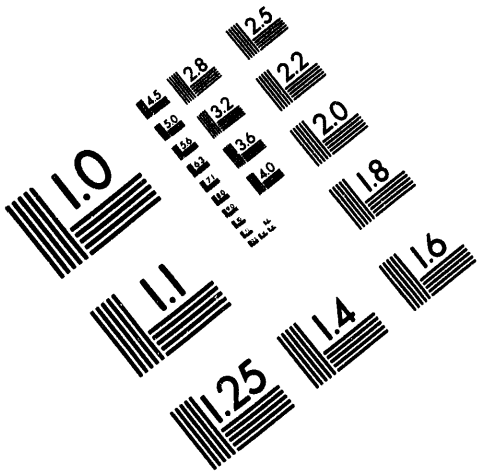

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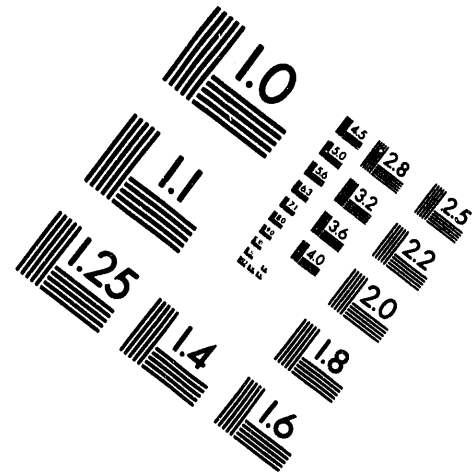

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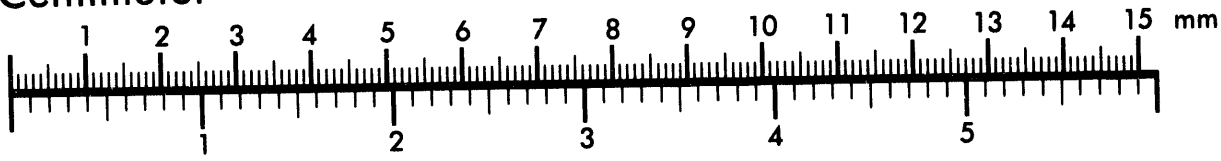

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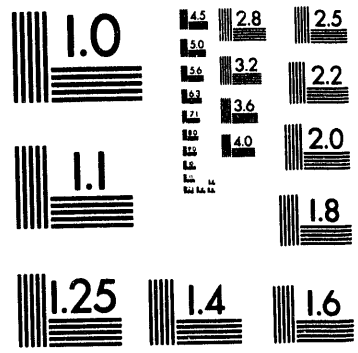

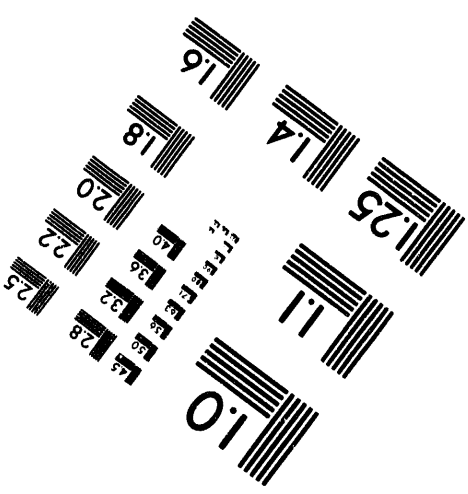

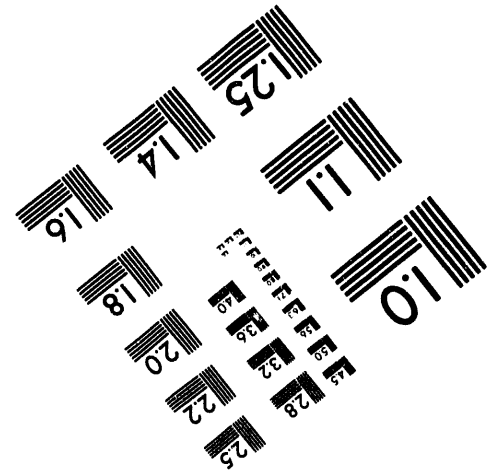

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SAVANNAH RIVER PLANT
ENGINEERING AND DESIGN HISTORY
VOLUME IV
#300/700 AREAS
&
GENERAL SERVICES AND FACILITIES

ENGINEERING DEPARTMENT

E. I. DU PONT DE NEMOURS & CO. (INC.)

Wilmington, Delaware

DOES NOT CONTAIN
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NUCLEAR INFORMATION

Reviewing Official: T. R. Coughenour 9/14/89

Prime Contractor

For

UNITED STATES ATOMIC ENERGY COMMISSION

U. S. CONTRACT NO. AT(07-2)-1

DU PONT PROJECT 8980

JANUARY, 1957

DPE-973 DELETED VERSION

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SAVANNAH RIVER PLANT

PROJECT 8980

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VOLUME II - #100 AREAS

VOLUME III - #200 AREAS

VOLUME IV - #300/700 AREAS AND GENERAL SERVICE FACILITIES

VOLUME V - #400 AREA

VOLUME VI - POWER AND ELECTRICAL FACILITIES (ALL AREAS)

SAVANNAH RIVER PLANT - PROJECT 8980

ENGINEERING AND DESIGN HISTORY

OF

#300/700 AREAS

&

GENERAL SERVICES AND FACILITIES

VOLUME IV

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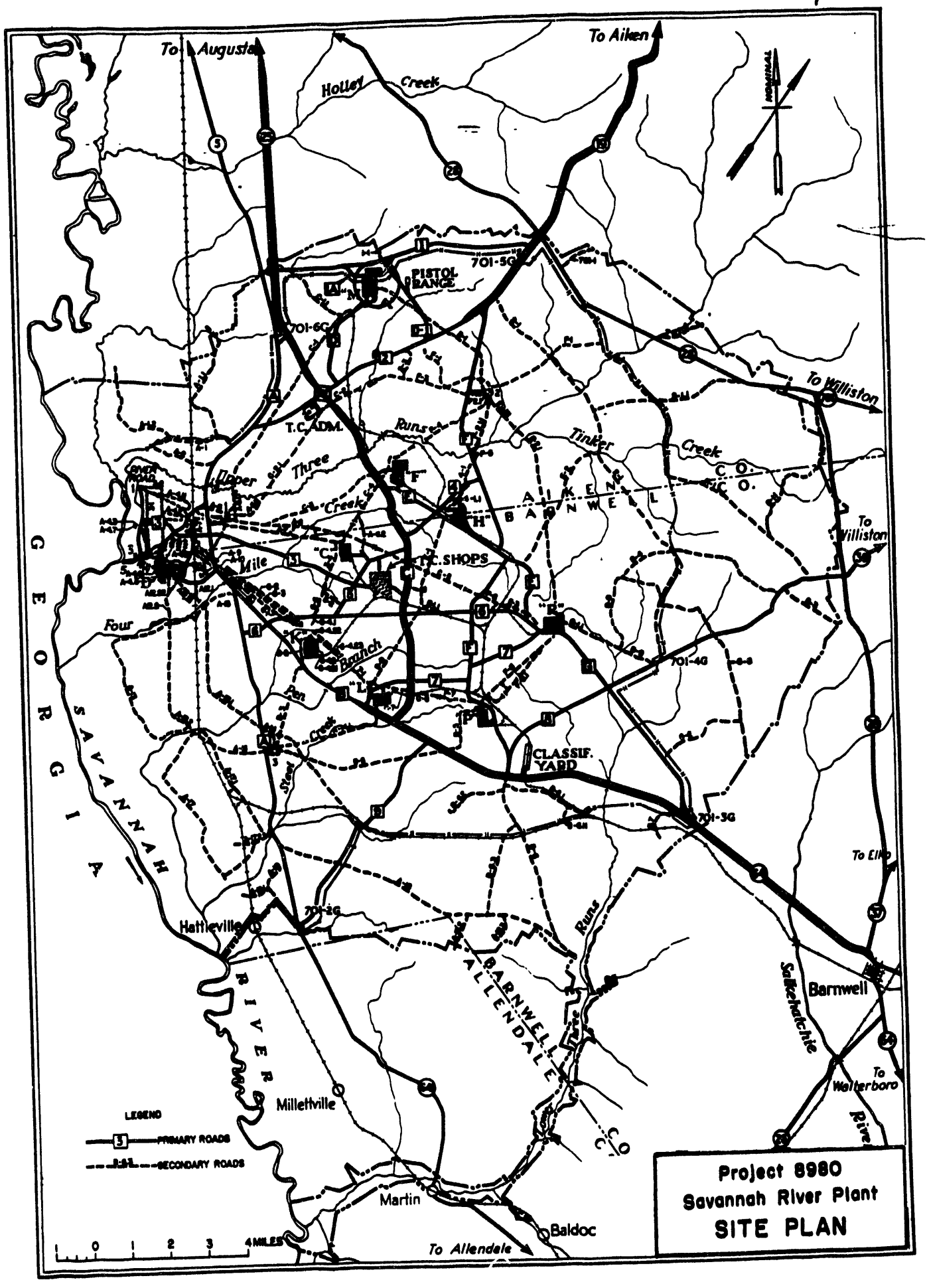
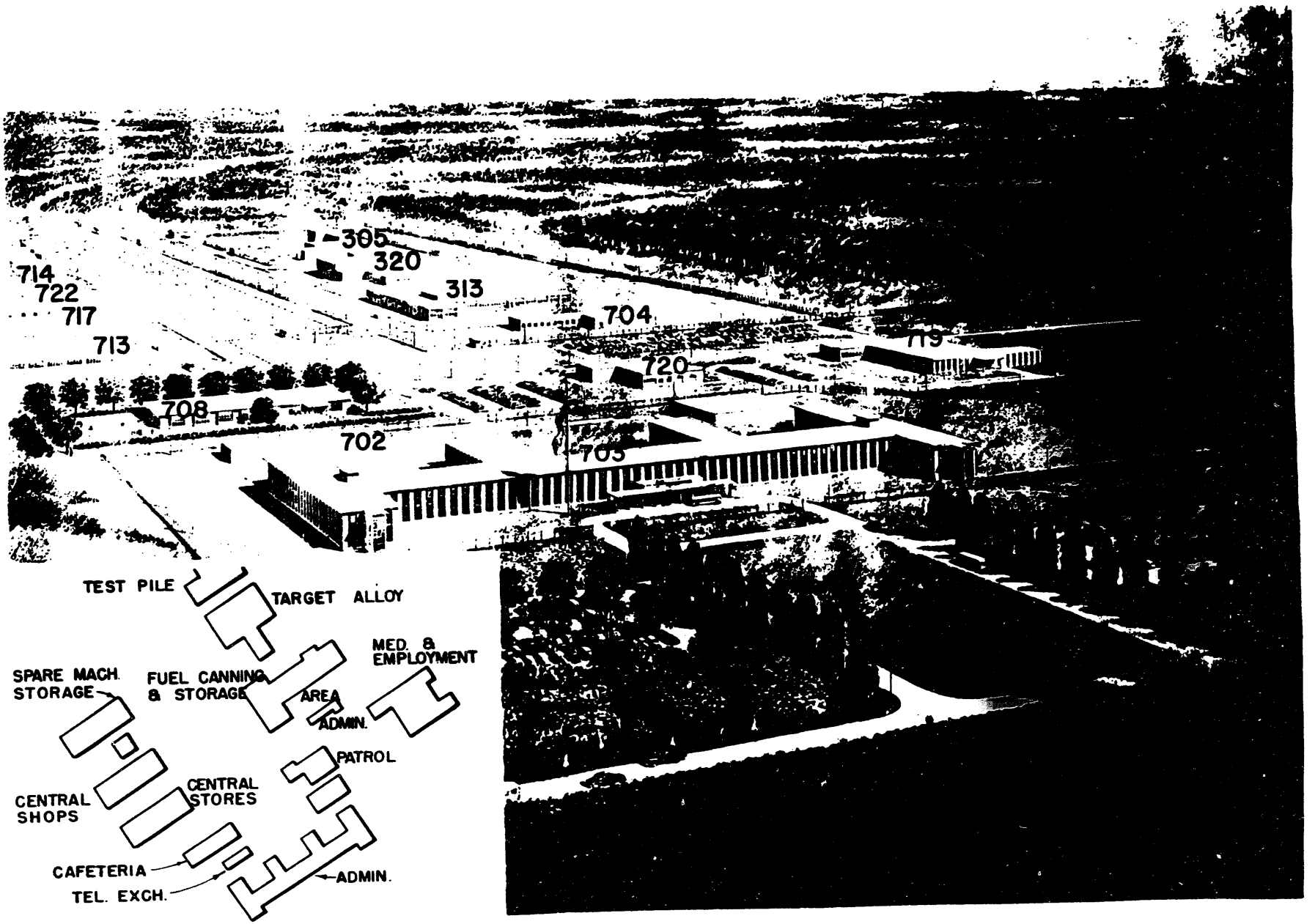

To Augusta
To Aiken
Holley Creek
PISTOL RANGE
701-5G
701-6G
To Williston
T.C.ADM.
Three Runs
Upper Three Runs Creek
Tinker Creek
C.O.
C.O.
AIKEN
BARNWELL
To Williston
T.C.SHOPS
Mile
Four Mile Branch
Pen Creek
Steer Creek
701-4G
CLASSIF. YARD
701-3G
To Elko
GEORGIA
SAVANNAH RIVER
Hattieville
701-2G
BARNWELL
ALLENDALE
Three Runs
Salkehatchie River
Barnwell
To Walterboro
Millettville
Martin
Baldoc
To Allendale
C.O.
LEGEND
PRIMARY ROADS
SECONDARY ROADS
0 1 2 3 4 MILES
Project 8980
Savannah River Plant
SITE PLAN



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TGB-4
TGB-11
TGB-A
TGB-B
TGB-C
TGB-D
TGB-E
TGB-F
TGB-G
TGB-H
TGB-I
TGB-J
TGB-K
TGB-L
TGB-M
TGB-N
TGB-O
TGB-P
TGB-Q
TGB-R
TGB-S
TGB-T
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TGB-V
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TGB-EE
TGB-FF
TGB-GG
TGB-HH
TGB-II
TGB-JJ
TGB-KK
TGB-LL
TGB-MM
TGB-NN
TGB-OO
TGB-PP
TGB-QQ
TGB-RR
TGB-SS
TGB-TT
TGB-UU
TGB-VV
TGB-WW
TGB-XX
TGB-YY
TGB-ZZ
TGB-AAA
TGB-BBB
TGB-CCC
TGB-DDD
TGB-EEE
TGB-FFF
TGB-GGG
TGB-HHH
TGB-III
TGB-JJJ
TGB-KKK
TGB-LLL
TGB-MMM
TGB-NNN
TGB-OOO
TGB-PPP
TGB-QQQ
TGB-RRR
TGB-SSS
TGB-TTT
TGB-UUU
TGB-VVV
TGB-WWW
TGB-XXX
TGB-YYY
TGB-ZZZ
TGB-AAAA
TGB-BBBB
TGB-CCCC
TGB-DDDD
TGB-EEEE
TGB-FFFF
TGB-GGGG
TGB-HHHH
TGB-IIII
TGB-JJJJ
TGB-KKKK
TGB-LLLL
TGB-MMMM
TGB-NNNN
TGB-OOOO
TGB-PPPP
TGB-QQQQ
TGB-RRRR
TGB-SSSS
TGB-TTTT
TGB-UUUU
TGB-VVVV
TGB-WWWW
TGB-XXXX
TGB-YYYY
TGB-ZZZZ

ENGINEERING AND DESIGN HISTORY

OF

THE #300/700 AREAS

AND

GENERAL SERVICES AND FACILITIES

SAVANNAH RIVER PLANT

I - DESCRIPTION AND DEVELOPMENT OF THE #300-M AREA

DESCRIPTION

The #300 Area, adjoining the #700 Area, lies approximately one mile south of the plant site perimeter in the northwestern sector of the reservation and approximately 4-1/2 miles north of the #200-F Area. Its primary function is the production and preparation of the fuel and target elements required for the #100 Area production reactors. Uranium slugs are prepared in a structure designated Building #313-M, while lithium-aluminum (Li-Al) alloy control and blanket rods are produced and prepared in a separate structure designated Building #320-M.

In addition to these two primary production buildings, the area also contains two other major process installations. A low power test pile, designated Building #305-M, is employed to test the components produced in Buildings #313-M and #320-M. A physics assembly laboratory, designated Building #777-M, is a facility for study and experimentation with nuclear pile operation and design, and for the calibration of various standards and monitoring devices.

In addition to these process facilities, the #300 Area includes an office and change house, Building #704-M; two gate houses, Buildings #701-1M and #701-2M; and an electrical substation, Building #352-M. Various service facilities such as rail lines, roads, walks, fences, sewers, steam and water distribution lines, and communications and alarm systems are also installed in the area.

Rectangular in shape, the #300 Area is completely enclosed by fencing and layed out on a nominal north-south axis. It is bounded on the north and east by the #700 Area from which it is separated by two roadways. Gate House #701-1M controls access to the area at the northeast corner of the fence, while Gate House #701-2M serves a similar function at the southeast corner.

The buildings within the area are arranged roughly along the axis of the site, with Building #704-M located at the northern end and Buildings #313-M, #320-M, #305-M, and #777-M each located south of the other in that order.

LAYOUT AND DEVELOPMENT

Originally, the #300 Area was conceived of as a self-sufficient plant including its own power house, water storage facilities, shops, and other required service installations. Subsequently, it was decided that the #300 Area process facilities, together with the plant service, shops, administration, and technical laboratory facilities (#700 Area) would be combined in a common location designated the #300/700 Area. The basis for this decision was economics, as it became apparent that centralized service facilities supplying the common requirements of all of these groups would be less costly.

From the standpoint of manpower requirements, it was desirable that the #300/700 Area be located equidistant from Aiken, South Carolina and Augusta, Georgia, the principal population centers nearest the Savannah River Plant. As a large proportion of the Plant Operations personnel would be employed in this area, particularly the administrative group, it was necessary that the area be as conveniently accessible as practicable from these two cities.

Operations specified that the #300 Area be located approximately five miles distant from the nearest #100 Area, as a safety precaution. Also, for similar reasons, it was stipulated that Building #305-M, housing the low power test reactor, be separated from the plant property line by approximately two miles. The foregoing considerations of location with respect to housing facilities and separation within the plant site, together with the economy to be realized through utilizing common service facilities, determined the location of the #300 Area. This location also permits unlimited expansion within the boundary limits specified.

It was at first intended that operating personnel in the #300 sector use the change house facilities in the #700 sector. But, because of the problems imposed by restriction of the #300 Area to personnel specifically cleared for this particular area, Building #704-M, Office and Change House, was added to accommodate the #300 Area Operations personnel.

During the early stages of design, a Building #306-M was planned for the assembly of canned Li-Al slugs into control and blanket rods. But it was subsequently determined that this process could be more efficiently conducted in Building #320-M, so plans for Building #306-M were canceled.

Originally, some thought was given to installing uranium rod rolling and machining facilities in Building #313-M, but developments proved that it was preferable to have machined uranium slugs supplied by an off-plant vendor.

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II - SELECTION AND DESCRIPTION OF PROCESS

Three of the process buildings installed in the #300 Area house facilities for the production and testing of reactor fuel and target elements. The fourth building, the Physics Assembly Laboratory, is an adjunct of the area which functions primarily as an experimental component of the production reactors. As there is no sequential process flow from building to building, except for product testing in Building #305, the processes conducted in the foregoing buildings are discussed individually.

BUILDING #313-M

The process in this building involves the preparation of uranium fuel slugs for the production reactors. This process is essentially the same as that employed at Hanford.

Machined slugs of natural uranium, each approximately 8 in. long by 1 in. in diameter, are supplied by an outside vendor. These slugs are first inspected, then cleaned, and successively dipped in baths of molten bronze, tin, and aluminum-silicon. Following these operations they are bonded to aluminum cans by immersing both cans and slugs in a second aluminum-silicon bath, inserting the slugs in the cans, and capping the cans. These canned assemblies are quenched in water, the tops of the caps machined, and the caps sealed to the cans by welding. Finally, the finished assemblies are tested for soundness of welds, effectiveness of bonding, and dimensional accuracy. Acceptable canned slugs are stored in this building pending shipment to the reactor areas as required.

BUILDING #320-M

Reactor control and blanket rod assemblies of lithium-aluminum slugs are produced in this building. As no integrated installation for this purpose existed previously, the process was selected on the basis of SRP reactor requirements and the metallurgy of Li-Al alloys. Practically every major step in the process involved original development to attain production scale output.

Lithium is alloyed with aluminum in a melt furnace and cast into ingots, both of these operations being carried out under vacuum. The ingots are extruded into rods which are machined to slug lengths of approximately 10 in. These Li-Al slugs are then inspected dimensionally, cleaned, inserted in aluminum cans, and capped. The canned assemblies

are then die sized to effect a tight fit of slug to can. The excess can length is machined off after die sizing and the caps welded to the cans. Finished slugs are tested for soundness of welds and dimensional accuracy.

Acceptable canned Li-Al slugs are loaded into aluminum tubes (16 slugs per tube for full rods), end fittings inserted in the tube ends, and the tubes evacuated and filled with helium. The assembled tubes are then sized in a rotary swager to produce a tight fit of cans to tube. The tube ends are machined after sizing and the end fittings welded to the tube. Finished rods are inspected dimensionally, straightened if necessary, and tested for helium leakage. Acceptable rods are stored in this building pending shipment to the reactor areas as required.

BUILDING #305-M

In order to test uranium slugs for reactivity and Li-Al slugs and rods for neutron absorption efficiency, a low power test pile was selected. This pile is a modification of a similar facility installed at Hanford for this purpose and is housed in Building #305-M. It is graphite moderated, blanketed with a helium atmosphere, and controlled by horizontal and vertical rod elements. The pile is powered by approximately 25 tons of bare uranium slugs inserted in horizontal channels in the graphite moderator.

A small percentage of the uranium and Li-Al slugs processed in Buildings #313-M and #320-M, and all of the blanket and control rods produced in the latter building, are sent to Building #305-M for testing in the test pile. This involves a comparison of the reactivity measurements of standard pieces with the test pieces, each type alternately charged in the test pile at the same power level. Uranium slugs are inserted in test holes located in the center of the pile, while Li-Al slugs and rods are charged into fringe test holes. The acceptability of the reactor elements produced in Buildings #313-M and #320-M for charging in the production reactors is indicated by comparable reactivity values of the test and standard pieces after irradiation in this low power test reactor.

BUILDING #777-M

This building, containing two experimental reactors, a process development pile and a standard pile, is a technical facility for experimental development of pile operating techniques and advanced designs.

The process development pile is a full scale mock-up of the heavy water moderated producer reactors installed in the #100 Areas, but operates at low power levels up to 100 watts. This unit is used for detailed study of the operation and performance of production reactors and for advanced pile design development and testing. Its general design was determined by the following considerations: duplication of the chemical and physical factors, but not the precise mechanical design, of the Plant production reactors; conservation of the heavy water used as moderator; safety; flexibility; and accessibility.

The standard pile, which normally operates in a power range below one watt, is used to determine the neutron cross section of reactor components, and to calibrate special detectors used in the production piles. It also determines the primary standards for devices used in health survey and personnel monitoring. The standard pile is also an auxiliary essential for reactivity measurements in support of the process development pile program.

The standard pile is powered by an alloy of enriched uranium and aluminum in the form of disks. Design of the SP was based on the Thermal Test Reactor built at the Knolls Atomic Power Laboratory.

An exponential tank with flexible lattice is operated in conjunction with the standard pile for study of various types and sizes of fuel elements under reactor conditions.

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III - DESIGN

PROCESS BUILDINGS

BUILDING #305-M - TEST PILE BUILDING

FUNCTION

This building houses facilities for the temporary storage and testing of a small percentage of the components to be used in the Building #105 reactors. Canned and bare slugs and control rods are received from Buildings #313-M and #320-M. These are tested and either rejected or shipped to the #105 Buildings. Loaded Q-foils and empty S-foils are received from the #105 Buildings, tested and returned.

All testing is done in the test pile and is, generally, by comparison of reactivity measurements of test pieces against standard pieces. Bare fuel slugs are tested for reactivity; control rods and canned producer slugs for efficiency as neutron absorbers; and aluminum components and canned fuel slugs for purity of the aluminum and to monitor the canning process. Quantities tested vary in proportion to the percentage of rejects.

PRINCIPAL COMPONENTS

Storage and Shipment Area

All shipments enter and leave through this area located on the north end of the building. Shipments first enter an airlock built as an annex to the building. An overhead crane and platforms on both sides of this airlock assist in handling shipments in this portion of the building.

The Hot and Cold Assembly Storage areas are located inside the building with truck parking space between them and the Hot Storage Area (for tested items) on the east side. Electrically operated doors separate this portion of the building and the airlock. These storage areas are isolated from the room of which they are a part by 7 ft. high by 8 in. thick concrete walls. An overhead crane handles shipments into and out of the storage areas and boxes are stacked between structural steel stacking frames. The Assembly Storage areas receive foils and control rods. Slugs and cans are stored in double concrete stalls, one of which is located adjacent to each of the Assembly Storage

areas while two are at the south end of the Test Pile area. Storage here is on pallets stacked on racks inside the stalls. Stalls on the west side of the building are for cold storage (untested items) and those on the east are for hot storage.

Test Pile, Charging, and Control Rod Area

This area occupies the major portion of the central first floor section of the building. The pile, located in the center of the area, with the charging machine portions immediately to its north and south, is generally similar to the Hanford test pile.

Immediately west of the pile is a portion of the building termed the Control Rod Room. Control rods are driven into the west face of the pile from this location.

Control Room

Pile control is from a room located over the Office and Welfare areas. A control desk and instrument panels are placed so that they give the operator a clear view of the pile through the Control Room windows.

Office and Welfare Area

Two offices are provided, each with accommodations for two people. There are also two toilet and wash rooms, a lunch room and a locker room for twenty people.

Electrical Equipment Room

This room, adjacent to and north of the Office and Welfare Area, is the distribution point for the electric lighting and power systems in the building.

Laboratory

This is a physics laboratory and counting room located east of the pile. No chemical analyses are made as a part of the regular test program but some chemical laboratory equipment has been provided. The facilities are used also in the calibration of instruments. This room, of bomb resistant construction with labyrinthed entrances, may serve when necessary as a shelter.

Supply Fan Room

This room houses refrigerating equipment for all three air conditioning systems and two air supply fans with coils. One fan supplies conditioned air to the main building and the other to the Control Room, Offices and Lunch Room. Also in this room is the water heater and storage tank supplying the Welfare Area.

Air Conditioning Room

This room houses the air conditioning unit and the water heater and storage tank for the Laboratory.

BUILDING FLOOR SPACE

Storage and Shipment Area	Approx. Sq. Ft.
Air Lock	745
*Hot Assembly, Storage Area	1190
*Cold Assembly, Storage Area	1190
Total	3125

Test Pile Area, Charging, Etc.	
Test Pile	1075
North Charging	3300
South Charging (incl. south stge. stalls)	3380
Control Rod Room	620
Total	8375

Office and Welfare Area	
Offices (2)	295
Toilets (2)	245
Locker Room	205
Lunch Room	180
Corridors	390
Total	1315

Control Room	1135
Laboratory (incl. entrance corridors)	1200

*Incl. half corridor, stalls, and space to Cols. 3.

Electrical Equipment Room	600
Supply Fan Room	1190
Air Conditioning Room	180
Cylinder Storage Platform (roofed)	145

BUILDING DETAILS

Size - Single story, except for Control Room, and irregular in shape. Over-all dimensions are 115 ft. by 180 ft.

Class - I
Laboratory (excl. entrances)
Area - 1270 sq. ft.
Volume - 15,900 cu. ft.

Class - II
Air Lock
Storage and Shipment
North Charging
Test Pile
South Charging
Control Rod Room
Office and Welfare and
Control Room above
Electrical Equipment Room
Supply Fan Room
Air Conditioning Room and
Cylinder Platform

Area - 15,128 sq. ft.
Volume - 540,085 cu. ft.

CONSTRUCTION DETAILS

Foundations - Reinforced concrete with spread footings.
Superstructure - Laboratory - Reinforced concrete.
Main Building - Structural steel frame, trusses in high portion, beams elsewhere.
Concrete roof slab.
Exterior walls - Poured concrete to 4 ft. above ground floor level, flat cement asbestos board above.
Interior partitions - Steel studs with flat cement asbestos both sides, except in Assembly Storage Areas.

Interior of exterior walls - No finish (exposed insulation), except in Control Room where acoustical "Fiberglas" applied to cement asbestos board is used over girts.
Toilet room walls - Painted Keene Cement Wainscot 6 ft. ht., flat asbestos above.
Shower room walls - Metal (stalls).
Ceiling:
Control Room - Acoustical, suspended.
Main Building - Exposed concrete.
Doors - Tin clad and hollow metal.
Windows - None, except special fixed Thermopane observation windows in Control Room.

Roofing - Laboratory - Integral waterproofing.
Main Building - Built-up, Type SG-1C1-20.

Insulation - Roof (between slab and roofing) and all exterior walls.

Floors - Concrete.

Floor Covering - Asphalt tile in offices and Control Room, bare concrete elsewhere.

Lighting - Fluorescent in Control Room, Laboratory and Offices. Incandescent in all other areas.

Lighting service is obtained from Building #320-M and the emergency diesel generator in that building also is the source of power for emergency lighting in Building #305-M.

A separate transformer is used to supply the instrument circuits in order to minimize the effect of voltage fluctuations on the sensitive instruments.

Heating - Forced air through steam heating coils in conjunction with air conditioning systems in all areas. The steam supply is 300 p.s.i. from the Power House, reduced to 15 p.s.i.

Air Conditioning - Laboratory, Control Room, Offices and Lunch Room:
Year-round condition - $77^{\circ} \pm 2^{\circ}$F. D.B. and $50 \pm 5\%$ R.H.
Main Building:
Winter conditions - 70°F. D.B.
Summer conditions - 85°F. D.B. and 55% R.H.

Ventilating
Mechanical Roof Ventilators in Fan Room, Electrical Equipment Room and Air Conditioning Room.
Multiblade fans with ducts in Toilet, Locker Rooms and Laboratory Hood.

EQUIPMENT

Storage and Shipment Area

E.P. 121 - Box Lifting Beam, Crane Rotator, etc. - used with E.P. 201 in loading assemblies into charging troughs.

E.P. 204 - One-ton monorail crane, twin hook - for lifting truck cover in air lock through pick-up frame, E.P. 204.1.

E.P. 201 - Three-ton double bridge crane - for handling boxed assemblies between truck, storage areas and charging machines. Also, for moving charging beam, tables and troughs. This crane spans 51'4" and travels the length of the building, but controls are set so that the trolley will not pass directly over the pile.

Test Pile, Charging and Control Rods

The test pile is an uncooled natural uranium pile with graphite moderator. It is surrounded by a five-foot concrete shield which is sufficient to reduce radiation to personnel tolerance level in the room housing the pile. A helium atmosphere is maintained in the pile at all times.

The pile is controlled by neutron absorbing rods electrically driven through the west face. Gravity driven safety rods are inserted into the top and the west face in cases of emergencies, and the pile reaction may also be stopped by dropping neutron absorbing nickel-boron balls into tubes located in the pile.

The graphite moderator is 15 ft. square by 16.4 ft. high, built up of 47 layers of blocks, each block measuring 4-3/16 in. square by 29 in. long. There are 360 channels for uranium rods located on a 8-3/8" lattice. The channels are 1.744" holes drilled in alternate blocks of alternate layers along the longitudinal axes of the blocks. No uranium channels are provided in the outer four blocks around the four sides of the pile. The central core, bounded by the outermost uranium channels, is of the highest grade graphite with the remainder of the 190 tons in the pile chosen from unpurified CSO graphite.

The blocks are stabilized by staggering rows and keying layers together. A total of 27 holes of varying size are provided at various locations throughout the pile. Graphite surrounding these holes is keyed together to prevent displacement of the stack.

Of the 27 holes in the pile, four are for vertical safety rods (E.P. 104 and 131). One of the horizontal holes is for a safety rod (E.P. 107), eight for instruments, three for control rods (E.P. 103, 105 and 106), and eleven are for testing purposes.

The pile is powered by approximately 25 tons of bare natural uranium slugs approximately 1.440 in. in diameter by 8.250 in. long. Each channel contains 16 of these slugs separated by graphite spacers. All of the 360 fuel channels are loaded with fuel slugs of a purity and density comparable to the standard production material supplied to Hanford.

The helium atmosphere is contained around the pile by a steel seal casing. Approximately 1/2 in. space is allowed between the moderator and the gas seal. The helium is fed to the seal from manifolded gas cylinders.

Each of the horizontal holes is lined with a magnesium tube extending all the way through the pile and the shielding in a north-south direction. These tubes provide a gas seal. Components to be tested are placed in highest grade graphite "slippers" which slide into graphite liners inside the magnesium tubes.

E.P. 103 - Shim Rod Assembly - the shim rod, a stainless steel bar 3.5 in. by 1.75 in. in section, is electrically driven into the pile on a horizontal graphite track at a speed of 1 in. to 200 in. per minute.

E.P. 104 - Vertical Safety Rod Assembly (2) - Assembly consists of a 3 in. diameter boron S.S. bar driven into the pile by its own weight, and a 2 hp. motor and winch for withdrawal of the rod. A magnetic clutch is provided between the motor and winch to permit the rod to drop when the power is off.

E.P. 105 - Coarse Control Rod Assembly - the rod, made of a cadmium strip between stainless steel bars, is electrically driven into the pile on a horizontal graphite track at a speed of 1 in. to 200 in. per minute.

E.P. 106 - Fine Control Rod Assembly - similar to E.P. 103, except rod is 1 in. diameter.

E.P. 107 - Horizontal Safety Rod Assembly - the rod, a 2 in. x 3.5 in. boron S.S. bar, is driven into the pile on a graphite track by the fall of a heavy weight transmitted through a cable and pulley system.

E.P. 111, etc. - Charging Machines - for charging materials into test holes in pile. The machine consists of a platform about 25 ft. wide and extending back 40 ft. from the pile face. It has one low and one high charging table. The low table is fitted with one Charging Trough and the high with two. The platform serves as a base and general working area, and is fitted with working and temporary storage tables for materials. The Charging Tables are movable on the platform to align with the test holes in the row served. The Charging Troughs are fitted with graphite slippers to suit the material being charged. Material is loaded into the slipper and the loaded slipper is driven into the test hole by the Pusher Assembly, E.P. 120.

E.P. 120, etc. - Charging Beam and Pusher Assembly - the beam carries an endless chain driven by a 3 hp. motor, which drives the Pusher Assembly. The entire assembly is movable as a unit and may be located at any test hole and varied in height to suit either Charging Table and Trough. Two pushing fingers are provided for simultaneous loading of two holes, but one finger may be turned back when not required. Charging speed is 6 to 60 f.p.m. The beam may be varied in height to suit either Table.

E.P. 131 - Safety Tube Hopper Assembly - for storage of boron-bearing shot to be discharged into vertical tube as an emergency safety rod. The shot is retained in the hopper by a solenoid-operated plug. Interruption of the current to the solenoid allows the plug to drop and release the shot.

E.P. 132 - Vacuum Producer - for recovery of shot from the tube. This unit consists of a centrifugal turbo-exhauster powered by a 7-1/2 hp. motor, a 24 in. centrifugal separator and receiver, and 50 ft. of rubber-covered steel hose.

E.P. 202 - One ton Monorail Crane - for pile maintenance. This crane provides services for lifting equipment from floor to top of pile, and spotting heavy loads on pile.

Laboratory

Balance and table.
Counting table with 4 counters.
Laboratory table with sink.
Miscellaneous laboratory equipment.
Exhaust hood with 600 c.f.m. fan. (E.P. 908)
Desks and chairs.
Files.
Neutron counters, absorber sets, etc.

Offices

Conventional office furniture.

Lunch Room

2 - Tables with seats (capacity 6 each).
1 - Refrigerator.

Control Room

Desk, tables, chairs.
Files, typewriter.
Battery and charger.
Relay cabinet.
Gauge board.
Amplifier panel.

Electrical Equipment Room

Panels.
Starters.
Amplidynes.
75 kv.-a. transformer.
Amplifier rack.
Roof ventilator (16 in.).

Air Conditioning Room

1 - Buffalo #G122, 2500 c.f.m. air conditioning unit with 2 hp. motor (E.P. 909).
1 - Vertical steam water heater - capacity 100 g.p.h. (E.P. 615).

Toilet and Locker Rooms

1 - 830 c.f.m. Fan with ducts from rooms (E.P. 905).

Supply Fan Room

1 - Buffalo #G123, 3300 c.f.m. air conditioning unit with 3 hp. motor (E.P. 906).
1 - Buffalo #7LL fan, 30,000 c.f.m. with coils and 25 hp. motor (E.P. 903).
2 - Carrier #5H80 40-ton compressors with 50 hp. motor, including condenser, heat exchanger, pump, water chiller and cooling tower (tower is located 30 ft. from building).

1 - Horizontal steam water heater - capacity 250 g.p.h.

INSTRUMENTATION

The instrumentation in Building #305-M is provided primarily for recording and controlling the behavior of the test pile and for health monitoring functions.

Pile Behavior and Control

Neutron Flux Measurements

Five ionization chambers are placed at points along one face of the pile and connected in parallel. These serve as primary elements for two galvanometers. One of the galvanometers measures the pile power level, while the other, in a differential circuit, is used in conjunction with a potentiometer to measure the pile power level deviations.

In addition to these five ionization chambers, there are three others located at different points in the pile. These are connected to three separate and independent instruments. One is connected to an electronic microammeter which operates a relay to "scram" the pile if the level becomes dangerous. The power level at which the scram circuit is actuated can be changed at will by the operator to compensate for changes in conditions of operation. The second ion chamber is connected to a separate microammeter which operates a pile panel level recorder. The recorder also actuates the scram circuit if a dangerous power level is reached. This power level cannot be changed by the operator.

The third independent ionization chamber is connected to a logarithmic amplifier which is in turn connected both to a power level recorder with a logarithmic scale and to a period meter. The period meter measures the rate of increase of pile power level. A recorder is connected to the period meter which also actuates visible and audible alarms when the rate of power level increase rises too rapidly. The recorder is connected with the scram system as are the other two independent ionization chambers.

In addition to operating the scram system manually the above safety devices permit automatic operation of the scram system in any one of the following instances: (1) when the pile power level exceeds an adjustable pre-set limit; (2) when the pile power level exceeds a non-adjustable pre-set limit; and (3) when the rate of rise in the power level exceeds a pre-set value.

Three neutron-sensitive proportional counter sets are provided for pile monitoring during construction and start-up.

Four foil counting sets are used to accomplish pile calibration.

Rod Measurements and Controls

Two tumbler-type, servo-driven units show the actual position of the fine and coarse control rods and the shim rods at any given time. These indicators are graduated in inches and in tenths and hundredths of an inch. In addition to this exact indication of the shim rod positions, an indication of their approximate positions is also given. This is accomplished by a limit switch on each end of the rod's travel and another switch in the center of the travel. These switches light signals which indicate "in", "out", or "center" for the shim rod positions.

The safety rod positions are only roughly indicated by an indication system similar to the switch and light system used as the auxiliary indicators for the shim rods. Five switches are provided for the safety rods, however. Two indicate "in" or "out" and three indicate intermediate positions of the rods. These switches light signals on the control panel which show the approximate positions of the rods.

Gas Envelope

Blanket gas is fed to the pile envelope through a limiting orifice which permits only a pre-determined amount of gas to enter the system. A seal pot on the exit end of the gas system and a pressure regulator prevent the pressure within the envelope from getting too high or too low. Gas pressure inside the envelope has been set at about plus one inch of water and the seal pot and regulating equipment have been designed for this requirement.

Health Monitoring

For the purpose of personnel protection, six beta window ionization chambers with gamma window attachments are placed in positions around the pile. These serve as primary elements for health monitoring instruments and a recorder.

These ionization chambers have leads to six microammeter transducers and these six instruments connect to one millivoltmeter strip chart recorder. The transducers constantly indicate any change in hazardous activity which the primary elements would pick up from around the area and the recorder keeps a record of such activity fed to it by the transducers.

PROCESS DESCRIPTION

Shipments of components are made to and from Buildings #305-M, #313-M, #320-M, and the #105 Buildings by covered truck. Trucks enter the air lock and then the building between the Hot and Cold Assembly Storage areas. In the airlock the cover of trucks carrying foils and rods is removed by the monorail crane and suspended from safety chains. Inside the building, the boxes are removed from the uncovered truck by the bridge crane and stored in the Cold Assembly Storage Area. When components are shipped from the building, the receiving procedure is reversed, except that shipment is from the Hot Assembly Storage Area.

Slugs and cans are received and shipped in trays on covered pallets. When these components come into the building, the truck covers are not removed and the pallets are unloaded by a fork lift truck used jointly in Buildings #305-M, #313-M, and #320-M.

Pallets are moved by the fork lift truck to the storage stalls previously mentioned. As with the other components, shipment from the building is a reversal of the receiving routine.

The actual testing of various components takes place in the pile where their reactivity is measured to determine their suitability for use in the process reactors.

The following tests are made.

Bare Uranium Slugs - These are placed, about 10 slugs to the hole, in two test holes located in the center of the pile. The slugs are charged alternately from the north and south side of the pile and are discharged to the same side from which they were charged.

Canned Uranium Slugs - These components are tested in the same holes and in the same manner as are the bare slugs.

Canned Li-Al Slugs - These slugs are charged into three fringe test holes. The number charged varies with the excess reactivity available in the pile and the uniformity of the alloying process in Building #320-M.

Control Rods - These individual rods are tested in the same holes as the Li-Al slugs. The testing detects possible omissions of or substitutions for lithium alloy slugs in the assembly, or an excessive number of Li-Al slugs containing a subnormal concentration of lithium in one rod. The full production of these rods is tested in #305-M.

Quatrefoils, Septifoils, Slug Cans, etc. - Occasional tests of these aluminum components are made to maintain a quality control check on metal used in their fabrication. These are tested in a central test hole as the concentration of impurities in the metal would be too low to detect in the fringe holes.

Testing Procedure

At the start of a shift in which uranium slugs are to be the first items tested, some standard samples of uranium permanently kept on hand are charged into the pile which is started up to the power level necessary for testing. The pile is checked against the standards by the following procedures.

1. The control rods are set as closely as possible to the position at which the pile power level remains substantially constant.

2. The change in power level with the rods in the above position is measured over a short period. The change during this period is referred to as "drift".

3. A control rod is moved a short distance and a new drift measurement taken.

4. The reactivity in steps 2 and 3 is calculated using the drift-rod movement-reactivity relationships determined when the pile was calibrated.

If the same reactivity value is obtained from the above two measurements, it is used as a basis for testing uranium slugs for the remainder of the shift. The standards are rechecked as often as necessary.

After the standards have been checked, they are removed from the pile and a sample of ungraded uranium slugs inserted in the same position. Their reactivity is then measured in the same manner as that of the standards. If results are substantially different, they are rechecked.

The reactivity of other components is measured in the same manner as is that of the uranium slugs (i.e., by comparison with standard samples). The neutron absorber must be continuous in the pile when the control rods are tested to prevent variations in pile power level.

The standards used daily (working standards) are checked occasionally against master standards normally stored in a safe in the control room. All standards are charged into the pile in the same graphite slippers used for testing the production samples in order to eliminate effects which might be caused by impurities in different graphite bars.

The foils and rods are taken directly from the boxes in which they are shipped to the building and placed in the troughs for loading by the charging machines. These assemblies are handled by the Box Lifting Beam and the Crane Rotator which serve as auxiliaries to the Double Bridge Crane traveling over the entire main bay of the building.

Canned and bare slugs are brought on their pallets from the storage stalls by the fork lift truck and placed on the charging machine platforms. Slug trays are loaded manually on the slug cart from the pallets after they are deposited on the charging machine platforms. Tongs are used to transfer the individual slugs from the slug cart trays to the troughs leading into the pile. After the slugs and cans have been tested, they are moved, manually again, from the troughs back to the trays. No shielding has been provided for handling the hot tested materials which come from the pile. However, if required, a portable Lucite shield can be provided for operator protection.

DEVELOPMENT OF DESIGN

The Hanford test pile building served as the basis for design of this similar facility for the Savannah River Plant.

In early 1951, AED requested that the Design Division take the Hanford design and make the necessary modifications to suit the following conditions.

1. Building to be Class II, and dust-tight to the degree attained in residential construction.

2. Pile to be purged and blanketed with inert gas.

3. Laboratory (counting room) to be included.

4. Bomb shelter for building personnel to be included.

5. Additional storage space to be provided.

6. Charging machines to be improved.

7. Operating to be on a one shift, five-day week basis, with capacity to be increased if necessary by the addition of another shift.

8. Isolation of pile from other buildings not necessary.

9. Estimated required capacity per year:

Item	Quantity	% of Plant Throughput
Bare uranium slugs	50,000	5
Canned uranium slugs	50,000	5
Canned Li-Al slugs	5,800	10
Li-Al control rods	3,600	100

10. Facilities also to be provided for occasional testing of loaded and empty quatrefoils and septifoils, slug cans, thimbles, etc.

11. Storage space required for the following:

Item	Quantity	
	Untested	Tested
Bare uranium slugs	1200	1200
Canned uranium slugs	1200	1200
Canned Li-Al slugs	100	100
Li-Al control rods	160	160
Quatrefoils	10	10
Septifoils	10	10

12. No shielding of tested materials required.

13. Building to be in operation in time to test first components fabricated in Buildings #313 and #320.

Building

In the preliminary designs for the building, the pile was to be charged and discharged through the north and south faces with the control mechanism on the west face. An airlock was planned for the south entrance to the building.

This arrangement held generally throughout the planning and design of Building #305-M, although the air lock was moved to the north end of Building #305.

The shielding around the pile was the subject of some study during the design of the building. It was felt at first that the use of concrete blocks for shielding on the north and south pile faces would be preferable since there was some possibility of changes in the test hole locations. However, the locations became firm by the time the shielding was to be erected, so Design specified that the shielding would be of poured lean concrete. This was installed using the steel gas seal casing as one side of the form.

Other minor revisions such as the relocation of equipment, building lines, etc., were made during the course of design.

Equipment

Test Pile

The test pile was designed on the basis of operating knowledge gained from the Hanford Test Pile. However, it is approximately 3 ft. shorter on the sides than the Hanford pile. The general design of this facility was therefore fairly well formulated in advance of actual Savannah design and there remained chiefly the work of incorporating improvements and changes into this existing design.

The over-all size of the pile was established and the lattice spacing determined on the basis of the 4-1/4 in. square blocks used in the Hanford test pile. Soon after preliminary work was started, however, it became apparent that the use of 4-3/16 in. square blocks would be more expedient. This was because the graphite machining equipment at Hanford was set for blocks of this size at the time material for the Savannah test pile was ordered. Gages were also available and a monetary saving was effected by utilizing this existing equipment.

