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Allied Chemical

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PREPARED FOR THE
UNITED STATES
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IDAHO OPERATIONS OFFICE
UNDER CONTRACT AT (10-1)-1375 S-72-1

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I. INTRODUCTION

About 2,300,000 ft^3 of the solid waste interred at the National Reactor Testing Station (NRTS) Radioactive Waste Disposal and Storage Area (RWD & SA) is alpha-contaminated, low-level waste from the AEC's Rocky Flats operation. Because of the necessity for long-term isolation of the transuranic contaminants, the AEC plans to place the waste in above-ground controlled storage, pending definition of ultimate disposal.

An operation of this magnitude presents varied problems and requires extensive facilities. Therefore, the AEC requested the Idaho Chemical Programs—Operations Office of Allied Chemical Corporation (ACC) to plan and perform a series of studies to define the problems associated with retrieving, sorting, compacting, repackaging, and storing operations, and to develop criteria for the proposed NRTS Transuranic Waste Retrieval and Repackaging Facility. Funds for the overall program have been allocated to Allied Chemical Corporation, with the retrieval and transportation portions of the program being directed by Aerojet Nuclear Company (ANC).

The Idaho Operations Office defined specific objectives of the original studies:

a) To retrieve and sort the Rocky Flats material into two basic categories: treatable and nontreatable (sludges, salts, etc.). Additional sorting of the treatable wastes is expected to provide for possible extended treatment at a later date.

b) To package and store all wastes retrieved in accordance to applicable AEC standards.

Definition of the scope of the development program to meet the above objectives was also provided by the Idaho Operations Office:

a) Develop methods and demonstrate retrieval and sorting techniques to segregate this waste into two categories: treatable and untreatable. Segregation of the treatable wastes must provide for possible future mechanical and chemical processing or repackaging without treatment.

b) Develop methods of repackaging and storage to meet applicable AEC standards.

Since the original objectives were defined, major changes in the program have occurred. This Program Plan was printed in draft form in August, 1974. At that time, the program direction specifically excluded any processing of the waste; sorting, compacting, and repackaging of the waste was the limit of the waste treatment. Since then, changes have occurred which render this document out of date. These include: (1) designation of the "National Reactor Testing Station" (NRTS) as the "Idaho National Engineering Laboratory" (INEL), (2) Reorientation of the program to include incineration of combustible wastes and packaging of the residue, (3) programmatic redirection to provide for full-scale waste retrieval and treatment to allow complete processing of the buried waste as well as the waste on ITSA over a 20 year period, thus eliminating the "Demonstration" phase of the program, and (4) delaying the program to provide construction funding no sooner than FY 1979 and possibly in FY 1980 instead of in FY 1977.

Although the program has changed significantly, the original program plan is being issued to document the work on the original program.

Also, the variously described Retrieval Facility concepts have been rated, and the costs for the highest rated concepts have been calculated. The large double-wall building was established as the preferred Retrieval Facility concept for the original program. The recent programmatic changes described will greatly affect this concept, and further evaluation may be required in the future. The various yearly technical support programs in terms of time and funding will also be changed significantly as a result of the programmatic redirection and delays.

A new program plan will be prepared in the future, probably after the conceptual design of the full-scale facility has been completed.

The report first describes the waste and waste disposal practices and hazards. Following this, the original proposed program for the burial ground support projects, including the repackaging facility, are described. Section V comprises the Aerojet Nuclear Company retrieval program. Schedules, estimated costs, and proposed technical support projects for the original program are discussed for each phase of the overall program. Finally, recommendations are given for further work.

II. WASTE DESCRIPTION

The NRTS RWD & SA has been used as a disposal area for a variety of wastes from several sources. The methods used for the disposal of these wastes has varied throughout the years. These burial practices and wastes are described in the following sections.

1. BURIAL PRACTICES

The NRTS RWD & SA was opened in July 1952 to dispose of solid radioactive wastes generated by the local AEC operations at the NRTS. However, waste generated by other organizations has also been accepted at the RWD & SA. Since April 1954, uranic and transuranic contaminated waste from the AEC's Rocky Flats operation has been shipped to the NRTS for burial or, since November 1970, storage on the Idaho Transuranic Storage Area (ITSA). From 1960 to 1963, wastes from various off-site sources were shipped to the NRTS for burial.

Trenches are utilized for the burial of most of the waste which originates at the NRTS. The trenches average 10 ft deep, 6 to 8 ft wide, and are up to 1,800 ft long. Cardboard cartons, 2- x 2- x 3-ft, and plastic wrapping are routinely used to contain the waste during transportation from the on-site plants to the RWD & SA. Figure 1 shows cardboard cartons being deposited in the trenches. The trenches are backfilled with a layer of 2 to 3 ft of soil so that the radiation level is reduced to less than 1.0 mR/hr at a point 3 ft above the surface. After an area is completely utilized, crested wheat grass is planted to reduce erosion and percolation of water through the soil. Individual depositions are referenced approximately to the markers at the end of the trenches and records maintained in case recovery becomes necessary. Shielded containers are used to transport wastes which emit high levels of radiation. Transfer of high-level radioactive material from the containers to the trenches is accomplished with a crane, as shown in Figure 2. Large burial pits are used for items too large for trenches, such as vessels and miscellaneous items which are contaminated to low levels. Rocky Flats waste is buried in trenches and pits.

Since 1954, waste contaminated with uranium, plutonium, and americium has been shipped to the NRTS from the AEC's Rocky Flats plant for burial or storage on the ITSA. Significant changes in Burial Ground practices have occurred over the years. Early shipments (1954 to 1957) were put in trenches interspersed with NRTS beta-gamma wastes. As the volume of Rocky Flats wastes increased, the use of pits for burial was instituted. From 1958 to November 1963, Rocky Flats wastes were hand-stacked in the pits (Figure 3); in November 1963, dumping the wastes in pits was begun (Figure 4). Dumping was continued until 1969 when receipts of Rocky Flats wastes increased. At that time, the policy of stacking the wastes in the pits was reinstituted because of concern for container integrity and the need to conserve Burial Ground space. In April 1970, separation of Rocky Flats and the NRTS beta-gamma wastes was begun. In November 1970, an above-ground ITSA was placed in operation for Rocky Flats waste to satisfy the 20-year retrievability requirements of IAD 0511-21, dated March 1970. All transuranic waste containing more than 10 nCi plutonium per gram of waste has been placed on the ITSA pad since its construction in

Fig. 1 Dumpster depositing waste in a trench.

Fig. 2 Waste being transferred from a shielded container to a trench.

Fig. 3 Typical pit with stacked waste.

Fig. 4 Rocky Flats waste being dumped into a pit from shipping container.

1970. Since September 1972 transuranic wastes containing less than this concentration of plutonium have been disposed of on a separate asphalt pad.

The NRTS was designated in May 1960 as one of two Interim National Burial Grounds for disposal of waste from any source. Since August 1963, off-site waste for disposal at the NRTS has been limited to material that cannot be adequately accommodated at privately-owned sites. Off-site waste received between 1960 and 1963 was interspersed with Rocky Flats Waste at the NRTS RWD & SA.

2. ROCKY FLATS WASTE

Unclassified, contaminated solid waste generated by the Rocky Flats plant is shipped to the NRTS. This includes waste from the 1957 and 1969 Rocky Flats fires, used equipment, lumber, paper, rags, plastic, floor sweepings, and other solid debris present in industrial, production, or research establishments. The radioactive contamination in this waste and the type of waste vary with changes in plant operations. The plutonium- and americium-contaminated solid waste generated at Rocky Flats, which is the main concern of this project, is categorized as first-stage sludge, second-stage sludge, evaporator salts, cemented liquids, grease, line-generated waste, nonline-generated waste, and large items in the form of crated waste. In addition, other wastes including uranium, beryllium, graphite, and hazardous laboratory materials have been shipped to the NRTS.

First- and second-stage sludges, evaporator salts, cemented liquids, and "grease" are generated in the liquid radioactive waste treatment plant. Aqueous liquids, low in radioactivity but high in chemical content, are sent to the waste evaporator in the treatment plant. The evaporator bottoms are sent to a double-drum drier where most of the remaining water is removed. Water vapor from the evaporator and drum drier is discharged to the evaporator stack. The dried salts are put in drums for shipment. Aqueous liquids containing significant concentrations of radioactivity and chemicals are processed through two stages of decontamination in the treatment plant, using a ferric hydroxide carrier-precipitation process. The precipitate is removed from the supernatant liquid by vacuum filtration. The filter cake with filter-aid is put in drums for shipment as first- and second-stage sludges. The resulting decontaminated aqueous waste is combined with the low radioactivity, high-chemical content waste and is processed as described above.

Other radioactive aqueous liquids with low chemical content are decontaminated in the second ferric hydroxide precipitation stage of the waste treatment process. This precipitate is also filtered and put in drums for shipment as second-stage sludge.

Ion exchange resins and aqueous wastes containing complexing agents are not amenable to the precipitation process. They are discharged into drums filled with magnesia and cement to set up before shipment. These solids form the category called "cemented liquids". Organic liquids, primarily cutting oil plus carbon tetrachloride, are sent to the waste treatment plant where they are mixed with calcium silicate (microcel-E) to form a putty-like mass called "grease". Each 55-gallon drum of grease contains about 37 gallons of organic waste in 45 gallons of Microcel-E.

Line-generated waste contains the bulk of the plutonium discarded and shipped in 55-gallon containers for disposal or storage. This waste is generated in the gloveboxes during production operations. Line-generated waste includes a wide variety of items such as gloves, Kimwipes, rags, small hand tools, graphite, pumps, filter housings, filters, gloveboxes, and large machines. Filters from the production buildings have been shipped in cardboard cartons and barrels. These filters may contain gram quantities of particulate plutonium fluoride and plutonium oxide.

Line- and nonline-generated items too large to be packaged in drums are crated in plywood boxes. These items constitute the category called "crated wastes". This category includes lathes, drill presses, gloveboxes, sheetrock, etc. Fifty-eight percent of the crates are standard size (4- x 4- x 7-ft); 17% of the crates are larger than standard, the largest being 8 ft 9 in. x 8 ft 9 in. x 22 ft; and 25% of the crates are smaller than standard size.

Waste disposal practices at Rocky Flats have changed significantly since 1954, and many of the early practices have been changed to reflect new standards. However, during the 1950s, sludge drums were used to dispose of such items as potassium cyanide, cobalt-60 sources, and bottles of highly concentrated americium-241 solution.

Assay of drums for plutonium content was initiated in 1964. At that time, segregation of line- and nonline-generated wastes into categories according to hydrogen content was started. However, enforcement of segregation procedures was difficult. The assay of drums was useful in finding drums with greater than 200 grams of plutonium; however, five drums were inadvertently shipped with greater than 200 grams of plutonium. One drum contained about 1,500 grams Pu. For safety considerations, it should be assumed that drums containing significant quantities of Pu were inadvertently shipped in the period from 1954 to 1964, when no assay existed. Current assay and administrative procedures at Rocky Flats preclude the shipment of containers with large quantities of Pu.

A summary of the Rocky Flats waste containers buried at the NRTS is provided in Table I. A summary of the estimated quantities of transuranic elements in the Rocky Flats waste is provided in Table II. The estimated total of 250,000 curies of uranic and transuranic waste may be low by a factor of 2 to 3, primarily due to the less effective accountability techniques of the 1950s and early 1960s.

3. NRTS WASTE

Radioactive elements, resulting from nuclear fission or neutron activation, are produced in all operating reactors. Many components of the reactor are radioactive. Worn or dismantled components (with neutron-induced activity) constitute about 90% of the solid radioactive waste which is discarded by burial at the NRTS. Whenever fuel elements are opened, as for post-irradiation inspection or for recovery of unburned uranium, fission products are exposed. Equipment in contact with the fuel element, fuel element fragments, fission products, or solutions is contaminated and must be buried as contaminated waste when no longer serviceable. Whenever significant quantities of radioactive material are

TABLE I

TYPES AND NUMBER OF CONTAINERS OF SOLID WASTES SHIPPED FROM ROCKY FLATS TO THE NRTS

Calendar Year	55-gal Drums Number	55-gal Drums Cu Ft	30-gal Drums Number	30-gal Drums Cu ft	40-gal Drums Number	40-gal Drums Cu Ft	Boxes (std)[a] Number	Boxes (std)[a] Cu Ft	Boxes (<std) Number	Boxes (<std) Cu Ft	Boxes (>std) Number	Boxes (>std) Cu Ft	Filters Number	Filters Cu ft	Cartons Number	Cartons Cu Ft
1954	1,705	12,617	2,265	11,325					5	50						
1955	4,381	32,419	174	870	53	318			7	106			1,205	5,664		
1956	4,773	35,320	11	55	1,054	6,324			8	106			2	9		
1957	7,138	52,821	535	2,925					61	2,367	3	672	1,251	5,880	101	2,112
1958	6,096	45,110	303	1,515	43	259			131	4,073	9	1,797	1,042	4,932	123	554
1959	7,833	58,334	119	595	5	30			139	5,399	7	1,268	1,679	7,891		
1960	7,689	56,399	30	150	1	6			160	8,104	22	3,257	130	611	34	156
1961	9,566	70,788	22	110	17	102			153	5,824	12	1,850	1,592	7,450		
1962	10,752	79,565	15	75	1	6			166	9,351	34	5,692	549	2,557	7	35
1963	12,012	88,889	4	20					199	13,835	87	13,732	535	2,065		
1964	11,383	84,234	2	10					168	10,120	211	33,645	1,023	4,927		
1965	9,784	72,402							91	4,493	280	41,476	762	3,581		
1966	13,596	100,610	12	60					59	3,344	454	64,345	575	3,101	10	95
1967	18,350	135,790	3	15			1	112	32	1,519	391	51,615	990	4,980	943	11,670
1968	19,118	141,473	66	330			425	47,600	76	5,850	588	95,555	323	2,433	4,267	52,484
1969	17,564	129,974	2,855	14,275			665	74,480	30	1,611	63	14,109	209	1,528	249	3,056
1970[e]	22,321	165,175	741	3,705			1,380	154,560	59	3,431	62	15,686	641	4,679	43	529
Totals Number	184,111		7,207		1,174		2,471		1,544		2,223[b]		12,508[c]		5,782[d]	
Totals Cu Ft		1,362,420		36,035		7,045		276,752		79,663		344,699		62,288		70,691

[a] Standard Box - 84 in. by 48 in. by 48 in.

[b] Includes 875 boxes 84 in. by 48 in. by 52 in. and 273 boxes 84 in. by 48 in. by 50 in.

[c] Includes 24 in. by 24 in. by 14 in., 24 in. by 24 in. by 16 in., 24 in. by 24 in. by 18 in., 24 in. by 24 in. by 28, and 28 in. by 28 in. by 16 in. cartons of filters.

[d] Includes 5,496 cartons containing 55-gal drums.

[e] Since November 1970, all Rocky Flats waste has been stored on the ITSA pad rather than being buried.

TABLE II
ESTIMATED QUANTITIES OF URANIUM, PLUTONIUM, AND AMERICIUM
IN ROCKY FLATS WASTES AT NRTS[a]
(curies)

Calendar Year	^{238}U	^{235}U	^{233}U	^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{242}Pu	^{241}Am
1954	Neg[b]	Neg	[c]	Neg	14.6	3.2	-	Neg	45.4
1955	Neg	Neg	[c]	2.6	93.7	21.5	562.5	Neg	84.3
1956	Neg	Neg	[c]	3.8	138.9	32.0	900.0	Neg	90.8
1957	Neg	Neg	[c]	5.2	195.2	44.9	1,350.0	Neg	139.4
1958	1.4	Neg	[c]	7.1	264.8	61.0	1,800.0	Neg	197.8
1959	1.2	Neg	[c]	8.0	294.2	67.8	2,025.0	Neg	200.9
1960	1.4	Neg	[c]	5.9	217.8	50.3	1,912.5	Neg	149.1
1961	1.4	Neg	[c]	9.2	339.5	78.4	2,925.0	Neg	226.8
1962	1.5	Neg	[c]	8.7	317.0	73.3	2,700.0	Neg	583.2
1963	Neg	Neg	[c]	26.6	977.4	225.7	8,550.0	Neg	661.0
1964	Neg	Neg	[c]	31.1	1,139.3	263.1	10,012.5	Neg	771.1
1965	1.4	Neg	[c]	42.3	1,553.3	358.7	13,725.0	Neg	1,341.4
1966	17.6	Neg	[c]	151.9	5,567.3	1,285.7	24,275.0	Neg	9,120.6
1967	17.5	Neg	0.5	94.0	3,447.0	796.0	30,487.5	Neg	6,898.0
1968	11.0	Neg	[c]	72.8	2,669.2	616.4	23,625.0	Neg	5,760.7
1969	7.5	Neg	[c]	56.6	2,332.2	538.4	16,762.5	Neg	15,795.0
1970	2.3	Neg	[c]	44.9	1,482.1	343.8	11,812.5	Neg	5,942.2
Total Curies	67.0	0.27	0.5	571.4	21,043.5	4,859.9	178,425.0	0.2	48,007.1
Total Weight	203,194 Kg	128 Kg	53 g	32.8 g	343 Kg	21.5 Kg	1.6 Kg	59.6 g	14.8 Kg

[a] At time of deposit.
[b] Negligible =<1 curie
[c] No information.

released to the environs, inside or outside a building, decontamination may be necessary. Decontamination operations produce considerable volumes of low-level contaminated solid waste. Table III lists typical solid waste materials which have been buried in the RWD & SA as a result of NRTS operations. Wastes have varied from very low (1 mR/hr at contact) to higher levels of radioactivity (500 mR/hr or greater at contact) when buried.

Only limited segregation of the NRTS-generated wastes from the Rocky Flats wastes was practiced prior to 1970. In general, only low-level NRTS waste was buried in the vicinity of Rocky Flats waste. High-level NRTS waste was buried in separate trenches. During April 1970, Pit 11 was designated to be used for transuranic waste only. A reasonable estimate of the amount of NRTS waste intermingled with the Rocky Flats wastes is difficult to obtain, but more than 100,000 ft^3 of all categories listed in Table III were buried (mostly in reopened pit 2) in 1961 and 1962 as a result of cleanup and dismantling of the SL-1 reactor facility. An accurate estimate of the number of curies involved cannot be obtained from the records.

4. OTHER OFF-SITE WASTES

As noted previously, the NRTS RWD & SA was designated as a national repository for radioactive waste from late 1960 to late 1963. As a result, a miscellany of wastes has been received from many organizations. Shippers included universities, hospitals, and private research organizations (most of whom were under AEC contract). The containers in which these wastes were shipped included cardboard cartons, wooden boxes or crates, metal barrels, wooden boxes filled with concrete, lead casks or other materials centered in barrels or boxes and surrounded with concrete, metal or concrete culverts filled with wastes and capped with concrete, and cast-concrete boxes with concrete covers. Burial records show that the barrels and cardboard cartons from off-site sources were intermingled with the Rocky Flats barrels, cartons, and boxes. Approximately 200,000 ft^3 of waste containing more than 18,000 curies of miscellaneous isotopes have been received.

TABLE III
TYPICAL NRTS SOLID RADIOACTIVE WASTES

CONSTRUCTION AND DEMOLITION MATERIAL	Lumber, wallboard, concrete blocks, steel plate and shapes, ducting, electrical wires, fuse boxes, roofing material, floor tile, insulation, lead sheet and bricks, asphalt paving material, soil, sand, gravel, steel stairways and ladders.
LABORATORY EQUIPMENT AND MATERIALS	Hoods, laboratory benches, desks, chairs, cabinets, glassware, plastic tubing, plastic and glass bottles, solutions stabilized in concrete or plaster, vermiculite.
PROCESS EQUIPMENT	Tanks, heat exchangers, tube bundles, condensers, pumps, piping, flanges, valves, OMRE organic wastes, ion exchange resins, zirconium plate, zirconium turnings and sawdust, HEPA filters.
PROTECTIVE EQUIPMENT	Clothing, rubber gloves, masks, hard hats, rubber and plastic aprons, boots.
MAINTENANCE EQUIPMENT	Hand tools, metal-working machines, cranes, hoists, welders, oils and grease, metal filings, abrasive wheels and sheet.
DECONTAMINATION MATERIALS	Paper, rags, plastic bags and sheet, floor sweepings, brooms, steel wool.
MISCELLANEOUS	Sewer sludge, garbage, animal remains and excreta, jet engines, vehicles, Test Reactor Area fuel end boxes, relatively small amounts of classified material.

III. HAZARDS

The hazards associated with sorting, compacting, and repackaging Rocky Flats waste can be divided into four classes: radiological, nuclear criticality, chemical, and physical. Radiological hazards could result from the radiation fields created by the waste and from the airborne particulate contamination caused by handling. Nuclear criticality safety is a significant consideration because of the potentially large quantities of fissile material in Rocky Flats waste. Chemical hazards arise mainly from the pyrophoric nature of the plutonium and other metals in the waste and specific chemicals that were buried with the waste. Physical hazards are always a problem when handling bulky items. The uncertainty of the contents of any given container greatly complicates treatment of the waste. This section will elaborate on problems created by the four major classes of hazards.

