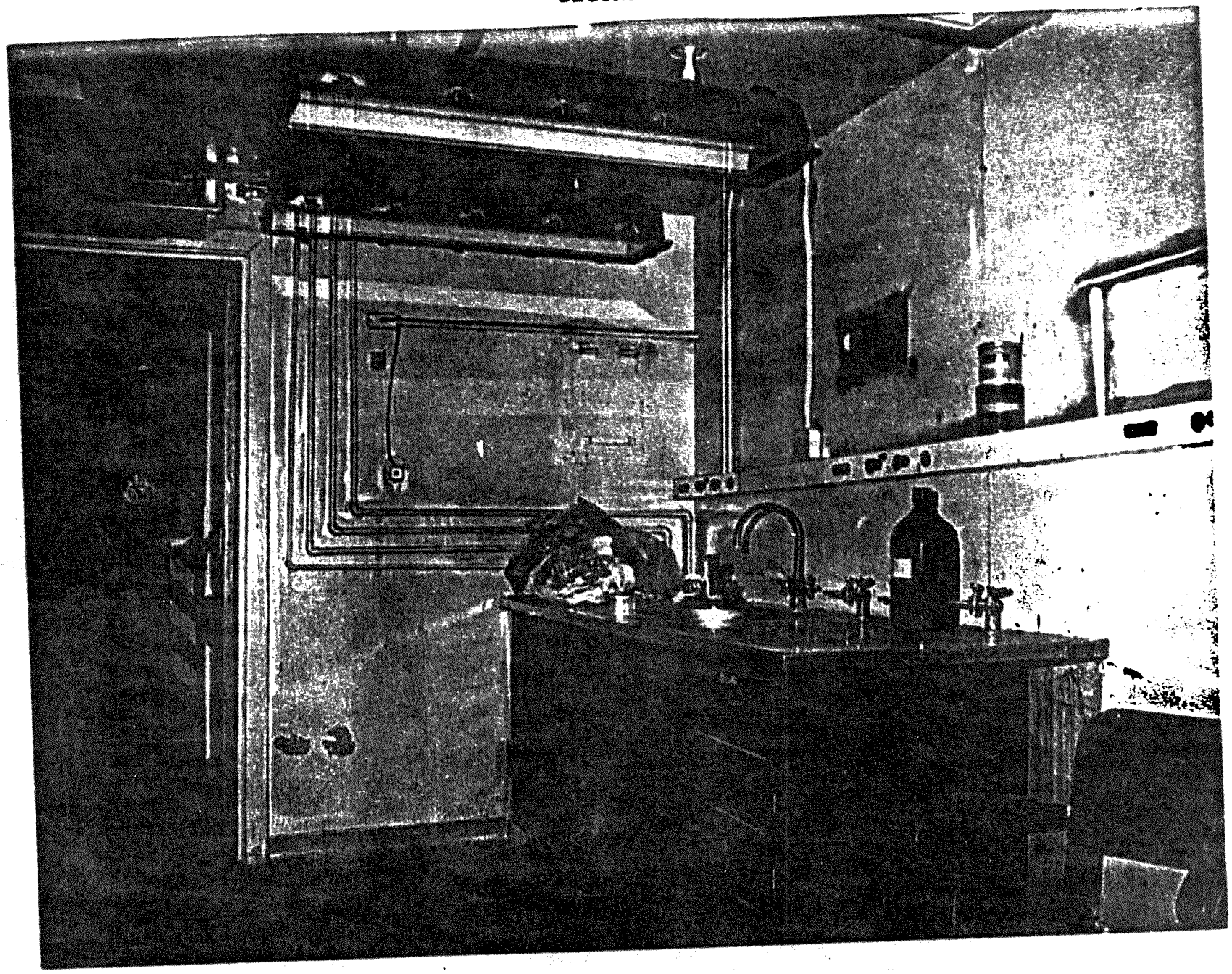
4. Demolition and Disposal

Demolition work started on March 31, 1975 and continued until May 8, 1975. This effort was divided into the following phases:

1) removal of remaining fixtures and equipment items;
2) dismantling and disposal of wooden section of Building 21 which included the process and hot change room;
3) demolition and disposal of concrete section of Building 21; and
4) removal and disposal of underground drain lines, manhole and septic tank.

To best utilize equipment and manpower, phase four was carried out intermittently throughout the complete operation. The work accomplished during each of the four phases and contamination levels that were encountered are described.

Fig. 9. SINK UNIT IN PROCESS ROOM BEFORE FINAL DECONTAMINATION



Phase 1. Removal of Fixture and Equipment Items

Items removed from inside the building consisted of light fixtures, sinks, cabinets, commodes and duct work. Exterior items consisted of exhaust blowers, piping, and light fixtures. The contamination levels detected ranged from several hundred to 100,000 dpm/60cm^2. After removal work was completed, the interior wall and floor surfaces were scrubbed and painted to further reduce the potential for plutonium dispersal. This resulted in conditions shown in Fig. 10.