As machining of the pile moderator material was done at Hanford, it was decided that the pile would be mocked up on the layout table available at Hanford with the possibility of saving time in lay up when delivery was made to Savannah.

Blanket Gas System

The use of a blanket gas system, sealed inside the steel membrane covering the pile, was a deviation from the

Hanford design. This improvement is estimated to have increased testing productivity as much as 25 per cent.

Carbon dioxide was selected for the system during early phases of design when it was planned to install aluminum liners inside the test and control holes. These liners were provided to seal off the open test holes and prevent the escape of the purge gas. Design studies in materials of construction developed that commercial aluminum was classified as one of the "poison metals" under irradiation, and magnesium was chosen as a substitute. On the other hand, magnesium deteriorated and a helium gas system was selected.

As finally designed, the blanket gas system can be operated with either carbon dioxide or helium. With helium operation, the gas is delivered to the system from cylinders through a manifold and a 1/2-inch feed line to the top of the pile and gives a 90 per cent purge in 24 hours or a 100 per cent purge in 48 hours. A normally installed spool piece and a blank flange in the gas lines permit a change to a CO_2 system with the gas entering at the bottom of the pile through a 1/2-inch line. Cylinder storage facilities can be converted to CO_2 service by the use of an immersion heater (for use with CO_2 only) and the substitution of special cylinder pigtails for the helium cylinder adapters.

Control System

The control system, included in the A.M. & F. scope of work, is composed principally of the horizontal and vertical rod elements.

The horizontal rods enter the pile at its west face. These rods, the coarse and fine regulating rods and the shim rods, are driven by amplidyne controlled variable speed gear motors. The positioning and indicating controls are on the main control panel. The rod speed unit remotely adjusts the speed travel within a range of 1 inch to 200 inches per minute. Positioning accuracy was a strict criterion in the selection of a drive unit. With the present method, "fast in" and "fast out" buttons can set initial positions and a job button allows the rod to be set to within .003 of an inch of any location in the 14 feet of travel.

In the selection of a drive unit to meet these requirements, a number of alternative designs were investigated. In addition to the type selected, a mechanical variable speed changer, a hydraulic drive unit and a Variac with d.c. motor drive were also considered. However, on the basis of best results in the light of speed range and

positioning accuracy, it was determined that the method used would offer the most satisfactory service.

The du Pont Design Division followed the studies on the various drives and suggested to A.M. & F. the use of the amplidyne system as being the most desirable drive. This system was investigated in conjunction with the General Electric Company to obtain the speed range and the final design proceeded.

The panel indicator unit which shows the position of the horizontal control rods is a servo-system geared to counters. An alternative selection considered was a system of glow-meter indication and panels of lights. This was eliminated because it was felt that the glow meter equipment would have been cumbersome and complicated and because the light panel would have demanded excessive maintenance.

Originally only the fine regulating rods were to be equipped for precision indication. Later in the course of design, it was determined that all the control rods should be so equipped.

Early design of the control rods also provided that they should be driven into the pile by battery-powered mechanisims in the event of a.c. power failure. Later this was canceled from the scope of work as it was felt that the safety rods, together with the tube, would be sufficient without having to drive the control rods into the pile.

The vertical safety rod drives are winch and pulley assemblies powered by gear motors located on the top of the pile. The rods are normally withdrawn from the pile during operation and fall by gravity in an emergency. Originally, these rods were specified to be of boron stainless steel but, due to fabrication difficulties, this was changed to boron carbon steel with a stainless steel jacket.

Another vertical safety component is the safety tube filled with boron nickel shot. The shot are held in a hopper at the top of the tube by an electromagnet mechanism until an emergency condition arises. The shot can then be dropped into the tube inside the pile by shutting off the current to the magnet retainer. The shot are generally also released into the pile when it is to be shut down for extended periods. In the original design the hopper was to have been located above the concrete pile shield. However, at the request of AED, the design was changed to an explosion proof arrangement with the hoppers buried in the shield. The hoppers are locked closed from the control room so that the shot cannot be diverted into the pile accidentally while it is in operation.

Charging Machine

The pushers on the charging machine load components into the pile from one face while the pusher on the opposite side of the pile holds a slight tension against the assembly being loaded to prevent the slippers from becoming separated. After installation of the equipment, AED requested that a force relief mechanism be installed to insure that the drive would cease to exert force if the assembly being loaded should become obstructed. During the course of design, it was determined that the machines should be arranged so that one operator on either side of the pile could operate both of the machines. When two operators are present, however, the machines are designed so that neither can be worked remotely from the opposite side. This prevents an obvious malfunction caused by remote operation from another point when an operator is present.

During the course of design, the pusher was also modified so that two adjacent test holes could be loaded simultaneously. This was accomplished by placing two fingers on the pusher. This allowed the two holes to be loaded or it allowed one finger to be folded back so that only one hole is loaded.

There are two charging tables. Table A is used in processing control rods and Table C is used for fuel slugs. As originally designed, there were three charging tables. However, by redesigning the tables and providing means for shifting them around on the supporting structure, Table B was eliminated.

The pusher is powered by a servo-controlled, dual, adjusto-speed drive unit. This unit was chosen for its extreme versatility as it can be set for any speed up to 60 ft. per minute in either the forward or backward directions. Several other drive mechanisms were considered and an American Blower Gyrol drive was initially specified. However, the versatility and positioning accuracy of the present drive resulted in its ultimate selection over the original specification. The drive finally accepted was the Louis-Allis Adjusto speed type consisting of a motor driving through a magnetic coupling, the torque of which could be closely regulated. This drive was suggested by and followed through the design and test stages by the du Pont Design Division.

After it was decided that the loaded quatrefoils would not be tested regularly, some consideration was given to changing the design of the pusher to that used at Hanford i.e., with a finger pusher protruding through a slot in the centerline of the loading table. However, because of the additional design work entailed, this idea was abandoned.

Special Handling Equipment

A box lifting beam is provided for handling troughs and transport boxes used in testing fuel slugs. In addition to this design, there was also a heavier, more complicated, piece of equipment intended for use in test loaded quatrefoils. When it was decided that the quatrefoils would not be production tested, the work on this piece of handling equipment had progressed to the stage where it was decided to complete fabrication. This was done and the equipment was placed in storage for use when quatrefoils are tested.

Some other simplifications were made in handling equipment, such as the elimination of a special beam for remotely handling control rods. Another such item was the elimination of safety rod handling equipment.

DRAWINGS

W-130205 - General Arrangement Plan - Sheet 1.
W-130206 - General Arrangement Plan - Sheet 2.
W-130207 - General Arrangement Sections - Sheet 1.
W-130208 - General Arrangement Sections - Sheet 2.
W-131138 - Furniture and Miscellaneous Equipment.
W-130984 - Isometric Arrangement of Packing.
W-130230 - Blanketing Gas Facilities.
W-130576 - Arrangement of Packing and Barricade - Long Section.
W-130575 - Arrangement of Packing and Barricade - Cross Section.

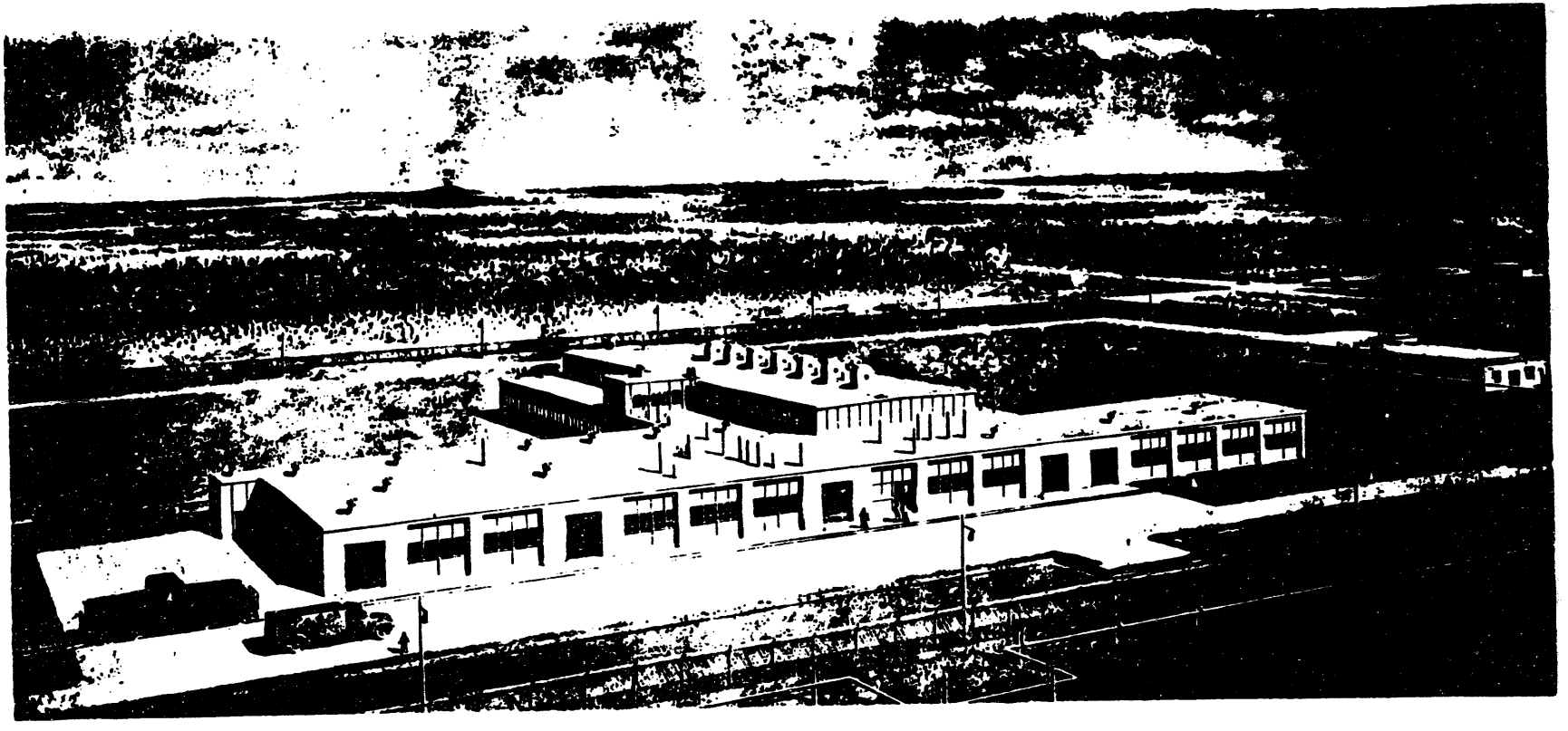
BUILDING #313-M - CANNING AND STORAGE BUILDING

FUNCTION

This building was designed to house equipment and facilities for canning and storing uranium fuel slugs for use in the #100 Area reactors.

PRINCIPAL COMPONENTS

Slug canning involves the insertion of uranium slugs into aluminum cans in a bath of molten aluminum-silicon to bond the slugs to the cans, and capping the cans. The canned assemblies are then machined, welded, and subjected to various tests to determine the effectiveness of bonding, soundness of welds, and general acceptability.



BUILDING #313M···CANNING AND STORAGE

These operations are performed in the following manufacturing areas of the building, with major equipment installed therein noted in operational sequence.

Receiving and Inspection Area

This area is located adjacent to the truck apron and railroad siding to receive incoming materials. Uranium slugs, canning sleeves, cans, and caps, purchased from outside vendors, are inspected in this area prior to use. Equipment is handled by means of a monorail and 1/2-ton hoist. Inspected materials are transferred to the cleaning areas by roller conveyors.

Can, Cap and Sleeve Preparation Area

Caps, cans, and sleeves are degreased and cleaned in a separate room equipped with ventilation facilities to dissipate noxious fumes evolved from the cleaning tanks. Cleaning equipment includes a standard vapor degreaser, stainless steel tanks containing solutions of acid and methanol, rinse tanks, and a forced hot air dryer. Caps, which comprise three components, are assembled in a bench type power press installed in this area.

A standard muffle furnace is installed in this area for "bluing" (oxidizing) the sleeves, together with a motor driven chuck to which a mandrel is attached for lapping the sleeves.

The cans, caps, and sleeves are contained in wire baskets during the cleaning cycle, and moved from tank to tank by means of monorail and 1/2-ton hoist.

Slug Preparation Area

Slugs are cleaned in an area adjoining the canning lines. This area contains a standard vapor degreaser, two acid pickling tanks, a rinse tank, and an oven dryer for drying the cleaned slugs.

Canning Area

The canning area is located in the clerestory section of the building. Sixteen electrical resistance furnaces are located in this area, constituting four canning lines: one bronze furnace, one tin furnace, and two Al-Si furnaces per canning line. The slugs are immersed in the foregoing

molten baths in pairs for closely regulated intervals, being canned and capped in the final Al-Si bath. Four centrifuges are installed in this area for removing excess tin from slugs following immersion in the tin baths.

Lathe and Welding Area

Two turret lathes are located in this area which adjoins the canning area. These lathes trim the hollow cap from the canned assemblies, face the cap, and machine a V-groove along the circumference of the cap face in preparation for welding. Two heliarc welding machines and two 200 amp. welders are also installed here to seal the caps to the cans by circumferential welding following the lathe operation.

Test and Inspection Area

A frost test device, consisting of a high frequency induction coil, is located in the test and inspection area to inspect the canned slugs for bonding defects. A standard vapor degreaser, a stainless steel acid tank, a rinse tank, and a hot air dryer are installed in this area to clean and dry frost-tested can assemblies.

The inspected can assemblies are stamped with a serial number by a code stamping press located in this area. A monorail and 1/2-ton hoist are installed for material handling.

Autoclave Area

Twenty autoclaves of 300 p.s.i. design pressure, 100 p.s.i. operating pressure, are installed in a separate area of the building for leak testing can assemblies. After removal from the autoclaves, the cans are quenched in a water tank. A ring and gauge tube is installed in this area for dimensionally testing the pressure tested can assemblies. A 3-ton bridge crane services the autoclaves.

X-Ray Room

The canned slugs are X-rayed in a separate room to inspect the quality of the cap-can weld. Standard X-ray and developing equipment are installed here. Cyclographic equipment is also located in this room, although cyclographic testing is not employed at this time.

Slug Recovery Area

Rejected can assemblies are processed in this area to recover the uranium slugs for re-use. The salvage equipment consists of a lathe for cutting off the caps and bottoms of the cans, and a series of stainless steel tanks containing caustic and acid solutions for removing the aluminum cans and bonding layers by successive stripping. A tube gauge and scales are located here to inspect the salvaged slugs for warp and weight loss.

AUXILIARY COMPONENTS

Storage Areas

The building contains four storage areas having the following designations: raw material storage, for bare uranium slugs; finished product storage, for finished canned slugs; Essential Materials Storage, for various materials used in the canning process; and Metal Storage, for the raw metals melted in the canning line furnaces.

Service Areas

Five offices are provided for the supervisory staff and toilets and smoking rooms were installed for approximately 100 operating personnel.

A tool room services the machine tools installed in the building and provides facilities for routine building maintenance.

Electrical and utility rooms house load centers, a hot water heater, and air compressors.

An instrument shop services control equipment.

A laboratory, three offices, and a gauge crib were provided for quality control.

BUILDING FLOOR SPACE

Process and Inspection	Approx. Sq. Ft.
Receiving Area	1,500
Canning Furnace Area	13,960
Lathe and Weld Area	2,790
Frost Test and Etch	2,450
Autoclave	3,500

Cap, Can and Sleeve Preparation	3,310
Recovery Area	2,880
Special Process	1,520

Building Service and Miscellaneous Areas

Offices	760
Toilets and Smoking Area	630
Electrical and Utility (Inc. penthouse and service floor)	4,610
Tool Room	670
Instrument Shop	335
Quality Control and Gauge Crib Areas	1,150
X-Ray	1,110
Main Corridors not included above	2,730

Storage

Essential Materials	960
Finished Product	2,880
Raw Material	3,215
Metal Storage	610
Special Process Storage	760
H. F. Storage	155

BUILDING DETAILS

This building, of Class II construction, is a single story (with clerestory) T-shaped structure. The cross at top of tee is approximately 344 ft. long, 98 ft. wide at the south end and 50 ft. wide at the north end with the high point of the roof approximately 17 ft. from finished floor. The leg of the tee is 181 ft. long on the south side, 229 ft. long on the north side and 112 ft. wide. The center portion of the tee is 60 ft. wide, with a clerestory height of 25 ft. to top of roof truss and 18 ft. clear to the bottom of truss.

Area -	Ground Floor	49,720 sq. ft.
	Service Floor	3,380 sq. ft.
	Total Area	53,100 sq. ft.

Volume - 997,565 cu. ft.

CONSTRUCTION DETAILS

Foundations - Reinforced concrete with spread footings.
Superstructure - Reinforced concrete frame; concrete

roof slab pitches to eaves. Steel truss and steel framing in clerestory. Siding - flat cement asbestos board on steel girts set in panels between concrete columns.
Interior partitions - Flat cement asbestos board mounted on steel studs with 4 ft. high, pressed fiber board wainscot.
Interior of exterior walls - 4 ft. high, pressed fiber board wainscot, exposed steel and insulation above windows.
Toilet - Concrete to height of 4 ft. with insulated cement asbestos partitions above.
Ceilings - Exposed concrete, asbestos hung ceiling in dark room.
Doors - Hollow metal.
Sash - Steel projected.

Roof - Built-up, 20-year bond.

Insulation - Roof, exterior walls and interior walls of toilets and rest rooms.

Floor Covering - Concrete floor throughout except for asphalt tile in offices. Acid-proof brick in etch area, recovery room, pickle area, and cap, can and sleeve preparation area.

Heating - Unit heaters in essential material storage area, finished product storage room, X-ray room, cap, can and sleeve preparation room, recovery room, inspection room, and raw material storage room.
Fin-tube radiators in offices and toilets and outlying rooms in leg of tee portion, battery storage rooms, and gage inspection room.
The canning area and clerestory section are heated by forced air through heaters and duct work. Heating steam is supplied from the #300/700 Area power house.

Ventilation

Air is brought into the building through six louvers located in the clerestory area above the furnace area. The louvers are provided with fans which draw air into the building through a set of filters and distribute it by ducts to the area located below the clerestory. This is supplemented by a network of ducts with flexible nozzles carrying air to operator positions at the canning furnaces. Heating coils are installed in the ventilation system.

Motor-driven roof ventilators are provided over the lower roof level areas. Above the clerestory there are seven motor-driven exhaust fans which have vent pipes running down into the building to a distance of about 8 ft.

from the floor in the furnace area. The bronze furnace is provided with a hood and flue which relies on natural draft to remove fumes.

All tanks which are heated or which contain corrosive solutions are provided with lip exhausts and motor-driven fans which exhaust through the roof of the buildings.

All intake fans are located on the inside of the building and all exhaust fans are located on the outside of the roof. The latter are located outside for economy of space and ease of maintenance.

Electrical

Electric power is supplied by means of a 13,800 volt underground cable from an outside overhead loop feeder which terminates at two load centers within the building. Load center #1 consists of a primary fused disconnect switch, a 750 kv.-a. 13,800/480 volt delta-delta transformer and a low voltage switchgear section which supplies the 480 volt motor control center equipment and the bus duct system. The motor control center equipment duplicates and is interchangeable with that in other #300 Area buildings. Two 400 ampere plug-in type bus systems were selected to facilitate future changes and additions. Load center #2 consists of a primary fused disconnect switch, a 1000 kv.-a. 13,800/208 volt delta-wye transformer and a low voltage switchgear section which supplies the resistance type furnaces.

Fluorescent lighting fixtures are installed in offices, the tool room, instrument shop, quality control room, smoking room, latch and welding area, canning area, special process room, gage inspection room and inspection areas. All other areas have incandescent lighting. Emergency lighting fixtures are provided in the furnace area and in locations necessary for personnel exit. Emergency power for these fixtures is supplied by a diesel generator located in Building #320-M which starts automatically upon interruption of normal power. All building lighting may be blacked out from the Patrol Headquarters, Building #720-A. Complete speaker coverage is provided in the building for the area Safety Alarm system. Conduits also are provided for Bell Telephone wire installation.

EQUIPMENT

Receiving and Inspection Area

Roller conveyors.
1 - Scale (print and weigh).

1 - Monorail and hoist - 1/2-ton capacity.
3 - Fork lift trucks - 4000-lb.
Miscellaneous inspection gages.
2 - Pallet transporters.

Can, Cap and Sleeve Preparation Area

2 - Vapor degreasers.
1 - Electric motor and chuck (sleeve lapping machine).
Monorail and hoists - 1/2-ton capacity.
1 - Cleaning tank with rotary brushes.
1 - Caustic tank.
5 - Rinse tanks.
1 - Soap tank.
2 - Hot air dryers.
1 - Duponal tank.
2 - Etch tanks.
1 - Methanol tank.
1 - Pump - 40 g.p.m. - 1-1/2 hp. motor.
Timers.
Parts racks and baskets.
2 - Pumps - 5 g.p.m. - 1/3 hp. motors.
1 - Cap assembly press.

Slug Preparation Area

1 - Vapor degreaser.
2 - Pickle tanks.
1 - Rinse tank.
1 - Hot air dryer.

Canning Area

1 - 1/2 ton Monorail system.
1 - 1 ton Monorail system.
Timers.
1 - Pump - 15 g.p.m. - 1/2 hp. motor.
Parts trays and racks.
1 - Hand truck.
16 - 60 kw. Electric resistance furnaces.
Control instruments.
4 - Centrifuges.
Quench tanks.
Exhaust fans.
Various fixtures, agitators, tongs, etc. for canning operation.

Lathe and Weld Area

2 - Turret latches.
2 - 200 amp. Welders.
2 - Welding machines.

Frost Test and Etch Area

1 - Spray booth.
Spray guns and tanks.
1 - 1/4 hp. Pump - 5 g.p.m.
Timers.
Parts racks.
1 - 1-1/2 hp. Pump - 40 g.p.m.
1 - Monorail and hoist - 1/2-ton capacity.
1 - Constant temperature chamber.
1 - 30 kw. High frequency induction heater.
1 - Vapor degreaser.
1 - Acid etch tank.
1 - Rinse tank.
1 - Hot air dryer.
1 - Code stamping press.

Autoclave Area

20 - 20" dia. - 300 p.s.i. Autoclaves.
1 - 3-ton Bridge crane.
Roller conveyors.
Parts racks and baskets.
Work benches.
1 - Duplex sump pump - 3 hp. - 200 g.p.m.

X-Ray Room

1 - Semi-automatic X-ray machine.
1 - Film developing machine.
Film viewers.
Film holders.
Work benches.
Cyclograph equipment.

Recovery Area

1 - Caustic tank.
1 - Caustic mix tank.
1 - Acid tank.
1 - H.F. acid tank.
2 - Rinse tanks.
1 - Neutralizing tank.

Agitators.
1 - Filter press.
1 - Table scale.
1 - Platform scale.
1 - Turret lathe.
Monorail and hoist 1/2-ton capacity.
1 - Trailer disposal tank - 1000 gal.
Timers.
Work benches.
2 - 1/3 hp. Pumps - 5 g.p.m.
2 - 3/4 hp. Pumps - 20 g.p.m.
1 - 1/2 hp. Sump pump - 20 g.p.m.
1 - 1/4 hp. Pump - 5 g.p.m.
1 - 1/2 hp. Pump - 30 g.p.m.
1 - 1/2 hp. Pump - 20 g.p.m.
1 - 7-1/2 hp. Pump - 20 g.p.m.
Parts racks and baskets.

Electrical and Utility Areas

1 - 1000 kv.-a. Unit substation.
1 - 750 kv.-a. Unit substation.
2 - Hot water heaters.
2 - Air compressors, 20 hp. - 122 c.f.m. piston displacements at 100 p.s.i.g.

Tool Room

Work benches.
Cabinet and shelving.
1 - Bench drill press.
1 - 10 in. Bench lathe.
1 - Bench grinder.
1 - Carbide tool grinder.
Miscellaneous small equipment, hand tools, etc.

Instrument Shop

Drying oven.
Work benches.
Cabinet.

Quality Control and Gage Crib Areas

Work benches.
Cabinet and shelving.
Laboratory furnaces.
Laboratory sink.

Stripping equipment.
Conventional office furniture.
Various inspection tools, gages, instruments, etc.
Table scales.
Hydraulic press - 50-ton capacity.

Storage Areas

Pallet rack.
Steel pallets.
Plastic boxes.
Plastic trays.
Benches and racks.
1 - Drying oven.
1 - Flux mixer.
1 - Platform scale.
1 - Metal cutting saw.
5 - Battery chargers.
1 - 1-ton Crane and hoist.

PROCESS DESCRIPTION

Slug, Can, Cap and Sleeve Preparation

The uranium slugs, the cans, the caps, and the sleeves are purchased.

The uranium slugs are measured for dimensional accuracy and visually inspected for metal soundness and surface flaws. A sample of the slugs received (5%) are sent to Building #305-M for non-destructive testing and then returned. The slugs are degreased, pickled in 50% nitric acid, rinsed, and dried.

The cans and caps are inspected for dimensional accuracy and are degreased, washed, etched in 20% phosphoric acid (cans only, the caps are etched in 1% hydrofluorosilicic acid), rinsed and dried.

New sleeves are inspected for dimensional accuracy and are degreased, blued (heated in a furnace until a blue oxide forms - to reduce rusting), lapped, soaped, and dried. Used sleeves are recycled through the canning line after caustic stripping, rinsing, soaping, and drying.

Canning

After cleaning, the slugs are dipped in a molten bronze bath at 730°C. to transform the uranium to the beta phase.

The molten bronze is covered with a layer of chloride flux to prevent oxidation of the bronze, to flux any oxide layer off the slug, and to protect the bronzed slugs from oxidizing after they leave the bronze bath. The bronzed slugs are quenched in molten tin at 600°C. to cool the slugs to the canning temperature. The tin removes copper from the bronze and promotes better wetting in subsequent dips.

The tinned slugs are removed from the tin bath and centrifuged to remove excess tin. The tinned slugs are then dipped in a molten aluminum-silicon bath at [redacted], and then into a second Al-Si bath at [redacted] The second dip lowers the tin concentration in the Al-Si that wets the slug.

Concurrent with the dipping of the slugs, the aluminum cans, encased in steel sleeves, are submerged in the second Al-Si bath. The slugs are inserted into the cans while they are submerged. Concurrent with the can submersion, the aluminum caps are pre-heated in the Al-Si bath and then forcibly inserted in the cans on top of the slugs. The sleeves and canned slugs are removed from the Al-Si bath, quenched in water, and then inverted so that the canned slugs slide out of the sleeves.

Facing and Welding

The cap ends of the canned slugs are cut away and faced to a cap thickness of 0.195", and a 45° V-groove, 0.050" deep, is machined into the Al-Si bonding layer between the cap and can wall - as successive operations on a single turret lathe. The caps are circumferentially welded to the cans using an argon-shielded heliarc weld. The collet holding the can assembly in the welding machine revolves automatically, the cap surface of the can being preheated through one complete revolution before the arc is positioned for the weld.

Inspection and Testing

The canned slugs are measured for length and those outside of specifications are rejected; this inspection rejects principally overlength canned slugs due to nonseating of the slugs or caps.

The canned slugs are inspected for unbonded areas above a certain minimum area in an induction heating operation known as the frost test. In the test, acenapthene is sprayed on the cans as a frost. The canned slugs are then passed through an induction coil that heats the

aluminum above the acenapthene melting point over unbonded areas above certain minimum size where the heat transfer to the slug is poor. Any acenapthene melted solidifies as a glaze, indicating a defective area on the can assemblies. The acenapthene is removed by vapor degreasing and the cans are etched in nitric acid and rinsed.

The canned slugs are visually inspected for weld quality, marred surfaces, wrinkled cans and Al-Si perforation and slop-over. Slugs not meeting specifications are rejected.

After visual inspection, the canned slugs are treated in an autoclave (steam at 100 lb./sq. in.) to test for soundness of can and weld. Defective can assemblies either swell or disintegrate. The autoclaved can assemblies are passed through a combination ring and tube gauge to reject slightly swollen units as well as those out of specification limits on diameter and warp.

The autoclaved can assemblies are etched in nitric acid and rinsed.

A certain per cent (5%) of the canned slugs are transferred to Building #305-M for testing in the test reactor and then returned to the lot from which they were selected.

The cap-can weld is X-rayed to inspect the quality of the weld. Cracks, pits, porosity, and other such welding defects brought to light by the X-ray test indicate a weld not hermetically tight, and such slugs are rejected.

The accepted can assemblies are placed in finished slug containers and stored until required by the #100 Areas.

Slug Recovery

Rejected canned uranium slugs are segregated and recovered by processing through a slug recovery area. In this area, the caps and bottoms of the cans are removed mechanically on a cutting lathe and the aluminum cans and bonding layers are removed by caustic stripping, rinsing, hydrofluoric acid stripping, rinsing, nitric acid etching, and final rinsing. The slugs are visually inspected for soundness; excessive slug warp is determined by a tube gauge; and the slugs are individually weighed to ±0.01 lb. Slugs out of specification limits are rejected.

DEVELOPMENT OF DESIGN

Building

General

Capacity, flexibility, and expandability were the major factors affecting design of this building. Another basic design factor was that this facility was to be a permanent component of the Savannah River Plant.

Based on Hanford experience, it was determined that the building should be sufficiently large to house all of its related facilities, both process and storage, under one roof to provide compactness and eliminate the necessity for smaller outlying buildings.

The building was designed to handle a production output of four operating canning lines, although equipment for only two operating lines was initially installed. To allow for future space expansion, this building was designed so that it might be extended in any of three directions without any appreciable rearrangement of equipment previously installed. It became apparent during the early stages of design that certain revisions in the process might be desired in the future. Therefore, the process areas of the building were designed to facilitate any process revisions which might develop after the building was constructed.

The furnace pits installed in the building floor were of flexible design. Resistance furnaces were installed, but the pits were designed to permit the future substitution of induction furnaces, if desired. Also, the furnace pits were designed to allow for the future addition of 16 more furnaces plus five spares. The low voltage electric resistance furnaces, with their resulting high current dictated a location of a substation for the furnaces as near as practicable to the furnaces. This necessitated the location of a transformer room on the roof of the Frost Test Area with space provision for the addition of a second transformer room for future furnaces. The electric feeder and control cables for furnaces were run in underfloor trenches in order to facilitate overhead crane access to the furnaces.

Hanford experience had demonstrated that some provision must be made for removing the great amount of heat accumulated above the metal furnaces. Wall fans were employed for this purpose at Hanford, but had not proved to be an efficient method of heat dissipation. To provide a more satisfactory solution to this problem, a clerestory area was designed over the furnace pit wing in Building #313-M.

The use of acids, caustics, and chlorine flux in the canning process presented some problems in design of the areas where such chemicals were employed. A natural exhaust hood was located over the bronze furnace to dispel chloride fumes from the bronze flux outside the building. Adequate ventilation was provided around the lathe in the slug recovery room so that the uranium concentration in the air could be kept within allowable limits during the machining operations.

Materials of construction specified for this building were of such a nature as to be unaffected by the action of the caustics employed in the process. Acid proof brick with furane resin cement binders was required for pits and trenches and for the floor areas around the pits.

In general, building design incorporated space for the future installation of sufficient equipment to double the processing and storage capacity of the existing structure.

Design Changes

While this building was being designed, additional process data and economic evaluations resulted in a number of changes being made in the original design. The decision to install X-ray equipment required that provisions be made for an X-ray inspection room. This was accomplished by placing a partition across one end of the finished products storage space to provide a room 20 ft. x 40 ft. for this purpose.

Originally, a long elevated loading dock was designed along the east side of the building. To bring the floor level of the building up to the same height as the floor of the loading dock would have necessitated raising the entire building. An economic evaluation of this consideration indicated that such an arrangement was not feasible, so the loading dock was eliminated. This made it possible to place the building on grade and utilize a more economical type of foundation.

Initial building plans located the motors for the roof ventilators inside the building. Later it was decided to relocate these motors outside the building in order to conserve inside overhead space and facilitate maintenance of these motors.

A four-foot high pressed fiber board wainscoat was added to interior walls along corridors through which trucks are moved. This was done to avoid cracking the brittle asbestos board which would normally cover such walls. In

the raw materials storage room, the finished products storage room, and the gauge crib, expanded metal partitions were added above the original 8 ft. 4 in. partitions and extended all the way to the ceiling. This was done for accountability and security reasons.

A number of other minor rearrangements were made in the building structure as a result of planning studies and involved such matters as door openings, space readjustments, and the like - namely, normal changes of no special significance.

Process and Equipment

General

The development of a process and the equipment for this building was based largely on established procedures employed at the Hanford Engineer Works. The problems of development, therefore, related primarily to the adaptation of the Hanford canning procedure to the Savannah River Plant requirements.

Slug rolling, while its development represented considerable work by numerous organizations, is done off the plant and relates to the development of the canning process only in so far as slug quality is affected as a direct result of handling inside Building #313-M. The greatest problem to arise in connection with slug fabrication by off-plant vendors concerned warpage. Various organizations, both AEC and commercial, undertook extensive experiments in rolling uranium rods in an attempt to correlate the degree of warp with some particular set of handling practices and rolling temperatures. Such conditions, it was found, did have some effect on the straightness of the canned slug; but it was also determined at Argonne National Laboratory and at Hanford that temperatures and cycles of the canning baths also influence the degree of slug warp. This was found to be true particularly in the alpha to beta phase transition in the bronze bath.

As a result of these experiments, the Savannah River slugs were rolled under the best conditions that could be developed from available metallurgical data, and the handling of finished slugs conformed to strict procedures.

Another background problem relating to the canning procedure concerned the machining of uranium rods. Like warpage during rolling, machining of the fuel element concerns this particular account of design development in a general way only; it is mentioned in the interest of filling in the background problems.

From the beginning, it was known that much higher production rates of machined rods could be obtained if automatic screw machines were employed for final surface finishing. But one of the principal drawbacks to the use of such machines was their inability to meet the demands for final surface finish, as demonstrated by experimental work conducted along these lines by the American Machine & Foundry Company. While slower, turret lathes offered better possibilities from the standpoint of surface finish it was thought that higher production rates would be necessary to meet start-up and production requirements than could be expected from such machines. For this reason, and because a lower machine cost per slug would result from higher production rates, extensive testing was done with screw machines. The difficulties encountered with finish and operation resulted in a request that vendors use turret lathes so that acceptable quality slugs might be obtained.

A review of Hanford canning procedures was instituted by the Design Division as a basis for developing the most practicable Savannah River installation. As a result, Design recommended to AED that, because of the background of experience and the time element involved in development of new methods the Savannah River canning process be patterned after the process currently employed at Hanford - the triple dip process utilizing Al-Si bonding of the fuel slug to the can. It was further recommended that a development program aimed at eventually producing a better can assembly be undertaken by du Pont.

This development program involved the efforts of numerous organizations other than du Pont. The program was under the over-all direction of the du Pont Explosives Department - AED, which delegated the design of machinery and equipment, its arrangement, and procurement to the Engineering Department Design Division. A design subcontractor, the American Machine & Foundry Co., designed and built prototypes of most of the machinery and equipment developed in conjunction with this program. The activities of AM & F in this respect were under the general supervision of the Development Engineering Division, which also provided engineering assistance along highly specialized lines.

Other commerical firms - metal producers and fabricators, tool and machinery manufacturers, engineering development organizations, and the like - were engaged in the development of the components utilized and the equipment employed. Numerous AEC installations performed research on basic process data and supplied materials for use in the development program, as well as testing equipment developed by other organizations.

The major problems which Design encountered in the development of the Savannah River uranium canning process were essentially those which aimed at an improvement of the Hanford triple-dip process to meet the more stringent fuel slug assembly requirements, and reduction in the percentage of rejects from all causes. In general, these problems fell into the following categories:

1. Development of improved handling fixtures and procedures;

2. Improvements in the canning cycle;

3. Improvement in the method of capping and closing canned slugs;

4. Development of methods and equipment for machining the caps of assembled cans for more exact gauging and facing tolerances, and to permit sounder welds to be made thereto;

5. Development of welding techniques and equipment to produce sounder can closure welds; and

6. Improved testing and inspection methods and equipment to indicate more accurately the cap cut-off position, the effectiveness of bonding and welding, and the degree of Al-Si penetration of the can walls.

Handling Fixtures

The first major design change to develop, after the decision had been reached to base the procedure on the Hanford operation, involved the size of the uranium slug to be employed. The slug currently in use at Hanford was 4 in. in length, although an 8-in. slug had been employed previously. AED specified a return to the 8-in. slug (actually, 0.997 in. diameter x 8.07 in. long as received).

This involved redesigning the handling equipment to accommodate this larger slug. AM & F therefore designed and built prototypes of the following slug handling equipment: Slug handling tongs; capping tongs; centrifuge baskets; quench baskets; and basket lifts. AM & F also developed equipment for mechanically agitating the tin bath basket, and a tin basket lift assembly - a refinement based on the results of tests run at Argonne. Mechanical agitators to hold two slugs in both the bronze and Al-Si baths were also developed by AM & F. Each of these prototypes was tested at Argonne National Laboratory and

subsequently shipped to the Savannah River Plant for preliminary canning operations. (Use of the Al-Si bath slug agitator was subsequently discontinued by Operations.)

Canning Cycle

Cap and Can Preparation

At one time consideration was given to designing a single piece of equipment capable of performing all operations necessary to prepare the cans and caps for the canning process. This machine was to be designed to degrease, rinse, Duponal wash, rinse, etch, rinse, methanol wash, and dry both caps and cans in the foregoing sequence. Following a study of the possibility of using such a machine, it was determined that the process involved was not firm and that such a machine might prove too inflexible to handle the required changes. Also, it became apparent from an economic evaluation that the advantages it would offer were not sufficient to off-set the additional cost. These factors resulted in a decision by Design and AED to accomplish the necessary preparation by using a separate unit for each step in the process. This process is essentially the same as that employed at Hanford, the handling equipment (baskets) and tanks being redesigned to accommodate the longer cans.

The cap etching agent was changed from phosphoric acid to hydrofluorosilicic acid, requiring the addition of another tank to the cleaning line.

Slug and sleeve preparation - degreasing, cleaning, etching, rinsing, and drying - duplicated the corresponding Hanford operations, the handling equipment being redesigned to process the longer slugs and sleeves.

Furnaces and Metal Baths

A review of the proposed operating cycle and equipment arrangement resulted in a reduction in the number of furnaces initially required from 20 to 16. Heavy-duty resistance furnaces were specified for the canning lines since Hanford had successful experience with this type furnace. Some consideration was given to the use of induction furnaces but, since no experience had been gained on melting the alloys concerned, this idea was rejected. However, the furnace pit was designed to accommodate induction furnaces for future installation if required.

Based on Hanford experience, certain modifications were made in the bronze holding furnaces to reduce the corrosive

effects of the vapors from the chloride flux covering the molten bronze. The furnace heating elements were raised 3 in. and the leads brought out at the top of the furnace rather than the bottom. Also, compressed air was introduced at the bottom of the heating chamber and exhausted from the top to prevent any concentration of fumes.

The current Hanford process for effecting the transition of the fuel slugs from the alpha to the beta phase specified a bronze bath temperature of 720°C. and a slug immersion time of 44 seconds. For this same operation at Savannah River, design specifications were altered to provide for a bath temperature of 730°C. and a total immersion time of 60 seconds; 45 seconds of mechanical agitation, the last 15 seconds manual agitation in a layer of flux.

Design specifications for the tin furnaces were subsequently changed to provide Tercod crucibles rather than graphite, based on superior operating performance and longer life as evidenced at Hanford. The Design Division designed the steel liners required for these furnaces.

A drying oven was provided to dry and preheat metal and flux before using in the furnaces. This oven also was designed to preheat replacement crucibles, to reduce breakage when new crucibles are replaced in the furnaces.

Automatic timers and air brakes were installed on the centrifuges (employed following the immersion of the slugs in the tin bath) to provide automatic operation.

The major portion of the instrumentation installed in the canning lines was in conjunction with the melt furnaces. Commercial temperature control and indicating devices were employed in this connection, which adequately provided the degree of accuracy at high temperature ranges required of this instrumentation.

The electric furnace manufacturer's design requirements for furnaces specified 192 volts maximum. This necessitated purchase of a substation transformer with nominal 208 volts secondary and special primary taps for obtaining the required voltage. Control of the furnaces was originally recommended to be on an On-Off basis from thermocouple controllers. Subsequent experience by AEC showed the need for closer heat control on some of the furnaces, and the use of autotransformers, resisters, and saturable core reactors was considered as means of control. Saturable core reactors were selected because of smoothness of control and least maintenance and installed in the bronze and four Al-Si furnaces.

Capping and Closure

As one step in design the fuel cap was changed to include the insertion of a steel ball in a hollow cap. This was developed by AM & F as a result of tests conducted at Argonne which facilitated the "Can Assembly Machining" procedure described later. This development is also discussed in a subsequent section dealing with inspection procedures and equipment, "Testing and Inspection". In this connection AM & F also developed a cap assembly machine - a mechanical press for inserting the steel ball at the same time the plug is staked in the cap.

An initial test, by Alcoa, of a die-formed and center welded closure of Al-Si bonded cans indicated no cracking or other apparent adverse effect on the bonding layer, and preliminary closures appeared satisfactory and uniform. Accordingly, effort was continued toward the development of this form of closure of bonded fuel can assemblies.

Subsequent tests (by AM & F) revealed that a slight void remained under the cap in fuel can assemblies closed by die-forming. In the course of the program to develop a satisfactory method of closing fuel cans by die-forming it became evident that the cans could not be held firmly in dies because of can warpage. In this connection, the following alternatives to the use of exact size dies were investigated: (1) steel chuck; and (2) oversized dies into which the can could expand while subjected to die-forming - this latter possibility being contingent upon the damage caused to the bonding layer with forcible expansion of the can.

Investigation of the use of oversized dies produced unsatisfactory results: frost test failures of more than half of the canned assemblies formed, indicating extensive damage to the bonding layers. It was also found impossible to get the formed-over portion of the can tight against the top of the slug despite the application of very heavy pressure. For these reasons, tests on this method of bonded fuel slug closure were suspended.

Experimental spun closure was tried on a few slugs, and the results appeared sufficiently promising to warrant further investigation. The Engineering Research Laboratory obtained special tools developed by the Aluminum Company of America for spinning the can foldover, and ran a series of tests investigating the possibilities of this method of fuel can closure.

Counterboring the top of the can and spinning the resulting peripheral lip down over the can top was accomplished without difficulty. But ERL was unable to successfully plug-weld these closures (see "Welding Closure").

Can Assembly Machining

As a result of developments during the welding investigations and the investigation of fluoroscopic inspection for accurately gauging the cut-off position of the fuel can assembly, AM & F was assigned the task of developing a lathe to cut off, inspect, face and V-groove the caps of fuel can assemblies as successive operations. The following general specifications were established.

1. A cut-off tool to make the initial cap cut-off.

2. A facing tool to do all facing operations simultaneously; a gauge bar mounted in anti-friction bearings in the shank of the form tool, to contact the gauging surface of the cap from which 0.005 in. of metal must be removed.

3. A grooving tool to machine a V-groove between cap and can. A 45° V-groove, 0.050 in. deep, was to be cut in the Al-Si bonding layer between the cap and can wall in order to reduce contamination of the weld bead by traces of bonding metal. This feature constituted an addition to the scope of work first assigned AM & F on this particular project - the result of the ERL welding development program.

The specified procedures were investigated by AM & F from the standpoint of current manual tooling, commercial machinery, and special machinery. Two vendors were found to have methods of doing the job with equal merit and comparable prices. AM & F therefore recommended that other methods under consideration, such as designing a new machine or redesigning a 50 caliber head turning machine, should be abandoned because of the excessive costs involved.

Cap design involved three separate components: (1) a hollow aluminum cap, the base of which was grooved to provide a gauging surface for final cut-off on the lathe; (2) an aluminum plug inserted in the hollow cap to keep Al-Si off the grooved face of the cap in the canning bath; and (3) a steel ball inserted in the plug to keep the cap from floating in the canning bath.

Also, five alternate hollow cap designs were investigated in connection with this project, and tests performed on the following:

1. Replace plug and ball with drive screw;

2. Solid cap drilled with small holes; and

3. Longer plug to eliminate steel ball and reduce air volume in cavity.

It was found that the plug then in use with the hollow cap was unsafe due to the leakage of cleaning fluids into the cavity, with the subsequent blowing out of plugs and the release of nauseous fumes. AED subsequently undertook to correct this problem.

This program resulted in AM & F preparing special functional specifications for incorporation in a commercially available turret lathe, thereby adapting this machine to cut-off, inspect, face, and V-groove the can assembly caps as successive operations.

Welding Closures

The Engineering Research Laboratory of the Development Engineering Division conducted an extensive investigation of welding processes applied to the closure of bonded aluminum fuel cans with the objective of improving existing methods and developing new methods. The bonding process results in a layer of braze metal (Al-Si) between the uranium slug and the can, which also fills the space between the can wall and the cap. When the cap and can are welded together, an undesirably high concentration of silicon from the braze metal develops in the weld bead.

ERL pursued two lines of investigation in its approach to this problem. The first was aimed at improving the circumferential can welding process employed at Hanford. The objective was to minimize the silicon content of the weld bead, thereby reducing the possibility of corrosion between the weld and the cap and can due to the difference in chemical composition. The second was a thorough investigation of the "sigma" plug welding process with the particular objective of determining whether or not it could be adapted for use in closing spun-over fuel cans as well as target cans.

The experiments with circumferential welding resulted in a new closure technique in which part of the braze layer is machined out (V-grooved) and the resulting groove closed or filled by welding. This groove welding technique substantially reduced the amount of silicon at the weld surface. ERL found that groove welding can be accomplished either with or without the addition of extra filler material, but the reduction in silicon concentration in the weld bead is greater when filler welding is used. Owing to the slightly eccentric positioning of the cap in the bonded can, the width of the braze layer between the cap and the can wall

varied considerably. This variation introduced a corresponding variation in the silicon content of groove welds.

It was found that a 45° half V-groove, 0.050 in. deep, gave the most satisfactory results in so far as removal of braze layer, ease of welding, and realization of good quality weld were concerned. The most important requisites for satisfactory filler welding were found to be: (1) proper current and speed of rotating the work; (2) proper rate of wire feed; (3) adequate preheating; (4) proper positioning of the electrode with respect to the groove; and (5) proper orientation, both vertically and horizontally, of the nozzle guide tube on the weld torch.

The material for the tests was supplied by Argonne National Laboratory. The equipment included a lathe for machining the groove, a special welding fixture designed and built by AM & F, with a semi-automatic welding torch, and the power supply with its associated current control and strip chart recording instruments. At the conclusion of the study, the equipment, as finally modified, was dismantled and sent to the Savannah River Plant for installation in Building #313-M. From the experience with the semi-automatic fillerweld machine, ERL concluded that a completely automatic operation could be developed.