1. RADIOLOGICAL HAZARDS

Radiation, including alpha and beta particles, gamma rays, and neutrons will be encountered during handling of the transuranic wastes from the RWD & SA. Close supervision and administrative procedures will be necessary to avoid excessive exposure of the labor force during retrieval, sorting, and repackaging operations.

Uranium and most of the transuranium elements emit alpha particles. These are not hazardous when outside the body; however, when these elements are ingested or inhaled, they are deposited in the bone, lung, and kidney. The long biological half-lives of the actinide elements, coupled with the concentration of these elements in the organs, results in severe localized damage by alpha radiation. The biological damage caused by the long-lived plutonium isotopes is so great that the maximum permissible body burden (MPBB) is 0.04 μCi (0.6 μg) in the bone and 0.016 μCi (0.2μg) in the lung.

2. NUCLEAR CRITICALITY SAFETY

The large quantities of fissile material contained in the Rocky Flats waste are distributed throughout the waste and are dilute in most cases. However, strict procedures and operational limits will be imposed on all phases of the retrieval and repackaging project because of the possibility of isolated instances of large amounts of plutonium in individual containers. To comply with operational limits, measurements will be required at the following points:

1) Field assay will be required to detect barrels with large quantities of fissile material. The definition of large quantities will be dependent on the physical configuration of storage arrays and processing equipment. The definition is expected to be about 100 grams of fissile material (e.g., plutonium) per container. Special handling will be required for containers with large quantities of fissile material.

2) Assay following compaction will be required to verify the quantity of fissile material in the new package and to determine if the quantity of fissile material is less than limits for interim storage arrays.

3) Assay of uncompacted waste will be required to assure the safety of interim storage arrays and for accountability purposes.

Strict procedures will be required in all areas to guarantee compliance with operational limits. Detailed records of all movement of fissile material will be required.

3. CHEMICAL HAZARDS

Uranium, plutonium, zirconium, and beryllium are pyrophoric when present as fine powder, turnings, or chips, even when partially oxidized. Zirconium powder from the Expended Core Facility has been buried in the trenches and pits and may inadvertently be sent to the Repackaging Facility. Uranium and plutonium turnings and chips are expected to be present in significant quantities in the gloveboxes, lathes, and other metal-working machines received from Rocky Flats. Small amounts of beryllium were shipped by Rocky Flats as beryllium-contaminated waste. If rubbed, struck, or jarred during retrieval or sorting operations, such materials could ignite. Fire prevention and control measures must be used.

Sludge barrels have been used as a means for disposing of hazardous materials. These include, at least, acids, potassium cyanide, and mercury batteries; therefore, appropriate precautions must be developed for handling the sludge barrels.

Waste packages received from Rocky Flats may be contaminated with beryllium. The quantity of beryllium shipped is less than 40 kg Be/yr and is in the form of wipe-down rags, paper, floor sweepings, etc. Table IV shows the quantities of beryllium-contaminated waste received during four years for which records are available. Since the requirements for plutonium handling are to be observed, beryllium should not be a significant additional health hazard.

4. PHYSICAL HAZARDS

Retrieval, sorting and repackaging must be accomplished in a manner to avoid injury by sharp objects and to avoid pinching or crushing by heavy equipment. All workers must be aware that continual working in rubber or plastic gloves makes the skin of the hands soft and subject to injury.

During repackaging operations, the adhesive used to seal the plastic drum liners will release vapors which may be flammable or injurious when breathed, and the vapors from the fiberglass-plastic box sealant may be hazardous.

TABLE IV
BERYLLIUM WASTE SHIPPED TO THE NRTS FROM ROCKY FLATS

Year	Batches[a]	Wt of Contaminated Waste (kg)
1965	374	16,878
1967	223	14,864
1968	339	19,928
1969	468	40,219
	1,404	91,889

[a] Assumed one batch per barrel

IV. PROPOSED PROGRAM – BURIAL GROUND SUPPORT AND WASTE REPACKAGING

The proposed plan for placing the transuranic waste under positive control consists of sorting the retrieved waste into four general categories (combustible, compactible, large machinery, and nontreatable), compacting the combustible and compactible fractions, disassembling and cleaning the large machinery pieces, repackaging the waste into 20-year containers, and storing the waste on ITSA pads. Wastes that meet the criteria of nontransuranic waste (less than 10 nCi/g) may be returned to nonretrievable storage.

Because of the high estimated cost of retrieving and repackaging all of the transuranic waste buried at the NRTS Burial Ground ($100 to $200 million over a 10-year period) and the undemonstrated methods and control procedures necessary to perform the tasks in a safe manner without dispersing the transuranic materials into the environment, the NRTS Transuranic Waste Retrieval and Repackaging Program has been reduced to a demonstration program designed to retrieve and repackage approximately 30,000 cu ft of waste each year for approximately 3 years. After the successful demonstration of equipment and methods for handling the waste, and development of improved cost data, the full-scale program, as described later, may be initiated.

The Ralph M. Parsons Company contracted to provide a conceptual design and cost estimate for the burial ground support facilities and the solid radioactive waste treatment building. The company had personnel with considerable expertise in the various Rocky Flats waste categories, methods of packaging, etc., and was able to expand upon the rudimentary concepts of waste sorting, compaction, size reduction and repackaging as supplied by Allied Chemical Corporation. In an attempt to provide a realistic cost estimate, Parsons provided a conceptual design much more detailed than normal. The description of the various facilities, the cost estimate for each facility, and a schedule for design and construction of this project are given in the following sections.

1. DESCRIPTION OF FACILITIES

The Transuranic Waste Treatment Facility is a new plant which, for conceptual design purposes, was located on an undeveloped site of approximately 25 acres adjacent to the northeast corner of the existing NRTS RWD & SA. This site was selected because of its location on a basalt ridge above the RWD & SA, thereby providing sewage and other drainage to the north, away from the RWD & SA. Access to the site is by an existing roadway.

The conceptual design includes five buildings and the yard and site work necessary to integrate them into an operable facility. The buildings are: a Vehicle Survey Building, a Vehicle Service Building, an Administration Building, a Support Building, and a Treatment Building. The vehicle survey, vehicle service, administration, and support buildings are similar in construction. All have steel wall and roof frame with insulated, prefabricated, prefinished exterior wall panels and built-up gravel roof on fiberglass insulated galvanized steel roof deck. All have poured concrete slab floors. The Treatment Building is a three-story reinforced concrete building with steel frame.

1.1 Site Preparation

Relocation of the on-site portion of the existing access road conforms with the plant arrangements and security requirements. Additional on-site roadways are provided for the site and plant functional requirements. An on-site parking area is provided for twenty on-site vehicles. Off-site parking is provided adjacent to the Administration Building and is sized to accommodate twenty private vehicles, one bus, and five government vehicles.

A plant sanitary sewer system, employing septic tank and tile field disposal, is provided for the site uncontaminated and domestic wastes. All contaminated or suspect wastes are routed through a separate system and are stored in tanks for special handling.

Site water is supplied from an existing well and storage tank. The existing pump house is modified, by the addition of new pumps, to provide the new plant requirements. Fire water is routed from the storage tanks to the buildings and on-site hydrants in a separate system. Potable water is provided from the same source but is treated before release to the site potable water system.

The site is cleared and graded so that drainage is away from the buildings and to natural drainage off-site. After construction, all disturbed areas are reseeded with crested wheat grass.

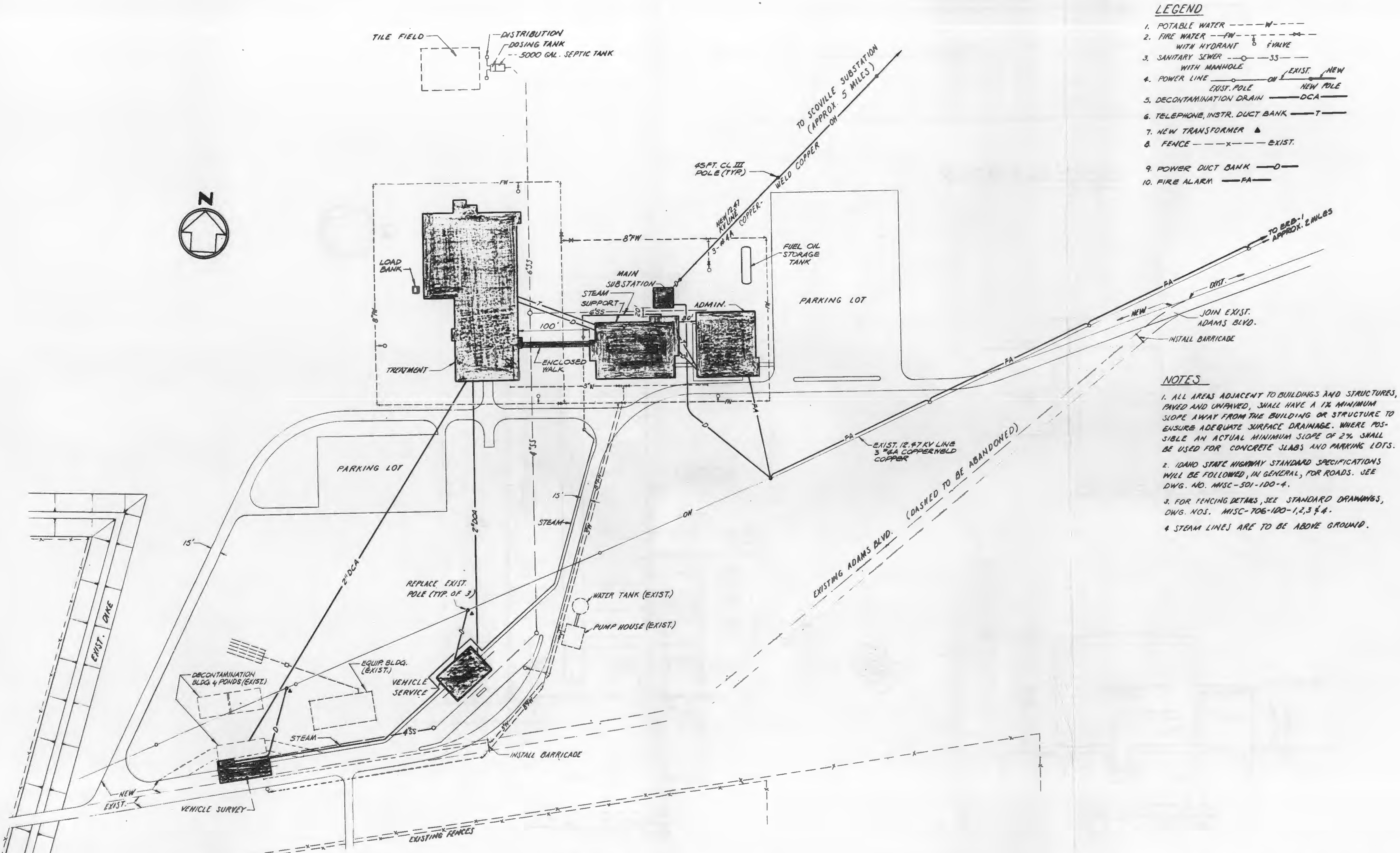
Primary power is provided by a new 12.47 kv overhead line from the Scoville Substation, and the alternative supply is from the existing on-site Burial Ground 12.47 kv overhead line. All on-site power distribution from the main substation is underground.

1.2 Vehicle Survey Building

This building is a 2,000 ft^2, single-story building containing 1,750 ft^2 of survey area and 250 ft^2 of support area, including an office, toilet facilities, and storage for monitoring equipment. An access pit is provided to permit surveying the underside of the various vehicles. The survey area floor and the pit are lined with stainless steel to facilitate decontamination efforts. Rollup doors are provided at both ends of the survey area. The building is shown in Figure 6.

1.3 Vehicle Service Building

This 2,828 ft^2, single-story building, shown in Figure 7, includes area for servicing all on-site and Burial Ground vehicles. Toilet facilities, office, a work bench, and tool lockers are also supplied. A service pit is provided to allow access to the underside of all



PLAN – BURIAL GROUND AREA

SCALE : 1" = 60'

Fig. 5 Transuranic Waste Repackaging Facility site plan.

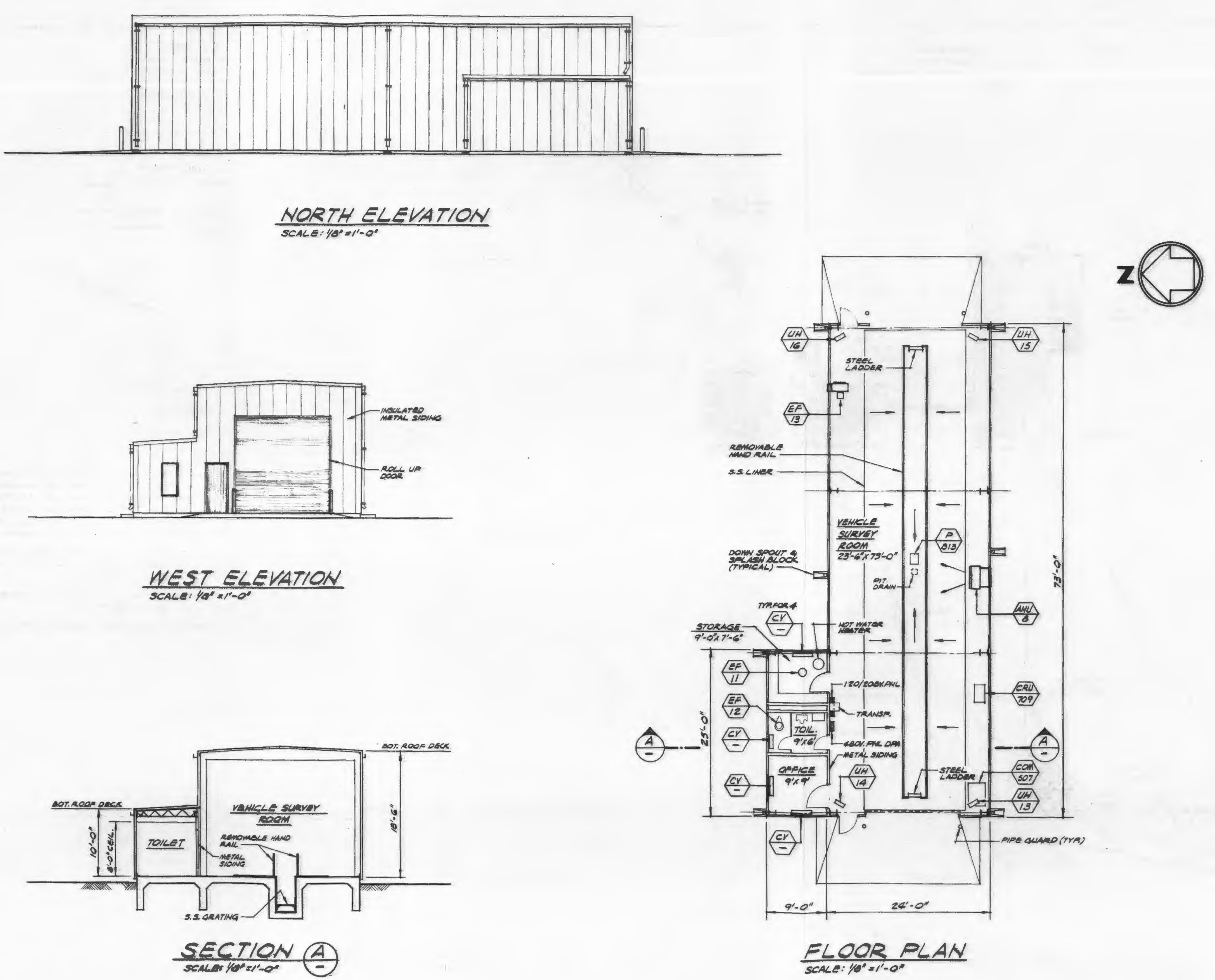


Fig. 6 Vehicle survey building.

vehicles. A vehicle exhaust collection system at the pit permits discharging the exhaust to the atmosphere. Pumps for dispensing gasoline and diesel fuel are provided exterior to the building. This is a drive-through building with rollup doors at each end.

1.4 Administration Building

This 7,600 ft^2, single-story building, shown in Figure 8, serves as the control center for the total Burial Ground facility. Security, computer and data logging, medical, cafeteria, and administrative functions are included.

Offices have been provided for the administrative, secretarial, and clerical functions. A cafeteria and assembly area are provided. The cafeteria will dispense pre-prepared meals and short-order foods. The cafeteria can seat 50 diners at a time and the adjacent assembly and training room can seat 50 people.

The plant computer is housed in this building. It and its peripheral equipment will be used for the data aquisition, logging, data display, alarming, and the computation and printout support for the assay equipment in the Treatment Building. In addition, it is used for the Burial Ground data collection and inventory control.

1.5 Support Building

This 9,500 ft^2, single-story building, shown in Figure 9, houses street and plant clothes locker rooms, heating and ventilation areas, a boiler area for plant steam supply, laundry facilities, a low-level alpha analytical laboratory, a health physics office and equipment room, and the main plant switchgear.

Locker rooms and sanitary facilities are provided for 125 men and 10 women in each of the street clothes and plant clothes sides of the building.

1.6 Treatment Building

The Treatment Building is a three-story, concrete, steel-frame structure. The basement and first floor areas are primarily dedicated to treatment operations and the second floor to utilities and ventilation systems. The building is designed to meet the basic requirements for a plutonium processing facility as described in AECM 6301, except where it is economically and practically feasible to do otherwise. The gross floor area is 79,727 ft^2. The building height is approximately 74 feet with 7 feet below grade. It is designed to receive, store, transport, sort, size-reduce, repackage, assay, and ship NRTS transuranic waste retrieved from existing burial sites. Necessary security, fire protection and suppression, ventilation, and radiation protection and monitoring systems are provided.

Space for future processing, 4,300 ft^2, is provided adjacent to the treatment area on the first floor and in the basement. The future space is at the end of the building to permit expansion if necessary. Basement, first floor, and sectional plans are shown in Figures 10 through 13, and a description of the operations and other details in the building is given in the following paragraphs.

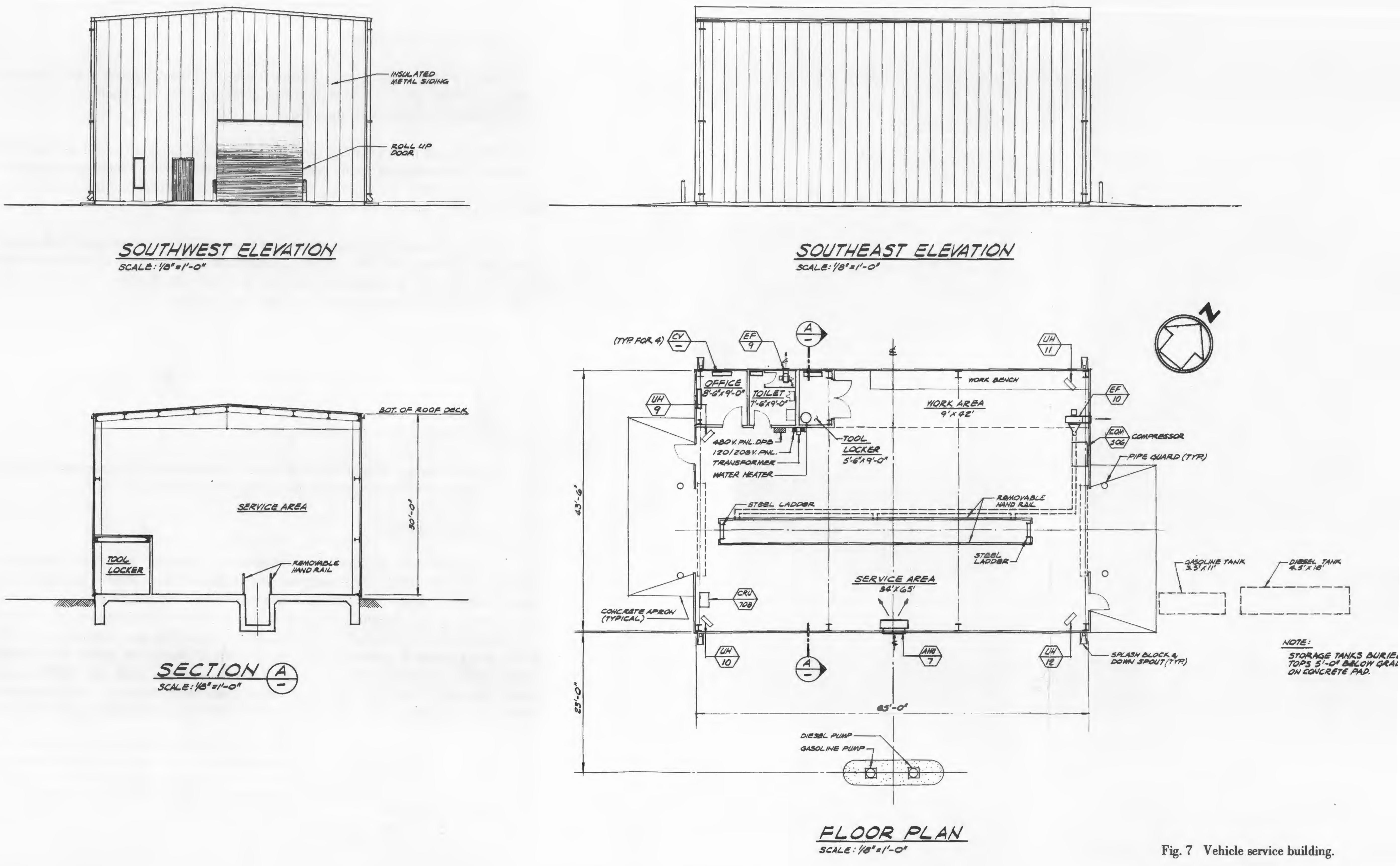


Fig. 7 Vehicle service building.