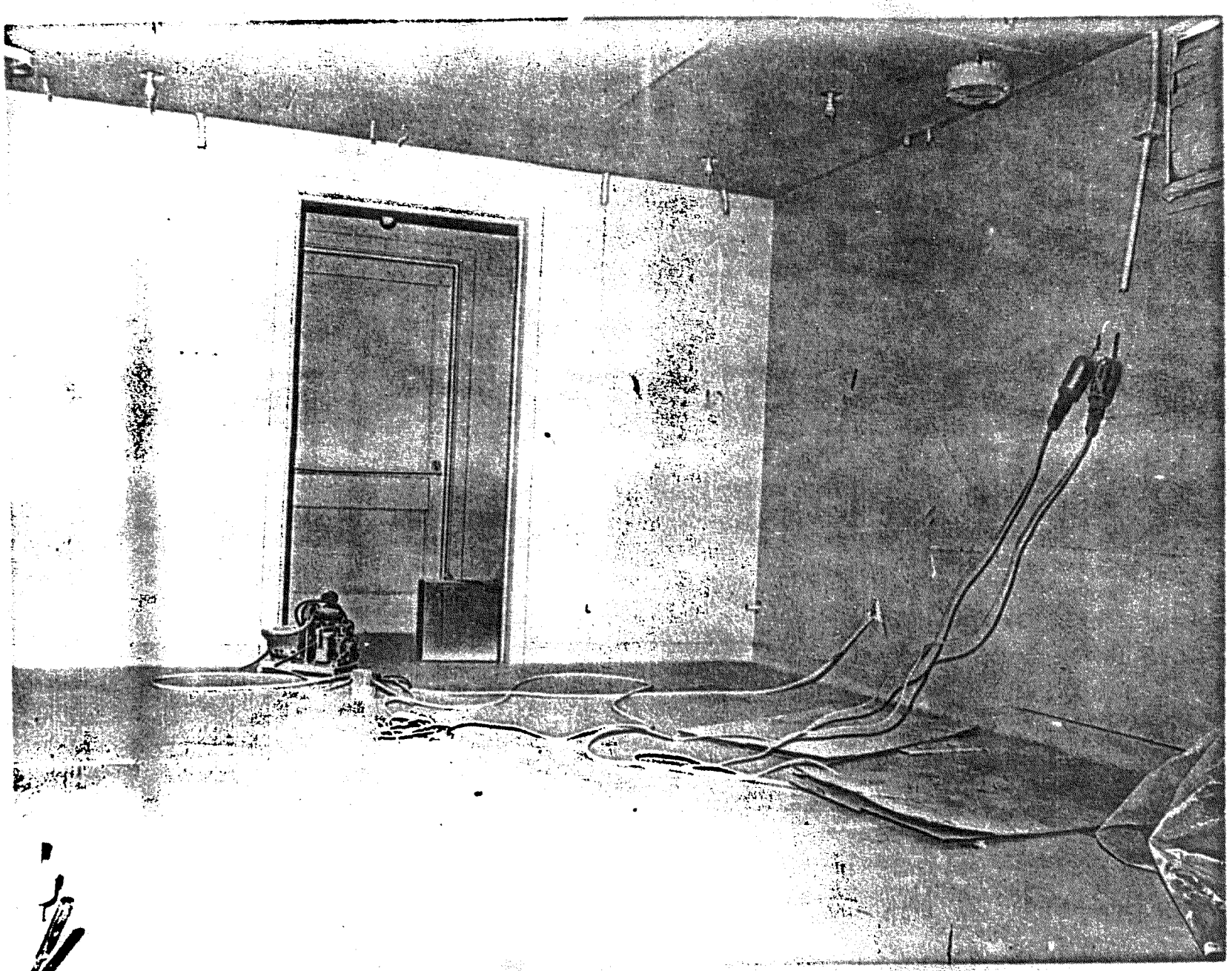
The furnace, compressor, and other small equipment items located in the utility room were cleaned, painted, dismantled and repainted. This operation produced the highest levels of surface and airborne contamination encountered during the project. The highest surface and airborne contamination levels were 100,000 dpm/60cm^2 and 40 x 10^{-12} μCi/cm , respectively.

All persons engaged in removal work wore full face respirators equipped with ultra-high efficiency filter canisters and anti-contamination clothing.

Phase 2. Removal of Wooden Structures

This phase involved the dismantling and removal of the wooden section of Building 21. This section housed the process and hot change room and was the main source of the remaining contamination. All interior wall paneling, ceiling, flooring and insulation were removed with the

Fig. 10. PROCESS ROOM PRIOR TO BEING DISMANTLED



exterior walls intact to prevent possible contamination release to the atmosphere.

Contamination levels detected ranged from 4,000 dpm/ $60cm^2$ under the linoleum to 12,000 dpm/$60cm^2$ on the walls. After removal of the paneling and insulation, the interior surfaces of the remaining walls and floor were repainted. A backhoe was used to remove underground piping and foundations. TA-33-55, the compressor shed, was also removed during this phase of demolition work, leaving conditions shown in Fig. 11.

Phase 3. Removal of Concrete Section

A large crane equipped with a "wrecking" ball was required for demolition of the concrete section as shown in Fig. 12. All perimeter fencing was removed to allow the equipment to maneuver. After each initial crushing of a portion of the wall and roof, an extensive radiation survey was conducted. Water spray was used for dust and contamination control. No contamination was detected on the debris or the heavy equipment used. The absence of loose contamination allowed use of conventional demolition techniques, thus avoiding high cost and time delay.

During phases 2, 3 and 4, a full set of anti-contamination clothing was required. Full face respirators were used at the discretion of the health physics surveyor in charge.