However, because successful filler welding was dependent upon the skill of the operator, ERL recommended that groove welding without adding filler metal be employed in the canning process at Savannah River unless the advantages gained by adding filler metal be found essential to reactor operation. This is the method currently employed by Operations in Building #313-M, although testing and evaluation of the fillerweld method is still in progress at SRP.

ERL further recommended that an effort be made to improve the canning process by decreasing both the average thickness and variation in thickness of the braze layer between the cap and can wall.

The second portion of ERL's welding research program dealt with the application of the "sigma" plug welding process to spun-over fuel cans. "Sigma" welding is a consumable-electrode, inert gas-shielded arc welding process. The process is characterized by high current densities on the electrode wire in order to provide adequate arc stability. This results in high rates of metal deposition and makes sigma welding especially suited for high speed welding of relatively thick metals.

However, using commercially available sigma welding equipment, no combination of welding conditions was found

which would produce satisfactory, leak-tight plug welds in aluminum. Excessive weld porosity and intergranular cracking were encountered in efforts to plug weld these closures. Porosity appeared to be related largely to the inherent characteristics of arc initiation. Intergranular cracking was believed to result from the high solidification shrinkage of aluminum, silicon segregation at the grain boundaries, and excessive restraint imposed by the joint design.

On the basis of this study, ERL recommended that consideration of plug welding by the sigma process at Savannah River be discontinued. It was the opinion of the ERL technicians that, even if the sigma process should be so improved as to eliminate the porosity associated with arc initiation, further research on this process should not be undertaken unless the fundamental difficulties arising from the high solidification shrinkage and the excessive restraint of the joint design were resolved.

Testing and Inspection

Observation by AED of the fuel canning technique at Hanford suggested that the operations performed by the marking fluoroscope, the cut-off lathe, and the inspection fluoroscope could be combined in a single operation to achieve the following objectives:

1. Decrease unit processing cost;

2. Reduce slug handling, thereby reducing rejects because of surface mars attributed to handling; and

3. Reduce rejects because of thick and/or thin caps.

A similar proposal had been studied at Hanford and the development of a suitable machine to combine the three foregoing operations had been recommended. Therefore, AED requested Design to proceed with the development of such a machine. Design assigned this project to AM & F.

The purpose of the fluoroscopic inspection and marking of fuel can assemblies at Hanford was to insure that approximately 3/16 in. of the aluminum cap remained with the fuel slug, this part of the cap being welded to the can. It had been known for some time that the fluoroscopic examination did not distinguish between the Al-Si bonding and the aluminum cap. For this reason, the fluoroscope operator was never certain of the exact cap thickness remaining after the cap had been cut away.

Design had suggested that a metal slug be incorporated within the cap, providing a reference point which could be located in the fluoroscope simultaneously with the fuel slug itself. Utilizing this suggestion, the operator would be assured that a given thickness within a tolerance of 0.050 in. remained after the cap had been cut away. However, the uncertainty of 0.050 in. was not acceptable as an over-all tolerance on the job and this proposal was abandoned.

In studying the development of a fluoroscopic means of inspecting fuel can assemblies prior to machining the caps, as called for in the original scope of work, AM & F concluded that an alternate method would be preferable: employing a hollow cap in which a reference point would be located as the cap was being machined. AM & F therefore suggested to Design that by employing a cap in which a hollow section (four radial grooves) machined into the cap lies beneath the cap plug, it would then be possible to use the machined surface exposed when the cap and plug are cut away as a reference point for locating the exact position of the cap and the over-all length of the slug.

AM & F was of the opinion that such a mechanical method of inspection was much superior to the fluoroscopic method as it was more accurate and the inspection could be done on lathes, eliminating inspection in a dark room and marking for cut-off. It was thought that a considerable labor savings would be realized thereby. It was subsequently agreed by all concerned with the problem that a fluoroscope would no longer be considered for use in locating the can assembly cut-off position.

As previously noted, the cap assembly machine and the cutting and tooling lathe required for this inspection procedure were developed by AM & F and placed in operation at the Savannah River Plant.

During the foregoing investigations, AM & F also gave consideration to the application of beamed X-ray equipment developed by Westinghouse and General Electric for locating the cut-off position of a canned fuel slug. These firms advised that such equipment could accurately and rapidly determine the position of the slug and a steel pin inside the cap within 0.002 in.; that these units could be mounted on the cut-off lathe and adjusted so that the operator could position the cut-off tool in relation to a dial meter indicating the position of the steel object in the cap. As noted, AM & F preferred the mechanical method of determining cut-off position. However, negotiations were continued with respect to utilizing beamed X-ray machines for the detection of voids in the bonded area of canned uranium slugs, with

the idea that this equipment could also possibly be used for locating the cut-off position of the slug. Subsequent tests of this equipment gave poor indications of the presence of voids, and the proposals for employing it were rejected by Design.

AM & F then conducted a preliminary investigation of all known test methods to determine whether any might be applied to the location of voids in the bonding area of a fuel can assembly. The American Society of Testing Materials listed twelve methods of non-destructive testing of this nature, of which the following seemed applicable to the problem:

1. Penetration radiation;

2. Ultrasonic inspection; and

3. Thermal inspection.

At the conclusion of the preliminary investigation, AM & F had been unable to locate equipment which could be used satisfactorily to detect voids at the ends of fuel cans.

Eddy-current inspection by means of a cyclograph was evaluated at Argonne as a means for detecting flaws in the uranium slugs and excessive Al-Si penetration of the can walls. As a result of these tests, cyclographic equipment for this purpose was assembled and calibrated at Argonne and shipped to the Savannah River Plant. However, the desired quality control could not be achieved and AED substituted destructive testing for the cyclographic method to determine the extent of Al-Si penetration of the fuel can walls: machining away the can wall on the cut-off and facing lathe, followed by visual inspection; and chemical stripping of the can for a predetermined time and etching to show up any exposed Al-Si.

To inspect the soundness of cap-can welds, X-ray equipment was obtained for installation in Building #313-M. This equipment did not include a work holder, so AM & F was assigned the job of designing and building one or more work holding fixtures - a device for positioning the can assembly cap end against the X-ray machine. However, AM & F was relieved of this project the following month and the work taken over by AED, who at this time had the man power and sufficient facilities to undertake a project of this nature.

The frost test equipment (for detection of unbonded areas between the slugs and cans) and constant temperature bath were completely redesigned for improved accuracy and increased production rates over Hanford equipment.

The autoclaves employed to leak test the welded can assemblies were designed to withstand 300 p.s.i. pressure instead of 125 p.s.i., the designed capacity of the Hanford autoclaves. Design anticipated that this higher operating pressure might be desired in the future, although an operating pressure of 100 p.s.i. was specified. The autoclave piping was subsequently revised to add an overhead water tank and float valve in the supply line to avoid any possibility of contaminated water backing up into the process water system in the event of a slug failure during the pressure test.

Slug Salvage

The Hanford stripping procedure was duplicated in setting up the slug salvage facilities in Building #313-M, as this was the only satisfactory method known for salvaging slugs which were bonded to their cans. Rejected slugs are decapped and the bottoms removed on a standard turret lathe. The slugs, still encased except at the ends, are then placed in a caustic bath and immersed until the aluminum can and all the Al-Si bonding layer are removed - a period of approximately 2-1/2 hours. The stripped slugs are then removed and washed with a cold water spray.

The slugs are next immersed in 10% hydrofluoric acid for one hour, then washed in a tank with cold running water. Finally, the slugs are immersed in a 50% nitric acid solution for 1-5 minutes, or until clean. The acid dip removes the green coloration from the slugs, which is imparted by chemical changes occasioned by the canning processes. After rinsing, the slugs are weighed for weight loss, and those under weight are rejected. They are also dimensionally inspected for warpage. Acceptable salvaged slugs are recanned; rejects are shipped back to the fabrication plant.

35W5 Program

Although originally a function of Building #313-M, the canning of 35W5 slugs was transferred to Building #320-M. This program is discussed in the history of the latter building.

DRAWINGS

W-155420 - Equipment Arrangement Key Plan.
W-155410 - Elevations Sheet #1.
W-155411 - Elevations Sheet #2.
W-155454 - Schematic Service Diagrams.
W-155468 - Diagrams of Systems and Controls.

BUILDING #320-M - ALLOY BUILDING

FUNCTION

The primary function of this building is the production of lithium-aluminum alloy control rods and circumferential blanket rods containing either 3-1/2% or 10% lithium.

PRINCIPAL COMPONENTS

The production of these rods involves seven major operations:

1. Melting the component metals to form the alloy.
2. Casting the alloy into billets.
3. Extruding the billets into rods.
4. Cutting rods to length and straightening.
5. Machining the rods into slugs.
6. Canning the slugs (unbonded).
7. Assembling the canned slugs in rods by encasing them in aluminum tubes and sealing the tube ends.

These operations are performed in the following specific manufacturing areas of the building.

Raw Material Storage Area

Aluminum ingots and sealed cans of lithium are received in this area for storage prior to being charged into the alloy furnace.

Furnace Room

The furnace room houses an alloy furnace, an outgassing furnace, and a sintering station.

The alloy furnace is designed to melt sufficient alloy to cast two 125 to 135 pound billets 27 ft. long by 8 in. in diameter, with facilities for casting three billets by the insertion of a larger crucible in the furnace tank.

The outgassing furnace is used to outgas the graphite molds for 3-1/2% alloy production and can be used for Al billet cans for 10% alloy production, miscellaneous furnace parts prior to a production cycle in the alloy furnace, and 10% alloy slugs prior to canning.

The sintering station is used to prepare the crucible for use in the vacuum furnace.

A 5-ton crane is installed in this room to handle billets, molds, to move the outgassing furnace vacuum retorts from station to station, and for general maintenance work on the furnaces.

X-Ray Room

A separate room is provided for an industrial X-ray unit to X-ray the cast billets for cropping and to detect the possible presence of flaws or voids in the metal.

Billet Machining Room

An air conditioned room was provided in which to machine the billets prior to extrusion. This room contains a 14-in. engine lathe and 250-lb. jib crane and hoist for handling the billets.

Billet Welding Area

This area contains equipment for welding aluminum caps in the 10% alloy cans: (1) an inert-arc type torch with an automatic wire feeder; (2) a motor-driven welding positioner for holding the billet can during welding; and (3) a monorail and 250-pound hand chain hoist for handling the billets.

Billet Storage Area

Both types of billets can be stored in this area prior to extrusion. A monorail, 250-pound hand chain hoist, and billet tongs are provided for handling and conveying the billets to the billet preheating furnace in the extrusion area.

Extrusion Area

In this area the alloy billets are preheated and extruded to rod in a 2750-ton extrusion press.

The extruded rod is received on a run-out table where it is cut into 12-ft. lengths and stored on pallets. A ten-ton crane services the extrusion press and other process equipment.

The 12-ft. lengths of extruded rod are cut into approximately 4-ft. sections on a rod cropping bench. A drilling

fixture drills one end of each cropped rod for the subsequent swaging operation. The rods are then stored on wood pallets.

The 4-ft. sections of rod are heat treated and then straightened within specified tolerances by a rotary swaging machine.

Air Conditioned Process Room

Because of the particular affinity of hydrogen for lithium, the Li-Al slugs are machined, canned, and die formed in a room in which the air is dehumidified.

The rods are cut to slug length and rough machined on two turret lathes. A suitable fume exhaust is provided to remove the objectionable Li-Al dust generated during machining.

Final slug machining consists of a precision cut-off on a 10-in. engine lathe. The finished slugs are then dimensionally inspected with conventional gauging equipment.

Finished Li-Al slugs are inserted into aluminum cans and capped. The canned assemblies are then die sized to the required diameter in a hydraulic press.

Can, Tube and Rod Cleaning Areas

The cans and caps are thoroughly cleaned prior to the slug assembly operation. The cleaning operation is carried out in stainless steel tanks and the cleaned components are then dried by a hot air dryer.

The cans, caps and assemblies are held in stainless steel baskets during the cleaning cycle and moved from tank to tank by means of a 1/4-ton hoist and monorail. Adequate exhaust equipment is provided to remove the fumes and vapors from the tanks.

The canned slugs, aluminum tubes, rod end fittings, and spacers are also cleaned in the same fashion prior to fabricating the finished blanket and control rods. During the cleaning cycle the tubes are handled in a stainless steel basket supported from an underhung bridge crane.

Can Processing Area

As a result of die sizing, variable can lengths are produced, and two 10-in. engine lathes are installed in this

area for trimming off the excess can length. An automatic inert arc welding machine then seals the cap to the trimmed can with a circumferential weld, and a coining press resizes the welded area to within can tolerance.

The canned slugs are then inspected dimensionally and visually. Conventional gauging equipment is used to check the dimensions and a "kerosene bubble tester" is used to determine the soundness of the weld.

The canned slug assemblies are then stored in trays prior to the next operation.

Rod Manufacturing Area

Canned slugs for control and blanket rods are loaded in this area into aluminum tubes which are evacuated and then injected with helium. The tube assembly then is swaged for size, the tube ends trimmed, and the rod ends sealed by welding.

The soundness of the rod welds is determined by means of a helium leak detector (mass spectrometer).

The finished rods are straightened and inspected with conventional gauging equipment prior to cleaning and storage.

Rod pallets and transport carts are provided for intra-building handling of the tubes and rods.

Finished Product Storage Area

Control and blanket rods are stored in "C" rod and "Q" tube transport boxes in this area. A monorail and jib crane with hoist are used to load the transport boxes into trucks for inter and intraplant shipping.

AUXILIARY COMPONENTS

Miscellaneous Storage Area

This area is provided for the storage of tubes, cans, caps, crucibles, billet cans, billet caps and miscellaneous operating supplies. A monorail and hoist is provided for the handling of tube containers from the receiving dock to the allocated storage space. Caps, cans, spacers and tubes are inspected dimensionally in this area.

Administrative Area

Four production offices are provided for the supervisory staff. The offices are air conditioned.

Maintenance Area

This area is provided as an auxiliary service shop for routine plant maintenance work. Major maintenance work is performed in Building #717-A, #700 Area.

Change Room, Washrooms and Lavatories

Washrooms and lavatories are provided to accommodate operations and laboratory personnel. Ten lockers are provided in the washroom for laboratory males. Operating personnel use the change house facilities in Building #704-M.

Laboratory Wing

Laboratory facilities were installed in Building #320-M for the analysis and control of raw materials and process control for both Buildings #320-M and #313-M. These laboratories are housed in a separate air conditioned wing of the building:

Spectrographic (with film room).
Metal Preparation.
Metallography.
Polishing and Etching.
Microscopy.
General Control.
320-M Quantitative Analysis.
313-M Control.
Gas Analysis.
Furnace Room.
Film Process.
Supplies Storage.

Service Area

Beneath the laboratory wing is a service area which houses the electric load centers, air compressors, air conditioning equipment and emergency power unit. A bomb shelter has been provided adjacent to this area for the protection of employees.

BUILDING FLOOR SPACE

Manufacturing Area	Approx. Sq. Ft.
Storage	9650
Furnace Room and Storage	6280
Billet Processing and Storage	1625
Scrap Storage	400
Extrusion Area	8600
Air Conditioned Process Room	1200
Refrigeration Room	600
Canning and Rod Manufacturing	5500
Can and Tube Preparation	2450
Maintenance	30
Offices	630
Lockers and Toilets	1250
Laboratory and Offices	7450
Service Area	7100
Bomb Shelter	1030

BUILDING DETAILS

This building is of Class II construction, of irregular shape, and contains both single and two-story sections. Over-all dimensions are 262 ft. long by 152 ft. wide by 28 ft. high for the manufacturing area. The single-story section of this area is 14 ft. high. The laboratory and service wing of the building is 140 ft. long by 53 ft. wide by 12.5 ft. high.

Total Area	54,742 sq. ft.
Total Volume	881,651 cu. ft.

CONSTRUCTION DETAILS

Foundations - Reinforced concrete with spread footings.
Superstructure
Framing - Structural Steel
Exterior Walls
Process Area: 6 in. cast-in-place concrete to height of approximately 4 ft. above first floor elevation. Above concrete is 1/4 in. flat cement asbestos board. All exterior walls in building have 2 in. of insulation protected in vulnerable sections by 1/4 in. tempered pressed fibre board.
Production Offices: 6 in. cast-in-place concrete to height of approximately 3 ft. above first floor elevation.

Laboratory Wing: 6-in. concrete to 8 in. above first floor.
Service Area: 12-in. concrete to underside of laboratory floor.
Bomb Shelter: 18-in. concrete to 24-in. concrete roof (below grade).

Interior Partitions
Process Area: 1/4-in. tempered pressed fibre board to a height of approximately 4 ft. above floor with 1/4-in. flat cement asbestos board on steel studs above.
Air Conditioned Process Room: 1/4-in. fibre board to a height of approximately 4 ft. above floor, and 1/4-in. flat cement asbestos board above. Interior space of wall contains aluminum foil insulation.
Plant Offices: 1/4-in. fibre board to a height of approximately 4 ft. above floor with glass sections and 1/4-in. flat cement asbestos board.
X-Ray Room: 16-in. thick cast-in-place reinforced concrete walls.
Toilet Room: 6-in. thick concrete to a height of 4 ft. above floor with 1/4-in. flat cement asbestos board above. Interior space ofwall is of 3-in. Fiberglas insulation.

Roof -
Bomb Shelter: 24-in. concrete (below grade).
Air Conditioned Process Room: Cement asbestos corrugated board.
All Other Roofs: Concrete slab with 2-in. insulation.

Ceiling -
Air Conditioned Process Room: 1/4-in. flat cement asbestos board with aluminum foil insulation.

Floors -
Concrete except second floor and mezzanine in furnace area which is 3/8-in. checker plate.

Floor Covering -
Can and Tube Cleaning Room: Acid-proof brick.
Laboratory Wing: Asphalt tile.

Doors -
X-Ray Room: Lead lined hollow metal doors.
Laboratory Wing and Offices: Hollow metal with locks.
Plant Area: Five steel roll-up doors. All other doors of hollow metal.

Sash - Steel.

<u>Heating</u> - Unit heaters are used in the manufacturing area except in the air conditioned manufacturing rooms and furnace room. Fin-tube radiators are

installed in the men's locker room and the viewing room of X-ray section. Forced air through heaters is used in conjunction with the air conditioning system in offices, laboratory and toilets.
Air Conditioning - Is supplied to the billet machine room, air conditioned process room, toilets, laboratories and offices.
Air Exhaust - By roof fans.
Lighting - Fluorescent fixtures are used in the billet process and welding area, maintenance, slug process, canning area, can and tube cleaning, offices and laboratory wing.
Incandescent fixtures are installed in all other areas.

EQUIPMENT

Raw Material Storage

1 - Horizontal band saw.
1 - Bench scale.
1 - Floor scale.
1 - 100 g.p.h. water still.

Furnace Room

1 - Alloy furnace.
1 - Sintering station.
1 - Outgassing furnace.
1 - 5-ton Crane.

X-Ray Room

1 - 250 KVP industrial X-ray machine.

Billet Machining Room

1 - Monorail and hoist.
1 - 14-in. Engine lathe.

Billet Welding Area

Welding equipment and transformer.
1 - Welding positioner.
1 - Monorail and hoist (1/8-ton).

Billet Storage Area

Racks.
1 - Monorail and hoist (1/8-ton).

Extrusion Area

1 - Low frequency induction furnace.
1 - Die heating furnace.
1 - 2750-ton Extrusion press and run-out table.
2 - Circular cut-off saws.
1 - Cropping table.
1 - Rod heating furnace.
1 - Quench tank.
1 - Rotary swage with feed and exit tables.
1 - Jib crane and hoist (1/2-ton).
1 - 10-ton Crane.
1 - 5-ton Hydraulic straightening press.

Air Conditioned Process Room

2 - #3 Universal turret lathes.
1 - 10-in. Engine lathe.
1 - 10-ton Die sizing press.
1 - Monorail and hoist (1-ton).

Can Cleaning Area

1 - Mild steel degreaser.
7 - Stainless steel tanks.
1 - Stainless steel dryer (steam heat).
1 - Monorail and hoist (1/8-ton).

Can Process Area

2 - 10-in. Engine lathes.
1 - 10-in. Engine lathe with hexagon turret.
1 - Die forming press.
1 - Can welding machine and 300 amp. a.c. transformer.
1 - Hand arbor press.
1 - Stamping (can identification) machine.
1 - Kerosene bubble tester.

Tube Cleaning Area

1 - Underhung bridge crane.
1 - Degreaser.

7 - 20 ft. Stainless steel tanks.
1 - 20 ft. Dryer.

Rod Manufacturing Area

1 - Rod assembly table.
1 - Rotary swager with feed and exit tables.
2 - 10 in. Engine lathes with spindle extensions.
2 - Welding torches and 300 amp. a.c. welding transformers.
1 - Helium leak detector (mass spectrometer).
1 - Rod straightening fixture.

Maintenance Area

1 - 1/2 in. Drill press.
1 - 10 in. Carbide tool grinder.
1 - Two-wheel grinder.

Finish Product Storage Area

1 - Monorail, jib crane and hoist (1-ton).

Service Area

2 - Refrigeration compressors and accessory equipment.
2 - 52 c.f.m. Air compressors.
1 - 150 kw. Diesel generator set.
1 - Vacuum pump and motor.

Miscellaneous Storage Area

Steel shelving and work benches.
Inspection equipment.
Monorail and hoist.
Platform lift truck and hand trucks.
Two-ton freight elevator.

Electric Power Supply

Electrical power is supplied by means of a 13,800 volt underground cable from an outside overhead loop feeder and terminates at two 1000 kv.-a. 13,800-480 volt load centers on the Service Floor. Secondary circuit breakers feed various motor control centers and panels throughout the building. One secondary circuit breaker is provided with an electrical operator and overload trip elements to control the extrusion press motor.

Lighting power is supplied through dry type 480/120-208 buses. Emergency lighting fixtures are provided as required for personnel exit. Blackout lighting fixtures are also provided and are supplied from a 150 kw. emergency diesel generator in case of failure of normal power. All lighting except blackout fixtures may be blacked out from Building #720-A, Patrol Headquarters. Complete speaker coverage is provided in the building for the area safety alarm.

Conduits were provided for Bell Telephone wire installation.

PROCESS DESCRIPTION

Alloy Production Preparations

Aluminum is received in specially sized ingots which are sawed in half to fit the furnace charging mechanism. Lithium, a pyrophoric element, is received in sealed aluminum containers which also fit the charging device. These materials are weighed in batch lots large enough to make two billets. It is necessary to vent the lithium cans to prevent their rupture and the resulting splashing of aluminum when they come in contact with the molten metal in the furnace. The cans are punctured just prior to loading them in the charging mechanism to minimize exposure of the contents to the atmosphere.

The 10% Li-Al alloy billets were to be cast in special aluminum cans and sealed for protection against atmospheric attack. The cans and their caps were to be dimensionally inspected, then cleaned by the same method employed for the fuel cans and caps in Building #313-M. They were then to be outgassed to minimize porosity in the cast billets.

The graphite molds in which the 3-1/2% Li-Al alloy billets are cast are both dimensionally inspected and outgassed, the outgassing operation being carried out under a vacuum of 1 to 5 microns at a temperature of 1500 deg. F. for approximately three hours.

The furnace crucible is assembled with an induction coil and held in place with filler material. This assembly is made in a portable framework and placed in a sintering station for thorough drying and removal of any gas-forming substances. Power applied to the induction coil is obtained from the same high frequency motor-generator set that is used for operating the vacuum alloy furnace. This operation requires about eight hours.

Melting and Casting

The aluminum and lithium metals are charged into the furnace from the charging chamber by remote control, melted under vacuum and cast as 125 to 135 lb. Li-Al alloy billets. Melting is carried out in the following sequence.

1. The aluminum is charged in the furnace and melted. The pressure in the melt chamber, which is controlled by a vacuum system, is then reduced to 1 micron.

2. Furnace pressure is raised to 100 microns by the addition of purified argon. Temperature is raised to 750-800° C. and lithium is added.

3. The argon added to the melt chamber is evacuated until the furnace vacuum has been raised to 80 microns. Purified argon is then bubbled through the melt for outgassing and the pressure maintained until melt is completely outgassed.

4. Temperature is adjusted to [redacted] at 80 microns pressure for pouring. The 3-1/2% alloy is poured in water-cooled graphite molds which have been outgassed; the 10% alloy can be poured into water-cooled aluminum billet cans which have been outgassed. The billets can be cooled under vacuum before removal from the mold chamber.

The composition of cast alloy can be controlled by laboratory analysis of the cast billets and melt samples withdrawn from the furnace during operations.

Billet Preparation

After cooling, the billets are X-rayed to determine the depth of piping (for marking cropping position) and the presence of cracks and voids. Acceptable billets are then cropped. The 3-1/2% alloy billets are machined over the entire outside diameter in preparation for extrusion, and the ends are faced.

The 10% alloy billets (none had been cast by January, 1956) will be counterbored at the top of the aluminum billet can and grooved for welding. An aluminum cap will then be welded in the billet can, completely encasing the alloy.

The billets will then be dimensionally inspected and stored.

Extrusion

Billets are transported from storage to the extrusion area by a monorail and hoist. Prior to extrusion the billets are heated in a low frequency induction furnace to a temperature of approximately 850°F. The extrusion press dies are also heated (in a die heating furnace) to billet temperature.

The 3-1/2% Li-Al alloy billets are extruded bare through a shear die into approximately 0.850 in. diameter rod. The aluminum clad 10% billets will be extruded through a 30° cone die into approximately 0.825 in. rod. The cladding of the 10% billet will act as a die lubricant and permits the extrusion of clad rod. The rod is extruded on to a runout table where the rod is cut into 12 ft. sections. The billet butts are cut off and scrapped.

Extruded Rod Processing

The 12 ft. sections of extruded rod are cut into 4 ft. sections and straightened in a rotary swager. The 3-1/2% rod is cold straightened, but it would be necessary to preheat the 10% rod in a muffle furnace to approximately 800°F. before straightening. The rod is then inspected for diameter and straightness.

The rod is then rough machined on turret lathes. The bare 3-1/2% alloy is machined over its entire surface and cut off to slug length - approximately 10-5/8 in.; the clad 10% rod would be cut to slug length of approximately 10-5/16 in.

Final machining of bare slugs is a precision cut-off operation on an engine lathe in which slugs are machined to a length of 10.14 in. The same facilities would also provide the final machining on clad slugs.

These machining operations are conducted in an air conditioned room to minimize hydrogen contamination of the slugs. The 10% alloy slugs would also be outgassed in the furnace room to remove surface hydrogen contamination, and stored in dry boxes until canned, if exposure to the air conditioned atmosphere is likely to exceed 15 minutes.

Canning

The Li-Al slugs are dimensionally inspected before canning, as are the purchased cans and caps. The latter are degreased and cleaned by a Duponal wash, rinsing, 20% phosphoric acid etch, and methanol dip and dryed by hot air.

The slugs are then inserted in the aluminum cans, two caps inserted in the top of each can, and the assembly die sized to assure a snug fit of can to slug. The can serves as a means of preventing exposure of the Li-Al slug to moisture contained in air and provides protection against corrosion of the slug in the reactor. Die sizing the can assembly permits good heat transfer between alloy and aluminum can during irradiation, and controls the diameter of the can assembly within tolerance. As the can tends to elongate during die sizing, the can overhang is trimmed flush with the cap after this operation. The cap is then sealed to the can by a circumferential weld and the weld area is coined flush with the outside diameter of the can. The final dimensions of the canned assemblies are approximately 0.850 in. in diameter by 10.5 in. long. The finished slugs are tested for weld soundness in a kerosene bubble tester.

Unacceptable finished slugs are salvaged by means of a salvage fixture which shears the can ends and slits the can longitudinally, freeing the slug. Such slugs are recanned if undamaged and within dimensional tolerances.

Rod Manufacturing

Control and blanket rods are assembled by inserting the canned slugs in aluminum tubes, closing the tubes with tapered end fittings, evacuating and injecting helium into the tubes, sizing the assembly by rotary swaging, and finally sealing the tubes by welding. The tubes and end fittings are dimensionally inspected and cleaned by the same procedure employed to clean the slug cans and caps. The canned slugs also are cleaned in this fashion prior to assembly.

After cleaning all components, the slugs are loaded in tubes on an assembly table, the end fittings inserted in the tubes, and one end of the loaded tube crimped. The tube assembly is evacuated and then filled with helium prior to swaging. A helium filling mechanism injects this gas into the assembled rod and the assembly is sized in a rotary swager. A feed and discharge table are used in conjunction with these operations to support the rods. Helium is injected to minimize the heat transfer barrier between can and tube, and for the purpose of subsequent testing of end closure welds. As the tube tends to grow during the sizing operation, the tube ends are trimmed to the specified length on lathes following this operation. The ends are then rolled and the seams between end fittings and tube welded with an inert arc welding torch mounted on the lathe.

The rod ends are then tested at a leak detector station (mass spectrometer) to determine the soundness of the welds. Finished rods are inspected for diameter, length, and straightness and straightened by means of a rod straightening fixture, if necessary. Finished rods measure approximately 1 in. (0.940 in.) in diameter by 185 in. in length. Acceptable rods are cleaned and stored in the finished product storage area in "C" rod transport boxes pending shipment to the reactor areas.

Unacceptable rods are cut into can lengths, the outer tube slit by a stripping device, and the cans pushed free. Salvaged cans are reused if undamaged and within dimensional tolerances.

DEVELOPMENT OF DESIGN

Building

General

All of the Savannah River Plant facilities for producing lithium-aluminum alloys are located in Building #320-M. This building was designed as a permanent, long-term installation, with provisions for future expansion of all manufacturing phases. Although it is a Class II structure, safety considerations dictated that the walls around the alloy furnace, the X-ray room, and the bomb shelter should be of heavier construction. Of these three areas, only the bomb shelter is protected from an outside blast. Class I construction was specified for this underground room. The heavier construction specified for the other two rooms was to protect personnel and/or equipment from the operation within the rooms. A 12-in. concrete wall was placed back of the alloy furnace, to protect electrical and vacuum equipment from possible hazardous operation. The four 16-in. concrete walls enclosing the X-ray room protect the operating personnel and building occupants from radiation.

Capacity, flexibility, and expandability were among the major factors affecting building design. It was determined that the most economical and efficient method of setting up this facility would be to design a single structure large enough to house all of the related activities under one roof. Sufficient storage space was required for a six months' supply of raw materials and a three months' supply of finished products. In addition to supplying the Li-Al alloy requirements of the five initial reactors, the possibility existed that additional reactors might be added in the future and that these would require Li-Al control and blanket rods from Building #320-M. As to flexibility,

eleven pile charging schemes were under consideration while this building was being designed. It was, therefore, necessary that the plan and layout selected should be sufficiently flexible to convert to any combination of production arrangements which might be required.

Where the nature of the process was likely to result in corrosion of normal construction materials, special resistant materials were specified. In this connection, acid proof brick with furane resin cement binding was specified for installation on the floor in areas where acid cleaning is employed.

Provisions for Expansion

It was anticipated that expansion within the building would most probably be required in the air conditioned process room. To provide for this, space was left in the extrusion and can processing areas so that the walls of the process room could be moved in either direction.

If further expansion should be required, building design incorporated provisions for the addition of another bay along the west wall of the extrusion area, process room, and canning area.

In the event of increased production demands, space was allocated in the can cleaning area for the installation of another cleaning line if required.

Design Changes

It was originally intended that the canned Li-Al slugs produced in Building #320-M would be assembled into control and blanket rods in a separate building designated as Building #306. However, it later became apparent that this phase of the process could be carried out more effectively in the building in which the canned slugs were produced. Design of Building #320-M was changed therefore to provide space for rod assembly equipment and storage space for the aluminum tubes and finished product.

In designing the alloy furnace room, bays were provided for the future installation of additional alloy furnaces. However, process developments subsequent to the completion of the layout determined that this extra space would be required for the outgassing furnace. This left no room for the future installation of additional alloy furnaces, but it was determined that production requirements could be met by increasing the number of production shifts and providing for the addition of a larger melting chamber in the installed alloy furnace.

The particular affinity of hydrogen for lithium presented certain building design problems. These related to the establishment and maintenance of conditions under which certain machining operations could be performed without grossly contaminating the Li-Al alloy materials with normal atmospheric hydrogen. At first it was thought necessary to conduct the various lathe machining operations in an inert gas atmosphere by utilizing dry boxes. However, as process requirements developed, it became apparent that closely controlled humidity and temperature conditions would be acceptable substitutes for dry box operations. Therefore, design of the building was modified to provide for the inclusion of air conditioning facilities to maintain a relative humidity of 35% and a temperature of 75°F. in the slug canning area. This was later extended to the billet machining operation. The laboratories in this building also required air conditioning for operational purposes and since the laboratory wing was near the building offices air conditioning was extended to this area.

Safety Provisions

Various safety considerations deriving from the nature of the contemplated production processes presented problems in building design.

Fire Control

The furnace room and chemical cleaning room were equipped with special fusible link, self-closing fire doors to seal off these areas from the rest of the building in the event of fire originating in either area.

Furnace Shielding

The alloy furnace was provided with reinforced concrete shields to serve as baffles in the event of a furnace explosion. Initially the probability of explosion while alloying lithium-aluminum was not considered great, but subsequent experience indicated that the probability of explosion during this process posed a potential hazard greater than originally anticipated. During process development, the possibility developed for the future need to alloy lithium with magnesium. This combination of elements presents more possibilities for explosion than does the lithium-aluminum alloy. Therefore, the shielding was designed to afford adequate protection in the event either type of alloy was produced. Also, to reduce and control any such explosion, the flanged head of the furnace was

designed to lift at 15 - 20 p.s.i., thereby venting the force of a furnace explosion into the immediate area.

X-Ray Shielding

Concrete shielding was designed for installation around the X-ray room for the protection of personnel against radiation.

Ventilation

The building areas in which the product components are cleaned for processing contain tanks holding volatile liquids. The fumes for these solutions are either noxious or irritating and must be exhausted outside the building. Such areas were designed to be well ventilated and exhaust hoods were furnished to draw off the fumes through ducts.

In the areas where the Li-Al alloy is machined during the various fabrication stages, the same ventilation considerations were observed since the Li-Al dust produced by the lathes is irritating to the eyes and nasal passages.

Shelter

An underground blast-proof personnel shelter was included in this building, adjacent to the service basement. Employing Class I construction, it was designed to accommodate the personnel from both Building #320-M and Building #313-M.

Process and Equipment

General

The process and equipment employed in Building #320-M were designed to produce lithium-aluminum rods to be employed in the #100 Area reactors for two purposes: (1) to control the reaction, and (2) to produce tritium by the transmutation of lithium. Two types of alloys were specified, one having a lithium content of 3-1/2% by volume, the other containing 10% lithium by volume. Initial production considerations called for the fabrication of control rods from the 3-1/2% alloy for use in either plutonium, or combination tritium-plutonium, producing reactors. It was intended that both control and circumferential blanket rods would be fabricated from 10% alloy for pile chargings designed to increase the tritium production rate. In

designing these alloy production facilities it was assumed that lithium alloys would continue to be employed as reactor control rods, and that all five reactors might eventually be charged as combination tritium-plutonium producers.

In designing the manufacturing facilities it was assumed that only lithium-aluminum alloys would be produced and processed. However, the ability to convert the process to other lithium alloys (such as lithium-magnesium) was a factor in the design and selection of equipment.

The primary function of this facility at plant start-up was the production of 3-1/2% alloy control rods for the plutonium producing reactors. However, the requirements for the production and fabrication of 10% Li-Al alloy were basic considerations in the specifications for equipment installed in this building.

If lithium alloys are exposed to normal atmospheric conditions, the surface of the alloy becomes contaminated with the hydroxide - the degree of such contamination being dependent upon the lithium content of the alloy and the degree of exposure. This type of contamination during the melting process results in billet porosity. Surface contamination of the alloy during fabrication or storage impedes the ultimate tritium extraction. The problem of contamination, therefore, was a major complication which had to be resolved before satisfactory lithium-aluminum alloys could be produced in quantity.

Prior to the start of development work for the SRP alloy facilities, the 3-1/2% alloy had been produced in small quantities and had proven to be a fairly ductile, easily extruded metal possessing a relatively low reactivity with hydrogen or water. However, less was known about the 10% alloy. Experimental work demonstrated that it was brittle, difficult to extrude without a protective sheath, and that it possessed a greater degree of reactivity with hydrogen or water than the lower alloy.

In designing equipment for Building #320-M, therefore, it was necessary to design for the production and fabrication of materials having differing characteristics, since it was anticipated that, eventually, the 10% lithium-aluminum alloy might ultimately be the primary product of this building.

Numerous organizations contributed to the development of the alloy production facilities, with design responsibility being shared by the American Machine & Foundry Company for fabrication equipment and the National Research Corporation for melting and casting equipment. Research conducted at Argonne National Laboratory in behalf of the

alloy program resulted in the development of much valuable design data respecting both alloy production and fabrication. The U.S. Army Air Force Manufacturing Methods Pilot Plant at Adrian, Michigan, and the Aluminum Company of America were instrumental in the development of extrusion data, while the latter organization also conducted a considerable amount of research in machining and canning the alloy slugs. Various vendors provided valuable design assistance and a number of other organizations conducted limited research programs in support of the Li-Al alloy project.

Over-all design responsibility was assumed by the du Pont Engineering Department Design Division on behalf of the du Pont Explosives Department - Atomic Energy Division. The Design Division utilized the facilities of the du Pont Engineering Research Laboratory for specialized research relating to the canning of the alloy. The Development Engineering Division of the du Pont Engineering Department administered the work done under the American Machine and Foundry contract.

Where uncertainties developed with regard to selection of process equipment, these were resolved with AED Operations, American Machine & Foundry and the Design Division, usually by the decision to install only sufficient equipment to provide start-up capacity. Future expansion beyond the initial installation would then be based on experience gained during the start-up operations.

Melting and Casting

Prior to the development of the melting and casting facilities installed in Building #320-M, production of lithium-aluminum alloys had been carried out only on a small scale in available equipment not well adapted for continuous vacuum operation. However, experience with such equipment established several requisites for incorporation in the design of the proposed new production-scale equipment.

Based on experimental Li-Al alloy melting and casting operations conducted at Argonne National Laboratories, it was found imperative that these operations be performed in a manner that would remove gaseous impurities, such as hydrogen and water vapor, from the raw materials charged into the furnace and prevent these impurities from reentering the alloy billets. The most feasible methods of accomplishing this appeared to be through the use of high vacuum or a combination of vacuum and argon atmosphere melting and casting. It also seemed evident that a stream of argon through the molten charge aided in degassing the melt.

It was concluded that a vertical bottom-pour crucible was not acceptable as a production unit because of mechanical difficulties encountered with the stopper mechanism. Therefore, it was decided that a tilting pot furnace would be adopted. Past experience indicated that a particular clay-bonded graphite crucible (Dixon C-7) would be the most suitable available melting pot, and that induction heating was a satisfactory method of melting the raw materials. But corrosion tests on other possible materials for crucibles and launders were instituted at the du Pont Engineering Research Laboratory for the purpose of developing longer lasting equipment where contact with the molten alloy was involved. However, it developed that the life of Dixon C-7 was not the determining factor in the continuous vacuum operation. Therefore, a change in material became less attractive.

In previous melting operations, considerable difficulty had been encountered with the loss of lithium due to its volatility in the molten state. This presented a problem affecting the regulation of the lithium content of the cast alloy which had to be resolved through further research. To overcome this lithium loss, it was proposed that cyclic melting be investigated: degassing by vacuum, then pressurizing the melting chamber with argon after the addition of lithium to molten aluminum.

After degassing and agitation to form a homogeneous melt, the molten charge would then be poured directly into molds of suitable size to form extrusion billets. The design and construction of the molds would be dependent upon the composition of the alloy being cast - 3-1/2% or 10% Li-Al. In order to provide a sheath of aluminum necessary for the extrusion of a 10% alloy billet, and at the same time to protect these billets from hydrogen and moisture contamination, it was proposed that the molten charge of this alloy be cast into aluminum cans.

Since it was anticipated that eventually the 10% Li-Al alloy might be the primary material processed in Building #320, it was necessary that the melting and casting equipment be designed to produce both this alloy and the less difficult 3-1/2% alloy.

Design and fabrication of the melting and casting equipment was delegated to the National Research Corporation (NRC), an organization with considerable experience in vacuum techniques and equipped to conduct the necessary research on Li-Al alloys, preliminary to specifying the conditions required for continuous vacuum operation on a production scale. The essential problem in the National Research Corporation program was to determine the procedure

by which an aluminum alloy containing 10% lithium could be prepared in high purity form, particularly with respect to hydrogen content (less than 1% by volume), with close composition control, and in the form of aluminum clad billets free of internal porosity.

NRC carried out preliminary research in a small capacity vacuum furnace. On the basis of this research, which incorporated the basic design considerations previously noted, a tentative procedure was established for use with a production capacity furnace. An experimental melting program was then carried out on this scale in order to: (1) produce some large billets of 10% Li-Al alloy for fabrication and testing; and (2) obtain design information required for the construction of a production furnace suitable for producing the billets in quantity.

This test melting program resulted in National Research Corporation recommending the following techniques as the most promising melting procedure from the standpoint of speed and reproducibility.

1. Melt and outgas aluminum under high vacuum.
2. Raise pressure in furnace by the addition of purified argon.
3. Make desired lithium addition and melt in.
4. Pump down (raise vacuum).
5. Remove hydrogen by bubbling purified argon through the melt.
6. Pump down to still higher vacuum and hold until melt completely outgassed.
7. Raise pressure by addition of purified argon to melt chamber.
8. Adjust temperature to [redacted] and pour melt into molds.

Pressures specified throughout the melt cycle were in the range of [redacted] microns.

Design of the SRP alloy melting and casting equipment was accordingly undertaken on the basis of the operating requirements established by the National Research Corporation research program. Although NRC carried a large portion of the design load, considerable design data was developed through experimental work performed for this

program at the Argonne National Laboratory. Operating experience at Hanford also provided additional design data for this equipment.

Furnace

Due to the high average dew point existing in the SRP area it was necessary to design the furnace with three vacuum chambers - charging, melting, and casting - each one valved separately so that a vacuum can be maintained continuously in the furnace. The chambers were constructed of stainless steel and connected by 10-in. lines and gate valves. A vacuum pump system and a motor generator for 3000 cycle power supply for induction heating completed the major furnace components.

The furnace was designed to melt sufficient alloy to cast two 125 lb. billets, with facilities provided for casting three 125 lb. billets by inserting a larger crucible. A mechanism was developed for charging weighed quantities of the constituent metals by remote control in order to maintain furnace vacuum during charging operations.

The mold chamber was designed so that three billets can be cast without breaking the vacuum on the chamber. Water-cooled graphite molds were specified for the 3-1/2% alloy. Contamination and extrusion considerations resulted in the decision to cast the 10% alloy in aluminum cans, these cans to be capped after removal from the mold chamber.

Preparations

The aluminum billet can and cap cleaning process was developed by du Pont and is essentially a duplication of the can and sleeve cleaning procedure employed in Building #313-M, the necessary equipment having been sized to handle the larger items cleaned in this building.

An outgassing furnace was designed to remove hydrogen from the billet cans and the graphite molds into which the molten alloy is poured, as well as the furnace launders through which the melt flows. This step was incorporated in the process as a means of minimizing billet porosity and reducing the operating cycle of the alloy furnace. The outgassing operation involved the design of a resistance furnace with removable muffle for cooling, to operate at a temperature of 1500°F. under high vacuum (1-5 microns) for approximately three hours. Design specifications were developed by du Pont based on data developed by the National Research Corporation and from previous du Pont experience with vacuum systems and furnace equipment.

AM & F designed and fabricated a rack to contain three billet cans and miscellaneous ceramic launders during the outgassing operation. These items are loaded in the rack and lifted into the vacuum crucible by a pin rack grab.

Inspection

AM & F supplied the specifications for conventional calipers and gauges for the dimensional inspection of billet molds and cans prior to casting.

A 250 KVP industrial X-ray unit was specified for determining the depth of billet piping (to mark cropping position) and the presence of cracks and voids in cast billets.

Billet Preparation

At first, a guillotine shear was specified for cropping the billets, and AM & F instituted the development of such a tool. However, this plan was canceled in favor of using the simpler power hack saw.

Several lathe machining operations are required to prepare the cropped billets for extrusion. Specifications were developed for a commercially available 14-in. engine lathe, with tooling specified and procured by du Pont, to perform the following operations on a single machine:

1. Machine 3-1/2% billets over the outside diameter to 8 in. diameter and face ends; and

2. Counterbore top of 10% billet cans and groove in preparation for welding aluminum cap in can to completely encase the alloy (as protection against hydrogen and water vapor contamination).

Because of the weight of the billet (approximately 125 lbs.) mechanical handling equipment is necessary to accomplish the foregoing operations. A monorail and 250 lb. capacity jib crane and hoist were specified for this purpose.

As a result of lithium-aluminum dust generated by the machining operations, it was necessary to install ventilating facilities to remove this irritating dust from the lathe area.

Due to the extreme affinity of the 10% Li-Al alloy for hydrogen, it was at first thought that the billet machining

would have to be conducted in either an inert gas atmosphere or in dry boxes installed around the lathe. This consideration stemmed from the nature of the cladding of the 10% billets at this stage, in that the top end of each billet remained exposed to hydrogen contamination. Subsequent evaluation showed such an arrangement to be impractical but controlled humidity within the area appeared to offer a satisfactory alternative. Accordingly, a unit air conditioner was specified to maintain the atmosphere in the billet machining room at 35% relative humidity at 75°F. This provision was not required for machining 3-1/2% alloy billets, although air conditioning is utilized in these operations as it is available.

A procedure was developed for welding aluminum caps in the machined tops of the 10% billet cans in an adjoining welding area, which is not air conditioned. AM & F developed a billet dry box in which to transport the machined 10% billets to the welding area - essentially, a container from which moisture has been largely removed. After removal from the dry box, the cap was to be welded in the can immediately. An inert arc welding torch with a standard commercial filler wire weld attachment was procured to seal caps to billet cans with a circumferential butt weld. A motor-driven welding positioner was procured to hold the billet in position during the welding operation. A monorail and 250 lb. hand chain hoist were specified to handle the billets during this operation.

Extrusion

It was known that Li-Al rod could be extruded in conventional extrusion presses using various types of dies, depending upon the alloy composition. Tests showed that 3-1/2% alloy could be extruded satisfactorily within the temperature range of [redacted]. but that temperatures of [redacted]. and extrusion ram pressures of [redacted] were required for the 10% alloy. Billet heating facilities therefore were required to obtain controlled temperatures.

Experimental extrusion of 10% billets indicated that hydrogen contamination of the bare extruded rod was many times that of aluminum-clad rod. It was also determined that aluminum cladding is essential as a die lubricant during the extrusion of 10% alloy. Therefore, it was decided that the 10% alloy should be cast in aluminum cans (previously noted under "Melting and Casting"). When billets so cast are extruded, the can casing provides the necessary lubricant and the resulting rod is aluminum clad and therefore much less vulnerable to surface hydrogen contamination.