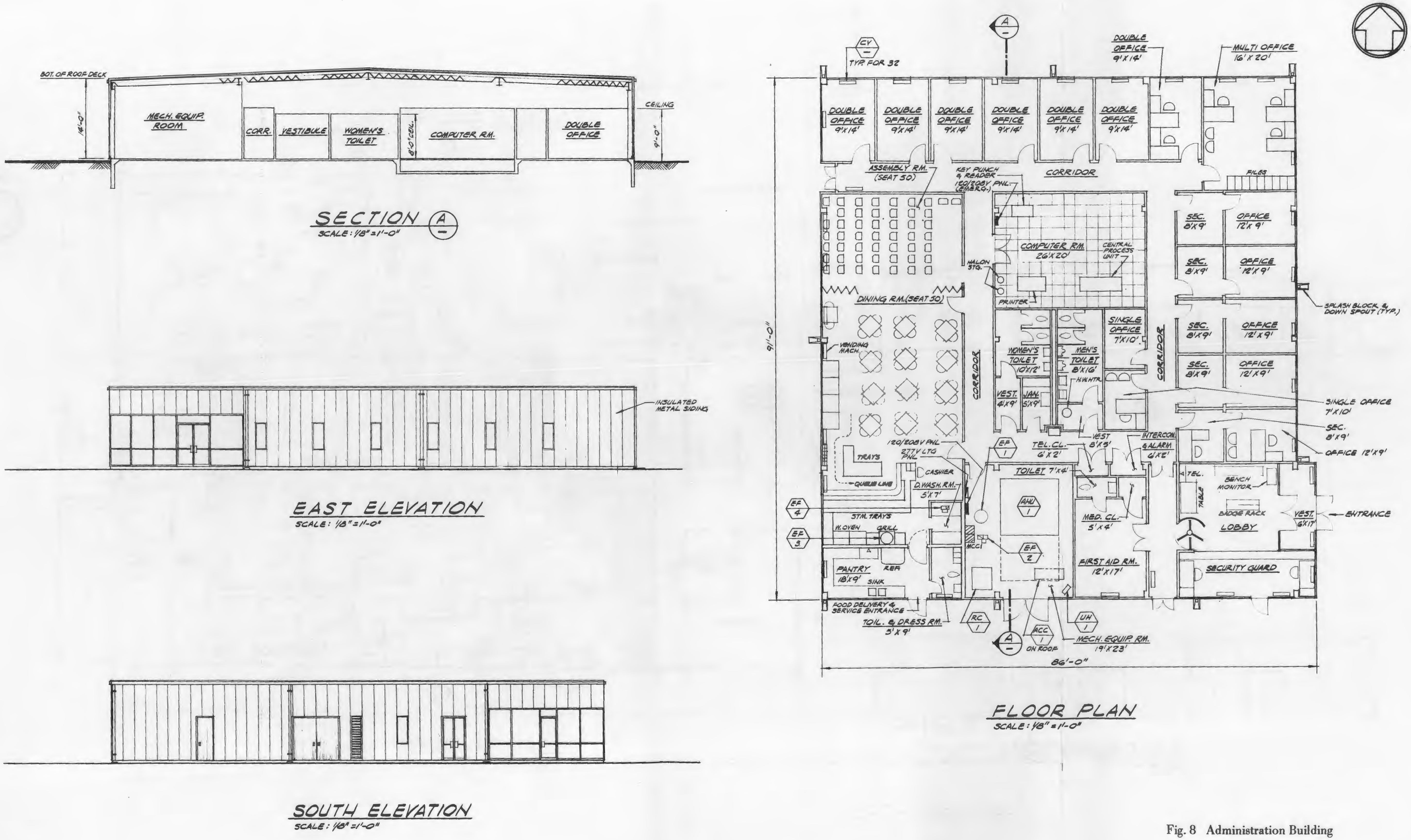


Fig. 8 Administration Building

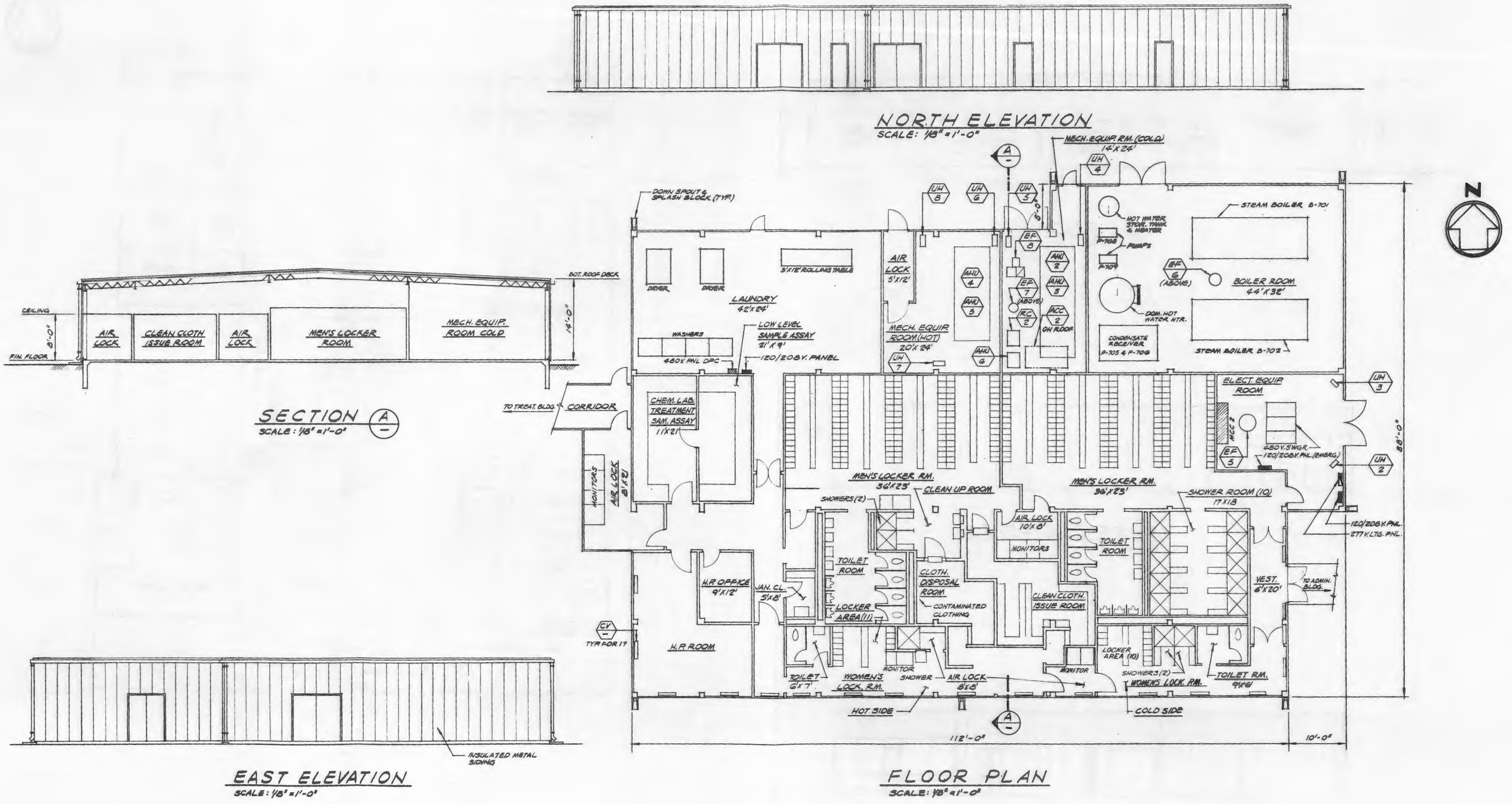


Fig. 9 Support Building.

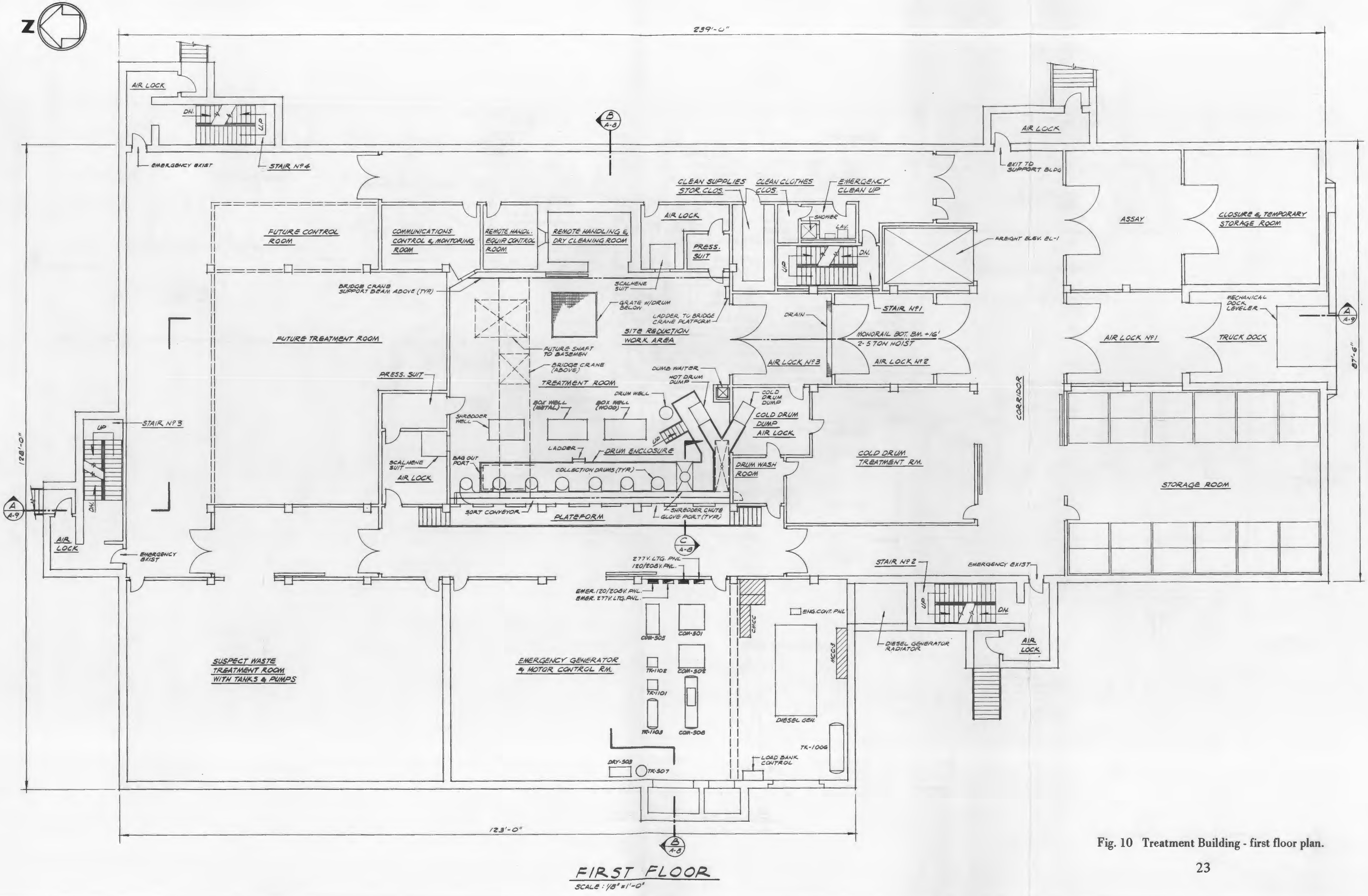


Fig. 10 Treatment Building - first floor plan.

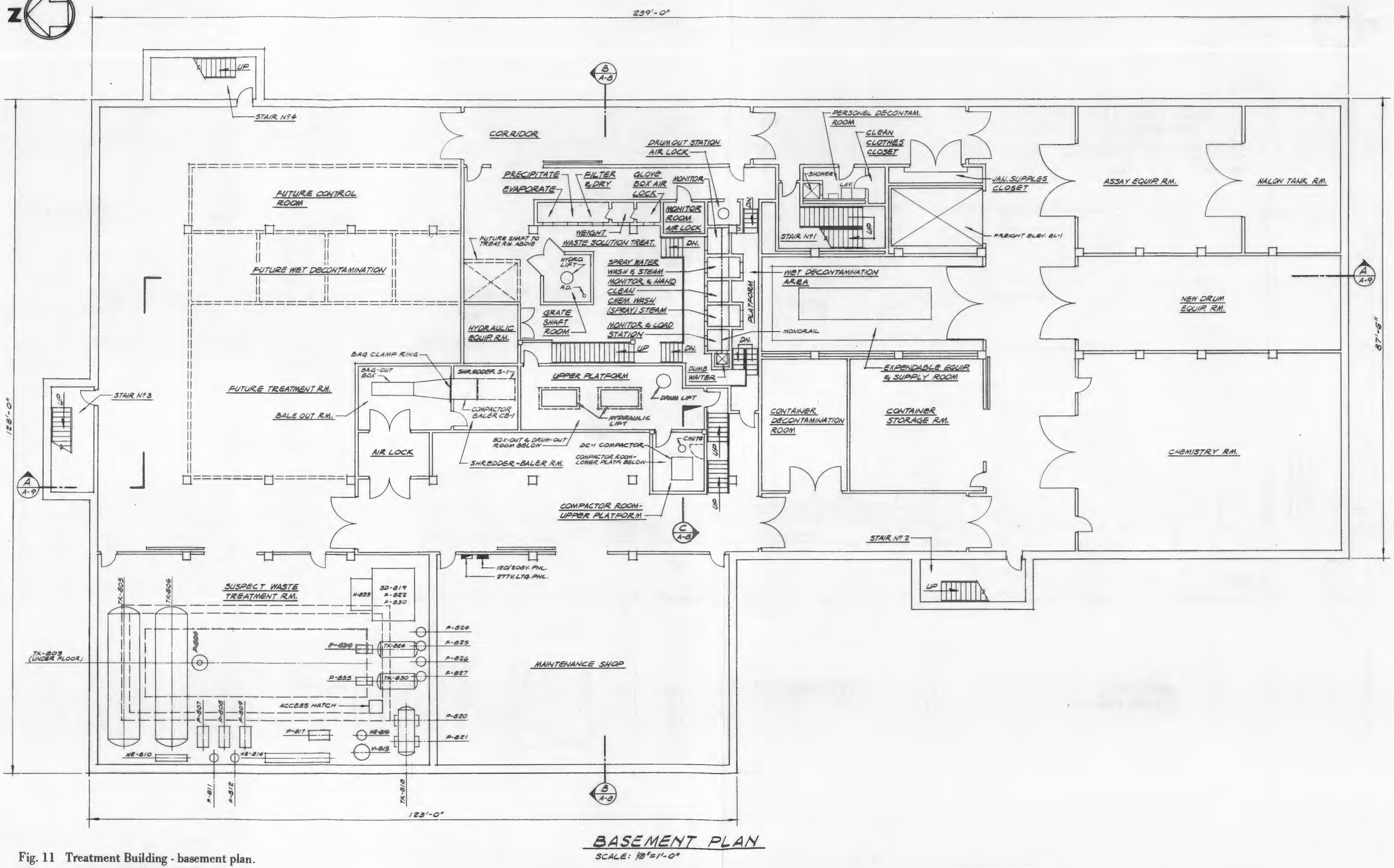


Fig. 11 Treatment Building - basement plan.

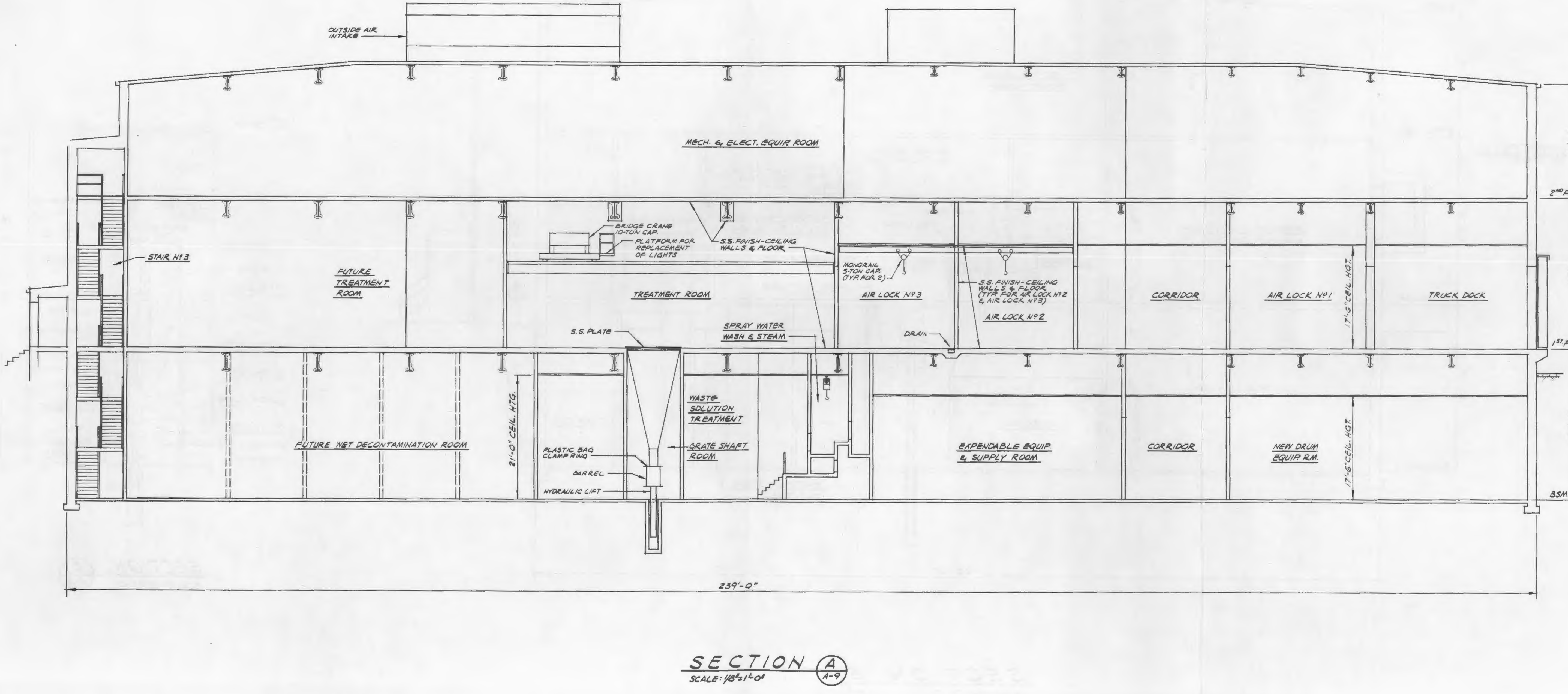


Fig. 12 Treatment Building - section looking east.

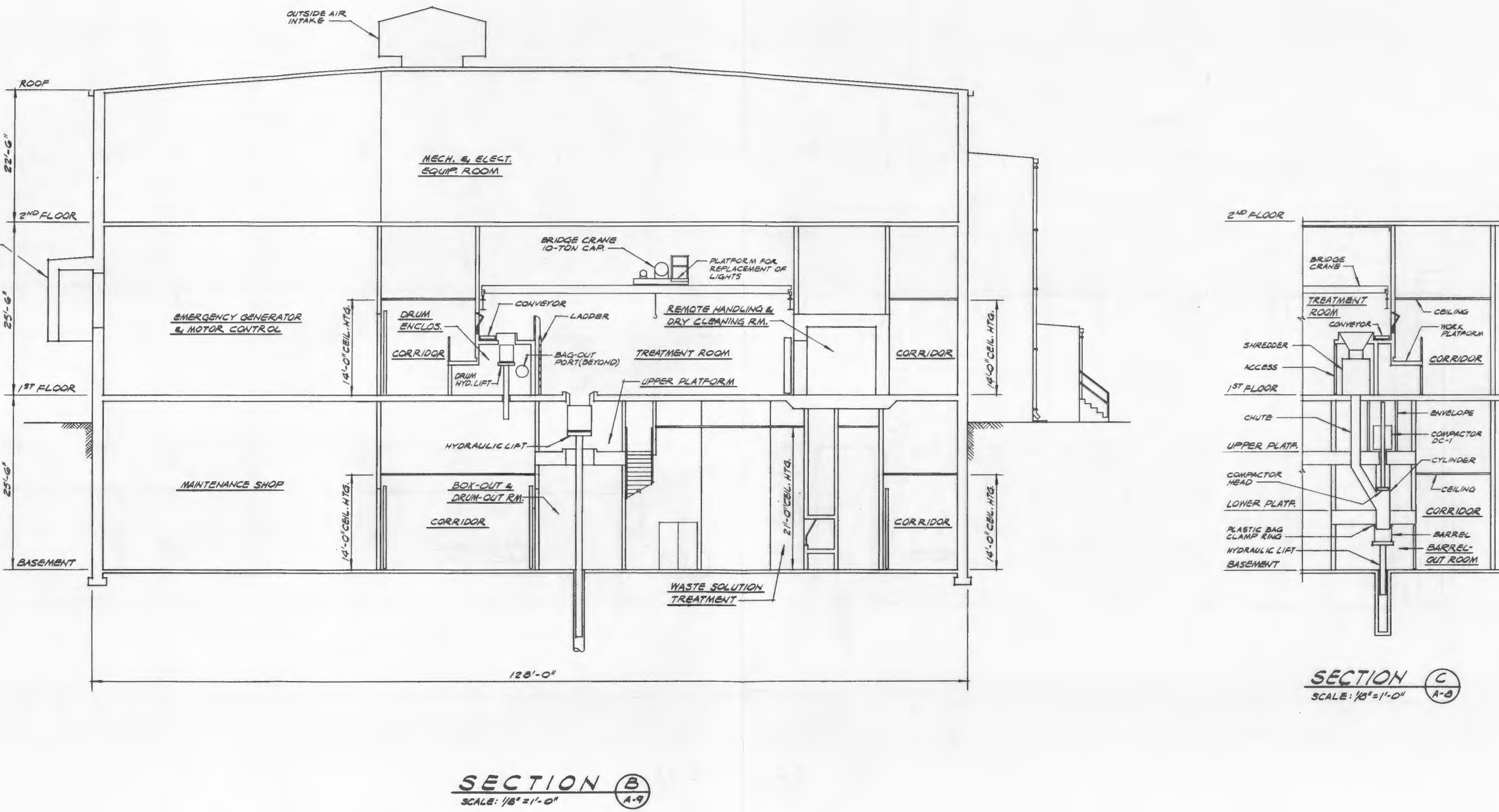


Fig. 13 Treatment Building - section looking north.