Fig. 11. CONCRETE SECTION PRIOR TO DEMOLITION

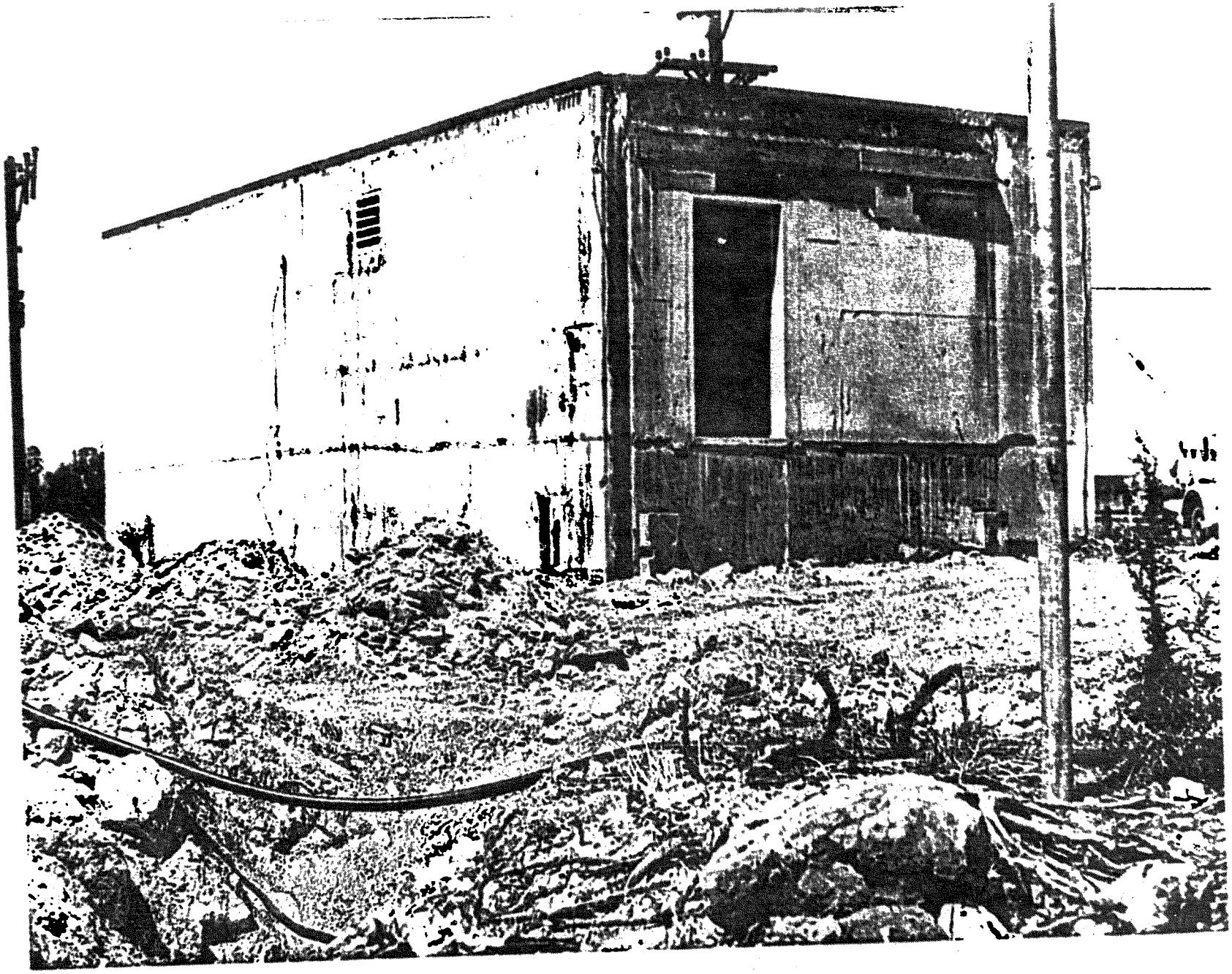
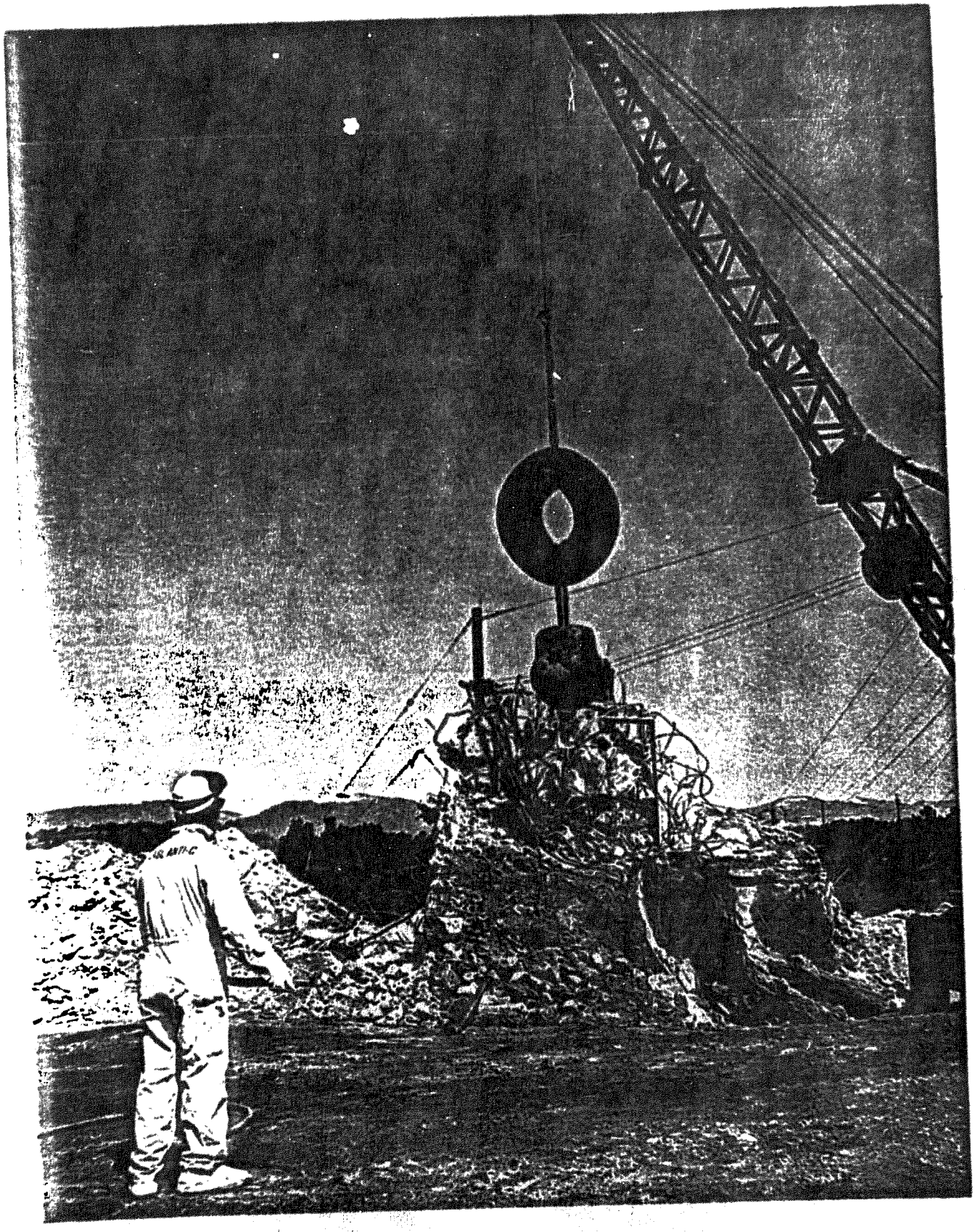