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However, extrusion problems continued. These related primarily to the cladding where blisters appeared in the aluminum sheath of the extruded rod or there was excessive sheath thickness or a gradual sheath thickness tapering from front to back of the extruded rod. These problems were resolved, eventually, by further experimental extrusion runs in which various combinations of temperatures, pressures, and dies were employed to determine the optimum extrusion conditions for the production of satisfactorily clad 10% Li-Al rod.

On the basis of results obtained during the Alcoa extrusion research program with 10% alloy billets, it was concluded that reduction ratios of approximately 100 to 1 produced the best rod from the standpoint of surface quality and straightness. These results dictated the size of the billets to be extruded 27 in. long by 8 in. in diameter.

Considerable scrap is accumulated during extrusion, primarily from the butt of the billet which is cut from the final extruded rod. As this butt has a high impurity content, it was decided that it would not be advisable to reuse such scrap in the melt cycle. Therefore, Li-Al scrap is accumulated for resale.

Press

The selection of extrusion press capacity was governed by the 1500-ton pressure required to extrude 10% alloy billets at temperatures in the range of 700-900°F.

A commercially available 2750-ton extrusion press, complete with extrusion tools, was selected and somewhat modified for use with both the 3-1/2% and 10% alloy billets. Although a smaller press would have been satisfactory for the 3-1/2% alloy billets, final selection was governed by the properties and requirements of the 10% alloy.

Dies

It was determined through tests that a shear die was preferable for the extrusion of bare 3-1/2% alloy billets, while a 30° straight-cone die gave best results on the 10% alloy billet. Since it was necessary to heat both dies to billet temperature, a standard box-type 12 kw. electric furnace was selected for this operation.

Billet Heating Furnace

A commercially available low frequency induction coil heating unit, rated at 107 kw., was specified for preheating the billets to a temperature of approximately 850°F. This method, rather than batch furnace heating, was selected for the following reasons:

1. Ease of temperature control;
2. Preheating of furnace eliminated; and
3. Heating time per billet held to a minimum.

Run-Out Table

AM & F developed the design specification for an extrusion press run-out table which would:

1. Keep the extruded rod straight while in the plastic condition;
2. Hold the extruded rod during extrusion;
3. Cut the extruded rod to 12-ft. lengths; and
4. Handle the hot extruded rod without bending or other damage.

The essential elements of the run-out table assembly are a multisection table for attachment to the press and two cut-off radial saws. Various methods of performing the operations were investigated and tested, and certain components originally specified as part of the design were eliminated as unnecessary. Flying shears to cut the rod while in motion and thereby permit continuous extrusion press operations were studied. Such a device posed a number of developmental problems, so it was abandoned in favor of the simplicity and proved result of the radial saws.

Rod Processing

AM & F designed and fabricated a rod cropping bench and drilling fixture for cropping the extruded rod to specified lengths, deburring both ends and drilling a hole (for subsequent swaging) in one end of the cropped rod.

Heat Treating

Previous experimental work at Hanford had indicated that it was necessary to heat treat the 3-1/2% alloy rod in order to produce a single phase, alpha-solid solution - which is retained when the alloy is quenched in water. This single-phase material reduces the hydrogen pick-up, thereby facilitating the ultimate extraction of tritium. AM & F conducted tests on resistance vs. induction heating and, on the basis of tests recommended resistance heating. Therefore, an electrically heated muffle, air recirculating type resistance furnace with recording and controlling pyrometers was specified to heat the cropped 3-1/2% alloy rod for one hour at a temperature of approximately 550°C. Following this heat treatment the rod is quenched in water. Specifications for this furnace were prepared by du Pont based on commercially available equipment.

This heat treating procedure was followed during the early stages of Building #320-M operations, but was subsequently abandoned as unnecessary - with the provision that it may again be employed in the future.

Straightening

It is necessary to straighten the extruded sections of rod within specified tolerances before machining. A number of recognized methods of performing the straightening operation were considered, such as bench, roll straightening, rotary swaging and stretch straightening. It was known that the 3-1/2% rod could be straightened cold because of its good ductility. However, the 10% rod was found to be relatively brittle at room temperature, with ductility increasing in proportion to the increase in temperature.

A rotary swager was specified for straightening both the 3-1/2% and 10% rod because of initial cost considerations and the ability of this machine to achieve rod diameter control. It was proposed that the muffle furnace specified for the 3-1/2% rod heat treatment should be used also to preheat the 10% alloy rod for straightening. Conventional dial indicators and dial snap gauges were specified for inspecting the processed rod for straightness and diameter. A gap press was also provided to make minor and spot corrections in straightness during the inspection operation.

Machining

Two commercial turret lathes were specified for rough machining both the 3-1/2% and 10% alloy straightened rod to

slug length, and for finishing the 3-1/2% rod over its entire surface. This finishing operation was developed to fix an approximately consistent rod diameter within the tolerance limits and to remove the accumulated surface hydrogen contamination.

The bare alloy (3-1/2%) machining operation involves turning the diameter for a distance of 10.5 in. and cutting off to length. AM & F investigated the possibilities of a hollow mill turret lathe machining method in this connection, with the idea that it would accelerate production and eliminate the final machining operation. However, tests along these lines indicated that considerable development work would be required before it could be applied to the process. It was intended that the clad alloy be rough machined to slug lengths of approximately 10-3/16 in.

Final slug machining is a precision cut-off operation to remove the drilled end of each slug, both type slugs being faced to a final length of 10.14 in. Two commercial 10-in. precision engine lathes were specified for this operation. Conventional gauges and dial indicators were specified for dimensionally inspecting the finished slugs.

Initially, the Li-Al slugs were specified to be machined to a nominal length of 8 in., the same length as the uranium fuel slugs. However, the outward similarity of canned uranium and Li-Al slugs of identical length presented an identification problem to the #100 Area Operations personnel. In order to facilitate positive identification of all canned material stored under water in the #100 Areas, the length of the Li-Al slug was extended to its present dimension at the request of AED.

Although it was conceded that the best way of preventing hydrogen contamination during the foregoing operations was to conduct them in a dry box, there were too many disadvantages and uncertainties to justify the installation. Therefore, an air conditioned process room to maintain relative humidity at 35% and temperature at 75°F. was provided in which to conduct the machining and subsequent canning and die-sizing operations.

Slug Outgassing and Handling (10% only)

After rough machining to length, it was intended that the 10% clad alloy slugs be outgassed to remove surface hydrogen. This outgassing operation would be performed in the outgassing furnace discussed under "Melting and Casting - Preparation", in which the 10% alloy billet cans and the 3-1/2% alloy molds are outgassed.

AM & F designed and built a prototype mechanism, to handle 10% slugs during the outgassing operation, consisting of the following components: three slug racks, three slug rack containers, and a rack container handling device. The slug racks received the slugs after rough machining (133 slugs per rack). Cylindrical slug rack containers were designed with rotating covers and a gas line connection for purging the containers with inert gas when loaded racks are in storage. The rack handling device transferred loaded racks into the outgassing crucible, and from the vacuum crucible after outgassing to the rack containers.

Other methods and equipment were considered in the approach to this problem but final selection was based on simplification of design and construction.

In order to store Li-Al slugs in a manner which would prevent moisture from contacting the surface of the slugs as they are transferred to and from the lathes, a dry tote box was developed by AM & F. Various designs were investigated before a box suggested by du Pont which utilized slug cans as containers for the individual slugs was finally selected. There is little moisture left in the can in the tote box after the slug is inserted, as the air in the area is controlled to a relative humidity of 35%. After the slug is inserted, the can is then capped with a rubber cup to prevent air from entering. Other designs, such as vacuum and inert atmosphere arrangements were discarded as too costly or impractical.

AM & F fabricated ten of these tote boxes for shipment to SRP. However, these are not utilized in handling 3-1/2% alloy slugs.

Blackness Tester

AED requested Design to develop an instrument for inspecting Li-Al rods and slugs for lithium concentration, to be installed in Building #320-M for use in the routine control of the process and inspection of the finished product. It was proposed that this be accomplished by measuring the neutron absorption of the alloy while passing the rod or slug between a neutron source and an ionization chamber.

The purpose of this inspection was to determine if the lithium concentration of the specimen was within the specified range throughout its length. It was expected that the composition of the extruded rod might vary continually from one end to the other, and a means was desired for determining what portion of the rod fell within

the specified concentration range. It was further intended that the finished canned slug assemblies would be passed through this device.

This problem was assigned originally to AM & F but was canceled and du Pont undertook the final development. An instrument, known as a "blackness tester", was developed, but it was found that the rod had to be inched through the instrument in order to obtain a reliable reading. This time lag, together with some other unsatisfactory characteristics of the device, resulted in the decision to discontinue its use.

Except where otherwise indicated, specifications for all of the foregoing rod processing and inspection equipment were developed by AM & F. Commercial lathes, a rotary swager, and a preheating furnace meeting the specifications developed were procured from outside vendors. AM & F designed and built all lathe tooling.

Canning

Preparation

The cans and caps are cleaned by the process developed by du Pont for cleaning these same components in Building #313-M. The handling equipment was modified to accommodate the larger Li-Al slug cans which are inspected dimensionally with conventional gauging equipment for which specifications were developed by AM & F. The can diameters and wall thickness, as procured, were specified to be sufficiently oversized so that the can wall is reduced during subsequent die sizing, producing a tight fit with less than 0.002-in. clearance on the diameter.

Assembly and Die Sizing

AM & F designed and fabricated a cap inserting fixture prototype, but it was not utilized since it was found that the caps could be inserted more efficiently by hand.

In order to produce a tight fit between slug and can, and to insure good heat transfer between the Li-Al alloy and the aluminum can during irradiation, a die sizing operation was specified for the canned slugs. Initially it was proposed that the can be shrink-fitted to the slug by preheating the can to 500-600°F. and inserting the slug and cap into the can at room temperature. However, subsequent experimental canning investigations by AM & F and Alcoa indicated that die sizing was preferable to shrink-fitting as a means of obtaining a tight fit.

A commercial 10-ton hydraulic sizing press meeting specifications developed by AM & F was selected for die sizing the canned assemblies. The die sizing press tooling was designed and fabricated by AM & F.

As noted previously, it was decided that the most feasible means of minimizing surface hydrogen contamination during the machining and canning stages was to conduct these operations in an atmosphere of controlled humidity and temperature. The assembly and die sizing equipment, therefore, was installed in the air conditioned process room.

Can Processing

Trimming

Variable can lengths are produced as a result of the die sizing operation, as the cans tend to elongate. The dimensional overhang of the can wall past the slug cap must therefore be trimmed to a predetermined length to insure uniformity in the subsequent can closure operation. Two standard 10-in. engine lathes, specifications for which were developed by AM & F, were installed in the can processing area for this purpose. AM & F designed and built tooling for these lathes whereby the cans could be machined for two types of closure, either "formed over" or circumferential. The tooling in both cases consists of a locating gauge and a trimming tool bit mounted on the engine lathe.

Can closure technique (subsequently discussed) as it would apply in actual operations was to be determined on the basis of experimental work in progress on both "formed over" and circumferential closure. Should the former method be decided upon, it was specified that the can length should be trimmed to allow a 3/8-in. overhang beyond the slug cap. Should circumferential closure be adopted the can would be trimmed flush with the outer surface of the cap. In this event the can is completely prepared for welding, and no additional machining operations are required.

Closure

The development of a practical can closure procedure was particularly troublesome. Two methods were investigated in detail: (1) circumferential welding, which had been successfully employed at Hanford - and had been adopted for sealing fuel slugs in Building #313-M; and (2) die forming the top of the can over the slug cap and welding a small

area in the center. Experimental work on both methods was conducted by AM & F, Alcoa, and the du Pont Experimental Research Laboratory to develop a satisfactory can closure which could be welded with a minimum chance of leakage.

A considerable amount of attention was devoted to die forming, as it presented two main advantages over the circumferential welded closure: (1) smaller weld area, and (2) removal of weld from area of high stresses. Research conducted on both canned Li-Al and uranium slugs demonstrated that a formed over closure could be accomplished by a five-step operation employing dies to: (1) curl the can overhang; (2) draw the curled metal in toward the cap; and (3) flatten the can wall extension against the cap. The aperture formed is then drilled and reamed and an aluminum button inserted in the hole and sealed by welding. The problems encountered with the formed over Li-Al can closure were essentially the same as those noted in connection with the formed over uranium can closure program discussed under Building #313-M, "Process Development - Capping and Closure".

AM & F developed specifications for such a die forming press and designed and fabricated the required press tooling. Du Pont procured a commercial press (Berger) meeting these specifications and the press and tooling were installed in Building #320-M. However, Operations was given the choice of either die forming or circumferential welding to accomplish can closure. Operations chose the latter method, a proven technique also employed in Building #313-M to seal fuel cans.

To permit the adoption of the circumferential weld closure technique, an additional aluminum cap is inserted in the can (making a total of two caps per can) in order to obtain the required can thickness at each end. The die sized can is then trimmed flush with the outer surface of the upper cap, leaving no can overhang. The cap of the machined can assembly is sealed to the can with a circumferential weld.

Welding

The welding equipment employed was developed under the Building #313-M development program. A detailed account of this is contained in the history of Building #313-M, "Development of Process and Equipment - Welding Closures". AM & F modified two commercial welding machines and sent one of these to the du Pont Engineering Research Laboratory for further tests, and retained the other at AM & F for the same purpose. The tests conducted by both ERL and AM & F indicated that satisfactory circumferential welds could be

obtained with this equipment on both bonded fuel cans and unbonded Li-Al cans - although it was anticipated that Li-Al can closure would be accomplished by die forming followed by center plug welding.

AM & F supplied no welding equipment for Building #320-M but developed two welding processes for sealing Li-Al canned assemblies. Initial studies were begun on circumferential closures pending final development of the die forming process necessary to produce formed-over closure can assemblies. These studies established a 0.040-in. double cap design as providing the best closure and was recommended as an alternate process. A series of tests involving various alternative methods of plugging the reamed aperture of formed-over closures established that the critical problems in welding such closures were outgassing and heat balance. A knurled button (aluminum plug inserted in the aperture) was proposed as a solution and a formal test program was instituted by ERL to evaluate can assemblies welded in this fashion.

A formed-over closure machine was developed and installed. However, before all the start-up difficulties were solved, Operations chose the circumferential closure because of production demands and the fact that it was an acceptable process. As a result, the welding machines in Building #320-M are identical to those in Building #313-M.

Simultaneously, with the work done at AM & F and ERL, outside vendors were engaged to provide facilities for tests on filler wire welding and spot welding of formed over closures and other processes for circumferential closure.

Finishing

In order to trim weld bead overhanging the outside diameter of the can, an arbor press with upper and lower coining dies was selected on the basis of operational simplicity. This press was also specified for finishing formed-over cans, but for a different reason: to remove the slight can bulges at the top and bottom of the cans which are a consequence of the pressure applied to the can in the die forming press.

AM & F developed equipment for finishing cans with formed-over closure, previously referred to under "Closure". This equipment consists of a commercial 10-in. lathe, equipped with a hexagon turret mounting tools to drill and ream a 0.375-in. diameter hole in the aperture, and a plug inserting fixture to insert an aluminum plug in the reamed hole. Since the lathe offered spindle and tool alignment

advantages, it was decided to mount a special fixture on the hexagon turret to insert the plug rather than to employ a separate press. These operations would precede the welding of the plug in formed over cans. The tooling was designed and fabricated by AM & F, specifications were developed for the lathe, and the complete assembly was installed in the can processing area in Building #320-M. However, the subsequent decision to close the cans by circumferential welding obviated the use of this equipment.

Inspection

In order to detect leakage of the canned assembly because of cap weld defects, it was proposed initially that a small volume of helium be injected into the can. After welding, helium trapped within the can would escape through any cracks or voids in the weld, such helium seepage being detected by means of a mass spectrometer. However, this approach presented the rather complex problem of retaining the helium in the can prior to welding. Therefore, work along these lines was abandoned and the simpler technique of kerosene bubble testing was adopted.

The kerosene bubble tester subjects canned assemblies to high vacuum (1 micron) while submerged in kerosene and detects weld leaks by observation of bubbles rising from the welded surface. Based on a similar device used at Hanford, AM & F developed and built a prototype horizontal bubble tester which offered certain advantages over the vertical bubble tester employed at Hanford: extraneous bubble evolution was decreased and mechanical handling somewhat simplified. A control arm developed for the horizontal tester permits the operator to suspend the can under test in vacuum prior to submergence in kerosene, an operation which vacuum-cleans the can surface. This step resulted from findings which indicated that exposure of the can to high vacuum prior to submergence in kerosene tended to free trapped air from the can surface; this surface air, if not removed, tended to form bubbles in the kerosene which obscured the bubbles evolved by leaks in the welded section of the can. This prototype was installed in Building #320-M.

AM & F specified conventional gauging equipment for the final inspection of canned assemblies for diameter, length, and straightness.

Identification

To identify every individual can assembly which passes inspection, a six-digit serial number is impressed into the

bottom surface of each. AM & F specified the following equipment to perform this operation: (1) a pneumatically operated, bench mounted, automatic steel stamping machine of commercial design; (2) a holding fixture for positioning the can assembly in line with the press ram, equipped with switches to electrically actuate air valves for operating the ram; and (3) a six-wheel hand indexing number and letter holder.

Mechanical presses were found to be unable to produce good stamped impressions on can assemblies which varied in length as much as 1/16-in., so a pneumatic press was selected. Production requirements were considered too great for manual stamping.

Salvage

In order to salvage the Li-Al slugs from rejected can assemblies, a fixture was developed by AM & F to free the slug from the can. This machine is essentially a pneumatic press with a can slitting fixture and a manually operated shear to remove the top and bottom ends of the can prior to slitting. The decanned slugs are received in a chute attached to the salvage machine.

The application of a commercial press was considered, but it was found that available presses which would accommodate the can assembly for vertical slitting were of much greater tonnage than was required for this operation. Consideration was given to machining the can ends from the assembly before slitting the can in the press, but the operating speed of the shear arrangement was found to be satisfactory. The shearing and slitting method of salvaging the slugs was selected as the most desirable means of accomplishing this operation on the basis of performance, cost and reliability. A prototype was designed and fabricated by AM & F and installed in Building #320-M.

Rod Manufacturing

AM & F developed the process and equipment to assemble, size, evacuate, helium fill, and finish the ends of blanket and control rods. The scope of work required that AM & F design and build any special equipment necessary to perform these operations, and specify any commercial equipment available. The equipment was designed to handle tubing and rods from 3/4-in. to 1-in. outside diameter and up to 210-in. in length. The purpose of these operations is to provide leak-tight Li-Al rods of suitable length for insertion in the reactor.

Preparations

Aluminum tubes are first inspected for outside diameter, wall thickness and straightness by inspection equipment specified by AM & F. The tubes and end fittings then are cleaned by the same process employed to clean the slug cans and caps except that the cleaning tanks are 20 ft. long to accommodate the long tubes. AM & F designed and fabricated a tube and rod cleaning basket and handling fixture of sufficient length to hold 20 empty tubes or assembled rods during the cleaning cycle. A tube and rod handling cart and rod pallets were designed for handling and storing these items.

The canned slugs also are cleaned prior to insertion in the aluminum tubes using the same process and equipment employed to clean the cans and caps.

Rod Assembly

The conception of this operation was basically one of loading the components into tubes in preparation for helium filling and sizing. For this purpose a rod assembly table, a long narrow structure to which the various components are secured, was developed. A "V" trough equipped with a length gauge was provided at the front end of the table for over-all length adjustment of the component parts to be assembled in the tube: 16 canned Li-Al slugs per tube, with top and bottom end fittings. Pneumatic clamps were located in back of the "V" trough to hold the tube during assembly and to crimp one end of the tube. A manually operated loading ram is positioned in line with the clamped tube to facilitate the insertion of the can assemblies. A second length gauge, affixed to the table, was provided for use in conjunction with the loading ram to check the component length after assembly. A transfer shelf was located in back of the clamps to receive the loaded tube assembly for transfer to the rod swager feed table.

Helium Filling and Swaging

This operation was specified in order to provide a tight fit between the canned slugs and the tube and to envelope the intervening space with a helium blanket to minimize the heat transfer barrier. Two methods of sizing were investigated: draw bench and rotary swager. Developmental work on draw bench sizing was conducted by the Trojan Tube Company of Newark, New Jersey and the Aluminum Company of America, as well as by AM & F.

The rotary swager was selected as the preferable means of performing the sizing operations for the following reasons: (1) use of a lubricant during sizing not required; (2) occupies less space than a draw bench; (3) better delivery schedule; and (4) considerably less expensive. Service and finishes obtained with the rotary swager compared favorably with those obtained with a draw bench, and tests performed by AM & F at the vendor's plant demonstrated that the rotary swager would not crack or damge the Li-Al alloy during the sizing operation.

AM & F conducted a helium filling development program to determine the feasibility of filling assembled rods with helium both before and after sizing. The program demonstrated that it would be necessary to insert helium into the assembled rod before sizing.

Therefore equipment was designed to helium fill and size blanket and control rods as integral operations. This equipment was developed around a commercial rotary swager and consists of the following attached components: a rod feed table; a rod discharge table; a helium filling mechanism; and a can restraining device.

The feed table, located in line with and adjacent to the end feed side of the rotary swager, is a long narrow structure equipped with a series of pivot-mounted rollers for supporting a tube assembly.

The can restraining device is mounted on the feed table and travels the length of this table. It is a double acting, double ended pneumatic cylinder, with a hollow piston rod and a collet chuck attached to one end of the cylinder. The collet receives and clamps one end of the tube assembly while the pneumatic piston rod exerts a constant pressure against the component parts of the tube assembly as it is pulled through the rotary swager.

The helium filling mechanism consists of a vacuum system, a helium supply system (cylinder), and a control panel. It is located at the front end of the feed table and is connected to the can restraining device to provide air for operating the pneumatic piston rod, and for evacuating the tube assembly and filling it with helium.

The discharge table is located in line with and adjacent to the out feed side of the rotary swager. It is a long, narrow structure equipped with grooved rollers for supporting and guiding the tube assembly as it is drawn through the rotary swager. A gripper mechanism is fastened to a feed chain mounted on the discharge table, the end of the tube assembly bottom end fitting being engaged by a collet and the tube assembly pulled through the rotary swager.

Rod End Finishing

This operation is required to trim the tube to the specified length after swaging, and then effectively seal the canned slugs in the tube by welding the seam between the top and bottom end fittings and the tube.

Several approaches were made to the problem of finishing the rod ends and sealing the tube with leak-tight welds. A form of pressure welding was considered and tested, but did not prove successful because sufficient pressure could not be obtained to completely seal the rod joints. Various configurations of end fittings were tried to facilitate ease of welding. A jury rig welding machine was used for experimental welding from which specifications were developed for the equipment installed in Building #320 for this purpose.

Two machines were developed, one for top end and one for bottom end finishing. Each machine comprises the following components: a commercial 10-in. precision engine lathe; lathe spindle extension; lathe tooling; welding torch with support; and a modified welding transformer.

A sized tube assembly is placed on the support rollers of the spindle extension and pushed through the lathe spindle. The end fitting is then properly positioned for machining. The excess portion of the aluminum tube is first cut off, then the tube is rolled and trimmed. After these machining operations the seam between the end fitting and the tube is inert arc welded. After welding the rod is removed from the machine and an end cap placed over the welded end. The rod is next moved to the second rod finishing lathe and the other end of the rod finished by the same process.

Leak Detection

After welding, the welds are leak tested at a helium leak detector station. Adaptors connect the rod ends with a vacuum system and a helium mass spectrometer. If helium within the rods seeps through the welded areas, this is detected by the mass spectrometer.

Several methods of rod leak detection were studied, among them: (1) helium mass spectrometry; (2) bubble testing; and (3) high pressure testing. Theoretical analysis and test data indicated that helium mass spectrometry provided a superior test because of the high degree of sensitivity of the mass spectrometer, and the over-all reliability of this method.

The rod helium leak detector station, as finally selected, is a table-type structure to which various components are fastened. Four rod end adaptors on top of the table provide a vacuum seal below the rod end welds. These adaptors were designed and fabricated by AM & F. A pump was mounted on the bottom of the table to evacuate the gas between the end welds and the mass spectrometer. A vacuum gauge indicates the vacuum pressure in the system, and piping and valves transmit the gas around the outside of the end welds to the mass spectrometer. The mass spectrometer has its own vacuum system and electrically analyzes the gas sample flowing through the system.

Inspection and Straightening

A rod inspection and straightening fixture was developed to inspect the over-all length and straightness of the finished rods, combining both inspection equipment and a straightening device.

Several approaches to the straightening problem were considered. Commercial straightening presses were investigated but it became apparent that available equipment would not be suitable considering the small forces required for straightening the rods. A test rig was prepared and tests conducted on the principal of rotary straightening. This approach was discontinued because, in the judgment of du Pont, the expense of the attendant design and development program necessary to produce a satisfactory device of this nature could not be justified. A layout was prepared for a straight-edge straightening fixture and a study made regarding the reduction of operator fatigue and waste motion. However, this plan was rejected because of the physical difficulty of operation.

The selected design combined features of a commercial press and straight-edge fixture, as such an arrangement was simple to fabricate and permitted inspection and straightening to be performed in the same location.

The inspection and straightening fixture chosen is a fabricated steel structure to which various components are fastened. A length gauge is located on one side of the fixture to indicate the over-all length of rods. A straightening device located in the center of the fixture allows for the inspection and straightening of rods in two-can lengths. Manually operated presses straighten rods by straining the rod tubing between the adjacent canned slugs. Guide rollers support and guide the rods during the straightening operation and inspection. A conveyor and surface beam assembly is located at the other side of the

fixture for inspection for localized out-of-straightness, this being indicated by a light beam visible between the rod and the finished surface of the surface beam assembly.

Identification

Each rod assembly is identified with a serial number stamped in the surface of the tube. The procedure and equipment developed for this purpose are similar to those developed for the identification of Li-Al canned slug assemblies. See "Can Processing - Identification".

Salvage

A can salvage shear and slitter press was developed to salvage canned slug assemblies from rods rejected because of processing flaws. This mechanism is a fabricated press frame structure consisting of the following components: a "paper cutter" type shear operated by a pneumatic ram fastened to the top of the press frame; a receptacle located below the slitter assembly to receive the salvaged slugs; and adjustable supports to hold and guide a rod assembly while it is sheared.

Rods are cut into can lengths by the shear. The cutters longitudinally slit the tube of the sheared can lengths. The pneumatic ram then pushes the cans from the slit tube into the receptacle. Salvaged cans are inspected and re-used if undamaged.

Two other approaches to the salvage problem were considered. One involved the application of a commercial tube cutter to separate the rod assemblies into can lengths. This required a gauging stop around the cutter so that the rod would always be in cutting position at the juncture between cans. The other alternative involved pressing the cans out of the tube with an arbor press. But tests indicated that galling occurred between the can and tube when the cans were pressed out in this fashion.

The design selected was simpler and quicker than the other methods evaluated and permits the freeing of cans undamaged by the salvage process. The cutting position, to shear the rod into can lengths, is determined visually.

35W5 Program

Initial design plans for Building #320-M also included the development of processes and equipment for assembling a

special material, designated as 35W5 slugs, into rods. These slugs, measuring 0.852-in. in. diameter by 6.00-in. in length, were to be supplied by another AEC facility. They were to be canned in Building #313-M and transferred to Building #320-M for assembly into rods. The 35W5 program anticipated charging these rods into the #100 Area reactors and shipping the irradiated components to another AEC installation for further processing.

The processes and equipment necessary to can and assemble the 35W5 slugs were developed in conjunction with the primary processes and equipment for Buildings #313-M and #320-M. But production of these items was suspended after sufficient rods for only one charging had been produced.

As the canning of 35W5 slugs was initially designated as a function of Building #313-M, investigations of the processes and equipment required to perform this function originally were conducted as Building #313-M developmental work. The scope of the 35W5 program, however, was limited as compared with that of the uranium slug canning program, and the 35W5 slugs were not to be bonded to the cans. Whereas the unbonded Li-Al slugs to be canned in Building #320-M were to be assembled into rods in the same building, the uranium slugs to be canned in Building #313-M were not to be assembled into rods. For these reasons it became evident that Building #320-M was more adequately equipped to handle both the canning and rod assembly of 35W5 slugs. Therefore, both of these processes were subsequently designated as Building #320-M functions and the entire 35W5 program transferred to this building.

Although quantity production of 35W5 rods was never attained, facilities and processes were developed for quantity production in anticipation of a continuing demand for such rods. The 35W5 slugs were smaller than the Li-Al slugs (6-in. in length as contrasted with 10-in.+) and the characteristics of the alloys differed. The 35W5 alloy is quite soft and brittle and requires gentle treatment to avoid cracking. Whereas 16 canned Li-Al slugs are required for a full rod assembly, a 35W5 rod assembly contained 22 slugs. But essentially, the processes by which the 35W5 slugs were canned and assembled into rods were simply size variations of the Li-Al canning and rod assembly processes. In order to utilize the same basic equipment used in processing Li-Al slugs, AM & F supplied the following tooling adapted to the size of the smaller 35W5 slugs:

1. Can sizing press tooling;
2. Can trimming lathe tooling;
3. Can assembly welding machine tooling;

4. Rod assembly table tooling;
5. Rod swaging tooling;
6. Rod trimming and welding tooling;
7. Rod leak detector tooling; and
8. Rod inspection tooling.

AM & F supplied a kerosene bubble tester for testing the welds of canned 35W5 slugs, essentially the same device provided for testing the welds of canned Li-Al slugs. The identification equipment provided for cans and rods was also the same type installed for stamping serial numbers (five digits instead of six) on the Li-Al components.

The salvage technique as applied to the 35W5 cans differed from the Li-Al counterpart. Both ends of the 35W5 cans are machined off on a lathe and the machined assembly placed in the salvage fixture developed for Li-Al cans. The slug is then pushed out by the pneumatic ram without previously slitting the can wall. Slitting the can assembly longitudinally as in the case of Li-Al cans was initially tried, but it was found that the cutters left deep impressions on the surface of the slugs. The "push out" method of salvage was selected because no damage to the slugs resulted from this technique.

Although the 35W5 production program did not materialize as originally anticipated, establishing the process and providing the special tooling necessary to utilize such a process consumed a considerable amount of development time.

Building #777-M Rods

Another limited function of Building #320-M was to supply Li-Al rods for the experimental reactors installed in Building #777-M. The only difference in the rods produced for these reactors was that some were only half loaded - 8 canned slugs per tube instead of 16. Otherwise the processes involved in producing a limited quantity of rods for Building #777-M are identical to those employed to manufacture production reactor rods.

DRAWINGS

W-155573 - Floor Plans, Sec. A.
W-155574 - Floor Plans, Sec. B.
W-155575 - Floor Plans, Sec. C.
W-155577 - Elevations, Sheet 1.
W-155578 - Elevations, Sheet 2.
W-155589 - Equipment Arrangement Key Plan.

PERSONNEL AND SERVICE FACILITIES

BUILDING #701-1M - GATE HOUSE

FUNCTION

A security check point, control of vehicular and pedestrian traffic, and a place to issue and process Health Physics personnel badges at the entrance to the #300 Area are provided by this facility.

PRINCIPAL COMPONENTS

These operations are performed in two buildings. One is a small sentry-box located on an island between the two traffic lanes and designed solely for traffic control. The other, larger building is equipped to handle two lanes of pedestrian traffic and to issue and process Health Physics badges.

BUILDING FLOOR SPACE	Approx. Sq. Ft.
Health Physics badge processing	120
Guard room	120
Sentry-box type gatehouse	16

BUILDING DETAILS

These are both one-story, Class III buildings, the small motor traffic gate house being approximately 4 ft. square by 9 ft. from the floor to the top of the roof slab. The main building is 30 ft. by 10 ft. by 9 ft. from the floor to the top of the roof slab, which extends 2 ft. to form a protective overhang on all four sides. The total area of the two buildings is 315 square feet and the total volume is 3150 cubic feet.

CONSTRUCTION DETAILS

Both buildings have reinforced concrete foundations and structural steel framing with open-web roof joists. Roofs and floors are concrete slabs. Flat cement asbestos board sheathing is used on both exterior and interior walls. The exposed underside of the roof slab forms the ceiling. Doors are hollow metal and sash is double-hung steel. Roofing is built up and insulation is installed in exterior walls and roofs. Heating in both buildings is furnished by electric heaters and lighting is incandescent.

EQUIPMENT

Water cooler.
Work bench.
30 kv.-a. Transformer.
Badge processing equipment.
Conventional office furniture.
3 - Electric heaters, 2, 4, and 5 kw. capacity.

DRAWING

W-156115 - Plans and Elevations.

BUILDING #701-2M - GATE HOUSE

FUNCTION

This gate house controls vehicular and pedestrian traffic at the entrance to Buildings #305-M and #777-M.

PRINCIPAL COMPONENTS

The structure is of the small sentry-box type with turnstiles regulating pedestrian traffic to Buildings #305-M and #777-M.

BUILDING DETAILS

This is a one-story, Class III structure with a total building area of 20 square feet and a total volume of 203 cubic feet.

CONSTRUCTION DETAILS

Erected on a reinforced concrete foundation with wall footings, the building has fire resistant wood frame walls and roof, and roof sheathing. Exterior walls, and interior walls and ceiling are finished with flat cement asbestos board. Roofing is built-up, and exterior walls and roof are insulated. The floor is concrete. Heating is provided by an electric heater and lightingis incandescent.

EQUIPMENT

2 - Turnstiles.
1 - 2 kw. Electric heater.
Stool.
Clock.

DRAWING

W-156161 - Plan, Elevations, Section and Details.

BUILDING #701-3M - GATE HOUSE

FUNCTION

This building provides security control facilities for vehicular and personnel traffic entering the southeast corner of the #300-M Area.

PRINCIPAL COMPONENTS

It is a single story, one room gate house with a counter and badge racks. The building is 13 ft. wide by 15 ft. long and approximately 9 ft. high. The flat, built-up roof extends 2 ft. beyond the side walls to form a protective overhang. The floor space is approximately 195 square feet.

CONSTRUCTION DETAILS

The foundation is reinforced concrete with wall footings. The building frame is wood and exterior walls, interior walls and the ceiling are covered with flat cement asbestos board. The walls and ceiling are insulated. The floor is a 4-in. concrete slab. Windows are double hung sash and doors are wood with a glass top panel. Heat is furnished by unit heaters and the lighting is incandescent.

EQUIPMENT

7.5 kw. Heater.
2 - Badge racks.
Costumer.
Stool.
Clock.

DEVELOPMENT

This facility was added to the scope of work, fence and road installations were redesigned and revised in the southeast corner of the #300-M Area to permit entrance of personnel generally to the #300 Area and separately to Building #777-M, to provide an emergency entrance for vehicles, and access means for trailer deliveries. In addition, adequate means for personnel evacuation from the area is achieved, the time lost by technical personnel getting to work from more distant parking lots is reduced, and better observation conditions are afforded for guard patrol.

DRAWINGS

W-161161 - Plans, Elevations and Details - Sheet 1.
W-160673 - Details and Sections - Sheet 2.

BUILDING #704-M - OFFICE AND CHANGE HOUSE

FUNCTION

As the area administrative headquarters, this building provides office facilities, a conference room, locker rooms and lunch rooms for the operating personnel.

PRINCIPAL COMPONENTS

There are five offices, a conference room which may be divided by a folding partition, lunch rooms accommodating ninety-six persons, locker, shower and toilet facilities for two hundred and fifty employees, a uniform storage room and a utility room housing the heating and ventilating equipment.

BUILDING FLOOR SPACE	Approx. Sq. Ft.
Offices	760
Conference room	810
Office toilets	350
Operators lunch room	1000
Laborers lunch room	370
Operators locker room	2600
Laborers locker room	350
Mechanical utility room	645

BUILDING DETAILS

A single story, Class III, L-shaped structure, one wing is approximately 41 ft. by 81 ft. and the other is 43 ft. by 100 ft. Both wings are 13 ft. high from the floor to the top of the flat roof slab. Total building area is in the range of 7700 square feet and the volume is 109,550 cubic feet.

CONSTRUCTION DETAILS

Foundations are of reinforced concrete with spread footings. The building has a structural steel frame with web roof joists and a flat concrete roof slab on rib lath. Exterior walls, interior partitions and the interior of exterior walls are sheathed with flat cement asbestos board. Toilet room walls are concrete to a height of 4 ft. with flat cement asbestos board above this level. Shower room walls are ceramic tile to a height of 7 ft. The ceiling is suspended and finished with flat cement asbestos board throughout the building, except in the utility room, which is left open to the roof. Doors are hollow metal and sash is steel, either projected or double-hung.

Roofing is built-up and exterior walls and roof are insulated. The concrete floor slab is covered with quarry tile in the operators shower room and with asphalt tile in the office section and the operators lunch room.

Offices and office toilets are heated by fin-tube type radiators. Heat is furnished to the conference room and lunch rooms by forced air through heaters in conjunction with an air conditioning system for these rooms. The locker rooms are heated by forced air through heaters and ductwork. The steam source for these services is the #700 Area power house. Air is exhausted by fans through ducts from the locker rooms, office toilets, and the office corridor. Fluorescent lighting fixtures are installed in the offices and conference room, with incandescent lighting in other sections.

EQUIPMENT

Offices

Conventional office furniture.

Conference Room

Facilities for 50 people. Folding partition.

Operators Lunch Room

Nine tables with seats attached for 8 people each.
Refrigerator, sink, hot plate and table.
Electric water cooler.

Laborers Lunch Room

Three tables with seats attached for 8 people each.
Refrigerator, sink, hot plate and table.
Electric water cooler.

Locker Rooms, Etc.

Operators - 226 lockers, benches.
Laborers - 24 lockers, benches.
Uniform Room - metal shelving.

Utility Room

15 kv.-a. Transformer.
Air conditioning and heating equipment (included under Heating and Ventilating).
Hot water tank.

Heating and Ventilating

3 - Air conditioning units, self-contained; 5-, 10- and 15-ton capacity, respectively, and ductwork.
1 - Indoor cooling tower, 30-ton capacity, with auxiliary equipment.
1 - Unit ventilator with heating coils, 2900 c.f.m. capacity, and ductwork.
5 - Exhaust fans from 500 to 1200 c.f.m., and ductwork.

DEVELOPMENT OF DESIGN

Design for this building was established on the basis of its function and expendability. Fire resistance was a desirable factor, but this, coupled with expendability, required care in the selection of materials to permit friability rather than missile danger in case of a bomb burst.

DRAWINGS

W-155379 - Floor Plan.
W-155382 - Elevations and Sections.

BUILDING #710-2M - STORAGE BUILDING

FUNCTION

This building provides space for the dry storage of lithium prior to its use in Building #320-M.

PRINCIPAL COMPONENTS

The structure is composed of a single, one-story room approximately 14 ft. wide by 19 ft. long and has 266 square feet of floor space.

CONSTRUCTION DETAILS

The foundation, with spread footings, is of reinforced concrete supporting a 4-in. concrete floor slab on compressed fill. The frame is of structural steel with exterior walls sheathed with flat cement asbestos board. The peaked roof is sheathed with corrugated cement asbestos board and there is a weatherproof metal louver at each gable end. A single tin-clad door at one end of the building and a double tin-clad door at the other end give access to the storage room. In order to prevent possible accidental combination of lithium and water and the resultant hazard, the concrete floor is covered with 1/4-in. steel plate to reduce moisture absorption by the concrete.

DEVELOPMENT OF DESIGN

The possible hazard of explosion, should lithium be accidentally combined with water, made it necessary to provide storage space for the canned lithium in an area well apart from other buildings.

DRAWING

W-161172 - Arch. & Elec., Plans, Sections, Elevations, and Details.

BUILDING #777-M - PHYSICS ASSEMBLY-LABORATORY

FUNCTION

This building contains a "zero power" process development pile (PDP) which is a full scale nuclear mock-up of the heavy water moderated producer piles. It provides the means to study in detail the operation and performance of production type units with easy access and complete safety for personnel. Advanced pile designs can also be explored and evaluated in the PDP.

This building also includes a standard pile (SP) to: (1) provide a flux of neutrons for calibration of foils and instruments used with the PDP; (2) determine cross sections and/or danger coefficients of samples; and (3) serve as a primary standard for health monitoring instruments and for maintaining standards of nuclear quality control.

An exponential tank with a flexible lattice operated in conjunction with the SP permits study, under reactor conditions, of various types and sizes of fuel elements.

PRINCIPAL COMPONENTS

A reactor wing and a laboratory wing are arranged in an L-shaped plan.

Reactor Wing

Process Development Pile Area

This area comprises the following components.

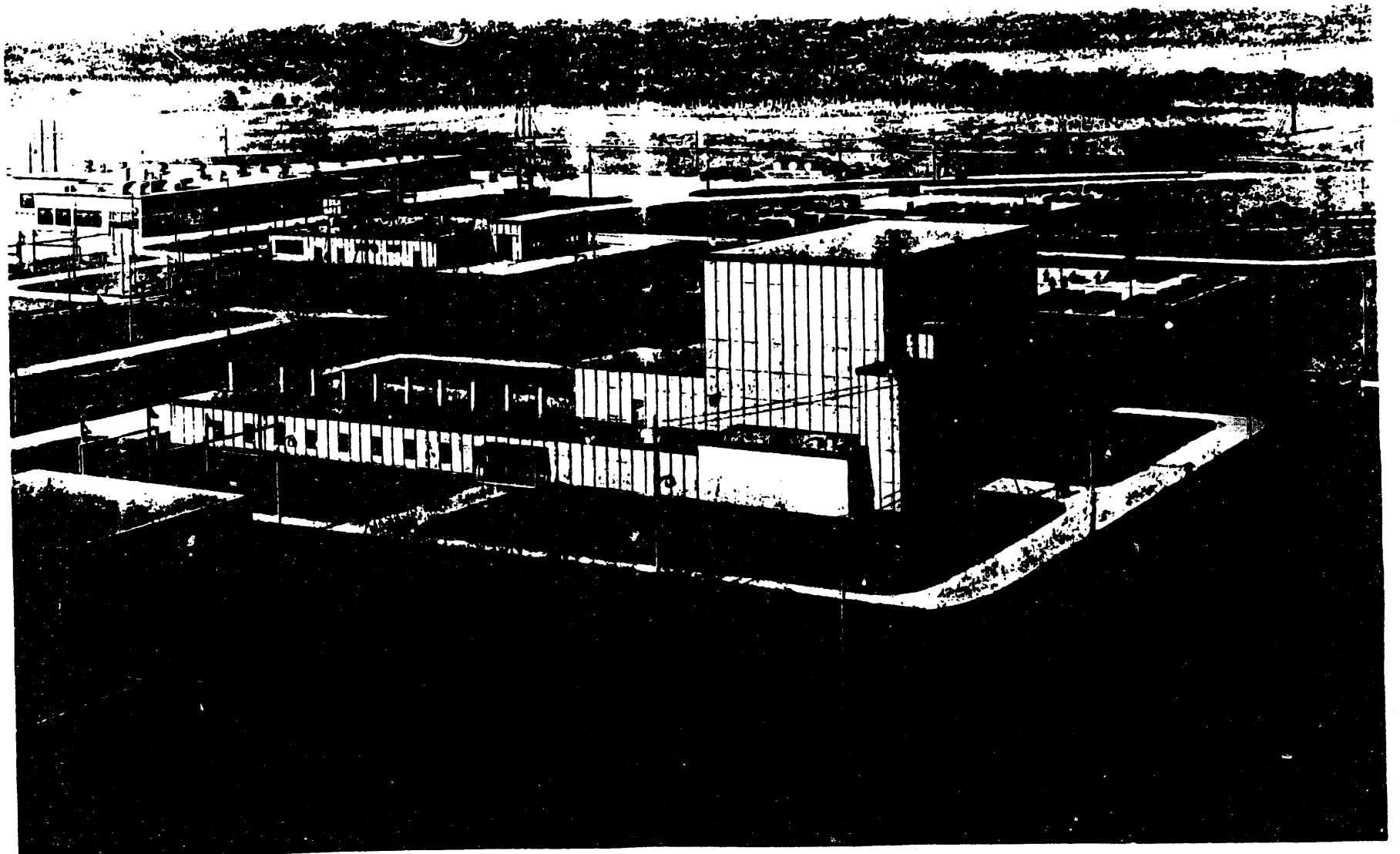
1. Moderator Storage Tank Area at -37'-3" together with process piping and valves.

2. Sub Basement Experimental Area at -28'-3".

3. Basement Experimental Area at -15'-3" level on which reactor tank is located. This area also contains the moderator recovery facilities.

4. Basement Service Area at -15'-3". Electrical controls, control rod drives, and emergency power equipment are located at this level in a shielded area.

5. Main Floor Experimental Area at 0'-0" level where reactor top is located. This area also contains the moderator loading and unloading station and storage for control rods.



BUILDING #777M--- PHYSICS ASSEMBLY LABORATORY

6. PDP Control Room at 0'-0" level, contains reactor control instrument panels located behind shielding wall.

7. Mezzanine Area at +13'-1" contains moderator purification equipment and reactor vent, plus walkway.

8. Fan Room at +13'-1" contains the heating and ventilation equipment for the reactor area.

9. Upper Floor Experimental Area at +27'-0" level provides access for loading reactor and handling experimental fuel samples. Sheave racks for cable operated rods as well as safety rod drive motors are also mounted at this level.

10. Upper Floor Storage Area at +27'-0" contains racks for storage of vertical elements for reactor plus access for fuel elements into assembly and disassembly area. The experimental and storage areas are serviced by a motorized bridge crane, operated from the 27'-0" level.

Assembly Area

Fuel loadings are assembled and disassembled for both the PDP and SP. In this working area which is shielded from the reactors the following components are included in the basement (-15'-3") level.

1. Vault for critical material storage.
2. SP assembly area.
3. Compressor room for refrigeration facilities.
4. Elevator equipment room.

The main PDP assembly equipment is located at the 0'-0" level, together with storage racks for loaded fuel tubes which are hung from steel frames at +16'-0" level. A covered loading dock and elevator serve this area. Also included adjacent to this area are the PDP Operations office and the building Accountability office.

Standard Pile Area

The standard pile, purchased as a complete package unit, is housed in this area which includes:

1. The SP experimental room at -15'-3" level.
2. The upper experimental room at 0'-0" level which contains a 1-ton bridge crane hoist.

3. SP Nuclear Physics laboratory at -15'-3" level where test instruments are mounted.
4. SP Control Room, housing the control instrument panels.
5. SP Operations office.

Laboratory and Office Wing

This is a one-story wing over a full basement.

Basement

Service Room for air conditioning.
Service Room and hood vent fans and service piping.
SP Beam Room (exclusion area) for neutron beam tests.
Balance Room for sensitive weight determinations.