1.6.1 Receiving and Storage. The retrieved, packaged transuranic waste materials are received at a truck dock in a 5- by 5- by 8-foot metal container. The container is unloaded by forklift, taken into the building through Airlock No. 1, and then stored or taken directly into the treatment room airlock system.

Storage is provided for approximately one month's supply of waste. Waste is segregated into essentially two categories, drums and boxes, and is campaigned on this basis. Containers retrieved and assayed at the Burial Ground which contain more than 100 g of plutonium will have been tagged for special handling. For those containers suspected to contain gross quantities of plutonium, a special-shielded, manipulator-accessed room is provided.

1.6.2 Treatment. The waste passes through a double airlock system (702 sq ft) to the treatment area. The metal container is transported to the first treatment room airlock with forklift. In the airlock, the waste containers are removed from the metal transport container with a hoist mounted on a monorail. Two hoists are provided to work one or both airlocks. The waste is moved into the second airlock. The metal container is monitored, decontaminated if necessary, and returned to the retrieval area for another load.

The retrieved waste containers, drums or boxes, in the second airlock are monitored. Boxes and wrapped or contaminated drums are routed into the treatment room. Noncontaminated (cold) drums are diverted into a cold drum handling room where they are opened and identified under an exhaust hood. Drums containing cold treatable waste (waste could be highly contaminated but wrapped in plastic) are dumped into a special airlocked bin connected to the treatment room. The nonradioactive or slightly contaminated empty drum is then washed, compressed, and stacked for reburial. Drums containing nontreatable waste or those which are highly contaminated inside are rerouted back to the airlock and into the treatment room. Drums containing nontransuranic waste may be removed from the cold drum handling room for reburial.

Boxes and drums entering the treatment room are opened and identified. Drums of nontreatable waste are resealed, placed either in larger drums or boxes meeting 20-year containment criteria, and sealed for ITSA pad storage. Drums containing treatable waste are dumped onto a transport conveyor for inspection and dispensing to a sorting conveyor. The special airlocked bin referred to above in the cold drum handling operation also dumps onto the transport conveyor. This conveyor system is all metal for receiving wastes that are being exposed to the atmosphere for the first time. Should a hazardous condition (spontaneous fire, chemical, etc.) exist, it can be contained on this all metal conveyor system. The operators working the sorting conveyor, through glove ports outside the treatment room, can control dispensing of material for sorting and handling. A bridge crane spans the treatment room for moving, raising, and lowering the waste. A flowsheet for the waste is shown in Figure 14.

Major pieces of equipment contained in boxes or drums are disassembled, dry-cleaned by grit blasting, and compacted, if desirable. Wood, including retrieved boxes, and massive pieces of plastics (shielding) are cut into pieces suitable for packing into the

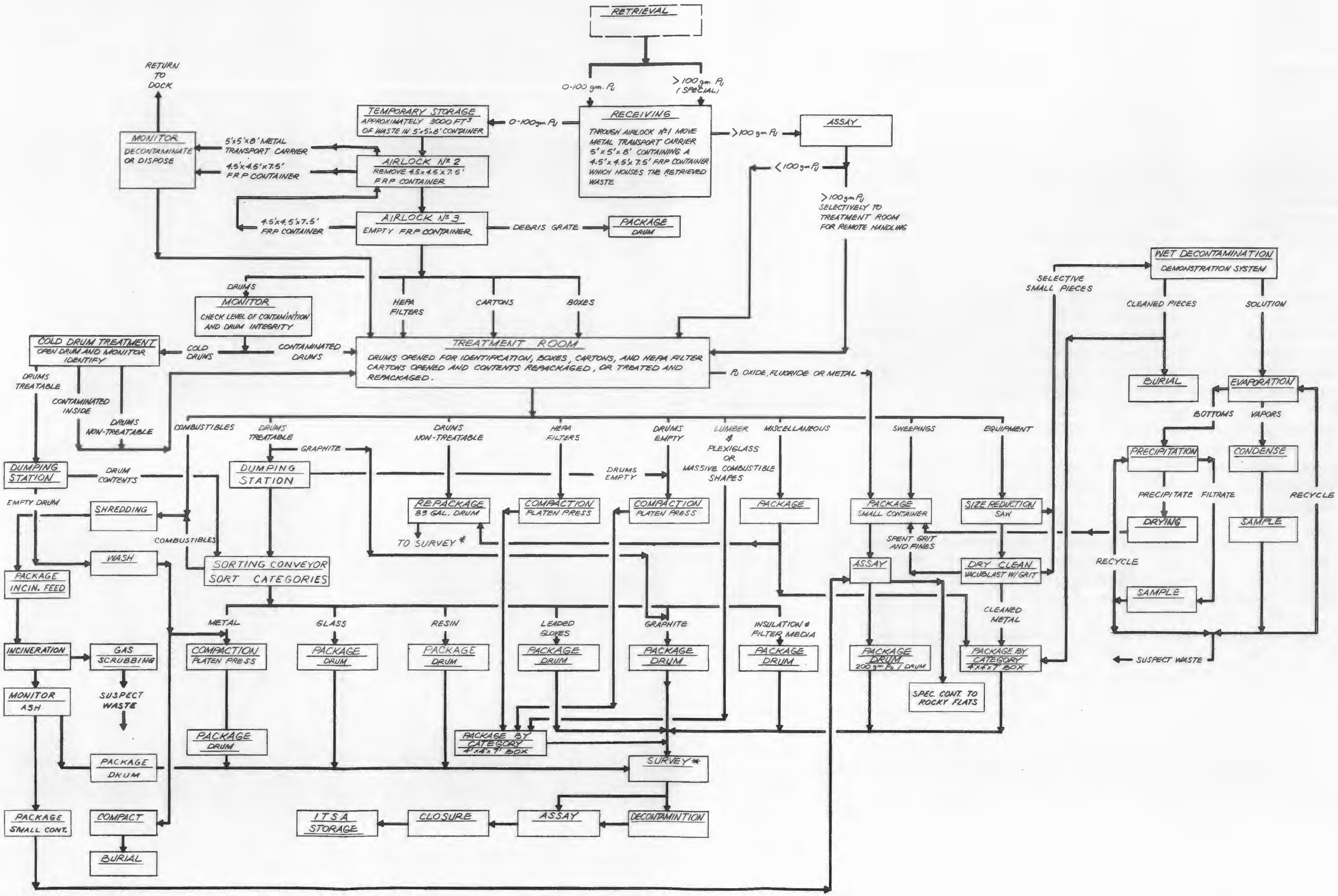


Fig. 14 Transuranic waste process flow diagram.

standard box. Sheet plastics, paper, and other shreddable combustibles are shredded and compacted into a drum or are shredded, baled, and packaged. The treated materials are lowered into their respective containers, sealed, monitored, and moved to decontamination and/or assay. The forklift is used to transport the containers.

The special, shielded room with manipulator access is used routinely for dry cleaning and, as needed, for remote disassembly of containers known or suspected to contain large quantities of plutonium.

The control room will contain equipment to monitor all alarms, a CRT display unit and printer for the computer, a TV system to observe the treatment and special shielded room, a window to view the treatment room, and equipment to communicate with the personnel in the treatment room.

The treatment room is a pressure-suit operation area. Access is provided from opposite corners using either standard pressure suit or the Scalhene suit (self-contained, portal-accessed suit which can be used repeatedly). All access points to the treatment room are airlocked, except the special openings where treated materials are placed in their respective containers. These openings provide for bag sealing between the container and treatment room. The drums for sorted material along the sorting conveyor are removed on the first floor. The boxes, large drum, and shredded combustible receiving systems are in the basement. Hydraulic lift systems are provided to position receiving containers at their respective locations.

A small, wet-decontamination system in glove boxes is provided to demonstrate the practicality of decontaminating machine parts and other materials to meet burial standards. The system is located in the basement and receives material by dumbwaiter from the treatment room above. This batch operation offers flexibility in wet treatment with a closed-loop spray system which can be alternately filled with different decontaminating agents. A monorail hoist is provided for lifting and moving the object from station to station. Depending on level of decontamination, the object can be removed for burial or placed in a drum. The solutions generated in wet decontamination are treated by evaporation, precipitation, and filtration. Sampling at each intermediate step is provided to determine effectiveness of treatment and the extent of treatment required to reduce decontaminating solutions to suspect waste levels.

Suspect waste solutions from the Support, Vehicle Survey, Vehicle Decontamination and Treatment Buildings are collected in tanks containing nuclear poisoned Raschig rings. The solutions are circulated, filtered, and sampled before being concentrated in a thermo-syphon evaporator. The overhead vapors are heated and exhausted to the stack through positive filtration. The concentrated bottoms are dried in a spray dryer. The dried particulate solids are collected in, and discharged from, a bag filter system. The vapor is exhausted through backup positive filtration to stack. Steam condensate from the reboiler is collected, sampled, and returned for boiler water makeup. Should the reboiler breach, causing the condensate to become contaminated, the condensate is cycled to suspect waste. The suspect waste treatment area is 2,480 square feet on both the basement and first floor.

1.6.3 Assay. Development work is required to design one assay system to determine plutonium content in the various size containers. Fifty-five gallon drum systems are available. Systems for 5- by 5- by 8-foot containers are not available. Discussions with vendors indicate that it appears possible to design one system capable of determining plutonium content to one gram or less in the treated waste if the waste can be identified and standards developed for the various categories. Assaying of unknown materials received from retrieval in the 5- by 5- by 8-foot transport container to a reasonable degree of accuracy is not considered practical. However, it should be possible to determine relative quantities and isolate items containing large quantities of plutonium for special handling. The present concept is to have a two-level system (672 square feet each level) where the container to be assayed is lowered into a counting chamber completely encircled with counting tubes. This is a passive system using coincidence counting.

A laboratory (1840 square feet) is provided for determining plutonium content in samples of various liquids (suspect waste, wet decontamination, condensate) and solids (fines from treatment room, precipitate) generated throughout the facility. The laboratory is concerned with pulverizing, weighing, dissolving, and counting, as well as running various chemical determinations.

1.6.4 Mechanical. Several pieces of mechanical equipment are required in the treatment operation. They include:

1) A forklift for transporting retrieved waste containers and repackaged containers.

2) A monorail and hoist system for handling containers through the double airlock system to the treatment room.

3) A bridge crane for lifting and moving materials in the treatment room, including depositing drums and cleaned equipment into repackaging containers. The bridge crane is equipped with a platform for relamping and cleaning the ceiling.

4) Two stationary drum hoists with geared drum turner for dumping treatable waste to the sorting conveyor system.

5) Portable grit blasting equipment for surface cleaning of contaminated equipment and miscellaneous shapes. The unit has automatic recycle and separation of reusable grit and fines.

6) A shredder with gravity fall to direct compaction into a drum, for combustible waste.

7) Two presses, one for 55-gallon (and smaller) drums in the cold drum treatment room and the other for drums, miscellaneous metal shapes, and HEPA filters in the treatment room.

8) An alternative compactor baler for combustible wastes.

9) A dock leveler, integral with the dock, for the forklift to pick up shipping containers from the transporting vehicle.

10) A freight elevator for moving equipment and containers between floors, which is sized to accommodate the forklift carrying a 5- by 5- by 8-foot container.

11) A master slave manipulator in the special shielded enclosure for probing containers suspected to contain gross quantities of plutonium.

12) Two conveyors to convey treatable waste to sorting operations.

1.6.5 Piping. Those systems essential for maintaining the integrity of the Treatment Building are located in the hardened structure. Other systems are located elsewhere with services piped to the building. The essential systems are compressed air, high- and low-pressure halon, health physics monitoring, and HEPA filter fire protection. These essential systems are on emergency power and are described below.

1) *Compressed Air System.* Two compressors (each sized for full system load) and associated equipment are provided for plant and instrument air. One additional compressor is provided for the breathing air system. Backup for the breathing air system is attained with a regulated cross-connection on demand from the plant and instrument air system. Breathing air stations are provided at each airlock access to the treatment room and at other locations adjacent to the contained contaminated operations. All breathing air is refrigerated and treated for personnel use.

2) *High- and Low-Pressure Halon.* The Halon system is the primary fire protection system for the Treatment Building. Two systems are included: a low-pressure flooding system for rooms and a high-pressure system for gloveboxes and laboratory hoods. The Halon storage is in a compartment in the basement near the dock for convenient recharging.

3) *Health Physics Monitoring System.* An air sampling system is provided to detect alpha contamination in all areas of the building. It consists of routine air samplers throughout the building and continuous air monitors, with alarms, at selected locations where a breach of containment would be immediately detected. A central vacuum system consists of two units, each sized for full system load. The continuous air monitor units will alarm in the Treatment Building control center and in the health physics office in the Support Building.

4) *HEPA Filter Fire Protection.* A tank and two pumps (one spare) are provided for spraying the air entering the HEPA filters for fire protection.

Other systems (nonessential) are as follows:

(a) Industrial and domestic water.

(b) Secondary fire protection sprinkler system with manual release. This covers all areas of the Treatment Building except the emergency generator, motor control, and treatment conrol rooms.

(c) Steam, condensate, and hot water.

(d) LPG and fuel oil.

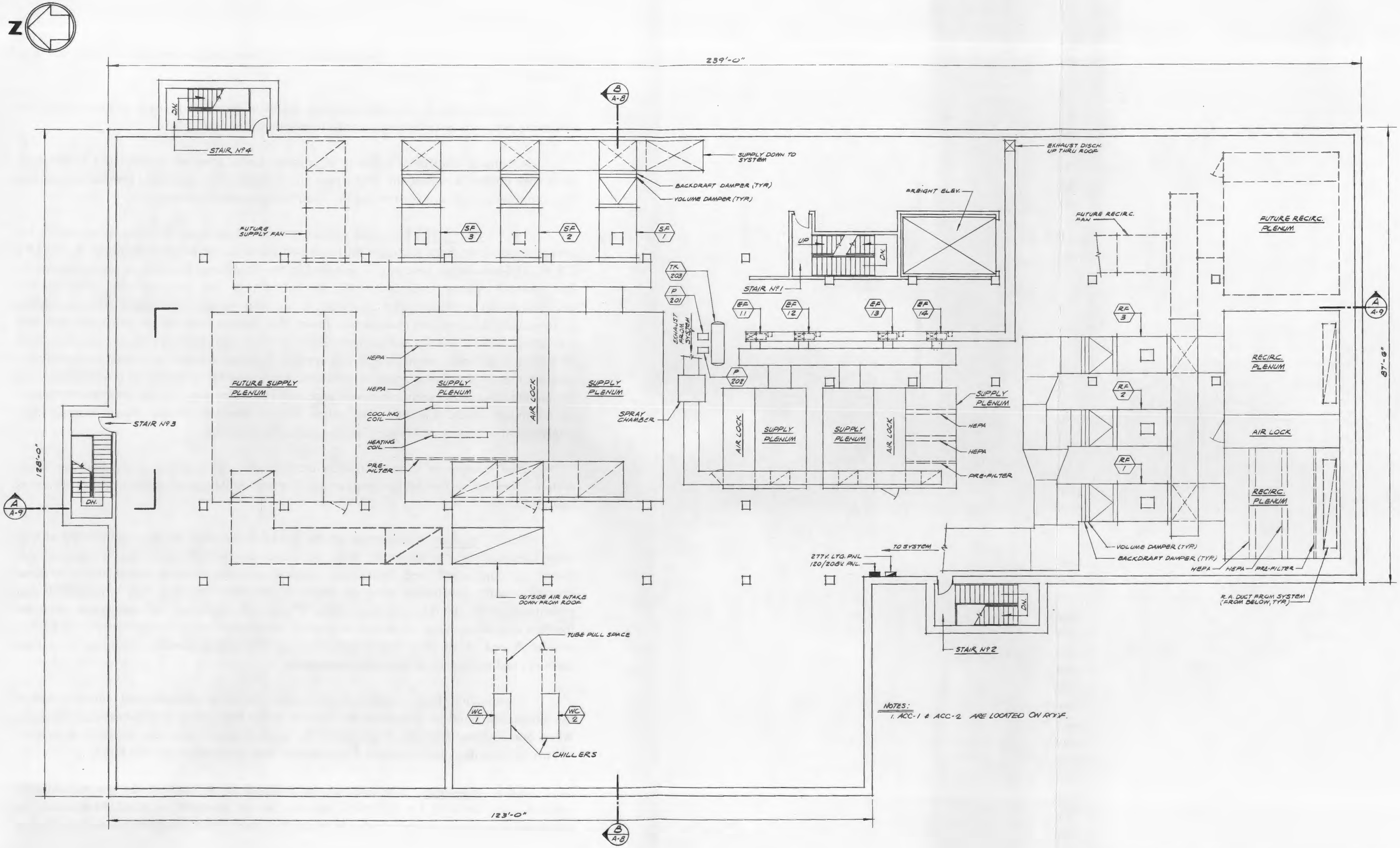
1.6.6 Ventilation. The ventilation system controls the confinement of radioactive materials during normal operations and all postulated accidents including those caused by natural phenomena. Differential pressures are maintained to insure the flow is from noncontaminated zones to potentially contaminated zones to contaminated zones. Approximately 90 percent of the air is recirculated. Only that air, about 10 percent, exhausted from the highly contaminated treatment areas, container closure room, lab hoods, vapors from waste evaporation, etc., is once-through filtered and exhausted to the atmosphere.

To insure maintenance of the ventilation system, redundant equipment or systems and emergency power and instrument air sources are provided. Dual controllers and control loops are included where failure of a control is detrimental to the system operation. Generally, the system consists of the following:

(1) *Supply Air System* (Figure 15). This system consists of fans drawing air through air handling plenums, complete with two stages of filtration, heating coils, and cooling coils. Three fans, each rated at 50% of total demand, are provided. Two fans are in operation with one fan on standby. Two identical plenums are included; one is in service while the other one is on standby.

(2) *Recirculating Air System.* This system consists of fans drawing air from the noncontaminated and potentially contaminated areas (areas surrounding contaminated operations) through two stages of filtration and returning it to supply. Three fans, each rated at 50% of demand, are provided. Two fans are in operation with one fan on standby. Two plenums are included; one is in service while the other one is on standby.

(3) *Once-Through Exhaust System.* Fans draw air from the contaminated operations, treatment room and glovebox operations, chemistry lab hoods, and the container closure room through two stages of filtration and then exhaust the air to the



SECOND FLOOR PLAN

SCALE: 1/8"=1'-0"

Fig. 15 Treatment Building - second floor plan.

atmosphere. Four fans are provided, each rated at 50% of total demand. Two fans are on standby. Three plenums, each rated at 100% of system requirement, are included; one is in service while two are on standby.

A continuous air monitor with an alarm is provided in each exhaust duct. An isokinetic system is installed just prior to total exhaust to atmosphere.

Automatic control of differential pressure across zones of confinement is provided. Each zone control is redundant. The sensor and controller for each point provide a signal for the computer as well as a control for the damper controlling the zone.

1.6.7 Electrical. Electrical service to the Treatment Building is provided by underground cable from the main 480-volt switchgear in the Support Building. A 500-kW, 0.8-pf, 480-volt diesel generator is installed in the Treatment Building to supply power to the essential exhaust fans, computer, instrumentation, and other selected loads on the essential motor control center in event of a power outage. The diesel generator starts automatically but requires manual shutdown. The transfer from the preferred source to the emergency power, and the subsequent return to the preferred power, causes an interruption of service to all loads connected to this system. Fans are arranged to restart automatically unless a master shutdown circuit is actuated. A maximum of a 30-second power outage can be tolerated. An uninterruptible power system (UPS) is not required for the instrumentation or computer loads. Lighting and alarm circuit breakers remain closed through any interruption of service and require no operator action to reset.