Fig. 12. CONCRETE SECTION DURING FINAL STAGES OF DEMOLITION



On several occasions, demolition was curtailed due to extreme windy conditions.

Phase 4. Removal of Underground Drainlines, Septic Tank and Manhole

As was mentioned earlier, the removal of the underground items were conducted concurrently with the demolition of Building 21 to best utilize manpower and equipment. The uncontaminated lines, i.e., the drainline from the count room and the septic tank system were removed first; no contamination was encountered. These items were easily removed using a backhoe and manual labor.

The tile field which received the industrial wastes from Building 21 was removed last to minimize spreading of contamination. Details of this drain field are shown in Fig. 13. Expectations were that the entire distribution and collection systems as well as the gravel between them would be highly contaminated requiring hand excavation and packaging of the materials. The excavation and removal of the 1.2 m sections of 10.2 cm clay pipe began at the out fall in hopes that this would be uncontaminated because wastes entering the field may not have reached this point.

It was soon evident that the entire collection system had never been exposed to contaminated wastes. This fact was verified by monitoring the inside of the pipe and by collecting and measuring soil samples under pipe joints. The

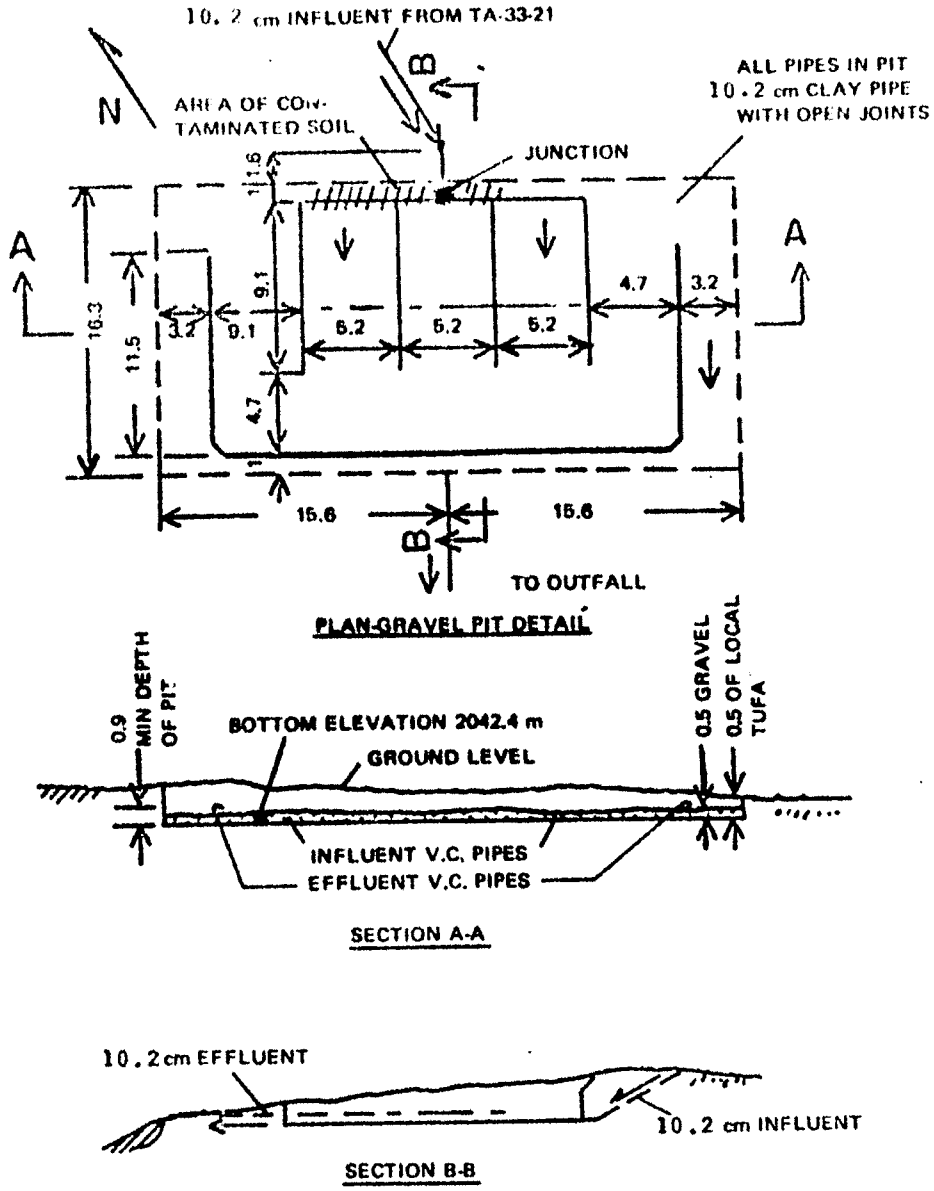


Fig. 13. TILE FIELD DETAILS

All Dimensions in Meters

collection system was removed in a fashion similar to the removal of the two uncontaminated drain systems. A typical trench, after removal of the clay pipe, is shown in Fig. 14.

The next step was the removal of the distribution system. Excavation was begun at the ends most distant from the junction shown in Figs. 13 and 15. All four east-west laterals were removed without encountering any contamination.

Contamination was encountered in the north-south lateral of the distribution system. As shown in Fig. 13, approximately 10 m of trench were contaminated to levels of approximately 80 pCi/gm gross alpha. Approximately 2.5 m^3 of contaminated soil from this trench and all of the clay pipe were sent to the contaminated waste burial ground and buried as non-retrievable waste. Sampling and analyses of the soil will be described in Section 8.

The fact that the contamination in the tile field was not as extensive as expected can probably be explained in this manner: Contamination from the 1960 accidental spill did not enter the field, and volumes of waste from normal operations prior to 1960 were small enough that the wastes did not migrate to very long distances from the entrance to the field.

The demolition portion of this operation required 28 working days and about 1700 manhours of on-site craft and

Fig. 14. TILE FIELD TRENCH AFTER REMOVAL OF PIPE

Fig. 15. JUNCTION OF BUILDING 21 INDUSTRIAL WASTE LINE AND TILE FIELD DISTRIBUTION SYSTEM

health physics manpower. Approximately 200 manhours were required for pre-demoli'ion decontamination work; hence, final disposition consumed a total of about 1900 manhours. No incidents occurred except for an uncontaminated minor scratch on the face of one man which occurred while he was helping dismantle the perimeter fence.

5. Health Physics