Main Floor

7 - Offices.
3 - Laboratories - Chemical, Mechanical, Electronics.
Dark room.
Counting room.
Instrument repair shop.
Health Physics room.
Lunch room.
Men's Locker room.
Men and Women's toilet facilities.
Janitors' closet.

BUILDING FLOOR SPACE	Approx. Sq. Ft.
Total	53,900
Reactor Wing	
Offices	915
Laboratories	730
Control Room	1,890
Experimental Areas	19,395
Vault	325
Service Areas	7,525
Truck Loading	200
Laboratory Wing	
Offices	1,345
Laboratories	3,565

Beam Room	1,065
Balance Room	175
Rest and Locker Rooms	570
Service Areas	7,465

BUILDING DETAILS

Class - III

Size

Area - 18,843 sq. ft.
Volume - 946,541 cu. ft.

Building is ell-shaped. One leg of this ell is approximately 52 ft. by 146 ft. and the other 83 ft. by 129 ft. Building has a partial sub-basement (under Process Development room) and a full basement.

CONSTRUCTION DETAILS

Foundations - Reinforced concrete mat footings under PDP sub-basement and standard room. Reinforced concrete spread footings under remainder of building.
Superstructure - Reinforced concrete for PDP and standard room. Structural steel frame, open web roof joists for remainder of building.
Reinforced concrete roof slab on steel beams over high bay and standard room, concrete roof slab on rib lath on remainder of building.
Exterior walls - Flat cement asbestos board on steel girts.
Interior partitions - Prefabricated metal partitions for all laboratories, flat cement asbestos board on steel studs for locker room, toilet rooms and offices.
Interior of exterior walls - Flat cement asbestos board on steel studs in office and process areas, metal lining on laboratory area.
Ceilings - Suspended ceilings in laboratory wing and standard control room and operations office. Flat cement asbestos board perforated with sound absorbent insulation in Rooms 110, 111, 112, 119, 120, 121, 122, 123, 124, 125, 126, 131 and 134, flat cement asbestos board without perforations and sound absorbent insulation in Rooms 113, 114, 115, 117, 118, 127, 128, 129, 130, 132, 133, 135, 136, 201 and 203.
Doors - Hollow metal.
Sash - Steel - double hung.
Roofing - Built-up.
Insulation - Roof and exterior walls.

Floors - Concrete and steel plate.
Floor Covering - Asphalt tile generally.
Personnel Facilities - Have been provided for a maximum of seventeen men, five women and two janitors.
Lighting - Fluorescent lighting is used in all laboratories and offices except the counting room and dark room. Incandescent lighting is used throughout the remainder of the building.

Heating, Air Conditioning and Ventilation

Laboratory Wing

Laboratories, corridors, offices, beam room and balance room are air conditioned. The counting room is maintained at a constant temperature and relative humidity year-round.

The toilets, change rooms and the entire service floor, with the exception of the beam room and balance room, are heated and ventilated.

Total air conditioning capacity in the Laboratory Wing is 135 tons.

Process Wing

The following areas are air conditioned: the PDP room, standard room, vault, nuclear physics laboratory, standard assembly room and passage, standard control room, standard operations office, accountability office, process development operations office, process development control room and process development assembly room.

The elevator machinery room, compressor room and fan room are heated and ventilated.

All heating is accomplished by forced warm air. Total air conditioning capacity in the Process Wing is 225 tons.

EQUIPMENT

Reactor Wing

PDP Moderator Handling and Circulation System

2 - 13,000 gal. Horizontal aluminum tanks.
2 - 500 g.p.m. Submerged vertical s/s pumps.
1 - 75 g.p.m. Submerged vertical s/s pump.

600-lb. Printweigh scale with roller conveyor platform.
50 g.p.m. Unloading pump with quick coupling connectors.
Ion exchange purfication unit - 1-1/2' diam. x 3', 304 s/s, 25 g.p.m.
200 c.f.m. Fan, heresite coated steel case with aluminum fan wheel.
Aerofin heater.
Refrigerated cooler-condenser for cooling 2000 c.f.m. to 50°F.
Alumina-filled dryer unit, aluminum construction - capacity 200-300 c.f.m. to 70°F. dew point.
Alumina-filled vent adsorber, 304 s/s construction - capacity 300 c.f.m.
Control panel for drying system.

PDP Reactor System

Tank - 304 s/s - approximately 16'-2" I.D. x 16' high, 1/2" wall, 1" bottom.
Tank top - 304 s/s - approximately 20' x 20' x 2', 1/4" plate.
Support beams - 62 - 3/8" x 18" x 20' long - 304 s/s.
Cover plates - 7/8" aluminum x 6" x various lengths.

Vertical Elements

606 - "Q" foil assemblies including 4 fuel tubes each; total capacity, 105 tons of fuel.
61 - "C" cluster assemblies, including 5 alloy control rods and 2 cadmium control rods each. Ten assemblies actuated remotely, 51 assemblies actuated manually. An additional 913 control rods include full, 3/4, 1/2 and 1/4 normal length rods to be used for experimental purposes and/or for manual set control clusters.
120 - Safety rod assemblies, including 60 units designated as shutdown rods, and 2 units to be equipped with source rods.

Actuator Drives

70 - "A" motor drives for control rods, each 1/8 hp. gearmotor connected to rods with 1/8" s/s cable and graduated steel tape.
60 - "B" motor drives for safety rods, 1/8 hp. with clutches, duplicating Bldg. #105 motor package "AH". Two of these units are "C" motor packages for use on source rods with electric connections omitted to scram.

4 - "J" motor drives for shutdown rods, each a 3-speed, 1.5 hp. gearmotor with servomotor position indication. Each "J" motor drives 15 shutdown rods in a gang via cables and pulleys mounted on a common line shaft.

Positioning and Handling Equipment

1 - Sheave rack carriage for supporting all cable sheaves over the reactor. Consists of two special design units, similar to a pair of bridge cranes, each provided with adjustable beams which are mounted so that sheaves can be repositioned when reactor core pattern is changed. Carriages are movable to permit access to reactor during loadings and alterations.
1 - Movable bridge - A movable walkway approximately 3 ft. x 20 ft. long mounted over reactor and sheave rack carriages to permit access to top of reactor for experimental handling of fuel elements.
1 - 1-ton Motorized bridge crane, equipped with a standard 1-ton trolley-hoist and a special single cable, 500-lb. trolley-hoist for experimental fuel tube handling.
16 - "F" Tube guide assemblies for loading test specimens.

Storage Racks

Hangers for vertical storage of 50 loaded Q foil assemblies at +27'-0" level.
Steel frame hangers set on +27'0" level for vertical storage of approximately 1000 loaded "F" tubes or control rods, in groups of four. Steel walkways at 42'-0" level are provided with jib cranes for handling loaded fuel tubes from the assembly room below.
For 9-12 ft. long control rods, horizontal storage facilities are provided at 0'-0" level for approximately 200 rods.

PDP Control Room

Main control console.
Control rod trim panel.
Neutron panel.
Pulse counter panel.
Safety rod panel.
Moderator panel.

PDP Operations Office

Conventional office furniture.
Operations office instrument panel, PDP supervisory monitoring instruments

Accountability Office

Conventional office furniture.

Fan Room

Air conditioning equipment for reactor rooms and assembly room area, 225-ton capacity.

Assembly Room Area Equipment

Fuel tube loading table designed to load uncanned slugs into "F" tubes in a horizontal position, tilt loaded tube and elevate vertically to PDP storage area for crane pick up. Also receives loaded tubes, tilts and unloads tubes from inclined position with slugs returned to loading table.
Storage racks, steel, with platform at +16' level for vertical suspension of loaded fuel tubes.
2 - 500-lb. Monorail hoists for transfer of loaded tubes to storage racks.
1 - 500 KG platform scale.
Vault - Steel shelving and special racks for SP fuel.
Work benches.
2 - 400-ton Centrifugal compressors for refrigeration, plus auxiliaries.
100 kv.-a. emergency power generator and electrical switchgear.
Elevator.

Standard Pile Equipment

Graphite pile complete with safety sheets, control rods, oil cooling system and controls.

Exponential tank, 5' I.D. by 7'-3-3/8", 1/2" aluminum complete with:
61 - Top plates, 7/8" stainless steel.
26 - Bottom plates, 3/4" aluminum.
18 - Grid Beams, 5-1/2" high by 5'-8-1/2" long, type 304 s/s.
1 - 1000 gallon s/s Storage tank with 25 g.p.m. submerged pump.

Q-foils, S-foils, "F"-tubes, alloy control rods.
Purification system consisting of de-ionizer, pre- and after-filters.

Bridge crane hoist.
Nuclear physics laboratory.

SP Control Room

Control console instrument panel.
Flux panel for neutron counters and sealers.

SP Operations Office

Conventional office furniture.
Instrument panel for supervisory monitoring of SP operation.

Laboratory and Office Wing

Service Room

Office and lab air conditioning facilities, 135-ton capacity.
Hood fans, space for CWS filters (not installed), piping for laboratory services and uncontaminated trade waste.

SP Beam Room

Standard work benches, plus conference room furniture.

Balance Room

Permanent balance stand and balance.

Offices

Conventional office furniture in seven offices.

Laboratories

Standard service strips and laboratory furniture.
10-in. Bench lathe.
Bench milling machine.

Pedestal grinder.
Drill press.
Hand drills.
Sander.
Welding hood.
Do-All band saw.
Electronics testing equipment.

Dark Room

Standard laboratory service strips and furniture.
Refrigerator.
Constant temperature bath.

Counting Room

Standard laboratory service strips and furniture.
Counting instruments.

Instrument Repair Shop

Standard instrument repair benches and laboratory furniture.

Health Physics Room

Standard service strips and furniture.
Health monitoring instruments.

Lunch Room

Cupboards.
Stainless steel sink.
Table and chairs.

Locker Room, Rest Room and Toilet

Conventional equipment.

INSTRUMENTATION

Instrumentation for this building consists of equipment for control of the PDP and SP reactors, the building health monitoring system, and laboratory instruments and apparatus.

PDP Reactor

The PDP reactor is designed for operation from the control room by a team of two men. One operator sits at a console on which all important measurements are indicated and from which he may operate the safety rods, shutdown rods and control rods in gangs. The second man is stationed at the nearby "trim panel". He makes precise individual adjustments of the control rods under the supervision of the operator at the console. Instrumentation for the reactor consists of the following systems.

Low Level Neutron Measurement

This equipment is used during pile loading and during start-up of the reactor. It consists of neutron detectors located at the pile which transmit to counters located on the scaler panel in the control room. The arrangements have been so designed that counters can be located at any of the 600 locations within the reactor lattice and at any location outside the reactor. These counters are connected into a loud-speaker system. The system is so arranged that each neutron detected produces a "pop" in the loud speakers located in each room associated with the PDP reactor. The system is used to warn personnel that the reactor is in operation and to give this audible indication of the power level and the consequent radiation hazard.

High Level Neutron Measurement

This system consists of a group of ion chamber neutron detectors located at the reactor which transmit to measuring instruments at a "neutron panel" in the control room. Readings of the key instruments are repeated at the operator's console. These instruments are also used to actuate alarms and to automatically "scram" the reactor should the power level become dangerously high.

Moderator Temperature Measurement

This system consists of thermocouples located in the reactor which transmit to recorders mounted on the "temperature panel" in the control room. The thermocouples are mounted in tubes each of which contains five thermocouples. Twenty-four thermocouple rods are provided, each of which can be inserted in any of 600 positions in the reactor lattice. Two 16-point recorders are provided which allow continuous recording of the temperatures at 32 points.

Moderator Level and Flow Control

Instruments are provided in the reactor room to transmit moderator level at the reactor and at the storage tanks to the control room. The measurements are received at a "graphic panel" located in the control room. Controllers for remote operation of the pumps and key valves are also located on the "graphic panel".

SP Reactor Instrumentation

The SP reactor was designed by General Electric and came equipped with the necessary instruments for its operation. The equipment consists of a low level and a high level neutron detecting system, both of which are similar to the system for the PDP reactor.

Equipment in the control room consists of a console containing neutron level measuring instruments and load controllers, a scaler panel containing low level neutron measuring equipment, and a cabinet containing rods and interlocks for operation of the rods.

Health Monitoring System

This system consists of ionization chambers permanently located at strategic positions in the SP and PDP areas of the building and transmit to recorders and alarm systems located in the SP Operations Office and PDP Operations Office and Health Physics Laboratory. A total of twenty-two ion chambers are to be installed.

Laboratory Instruments and Apparatus

These items consist largely of standard laboratory equipment.

DEVELOPMENT OF DESIGN

Building

Flexibility

The Physics Assembly Laboratory is a technical facility for experimental development of pile operation techniques and advanced pile designs. The building design had to incorporate many features which would allow the operating staff considerable flexibility in building and

equipment use. Although this is reflected chiefly in the design and layout of equipment, the various rooms had to be so sized and designed that adequate and efficient working space would be available. This included the shielded reactor control rooms, close control of and ready access to expensive production materials, storage of reactor components and moderator, and adjacent assembly and disassembly areas. The great importance of an efficient initial design was emphasized by the need for shielding around the standard and process development rooms, a factor that would make subsequent alterations in design difficult. It was, therefore, only after a very detailed analysis of requirements and the firming of general equipment designs that the layout and dimensions of the building were approved. In the laboratory wing the problem of flexibility was much simpler and there the use of basic 12-foot modules made it possible to enlarge or contract any area with comparative ease.

During the early stages of planning it was believed that the operations wing should be designed as a Class I structure. This decision was based on the importance and required continuity of the work in this area and the fact that reinforced concrete shielding would be necessary in many locations. A later study of costs of this class of construction versus Class III construction, with shielding walls only where required by process activity, resulted in the selection of Class III as the most economical and satisfactory design.

Shielding

Radioactivity present in the process development room and the standard room during pile operation made it compulsory to incorporate shielding around these rooms. Personnel in the building are protected from radiation by concrete walls ranging in thickness from five to six feet. Location of the reactors below grade level further protect personnel in the building and in the area. Each access door to the radioactive areas is equipped with safety switches which automatically shut down the pile if doors are opened while the reactors are in operation. The openings provided in the walls for the installation of service piping, instrumentation and electrical control cables and experimental work have been kept to a minimum size. Such openings are located at a minimum height of 7 ft. above floors to protect personnel and are sealed to prevent air leakage from reactor rooms. Heavy concrete slabs used for flooring and ceilings in the radioactive areas are primarily for structural purposes, but in some cases also provide shielding. Additional shielding in the operations wing is provided around

the ventilating shaft serving the process development room. Here the 7-foot square shaft which is continuous from the basement level to the roof of the building is constructed with an 8-inch exterior concrete wall and an inside wall two feet thick.

In the laboratory wing's counting room, where low levels of activity are measured, the absolute accuracy of the instruments was insured by erecting shielding walls along the corridor side and between the counting room and the adjacent chemical laboratory. These heavy walls eliminate the disturbing effects of any radioactivity emanating from the reactor rooms in the building and from the nearby Building #305. The corridor wall is 11 inches thick, the partition wall, 24 inches thick.

Decontamination

Radioactivity at very low levels are encountered in the laboratory wing. The typical laboratory design developed for Building #773-A was used as a basis, and modified to eliminate more elaborate features required for hot labs. This reduced design costs and also gave the building added flexibility, since it can be converted to handle high activity work with relatively low cost alterations.

Emergency showers are provided adjacent to the chemistry laboratory and shop as a normal safety feature. The men's locker and shower room is arranged so that it can serve as a decontamination facility for the operating staff in the event such treatment becomes necessary.

Emergencies

To permit fast evacuation of the building in case of emergencies all doors except the main entrance are equipped with panic hardware operable from the inside only. Convenient exits are provided in every work area.

The nature of the fuel and the moderator exclude the use of water and certain chemicals as fire fighting agents in the reactor rooms, assembly rooms and the vault. These areas are equipped with CO_2 hand extinguishers. Other areas are equipped with CO_2 dry powder fire fighting equipment.

Lighting and Safety Circuits

Fluorescent lighting is used in the offices and laboratories with the exception of the nuclear physics laboratory, counting room and beam room where incandescent lighting is used. An original premise that use of fluorescent lights would interfere with electronic instruments did not prove true, but was used as a basis for type of lights used prior to the time the new information was developed.

In addition to the electrical circuits installed for illumination there are five special safety circuits. A sign circuit illuminates "PDP-On" and "SP-On" signs at various locations in the operations wing and in the secretary's office, counting room and health physics room. A shutdown interlock circuit automatically shuts down the reactors if any door connected to the system is opened while the piles are operating. A third circuit includes scram buttons located in the operations wing. A door closure indication circuit makes it possible for the pile supervisor to ascertain whether or not specific doors are closed when the pile is to be operated. This circuit includes those doors which can be opened after the pile has been placed in operation only with special permission and under the close supervision of health physics. The fifth special circuit makes it possible to establish special security switches on certain doors in the reactor areas.

Air Conditioning

The entire operations wing, the counting room and the chemical laboratory are air conditioned to 50% plus or minus 5% relative humidity and 75 degrees F. plus or minus 2 degrees. A closer tolerance is set for the standard pile room where the temperature is held to within plus or minus one degree of 75 degrees F. The air conditioning system had to be carefully designed to prevent excessive contamination of the moderator in the experimental reactor, deterioration of source fissionable material and to insure the proper operation of counting apparatus.

Ventilation

In the laboratory wing the modular design includes provisions for the future installation of CWS filters in the exhaust duct systems at all laboratories if required. The heating and ventilating ducts leading into the reactor rooms are equipped with safety cut-off dampers that will close the ducts at any excess pressure up to 3 pounds per

square inch. Adjustable pressure sensitive instruments are installed in the system. Radiation sensitive trips were installed after operations start-up.

Electrical

Electric power is supplied by means of 480 volt underground cables from Substation #352-1M, on the south side of the building. Two air circuit breakers equipped with motor overload relays act as starters for two 200 hp. refrigeration units. Lighting is supplied by means of 120/208 volt cables from Substations #352-3M. Emergency lighting fixtures are provided as required for personnel exit. All vestibule and outside lighting may be blacked out from Patrol Headquarters, Building #720-A. Speaker coverage is provided in the building for area safety alarm. In addition, an intercommunication system is provided for two way communication between control room and reactor area. This system is an open wire system requiring no "Press-to-Talk" switches. Conduits are provided for Bell Telephone wire installation.

Interlocks were provided on all doors to PDP reactor to shut down reactor in case of unauthorized openings of doors. Similarly, doors to Standard Pile area were interlocked with shut-down inserts so that unauthorized opening of doors shut down this pile automatically.

Instrument power, emergency lighting, and critical ventilating equipment are so connected that failure of normal power supply automatically transfers the circuits to the emergency diesel generator which is started automatically.

Equipment

Process Development Pile

Four basic considerations determined the general design of the process development pile. These were: faithful nuclear mock-up, safety, heavy water conservation, accessibility and flexibility.

Mock-Up

As a reactor unit capable of perfecting process procedures, the pile had first of all to duplicate in detail the nuclear pattern of the producing reactors. This requirement applied to the chemical and physical factors in

operation in the pile and not to the precise mechanical design of the unit itself. In effecting this design it was possible to eliminate several features of the reactors in the #100 Areas. Because the pile is operated at relatively low power levels there is no need for a gas blanket and none of the numerous secondary coolant problems are encountered. Also, control rods can be set by hand while the PDP is shut down making it necessary to set only a fraction of the control rods by remote control.

Safety

Since it is necessary for the reactor operators in their experimental work to approach the reactor more closely than is the case with the personnel in charge of the producing reactors, more consideration had to be given to safety. Reasonable insurance against radiation hazards was incorporated in the building and equipment design by installing shielding walls with gas-tight doors, automatic shut-off valves in the ventilation ducts, permanently located health monitors which print a record of exposure at various locations and facilities for unloading samples from the reactor from the 27-foot level when close access to the pile is not desirable.

Normally this pile operates at 10-100 watts power level with essentially no hazard to personnel, even if unshielded. However, to protect personnel during experiments where the reactor power might accidently reach a dangerous level during the set-up period, extra safety capacity is provided.

Shutdown rods, which are not installed in the production reactors, have been added to the PDP design to make possible a temporary reactivity shutdown and to reduce the pile activity without changing the adjustment of all hand set control rods. Those thimbles in the producing reactors used for some instrument rods and the producer rods are used in the PDP for the shutdown rods. There are no differences between the safety rod systems of the PDP and the #100 Area reactors, except in location and physical arrangement of the actuators, and in the type of latches used.

Heavy Water

In view of the fact that the heavy water moderator used in the pile is worth several million dollars, conservation of the D_2O and its protection from contamination received special attention during design. To achieve these ends the tank is fabricated of noncorrosive materials, the use of mercury or mercury containing instruments is avoided in the

reactor room, and the top of the reactor is tightly sealed against dust and light water vapor. Every feasible method for elimination of heavy water loss by breathing during pressure changes, through cracks and leaks in piping or pumps has been adopted. Finally, a drying system has been installed to remove residual heavy water from the tank and core, and Teflon wipers are built into the fuel thimble supports.

Flexibility-Accessibility

To fulfill its function as an experimental unit the PDP must make possible rapid and varied studies of fuels, miscellaneous samples and neutron detecting foils and instruments located within the tank. To accomplish this the top of the tank has been kept as free as possible of permanently installed equipment, so that elements can be installed and removed easily. Pile operators can readily reach any tube in any portion of the tank. As an aid to studies in shielding requirements and effectiveness, a 90 degree sector of the tank wall and a 5-foot square section under the tank have been kept free of major obstructions.

Highly essential flexibility in lattice arrangements is incorporated to make possible not only a study of loadings in the 7-inch hexagonal lattice chosen for use in the producing reactors but also desirable variations of that arrangement of more than 7-inch spacing. It is also possible to use fuel elements of different sizes and shapes in square or circular patterns as well as the hexagonal pattern. Any section of the tank lattice can be arranged in a unit by itself for experiments of smaller magnitude. Further flexibility in pile operation is offered by the relative ease with which locations and positions of the control, shutdown and safety rods can be changed and also by the use of a heated moderator. Equipment is installed to bring the temperature of the moderator to 125 degrees F. for studies on the temperature coefficients of reactivity.

Design Responsibility and Fabrication

After general specifications had been established for the PDP, the Design Division proceeded to evolve the basic concepts and complete the first stages of development. Then, to speed design development by placing more specialized manpower on the project, it was decided to subcontract a portion of the work. On September 26, 1951, the scope of work of the American Machine and Foundry Company, already at work on design and development of the #100 Area pile components, was enlarged to include the process development

pile. In this scope addition AM & F was requested to develop and design a low power reactor with a flexible lattice arrangement which could start with a duplicate of the core of the plant reactor, using as much of the #100 Area vertical element design as possible. For a period of four or five months AM & F presented studies on several alternate designs. These were all too complicated and offered insufficient flexibility and accessibility. Therefore, AED and the Design Division mutually agreed that the original basic plans developed by du Pont Design would be followed and AM & F was requested to confine its development work to the controls and vertical components. Through cooperative efforts between du Pont and AM & F most of the designs for vertical elements were simplified for the PDP and only the safety rod drive was adopted from the #100 Area. New designs were developed for control of shutdown rods and control rods. AM & F finally produced nearly all the design work on the Q-foils, S-foils, control safety rods and rod drives, except the control rods, the assembly and disassembly machine, and electric control diagrams.

The final design of the tank, lattice support arrangement, materials handling and storage and control rod drives was done by Voorhees, Walker, Foley & Smith in cooperation with du Pont Design. The final electrical design for controls was also developed by VWF & S.

The fabrication of the stainless steel tank, beams and cover plates became a part of the scope of work of the New York Shipbuilding Company, Camden, New Jersey in November, 1951. Fabrication of full scale prototype of the #100 Area reactors had been underway at the Camden plant for some time and the firm had already contracted to fabricate the five production units planned for the Savannah River Plant.

PDP Structure

Fabricated of Type 304 stainless steel, the cylindrical tank has an inside diameter of 16 feet 2-3/4 inches and a usable liquid height of 15 feet 3 inches. The tank walls are 1/2-inch thick, the tank bottom 1-inch thick. Unlike the production reactors which consist of a tank, top and bottom tube sheets and plenum chamber, all very precisely machined and meticulously welded, the experimental reactor includes the tank and a square, top-mounted variable beam and tube support assembly. Operated at very low power the tank poses no problems of secondary cooling.

To each of the 20-foot long open beams are bolted a series of special cover plates each containing a hole accommodating the various tubes used in the reactor. Each

of the tubes rests on a circular seal and maintains verticality by gravity. A grid arrangement is built into the tank at the bottom to position safety rods, shutdown rods and instrument thimbles. Baffles built into the tank and the low requirements for D_2O flow for cooling purposes combine to eliminate any water turbulence that might disturb the tube patterns. A constant flow of moderator within the tank, maintained by a pumping system, is used primarily to keep the moderator level within very close tolerances.

The design of the beams and adjustable cover plates, both of which were specially developed, gives complete flexibility in lattice spacing from an initial minimum of 7 inches to any desirable distance. Actually this minimum distance can be further decreased, should it be desirable in the future, by the fabrication of smaller cover plates. Blank plates are at hand for use where no tubes or rods are to be located. Because the support grid beams were of unconventional design, and not subject to accurate calculation, a mock-up beam and cover plates were constructed for load tests. Weights to be supported include 105 tons of uranium, 10 tons of aluminum and 20 tons of control rods. Supported and positioned by the tank top are 606 quatrefoils, 61 septifoils, 60 shutdown rods, 60 safety thimbles and additional instrument thimbles. Strength and rigidity tests of a prototype beam built by Wilmington Shops and tested at New York Ship proved that it exceeded requirements by better than 200 per cent. As constructed, the beams are stainless steel plates approximately 18 inches high, 3/8-inch thick, and are tapered top and bottom. Two of these plates are tied together at the ends by spacers and machine bolts. The tapered tops and bottoms fit tightly into slots in the top and bottom plates which are fastened in place by four bolts. The cover plates are 7/8-inch thick, approximately 6 inches by 7 inches. About 20 different types of cover plates have been designed to give flexibility in top arrangement. All materials are stainless steel except the cover plates which are aluminum wrought alloy.

After loading, all openings in the tank are sealed with pressure sensitive lead-foil tape or are closed with gasketed fittings to prevent contamination of the heavy water by dust or vapor. When changes are to be made the tape can be peeled off.

A special feature of the process development pile is an 8-inch porthole built into one side of the tank approximately 7 feet above the tank bottom. It is equipped with a bulls-eye sight glass which is used for calibration of level instruments. It can also serve as an opening for the insertion of a tube to study the neutron spectrum between two rows of lattice points near the center of the tank and to obtain a neutron beam from the reactor for special testing.

A traveling neutron monitor was designed and furnished by Argonne National Laboratory. Immersed in the tank by a special suspension arrangement, the monitor can traverse the tank horizontally at any level and transmit to the control room its reading of power levels within the reactor.

Control System

Of the 427 control rods built into the PDP, 357 are set by hand and clamped tightly into position. The remaining 70, which are remotely operated, can be set individually or in groups of 10 each including one from each of the 10 septifoils. A switch on the control console makes it possible to change the operation of the control rods from gang motion to individual motion. A separate trim panel contains the equipment necessary to adjust settings of the 70 rods individually. At no time can the control rods be removed from the pile until all safety rods are out. Position of each gang is indicated via selsyn motor indicators on the control console. Rods can be set to less than 5 mm. accuracy. Sixty shutdown rods are incorporated in the pile and are arranged in four gangs of 15 each. Remote electronic indicators permit the adjustment of these rods to within plus or minus 5 cm., a design feature that eliminated 60 safety rod drives. It is impossible to move the shutdown rods out of the pile unless all safety rods are cocked and other interlocks are closed. When the pile is shut down or scrammed, all shutdown rods are run into the limit of their movement at a speed of 15 feet per minute. An emergency power supply will set the shutdown rods if the normal power source fails. At a scram warning the 60 safety rods drop into the pile independently in less than three seconds and are snubbed at the end of their fall by special devices to prevent damage to the pile. During operation it is possible to drop or withdraw any rod for experimental purposes without causing a scram. It is, however, impossible to withdraw any gang of safety rods unless the shutdown rods are all "in" and a neutron source is "in".

To support and guide control rod cables a sheave rack is mounted at the 27-foot level over the tank. Fabricated of a bridge crane frame and a completely adjustable rack composed of bolted sheave supports and rack members, it can be made to position cables directly over any portion of the reactor. The cables from 70 remote operated control rods lead over the pulleys in the rack, into the adjacent control room, over a second set of pulleys and into the trim panel to terminate on motor-driven take-up reels. Steel tapes graduated in centimeters are attached to the control rod cables making it possible for the operator at the trim panel to take direct readings of control rod positions. Cables

from the shutdown and safety rods are also passed over pulleys on the sheave rack under a second set of pulleys and up to a bank of motor-driven drums mounted above the 27-foot level. The cable operated control rod system was adopted in place of the rack and pinion system of the #100 Areas to achieve simplicity and effect substantial savings.

By moving the two sections of the sheave rack aside an opening can be made at the 27-foot level through which the ceiling mounted bridge crane can load and unload the reactor.

In the design and construction of the pile and its controls numerous precautionary measures were taken to assure absolute safety in its operation. Controls are so interlocked that startup can be made only after definite procedures have been followed. Similarly, procedures have been established for temporary shutdown, pile inspection, scram and complete shutdown.

Moderator System

The heavy water is stored in two 13,000 gallon aluminum tanks located below the sub-basement level. Vertical submerged pumps transfer a full charge of moderator from the storage tanks to the reactor in less than 30 minutes; a smaller system maintains the moderator level within 1/25-inch at any height between 3 feet and 15 feet 3 inches. Both systems are operated remotely from the control room. Drainage of the moderator into the storage tanks is by gravity. To maintain the purity of the heavy water, all moderator being introduced to the system can be passed through a resin bed and during operation the 10 to 50 g.p.m. flowing for level control are passed through the resin. Additional filters are installed before and after the ion exchanger to remove non-ionic contaminants from the moderator.

A drying system incorporated in the reactor design permits drying of reactor and piping without loss of heavy water. A breathing system, equipped with an alumina absorber, maintains the tank at atmospheric pressure to prevent contamination by light water vapor. The moderator and drying system are equipped with safety valves and devices to prevent excessive pressure or vacuum being created in any of the tanks at any time. Studies in the relationship of moderator temperature to pile activity can be conducted in the PDP by the use of a moderator heating system which increases the temperature of the heavy water from room temperature to 125 degrees F. within 24 hours.

Pile Components

Following the general practice of duplicating the process piles and adding those refinements which would give simplification and flexibility, designers of the pile components maintained a close resemblance between these in the PDP and those in the process piles. The Q-foils are slightly longer and their bottoms are partially covered with square plates to retain "F" tubes if breakage occurs. For experiments with other coolants, however, the foil bottoms can be closed. The low power at which the PDP operates eliminated the need for the top reflector built into the process piles and raised the problem of substituting materials that would precisely duplicate the reflector action. To accomplish this, aluminum reflector cans were designed to be filled with heavy water and occupy the space above the highest slugs in each F-tube of the Q-foil. Hollow aluminum "filler" cans which fit tightly into the F-tubes are inserted between the top slug and the reflector can to prevent displacement of the slugs while the tube is being handled.

For the added convenience it offers in experimental work, the system of using uncanned slugs in the PDP was adopted. This made it essential to design a substitute assembly that would duplicate the action of the slug cans. This was achieved by designing the F-tubes of a pure, hard aluminum that equals the thickness of the cans and the original F-tube. Aluminum spacers are used between the slugs to simulate the action of the can ends. Because the loadings of the F-tubes may vary, each tube is individually supported.

Except for variations in length the S-foils, control rods, safety rods, safety rod thimbles, perforated I-tubes and thermocouple I-tubes are identical with those in the process piles.

An additional feature present in the PDP is the provision made for the use of neutron sources. Two polonium-beryllium sources were used when the pile was ready for its initial testing and can be used at any time the pile is subcritical. When criticality is reached one or both sources can be raised into a shielding tank containing a boron carbide-paraffin mixture. Sources are stored inside sleeves provided in the concrete shielding walls.

Assembly and Disassembly

Fuel, F-tube and Q-foil handling in the PDP area is completely different from the system employed in the #100 Areas. All components except the F-tubes, slugs, spacers, reflector cans and fillers are received in the reactor

room and are clean enough when unpacked for immediate use. Other components are received in the assembly room. Because the F-tubes are structurally weak a specially designed horizontal loading table is used to load the slugs, spacers, fillers and cans. Developed by AM & F, the table has multiple "V" groove horizontal troughs in which the units to go into the tube are assembled. A motor-driven rod pushes the load into the tube which is fastened to a tilting table. This table in turn is raised from the horizontal to the vertical position by a guide riding in a channel curved from an almost horizontal line to a vertical line. Continued travel of the table in its vertical position raises the tubes through an opening in the floor at the 27-foot level so that the crane over the assembly area can grip the tube and either carry it to the reactor or place it in the storage area on the mezzanine. The tilting table, which can be moved through a 135 degree angle, is also used to unload the fuel tubes. A combination of limited storage space within the reactor and assembly areas for the rather bulky pile components and the need for available loaded tubes, Q-foils and alternate control rods led to the design of a catwalk mezzanine at the plus 42-foot level over the PDP assembly room. Here approximately 1152 F-tubes or control rods can be stored. These tubes are placed by the crane in a specially designed rack which accommodates 288 clusters of 4 tubes. There are also storage facilities for approximately 140 F-tubes in the assembly area and for 50 loaded Q-foils near the south side of the shielding wall at the 27-foot level.

Every effort was made by the du Pont Design Division to simplify the electrical control and to reduce the cost. Because of the large number of motors involved a basic scheme of cost reduction was developed and given to VWF&S for detail design. This used a rack structure with fused caps for insertion into a 3-phase 110 volt bus receptacle. From the cap a flexible cord extended to a reversing motor starter. In this manner flexibility in maintenance was introduced and a large amount of space saving accomplished.

Standard Pile

Three principal functions are performed by the standard pile.

1. It provides standard fluxes of thermal and epithermal neutrons for the intercalibration of foils and instruments which is information essential to the testing programs carried out in the process development pile.

2. It enables the Technical Division to conduct detailed studies of cross-sections, do work in exponential experiments and to supply the laboratories with special radioactive samples.

3. It makes possible the calibration of special detectors used in the verification of primary standards needed for equipment used in health survey and personnel monitoring. As an additional function it makes possible the establishment or revision of standards of nuclear quality control.

Design Responsibility and Fabrication

The standard pile was designed, constructed and tested by the General Engineering Laboratory of General Electric following largely the design of Thermal Test Reactor of similar size developed at the Knowles Atomic Power Laboratory. The decision to follow the pattern of the KAPL Thermal Test reactor was founded on the belief that a more effective design could not at that time be developed at a lower cost. Therefore, the standard pile is essentially the KAPL unit but contains several modifications which offer operational improvements. These include the change from a vertical to a horizontal unit and the design of the central core as a straight-through passage for samples. Also, the control rods are actuated by a reset type switch rather than a manual on-off push button.

SP Structure

The reactor fuel container is constructed from two aluminum cylinders, 10-1/2 in. I.D. and 18 in. I.D., welded to two aluminum rings which close the annular space between. The container is equipped with a squirrel cage type rotary rack on which fuel rods can be mounted. In this rack are located fourteen 3-inch diameter fuel loading rods that hold the fuel discs for the active lattice. The U235 discs, covered by an aluminum alloy, are immersed in the light paraffin oil which fills the annular space and serves as the coolant. In the center of the reactor is a 4-1/2 inch aluminum tube forming a passage for the insertion of sample loadings in a 4-inch diameter graphite rod. Contained in seven 1/2-inch diameter aluminum tubes located in the larger can are the safety, control and source rods. A total of approximately 3 Kg of fuel can be placed in the reactor through a special loading chute with variations possible in at least 40 increments. The reactor can is located in the center of a 5-foot cube of graphite and the center of the 10-1/2-in. cylinder is filled with graphite. Enclosing the

entire graphite block structure is a cover of 1/4-inch aluminum plate and steel plate lined with cadmium.

Control, safety, source and fuel mechanisms operate from the east side of the reactor. Control is effected by three cadmium rods 18 inches long. Sliding in aluminum guide tubes, these rods give control to a reactivity level of .01 per cent. The four safety rods are also made of cadmium, 18 inches long, and slide in aluminum tubes. All the rods are horizontal spring loaded units manually cocked and magnetically held in a latched position. They are released by a signal from an ionization chamber circuit and enter the reactor core in one-half second. Six 4-inch by 19-inch safety sheets of cadmium, 1/32-inch thick, are located between the reactor container and the graphite reflector and are inserted by remote control. They can be withdrawn only after the safety rods have been removed.

By changing the unit from a vertical to a horizontal position it became possible to construct a through test hole making studies feasible on a large number of danger coefficient samples. This was impossible in the vertical unit since pile poisons would have fallen out of the core. By constructing a horizontal unit it also became possible to add an exponential tank above the SP.

For various kinds of experimental work and instrument calibration a 4-foot square opening in the shielding wall of the Nuclear Physics Laboratory is provided. A similar opening has been left in the wall between the Nuclear Physics Laboratory and the Beam Room. This opening is equipped with a thermal column made of graphite blocks. East of the thermal column and next to the Nuclear Physics Laboratory a beam room is provided to give a clear span of at least 120 feet through which time of flight studies may be conducted.

Control System

By the use of three control rods - the original KAPL unit had only two - fine graduations of power level are possible. The safety sheets of the KAPL unit are referred to in the SP unit as shutdown sheets and are so designed that five sheets must be withdrawn before the sixth can be removed. The safety rods are mechanically fired, are snubbed at the end of the stroke, and can be cocked either remotely from the control room or directly in the SP room.

Carefully prepared procedures have been developed for the operation of the reactor and a system of control interlocks is installed to assure maximum safety.

Instrumentation

Included in the instrumentation are pulse counting circuits and the power level circuits comprising the linear circuits, logarithmic circuit and a differential circuit. The control panels include a control console, flux panel and operations office panel. These closely resemble in design the circuits installed on the process development pile. Because the instruments connected with the pile require many hours to reach operational equilibrium after they are energized, the instruments are left on 24 hours a day.

Exponential Tank

This facility consists of a tank for small scale tests of various fuels, lattice arrangements, and chemical and physical reactions. It is the first step in the demonstration of a theoretically proven nuclear pattern. After elementary experimentation in this tank, a nuclear problem can be set up in the PDP as a segment operation and then, if still interesting and promising, can be investigated through a full-scale operation of the PDP. Any new type of fuel element in various sizes and shapes can be tested in the exponential tank.

Design Responsibility and Fabrication

The design of the tank was patterned roughly on one designed by the Argonne National Laboratory. The Savannah River tank has the same inside diameter but is higher and has a completely different arrangement on tube supports and component designs. VWF&S, at du Pont's direction, adapted the designs of the grid beams, cover and bottom plates of the PDP to fit the smaller unit and similarly modified the tube assemblies to meet the smaller specifications. The tank itself was procured by the field and du Pont awarded the contract for the plates and beams to a commercial metals fabricator.

Tank Structure

A cylindrical tank with an inside diameter of 5 feet and an overall height, including the tube supports and cover, of approximately 8 feet, the unit is constructed of 1/2-inch 2S-aluminum, has a 1/16-inch cadmium covering held in place by stainless steel banding. The maximum water depth in the tank is approximately 6 feet 1 inch. For the needed flexibility in loadings, the tube support system resembles that of the PDP. The grid beams are of 3/8-in.

stainless steel with an overall length of 5 feet 8 inches. The top plates, fabricated from 7/8-inch wrought aluminum, are 4-5/8 inches wide, 5-1/2 inches long. Bottom plates are the same size and made of 3/4-inch Type 304 stainless.

When first designed there were no provisions for control rods in the exponential unit. The later addition of these made it necessary to re-design some of the top and bottom plates to accommodate the lithium-aluminum control rods.

Loading of the tank is effected through a special rotating cover which contains four circular openings 9 inches in diameter and one oval opening, 9 inches by 16-1/2 inches. The openings are so placed that with rotation any portion of the tank can be reached. Each of the openings has its own clamp-on cover. Air operated "C" clamps seal and lock the tank cover in position after loading is completed. Neoprene gasketing gives a tight seal between the cover and the tank. A 3/4-ton hoist is mounted on a bridge crane over the tank to aid in handling tank components and in loading and unloading operations.

When the standard room was planned and the SP designed, consideration was given to the future installation of an exponential unit. The change from a vertical to a horizontal SP was partially based on that expectation. As installed, the exponential tank is mounted over the SP with a 16-in. graphite pedestal between the tank bottom and the top of graphite cube surrounding the SP. The top of the tank is at the 0'-0" level where a steel grating floor has been installed in the standard room and on the level of the PDP assembly-disassembly room. The exponential tank is supplied with thermal neutrons from the standard pile. These are projected from the SP through the graphite pedestal and the tank bottom to activate samples in the tank.

To accommodate the D_2O moderator system a 1000 gallon storage tank was installed at the -15 ft. 3 in. level and connected to the reactor by fill, drain and overflow lines. Moderator is pumped into the unit by a vertical submerged pump and drained by gravity. For moderator purity a system of filters and a deionizer is built into the circulating lines. This equipment is mounted over the storage tank.

Components

The initial load provided for this tank is the same as that used in the PDP. Except for their length, the components of the exponential tank are similar in design to those used in the PDP and the process building, Building #105.

Control

No automatic or remote control of the components in the exponential tank is provided. Elements are placed manually in the tank and remain fixed. The only control installed is a trip valve, remotely operated, which keeps the moderator level at the required elevation.

Miscellaneous Equipment

In addition to the reactors and their associated equipment and the standard office and laboratory equipment, the Physics Assembly Laboratory contains two temperature controlled photo sinks, a pedestal grinder, lathe, milling machine, band saw, several drill presses, welding equipment, instrument maintenance equipment, balances, parts cases, work tables and benches.

Design Responsibility for Building and Equipment

Two subcontractors were employed by du Pont in the execution of the Physics Assembly Building.

Voorhees, Walker, Foley & Smith, New York City engineering firm, was responsible for the design and all drawings on the building and approximately 90 per cent of the instrument and electrical drawings. This firm also established specifications for the standard commercial equipment and issued purchase orders for the equipment. It also handled all work on the PDP, except for design of vertical elements and controls which was executed by the American Machine & Foundry Company.

DRAWINGS

W-147386 - Instrument Control Diagram Sheet #1.
W-131849 - Instrument Control Diagram Sheet #2.
W-132702 - Instrument Control Diagram Sheet #3.
Instrument List - Part 1.
Instrument List - Part 2.
W-157394 - PDP Control Room Panel Arrangement.
W-157111 through W-157115 - Floor Plans.
W-157116 - Sections.
W-157117-118 - Elevations.
W-132454 - Tank and Support Arrangement Sheet #2.
W-157503 through W-157506 - Equipment and Piping Arrangement - Plans.

W-157507-508 - Equipment and Piping Arrangement - Plans.
W-157448 - Process Piping Diagram.
W-157131-132 - Laboratory Equipment Arrangement.
BPF-120313.

ELECTRICAL FACILITIES

No electric power is generated in this area, power requirements being supplied from the Plant high voltage network through substations installed in the area. Three secondary substations serve the #300 sector. The following electrical facilities are discussed in detail in Volume VI of this history.

Bldg. #353-M - Secondary Substations
Bldg. #501-M - Fence and Road Lighting
Bldg. #503-M - Distribution Lines
Bldg. #505-M - Fire Alarm Systems
Bldg. #506-M - Telephone Cable and Instruments
Bldg. #507-M - Safety Alarm System

STEAM FACILITIES

All steam for process and heating use within this area is supplied from the Boiler House, Building #784-A in the #700 Area. The following steam facilities are discussed in detail in Volume VI of this history.

Bldg. #801-M - Pipe Supports
Bldg. #802-M - Steam Lines

WATER FACILITIES

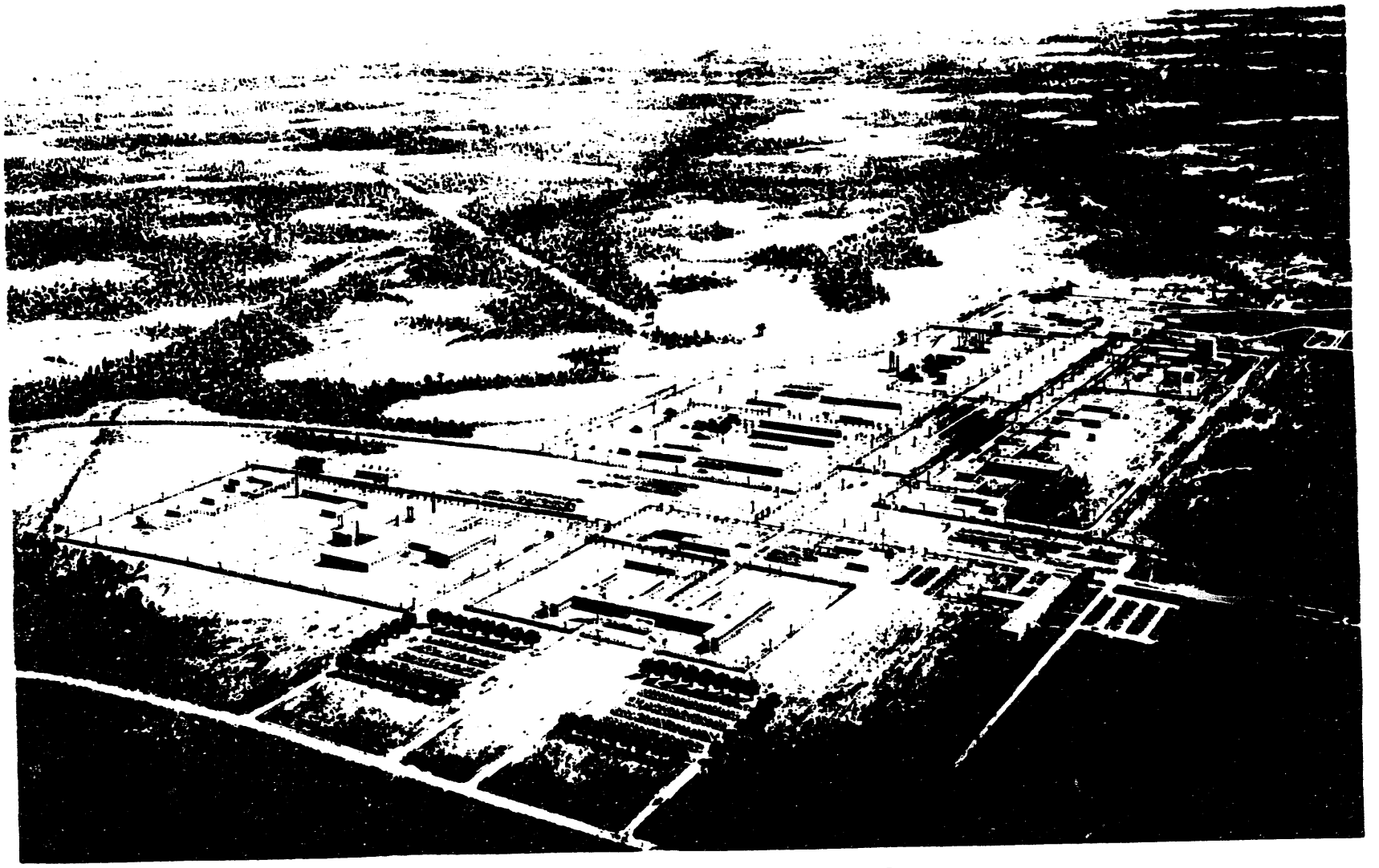
Water requirements for this area are included in the discussion of those for the #700 Area. The following water facilities are discussed in detail in Volume VI of this history.