Two systems of communication are included, an intercom and telephone. Each system is linked to the Administration and Support Buildings. A speaker paging system is included.

1.6.8 Nuclear. Although all of the Rocky Flats waste received monitoring and/or assay valuation prior to shipment, there are nuclear safety implications as it is disassembled, sorted, or compacted, and repackaged. Nuclear criticality control begins in the retrieval operation with monitoring assay to pinpoint containers showing high radioactivity and potentially gross quantities of plutonium. When such containers are uncovered, they are handled selectively. They are stored or treated, as received. Before being treated, a dedicated area is cleared of all other waste materials, and the item is handled piecemeal to isolate, identify, and recover the radioactive substances.

A criticality alarm system is provided and consists of detectors and control panels in the Treatment Building. Detectors are located in the halls, three detectors at each location. When one detector activates, it alarms at the control panel (visual and audible). Activation of two of three detectors is required to sound an evacuation alarm for the building.

1.6.9 Radiation. The bulk of the material to be handled has low radionuclide content, and shielding for radiation exposure is not generally included. Monitoring for abnormal situations is administratively controlled, and portable instruments are provided to alert personnel to abnormal situations. The radiation exposure badges worn by the personnel will be read on a routine basis to maintain control of exposures. For the critical situation, a heavily shielded manipulator accessed room is provided.

1.6.10 Data Logging, Display and Printout. The computer is located in the Administration Building. A multiplex, transmitter-receiver is located in the Treatment Building control room along with a CRT display unit and a printer. A printer is also located in the assay room for receiving computations on assayed containers of treated waste. A CRT unit is located in the health physics room in the Support Building. CRT readout for alarms and/or process variables are on demand with scanned rotation changing at 10 lines per minute. If an alarm condition occurs, the CRT system will print the set point and actual values.

In addition to the CRT display, readout on a printer is provided at the treatment building control room and in the computer room. The operator in the treatment building control room is able to call up any process variable or groups of variables for display at will. CRT readouts are available in the support building health physics office.

The printer in the computer room provides readouts of all variables on 30-minute intervals with alarms as they occur on a first out basis printing in red.

The CRT in the treatment building control room provides readouts of process variables as they are recorded in the computer room and the off-normal alarms as they occur. The printer provides readouts of all process variables, all alarms, door openings and closings, fire alarms, all radiation levels at half-hour intervals unless alarmed, and air system balance in the Treatment Building.

The Guard House has all five stations hard wired to a panel with each station wired back to the Computer I/O panel. A single alarm light in the Guard House activates whenever any variable, other than fire stations, goes off-normal. This is used for off-shift warning when the guard can go to the computer room, determine which variable alarmed, and investigate.

2. ESTIMATED COSTS

The estimated cost (11/1/74) for the Treatment and other supporting buildings is \$20.6 million including 10% escalation above Parsons's 3/1/74 estimate and 25% contingency and 32% engineering, design, and inspection (ED&I).

Escalation because of inflation can significantly increase the total project cost. These capital costs are summarized in Table V.

The annual operating costs for treating 30,000 ft^3/yr of retrieved waste is estimated to be \$3.6 million. This includes container costs, direct and indirect labor, as shown in Table VI, and expendable equipment, but does not include heating, lights, electricity, maintenance materials, etc. Capital and annual costs are summarized in Table VII.

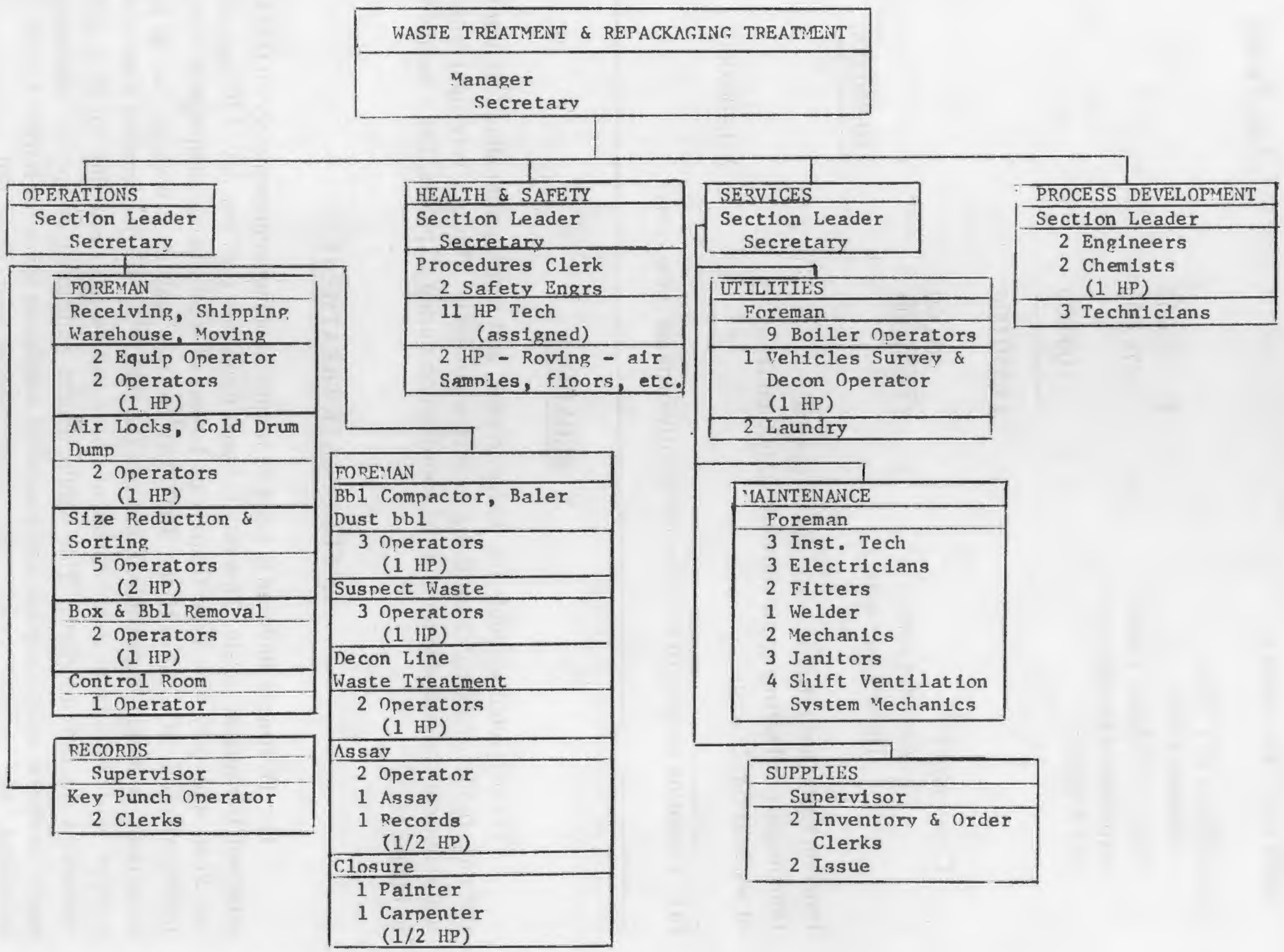
TABLE V
NRTS TRANSURANIC WASTE REPACKAGING FACILITY
Capital Costs[a]

Construction Costs ($1000)			
1. Improvements to Land			$ 325.
	Grading & Reseed	$ 133.	
	Roads	$ 60.	
	Parking Lots & Walks	$ 85.	
	Sewage System	$ 47.	
2. Buildings			$11,078.
	Vehicle Survey	$ 225.	
	Vehicle Service	$ 173.	
	Administration	$ 486.	
	Support & Covered Walk	$1057.	
	Treatment	$9137.	
3. Utilities			$ 1,037.
	Electrical	$ 374.	
	Potable Water	$ 15.	
	Fire Water	$ 351.	
	Steam	$ 69.	
	Fuel Oil	$ 175.	
	Waste	$ 53.	
	TOTAL CONSTRUCTION COSTS		$12,440.
Engineering, Design & Inspection @ 32%			$ 4,050.
Title I	8 months	$ 940.	
Title II	12 months	$2200.	
Title III		$ 600.	
Construction Superintendent		$ 100.	
Project Manager		$ 100.	
Quality Assurance		$ 40.	
Health & Safety		$ 50.	
Purchasing		$ 20.	
	Subtotal		$16,490.
	Contingency @ 25%		$ 4,110.
	TOTAL - 1974 Cost		$20,600.

[a] Escalation because of inflation can greatly increase these costs. For example, esculation at a rate of 8.8% per year for a 6½-year period will increase the capital cost to $35,600,000

TABLE VI

CONCEPTUAL ORGANIZATION CHART-TREATMENT & SUPPORTING AREAS



Note: HP's are in H & S Section but work for others.

TABLE VII
COST SUMMARY FOR NRTS TRANSURANIC WASTE REPACKAGING DEMONSTRATION FACILITY[a]

Capital (3/1/74 estimate)		$20,600,000
Annual Costs (FY-75)		
Container Costs	$ 75,000	
Direct & Indirect Labor	3,375,000	
Expendable Equipment and Supplies	100,000	
	$3,550,000	
Contingency	50,000	
Annual Costs	$3,600,000	
Three Year Costs		10,800,000
Program costs (less retrieval costs) for three-year Demonstration Treating approximately 90,000 cu ft of waste at FY-75 costs		$31,400,000

[a] Escalation because of inflation can greatly increase these costs.

3. SCHEDULE

The projected schedule for design, review, and construction allows 39 months from the time funds are available until the project is complete. This is a very tight schedule and will require a considerable amount of coordination during all phases. The schedule is shown in Figure 16.

4. FULL-SCALE TREATMENT

The Treatment Building is sized to permit handling approximately 30,000 ft^3/yr of retrieved transuranic waste. This rate is based upon one shift per day, 230 operating days per year, and only one type (barrels or boxes) of waste being campaigned through the treatment room at a time. If the 30,000 ft^3/yr is a realistic processing rate at the given conditions, it should be possible to process 280,000 ft^3/yr when operating 3 shifts/day, 365 days/yr, with simultaneous treatment of boxes and barrels (assuming handling and sealing operations do not interfere). This would require additional manpower, increased locker space, increased cafeteria space, and additional warehouse space for retrieved waste awaiting treatment, but would convert the demonstration unit to a full production facility. Therefore, it is not planned to add another treatment building when changing from the demonstrational program to full-scale operation.

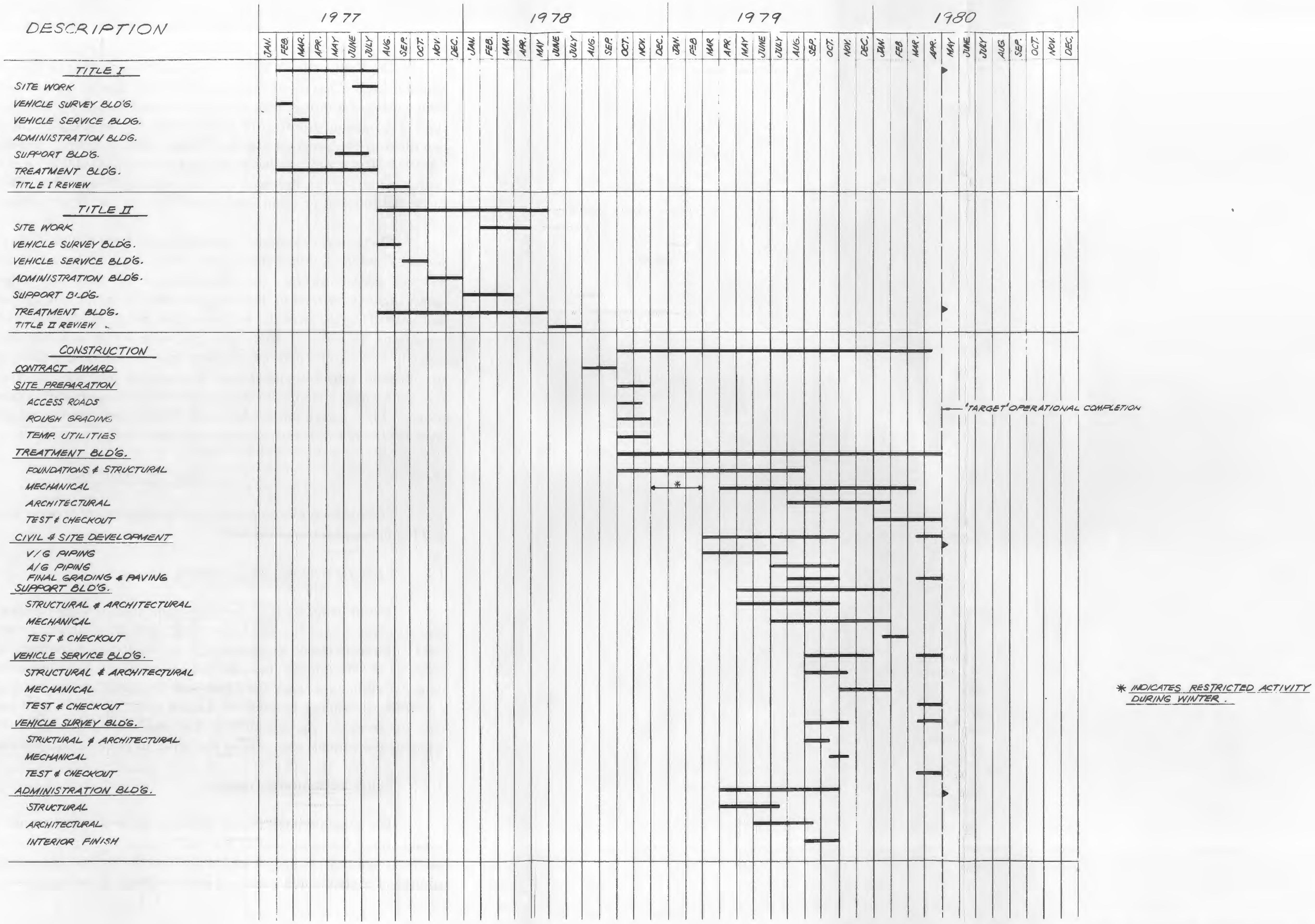


Fig. 16 Proposed schedule for Transuranic Waste Repackaging Demonstration Facility.

V. PROPOSED PROGRAM - RETRIEVAL

The Radioactive Waste Disposal and Storage Area (RWD&SA) at the NRTS includes approximately 25 acres of land where low-level transuranic contaminated (alpha) waste has been buried. From this area, the most recently buried alpha waste (approximately 16,000 stacked 55-gallon drums) will be retrieved for repackaging and storage on the ITSA as described in the program plan for "Initial Drum Retrieval" and funded by 189c 1805c in FY-1975. The waste remaining, approximately 2,200,000 ft^3 will be retrieved as described in this section of the Retrieval and Repackaging Program Plan. The experience gained from the initial retrieval program may reduce the cost and time for the demonstration program.

Alpha waste retrieval operations (including those of excavation, exhumation, sorting, handling, containerization and transportation), have been conducted successfully on a small scale; however, the limited scope of these past activities has not provided comprehensive retrieval information. Potential problems have been identified, but the means and cost of coping with the problems have not been demonstrated for large-scale retrieval operations. Therefore, retrieval of alpha waste will be demonstrated on a pilot scale basis in order to develop the methods, demonstrate the safety, and determine the costs appropriate to full-scale retrieval operations. This section describes the transuranic waste retrieval program, which includes the goals, the retrieval demonstration plan, the full-scale retrieval program plan, Rough Order Magnitude (ROM) costs for the demonstration program, ROM costs for the full-scale retrieval program, and schedule projections.

1. PROGRAM GOALS

The program goals are segregated as appropriate between the retrieval demonstration and the full-scale retrieval operation.

1.1 Retrieval Demonstration Program

The program goals of the transuranic (alpha) waste retrieval demonstration program are: to demonstrate the ability to safely and economically retrieve alpha waste from the NRTS Burial Ground; to provide a basis for the establishment of "Full-Scale Retrieval" scope and magnitude; to establish alternative cost comparisons; to establish from demonstration experience the "Full-Scale Retrieval" design criteria; to establish budget and performance criteria; to establish hazard levels associated with the retrieval and handling; and to compare the operational and residual hazards of Full-Scale Retrieval vs the alternative solutions, e.g., leaving the waste in place or encapsulating of the waste in place.

1.2 Full-Scale Retrieval Program

The program goals of the full-scale retrieval operation are: to retrieve all the alpha wastes stored below ground at the NRTS Burial Ground; to conduct all retrieval operations safely; to control radioactive emissions from the facility; and to minimize the production of additional contaminated waste as a result of the retrieval operations.

2. DEMONSTRATION PROGRAM

The alpha waste retrieval demonstration program has been subdivided into five phases of work, each of which includes several tasks. Work phases and associated tasks are described in the following paragraphs.

2.1 Phase One - Retrieval Demonstration Program Concept

Phase One work consists of five major tasks, each of which can be further subdivided into subtasks.

2.1.1 Conceptual Design Criteria. To establish the conceptual design criteria, the scope of work, objectives and functional requirements of the project must be identified and shall be reviewed and approved by AEC. When the functional requirements are fixed, criteria which will satisfy the requirements shall be established for facility features, utilities, effluent control and monitoring enclosures, storage facilities, special safety features, emergency planning, quality assurance and security.

2.1.2 Conceptual Design Package. The conceptual design shall consist of the development of various facility concepts which can satisfy the design criteria, and the evaluation of the concepts to determine the most satisfactory concept from the point of compliance with the criteria. Concepts to be investigated shall include:

1) A large (150 ft x 300 ft x 50 ft) air support building as an external, tertiary confinement which will contain a relatively mobile secondary confinement area capable of sustaining an internal negative air pressure (see Figure 17). The secondary confinement will enclose and move with the working face. The tertiary confinement will require relocation only once per year.

2) A large (150 ft x 300 ft x 50 ft) butler-type building capable of sustaining a negative air pressure as an external, tertiary confinement which will contain a relatively mobile secondary confinement area capable of sustaining a negative air pressure (see Figure 18). Mobility requirements will be identical to those of previous concept.

3) A Quonset Hut (100 ft x 200 ft x 50 ft) type building capable of moving on a rail system 2000 feet in length as an external, tertiary confinement with a relatively mobile secondary confinement area inside which shall be capable of sustaining a negative air pressure (see Figure 19). The tertiary confinement was sized to require only one primary relocation of the rail system in order to cover the retrieval area.

4) A self-contained and propelled, solid-walled containment mounted on tractor treads, capable of sustaining a negative air pressure. and containing a track-mounted hydraulic operated excavator (see Figure 20).

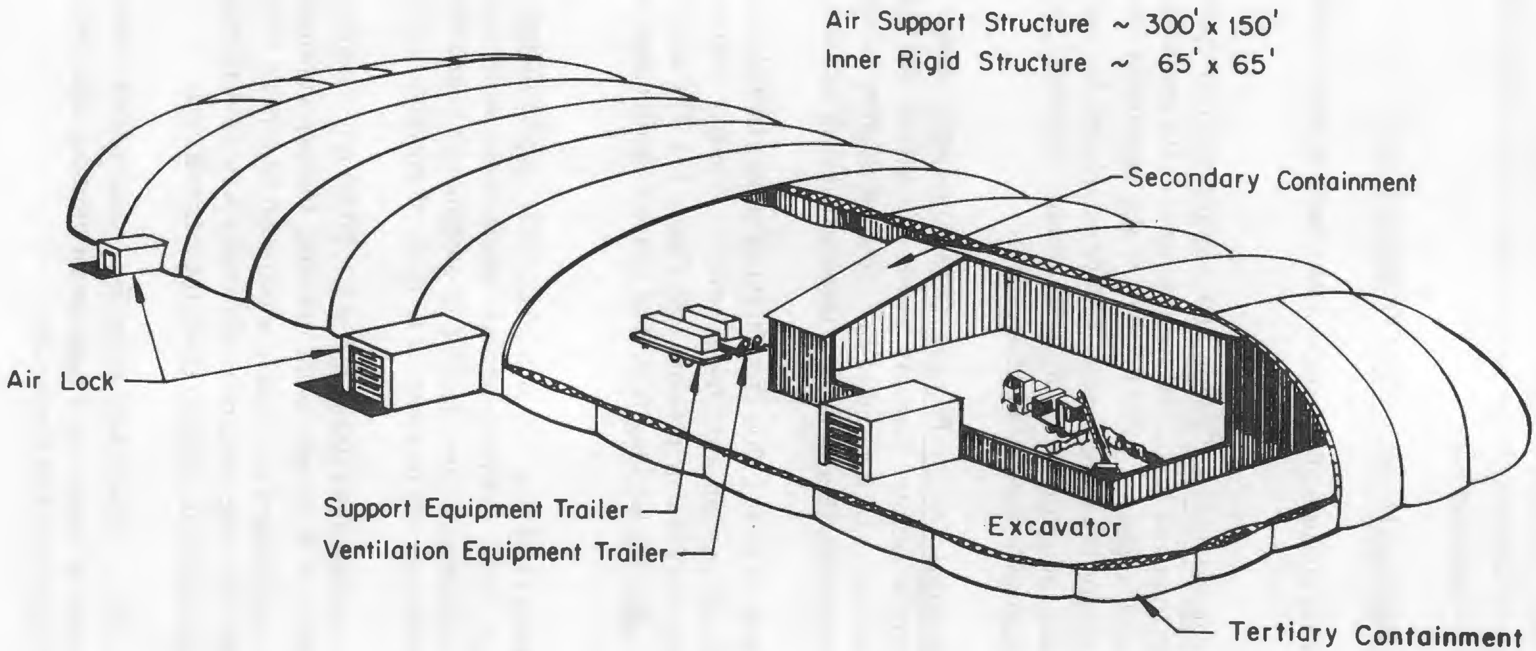


Fig. 17 Air support building.