A standard operating procedure that established health physics provisions was prepared prior to starting final decontamination and demolition work. Trailer facilities shown in Fig. 16 were located approximately 30 meters east of Building 21. These trailers provided space for health physics monitoring, change rooms, and eating facilities. Provisions established for health physics included:

1) Personnel assigned to work at TA-33-21 were quantitatively fitted with full face respirators and sampled for urinary plutonium before they could work at the site.

2) A complete change into protective anti-contamination clothing was required for workmen and health physics personnel actively engaged in decontamination and demolition work. This included socks, underwear, safety shoes, booties, coveralls, surgeon's cap, gloves, and hard hats.

Fig. 16. TRAILERS USED FOR HEALTH PHYSICS

3) No personal items such as rings, wrist watches, cigarettes were allowed on personnel engaged in decontamination work.

4) Health physics monitoring was provided continuously and workers were provided film badges even though only background beta-gamma levels existed.

5) All workmen were surveyed for contamination at noon and at the end of the work shift. More frequent surveys were conducted during the final decontamination phase.

6) Nasal smears were taken at the end of each work shift as a minimum.

7) Workmen were required to take shower baths at the end of the work shift.

8) Any injury was reported to health physics for proper monitoring.

9) Tools and equipment used in the area were monitored for contamination prior to removal.

10) All dump trucks were monitored for contamination after being loaded at TA-33-21 and after each load was dumped at Area G, TA-54.

11) Daily air samples were collected in work areas during the entire operation.

12) Workers were placed on a routine plutonium urine sampling program to assure post work sampling.

Minimal airborne and personnel contamination control problems were encountered during final decontamination and demolition phases of the project because prior decontamination efforts in 1960 had removed and/or fixed most of the original plutonium contamination.

Airborne plutonium levels exceeded 2×10^{-12} μCi/cc in the utility and process rooms on four days during final decontamination work. The highest measured concentration was 40×10^{-12} μCi/cc which equals the concentration guide for insoluble plutonium. The highest single nasal smear activity was 8 dpm and no contaminated injuries occurred during the job.

6. Waste Management

All structures, fences, and underground tanks and lines at TA-33-21 were removed and disposed of at the LASL's radioactive solid waste disposal site as nonretrievable, < 10 nCi/g, plutonium contaminated solid waste. These waste materials were packaged in different ways depending on size and contamination level to make transport and disposal safe. Contaminated small items were placed in plastic bags and 0.56 m^3 cardboard boxes; the bags and boxes were sealed with tape. In addition to the boxed waste, large items and structural materials were taken to the disposal site in covered dump trucks as shown in Fig. 17. Fixing the contamination on large items with several coats of paint allowed

Fig. 17. VEHICLE LOADED WITH DEBRIS FOR BURIAL

handling, transport, and disposal without vehicle or personnel contamination problems. Ninety-seven truck loads, or about 450 m^3 of contaminated debris were removed from the site.

Waste packages and unpackaged items were monitored for plutonium contamination with portable alpha survey instruments prior to removal from the site.