Bldg. #901-M - Water Lines
Bldg. #902-M - Fire Lines

GENERAL FACILITIES

A discussion of the general facilities and services of the type used throughout the entire plant, such as roads, walks, parking areas, sewage treatment and site work, is contained in Section VI of this volume. There, the over-all site problems and specific solutions are discussed in detail and a description of their general characteristics and scope is presented.

Bldg. #601-M - Standard Gauge Track
Bldg. #603-M - Roads (Inc. Bridges and Culverts)
Bldg. #604-M - Walks
Bldg. #613-M - Parking Area
Bldg. #697-M - Site Work and General Grading
Bldg. #698-M - Landscaping
Bldg. #903-M - Sanitary Sewers
Bldg. #904-M - Process Sewers
Bldg. #907-M - Storm Sewers



#300 & 700 AREAS

SECTION IV

DESCRIPTION AND DEVELOPMENT OF THE #700-A AREA

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IV - DESCRIPTION AND DEVELOPMENT OF THE #700-A AREA

DESCRIPTION

The #700-A Area contains housing and facilities for plant management, general plant services, and certain technical activities. The area is located approximately one mile south of the site perimeter, in the northwestern sector of the plant, and on a connecting road between the two main highway approaches from Augusta, Georgia, and Aiken, South Carolina. It adjoins the #300-M Area, which it partially surrounds, and lies approximately four and one-half miles north of the nearest critical Process Area, #200-F.

In general, the major buildings are arranged in three fence-enclosed groups by functional category - administration, technical, and service and storage. Numerous other buildings and facilities are located between or in varying proximity to these three enclosures.

The Administration Building, located within the fenced rectangular plot facing the access road to the Area, houses the Operations management and Atomic Energy Commission personnel and serves also as the repository for permanent records. The Telephone Building also is located within this plot, but the Medical and Employment Building, the Cafeteria, and the Patrol Headquarters are located outside of but adjacent to this enclosure.

The technical buildings, situated in a separate fenced area east of the Administration Building, include the Main Technical Laboratory, the Waste Concentration Building, the Health Physics Headquarters, and the Health Physics Calibration Building. A sewage lift station and a gate house also are located inside this security fence.

The Main Technical Laboratory contains equipment to evaluate, test, and develop the various processes employed throughout the plant. The Health Physics Headquarters houses facilities for sampling and analyzing materials for radioactivity and for monitoring for radioactive contamination and personnel exposure to radiation. Here also are facilities for the development of methods and instruments for measuring and controlling radioactive contamination. The Health Physics Calibration Building provides for the periodic calibration of portable radiation-measuring instruments used throughout the plant. Wastes from the Main Technical Laboratory and the Health Physics Headquarters, some of which are radioactive, are temporarily stored and treated in the Waste Concentration Building.

As numerous buildings within the #700-A Area require chilled water for air conditioning purposes, a central refrigeration plant was installed in this area. This Refrigeration Building, a cooling tower and a small building for the chemical treatment of well water are located outside of but adjacent to the enclosed plot containing the four technical buildings.

The third and largest fence-enclosed group of buildings in the #700-A Area consists of a number of service and storage facilities arranged roughly in a north-south alignment east of the #300-M Area. From north to south, the principal buildings in this group are the Central Storage Building, Steel and Pipe Storage, Maintenance Central Shops, Instrument Shop, Spare Machinery Building, Boiler House, and the Primary Electrical Substation. A small motor pool office and a ground storage reservoir are located adjacent to the boiler house. The following smaller storage facilities are also located within this fence to the east of those noted above: Compressed Gas Storage; Propane Storage; Flammable Storage; Lumber Storage; Paint Shop; and a warehouse converted from a temporary construction building.

Two gate houses, one at either end, permit access to and egress from this area. A railroad siding, with spurs to the coal storage yard and boiler house, and the primary storage and shops buildings, are located within this fenced area.

The following service facilities are situated to the southwest of the enclosed service and storage area: Safety and Fire Protection Building; Labor Office, Tool Storage and Riggers Loft; Automotive Repair Shop; Gasoline Station; Burning Ground; Sewage Treatment Plant; Salvage and Reclamation Building; Salvage Yard, and Sandblasting Building.

Twelve secondary substations are located throughout the #700-A Area to supply overhead and underground electric service to the various buildings. Service facilities such as railroad lines, fences, sewers, steam and water distribution lines, communications and safety systems, and parking areas are also installed as required.

LAYOUT AND DEVELOPMENT

Originally, the #700-A Area was conceived as a separate group of buildings physically removed from all process operations, in which all plant-wide administration, service and storage facilities would be located. The site of this area was determined principally on the basis of accessibility and safety. From the standpoint of manpower requirements also it

was desirable that the #700-A Area, which would contain a large majority of the manpower necessary to operate the plant, should be located equidistant from Aiken, South Carolina, and Augusta, Georgia, the principal population centers nearest the Savannah River Plant. Operations specified that this area should be located approximately five miles away from the nearest #100 Area as a safety precaution. Unlimited expansion within the specified boundary limits was another factor in the location of this area, and these considerations determined that the site should be near the plant property line in the northwestern sector of the site.

Subsequently, it was decided that the fuel and target slug preparation, canning and testing facilities (#300-M Area) would be combined with the administration, service and storage facilities in a common location designated the #300/700 Area. This decision was based on economy, as it became apparent that centralized service facilities supplying the common requirements of steam, water and electricity to both the #300-M and #700-A installations would be less costly.

A single sanitary sewage system also was designed to serve both the #700-A and #300-M Areas and to discharge into a common sewage treatment plant, Building #607-1A. However, separate water disposal systems were provided for the two areas, discharging into drainage ditches leading to tributaries of the river.

The #300-M Area is supplied water from the tank reservoir, Building #782-A. The boiler house and the primary substation located in the enclosed service and storage plot of the #700-A Area serve as central steam and electric power sources to supply the needs of both areas.

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V - DESIGN

ADMINISTRATIVE AND TECHNICAL FACILITIES

BUILDING #703-A - ADMINISTRATION BUILDING

FUNCTION

The central administration offices for the Savannah River Plant are located in this building. These include accommodations for the plant management group, Atomic Energy Commission personnel, engineering offices, permanent record storage and certain clerical and accounting functions. Management and operations personnel occupy the premises during a regular eight-hour business day, but twenty-four hour security patrol protection is maintained.

PRINCIPAL COMPONENTS

Administrative areas provided for the Atomic Energy Division of the du Pont Company consist of supervisory, accounting, clerical, engineering, methods and process, technical, reproduction and printing, security, service, transportation and traffic, and personnel offices, with record storage and vault facilities. The Atomic Energy Commission occupies administrative, managerial, legal, public information, technical and production, engineering and construction, finance and general administrative overhead, organization and personnel, and security offices, and has space for record storage and record vaults. Other building components are lobbies, corridors, stair towers, men's and women's toilets and rest rooms, mechanical equipment and fan rooms, protective bomb shelters, and a main entrance portico with platform for busses and motor vehicles.

BUILDING FLOOR SPACE	Approx. Sq. Ft.
Total AED office space, including files and miscellaneous storage	46,760
Total AEC office space,	32,635
Record rooms, vaults, AED	2,675
Record rooms, vaults, AEC	7,425
Printing, reproduction and dark room,	2,050
Unassigned space	3,420

Lobbies, corridors, stairs —	25,775
Toilets and rest rooms	8,165
Mechanical equipment and fan rooms	14,610
Bomb shelters	7,260
Entrance canopy and platform	9,825
Loading platform	250

BUILDING DETAILS

The shelter areas including the eight shielded entrances to these enclosures are of Class I construction. The rest of the building was designed as a Class II structure with two stories and a basement. The building is composed of a main central structure from which four wings project to the rear and two wings extend from the front of the building, one from each end. The main structure is approximately 61 ft. wide by 487 ft. long by 33 ft. high. Two of the rear wings are 41 ft. wide by 122 ft. long by 33 ft. high, and the other two are 41 ft. wide by 124 ft. long by 33 ft. high. These dimensions do not include the end stair towers and the extra wall thickness around the basement bomb shelters and shelter entrance steps. The front wings are each approximately 41 ft. wide by 61 ft. long by 33 ft. high, and the six stair towers located at the ends of each of the projecting wings are each 11 ft. by 18 ft. by 33 ft. high. Two flat-roof stair penthouses are each 8 ft. by 17 ft. and extend 9 ft. above the main roof, and the two sloping-roof stair penthouses are each 8 ft. by 18 ft. and extend an average height of 5 ft. above the main roof. The one-story lobby projection at the entrance to the building is 34 ft. wide by 82 ft. long and 14 ft. average height from the lobby floor to the top of the roof slab. The eight shielded entrances to the shelter areas, located outside of the building, each measure approximately 9 ft. by 27 ft. to the outside of enclosing walls by 11 ft. high from floor to top of roof slab. Each of the sixteen stair areas is approximately 9 ft. by 10 ft. to the outside of enclosing walls by 6 ft. to grade.

The basement elevator room is approximately 10 ft. wide by 25 ft. long to the outside of enclosing walls and 11 ft. high from the floor to the top of the loading platform slab.

The area of Class I construction is 9,420 square feet and the combined area of the Class I and Class II sections is 175,615 square feet. The total volume of the building is 1,991,400 cubic feet.

CONSTRUCTION DETAILS

The building is erected on a reinforced concrete foundation with spread footings. The superstructure is composed of reinforced concrete columns, wall piers and roof with steel framing between the piers for windows and spandrel wall construction. The exterior walls are sheathed with smooth cement asbestos board between the piers and flat cement asbestos board on steel furring is used for interior wall finish. In the basement the interior walls are exposed concrete. Interior partitions are wire mesh and flat cement asbestos board on steel studs. Toilet room walls are concrete to a height of 4 ft. with flat cement asbestos board above. Doors are hollow metal and sash is steel, both projected and fixed. There are approximately 48,600 square feet of acoustical tile ceiling applied directly to the concrete slab, with 83,000 square feet of exposed concrete ceiling in the remaining areas of the building. Ceilings in the vestibule, lobby and adjoining spaces are suspended and treated with Fiberglas, as are the corridors on the first and second floors.

There is an electric and telephone underfloor duct consisting of a single line of two-way duct in office spaces of 15 ft. width and a double line in offices and work spaces 25 ft. wide. Roofing is builtup with both exterior walls and roof being insulated. The concrete floors are finished with asphalt tile except in the mechanical equipment, elevator machine and fan rooms, and in the storage, communication equipment, emergency generator and receiving rooms, and in the shelter areas. Heating in the first and second floor offices is furnished by forced warm air through ducts and warm water through coils of the perimeter air conditioning system. The first floor lobby, basement office space, the training room, reproduction and printing rooms, the records room and the vaults are heated by forced air through coils and ducts in conjunction with seven separate air conditioning systems. Unit heaters are installed in the basement equipment room. The steam source for these services is the area power house. The shelter areas are not heated.

The first and second floor offices are air conditioned by a perimeter system, while the first floor lobby and all tenanted basement areas are conditioned by separate systems. The area refrigeration plant provides the chilled water source for these systems. Ventilation is maintained by fans through ducts from the corridors on both floors, from toilets, rest rooms and janitor's closets, from transformers in core fan rooms, and by return air ducts and fans for recirculation in the air conditioning system serving the first floor lobby and the tenanted basement spaces.

Lighting in the lobby, offices and work spaces, and in the record rooms and vaults is fluorescent. All other areas have incandescent lighting.

Electric power is supplied to the building from two 1000-kv.-a., 480 v., 3-phase load centers located outside the building. Dry type transformers are used to step the voltage for lighting down to 120-208 volts, 3 phase. A 100-kw. emergency diesel generator is provided to start automatically in case of failure of normal electric power. It supplies emergency lighting in Bldg. #703-A, #702-A, #708-A and 719-A. All lighting, including emergency lighting, except the low intensity blue lights for use during blackout periods and in bomb shelter rooms, may be blacked out from Patrol Headquarters - Building #720-A. Area alarm or instruction during emergency conditions may be given all building personnel from Building #720-A by means of loudspeakers located throughout the building.

EQUIPMENT

Exterior tramrail and trolley, with window washing cage, continuous around entire building perimeter.

Lobby furniture, guard station counters.

Conventional office furniture, record room and vault file cabinets.

Drafting room furniture, drawing files.

Record vault shelving, approximately 400 linear feet.

Two 4-hour vault doors.

13 Water coolers.

Continuous photostat machine, blueprint machine.

Developers, printers, dryers, sink, tables, and dark room equipment for reproduction work.

Multigraph, multilith, zerograph, etc., for printing work.

Microfilm equipment and reader.

Perimeter Air Conditioning -
Eight systems, with independent built-up units consisting of filters, coils, dehumidifiers, fans, ductwork, hot water converters, pumps, piping and window units:

System	Air C.F.M.	G.P.M.- 40°F. water	Approx.Tons Refrig.
1	4316	96	52
2	3154	71	39
3	5460	121	66
4	4150	93	51
5	6250	139	76
6	6230	139	76
7	3320	75	41
8	4316	96	52
TOTAL -	37,196	830	453

Conventional Air Conditioning -

Seven systems, complete, with fans, coils, filters and ductwork:

System	Air C.F.M.	Approx. Tons Refrig.
1, 2	4500	15 each - 30
3	6050	22
4	6200	21
5	3300	19
6	6500	21
7	4000	24
TOTAL	30,550	137

Hot Water Converters -

1 - 100 g.p.m. - 114°F. to 120°F.

1 - 110 g.p.m. - 114°F. to 120°F.

2 - 140 g.p.m. - 114°F. to 120°F.

1 - 165 g.p.m. - 114°F. to 120°F.

1 - 30 g.p.m. - 119°F. to 200°F.

Chilled Water Pumps

3 - 415 g.p.m. - 40°F. water 25 h.p.

2 - 400 g.p.m. - 40°F. water 30 h.p.

Chilled and Hot Water Circulating Pumps (for air conditioning):

2 - 140 g.p.m. - 45' head

1 - 165 g.p.m. - 42' head

1 - 110 g.p.m. - 40' head

1 - 100 g.p.m. - 45' head

1 - 30 g.p.m. - 25' head

23 - Ventilating and Return Air Fans

Centrif: 4 - 7000 c.f.m.

14 from 500 to 4000 c.f.m.

1 - 400 c.f.m.

1 - 200 c.f.m.

Propeller: 3 - 250 c.f.m.

Unit Heaters -

4 - 46 lb/hr. 510 c.f.m.

1 - 28 lb/hr. 438 c.f.m.

Hot water storage heater - 1731 gal. cap., 1000 g.p.h. generation.

Transformers -

7 - 75 kv.-a. - 480/120 - 208

1 - 75 kv.-a. - 480/220 -

12 - 15 kv.-a. - 480/120 - 208

Main electric load center is located outside the building.

13,500 lin. ft. - Two-way sheradized underfloor duct, with fittings and boxes.

1 - Freight elevator, hydraulic, 6000 lb. capacity, 6' x 7'-11" platform, 25 - 30 f.p.m.

100 kw. Emergency diesel generator.

DEVELOPMENT OF DESIGN

The initial design concept of the Administration Building was based on a preliminary organization chart which indicated the total number of personnel to be accommodated in the building to be 475. This early estimate was revised later and the occupancy placed at 868 of which 538 were du Pont and 330, AEC personnel. This figure prevailed only briefly and the occupancy figure was eventually set at 1100; 740 du Pont and 360 AEC employees. This change in space requirement occurred between the last few weeks of 1950 when design started and the issuance of Revision #2 of the Design Data Report, dated March 25, 1952. The external dimensions of the building have not been increased since that time but the capacity of the building was increased when it was found possible to make the basement space in the central structure available for personnel occupancy by removing and relocating heavy machinery, air conditioning apparatus and other mechanical equipment. The floor space released by these changes was utilized for record, tabulating, IBM and other clerical functions. It also made possible the installation of the print shop, the engineering reproduction section and stationery storage in this area. At this same time one wing of the basement was set aside for record storage and a separate record storage building previously contemplated, was eliminated.

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W-155216 - Basement Plan Wings A-1, B.

W-155236 - Basement Plan Wing E-2.

W-155218 - Basement Plan Wings D-2, E-3.

W-155259 - Basement Plan Wings C, D-1.

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W-155225 - 2nd Floor Plan Wings A-2, E-1.

W-155226 - 2nd Floor Plan Wings A-1, B.

W-155227 - 2nd Floor Plan Wing E-2.

W-155228 - 2nd Floor Plan Wings D-2, E-3.

W-155229 - 2nd Floor Plan Wings C, D-1.

W-155230 - Roof Plan

W-155231 - Elevations - Sheet #1.

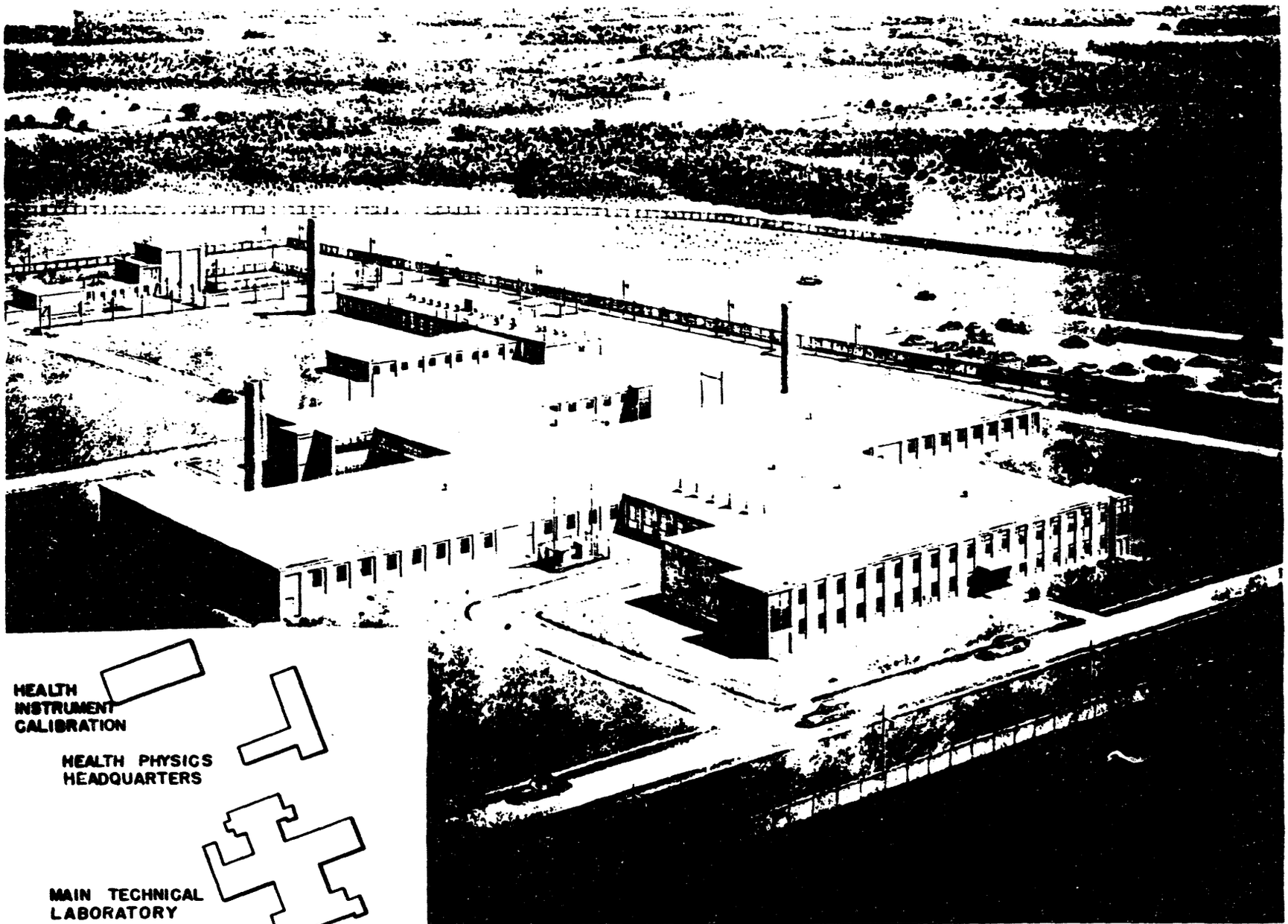
W-155232 - Elevations - Sheet #2.

W-155854 - Electrical Single Line Power Diagram.

BUILDING #735-A - HEALTH PHYSICS HEADQUARTERS

FUNCTION

Permanent facilities for performing a major portion of the Health Physics operations at the Savannah River Plant are provided in this building. These functions include sampling and analyzing for radioactivity the specimens of earth, air, water and plant and animal life collected on or near the plant site; the development of methods and instruments for measuring and controlling radioactive contamination; monitoring for radioactive contamination and personnel exposure resulting from plant processes; and headquarters for personnel monitoring facilities and Health Physics personnel records storage as well as a base of operations for Health Physics operations employees.



700 AREA-TECHNICAL

PRINCIPAL COMPONENTS

The Health Physics Headquarters Building is located in the #700-A Technical Area between the Main Technical Laboratory and the Health Physics Calibration Building.

It is a T-shaped building with a main floor at ground level and a service floor basement. Laboratories and auxiliary modules occupy the main floor. Service facilities and air conditioning equipment are housed in the basement.

The main wing of the T is divided by a corridor which is flanked on one side by laboratory modules and on the other by auxiliary office modules. These basic units were modified, in several instances, to special laboratory and particular auxiliary functions. Quarters and facilities are provided in this wing for the Site Survey group, the Control section, Counting operations, and the Methods group. Change rooms, a combination lunch and meeting room, a tool room, a consultant's office and the Health Physics Survey office are also located in this wing.

Site survey operations are accommodated in the east end of the main wing. A double auxiliary module serves as a Sample Receiving Room where site survey equipment is assembled, preparations made for field trips, and samples received. A loading platform with a protective overhead concrete canopy is provided outside the Sample Receiving Room on the south side of the building. A permanent sample storage room for certain earth, water, and vegetation specimens and for laboratory supplies is located directly beneath the Sample Receiving Room in the basement and these two areas are serviced by a small dumb-waiter type elevator which runs between them. Next to the Sample Receiving Room are two small offices, one serving as a Trip Headquarters Room where current site survey records are maintained and the other as a Health Physics office for personnel responsible for monitoring the building. A Computing and Files office, a Group Supervisor's office, a Cartography room for preparing maps and charts presenting and evaluating results of site survey investigations, and a Chamber Repair room are located in auxiliary office modules and complete the facilities devoted to Site Survey operations.

The Chamber Repair room is equipped to perform periodic checks and make necessary adjustments on portable ionization chambers located at various points throughout the plant site which are exposed constantly to minor damage and interference.

Control section personnel are engaged in the preparation of samples collected by the Site Survey group for radioassaying in the Counting room. The facilities provided for Control operations consist of eight laboratories, a Contaminated Dark Room, and a supervisor's office. These include a

Vegetation laboratory for preparing plant life specimens, two water processing laboratories, a Wastes laboratory where samples of waste sludges and river mud are prepared for analysis and counting, a Fluorophotometer laboratory for low-level analyses involving the use of a fluorophotometer and a spectorophotometer, two Control laboratories for sample radio assay, and a Biology laboratory for preparing plant and animal life samples. The Contaminated Dark Room in this section provides facilities for exposing film to possible contaminated filter papers and testing biological and botanical specimens for radioactivity.

Specimens are sent from the Control section to either the low-level or high-level counting room. In both rooms the atmosphere is maintained at 45% ±5% relative humidity and 75° ±2° temperature, Fahrenheit. The low-level counting room occupies a double laboratory module, with an Instrument Maintenance Shop between it and the single module high-level counting room. Facilities are provided in this shop for the repair and adjustment of instruments and laboratory equipment assigned to the building.

The Methods Instrument Group is composed of three sections; Chemistry, Physics and Instrument Methods. Two individual laboratories in the east end of the main wing are devoted to the Chemistry Methods operations by which procedures are developed for routine measurement and control of personnel exposure to radioactivity. Physics Methods operations are accommodated in a single module laboratory at the opposite end of this wing where instruments are tested and exact physical measurements are calculated. Two laboratories are provided for the Instrument Methods section. One is a shielded laboratory for evaluation and experimental work on new types of counting instruments, particularly crystals and phosphors. The walls of this laboratory are of reinforced concrete, one foot thick. The other Instrument Methods facility is a double laboratory for experimental work on portable instruments. An Isotope Storage and Dilution laboratory, which is part of the Instruments Methods facilities, occupies a single laboratory at the east end of the main wing beyond the two Chemistry Methods laboratories. A monorail and hoist are provided here for handling isotopes to and from shielded storage containers recessed in a special pit built into one corner of the laboratory floor. Shielded facilities are provided for the dilution of isotopes. Each of these three sections has a small auxiliary office near the respective laboratory operations.

A Tool Room for the laboratories, a combined lunch and meeting room, and change room facilities with lockers, showers and toilets for laboratory employees occupy the rest of the space in this area.

The smaller wing, approximately 45 ft. wide by 112 ft. long, houses the operations involved in reading and recording film badges and personnel meters, the offices for supervisory and clerical functions, a small storage room for the Personnel Meters group, and the approximately 1200 square feet of space at the north end of the wing for the storage of plant personnel Health Physics monitoring records. Facilities provided in this area for the Personnel Monitoring operations consist of a routine dark room for developing film badges, a Meter and Filing Room where film badges and personnel meters are tested for exposure and where films are read, a special dark room where unique film contamination and special problems are processed, and a Microscopy laboratory essential for use by the #700-A Technical facilities.

A small acid and solvent storage shed is located near the northeast corner of the main wing. Two cylinder storage sheds for burner gas, inert gas, and methane gas, used in laboratory operations, are attached to the building on the north wall outside of the control laboratories.

BUILDING FLOOR SPACE

Site Survey	Approx. Sq. Ft.
Auxiliary Offices, four	650
Trip Headquarters Office	85
Sample Receiving Room	340
Control	
Laboratories, eight	2,350
Contaminated Dark Room	160
Office	170
Counting Room	
Low-Level Counting Room	590
High-Level Counting Room	300
Instrument Repair Room	250
Methods	
Laboratories, six	1,600

	Approx. Sq. Ft.
Shielded Laboratory	240
Offices, three	500
Lunch and Meeting Room	570
Tool Room	340
Change Rooms and Sanitary Facilities	1,000
Consultant's Office	140
Health Physics Survey Office	85
Personnel Meters	
Dark Room, two	600
Metering and Filing Room	400
Microscopy Room	200
Personnel Records Storage Room	1,000
Personnel Records Office	150
Pencil Meters and Storage Room	150
Administrative	
Offices, six	950
Clerical and Daily Reports Office	400
Corridors	
Main Laboratory Wing (Including laboratory service shafts)	2,700
Personnel Meters Wing	550
Basement	12,300
Store Room in Basement	360
Shelter	530

BUILDING DETAILS

A single story, T-shaped building of predominantly Class II construction, the structure includes a Shielded Instrument Laboratory and a basement shelter of Class I construction. The main wing is approximately 50 ft. wide by 260 ft. long by 13 ft. high from the floor to the top of the roof slab. The smaller wing is approximately 46 ft. wide by 113 ft. long by 11 ft. high. There is a full basement under the main wing and a shelter under that end of the smaller wing where it joins the larger section of the building. Both areas are approximately 14 ft. high from the basement floor slab to the top of the first floor slab.

The area of the Class I portion of the building is approximately 1500 square feet and the volume is approximately 21,000 cubic feet. The Class II area is approximately 31,500 square feet with a volume of 417,050 cubic feet.

CONSTRUCTION DETAILS

Building foundations are of reinforced concrete with spread footings, the Class I areas also having reinforced concrete walls and roof. The Class II portion of the building has reinforced concrete framing and roof slab. The exterior walls are flat cement asbestos panels on steel girts between the reinforced concrete columns. The interior of exterior walls is of flat cement asbestos board on steel studs in the offices and in the laboratories, a metal wainscot to line with the top of reagent shelving with cement asbestos board from this height to the ceiling. Interior walls of the offices are of cement asbestos board on steel studs, while the laboratories have flush type metal partitions with posts to the top of reagent shelving and cement asbestos panels above this level. Toilet room walls are of concrete to a height of 4 ft. with cement asbestos board on steel studs above. Walls in the change rooms are of flat cement asbestos board.

Hung ceilings in the corridors and laboratories are finished with flat cement asbestos board and in the counting rooms and instrument repair room with acoustical tile. Ceilings in the microscopy room, the metering and filing areas, the women's change rooms and toilets, the lunch and meeting room, and the clerical and daily reports room have acoustical tile applied to the underside of the concrete roof slab. In the remainder of the building the ceiling is formed by the underside of the roof slab or the underside of the first floor. Doors are hollow metal and sash is fixed, steel.

Roofing is built up and the roof, exterior walls and walls of toilet rooms are insulated. The concrete floor is covered with asphalt tile except in six laboratories which have vinyl tile covering.

The entire structure is air conditioned for comfort. Heating in the personnel meters wing is augmented by hot water coils in the window units of the perimeter system and by fin-tube radiators in toilet rooms, shower rooms and change rooms. The steam source for these services is the area power house. The air conditioning system in the main laboratory wing is conventional with cooling coils and target sprays in the ducts to maintain a temperature of 75° ±2°F. and a relative humidity of 45% ±5% in the counting rooms and the instrument repair room.

Air is exhausted from hoods or bypass ducts in the laboratories through roof fans. Ventilation is maintained in toilet and change rooms by utility fans.

Lighting is incandescent in the basement, corridors, dark rooms, lunch and meeting room, change and toilet rooms, tool room, and sample receiving room. In all other areas fluorescent lighting is provided.

Electrical power is supplied to the building from substation Building #752-6A via aerial feeder at 480 volts three phase. Dry type transformers are used to step the voltage for lighting down to 120-208 volts three phase. In case of failure of normal electric power, a feeder from the emergency diesel generator in Technical Laboratory Building #773-A provides power to emergency lighting and critical ventilation motors. All lighting which may be seen from outside the building may be blacked out from Patrol Headquarters, Building #720-A. Area alarm on instruction during emergency conditions may be given to all building personnel from Building #720-A by means of loudspeakers located throughout the building. A power supply for instrumentation circuits is provided in a separate feeder from 75 kv.-a transformer located at Substation Building #752-12A. With the addition of the Biological Assay Building it was necessary to install another power service which was a 480 volt aerial feeder from Substation Building #752-16A.

EQUIPMENT

Carrier perimeter air conditioning system for personnel meters wing.

Primary unit, 24 tons refrigeration

Window units, 10 tons refrigeration.

Air conditioning system for 9 laboratory and office modules, 62 tons refrigeration.

Air conditioning system for 10 laboratory and office modules, 82 tons refrigeration.

Air conditioning unit for lunch room, 15 tons refrigeration.

2 Laboratory centrifugal exhaust fans, 1-1/2 hp., 1750 r.p.m., 2000 c.f.m.

2 Contaminated laboratory exhaust fans, 10 hp., 1750 r.p.m., 6000 c.f.m.

1 Basement exhaust centrifugal fan 1/3 hp., 1750 r.p.m., 2000 c.f.m.

1 Laboratory supply centrifugal fan, 1-1/2 hp., 1750 r.p.m., 2250 c.f.m.

1 Laboratory supply centrifugal fan, 5 hp., 1150 r.p.m., 8500 c.f.m.

1 Laboratory supply centrifugal fan, 5 hp., 1150 r.p.m., 7650 c.f.m.

1 Laboratory supply centrifugal fan, 3 hp., 1350 r.p.m., 4500 c.f.m.

1 Corridor supply centrifugal fan, 1-1/2 hp., 1600 r.p.m., 2640 c.f.m.

1 Toilet exhaust centrifugal fan, 1/4 hp., 1060 r.p.m., 1150 c.f.m.

8 Laboratory exhaust centrifugal fans, 1/4 hp., 1750 r.p.m., 850 c.f.m.

1 Basement exhaust centrifugal fan, 1-1/2 hp., 395 r.p.m., 8000 c.f.m.

1 Basement exhaust centrifugal fan, 1/2 hp., 1180 r.p.m., 2700 c.f.m.

1 Basement exhaust centrifugal fan, 3/4 hp., 590 r.p.m., 4000 c.f.m.

1 Laboratory exhaust centrifugal fan, 1-1/2 hp., 1990 r.p.m., 2400 c.f.m.

Association for Information and Image Management
1100 Wayne Avenue, Suite 1100
Silver Spring, Maryland 20910
301/587-8202

Centimeter

Inches

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3 of 5

1 Laboratory exhaust centrifugal fan, 3/4 hp., 1460 r.p.m., 1500 c.f.m.

1 Laboratory exhaust centrifugal fan, 1/2 hp., 1380 r.p.m., 1200 c.f.m.

2 Carbon ring air compressors, 15 hp., 360 r.p.m., 89 c.f.m. Displacement

1 Chilled water pump, 25 hp., 1750 r.p.m., 520 g.p.m., 100 ft. head

1 Chilled water pump 5 hp., 1750 r.p.m., 65 g.p.m., 70 ft. head

1 Chilled-hot water pump, 2 hp., 1750 r.p.m. 35 g.p.m., 50 ft. head

2 Drain exhaust industrial exhausters, 1/2 hp., 3500 r.p.m., 50 c.f.m.

2 Health physics air sampling centrifugal blowers, 5 hp., 3500 r.p.m. static pressure, 60" of water, 140 c.f.m.

2 Off-gas exhaust centrifugal blowers, 3 hp., 3500 r.p.m., static pressure, 45" of water, 275 c.f.m.

1 Steam hot water heater, 575 gallon storage

1 Duplex sump pump, 50 g.p.m., 15 ft. head

1 Steam hot water heater, 420 gallon storage

1 Hot water circulator, 1/4 hp., 1750 r.p.m.

2 Vacuum pumps, displacement of 115 c.f.m. at 26" mercury vacuum

2 Steam water stills, 5 g.p.m.

The following 4'0" long pieces of laboratory furniture are provided:

Sink and drainboard units	14 pieces
Cabinet units	153 pieces
Wall cabinets	36 pieces
Tables	56 pieces
Pegboards	10 pieces

Amercoated plywood fume hoods	47 pieces
Work benches	15 pieces
Shielded glove box	
Crane and hoist, 1-ton	
10" Tool room lathe	
Jeweler's lathe	
6" Pedestal grinder	
1/2" Capacity drill press	
"Do-all" Saw	
31 High shelving sections, 3' x 7'	
5 High shelving sections, 4' x 7'	
9 Lunch room tables	
36 Chairs	
Conventional office furniture in all offices.	

Maintenance and test instruments, portable radiation monitoring equipment, health physics analytical instruments used for chemical analysis and radiation experiments and detection are provided.

DEVELOPMENT OF DESIGN

Design Changes and Additions

Initial planning for this building was developed from an outline prepared by the Operating Department and submitted to Design in March, 1951. This was fundamentally a summary of essential facilities in the form of space requirements, and from this tentative breakdown a preliminary plan was formulated which incorporated the specifications indicated. Questions which had arisen and factors requiring amplification and clarification were submitted along with this initial plan to AED late in April, 1951. The proposal was reviewed by AED and the Design Division was subsequently advised that the facilities contemplated originally were to be reduced about 35 per cent. The first Design Data Report was then prepared by AED, based on the preliminary plan and the reduced requirements, to confirm the revisions and

eliminations. On the basis of this first Design Data Report the Design Division prepared the plan which was to be essentially the final one and it was presented to and approved by AED late in June.

Several factors influenced the original Design Division concept of the building during the earliest design stages and were included in the preliminary plan. It was decided to use a controlled velocity hood exhaust system rather than a constant volume system because of the large number of hoods per module in the building and the resultant saving in the amount of conditioned air required for each module. Downdraft hoods were specified since hoods of this type became economical and practical when exhaust air must be filtered and discharged through a central exhaust system and stack outside the building. It was decided to isolate the Fluorophotometer laboratory and to locate it out of the hot area and away from the general stream of traffic of the high-level laboratory operations. The change room facilities were enlarged and showers were included.

As a result of AED's revised requirements some facilities were deleted entirely, others were combined with related activities, and still others were accommodated in areas of reduced size or were relocated for more efficient and effective operation. The Tool Shop for the laboratory groups was placed in the southwest corner of the main wing near the Physics and Instrument Methods laboratories.

In August, 1951, it was agreed that a fire wall was required at the juncture of the two wings and this feature was added. In the same month the exterior concrete structural piers for the laboratory modules were reduced from 24-foot to 12-foot centers and the concrete wainscot was deleted and replaced by flat cement asbestos board in order to achieve the required 50 per cent friable area. In January, 1952, the title of the building was changed from Health Instruments to Health Physics Headquarters. During this same period the free standing exhaust stack was eliminated and in its place an exhaust stack connected to the building on the east wall of the main wing was provided next to the Isotope Dilution laboratory at the point where the exhaust leaves the building. This is a stainless steel stack rising to a height of 8 feet above the highest elevation of the building.

In compliance with early design philosophy, a Class I shelter to accommodate 80 persons was provided in the basement under the smaller wing at the point where it is joined to the main wing. Both an interior and an exterior stairway give access to this facility. Later, it was determined that this shelter was not required, but construction had progressed to such a degree that the room was installed before the decision to delete it had been reached.

Biological-Assay Building

In the early design stages of the Savannah River Project the need for a laboratory to house the facilities for routine analysis of urine samples of plant employees for radioactive nuclides was anticipated in the designation of a Biological-Assay Laboratory, Building #737-A. Concurrently with this provision the necessity for extensive on-site studies of water treatment and equipment was recognized. The CMX and TNX facilities were speedily constructed for these water studies and development programs with the objective that they would serve development requirements temporarily and no longer be required by the time the Plant was ready to operate. On this basis, it was then thought that some of the laboratory facilities, necessary for the temporary operations, would be permanently capitalized and used for the bio-assay functions. As the project developed, however, it became apparent that the need for development work on water cooling and other equipment would continue indefinitely. The CMX and TNX laboratory facilities already provided were barely adequate for the work for which they were originally intended. In order to fill the need for bio-assay laboratory requirements separate facilities had to be provided.

The quantitative measurement of plutonium, P-10, uranium, fission products and other radioactive elements in the urine of plant employees is a permanent routine function and a vital necessity in plant operations. A second function in operating control is the analysis of blood, feces, sputum and other biological samples.

It was decided, early in 1953, to incorporate the bio-assay laboratory facilities in the existing Health Physics Headquarters, Building #735-A, by adding an extension to the smaller wing of this structure.

Eight laboratory modules, men's and women's locker rooms and toilet facilities, an office for the supervisor and a larger clerical office are provided. This new wing is joined to the end of the personnel meters wing of the original building and extends parallel to the main wing. The laboratory area is divided into a Receiving and Dispatching Room, an Evaporation Room, Separation, P-10, Uranium, Electro-Deposition and Microscope laboratories and a Dark Room. Urine containers and their carrying cases are received and stored in the Receiving and Dispatching Room which serves also as a transfer point. The containers are taken from their carriers and transferred to a laboratory. This regulation precludes the introduction of the carrying cases, which might be contaminated, into the laboratory area. Radio-autographic analysis of plutonium is done in the Microscopy

Room. Film used in radioautographic analysis is exposed and developed in the Dark Room. Urine samples are evaporated and the containers cleaned in an Evaporation Room which adjoins the Receiving and Dispatching Room. The other four laboratory modules are devoted to uranium, P-10, separation and electro-deposition operations. This area may be closed off from the rest of the wing by double doors in the central corridor. Men's and women's change rooms and toilet facilities, the supervisor's office and the clerical office are located in the service end of the wing.

The extension conforms in construction to the main part of the building and is a Class II structure. It has a structural steel frame with flat cement asbestos siding, concrete slab roof and floor, but no basement. Approximately 43 ft. wide by 82 ft. long, the addition is 13 ft. high from the floor to the top of the roof slab. Laboratory floors are covered with vinyl impregnated asbestos tile, floors in the service area are covered with asphalt tile. The structure is air conditioned, and fluorescent lighting is provided.

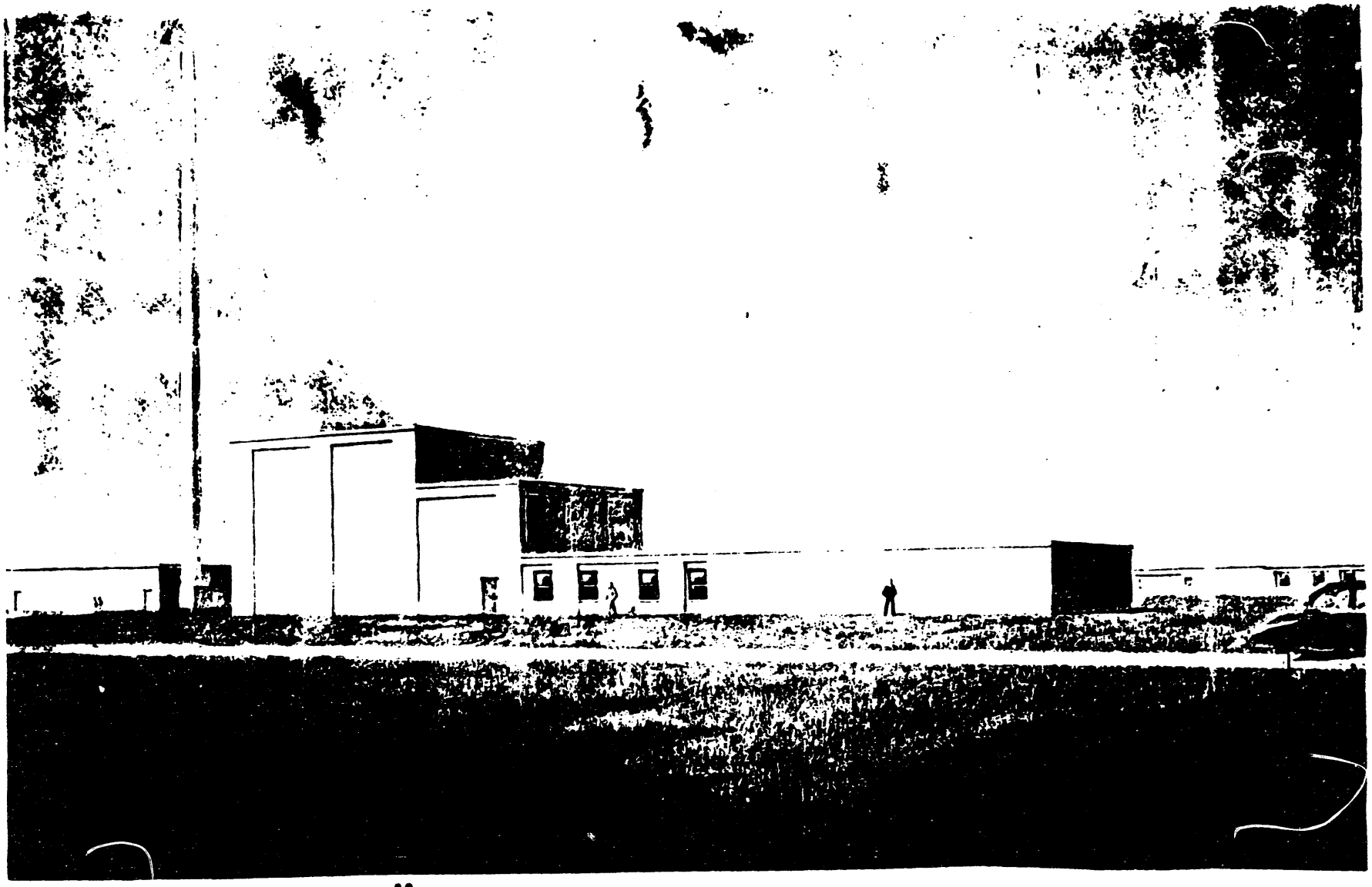
There is a protective canopy over the outside entrance to the Receiving and Dispatching Room, and a small cylinder storage shed is attached to the south side of the new wing outside of the Evaporation room. There is a penthouse water still on the roof over the Receiving and Dispatching Room. All of these appended structures have corrugated cement asbestos roofs.

Instrumentation

A large quantity of commercially available laboratory instruments, which required no special design, was purchased for this building. Three items, pocket chambers, charge readers and portable survey instruments, however, required extensive testing and some alteration to commercially available models before they could be adapted to the Savannah River Plant needs.

The pocket chambers are small fountain-pen-shaped instruments which are worn by all plant personnel subject to chance radiation exposure. These instruments indicate the amount of radiation encountered and the charge reader makes a record of the radiation at the end of each day. In this manner, a day to day record of the exposure of each employee is maintained. Hence, extreme accuracy and dependability were the most important requirements of these pocket chambers.

From this building three types of portable survey instruments are distributed for use in all areas in which there is



BUILDING #736A··· HEALTH PHYSICS CALIBRATION

any possibility of radiation being present. Facilities also are provided in the building for maintaining and periodically calibrating the survey instruments. The three types which are provided are (a) one which detects gamma radiation only, (b) one which detects alpha, beta, and gamma radiation indiscriminately, and (c) a third which can detect either beta or gamma radiation and differentiate between the two. Each of these three types is used for a different purpose.

DRAWINGS

W-155951 - Service Floor Plan Architectural.

W-155952 - Main Floor Plan Architectural.

W-155953 - Roof Plan Architectural.

W-155954 - Elevations Plan Architectural.

W-155955 - Building Sections Architectural.

W-155956 - Wall Sections Sheet #1 Architectural.

W-155957 - Wall Sections Sheet #2 Architectural.

BUILDING #736-A - HEALTH PHYSICS CALIBRATION BUILDING

FUNCTION

Facilities for the periodic calibration of portable radiation-measuring instruments are provided in this building. These include such instruments as portable ionization chambers, Geiger-Mueller tubes, pocket meters, film badges, and neutron measuring devices. Miscellaneous special instruments used by the Technical Division are calibrated here also. In addition, the building is headquarters for the personnel and equipment employed in the routine calibration of fixed equipment in all operating and service areas, and also serves as the repository for the inventory of radiation sources used throughout the plant.