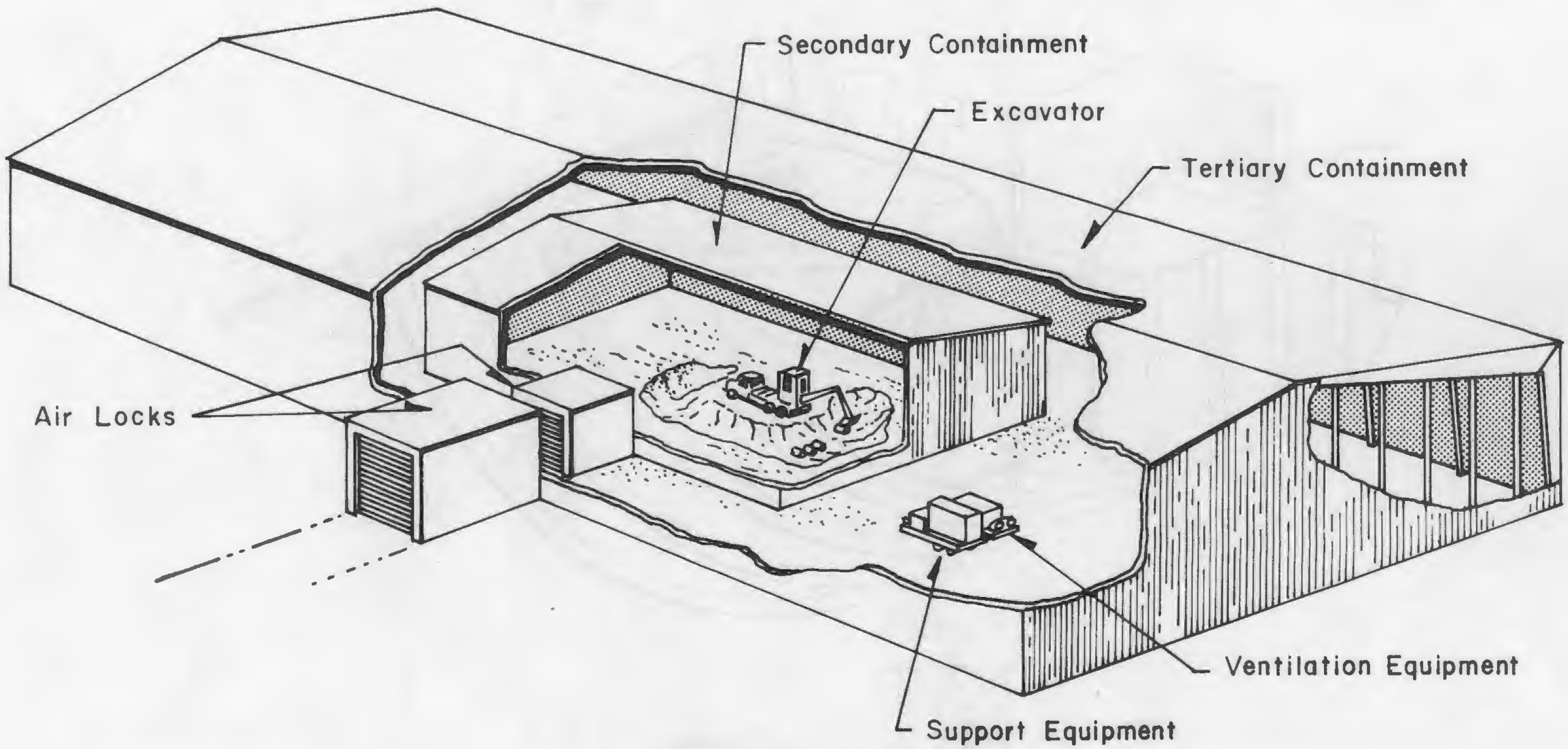


Fig. 18 Large butler building.

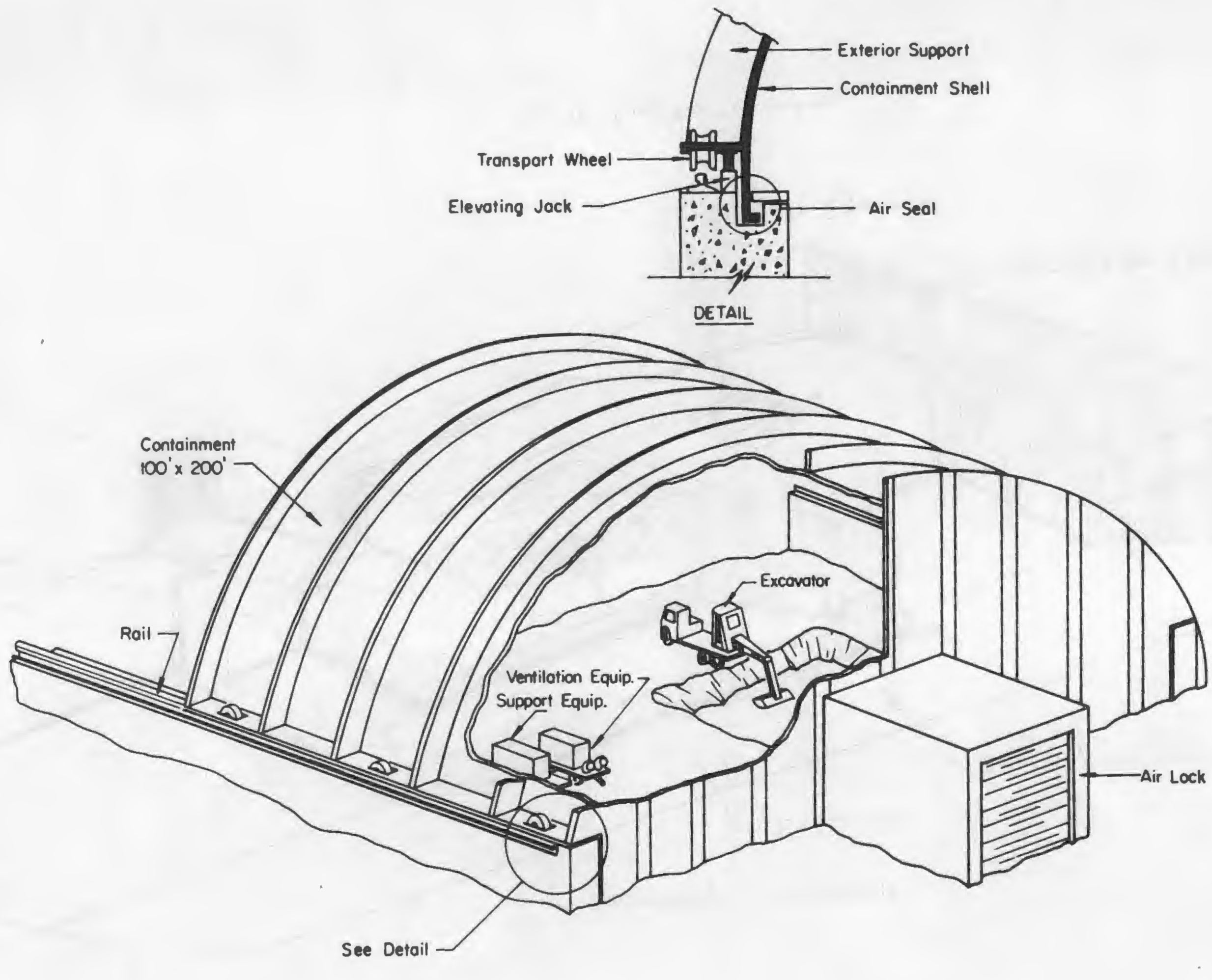


Fig. 19 Quonset hut on rails.

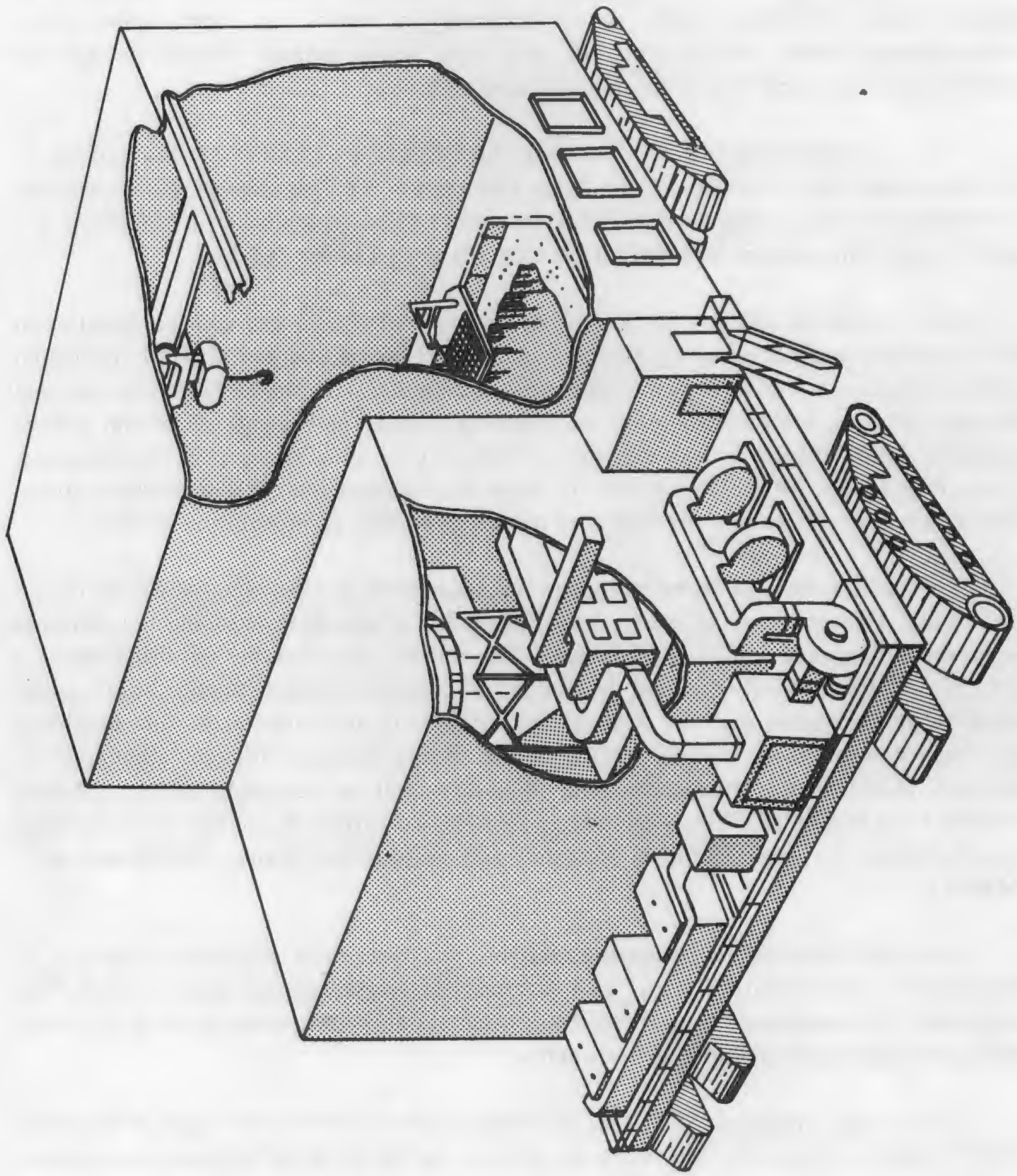


Fig. 20 Retriever I.

5) A concrete slab constructed over the working portion of the Burial Ground, using mining techniques for removal of the waste from beneath the slab (see Figure 21).

6) A polyresin impregnation of the top 1-ft-6-in. of the working portion of the Burial Ground, using mining techniques for removal of the waste from under the self-supported, impregnated soil (see Figure 22). This concept would be supported by external mobile equipment such as containerization room, air locks, transporters, communications trailer, HP trailer, hot and cold waste tankers, ventilation and air conditioning module, and change room and shower module.

7) A large (200 ft x 500 ft x 50 ft) double wall, steel frame and skin building to form the tertiary and secondary confinement (see Figure 23). This concept will require less moves than any other concept and might be located to demonstrate retrieval operations at a single location. The support facilities will be included as part of the building.

8) A small (80 ft x 70 ft x 50 ft) double wall steel frame and skin building to form the tertiary and secondary confinement, supported by external mobile equipment such as containerization room, air locks, transporters, communications trailer, HP trailer, hot and cold waste tankers, ventilation and air conditioning module, and change room and shower module, all designed to interface with the containment by quick disconnect and reconnect systems (see Figure 24). This concept provides the smallest acceptable working space; however, it requires seven moves per year to meet the retrieval demonstration criteria.

The facility concept drawings and specifications shall be evaluated against the design criteria using a forced ranking matrix (see Figure 25) which allows ranking the concepts against each functional criteria requirement. The criteria requirements are weighted as a percentage of 100 percent based on the evaluator's judgment of the function value to the demonstration programs; and the sum of the products of the ranking and the weighting factor shall determine the overall ranking of the facility concept from the standpoint of functional requirements satisfaction. The evaluation will be accomplished by qualified personnel from Project (E&WM), Engineering Division, Construction and Site Services (A&E Branch), Safety Division, Chemical Research and Engineering Branch (ACC) and AEC (WM&EA).

From the eight initial conceptual designs, the three most acceptable concepts, as determined by the evaluation team, shall be upgraded to preliminary design quality. The designs shall be based upon the approved conceptual design criteria and shall be in sufficient detail to provide for preliminary cost estimates.

2.1.3 Cost Analysis. ROM cost estimates shall be prepared for each of the three selected facility concepts to determine the relative capital costs for comparison purposes. Estimates shall also be prepared for operating and related capital equipment expenses for a five-year period in order to develop a total cost picture for each of the facility concepts. The three facility concepts shall then be ranked by total cost and compared with the functional requirements satisfaction ranking. The facility concept which is the most cost-effective

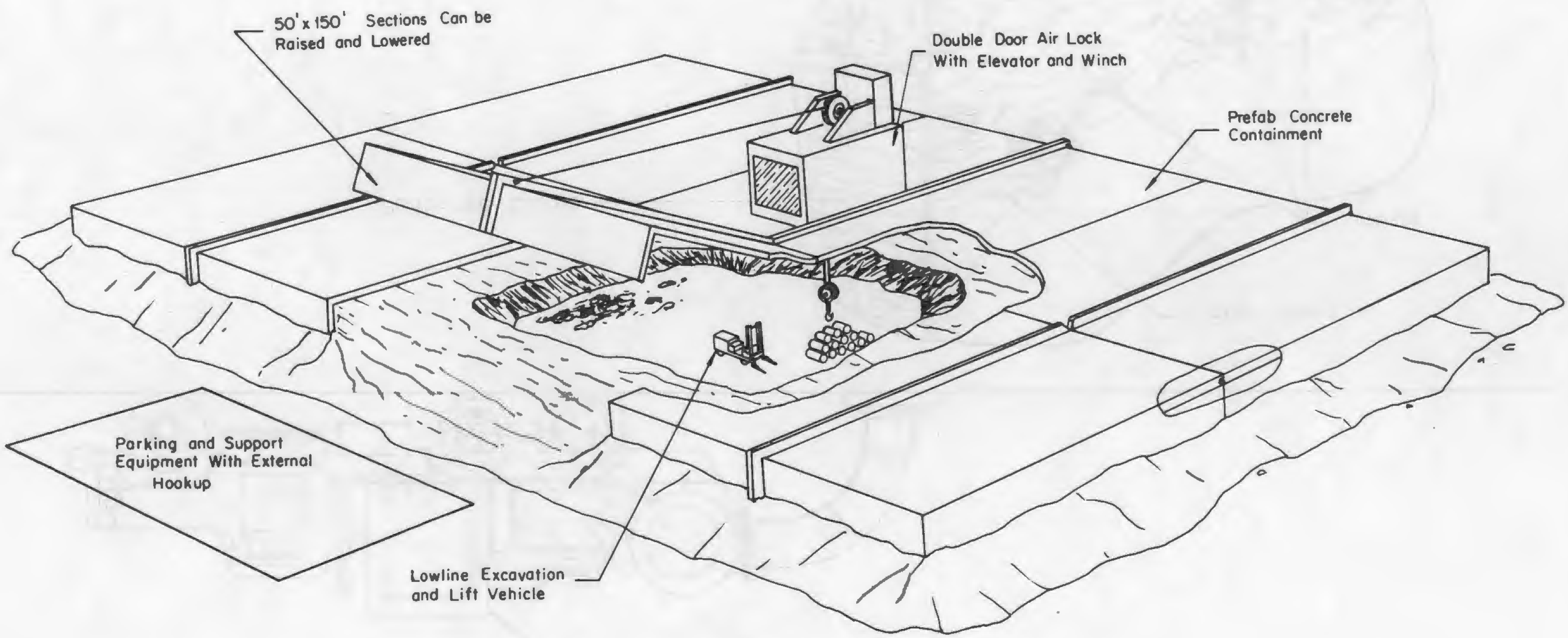


Fig. 21 Concrete slab.

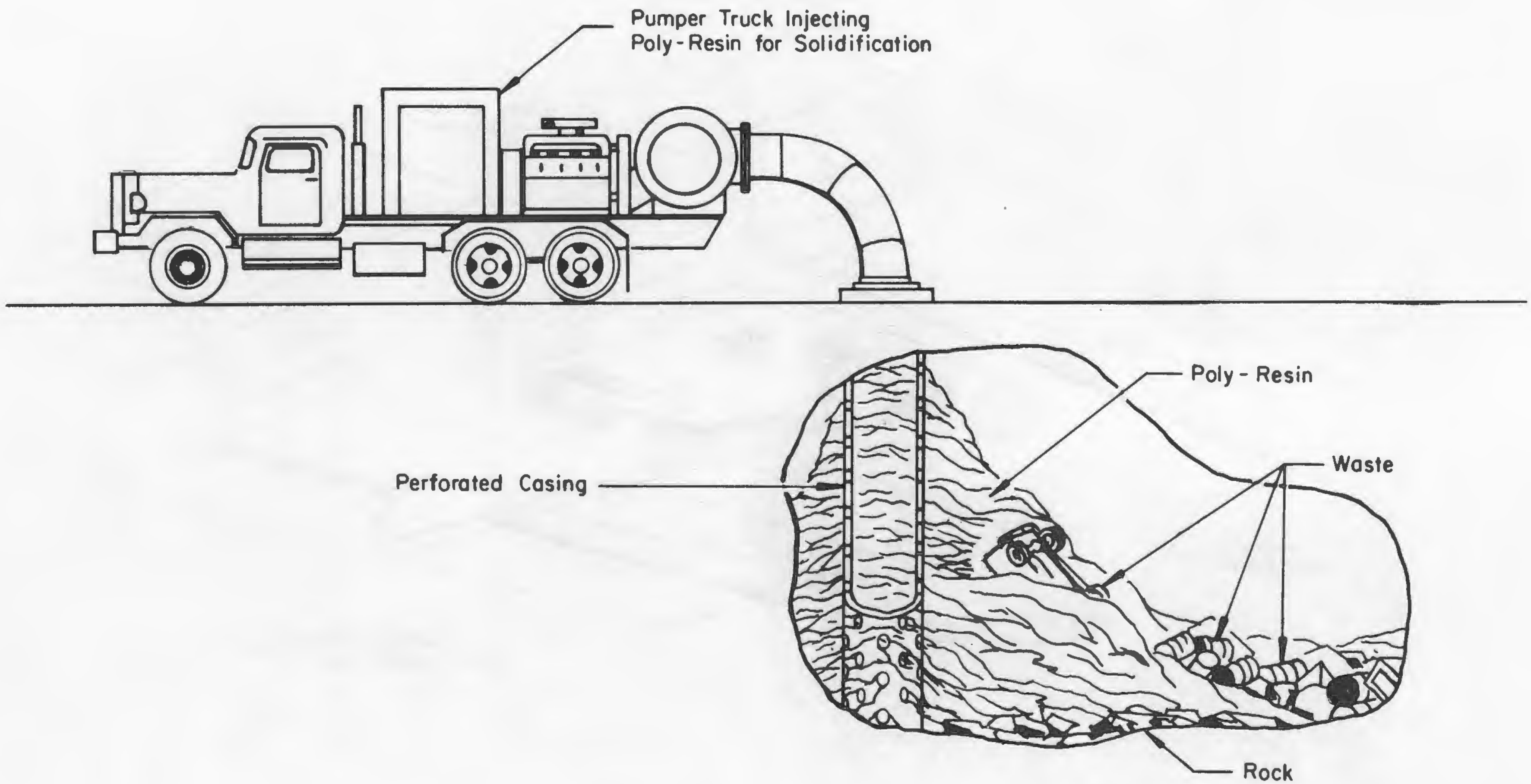


Fig. 22 Polyresin inpregnation.