7. Environmental Air Monitoring

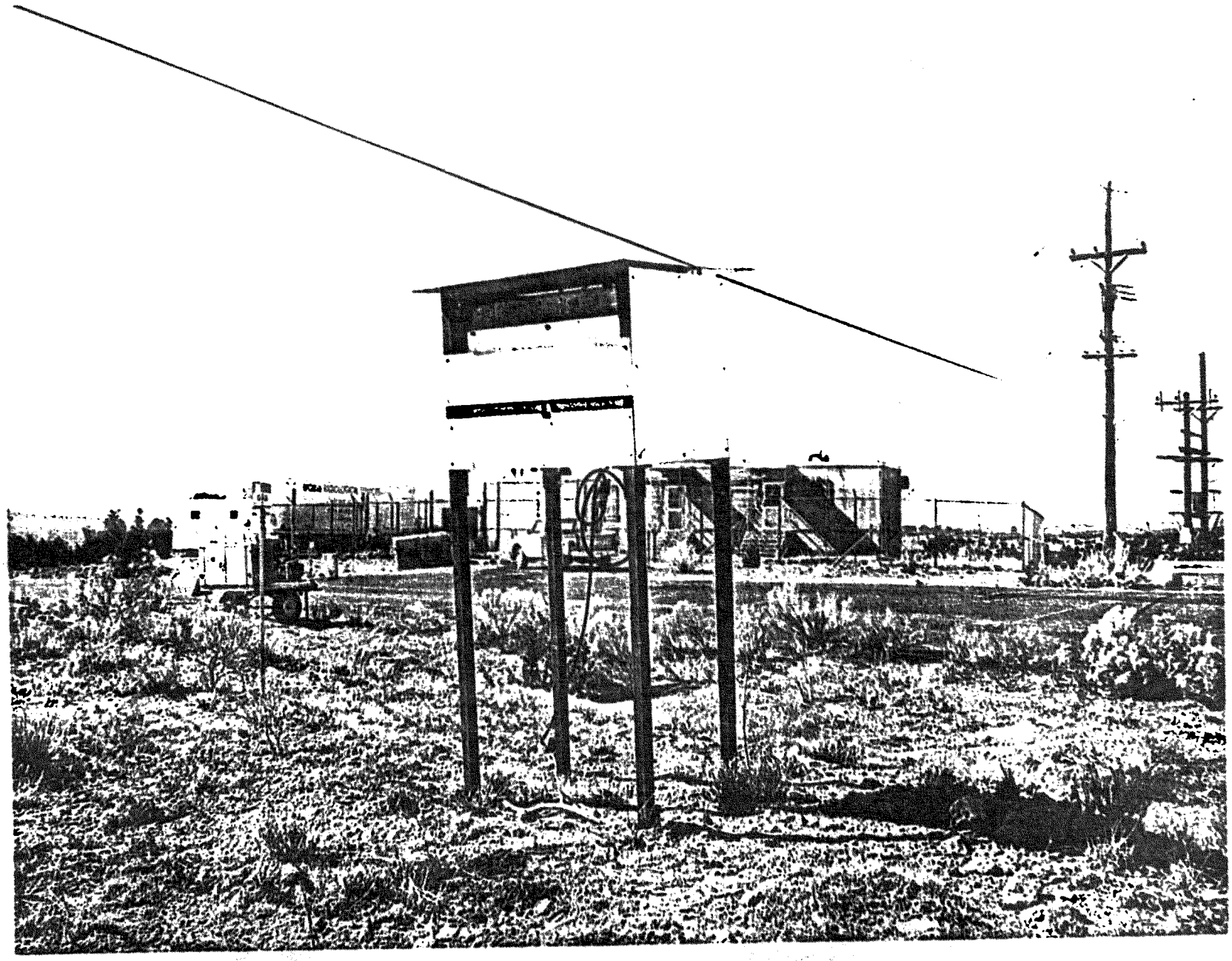
Environmental monitoring of the demolition operation was conducted with a special on-site air sampling program. Two trailer-mounted, gasoline-powered generators were used to provide electrical power at the site. Each of the generators powered two environmental air samplers. A sampler and a generator can be seen in Fig. 18. The sampler locations are shown in Fig. 19.

The samplers drew air through a 78-mm Microsorban filter with an efficiency of about 99.8% for 0.3μ dioctylphthalate (DOP) particles (a standard test aerosol for determining filter efficiency) at a rate of about 70 ℓ/min.

The samples were collected weekly. This schedule was not intended to provide an early detection of a plutonium release, but was to document the magnitude of an accidental release.

Each week's samples were composited for plutonium analyses to determine environmental plutonium levels during the demolition. For comparison, the sampling program was