PRINCIPAL COMPONENTS

An Instrument Receiving Room is provided for contamination check and any necessary decontamination of incoming instruments. Instrument battery check and replacement and other minor maintenance is done in a Maintenance Room. An X-ray Room handles primary calibrations and development work with X-ray and gamma radiations, and an X-ray Control

Room houses X-ray unit controls and has laboratory space for the preparation of instruments and meters undergoing X-ray calibration. Four shielded calibration rooms are provided. Calibration of badge film and pocket meters is done in a Gamma Film Calibration Room. There is a Gamma Instrument Calibration Room and a Neutron Source Room for housing the neutron source used in calibration requiring neutron bombardment. The remaining room in this section is a Cobalt Room in which radioactive cobalt can be raised and lowered into a shielded well, providing a variable degree of radiation during calibration of instruments.

Two rooms are provided for unshielded calibration. One is a Beta Film Room for work concerned with badge film calibrations and the other is a Pocket Meter Reading Room for use in reading and charging pocket meters after X-ray and gamma exposures.

A Storage and Shipping Room provides for the temporary storage of calibrated instruments before shipment to their points of origin.

Wash, locker and sanitary facilities are provided for a maximum of twenty women and ten men, based on an occupancy of ten women and five men per shift.

There is an office for the supervisor and typist, with space for the files assigned to the building. The plant inventory of radioactive sources is stored in a vault, a shielded room with a maze entrance. Janitor's supplies are accommodated in a closet which also contains a toilet for the use of the janitor assigned to this building and to the Health Physics Headquarters, Building #735-A. Service facilities for the building are located in a Utility Room on the first floor, eliminating the need of a basement.

BUILDING FLOOR SPACE	Approx. Sq. Ft.
Receiving Room	200
Maintenance Room	100
X-ray Calibration Rooms:	
X-ray Room	1,650
X-ray Control Room	700
Shielded Calibrations Rooms (based on inside dimensions of shielded walls):	

	Approx. Sq. Ft.
Gamma Film Calibration Room	300
Gamma Instrument Calibration Room	300
Neutron Source Room	450
Cobalt Room	400
Unshielded Calibrations Rooms:	
Beta Film Room	150
Pocket Meter Reading Room	150
Storage and Shipping Room	200
Wash and Locker Rooms	415
Office	160
Vault (based on inside dimensions of shielded walls)	130
Janitor's closet and toilet	40
Utility Room	550

BUILDING DETAILS

The building is a combination of Class I and Class II construction, with a total approximate area of 7,800 square feet, and a total volume of 154,000 cubic feet. It is a rectangular structure approximately 153 ft. long by 45 ft. wide. The roof has three elevations; 92 ft. of the length is 11 ft. from the floor to the top of the flat roof slab; 20 ft. of the length is about 27 ft. from the first floor slab to the top of the roof slab with an intermediate floor 15 ft. above the first floor slab; and 41 ft. of the length is 39 ft. from the first floor slab to the top of the flat roof in the X-ray room section of the building.

CONSTRUCTION DETAILS

Foundations are of reinforced concrete with spread footings, with the Class I portion having reinforced concrete walls, roof, and interior partitions. In the Class II section, the reinforced concrete roof slab is supported on a reinforced concrete frame, with exterior walls of flat cement asbestos panels on steel girts between the reinforced concrete columns, and interior walls of the same material on steel studs. The inside wall of the X-ray room

is of reinforced concrete. The interior surface of the exterior walls and all locker room walls is faced with flat cement asbestos board on steel studs. Toilet room walls are concrete to a height of 4 feet with flat cement asbestos board on steel studs above this level.

The underside of the roof slab is painted and forms the ceiling of the building. Doors are hollow metal and sash is double hung steel. The roofing is built up, and the roof, exterior walls, and walls of toilet, rest rooms and the utility room are insulated. Asphalt tile floor covering is installed over the concrete floor throughout the building except in the locker rooms, utility room and janitor's closet. Heating is furnished to the wash room and locker room by steam coils in the ductwork, while the rest of the building is comfort conditioned by means of a conventional air conditioning system. This system is not equipped to humidify air during winter months. The Pocket Meters Reading Room, however, is serviced by a built-up unit with a separate compressor and condenser unit to maintain 75° ± 2° F. temperature and 45 ± 5% relative humidity.

The vault, janitor's closet, utility room, receiving room, wash rooms and locker rooms have utility fans exhausting above the roof. Air to the remainder of the building is recirculated or exhausted as required by exterior temperature conditions.

Incandescent lighting is furnished in the X-ray, Utility, Receiving, Maintenance, Shipping and Storage, wash and locker rooms, vault, corridors and the janitor's closet. All other areas have fluorescent lighting.

Electrical power is supplied to the building from substation Building #752-6A via aerial feeder at 480 volts, 3 phase. Dry-type transformers are used to step the voltage for lighting down to 120-208 volts, three phase. In case of failure of normal electric power, a feeder from the emergency diesel generator in Waste Disposal Building #776-A provides power to emergency lighting. All lighting which may be seen from the outside of the building may be blacked out from Patrol Headquarters Building #720-A. Area alarm or instruction during emergency conditions may be given to all building personnel from Building #720-A by means of loud-speakers located throughout the building.

EQUIPMENT

Receiving Room

1 Cabinet type piece of laboratory furniture.

2 Cabinet type sink units.

6 Instrument dollies.

1 Electrically heated cabinet.

Maintenance Room

2 Work benches.

X-Ray Room

1 250-volt Constant potential X-ray machine.

1 X-ray equipment positioning bracket.

X-Ray Control Room

5 Work tables.

1 Instrument truck.

1 File cabinet.

Gamma Film Calibration Room, Gamma Instrument Calibration Room, Neutron Source Room, Beta Film Room

Special equipment required for these rooms was built by operations in the field.

Cobalt Room

2 Cobalt source manipulators.

Pocket Meters Reading Room

Built-up air conditioning unit with 1-1/2 hp. compressor and condensing unit with supply and return ducts from utility room.

Storage and Shipping Room

15 Shelving units, 2' x 3' x 7'-8" high.

7 Instrument trucks.

Office

Conventional office furniture.

General

Conventional 25-ton air conditioning unit with accessory fans and duct work, chilled water from central refrigeration plant.

Hot water heater with storage capacity of 118 gallons.

Portable radiation detector and routine test instrument.

DEVELOPMENT

The preliminary scope of work for this building anticipated a rectangular structure with two Class I sections separated by the necessary service facilities and with a vault adjacent to the X-ray room at one end of the building. These tentative plans were reworked in order to locate the vault and the shielded calibration rooms of Class I construction in the north end of the building and to place the X-ray room at the other end of the building in such a way that the required 100 feet of clear space adjoining it would be provided. The service facilities and unshielded work areas were then placed between the two Class I sections. To meet design requirements for shielding walls, Class I construction was required for the four calibration rooms and for the wall between the X-ray room and the rest of the building. A space with a clear area forty feet square and forty feet high was required for the X-ray Room to provide a space in which instruments could be calibrated by X-ray bombardment without having X-ray "back-scatter" from the walls and ceiling.

The original scope of work did not include protective canopies at the entrance, but it was decided early in design to extend the roof at the truck entrance of the Shipping and Storage Room to protect instruments being loaded during inclement weather.

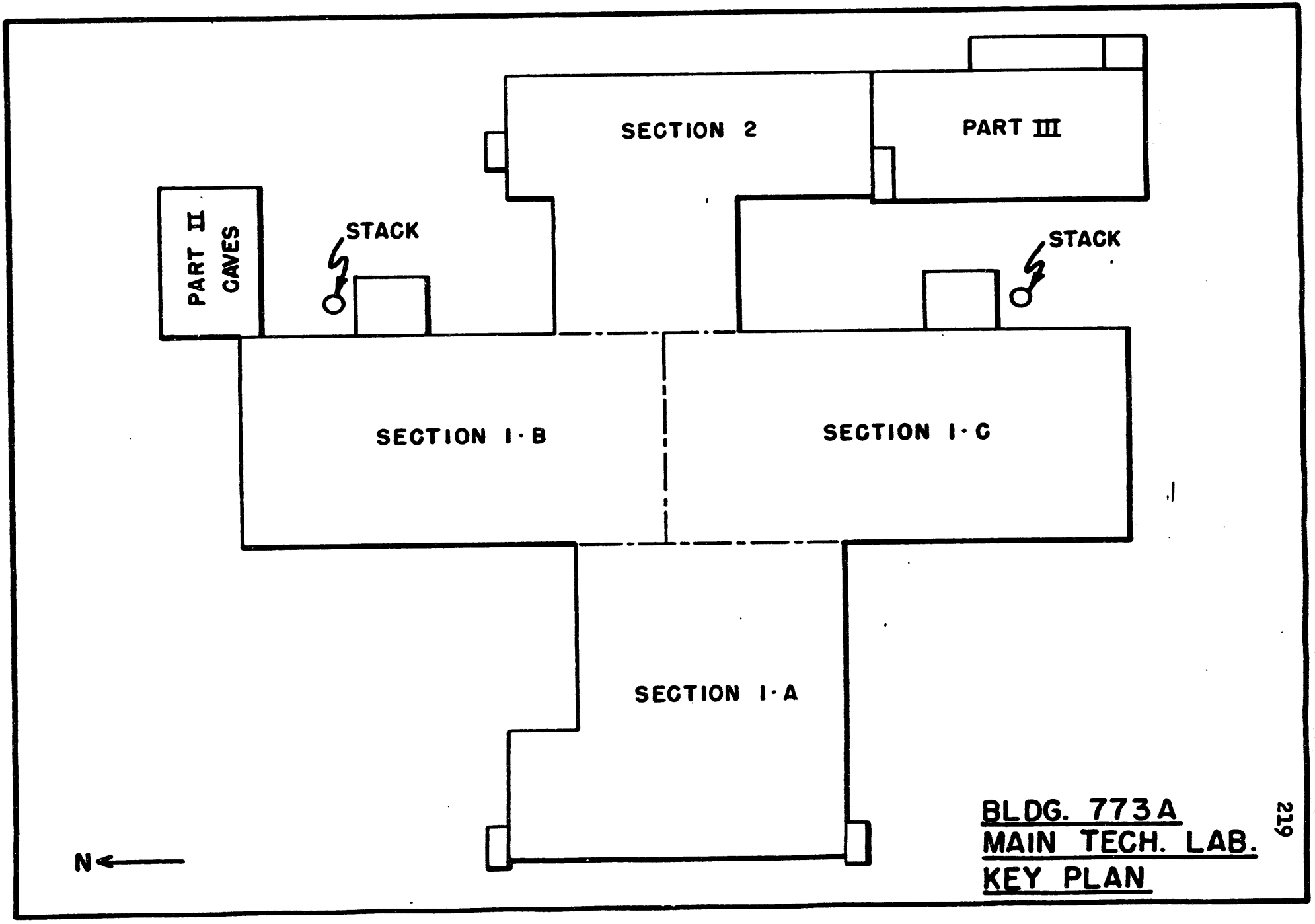
The original specifications for a Class I concrete floor finish were revised on July 9, 1951, to provide asphalt tile floor covering in the entire building to insure dust control.

DRAWINGS

W-155932 - Main Floor Plan - Architectural.

W-155933 - Second Floor and Roof Plan - Architectural.

W-155934 - Wall Sections and Details - Architectural.



BLDG. 773A
MAIN TECH. LAB.
KEY PLAN

BUILDING #773-A - MAIN TECHNICAL LABORATORY

FUNCTION

Designed as the main laboratory facility of the plant's Technical Division, this building houses the numerous services and equipment required for development work in physics, pile engineering, instrumentation, process and analytical chemistry, chemical engineering and metallurgy. Also included are the administrative offices of the Technical Division, technical information service facilities with permanent classified document storage, technical shops and chemical stores.

PRINCIPAL COMPONENTS

Part I

Section I-A, the front wing of the building, contains the administrative and technical services, the change area and "cold" laboratories. Principal access to the building is through this section. A room, seating approximately 70, is provided in the basement of this wing for employees who bring their own lunches.

Sections 1-B and 1-C make up the main central portion with laboratory modules located back to back but separated by a utility corridor and flanked on the outside walls by auxiliary modules and personnel corridors. Both of these sections are equipped to handle radioactive materials.

Section II, a rear wing, contains stores, shops, and metallurgical and instrument development facilities.

Part II

The High Level Caves wing is located at the left rear corner of the long center wing of the main building and is distinguished by heavy bulk shielding to permit the handling of highly radioactive materials.

Part III

The Metallurgical Extension to Section 2 provides facilities for developing fabrication and processing techniques in the production of extended fuel elements.

NOTE:

For convenience, the three parts of the building are treated in separate sections of this history. Reference

to Drawings W-157650 and W-157654 and the preceding Key Plan, page 219, will acquaint the reader further with the details of building arrangement.

BLDG. #773-A - PART I - ADMINISTRATIVE AND TECHNICAL

PRINCIPAL COMPONENTS

Twenty-four offices, a conference room for seventy-five people, facilities for card program calculator work, a security and reception room, a fire and safety room containing the building alarm system, and toilet facilities for men and women are provided in this area.

Technical Information Service

This section contains the library with reading room, cubicles, two floors of stacks, a classified document room and five work rooms for the preparation of documents and library material. There is also a print shop for reproduction and printing, a Class I vault for the storage of documents, an incinerator for the destruction of classified papers, a mail room to service the entire building and six offices.

Change Facilities and Health Physics

Facilities are provided between the administrative area "cold" laboratories and the radioactive "hot" laboratories for the storage and complete change of clothing as well as health monitoring, personnel decontamination, showers and lockers for a maximum of approximately 280 people, sixteen hand and foot counters, three rooms for the first aid treatment of contaminated persons, and an instrument cleaning and storage room.

One Health Physics tool check room is provided in Section 2 of the building to serve as a separate base of operations in this area.

Raw Materials Laboratories

Specification analyses of the majority of materials purchased on the plant will be done in this section. Facilities consist of:

1 24 ft. by 36 ft. Laboratory
6 12 ft. by 24 ft. Laboratories
2 Balance rooms
1 12 ft. by 14 ft. Glass shop

4 Offices

This section is designed for "cold" work (no radioactivity).

Physics and Pile Engineering

Six double module laboratories each 24 ft. by 24 ft. are provided for galvanometer and general physics work, foil preparation, and small-scale mock-ups in pile engineering. Personnel assigned to these developements occupy twelve 12 ft. by 14 ft. offices. A small dark room is also located in one auxiliary module.

Instrument Development

Four single module 12 ft. by 24 ft. laboratories in Section 1-C and six shops and labs in Section 2 are for the manufacture and testing of varied types of electronic, mechanical and servo instruments.

Analytical Services and Development

Sixteen 12 ft. by 24 ft. modules and twelve auxiliary 12 ft. by 14 ft. spaces are provided with such analytical facilities as spectrometers and densitometers needed to support the development programs carried on in other sections of the building and to undertake programs too extensive for area routine control laboratories. New analytical methods will also be developed.

Chemistry and Chemical Engineering

Sixteen 12 ft. by 24 ft. modules and twelve auxiliary 12 ft. by 14 ft. spaces are provided with facilities for laboratory-scale chemical engineering studies for the support of plant operation activities. High and low level uranium and fission products, as well as development work on plutonium plant processes, can be handled.

Counting Room

Eight auxiliary 12 ft. by 14 ft. modules, four in chemistry and four in analytical, are equipped to serve as counting rooms. These are segregated according to the level of radioactivity, with one specifically for "standards" counting.

Metallurgy

This section of sixteen 12 ft. by 24 ft. modules and sixteen auxiliaries is provided for physical property and corrosion testing, metallography and x-ray diffraction studies,

and general physical and chemical studies in support of the reactor fuel development program.

Technical Stores and Shops

The stores section, including a material control office, is the main facility for parts, glassware, and chemical supplies for this building as well as all laboratories on the site.

Cylinder and tank storage and manifolded distribution stations for various gases such as nitrogen and propane are located outside in sheds adjacent to the rear of the building.

The shops area consists of seven shops for different crafts with accompanying tool cribs and a mock-up room for assembling large-scale laboratory equipment.

Metallurgical Development

A fabrication laboratory, foundry, welding lab and development office are provided for full size metallurgical development work. Facilities are suitable for melting, vacuum melting, forging, rolling, heat treating, machining, welding and pickling various metals.

Service Facilities

Supporting equipment such as air-conditioning units, water heaters, air compressors, electrical load-centers, and service distribution mains are located in the basement of Sections 1-A, 1-B, and 1-C. Emergency power generating equipment also is provided to avoid the shut down of critical equipment (such as exhaust units) in case of a utility failure.

Portions of the basement are isolated by shielding walls from these "clean" services areas. This regulated area segregates contaminated systems such as air exhaust from hoods and glove boxes, vacuum lines, and contaminated liquid waste drainage piping. Restricted zones are required also in equipment rooms housing off-gas blowers, vacuum pumps, and drain exhausts.

Rooms are provided with special sinks and hoods for decontaminating glassware and equipment, and these are supplied with facilities for handling strong acid.

BUILDING FLOOR SPACE

Administrative	Approx. Sq. Ft.
24 Offices	4800
Conference Room	1170
Computing Equipment Room	1350
Security Office	150
Fire and Safety Room	150
Technical Information Service	
5 Work Rooms	2850
6 Offices	1000
Vault	3000
Print Shop	2000
Library (Stacks and Reading Rooms)	3000
Mail Room	200
Incinerator Room	200
Change Area and Health Physics	
Locker, Toilet, Shower, and Clean Clothes Rooms	7600
Personnel Decontamination Rooms	350
Instrument Cleaning and Storage Room	150
Hand and Foot Counters Room	150
2 Offices	300
Health Physics Tool Check Station (Section 2)	150
Auxiliary (Local) Toilets, Rest Rooms, and Janitor's Closets:	
Section 1-A	800

	Approx. Sq. Ft.
Sections 1-B and 1-C	1250
Section 2	600
Raw Materials Analysis	
Laboratories (9 modules)	2650
2 Balance Rooms	350
1 Glass Shop	170
4 Offices	680
Physics and Pile Engineering Development	
Laboratories (12 modules)	3530
12 Offices	2050
1 Dark Room	170
Instrument Development	
Laboratories, Sec. 1-C (4 modules)	1170
2 Offices	340
1 Storage Room	170
Shops at Sec. 2	3600
Analytical Services & Development	
Laboratories (16 modules and 2 auxiliaries)	5020
1 Balance Room	170
1 Dark Room	170
1 Glass Shop	170
Plate Storage, Electrode Prep. and Densitometer Rooms	510
3 Offices and I Record Room	680

Chemistry and Chemical Engineering	Approx. Sq. Ft.
Laboratories (16 modules and 2 auxiliaries)	5020
1 Glass Shop	170
9 Offices	1530
Counting Rooms (8 auxiliary modules)	1360
Metallurgy	
Laboratories (16 modules and 2 auxiliaries)	5020
Physical Properties and Corrosion Testing	2680
Metallography and X-Ray Diffraction	1460
Task Force Chemical and Physical	880
3 Dark Rooms and 1 Microphotography Room	850
9 Offices	1530
Technical Stores and Shops (Including both Ground and Main Floors)	
Stores, Receiving and Disbursement	11,525
Shops	5950
Tool Bin	650
Mock-up Room	980
Offices and Drafting Room	850
Roofed-over Gas Storage Sheds	435
Metallurgical Development	
Fabrication Laboratory	3400
Foundry	750
Welding Lab	720
Office	150

Service Areas (Basement of Sections 1-A,B&C)	Approx. Sq. Ft.
General Building Service Equipment Areas	53,650
Emergency Generator Room	470
Regulated Area and Filter Room	11,500
Equipment Room (Exhausters)	3750
Decontamination Rooms	1150

BUILDING DETAILS

Class - II, except classified document vault which is Class I.

Size -

Class I	Class II
Area - 3250 sq. ft.	Area - 206,500 sq. ft. *
Volume - 46,500 cu. ft.	Volume - 2,797,000 cu. ft.*

* Includes basement and fan rooms

The structure is single story except for part of the administrative section which has a second floor for offices. The grade drops off gradually from front to rear of the building to such an extent, however, that all of Section 2 and Parts II and III have their ground floor at the same level as the basement or service floor of the main part of building. By providing windows on this lower floor, Section 2 is in effect two-story, allowing shops and stores on both floors.

Main laboratory portion, Section 1-B and 1-C, is rectangular, approximately 113 ft. wide by 457 ft. long, and 13 ft. from floor to top of flat roof slab. The front wing of the building, Section 1-A, is ell-shaped with one leg 73 ft. by 184 ft. and the other 96 ft. by 134 ft. The first leg, the two story office portion, is 23 ft. high from main floor to top of flat roof slab and the other 13 ft. A full basement is provided under all of Sections 1-A, B, and C measuring 14 ft. from floor to top of main floor slab. A vault for classified document storage occupies a part of the basement under the offices of the administrative wing. The remainder of the basement contains service facilities. Two

areas each 26 ft. by 215 ft. are walled off as restricted housing for waste and exhaust systems and decontamination equipment. Basement extensions, 33 ft. by 39 ft. are provided for large exhausters at the rear of Sections 1-B and 1-C. The floor level of the extensions is depressed 6 ft. 9 in. These two fan equipment rooms are 18 ft. high to their flat roof slabs and are connected to the exhaust air filters in Sections 1-B and 1-C by 550 ft. of 5 ft. by 5 ft. underground concrete plenum having special "amerplate" lining.

The shops and stores rear wing is tee-shaped. The cross of the tee is 65 ft. wide by 194 ft. long and the base is 72 ft. by 97 ft. The ground floor is 14 ft. from floor to top of ceiling slab and the main floor height is 12 ft. from the floor to the top of the flat roof slab (same as in Sections 1-A, B&C). The fabrication laboratory and mock-up areas are high-bays measuring 27 ft. from floor to top of roof slab.

CONSTRUCTION DETAILS

Foundations throughout the building are of reinforced concrete on spread footings. In the small Class I portion, the vault in the Administrative wing, the walls and ceiling are reinforced concrete. In the Class II portion, constituting the major part of the building, the framing and roof slab are of reinforced concrete. Here the exterior walls are flat cement asbestos panels on steel girts between reinforced concrete columns. In the Administrative and change area the interiors of exterior walls are sheathed with flat cement asbestos board on metal studs. In the laboratory the interior walls are a combination of prefabricated metal panels and flat cement asbestos board on metal furring. The shops have flat asbestos board to a wainscot height of 6 ft. in normal shops and to ceiling height in instrument shops, except under windows where the wainscot extends to sash height.

Interior walls separating the main laboratory portion of the building from the administrative-change area and the stores-shops area are of poured concrete with Class A fire doors. In the Administrative, change, normal shops, and stores areas the interior partitions are flat cement asbestos board on steel studs. Partitions in the laboratory areas and instrument shops are the prefabricated, flush type with metal posts and panels at corridors, service shafts and around columns. The laboratory interiors have metal to the top of the reagent shelf and cement asbestos panels above. Toilet room walls have concrete to a height of 4 ft. with flat cement asbestos board on steel studs above. Shower room walls are concrete faced with ceramic tile to a height of 7 feet.

Hung ceilings of flat cement asbestos board are installed in the corridors, counting rooms, glass shop, and all 12 ft. by 24 ft. modules of the laboratory areas. Acoustical tile is applied to hung ceilings in the counting rooms. In the remainder of the building, the underside of the concrete roof slab is exposed. Doors are hollow metal and the steel sash are double hung in all except the shops and stores where they are of the projected type. The roofing is built up. Insulation is applied to the roof and exterior walls.

The floors are concrete with asphalt tile applied as a floor covering in the administrative portion except in the library areas which have rubber tile. Quarry tile is installed in the shower rooms but the locker room floors are exposed concrete. In the laboratory areas the floors are covered with vinyl tile and in the regulated areas, acid stores and metallurgical development area vinyl paint is applied to the concrete floor. The normal shops have bare concrete floors and the instrument and glass shops have asphalt tile.

Heating

The offices have a hot water perimeter system, but in the other portions of the administrative area steam heating coils are installed in duct work. The laboratory and auxiliary modules and instrument development areas are heated by a forced air system through heaters. A similar system of forced air through heaters and duct work is used in the change room area and shops. Unit heaters are installed in the stores area. All steam is supplied by the area power house.

Air Conditioning

A perimeter system is installed for comfort conditioning in the administrative area. Conventional air conditioning with partial recirculation is provided with booster coils installed in modular branches for close control of the air in counting rooms to maintain 75 deg. F. plus or minus 2 deg. and 45 per cent relative humidity, plus or minus 5 per cent.

Ventilation

All air supplied to the building, except the change rooms, vault, stores, shops and metallurgical development, is exhausted from hoods or by-pass ducts in laboratories. Two central exhaust systems serve multiple rooms, one for each half of the main laboratory part of the building, with separate fan houses constructed near the base of the two stacks. Filtration to remove radioactivity is by AEC filters at each module. "Cold" laboratories exhaust individually to

stub stacks. Vault, change rooms, toilets and stores have utility fans exhausting above the roof. The metallurgical development and shops areas use roof fans exhausting through dust collectors or fume hoods.

Lighting

Fluorescent fixtures are installed in the administrative area, all laboratory modules and the instrument shops. Incandescent lighting is used in counting rooms, corridors, shops, stores and all service areas. The glass shop has variable intensity lighting.

Electrical

Electric power is supplied to the building by four 1000 kv-a. and one 750 kv-a. substations at 480 volts from 13,800 volt aerial lines. A total of sixteen underground feeders from these outdoor substations is run to the building. The general lighting distribution is connected to three of these feeders and dry type transformers are used to reduce the voltage to 120-208 volts for lighting. Fluorescent fixtures are installed in the administrative area, all laboratory modules and the instrument shops. Incandescent lighting is used in counting rooms, corridors, shops, stores and all service areas. The glass shop has variable intensity lighting. Upon loss of normal power, a 400-kw. diesel generator automatically starts and supplies emergency lighting and power to critical ventilation motors.

Instrumentation

Instrumentation for the building has been divided into equipment which is used for recording, warning, signalling and controlling. A central control panel in the basement service area coordinates the building services. A supervisory panel indicating service difficulties is located in the safety and fire protection office in the Administrative Area. Electric power for instrumentation is supplied by a separate 75-kv.-a. 13800/120-208 volt transformer located outside the building. Original requirements for voltage regulation on these circuits indicated protection only against isolated voltage dips caused by motor starting within the building. Subsequent requirements of extremely close voltage regulation have since made necessary the installation of motor generator sets for instrument power supply.

EQUIPMENT

Administrative

Conventional office furniture

Technical Information Service

Press Equipment

2 Offset presses

1 Multigraph with accessories

1 Addressograph

Composing Equipment

1 Vari-typer

1 IBM Executive typewriter

Binding equipment, including paper cutter, perforator, stitcher, and jogger.

Photographic equipment

1 24" x 24" Process camera with accessories

1 Exposure frame

1 Vacuum printing frame

1 Contact printer

1 Stripping table

1 Developing sink

Lunch Room

Tables and Chairs

Library Shelving

50 Single-face units, 3' wide x 7' high x 9-1/4" deep

41 Double-face units, 3' wide x 7' high x 19-1/4" deep

Computing equipment consisting of card-programmed electronic calculators (CPC Units) with collators, card punchers, and verifiers.

Change Area and Health Physics

282 Clothing lockers

284 Shoe lockers

4 Laundry chutes

3 Medical tables and examination chairs

16 Hand and foot counters.

Laboratories of Sections 1-A, B & C.

Steel junior caves - 6 Assemblies with viewers and manipulators.

Standard laboratory furniture units - 774 Pieces consisting of balance tables, cabinets, and sinks.

Standard hoods - 76 complete with desks.

Radio-bench hoods - 9 complete with desks.

Gas rack and hood complete with special services.

Decontamination hoods - 2 arrangements comprising slurping, acid washing, rinsing, and drying facilities on the main floor and 2 in the basement.

Special hoods - 8 with arrangements for special metallurgy work.

Slurping hood dollies - 16 for use at decontamination hoods.

Mass spectrometer Consolidated Model #21-103 Emission spectographs - Jarrel-Ash, 21' focal length; and B&L Littrow, Model #33-84-44

Densitometers - 2 N.S.L. Comparator - Microphotometers.

Power sources - Jarrel-Ash "Varisource" Excitation unit; and M.S.L. Spectographic unit.

Coal and gas analysis apparatus.

Standard dark room equipment - facilities for five 12' x 14' rooms.

Counters (scalers, poppies, etc.)

Metallurgy (Sections 1-C and 2)

Physical Properties Evaluation

4 Creep test machines with furnaces

5 Fatigue test units

1 Impact tester

2 Tensile testers - 500 lb. and 120,000 lb.

4 Hardness testers (4 types)

1 Strain analyzer

Corrosion Testing and Chemical Testing

26 Corrosion-resistant hot plates, stainless steel.

1 Constant-temperature water bath.

2 Test-tube ovens

10 Vacuum pumps

1 Spark-gap converter

Weighing and analyzing apparatus.

Metallography

2 Wet Cut-off wheels

1 Belt sander

2 Sample mounting pressers

5 Sample polishing table assemblies

2 Metallographs complete with accessories and independent power source

10 Microscopes

Electrolytic etching equipment

Low-power photographic equipment.

X-ray Diffraction

2 X-ray diffraction machines with central panel and power sources

X-ray Spectographic equipment.

Metallurgical Development Laboratory

1 16" x 24" Two-high rolling mill with power source

1 300-ton Forge press

1 75-ton Straightening press

6 Heat treating and drying furnaces ranging from 600° to 2500° F.

1 Vacuum muffle with pumping equipment

1 Crop shear

1 Vapor degreaser with fume hood

3 Pickling tanks with fume hoods and 1/2-ton monorail system

1 5-ton 40 ft. Bridge crane

1 Rotary swager

1 Metal cutting band saw

1 10" Lathe

4 Metal lathes

3 Drill presses

1 1/2-ton monorail system

Complete servo equipment

Hydraulic testing equipment

Helium, hydrogen, and high-frequency leak testing equipment.

Spot welder and gas welding equipment.

Technical Stores

Portable laboratory apparatus and supply items: Balances, glassware, potentiometers, spectrometers, thermometers, oscilloscopes and miscroscopes.

1200 ft. Shelving, 7 feet high

800 ft. Shelving, 10 feet high

5 Rotary bins and 1 sheet metal rack

42 ft. Bar racks

1 Precious metal safe, 18 cu. ft.

10 Dollies

Drum handling equipment.

Technical Shops

2 Universal milling machines

1 Comparator

3 Grinders - surface, universal, and tool types

2 Turret mills

6 Lathes	2 Power saws	2 Drill presses
1 Metal shaper	1 Bench shear	1 Bench brake
1 Arbor press	1 Pantograph engraver	

1 1-ton, 40 ft. Bridge crane

1 400 amp. DC welder.

2 Glass welding equipment

Glass blowing equipment

Wood working equipment

Paint spray facilities including water curtain spray booth.

Service Areas

Section 1-A Service Floor

3 Carbon ring air compressors, 98 c.f.m., 125 p.s.i., 301 HP each

1 Air-cooled compressor

2 Domestic hot water storage heaters - 1500 gals. each.

1 Process hot water storage heater - 1500 gals.

3 Chilled water pumps - 1500 g.p.m. each with 50 h.p. motor.

2 Chilled water pumps - 100 g.p.m. each with 5 h.p. motor.

1 Perimeter air conditioning unit for 1st and 2nd floor offices - 11,300 c.f.m.; 25 tons capacity.

5 Standard air conditioning units with supply fans ranging from - 1900 to 12,000 c.f.m.; 238 tons total capacity.

16 Exhaust fans ranging from 100 c.f.m. to 4000 c.f.m. (for basement supply only)

Section 1-A Second Floor Mech. Room

2 Standard air conditioning units with supply fans, 2300 and 8800 c.f.m.; 43 tons total

3 Exhaust fans ranging from 2250 to 7650 c.f.m.

2 Water stills - 25 gal./hour each with 150 gal. storage.

Section 1-A Roof

6 Exhaust fans ranging from 1000 to 4150 c.f.m.

Section 1-B Service Floor

15 Supply fans - 4 at 4800 c.f.m.

4 at 6800 c.f.m.

2 at 3780 c.f.m.

2 at 1920 c.f.m.

2 at 10,000 c.f.m.

1 at 1700 c.f.m.

9 Air conditioning units -

4 at 11,600 c.f.m.

2 at 5800 c.f.m.

2 at 10,000 c.f.m.

1 at 1700 c.f.m.

Total tonnage - 480 tons.

5 Exhaust fans - 4 at 20,240 c.f.m.

1 at 20,000 c.f.m.

2 Vacuum pumps - 235 c.f.m. displacement each with s/s 7' x 36" tank and 10 h.p. motor.

2 Off-gas exhaust blowers - 1100 c.f.m. each at 60" S.P. with 20 h.p. motor.

3 Health Physics blowers - 435 c.f.m. each at 60" S.P. with 10 h.p. motor.

1 400 kw. diesel generator

Section 1-C Service Floor

Same as for Section 1-B, except diesel unit.

Section 2 Service Equipment

38 Exhausters varying in capacity from 870 c.f.m. to 8000 c.f.m.

6 Supply ventilators varying in capacity from 3000 c.f.m. to 16,800 c.f.m.

20 Unit heaters with a steam capacity of 585 lbs. of steam per hour.

5 Fin-tube space heaters with a steam capacity of 175 lbs. of steam per hour.

3 Air conditioning units with a total capacity of 75 tons.

2 Vacuum pumps 37 c.f.m. each

Fire Protection and Evacuation Systems

A fire detection system is provided consisting of primary sensing elements which are rate-of-temperature rise detectors. These are located in all the laboratory modules and other potentially fire hazardous areas. They connect to a central panel in Office A-142 to give an indication of fire location to Building supervision. Manual evacuation alarm stations located in these areas also give alarm indication to the central panel. Alarm is manually relayed to the area fire house while an operator is in the office and automatically at other times.

"Break-glass" stations are provided at five locations on the main floor and seven locations on the service floor where an alarm may be sounded over loud speakers for building evacuation in case of a serious emergency. Area alarm or instruction during an emergency period may be given to all building personnel from Patrol Headquarters, Building #720-A by means of loudspeakers located throughout the building.

Instrumentation

Central Panel at Service Floor

Recording Instruments -

Records are kept of the exhaust air plenum pressure, building service vacuum, off-gas exhaust pressure, and health physics exhaust system pressure.

The performance levels of the vacuum pumps and air compressors are also recorded.

Alarm Instruments -

The panel contains one common horn which can be activated by any of the installed alarms. When it sounds, an illuminated name plate identifies the alarm and its location. The following alarms are provided.

1 - Static pressure alarm for the exhaust air plenum, Health Physics exhaust system, off-gas exhaust system, drain exhaust system, and each high level cave exhaust fan.

2 - Alarms for high or low liquid levels in the exhaust air plenum sump and waste line trench sump.

3 - A low pressure alarm on the instrument air system.

Controls -

Each motor in the main fan rooms has a start and stop push button, located at the central panel board. A manual switch is provided to operate each sump steam jet and make-up water valves.

Signalling Lights -

Each of the following facilities has a red illuminated panel signal which lights when the motor is stopped: The main exhaust fans, purge fans, off-gas exhaust

blowers, Health Physics blowers, drain exhaust fans, vacuum pumps, and fan room air supply and exhaust blowers.

Indicating Instruments -

Ammeters are provided to show loads on the emergency power generator.

Supervisory Alarm Panel at Office A-142 -

There is a static pressure alarm for the exhaust air plenum high pressure, an alarm for the off-gas exhaust high pressure, and also for the high level cave exhaust pressure.

Alarms are provided for high and low level system in Building #776-A.

DEVELOPMENT OF DESIGN

Building

The #700-A Technical Area Scope of Work issued on April 31, 1951, established Building #773-A as the main laboratory facility of the AED Technical Division. The AED Design Data Report issued June 27, 1951, superseded the scope and added the Technical Shops and Stores and a Metallurgical Section. These had been planned originally for a separate building. Later, in August 1951, a revised #700-A Technical Area Scope of Work requested the addition of a "caves" wing to permit laboratory work at multicurie levels. The final design of the Main Technical Laboratory, therefore, combines the facilities of the originally planned separate buildings, #773-A, #774-A and #775-A. A further revision of the scope in February, 1953, requested the addition of a Metallurgical Extension to Section 2 of the main building.

General Design Considerations

As a principal laboratory, Building #773-A had to be both well-equipped and flexible. To perform its function of supporting plant operation by investigating many nuclear problems and also by devoting a portion of its facilities and staff talent to research and development, it had to incorporate the complexity of laboratory and shop equipment. Also apparent was the fact that, designed as it was for work in the essentially new field of nuclear research, the laboratory might, over a period of years, face new and very different requirements for equipment and services. As a result of this multiple occupancy the building requirements increased in order to house a quantity of general and highly specialized laboratory equipment as well as facilities for metal

working and testing on a semi-works level. Safety considerations were important throughout design and in many ways affected the ultimate layout of the building and equipment.

The laboratory was first planned as a structure having a separate wing for each function of work, these wings to be connected by a spinal corridor. Technical stores and shops and metallurgical development were to be in separate buildings. After preliminary design studies were made it was found practical and economical to consolidate the principal laboratory sections in an integral, rectangular structure under one roof with compact tee-shaped sections for suxiliary functions such as administration at the front and stores at the back of the building. This plan yielded maximum floor space with minimum periphery, centralization of services and easier future expansion.

Since the work to be done in the laboratory would vary from non-radioactive to highly radioactive levels, sections were so arranged that there is a progression of activity levels. Administrative and change areas, "cold" laboratories, shops and stores are segregated from the "hot" laboratories. The highest levels are contained in the High Level Caves, Part II, which is connected to the main building only by a personnel corridor. By this grouping together of "hot" sections, the potential spread of activity was reduced and waste handling, off-gas and other special facilities were simplified.

To permit expansion of the building, one end of each section was so constructed that additions could be made with minimum change to the existing structure.

Assurance of the latest and most efficient building and equipment designs was accomplished by du Pont inspection of other Atomic Energy Commission installations and laboratories and of research centers of private industry. All the applicable experience of these installations was analyzed and considered for possible use in Building #773-A. In some cases exact duplications were used; in many cases modifications were made for greater usefulness of the building or better performance of the equipment.

Detailed Design Considerations

Laboratories -

To facilitate future changes in technical programs at the lowest possible cost, flexibility in laboratory design was emphasized. The modular concept of standard repetitive construction was therefore adopted in which

each typical unit or module has the same structure, the same services and the same off-gas system and ventilation. Unitized furniture such as benches, cabinets and identical hoods have been provided, and service mains and modular branches have tee connections on a unit basis making all services available if needed at each furniture piece. Service piping "run-outs" along partitions are mounted independently of the benches.

All corridor partitions in the laboratory portions of the building are of the Hauserman type. Laboratory partitions are metal to the top of the reagent shelf and cement asbestos above, a measure taken to preserve the blow-through principle of Class II construction. Partitions are coved-off and sealed at the floors to make them watertight. They have a minimum number of joints and are so designed that one side can easily be dismantled without disturbing the partition of the adjoining laboratory. The ease with which the partitions can be re-arranged makes possible many space combinations to suit specific equipment changes.

It was only after studies of existing laboratories of this type that a standard module size was selected. Experience at these laboratories indicated that the most serviceable arrangement would be a 12 ft. by 24 ft. module, two such modules to be located in the center of the wing with a service corridor separating them. Auxiliary modules arranged along the outside walls are used for counting rooms and supporting facilities. Personnel corridors between the laboratories and the auxiliary modules give access to all areas of the various wings.

Safety -

From a design standpoint, the greatest hazards existing in the building involve air movement and waste disposal. All aspects of these dangers were studied and systems designed to establish safe operation. Design consideration, of course, was given also to other hazards such as spillage or tracking coincident with operation of the building.

Emergency Showers -

If an employee is exposed to acids, he has emergency showers available in strategic locations. Each of the two personnel corridors in each wing has such a shower and two are installed in the corridor separating two laboratory areas. Additional showers of this type are installed on the service floor and one in the Technical Stores Section.

Decontamination -

In all areas of the building where contaminating materials are to be used, the materials of construction are the most practical possible from a decontamination viewpoint. Laboratory partitions can be removed quickly, base coving is sealed to prevent liquid flows, table tops are Formica and sinks are alberene. Laboratory floors are of vinyl tile and vinyl paint has been used on hoods. Rooms are provided with special sinks and hoods.

Change Rooms -

By routing the main corridor into the building through change rooms, the Laboratory designers have assured the general practice of changing clothing as members of the Operations staff enter or leave the building. Equipped with separate lockers for street and work clothes, these rooms permit a complete change of clothing. Facilities for distributing and collecting clothing are provided as are sinks, showers, medical type treatment chairs and "solid contaminated waste" disposal cans. The sinks and showers are connected with the process waste drain system. Personnel decontamination rooms adjoin the change rooms.

Shielding -

No rooms or areas of the Laboratory, with the exception of the High Level Caves and the enclosed waste system on the service floor, have been shielded. Where protection from radioactive materials is required, the individual equipment is shielded, and/or glove boxes and hoods are installed. For this local shielding the floors are designed for a load of at least 750 pounds per square foot. Hood bases can carry as much as 2500 pounds of lead.

Fire Alarm System -

Standard fire fighting equipment, including both extinguishers and fire blankets, is placed strategically throughout the building. In case of fire, a special telephone number can be used to report the location to the building supervisor. Also located in potentially fire hazardous areas and in all laboratory modules are temperature sensetive detectors which, when activated, give an alarm on an annunciator panel in the Fire and Safety Office. The area firehouse is notified of fires in the building either by telephone or by pullboxes provided outside the building.

Emergency Evacuation -

If an emergency arises requiring the evacuation of a portion or all of the building, the building supervisor normally is notified over the special sound-powered telephone system. If an extreme emergency develops, an immediate evacuation alarm can be sounded from any of the "break-glass" stations in the various corridors wherever a sound-powered telephone also is installed.

A second sound-powered telephone system, not limited in its use to evacuation alarms, is also provided. It furnishes an independent communication system between the various operating stations, leaving the other telephones available for outside contacts in case of an emergency. The five-station system connects a master station in A-142 with the motor control panel in 1A basement, the emergency generator panel in 1B basement, the supervisory panel in 1C basement and the hallway near the Electrical Equipment Room in Section 2.

Waste System

The method of controlling contamination by confining possible sources to definite areas of the building was supplemented by the design of a waste system that would segregate types of waste. Drain, vacuum and off-gas lines as well as filters for exhaust air are all located on the service floor in a section enclosed by one foot-thick concrete walls. Glove boxes and small caves, connected only to the controlled off-gas exhaust lines, are used in laboratories where types of activity require confinement. Down-draft hoods are employed since these permit the simplest possible system consistent with the policy of segregating waste systems and filters in the regulated areas on the service floor. Central exhaust systems with fans located at stacks are used rather than a pressure plenum in order to avoid possible leakage of contaminated air in event of filter failures.

Since gravity-flow systems for contaminated wastes in reasonably shallow and accessible trenches were the simplest and most economical for the selected building location, use of the service floor for laboratories was precluded. This allowed adequate space for all service equipment and piping on that floor and eliminated the need for an attic.

Four main process liquid disposal systems are installed: high-level, low-level, trade waste and clear water drains. Both the high and low level systems, which are

entirely separate, drain from the building by gravity through stainless steel lines to the retention tanks at Building #776-A, Waste Concentration Building. It is anticipated that most actual contamination can be confined to the hot drains located in hoods. The use of bench sinks connected to the low-level drain will be limited to safe tolerance levels. A trade waste system is installed for the cold laboratories requiring a regular acid sewer, and the clear water drain discharging to the regular storm drain is used for effluent cooling water from the condensers used with various pieces of laboratory equipment.

One purpose in separating the waste lines was, of course, to reduce the volume of liquids to be monitored and concentrated by Building #776-A. By the time the building was constructed, and partially occupied by the Operations staff, it became advisable to reduce further the quantitiy of water flowing to the Waste Concentration Building. In May, 1953, AED requested the Design Division to disconnect the drainage from the pickling tank, quench tank, bench sinks and floor drains in the Metallurgical Fabrication Laboratory and Foundry, from the low level waste system. Instead, these wastes which could contain only uranium were to be discharged to an open field. It was expected that they would require neutralization and, if uranium losses became excessive, the stream would have to be filtered. At the same time the drains from the cup sinks in the hoods of the Instrument Development Laboratories on the main floor of Section 2 were removed from the low level lines and connected to the trade waste lines. Traps were installed in the hood drain lines to prevent the backflow of vapors from the Fabrication Laboratory drain system.

To obviate a potential hazard and public relations problem, the clear water drain from the Chemistry and Analytical Development section was disconnected from a storm sewer discharging into a ditch and connected to the storm sewer line discharging into an open field east of the #700 Area Technical Area. Previously the water flowed through the ditch into Holly Creek, through Jackson and then into the Savannah River. With the remote possibility that an operating error could occur simultaneously with an equipment failure, some contamination of the stream would take place. Under the new arrangement, which conforms with the plant policy of permitting no contaminated waste, even to a minute degree, from leaving the property except after entering the Savannah River, the waste will flow into Upper Three Runs Creek and then into the river.

Air Conditioning and Ventilation

Not only was it necessary in planning the ventilation system to assure a constant supply of fresh air to all parts of the building but it was also necessary to remove from some areas a large amount of heat and from other areas quantities of contaminated airborne particles. Positive air flow patterns had to be established that would prevent any "back-up" from the hot laboratories into corridors or cold areas. Temperature and humidity controls on the air conditioning system were required to assure "sweat-free" conditions and those air-flow requirements demanded by localized operating conditions.

All air is exhausted from the laboratories through down-draft hoods which can be easily decontaminated and are acid and solvent resistent. The hoods are a straight-through, constant volume type similar to those used at Hanford and Los Alamos. The system has an average capability of 1.7 hoods for each 12 ft. by 24 ft. module. Hood face velocity of 100 feet per minute has been established as the minimum allowable where radioactivity is present in the hood. Certain areas such as the counting rooms and special instrument rooms require a very rigid control of temperature and humidity. Average conditions there are 75° F. plus or minus 2° temperature and 45 per cent relative humidity, plus or minus 5 per cent.

For bench-test corrosion studies special hoods, constructed of plywood and stainless steel, have been provided. The largest wall-type unit is 16 ft. long and approximately 3 ft. deep. Among the five hoods is a floor unit, 10 ft. long and approximately 6 ft. deep. Standing almost 6 ft. high it contains two large counterbalanced safety glass sashes in each side and a service outlet panel at each end. In each of these hoods the interior surfaces, including the floors and some outside surfaces exposed to corrosive chemicals, are covered with stainless steel. Other surfaces are painted with "Amercoat 23". Lighting is built into the roof of the hoods.