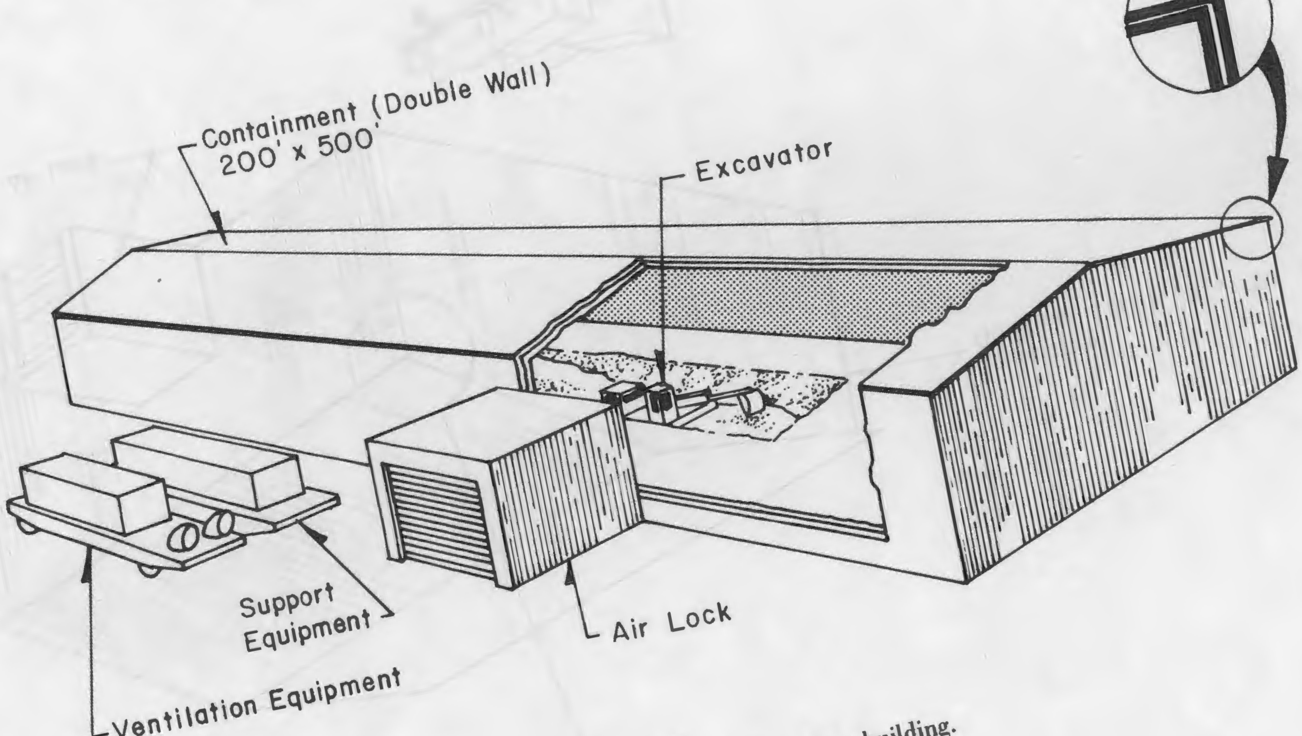


Fig. 23 Large, double-wall steel frame building.

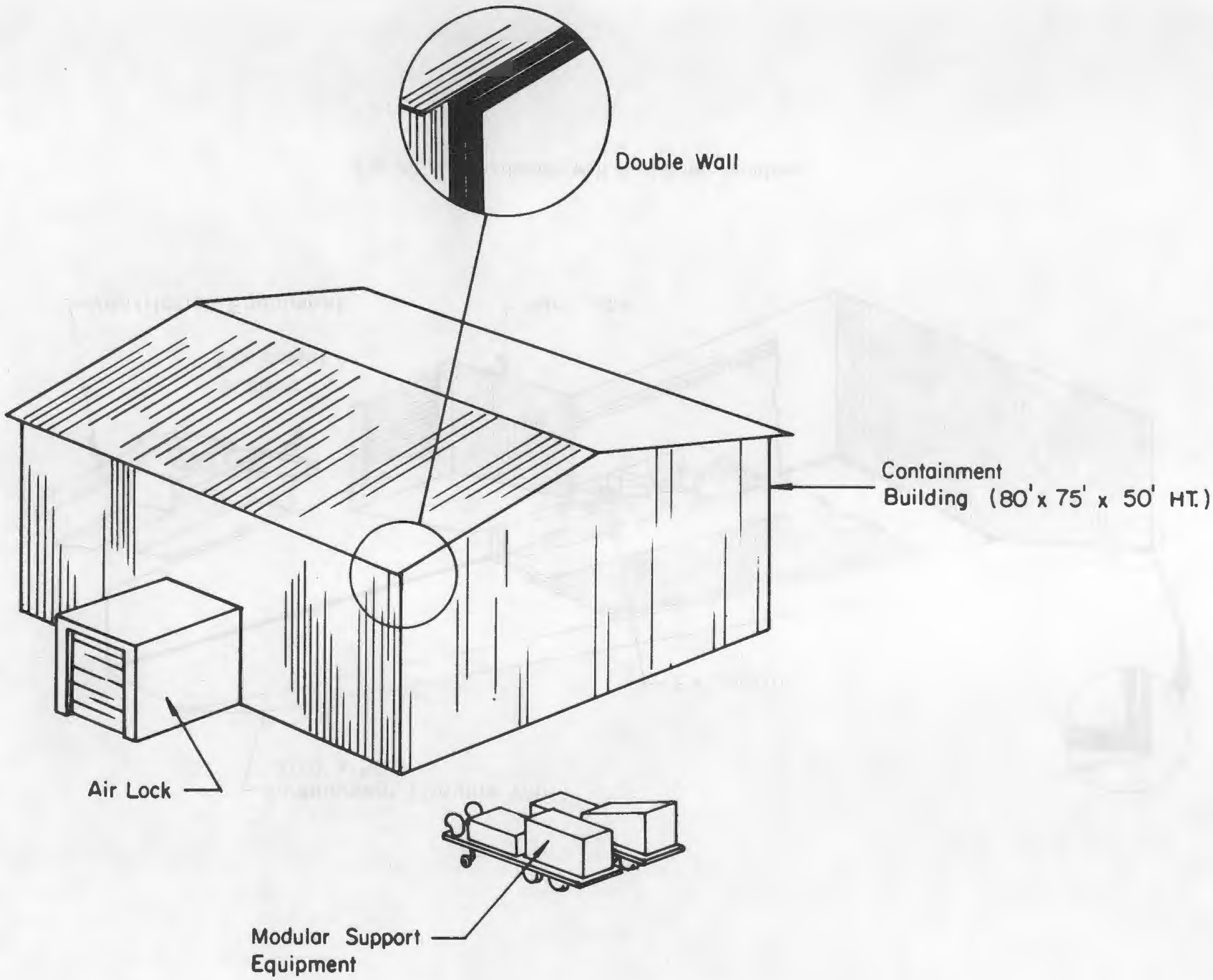


Fig. 24 Small, double-wall steel frame building.

CRITERIA REQUIREMENTS	CONCEPTS: Air Support Struct	Butler Bldg	Quonset/Rail	Retriever I	Concrete Slab	Polyresin Slab	Small Double Wall	Large Double Wall	Wt % of 100
Mobility									
Confinement									
Operations									
Versatility									
Resistant, wind & snow									
Fire resistant									
Seismic design									
Negative pressure									
Modular construction									
Compartmentalization									
Heat and ventilation									
Change room and air lock									
Decontamination or disposal									
Maintenance									
Sum of products									
Ranking x Wt%									

Fig. 25 Concept ranking matrix.

(while satisfying functional requirements) shall be selected for preparation of a more detailed cost analysis–suitable for use in the preparation of a Schedule 44 construction budget.

The facility construction cost shall be based upon the direct cost of labor and materials, plus the following factors:

1) Indirects equal to 30 percent of the direct labor and material.

2) Engineering, Design and Inspection equal to 25 percent of the direct plus indirect costs.

3) Contingency equal to 10 percent of the direct labor and materials plus indirects plus ED&I.

4) Escalation to the construction year at 10 percent per year, for the sum of all the previous costs.

Operations and related capital equipment costs shall also carry all indirects and escalation on labor and equipment at a rate of 10 percent per year. In addition, all direct labor shall carry a 38 percent administrative burden.

2.1.4 Documentation. A Schedule 44 request, environmental assessment, and other necessary forms will be prepared for the AEC. These documents will be submitted jointly with Allied Chemical Corporation and will discuss both the retrieval and repackaging portions of the program. Preliminary operating procedures will be prepared in adequate detail to provide information for pricing the cost of operations and related capital equipment. A joint environmental statement will be prepared.

2.1.5 Retrieval Support Studies. Technical studies will be performed to provide a sound basis for the design and fabrication of equipment required to perform the retrieval operation. These studies are discussed in Section VI.

2.2 Phase Two - Retrieval Demonstration Program Design

2.2.1 Title I Design

1) *Fundamentals, Codes and Standards.* The retrieval facility will be designed in accordance with the retrieval demonstration design criteria. Applicable industrial codes and standards, government codes and rules, and safety regulations will form the nucleus around which the design of the retrieval facility will be expanded from the conceptual to firm Title I design basis. Retrieval facility design will be done in compliance with Part II, Section H AECM, Appendix 6301, where it is economically and practically feasible to do so. When these criteria are not complied with, justification will be provided.

2) *Systems Design Analysis.* The major plant systems will be identified and evaluated in sufficient detail to allow preliminary sizing and equipment selection. This evaluation shall consist of determining the system requirements and the methods for incorporating these requirements. Equipment will then be selected on the basis of compliance with the system requirements. The important aspects of this selection are: capacity, physical size, weight, availability, and lead time of items selected within design requirements.

3) *Preliminary Drawings and Equipment Specifications.* Preliminary design drawings and equipment specifications will be developed which will utilize the conceptual design performed under Section V. 2.1.2 of this Program Plan. These documents will be prepared in sufficient detail to depict the system processes and the major equipment items needed to complete system fabrication. A technical specification will then be prepared which details requirements pertinent to the equipment, its function, and its design basis.

2.2.2 PSAR. A preliminary Safety Analysis Report will be written in conjunction with the Title I design package. This will be incorporated by ACC into one PSAR for both the retrieval and repackaging portions of the program.

2.2.3 Procurement of Long-Lead Items. Long-lead-time, difficult procurement items will be procured by the government and supplied to the contractor for installation in the retrieval facility.

2.2.4 Title II Design

1) The final retrieval facility design will be completed after incorporating the comments from the Title I Design Review in sufficient detail to allow facility construction.

2) The final retrieval facility design will be translated to Title II Drawings and submitted to AEC for approval.

3) Final procurement and construction specifications will be prepared in sufficient detail to complete the bid package for construction contractors.

4) The Title II Drawing and Specifications will be incorporated into a formal construction contract document which will be used to regulate construction of the retrieval facility. This document will describe the work required, codes and applicable standards, legal considerations, and applicable construction requirements.

2.2.5 Approvals. The design of the retrieval facility and applicable documents will be submitted to safety, operational and maintenance groups at appropriate intervals for review and comment. The results of these reviews shall be incorporated into the facility design. Both Title I and Title II designs will be submitted to AEC-ID for approval.

2.2.6 SAR. Upon completion of the Title II design, the PSAR will be updated to a SAR. This involves incorporating all design changes and improvements in the SAR that have been generated in completing the Title II design.

2.3 Phase Three - Retrieval Demonstration Program Construction

2.3.1 Bid and Award. The completed and approved drawings and specifications will be assembled into construction bid packages for submittal to bid by the AEC-ID contracts branch. Bids will be received and reviewed by AEC-ID Nuclear and Plant Engineering Division, AEC-ID Waste Management Office, by ANC Construction Management Branch, and by ANC Environment and Waste Management Branch. Award for construction will be made to the lowest responsive bidder provided the bid is within the limits of the project budget.

2.3.2 Facility Construction. Facility construction will be initiated following the award of construction contracts. Facility construction is scheduled to begin in the third quarter of FY 1978 and be completed in the first quarter of FY 1980.

2.3.3 Operating Procedures. Operating procedures will be generated and submitted to ANC Safety for approval on a schedule that will assure their completion for systems operation testing. Operating procedures will be completed prior to training the operating crew for waste retrieval.

2.3.4 Training. Training will be conducted for the operating crew prior to systems testing. Training will primarily include operational and safety considerations.

2.3.5 Construction Component and System Operations Tests. Component inspection and testing will be performed as components reach a state of completion that will enable the tests to be performed. Construction Component (CC) testing will be accomplished by the construction contractor with ANC Inspection.

Systems Operations (SO) Testing and Facility Acceptance Operational tests will be performed on the total unit by ANC working crews. When these tests are satisfactory, the unit will be accepted and ready for waste retrieval demonstration.

2.3.6 Facility Acceptance. The facility will be accepted from the construction contractor after all CC and SO tests have been satisfactorily completed and all punch list corrections made by the contractor. The facility acceptance team shall include the AEC contracting officer's representative, and representatives from ANC Construction Management Branch and ANC Environment and Waste Management Branch.

2.4 Phase Four - Retrieval Demonstration Program Operations

2.4.1 Demonstrate Waste Retrieval Operations. The retrieval facility will be operated in a transuranic waste demonstration. This will entail excavating, retrieval, sorting, monitoring, handling, packaging, and transporting the waste to its proper destination. Selected areas in the Burial Ground will be chosen for waste retrieval to demonstrate the retrieval facility capabilities under a variety of situations. The retrieval facility will then be used for production operations.

2.4.2 Modification Studies. During the above demonstration operation, studies will be made of the operation and of design changes that may be beneficial to provide a safer and more efficient operation. Those changes that can be made on the demonstration facility will be accomplished. More complex modifications will be incorporated in the full-scale retrieval facility design.

2.4.3 Operating Procedure Revisions. Operating procedures will be upgraded and changed as needed to provide the safest and most efficient operation.

2.4.4 SAR Revisions. SAR revisions will be made as modifications are required and implemented.

2.5 Phase Five - Retrieval Demonstration Program Analysis

2.5.1 Safety Aspects of Retrieval Operations. Retrieval operations will be analyzed to determine a safety experience factor for all operations. The extent of injuries and radiation exposure to personnel during the demonstration program will be evaluated, as well as the extent of radiation release to the environment during the operations. From this analysis, projections will be made of the potential safety hazard involved in the full-scale retrieval.

2.5.2 Statistical Analysis of Retrieval Operations. Statistical information generated during the retrieval operations will be analyzed. The analysis of information concerning waste classification; mix ratios and condition; quantities of waste contained, partially contained, or uncontained; environmental restraints due to site geology, climate, and waste conditions; operational constraints; and retrieval rates and cost will provide the basis for estimating the scope and magnitude of the full-scale retrieval effort.

2.5.3 Unit Operation and Alternative Cost Comparisons. Accounting records maintained during the demonstration will be analyzed in order to develop costs by waste category of operations such as: cover stripping, exhumation, first-level sorting and monitoring, and transport preparation, and transport. The related costs for personnel protection and environmental protection will be analyzed in order that a total cost of capital facility and operations can be developed with cost options and safety tradeoffs identified.

2.5.4 Evaluation of Hazard Levels. The demonstration will provide data for evaluation of the relative hazard levels associated with various retrieval methods. Rating of retrieval methods based upon relative hazard to the individual or the environment will provide a basis for tradeoff of cost vs hazard. Prior to making the final decision to embark on a full-scale retrieval program, the hazards involved should be projected as less than those associated with alternative courses of action.

3. FULL-SCALE RETRIEVAL PROGRAM PLAN

The alpha-waste full-scale retrieval program plan has been subdivided into four phases of work, each of which includes several tasks. Work phases and associated tasks are described in the following paragraphs.

3.1 Phase One - Full-Scale Retrieval Program Concept

Phase One work consists of seven major tasks.

3.1.1 Design Criteria. The information gained in the demonstration retrieval program will be used to upgrade the conceptual design criteria.

3.1.2 Conceptual Design Package. Concepts demonstrated in the demonstration retrieval program will be analyzed based upon actual operation's history. The concept which best satisfies operational, safety and economics criteria will be developed to produce a conceptual design package in adequate detail to allow the preparation of preliminary cost estimates.

3.1.3 Cost Analysis. ROM cost estimates for operating and related capital equipment expenses for the expected operating period of the facility shall be prepared from the conceptual design package.

3.1.4 Environmental Assessment. An environmental assessment of the "Full-Scale" retrieval operation will be prepared to discuss the environmental impact on the Burial Ground and the surrounding environment.

3.1.5 Preliminary Operating Procedures. Operating procedures developed during the demonstration program will be upgraded and developed into full-scale retrieval operating procedures. These will provide the information required to price the cost of operations and related capital equipment.

3.1.6 Schedule 44. A Schedule 44, environmental assessment, and the necessary forms and submittals will be made to the AEC for Congressional approval of the full-scale retrieval construction funds for the retrieval of alpha waste from the NRTS Burial Ground.

3.1.7 Draft Environmental Statement. A draft environmental statement will be prepared for submittal to the AEC-ID by September 1, 1983.

3.2 Phase Two - Retrieval Program Facility Design

The facility design will follow the appropriate steps involved in all major projects. These include the usual items of Title I and Title II design, writing the PSAR and FSAR, procuring long-lead items, and obtaining the necessary approvals.

3.3 Phase Three - Retrieval Program Facility Construction

The six tasks associated with Phase Three include bid and award, facility construction, preparation of final operating procedures, personnel training, construction component and system operations tests, and facility acceptance. Construction completion is now scheduled for mid-FY 1985.

3.4 Phase Four - Full-Scale Retrieval Operations

Retrieval operations following the demonstration program could be continued into the succeeding years using the demonstration equipment while new construction is taking place. Full-scale retrieval operations will be achieved in the third quarter of FY 1985. Based upon projected repackaging plant capacity at 280,000 cubic feet per year and assuming that about one-fourth of the waste retrieved will not go to the repackaging facility, it will be necessary to design the full-scale retrieval equipment to handle 370,000 cubic feet of waste per year. At this rate, approximately six full years of operation will retrieve all of the alpha waste at the NRTS RWD&SA.

4. ROM COSTS FOR DEMONSTRATION PROGRAMS

Estimated costs for the retrieval demonstration period are $6,825,000. These costs, including capital, operating, and RCE costs, are summarized in Table VIII.

5. ROM COSTS FOR FULL-SCALE RETRIEVAL PROGRAM

Estimated capital, operating, and RCE costs for the full-scale retrieval program are $17,690,000 over a twelve-year period, including six years of retrieval. These costs are summarized in Table IX.

6. SCHEDULE PROJECTIONS

Major schedule milestones for the alpha waste retrieval demonstration and full-scale programs are shown by Table X. The retrieval program could be accelerated if the retrieval demonstration program were deleted; however, since the repackaging facility will not be available to receive waste until May 1980, achievement of full-scale retrieval operation at an earlier date would not be beneficial. Experience which will be gained in the Initial Drum Retrieval Program, starting September 1974, may allow considerable reduction in cost and time for the demonstration program.

TABLE VIII

ROM COSTS FOR DEMONSTRATION PROGRAM[a]

Year	Purpose	189c	RCE	Schedule 44	Total[b]
FY-1975	Documentation and development	130	20		150
FY-1976	Support studies and documentation	120	20		140
FY-1977	Support studies, construction	85	20	3500	3605
FY-1978	Support studies	85	20		105
FY-1979	Support studies	90	20		110
FY-1980	Retrieval operating costs (part year retrieval)	320	50		370
FY-1981	Retrieval operating costs	855	50		905
FY-1982	Retrieval operating costs	855	50		905
FY-1983[c]	Retrieval operating costs (part year retrieval)	535			535
Total		3075	250	3500	6825

[a] Based on FY 1974 costs. Does not include escalation because of inflation.

[b] Thousands of dollars.

[c] Retrieval can be continued beyond the 3-year demonstration program using the demonstration equipment at approximately $855,000/yr at the 30,000 cu ft per year rate. This rate could be accelerated to a full-scale operation in FY 1985 when construction of new facilities is complete.