Fig. 18. ENVIRONMENTAL AIR SAMPLER AND GENERATOR



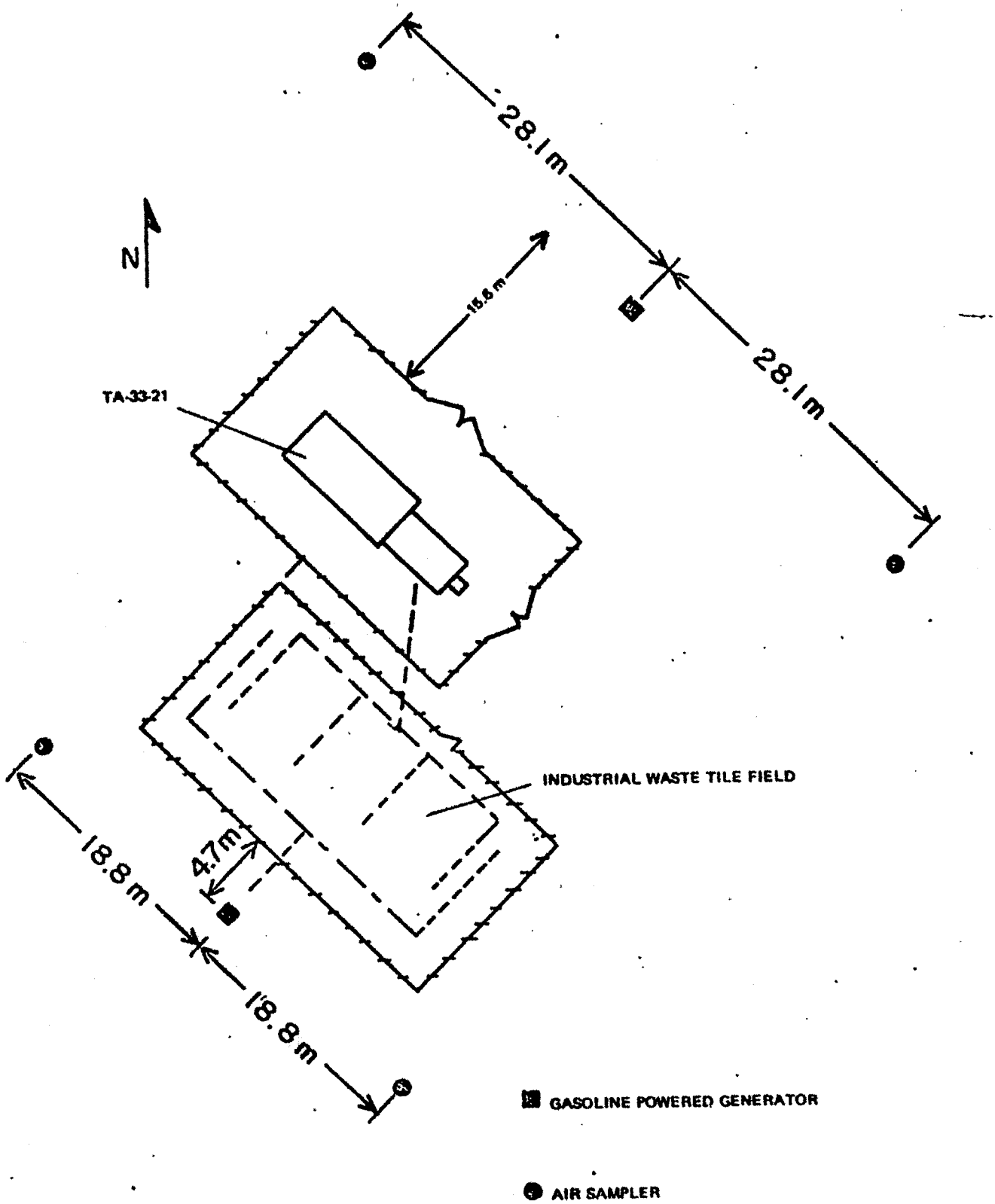


Fig. 19 ENVIRONMENTAL AIR SAMPLER LOCATION PLAN

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begun three weeks prior to start-up and was continued two weeks after completion of the demolition operations. The weekly concentrations of atmospheric ^{239}Pu including the predemolition and post demolition periods are listed in Table 2.

8. Soil Sampling and Analyses

An extensive soil sampling program was effected in the tile field. Samples were collected under pipe joints at intervals of approximately 1.2 meters. The samples were homogenized by mixing in the plastic collection bags. A 100 x 15 mm plastic petri dish was filled with soil. The dish and its contents were dried under a heat lamp for five minutes and then allowed to cool. Gross alpha measurements were made on each sample with a ZnS alpha counting system.

Alpha activity levels were considered to be significant if the gross counts were greater than 3σ above the approximately 20 counts per 5 min observed on a background sample of the type of soil found at TA-33-21. The equation used was:

$$A = 1.33\ (G-20)$$

where

A = alpha activity in pCi/gm

1.33 = calibration factor obtained from a 2 nCi/gm standard

G = gross counts for five minutes

20 = background counts for five minutes.

Table 2

Environmental Air Sampling Data

Week	Status of Project	^{239}Pu Concentration (10^{-18} µCi/ml)	% of ERDA CG**
1*	Background Air Sampling	56±30	<0.01
2	Background Air Sampling	33±9	<0.01
3	Background Air Sampling	57±11	<0.01
4	Final Building Decontamination	1821±66	0.18
5	Final Building Decontamination	922±40	0.09
6	Building Demolition	245±24	0.02
7	Building Demolition	70±12	<0.01
8	Building Demolition	80±24	<0.01
9	Building Demolition	124±18	0.01
10	Background Air Sampling	58±8	<0.01
11	Background Air Sampling	58±8	<0.01

*Sampling began March 5, 1975.

**Concentration guide for uncontrolled area for insoluble ^{239}Pu in air equals 1×10^{-12} µCi/ml.

With a gross count of 35 counts/5 min, (just above the 3σ level of significance), the significant alpha activity level was 20 pCi/gm.

Ninety percent of the samples (48 out of 53) taken from under clay tile distribution and collection systems contained less than 20 pCi/gm gross alpha. The remaining five samples, taken from the area where the soil was removed, ranged from 25 to 80 pCi/gm.

Samples taken from the area where soil was removed (after the removal of the contaminated soil) indicated that the remaining soil contained less than 20 pCi/gm gross alpha. Four surface samples collected in the area of TA-33-21 after the demolition but prior to back filling with top soil also contained less than 20 pCi/gm gross alpha activity.

Ten soil samples collected during the removal of the tile field lines were selected for plutonium analyses to confirm the gross alpha measurements made with the ZnS system. The Pu concentrations ranged from 0.01±0.01 to 0.10±0.01 pCi/gm for soil left in place. The highest measured Pu concentration for soil removed for burial was 130±10 pCi/gm.

9. Final Site Condition

The 10 to 15 cm depression remaining after the removal of Building 21 and its related structures was backfilled with top soil to restore the site to its original contour. The area (approximately 2000 m^2) was planted in blue gramma and

stream wheat grasses, and fertilized with ammonium nitrate and super triple phosphate Figure 20 shows the site following site grading, seeding, and fertilizing operations.

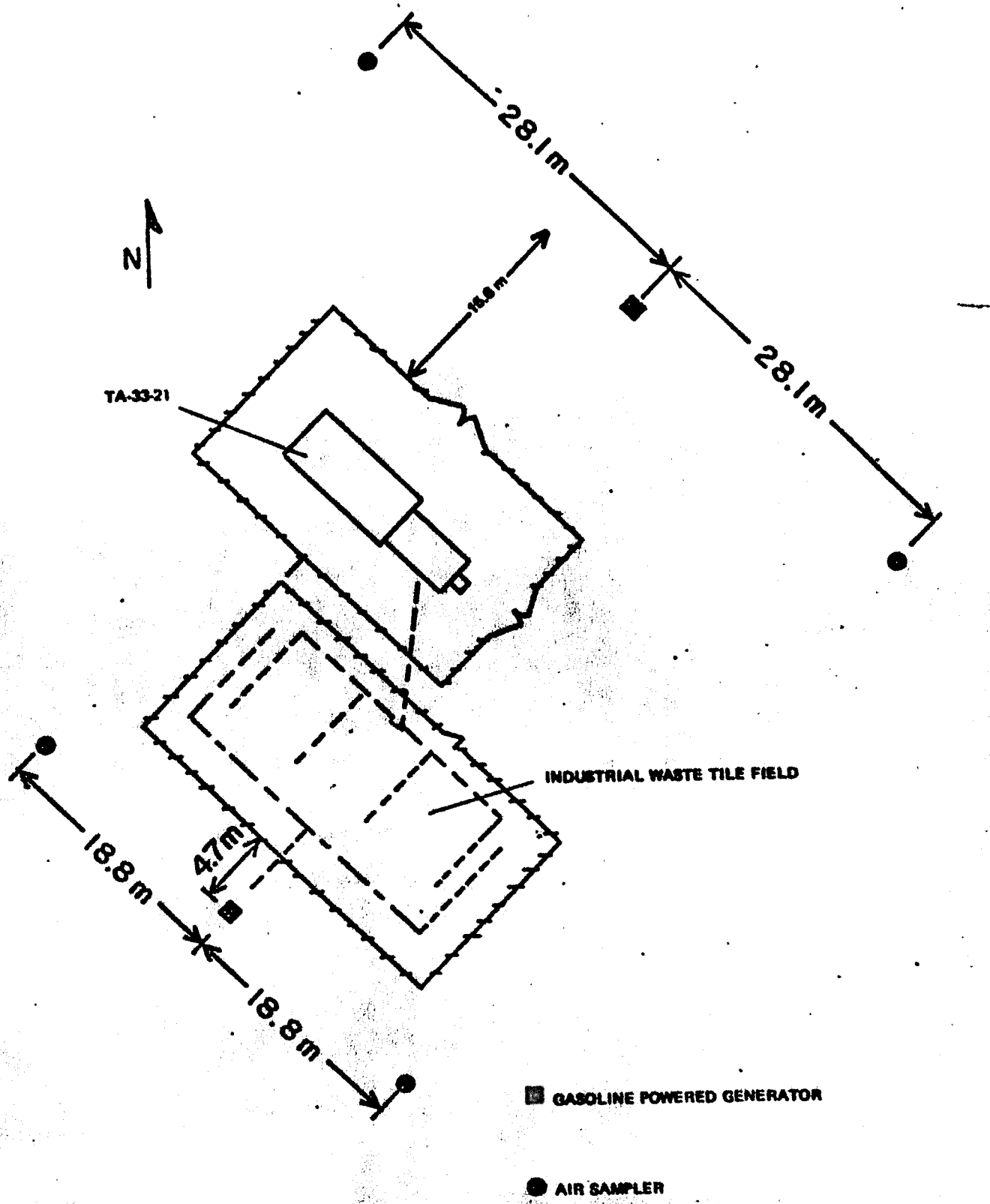

Fig. 19 ENVIRONMENTAL AIR SAMPLER LOCATION PLAN

Fig. 20. SOUTH TO NORTH VIEW OF SITE AFTER FINAL GRADING

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7	Building TA-33-21 Floorplan
8	Sanitary Sewer Manhole and Industrial Waste Drain Field
9	Sink Unit in Process Room Before Final Decontamination
10	Process Room Prior to Being Dismantled
11	Concrete Section Prior to Demolition
12	Concrete Section During Final Stages of Demolition
13	Tile Field Details
14	Tile Field Trench after Removal of Pipe
15	Junction of Building 21 Industrial Waste Line and Tile Field Distribution System
16	Trailers Used for Health Physics
17	Vehicle Loaded with Debris for Burial
18	Environmental Air Sampler and Generator
19	Environmental Air Sampler Location Plan
20	South to North View of Site After Final Grading