TABLE IX
ROM COSTS FOR FULL-SCALE RETRIEVAL PROGRAM[a]

Year	Purpose	189c	RCE	Schedule 44	Total[b]
FY-1980	Design criteria & conceptual design	100			100
FY-1981	Schedule 44 and EA	80			80
FY-1982	PSAR	60			60
FY-1983	Design & construction			5000	5000
FY-1984					
FY-1985	Initial operations	300	50		350
FY-1986	Operations	2000	100		2100
FY-1987		2000			2000
FY-1988		2000			2000
FY-1989		2000			2000
FY-1990		2000			2000
FY-1991		2000			2000
	Total	12540	150	5000	17690

[a] Based on 1974 cost estimates. Does not include escalation because of inflation
[b] Thousands of dollars

TABLE X - SCHEDULE PROJECTIONS FOR ALPHA WASTE RETRIEVAL

MILESTONE	1974	1975	1976	1977	1978	1979	1980	1981	1982	1983	1984	1985	1986
Demonstration Facility													
Issue Conceptual Design Criteria	May 1, 1974												
Schedule 44		April 15, 1975											
Design Complete and Approved					January 1978								
Construction Complete						August 1979							
Deliver to Repackaging Facility							May 1980*						
3 Year Retrieval Demo										May 1983			
Full-Scale Facility													
Conceptual Design Criteria								February 1981					
Schedule 44								May 1981					
Design Complete and Approved											October 1983		
Construction Complete												December 1984	
Retrieval Using Demo Equipment												February 1985	
Full-Scale Operations												February 1985 →	

FISCAL YEAR

* Date Keyed to Completion of Repackaging Facility

VI. PROPOSED TECHNICAL SUPPORT PROGRAMS AND BUDGETS

The major milestone charts for the program development and overall demonstration project schedule for retrieval and treatment of the waste are shown in Tables XI and XII. The main purposes of these tables are to define the proposed technical support programs for the project and to show the interrelationship of the technical support programs and the actual construction and operation functions to bring the retrieval and repackaging facilities on line. Figure 26 shows the project costs for the proposed technical support budgets for FY 1975 through FY 1981. Subsequent subsections present the major areas of effort and the budget and manpower required to accomplish the proposed technical support programs. Operating and construction costs are not included in these figures.

1. FY 1975 TECHNICAL SUPPORT PROGRAM

The main projects for the 1975 technical support programs are the initiation of an alternatives study, initiation of work on the environmental statement, submission of the Schedule 44 and Environmental Assessment, and initiation of preliminary development studies. In addition, the conceptual design package and cost analysis for the retrieval program will be prepared.

An estimated 15 man-months will be spent in FY 1975 to analyze the cost, safety, and environmental considerations associated with several alternatives to retrieval and repackaging. This information will be part of the input to the environmental statement. An additional 24 man-months of effort is envisioned for the preparation of the environmental statement, and three man-months will be used to prepare and issue the Schedule 44 and environmental assessment.

Process development studies will be initiated to define assay requirements at the retrieval and treatment facilities. Related methods and equipment evaluations, consisting of evaluations of bag sealing equipment, assay methods, and coatings and controls evaluation will be initiated. A detailed engineering study will be performed to design and develop containers suitable for handling and transporting the transuranic waste. A study also will be performed to find spray coatings that could be used to effectively fix radioactive contaminants. Present concepts indicate that at least the following four types of coatings will be needed:

(a) Light, fast-drying waterbase coatings for soil and extremely rough surfaces.

(b) Light, fast-drying material that forms a thin, resilient, tough coating for application to relatively smooth surfaces.

(c) A viscous material which foams or swells as it dries that can be used on extremely rough or irregular surfaces.

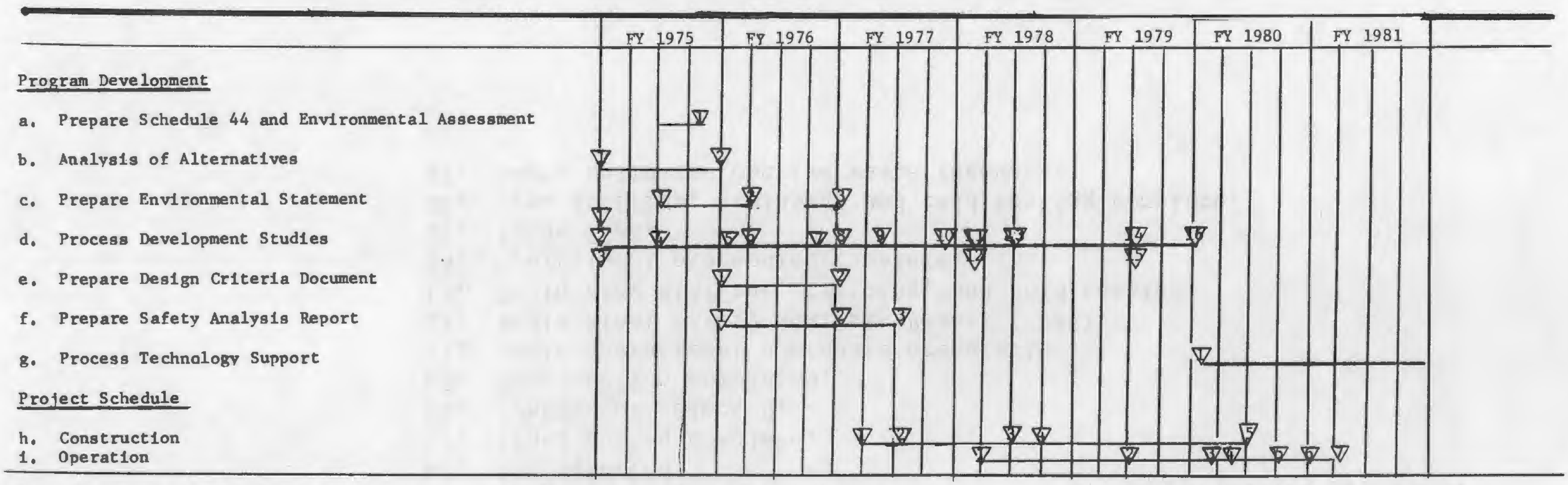
(d) A light material that dries fast and forms a resilient strippable coating.

WORK PHASE	DESCRIPTION	FY-74 FY-75 FY-76 FY-77 FY-78 FY-79 FY-80
1	PROGRAM CONCEPT	
1.1	Conceptual Design Criteria	May 1, 1974
1.2	Conceptual Design Package	
1.3	Cost Analysis	
1.4	Environmental Assessment	
1.5	Preliminary Operating Procedure	
1.6	Schedule 44	April 15, 1975
1.7	Retrieval Demonstration Support Studies	
1.8	Draft Environmental Statement	Sept. 1, 1975
1.9	Final Design Criteria	July 1, 1976
2	PROGRAM DESIGN	
2.1	Title Design	Nov. 1976
2.2	PSAR	Nov. 1976
2.3	Procure Long Lead Items	
2.4	Title II Design	
2.5	SAR	Sept. 1977
2.6	Receive AEC Approval	Jan. 1978
3	PROGRAM CONSTRUCTION	
3.1	Bid and Award	
3.2	Facility Construction	Aug. 1979
3.3	Operating Procedures	
3.4	Training	
3.5	CC and SO Tests	
3.6	Facility Acceptance	Feb. 1980
4	PROGRAM OPERATIONS	Deliver Waste to Repackaging Facility in May 1980
4.1	Deomonstrate Waste Retrieval	
4.2	SAR Revisions	
4.3	Operating Procedure Revisions	
4.4	Modification Studies	FY-80→
5	PROGRAM ANALYSIS	
5.1	Safety	
5.2	Statistical Analysis of Operations	
5.3	Cost Factors	
5.4	Hazards Levels	FY-82→

Table XI. Alpha Waste Retrieval Demonstration Program

TABLE XII

MILESTONE CHART FOR REPACKAGING PROGRAM DEVELOPMENT AND PROJECT SCHEDULE (FY 1975 - 1981)



Explanation of Milestones:

- a1. Submit Schedule 44 and EA to AEC.
- b1. Initiate study of alternatives.
- b2. Complete study of alternatives.
- c1. Begin draft environmental statement.
- c2. Submit draft environmental statement to AEC.
- c3. Incorporate comments in environmental statement.
- d1. Begin development of assay & inventory techniques.
- d2. Initiate development of bag sealing techniques.
- d3. Initiate development of coating and contamination controls.
- d4. Complete bag sealing evaluations.
- d5. Complete coating and contamination control studies.
- d6. Begin related methods and equipment evaluation (including safety).
- d7. Complete development of assay and inventory techniques.
- d8. Issue a report on evaluation and development of coating materials.
- d9. Begin evaluation and testing of treatment facility methods and equipment.
- d10. Issue interim report on related methods and equipment evaluation.
- d11. Continue evaluation and testing of treatment facility methods and equipment.
- d12. Begin evaluation and testing of waste retrieval and mechanical handling technology.
- d13. Continue related methods and equipment evaluation.
- d14. Complete evaluation and testing of treatment facility methods (including safety) and issue report.
- d15. Complete evaluation and testing of waste retrieval and mechanical handling technology & issue report.
- d16. Complete related methods & equipment evaluation and issue report.
- e1. Initiate work on design criteria document.
- e2. Issue design criteria document.
- f1. Begin PSAR.
- f2. Submit Draft PSAR for AEC-ID review.
- f3. Issue PSAR.
- g1. Begin process support for inplant operational problems.

TABLE XII (Continued)

Explanation of Milestones (cont):

h1. Capital funding approved.
h2. A-E selected.
h3. Final design complete.
h4. Contractor selected.
h5. Construction completed.
i1. Begin operational procedure preparation.
i2. Begin Final Safety Analysis Report (FSAR).
i3. Begin crew staffing, training, and cold testing.
i4. Operational procedures complete.
i5. Issue FSAR.
i6. Crew staffing, training, and cold testing complete.
i7. Begin solid radioactive waste recovery.

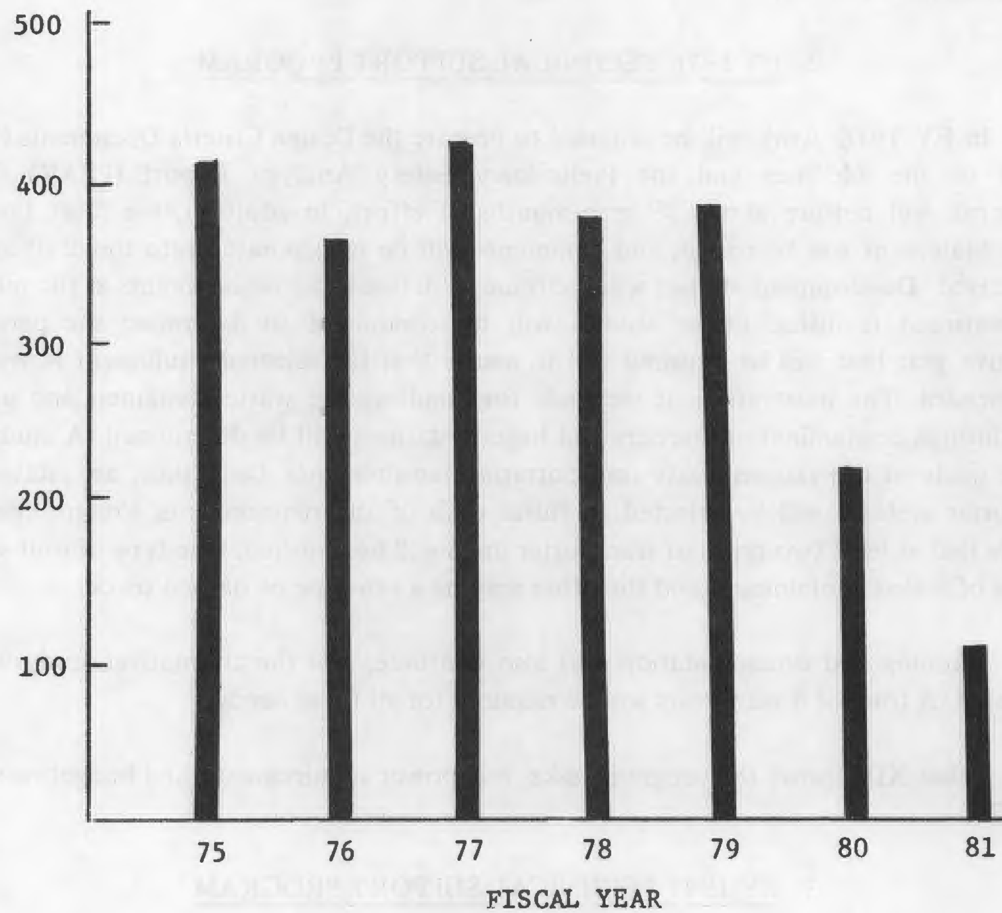


Fig. 26 Proposed technical program support budgets for 1975 to 1981 (does not include facility operating or construction costs).

Development work also will be performed during FY 1975 on a retrieval operation criticality potential screening system. Instrumentation and procedures will be developed to provide a criticality-potential screening system that is operational by FY 1980.

Table XIII shows the program tasks, manpower requirements, and budget projections for FY 1975.

2. FY 1976 TECHNICAL SUPPORT PROGRAM

In FY 1976, work will be initiated to prepare the Design Criteria Documents (DCD) for all of the facilities and the Preliminary Safety Analysis Report (PSAR). These documents will require about 39 man-months of effort. In addition, the draft Environmental Statement will be issued, and comments will be incorporated into the draft as they are received. Development studies will continue to define assay requirements at the retrieval and treatment facilities. Other studies will be conducted to determine the personnel protective gear that will be required and to assure that the selected equipment is available when needed. The most efficient methods for handling the waste containers and moving them through contamination barriers and bagout stations will be determined. A study will also be made of the various waste transportation requirements. Once these are established, transporter systems will be selected to fulfill each of the requirements. Present concepts indicate that at least two types of transporter units will be required. One type of unit will be capable of sealed containment and the other may be a van-type or flatbed truck.

Planning and documentation will also continue, and the alternatives study will be completed. A total of 8 man-years will be required for all these needs.

Table XIV shows the program tasks, manpower requirements, and budget needs for FY 1976.

3. FY 1977 TECHNICAL SUPPORT PROGRAM

The Preliminary Safety Analysis Report (PSAR) and the Design Criteria Document (DCD) for the facilities will be issued in FY 1977 as major topical reports. The DCD is required for the selection of the architect-engineer and the initiation of Title I and II design. These documents mark the beginning of the preparation for the construction phase of the project.

Development studies for the assay and inventory techniques for the project will be completed, and evaluation, testing, and development of contamination control and treatment techniques in the treatment facility will begin. Program planning and documentation will continue. Liaison with the AE will begin.

Table XV shows the program tasks, manpower requirements, and budget needs for FY 1977.

TABLE XIII
FY 1975 TECHNICAL SUPPORT PROGRAM

	Task	MANPOWER REQUIREMENTS (Man-years) ACC	ANC	Total
1.	Prepare Schedule 44 and Environmental Assessment	1/2	1/4	3/4
2.	Begin Environmental Statement	1-3/4	1/4	2
3.	Program Planning, Documentation and Management	1/4	1-1/4	1-1/2
4.	Prepare Alternatives Study	1-1/4	–	1-1/4
5.	Development Studies	1-1/4	3/4	2
6.	Prepare Design Descriptions Conceptual Design and Cost Analysis	1/4	1	1-1/4
	Total	5-1/4	3-1/2	8-3/4

Expenditures	
Labor	338,000
Materials and supplies	15,000
Computer services	2,000
RCE	55,000
Total	$410,000

TABLE XIV
FY 1976 TECHNICAL SUPPORT PROGRAM

	Task	MANPOWER REQUIREMENTS (Man-years) ACC	ANC	Total
1.	Complete Environmental Statement	3/4	3/4	1-1/2
2.	Begin Preparation of PSAR	1-1/2	3/4	2-1/4
3.	Process Development and Support Studies	3/4	1/2	1-1/4
4.	Program Planning, Documentation and Management	1/4	1	1-1/4
5.	Alternatives Study	3/4	-	3/4
6.	Design Criteria Document	1	-	1
	Total	5	3	8
Expenditures				
	Labor	323,000		
	Material and supplies	15,000		
	Computer services	2,000		
	RCE	30,000		
	Total	$ 370,000		

TABLE XV
FY 1977 TECHNICAL SUPPORT PROGRAM

TASK	MANPOWER REQUIREMENTS (Man-years)
1. Issue PSAR	2
2. Issue Design Criteria Document	1
3. Process Development Studies	4-1/2
4. Program Planning, Documentation and Liaison	1/2
5. Total	8
Expenditures	
Labor	333,000
Materials and supplies	20,000
Computer services	2,000
RCE	60,000
Total	$ 415,000

4. FY 1978 TECHNICAL SUPPORT PROGRAM

Contamination control technology studies will be completed in FY 1978. Evaluation and testing of treatment techniques will continue, and final testing and evaluation of mechanical handling technology for waste retrieval will begin. Related methods development, including safety aspects, will continue from the previous year.

The preparation of operating procedures will begin in anticipation of crew training and facility operation. Program documentation, planning, and liaison will continue. Table XVI shows the program tasks, manpower requirements, and budget needs for FY 1978.

TABLE XVI
FY 1978 TECHNICAL SUPPORT PROGRAM

TASK	MANPOWER REQUIREMENTS (Man-years)
1. Process Development Studies	4-1/2
2. Begin Preparation of Operating Procedures & Safety Review	2
3. Program Planning Documentation and Liaison	1/2
4. Total	7
Expenditures	
Labor	$ 308,000
Material and supplies	20,000
Computer services	2,000
RCE	50,000
Total	$ 380,000

5. FY 1979 TECHNICAL SUPPORT PROGRAM

The preparation of the Final Safety Analysis Report will begin, and process development studies will be concluded. The emphasis of the Technical Support Program will change from technology development to technical support for facility startup, training, and operation.

Evaluation and testing of treatment and retrieval technology will be completed, and related methods development and evaluations (including safety considerations) will be finalized. Documentation and planning efforts will continue. Operating procedures preparation, safety review, and support staff training will begin. Table XVII shows the program tasks, manpower requirements, and budget needs for FY 1979.

TABLE XVII
FY 1979 TECHNICAL SUPPORT PROGRAM

TASK		MANPOWER REQUIREMENTS (Man-Years)
1.	Start Preparation of FSAR	1
2.	Support Staff Training	1/2
3.	Process Development Studies	3
4.	Continue Preparation of Operational Procedures & Safety Review	2
5.	Program Planning, Documentation and Safety Review	1/2
6.	Total	7
Expenditures		
	Labor	328,000
	Materials and supplies	20,000
	Computer services	1,000
	RCE	35,000
	Total	$ 384,000

6. FY 1980 TECHNICAL SUPPORT PROGRAM

The direction for the technical support program will be oriented toward operational aspects. The emphasis will be placed on personnel training, cold testing, and completion of the FSAR. Program documentation, planning, and liaison will continue.

Table XVIII shows the program tasks, manpower requirements, and budget needs for FY 1980.

TABLE XVIII
FY 1980 TECHNICAL SUPPORT PROGRAM

TASK		MANPOWER REQUIREMENTS (Man-years)
1.	Support Crew Training	1/2
2.	Support Cold Testing	2
3.	Complete FSAR	1
4.	Program Planning Documentation and Safety Review	1/2
5.	Total	4
Expenditures		
	Labor	199,000
	Materials and supplies	10,000
	Computer services	1,000
	RCE	10,000
	Total	$ 220,000

7. FY 1981 TECHNICAL SUPPORT PROGRAM

With the onset of the solid radioactive waste recovery and treatment operations, technical support will be provided for facility operational problems. It is estimated that 2 man-years of effort will be required, with funding at about $115,000 for labor, materials and services, computer services, and RCE.

VII. DISCUSSION AND RECOMMENDATIONS

The construction of the demonstration facilities will provide a means for field testing and final development of safe and effective retrieval and treatment processes. The recovery of alpha-contaminated wastes from the NRTS Burial Ground represents a problem which is unique in both scope and scale. The waste is heterogeneous; a wide range of materials will be encountered in the various types of containers, within each class of container, and in each individual container. In a sense, the entire operating life of the facility will be a continual process of learning, improvisation, and adaptation. The economies of scale which are usually available in chemical process development do not exist. The units of waste which must be handled in the full production-scale facility are those which must be handled during process development. The problems of containment, contamination control, and safety are the same for either facility.

The construction and operation of demonstration retrieval and repackaging facilities will avoid the technical and economic hazards of beginning a 100 to 200 million dollar program without prior operating experience. In addition to the information obtained during the operation of the demonstration facilities, the expansion of the operation to full scale may be accomplished by merely adding additional retrieval facilities, manpower, locker rooms and retrieval waste warehousing facilities. Also, process modifications can be made to reflect both new technical information and future standards for waste destined for storage in a Federal repository. The expansion changes discussed above can convert the demonstration facility (capacity 30,000 ft^3/yr) to a full-scale treatment facility with a capacity of 280,000 ft^3/yr.

Total development costs for the Program are summarized in Table XIX.

TABLE XIX
TRANSURANIC WASTE RETRIEVAL AND REPACKAGING DEMONSTRATION COST SUMMARY[a]

Year	Technical Support Program[b]		Capital Costs		Operation		Total
	189c	RCE	ACC	ANC	ACC	ANC	
FY 1975	355	55					410
FY 1976	340	30					370
FY 1977	355	60	20,600	4,800			25,815
FY 1978	330	50					380
FY 1979	349	35					384
FY 1980	310	60			1,800	320	2,490
FY 1981	195	50			3,600	855	4,700
FY 1982	60	50			3,600	855	4,565
FY 1983					1,800[c]	555	2,335
Total	2294	390	20,600	4,800	10,800	2,565	41,449

[a] Based on 1974 costs. Excalation because of inflation can greatly increase these costs. For example, escalation at a rate of 8.8% per year will essentially double the costs in 8 years. Figures represent thousands of dollars.

[b] Includes both ACC and ANC Support Programs.

[c] Operating costs are for 3 years of demonstration facility operation only. Costs to upgrade the demonstration facility to full-scale operation and full-scale operating costs presently are not known.