Where contamination of the exhaust air stream results from metal working or fabrication, the large particles such as chips or shavings are screened at each machine location. Unscreened dust is conveyed by a 4400-ft. per minute air stream to the central filtering system in the regulated area of the basement. Ductwork is 304 ELC stainless steel of welded construction with flanged

joints for clean out at 16 to 20 foot intervals. The air is filtered in the enclosed area of the basement. Tongs and dollies are used when any of these filters must be changed. All air then passes into the Amerplate-lined concrete plenum under the regulated area. An absolutely gas-tight discharge plenum from the fan room and underground plenum to the stack was provided to avoid leaks of exhaust air into nearby fresh air intakes.

Emergency and Blackout Lighting

One of the eight light fixtures in each laboratory is connected with the emergency lighting circuit and any emergency light can be extinguished by single switches located in corridor panels. Emergency lighting is supplied from the emergency diesel generator in case of failure of normal power.

Blackout lights are installed only in corridors and exits although the lighting system has been so designed that such lights can be installed in laboratories. No such provision has been made for the auxiliary modules. All lights which are visible from outside the building may be blacked out from Patrol Headquarters, Building #720-A.

General Design Considerations, Part I, Section 2

Problems presented in the design of Section 2, Technical Stores and Shops, were quite different from those in Sections 1A, 1B and 1C. It was possible to adapt the modular basis of design to only a few shops and laboratories. The principal shops and the stores area are open to accommodate variations in equipment sizes and services required. Columns are placed on 24 ft. centers, and electrical grids have been installed in certain areas to provide flexibility in equipment arrangement. The mock-up room and the fabrication laboratory had to remain as open, high-bay areas to accommodate equipment and allow for material handling.

For the most economical and simplified installation the pipes, ducts and wiring have not been covered except where over-all economy would result. The small laboratories on the main floor have been designed with the service strip and shaft construction typical of the laboratories in Section 1. This saved design time, provided uniformity in laboratory design, and simplified housekeeping.

Shops and stores related to heavy equipment have been kept on the service floor to minimize material handling.

Rooms for lighter equipment and materials have been grouped on the main floor adjacent to the laboratory areas of Sections 1B and 1C.

All of Section 2 has been designated a "cool" area since plans for its operation include no radioactive materials of a hazardous level. It is distinguished from a "cold" area in that reactor fuels processed in the Metallurgical Development Section represent a quantity and type sufficient to affect sensitive instruments and discount standard datum line readings. Classifying this portion of the building as "cool" also resulted from the possibility of "tracking" radioactive materials from localized areas into other parts of Section 2. As a "cool" area Section 2 permitted normal ventilating practices but compelled the use of dust collecting systems with any equipment likely to be a dust source. Drainage is to the trade waste line.

Detailed Design Considerations

Instrument Development -

Since the work of the Instrument Development Section of the laboratory involves a variety of assignments, separate facilities have been provided. An instrument laboratory including several modules is provided in the 1C area, in the Section 2 "cool" shops, and in a special "cold" shop in Section 2. In all the instrument shops, sweat-free air conditioning is required. For contamination control the "cold" shop operates as a unit apart from the other instrument shops with its separate ventilating system, monitoring, supply stock handling and tooling facilities. To aid in precise measurements unaffected by radio frequencies emanating from laboratory equipment in other parts of the building, a special, copper screen enclosed, shielded room is installed in Room 1C - 134. Included are four filter panels through which services can be introduced to the room without reducing its attenuation characteristics.

Glass Shop -

Special design problems were presented by the glass shop in which exceptionally high heat releases accompany requirements for very low drafts. The resulting design combines partial air conditioning with very large, low felocity air entry ducts for the room. The glass blowing lathes and equipment are supplied with a diluted gas from a carburetor system which lowers the heat content of the building's propane gas system. Variable intensity lighting is also installed to permit temperature gauging of heated glass by observing glow intensities.

Equipment

Standard items comprise the bulk of the extensive equipment list for the building. In the metallurgy section, however, several equipment pieces are of special design.

Tilting Vacuum Furnace -

The furnace design is, to a large extent, based on the experience of Oak Ridge National Laboratory in the melting of reactor materials, and is a modification of a design developed there. It is a flexible unit which permits close control over temperatures and vacuum and accurate control over pouring rates directly from the crucible into water-cooled copper molds within the furnace.

Approximately 6 feet in diameter and 5 feet high, the water-cooled furnace, constructed of 3/8 in. non-magnetic stainless steel, has a fixed bottom and a removable cover secured by quick-opening clamps. The furnace accomodates separate coil assemblies. One consists of a zirconia crucible for melting 100 pounds of thorium; one has a graphite crucible for melting 150 pounds of uranium; one has a Beryllia crucible for melting 100 pounds of thorium; and a fourth has a Dixon C-7 crucible for melting 60 pounds of aluminum. The furnace is large enough, however, to use coil assemblies and crucibles with twice this capacity and the power supply has been sized accordingly. The tilting of the crucible is effected by means of a windlass mechanism operated through a rotary seal and controlled from outside the furnace. Two sight glasses are provided, one in the top cover for observation of the interior of the crucible, and one in the side of the furnace for observing the mold during pouring.

A circular, rotating charging chamber was designed which contains 13 three-inch holes in its bottom plate. When a hole is aligned over the charging port of the furnace, a three-inch OD can, six inches long, is dropped into an enclosed chute which leads the can to a point over the center of the crucible and from there it drops into the crucible.

The two cylindrical molds supplied with the furnace are water-cooled, one is 3-1/4 in. ID by 20 in. long for uranium or thorium and the other is 8 in. ID by 20 in. long for aluminum. A non-water cooled mold can also be attached to the crucible assembly.

Energy for the furnace is supplied by a 100 kw. 3000 cycle air-cooled generator driven by a 150 h.p. electric motor. Controls with the unit include a 100 kw. frequency changer set, a 3000 cycle ammeter, voltmeter, wattmeter,

power factor meter, capacitor voltmeter, line contactor with load relay, field ammeter, voltage regulator and adjusting rheostat, a special 100 kv.-a. 3000 cycle controlled transformer and a capacitor bank assembly including an internally water-cooled capacitor equivalent to 1000 microfarads for low voltage operation.

Vacuum Muffle -

For use in the vacuum heat treating of metals in a vacuum furnace, the muffle is fabricated of 10 in. and 6 in. stainless steel tubing with a 3/8 in. wall thickness. Designed for continuous operation at 1500° F., the muffle had to be fabricated to specifications limiting maximum leakage to 25 microns per cubic foot per hour at a pressure of one micron. Three individual cooling coils, separately connected, are supplied with the muffle.

Hydraulic Test Stand -

Modeled after a unit at Argonne National Laboratory, the test stand is designed to aid in the development of hydraulic servo-mechanisms. Constructed of welded channel-iron, the stand has a working surface of 30 in. by 72 in. and a plywood back 71 in. high. The table has a drip pan, above which can be fastened two aluminum plates each approximately 25 in. by 35 in. The plates are perforated by 187 one-quarter-inch tapped holes. A variable delivery pump giving up to 5000 p.s.i. is used with the stand.

Constant Temperature Bath -

For corrosion testing of metals, a type 304 stainless steel tank was designed with an inner and an outer shell separated by one-inch magnesia block insulation. The operating range is 30° C. to 80° C., plus or minus 0.5°C. from any selected temperature setting. The water level can be controlled within 1/8-inch. Metals to be tested are normally placed in the bath in laboratory beakers.

Test Tube Oven -

Similar in purpose to the constant temperature bath, these two ovens are designed to accomodate only test-tube quantities of metals. Each is an electrically-heated, forced convection oven with a one-inch transite top perforated by 20 holes into which the test tubes may be set. They can operate continuously at any temperature from 50°C. to 200°C. The heating elements and recirculating fans are externally mounted to prevent any influence on individual tubes by radiant heating. Thirty-two inches wide, 40 inches long, and 32 inches high, each oven has a drip pan to collect glass and

liquids from broken tubes. The design of the unit follows closely that of an oven developed at the du Pont Experimental Station.

Electrolytic Etching Equipment -

In various laboratory studies a need develops for highly polished surfaces on metallurgical specimens. Both to perfect techniques in this type of polishing and to meet the limited requirements for special metal surfaces, this equipment was installed. Electrical components were carefully selected to give the very precise voltage control required. These include a duplex motor-generator set consisting of two 300 watt D.C. Generators driven by a single one and one-half h.p. squirrel cage induction motor with a common direct connected D.C. exciter; one voltage control panel for controlling D.C. output voltage from 2 to 110; and one combination magnetic starter complete with undervoltage release and control transformer.

Additional Equipment -

As the building was being occupied and development work got underway, the Atomic Energy Division made an appraisal of the equipment on hand. Completed late in 1953, this appraisal indicated that the initial complement of equipment should be increased to include: (1) those items the need for which was not foreseeable earlier in the program and (2) those items not originally requested in sufficient quantity. Since many of the apparatus components requested at that time had to fit facilities on hand and because of the close coordination necessary between the plant's technical staff and the design and procurement staff, most of the design and procurement work was done on the site. The immediate need for a number of items made it advisable to proceed on several fronts. Voorhees, Walker, Foley and Smith, which had an available manpower force experienced in the procurement of laboratory equipment, was assigned all instrument items of a catalog nature. The Development Engineering Division of du Pont was assigned specialized mechanical items. Wilmington Shops was given orders for specialized equipment on which its staff did design work in addition to normal fabrication. Central Shops of the plant's Construction Division built many of the rush items working solely from sketches or preliminary models.

The Design Division focused chiefly on non-catalog items for "hot" analytical operations in the junior caves. Especially important in these operations was the scale-down of the separations equipment used in the #200 Area. In its work the Design Division concentrated to some extent on improving and changing models made by the plant Technical department by using more standard, readily available parts, by

minimizing maintenance, and by simplifying decontamination. Because of the unusual nature of many of the remotely-operated devices, a prototype of each was usually made and tested before the design was released for fabrication.

Included in these special designs were:

1. Mixer-settlers - for simulating extraction processes.

2. Elevator and cranes - for remote handling of hot materials in conjunction with the caves.

3. Titrimeters and burets - for remotely controlled analytical operations.

4. Gear and tong manipulators - for use through ball-sockets of the junior caves in performing remote operations.

5. Slurpers, racks and slurper hoods - for the transfer of hot materials and decontamination of equipment.

6. Shielded containers - for handling high level radioactive materials.

7. Metal assay panels, electrical panels, etc. - for remote control of apparatus in the caves.

8. Several types of viewers and tongs - for observation and remote handling of shielded objects.

9. Various waste containers - for handling radioactive wastes.

10. Polishing equipment - for polishing hot specimens.

The major problem in the design of this equipment, aside from the consideration given to proper functioning, was the matter of surface finish. To permit practical decontamination, all exposed surfaces had to be free of pits, scratches or other defects. Much design effort was expended in minimizing seams and contact junctions in which contaminated materials could become pocketed. An investigation was made of polishing materials and procedures and on several of the most critical apparatus items all exposed surfaces were polished to a mirror finish. This proved simpler and more economical than the application of special vinyl finishes which would require extreme care in application and baking, and which would be subject to chipping when used.

DRAWINGS - PART I

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W-157650 - Service Floor Arrangement
W-157654 - Main Floor Arrangement
W-156377 - Service Floor Plan - Section 1-A
W-156378 - " " " - Section 1-B
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W-156381 - Main Floor Plan - - Section 1-A
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W-156385 - Second Floor Plan - Section 1-A
W-156390 - Elevations - Sheet #1
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W-156485 - Electrical Single Line Diagram
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BLDG. #773-A - PART II - HIGH LEVEL CAVES

FUNCTION

These caves provide facilities for physical, chemical and metallurgical work with high level radioactive materials. Results of the studies are applicable to various plant processes.

PRINCIPAL COMPONENTS

Operating Area

This area contains the controls for remote operating equipment, the viewing end of optical equipment, services for the caves and office space.

Mock-Up Area

Remotely operated laboratory equipment to be installed in the caves is set up and tested in this area. At the same time operators can practice remote operating techniques prior to the installation of equipment in the caves. Facilities for minor alterations to equipment, when required, are also provided.

Caves

Three shielded caves, each approximately 6 ft. wide and 11 ft. long, containing several types of remote operating equipment provide safe conditions for work with high level radioactive materials. Each cell has a viewing window approximately 30 in. high, 34 in. wide and 3 ft. thick.

Contamination Control Room

Contains facilities for storing clean clothes, disposing of contaminated clothes, washing hands, and monitoring hands and feet.

Loading Zone

This area contains a truck entrance, underwater storage pits, and a crane to handle casks or heavy equipment. In addition this area provides access to the cave interiors and miscellaneous cave services.

Storage Area

Equipment and tools are kept in this area until checked for possible contamination.

Mechanical Equipment Room

This room houses the heating, ventilating and air conditioning equipment for both the clean and contaminated areas.

Manipulator Reel Room

Take-up reels for the General Mills manipulators and the one-ton crane installed in the caves are located in this room.

Electric Control Room

Contains switchgear, starters and motor control centers for all equipment in the high level caves wing.

BUILDING FLOOR SPACE

	Approx. Sq. Ft.
Operating Area	830
Mock-up Area	740
Contamination Control Room	370
Loading Zone	800
Storage Area	580
Mechanical Equipment and Electrical Control Rooms	1750
Cells	540

BUILDING DETAILS

Class - III

Size - Area - 6200 sq. ft.

Volume - 110,000 cu. ft. (Including concrete cells)

The high level caves wing is rectangular, approximately 53 ft. wide by 80 ft. long. The roof has three elevations. For a width of 16 ft. along the entire length and on the end adjacent to the main building the roof is at the same elevation as Part I. Fifty-five feet of the length is a high-bay area measuring about 39 ft. from ground floor to top of roof slab. The remaining area has a roof elevation of approximately 12 ft. The high-bay area contains crane facilities, a main loading zone and three cells enclosed by 3 ft. thick, high density concrete shielding walls. A total of 226 cubic yards of 200 lbs. per cubic ft., High density concrete (Barytes aggregate) was used in the cave construction. Each cell has two special laminated plate glass viewing windows and 10 inch thick steel doors.

CONSTRUCTION DETAILS

The building shell of structural steel framing and web roof joists is constructed on reinforced concrete foundations with spread footings. Exterior walls are of flat cement asbestos panels on steel girts and the interior of the exterior walls as well as interior partitions are cement asbestos panels on studs. Ceilings are flat cement asbestos panels on furring strips. Doors are hollow metal and there are no windows. Within the building the shielded cells are constructed of special high density concrete. The roofing

is built up and both the roof and exterior walls are insulated. Floors are exposed concrete except in the cells where they have been covered with vinyl paint.

Steam and chilled water are supplied from the main building to an air conditioning unit in the high level caves wing by which the operating, mock-up, storage and loading areas are air conditioned. For contamination control no air is recirculated. Exhaust fans in various areas are set to insure a flow of air from clean to contaminated areas. Vitiated air from the loading area is drawn through the caves roof at the rate of 500 c.f.m. per cave, and is exhausted at the floor level. The air is filtered through paired AEC filters and discharged through separate stacks 20 ft. above the main roof.

Fluorescent lighting is installed in the operating, mock-up, contamination control and loading areas and is used in the caves while operations are being set up. Incandescent fixtures are installed in the storage area, manipulator reel room, electrical control room and the mechanical equipment room. Portable underwater flood lights are installed in the pits. Sodium vapor lighting is provided in each cell for use during operations and is required for viewing through the thick glass windows without aberration.

EQUIPMENT

Operating Area

2 General Mills manipulator controls, dolly-mounted.

Controls for transfer drawers.

Control and recorder for contour gage.

Racks for KAPL plugs.

Sound-powered telephone for each cell.

Signal and alarm panel.

Sliding slot mechanism for master slaves.

2 - Six-power binoculars.

Contamination Control Room

12 - Clothing lockers.

2 - Bins for contaminated clothing.

Sink with foot operated controls.

Hot water heater.

Loading Area

1 - 10-ton Bridge crane.

1 - Circulating pump and water demineralizer for pit water supply.

2 - Underwater grapplers.

6 - Transfer casks.

Manipulator Reel Room

2 - Cable reels for General Mills manipulators.

1 - Cable reel for 1-ton crane.

Caves

2 - General Mills manipulators - remote operating.

1 - Pair Master slave manipulators.

1 - 1-ton Crane, remote operating.

2 - Cave transfer drawers.

3 - 10 in. thick remote operated guillotine doors.

2 - Remote operated steel intercell barriers raised and lowered by jib hoist.

1 - Remote operated "Tukon" hardness tester with monocular periscope.

1 - Remote operated Rockwell hardness tester.

1 - 12 in. Lapmaster machine.

1 - 8-ton Hydraulic press.

1 - Contour tracing gage.

4 - Balances.

1 - Buehler speed press.

4 - Buehler polishers.

1 - Remote operated research metallograph.

1 - X-ray diffraction unit.

1 - Spectro Goniometer.

1 - Binocular viewer.

1 - Underwater cut-off saw.

1 - Borescope

Mock-Up Area

1 - Bench grinder

1 - Floor type drill press

2 - Tool cabinets

1 - Revolving bin

3 - Service carts

Mechanical Equipment Room

1 - Air conditioning unit, 6000 c.f.m., 31-ton capacity

1 - Air conditioning unit, 1700 c.f.m., 11-ton capacity

3 - Auxiliary heating coils

6 - Cave exhaust fans, 500 c.f.m. each, with 1 hp. motor

2 - Pit exhaust fans, 620 c.f.m. each, with 2 hp. motors

1 - Drain exhaust fan, 26 c.f.m., with 1 hp motor

2 - Contamination control and storage room exhaust fans, 1200 c.f.m. each, with motors

1 - Mechanical equipment room exhaust fan, 2215 c.f.m., with motor

1 - Operating and mock-up area exhaust fan, 2230 c.f.m., with motor

12 - AEC type filters for exhaust air from contaminated areas

Miscellaneous lockers, cabinets, racks and office and laboratory furniture are provided.

DEVELOPMENT OF DESIGN

Building

Added to the scope of work of the Main Technical Laboratory in August of 1951, the high level caves are located in a separate building adjoining the northeast corner of the center wing. They provide facilities for many varied studies of high level radioactive materials.

The Design Division was requested by AED to pattern the caves after similar facilities operated by the Atomic Power Division of the Westinghouse Electric Corporation at Pittsburgh. Westinghouse responded very generously to du Pont's request for information and supplied a complete set of prints of the WAPD facilities. Although designed on the basis of the Westinghouse plan, the caves incorporate a number of changes resulting from developed operating techniques and the requirements of improved equipment. The following are the major differences.

Recommendations by Westinghouse

As a result of its operating experience, Westinghouse submitted to du Pont a list of design changes which, in their opinion, would simplify or improve the SRP caves. These were generally alterations in building details that would eliminate minor operating difficulties. Some of these, by coincidence, would have been required to comply with du Pont safety standards. WAPD did point out inconveniences with 30-inch wide access doors at the back of the caves, and as a result the SRP caves have doors 36-inches wide. It was also suggested that provisions be included for increasing the number of caves and this is done by simplifying the removal of the concrete shielding wall at the end of the third cave.

Incorporation of Isolation Technique

In some studies of radioactive materials it is possible as a result of either an operating error or an accident to contaminate the entire cave causing an interruption in its use and compelling costly decontamination. This danger had been eliminated at the Knowles Atomic Power Laboratory, Schenectady, New York, through the design and use of a metal box which could be placed in the cave to contain the highly redioactive materials. This isolation technique had distinct advantages. Should an accident occur, the box could be removed and the cave itself would remain uncontaminated. These KAPL boxes were rather elaborate and in some cases expensive. A similar technique using disposable plywood boxes had been successfully tried at the University of California, and this method was adopted for use at SRP.

Use of New Style Manipulators

The decision to use the master slave style manipulators as developed at Argonne National Laboratory, instead of the rectilinear manipulators installed at WAPD, made it necessary to incorporate a higher roof elevation over the caves than is the case at WAPD.

Provisions for Future Equipment

Flexibility and accomodations for future equipment are made possible by additional changes in the WAPD design.

1. One large cell almost 40 ft. long can be formed by the removal of concrete blocks and sliding steel barriers between the cells. The use of sliding doors is not new, their installation being required both at WAPD and SRP to permit movement of the manipulators from one cell to another, but a redesign at SRP clears a larger opening. Removable blocks were not used at WAPD.

2. A slot about 10-inches high and extending the full length of the caves is included in the design to permit the future installation of master slaves, periscopes, stereo viewing equipment or any other items requiring similar access to the caves. Nine feet above the floor, the slot is normally filled with removable blocks.

3. A removable block containing 28 portholes, each approximately 3-inches in diameter, is installed below each viewing window. These can be used for a number of special items including shielded plugs for introducing services to the caves or for equipment transmitting rotary motions to apparatus in the cave. The portholes are so located that they align with ports in the KAPL isolation box which might at infrequent intervals be used at SRP for special studies.

4. A 12-inch square transfer port has been located at the back of the caves to permit the introduction of special equipment.

5. Ten additional 3-inch ports and two 10-inch ports also have been located at the front of the cave.

6. One end cell has a removable 18-inch plug to facilitate the introduction of long fuel elements should study on these be required.

Number of Caves

Based on estimated requirements only three caves are constructed at SRP instead of five as at WAPD.

Changes to Comply with du Pont Safety Standards

Although all changes in design were made only after consideration of safety standards, several were made specifically for safety purposes. All permanent openings between the clean or operating side of the caves and the cave interiors have been eliminated. Where ports have been provided for the introduction of equipment to the caves, plugs are used to close the openings. These plugged openings are sealed before cave operation begins.

For improved control of contaminated air the caves are kept under negative pressure and only down-draft ventilation is used. The caves receive vitiated air from the loading areas through the roof. All exhaust air from contaminated areas is passed through AEC filters before discharge to the atmosphere. A cyclone and precipitrons were used at WAPD.

Shielding

Shielding around the caves is equivalent to three feet of high density concrete which has a weight of 200 pounds per cubic foot. Barytes aggregate was used. Ducts and conduits in the cave walls are backed up with steel or lead to obtain equivalent shielding.

Windows

The Corning Glass Company's first production of a new non-browning plate glass with a specific gravity of 3.2 was used in the six cave windows. Approximately 30-in. wide by 34-in. high, each window contains eight four-inch thick pieces of this glass. On the cave side is one 1-inch thick, non-browning cover glass and on the outside is one 1-inch thick plate glass cover. Mineral oil fills the 1/32-inch separations between the glass sections.

These windows differ from those at WAPD where two other types were installed. One was filled with zinc bromide and the other was constructed of 1-in. thick laminated glass. Both had a specific gravity of 2.5. Neither offered sufficient shielding for the work contemplated at the Savannah River Plant.

Equipment

As is the case in the main building, much of the equipment in the High Level Caves is standard or slightly modified special equipment similar to that used at nuclear research installations throughout the country.Three equipment pieces are of original design.

Contour Tracing Gage

Since the surface characteristics of reactor fuels have a direct bearing on their performance during irradiation, storage and disassembly, a phase of nuclear research centers on surface and contour studies. For the type of work anticipated in the High Level Caves no previously developed gage or measuring method offered the necessary flexibility or range. Also, designers of the caves were convinced that a satisfactory gage could be developed at a cost much below that of equipment offering some of the desired features. Therefore, a completely new gage was designed by du Pont with the cooperation of the vendor, Cleveland Instrument Company. Specifically, the instrument had to be capable of gaging a cylindrical or flat specimen up to 18 inches in length and measuring surface deviations from .100 to .0001 of an inch. Cylindrical shapes to be studied would measure up to one inch in diameter and flat shapes would range up to four inches wide.

The gage consists of a measuring head, support blocks for round or flat specimens, a three-scale amplifier, a recorder and a control panel. The hardened steel measuring head, through motor controls, can traverse the ways on which it is mounted at speeds of 12 inches per minute, 2.4 inches per minute and 1.2 inches per minute, either forward or in reverse. Two "V" blocks support cylindrical shapes and two other blocks with an adjustable clamp support flat pieces. The three-scale amplifier carries measurements directly from the head to a chart recorder which operates at 12 inches per minute. Both the portable control panel and the gage are fitted with amphenol connectors so that the gage can be placed in the cave and controlled from the panel in the operating area.

Underwater Cut-Off Saw

This saw is designed to cut wafers from cylindrical or flat reactor fuels to permit close examination of cross-section grain structures. Because of the combustible nature of the nuclear fuels and the danger of contamination, the saw operates under water in a completely enclosed portable unit which is remotely operated. Previously designed equipment did not offer the desired flexibility in controls.

The new equipment is composed of a rectangular metal tank supported on metal legs which stand in an inch-deep metal pan. The tank has a hinged lid and a bottom irregularly shaped to permit first, the operation of the circular saw under water, second, the collection of chips and fines in filters, and finally the drainage of all water into removable metal tanks. Connections are provided for electricity, water and air. Instrumentation is designed to prevent operational errors and at the same time to give maximum flexibility.

After the saw is properly positioned in the cave and the various connections are made, an operator turns a small handwheel in the operating area to raise the lid of the saw. With the manipulators one of the sump tanks is swung into position and the specimen is placed in the hydraulic vise which is remotely controlled from the panel in the operating area. The lid is lowered, water is admitted to the unit and then, with a second handwheel, the vise is cranked down. Micro-switches automatically start and stop the abrasive-type, motor-driven cut-off saw as the specimen nears the saw and after the wafer has been cut off. After the vise and lid have been raised, hydraulic pressure on the vise is released and the specimen and wafer can be removed with the manipulators. If necessary, a wafer can be so placed in the vise that a cut at right angles to the original can be made. The machine will accept specimens up to 30-inches in length. Flushing of the tank interior, sump changing, evacuation of the water from the tank and sumps, and replacement of filters can all be done remotely. Saw blades may also be changed by the use of the manipulators and an impact wrench.

Borescope

Among the planned improvements in reactor technology are new fuel shapes which it is believed will add to efficiency and reaction rates. One line of investigation will center on tubular fuel elements, so it was for the close examination of radioactive tube interiors that the borescope was designed and procured. It can be mounted in the concrete wall of a cave near a shielding window and will permit an operator to look into an eyepiece and see the interior walls of a tube section which is located in the cave and parallel with the window.

The 1-1/8-inch diameter housing within the cave is of brass and contains non-browning lenses; that outside the cave is of stainless steel and carries ordinary glass lenses. Two objectives each about 36-inches long are supplied with the borescope, one for direct vision through a tube sample, the other for right angle viewing. These are fitted with small lamps controlled through a special transformer to give any desired level of illumination. The instrument's full

viewing distance of nine feet results from the addition of two 36-inch extensions. To further increase the usefullness of the borescope, two eyepieces are furnished which give, at a working distance of one inch, linear magnifications of 2.8 and 7.7 power. Each eyepiece can be focused to permit observation of objects at any distance between 3/4-inch and 3-inches from the borescope axis. The entire instrument can be dismantled easily yet is rugged enough to be rotated from the outside on the axis of the wall tube.

Design resulted from consultations between AED, the Design Division, optical specialists at du Pont's Engineering Research Laboratory, and the vendor, American Cystoscope Makers, Inc.

To hold a tube section during borescope examination a 6-foot long angled support was designed with ball casters to allow rotation or longitudinal movement of the tube by the slave manipulators.

DRAWINGS - PART II

W-157465 - Key Plan and Drawing Index - High Level Caves

W-157466 - Service Floor Plan

W-157467 - Main Floor Plan

W-157469 - Building Sections

W-157470 - Elevations

BUILDING 773-A, PART III - MAIN TECHNICAL LABORATORY - METALLURGICAL EXTENSION

FUNCTION

This addition provides increased space for the Metallurgical Section of the Technical Division. It houses equipment required for the development of new fuel elements.

PRINCIPAL COMPONENTS

Element fabrication area.

Electroplating and cleaning area.

Tube cleaning area.

Vertical assembly area.

Nondestructive testing area.

Machine shop.

Storage area.

Offices and toilet.

BUILDING DETAILS

A Class III building, it is two stories high with one portion a two-story high-bay crane area. A penthouse, containing 370 square feet, is constructed over the assembly area. The main building dimensions are approximately 69-ft. by 140 ft. An attached shed for storage, toilets and as part of the assembly area is 16 ft. by 96 ft. The total area of the building is 19,450 square feet and its cubage is 297,000 cubic feet.

CONSTRUCTION DETAILS

The building is constructed on spread concrete footings with a concrete slab at grade. The framing is steel and side panels and partitions are flat cement asbestos. The roof is a concrete slab on steel framing and, like the exterior walls, is insulated. The floor is concrete and acid brick, with asphalt tile in the offices, corridor and toilet. Wood slats are used over the acid brick area.

All fumes and heat are removed by circulated air.

Lighting is incandescent in all manufacturing areas and fluorescent in the offices and the uranium machine shop.

EQUIPMENT

Tensile tester.

Draw bench - 20 ft. draw, 20,000 lbs., maximum die size - 3-1/2-inch diameter.

Salt bath heat treating furnace.

Stretch straightener - 30-ton, maximum length - 16 ft., width - 3-inch.

Plate shear.

End milling, drilling and welding equipment.

Degreasers.

Pickling and washing tanks and dryers.

Plating tanks.

Planer.

Roller leveller - 9-roll type, capacity to straighten metal of 90,000 lbs. per sq. in., 1/8-inch to 3/8-inch thick, by 8-inch wide.

Steam autoclave - Capacity 6 plates, 15 ft. by 4 in. by 1/2 inch.

Brazing equipment.

Lathes.

Milling machines.

Shaper.

Tool grinders.

Hack saw.

Precision radiographic unit, 30 to 100 k.v.-a range, complete with high voltage transformer.

DESIGN BASIS

The added productiveness resulting from higher surface to volume ratios of uranium, a well recognized reactor principle at the beginning of the Savannah River Plant's design, could not at first be used to full advantage. Two somewhat related factors prevented designers from fully exploiting the principle. First, the earliest possible start-up for some production reactors was considered a vital necessity. This made it advisable to utilize existing facilities for the production of cylindrical fuel shapes and concentrate on adapting these to a heavy water moderated reactor. Second, not only were the fabrication techniques for other fuel shapes, either flat or tubular, not available but it appeared likely that their development would result only from prolonged study and experimentation. Major development time would be occupied by testing and by bonding, if the latter proved necessary.

Building #313-M Semi-Works

Coordination of development work on the fabrication of flat fuel became an assignment of the Savannah River Plant's Technical Division late in 1952. To take full advantage of

existing plant facilities it was planned to use three buildings for the development work. Cleaning equipment in Building #320-M, used for control and blanket rods, would be used for cleaning the sheaths. Full scale demonstrations of melting and rolling could be made at the Metallurgical Development Laboratory of Building #773-A. It remained necessary, then, to install heat treating, cleaning, machining, welding and sheathing equipment. Building #313-M was selected as a temporary location since it had unoccupied space reserved for future expansion of canning lines. Principal equipment to be installed there consisted of a draw bench, salt pot, quench tank, stretch straightener, plate shear, drill press, milling machine, degreaser, cleaning tanks, a dryer, steam autoclave and welder.

Building #773-A Extension Approved

After equipment had been specified and purchase orders issued, a reconsideration of plans early in 1953 after new knowledge of the process had been developed, uncovered serious complications. First, process cleanliness would be more difficult to maintain with a division of work among the three buildings. Second, it had become evident that element bonding to its sheath rather than simple unbonded "raincoating" would be compulsory. Third, space available in Building #313-M would not be sufficient to accommodate the additional bonding and testing equipment required. It was proposed, therefore, that an extension southward from Section 2 of Building #773-A be authorized. This would place the new facilities adjacent to the fabrication and heat treatment of the Main Technical Laboratory. The immediate objective of the program in the new extension would be the successful development of flat fuel elements and the production of the first reactor charge. Following the completion of this program the development work would probably be directed toward other improved shapes.

The proposed extension was approved by the Atomic Energy Commission and was added to the scope of work in February 1953.

PROPOSED PROCESS

As a result of plate rolling, sheath fabrication development work, bonding experiments and preliminary analyses of various testing methods conducted at research and industrial establishments over a period of several months, a tentative but rather well-defined process procedure was developed in February, 1953, for the extended fuel program. The principle difficulties were anticipated in the bonding and testing phases.

Core Preparation

Natural uranium billets, approximately 3 inches by 2 inches by 8 inches, were to be heated in a pot furnace to a temperature of 1100°C., and transferred to the rolling mill which formed the metal into a strip approximately 1/4-inch by 7 inches by 16 ft. This strip was then reheated and re-rolled to bring it within closer dimensional tolerances. Then it was passed through the cold water rinse tank, the salt bath, pickled in nitric acid, rinsed with cold water and dried. After re-rolling at room temperature, the strip was placed in the plate shear which cut it in half longitudinally. Heat treatment to 650°C. in a Hultgren furnace was followed by quenching.

After the heat treatment and quenching, each of the sheared strips was expected to be approximately 1/4-inch by 3-1/2-inches by 16 ft. Permissible deviations at this stage were .070 in thickness, .150 in the width, a flatness variation of 2 inches and a camber of 1 inch. To bring the plate closer to process requirements it was passed through a stretch straigntener which reduced the flatness deviation to .500 and the camber to .060. The crop shear then cut the ends of the plate making it approximately 14 ft. The scope of work issued in early 1953 did not establish precise process requirements for the element length, so a tolerance of plus or minus 6 inches was planned for the development work at this stage. A planer then trimmed the plate to a camber of plus or minus .020-inches, the edges were machined and a tongue milled and drilled on each end of the plate. Cleaning and pickling followed with preplating and electroplating as the final steps. At the time hot-dipping was considered to replace electroplating.

To prevent deformation of the plates a V support was designed for processing the plates in solutions, with interval supports for high temperature processing and continuous flat supports for plate cooling stages. The material was transported manually on specially designed fixtures or carriers.

Sheath Preparation

The aluminum sheaths were to be supplied by an off-plant vendor and no pre-assembly treatment was considered necessary except cleaning and inspection. The sheaths, end fittings, and pins were degreased, Duponal dipped, rinsed in hot and cold water, acid treated, cold water rinsed, treated for water removal and dried. After this cleaning process on the service floor, the sheaths were lifted to the main floor inspection table.

Assembly

For vertical assembly the sheath was to be transported horizontally in a box or special support to a vertical assembly area. There, either the 3-ton hoist or a motor-driven wind-up drum would lift the sheath to a vertical position. A similar procedure would be followed in moving the core on the main floor to the assembly area. It was to be determined whether it would be more satisfactory to lower the core into the sheath or to raise the sheath to envelop the core. At that time it was expected that horizontal loading experiments also would be conducted.

The assembly then was to be sized by the 20,000-pound draw bench, the end fittings attached, pins inserted and the end fittings welded to the sheath.

After inspection of the assembly it was to be degreased, processed through the vacuum annealing and brazing furnace, degreased, rolled, planed, and finally machined in the roller-leveller.

Tentative specifications were for a size of 1/4 inch by 3-1/2 inches by 15 ft. with a maximum deviation of .010 of an inch in any foot of length and a maximum twist in the full length of 5 degrees.

After final rolling the assembly was to be pickled, rinsed, dried, autoclaved, X-rayed, leak tested, ultransonic tested, and frost tested.

DEVELOPMENT OF DESIGN

Building

The south portion of Section 2 of Building #773-A had been designed to simplify expansion with an area approximately 70 feet wide extending to a hot drain some 145 ft. from the south building wall left open for construction. This became the location of the Metallurgy Extension.

From the original belief that 8000 square feet of space would suffice, plans changed to a building 70 feet by 120 feet and finally to a two story building 70 feet by 140 feet. A Class III structure, it contains five 24-foot bays and one 20-foot bay, portions of the first three bays nearest the main building remaining open to provide material transfer facilities between floors. The ways of the five-ton crane installed in the fabrication and heat treatment laboratory in the main building are extended to cover the new bay area approximately 12 feet of the main floor.

Initially no storage facilities were contemplated other than racks within the building. As storage requirements expanded a single story shed, 16 feet wide and 72 feet long, was placed on the east side of the building. This was later increased by one bay to a total of 96 feet. Later, under a "P" Work Order, a portion of this storage area was converted to security storage by the addition of expanded metal partitions and a door equipped with combination lock. Additional protection is afforded by an alarm system which sounds an alert at Bldg. #720-A, Patrol Headquarters. A separate storage pad for drums containing inflammable materials is provided within the security fence area.

When it was realized that contamination control in the vacinity of the uranium cleaning and electroplating areas would be simplified by partitioning, these areas, as well as the adjoining aluminum cleaning area and the mechanical equipment room were enclosed. This was a departure from the general practice of providing an open type of construction to permit maximum freedom for process changes.

The heavier equipment is installed on the service floor which contains the element fabrication, electroplating and cleaning, and the tube cleaning areas. Space has been allocated for the future liquid honing machine, the hydraulic press and the induction furnace. Also located on the service floor are the electric equipment room and lower portion of the vertical assembly area. Placed on the main floor are the non-destructive testing equipment, the brazing equipment, the upper portion of the vertical assembly area, an electric equipment room, and two four-man offices. There is also a machine shop on the main floor, the result of a later design change. Toilet facilities are contained in a section of the storage shed.

Structural Design

With a beneficial occupancy date set approximately 10 months from the actual commencement of design, steel construction with asbestos side panels and partitions was adopted. Some delay resulted from proposals to use light steel available at the site and have it fabricated by construction forces into floor trusses, a plan which would have decreased the head room for the service floor. Before this fabrication could be started a source for rolled structural steel was located and, with a premium payment authorized, the material was delivered to the site within two weeks of the required date.

The steel procurement procedure differed from the standard practice for the project in that the purchase order was

turned over by Wilmington Design to the field to be expedited and completed by small quantity additions. This departure resulted mainly from the fact that field procurement previously had located many sources of small quantities and some of these steel suppliers were located near the plant site. Wilmington Design did retain the right of approval on the complete order.

Added versatility is incorporated in the structure by stopping the steel framing for the main floor a few feet short of the west building wall. This will permit simple alterations in ductwork and piping to accommodate future changes in semi-works equipment. For maximum visibility, a continuous line of windows is installed in all building walls on each floor. Original design of ductwork obstructed some of these, but with changes probable in duct locations it was felt that the window design would assure good visibility under any changes.

Because of the proximity of the trench carrying the high level drain at the south end of the building, footings there were carried below all trench backfill. Footings adjacent to the high bay area were also carried deeper than normally required but this was necessitated by the probable installation of heavy equipment in the bay area. To leave the way free for the deep foundations required by such equipment, the area under that part of the slab was left free of trenches or conduits.

Maximum floor loadings are 1500 pounds per square foot on the service floor and 250 pounds on the main floor, with some local areas capable of carrying 500 pounds. Roof loading is 40 pounds over the high bay area and 100 pounds elsewhere.

Heating and Ventilating

At first it was planned to install a system providing for an air change every three minutes in all portions of the building except the offices. Exhaust fans were to be roof-mounted with air intake through the windows. Operations experience with the same rate of change in the main building had, however, indicated that in some cases a greater air velocity was necessary. As a result of this experience, plans were reversed and air supplied from the roof-mounted fans through ducts to each machine position. In the process rooms air is supplied through a ceiling-mounted diffuser. From these rooms and the open shop, fumes and heat are exhausted through plenums mounted over the equipment, creating an air change once a minute. Offices are air-conditioned.

In the open shop areas heat is supplied by unit heaters, while in the process rooms intake air is heated before being dispelled through the diffuser.

When it became evident that the geometry of the extension would make it difficult to assure a fresh air supply because of the stack exhaust from the main building, a 25-foot addition to the main stacks was authorized.

All uranium dust is collected in stainless steel ducts and passed through CWS filters before discharge to the atmosphere.

Waste Discharge

The addition of an expected 160 g.p.m. of waste requiring monitoring and possible decontamination made it impossible to tie the waste lines of the extension into the existing system with disposal in Building #776-A. The capacity of the Waste Concentration Building would have been quickly overtaxed. It was also impractical to join the uranium waste with the waste from the main building which might contain plutonium, for no distinction between the two was possible by monitoring. That distinction was important, for any plutonium losses through the waste lines had to be detected quickly and stopped.

Therefore a separate trade waste line of Duriron was constructed, with all sources of uranium contamination in the main building and extension draining into this line. It terminates at a basin in which the waste is aged before it is discharged to a stream.

Building Services

The installation of direct service lines for steam, water and electricity to the extension proved more economical than joining these lines to supply points within the main building. Only the air supply is drawn from the main building.

A separate outdoor substation with two 1000 kv-a. load centers is installed to service the extension and the Bio-Assay Laboratory of Building #735-A.

Equipment

Of the equipment ordered for the semi-works in Building #313-M the draw bench, salt pot, stretch straightener, plate shear, drill press milling machine, degreaser and welder were retained for installation in Building #773-A. Cancellation charges were paid on other equipment orders for the

semi-works. Although much of the equipment installed in the Metallurgical Extension had to be adapted to the processing of long, thin metal components, their design and operation were based on standard commercial practices. Only two items required development work.

Steam Autoclave

After the fuel unit has been assembled it is placed in the autoclave to determine whether or not the core is properly sealed by the sheath. Steam is injected at 125 p.s.i.g. and the assembly subjected to a temperature of 350°F. for a period of 48 hours. Should there be any imperfections such as pinholes in the sheath, the reaction of the steam with the uranium causes the formation of uranium hydrides and hydrated oxides. Although the assembly is not visible during testing, the presence of these hydrides and oxides can be detected in the tank which is installed to collect all condensate flowing from the autoclave. If an assembly has failed in the autoclave it is hosed before removal, the wash water flows into the catch tank and the contents of the tank are then processed for recovery of the uranium.

The autoclave differs from standard units in its dimensions and in the use of the catch tank for condensate flow.

Vacuum Annealing and Brazing Furnace

Designed to stress relieve the uranium and to outgas the electroplated layer, the furnace is a flexible unit specially designed for the extended fuel development program. It accomplishes annealing of the bare or electroplated uranium core under vacuum or controlled atmospheric conditions and it can heat the jacketed elements under an inert or controlled atmosphere at low pressure.

Very stringent performance requirements were established for the furnace at the beginning and, although its performance and fabrication standards remained high, some requirements were relaxed to simplify its fabrication. The original specification requested an operating temperature of 1000°C. and a pressure within the furnace of 100 p.s.i.g. These were reduced to 600°C. and a pressure of 50 p.s.i.g. The vacuum requirements remained at 0 to 10 microns with a maximum leak rate of 25 microns per hour. Very careful machining of the element supports within the furnace was demanded to assure a finished unit with a straightness deviation of no more than .020 of an inch over its 15-foot length.

Before adoption of the present single furnace, an automatically operated three-piece unit was considered. Under

that plan the core or assembly would have been moved on a transfer table from the furnace to a separate cooling unit and finally into a separate low pressure heating unit. Subsequent alterations in the purchase order eliminated first the separate heater and transfer table and finally the cooler. It was agreed that, although it would then be necessary to cool the furnace before removal of the element, the time factor was not critical and the expenditure of an additional $100,000 could not be justified.

Crash Program

With only approximately ten months from the commencement of design to the date set for beneficial occupancy of the building, a "crash" program became necessary in the procurement of materials and equipment. Premium payments were authorized for structural steel and for some equipment. In the latter case this involved chiefly the payment for overtime work on the part of the subcontractor, Voorhees, Walker, Foley and Smith, which was doing the procurement work, and overtime payment to some vendors. In a few necessary cases vendors were selected on the basis of early delivery rather than low bid. A resident du Pont engineer was placed at VWF&S to coordinate the procurement program and, where possible, orders were placed by letter or phone. Vendors were authorized to proceed before formal purchase orders were issued. By this method the six weeks normally required for the placement of orders was reduced to an average of three weeks. The entire program enabled Operations to commence its work on a beneficial occupancy basis on February 17, 1954.

DRAWINGS - PART III

W-157644 - Equipment Arrangement, Service Floor

W-157645 - Equipment Arrangement, Main Floor

BUILDING #776-A - WASTE CONCENTRATION BUILDING

#776-A - Waste Tank Structure

#776-2A- Loading Station

#776-3A- Control House

FUNCTION

Storage and treatment facilities for the radioactive and non-radioactive wastes from Buildings #735-A and #773-A are provided in this installation.

"Low-level" and "high-level" wastes from these buildings flow by gravity through a series of process sewers to the Waste Tank Structure where they are collected in a two-section tank farm. All waste tanks are equipped with paddle-type agitators which maintain a constant concentration throughout the liquid in each tank and insure mixing and neutralization of the contents in the shortest time possible. Small test quantities from the individual tanks are obtained by means of jet samplers, one of which serves each tank. The wastes are then analyzed and classified and their eventual disposition determined. Liquids that are innocuous, from the standpoint of radioactivity, are drained directly into "trade waste" after appropriate steps have been taken to neutralize them. Neutralization is accomplished by the addition of a caustic stored in a tank located in the control house.

Low-level and high-level wastes are similarly treated and then siphoned by individual steam jet systems to the loading platform where they are transferred to tank trucks for transport to disposal facilities in the #200-F Area.

PRINCIPAL COMPONENTS

These waste concentration facilities are located in the extreme northeast section of the #700-A Technical Area, a site expressly selected to meet the gravity flow requirements of the waste piping system. The largest of the three separate components is the tank farm. East of this installation is a two tank-truck loading station. The control house is south of the loading station and also adjacent to the tank farm. The entire facility is designated Class III construction although the tank farm, which is almost entirely underground, is essentially a Class I structure due to the incorporated shielding requirements.

Waste Tank Structure - Bldg. #776-A

Two distinct areas of operation are contained in the tank farm. This component is a concrete pit, largely below grade, 124 ft. long, 26 ft. wide at the north end and 45 ft. wide at the south end. In the narrower end are four individual tank cells where high level liquid wastes are received and stored. There are three 4000 gallon capacity tanks and one 5000 gallon capacity tank. There are three double tank cells for handling low-level waste in the southern portion of the tank farm. Each of these six tanks has a 5000 gallon capacity. The two tank sections are separated by a 10 ft. wide area where much of the receiving and distribution pipework is housed.

Three of the tank cells in the high level area are identical, 11 ft. by 14 ft. and approximately 26 ft. deep. The fourth cell is slightly larger, 13 ft. by 14 ft., to accomodate the larger receiving tank. The outside walls of the cells are 18 in. thick reinforced concrete and partition walls between each cell are 12 in. thick reinforced concrete. Each cell has a concrete floor sloped to a drainage trench, built into the floor along one side, which drains into a sump in one corner of the cell. There is a steel, wall mounted, access ladder to each cell interior for minor servicing on the tank or ion chamber. Adjoining the tank cells to the west is a pipe gallery 15 ft. deep enclosed by 12 in. thick reinforced concrete walls. It has a concrete floor base and a checkered plate pipe gallery floor at the same level as a similar floor in the section separating the two tanks areas.

The low-level tank area resembles the high level tank area except that it has three tank cells, each 19 ft. by 24 ft., with two tanks in each cell. The adjoining pipe gallery for the low-level tanks does not connect with the corresponding high-level area and is reached by an enclosed concrete stairway.

The flat roof of the tank farm is 8 in. thick reinforced concrete. Removable covers, 11 feet square over the high-level tanks and 13 feet square over the low-level tanks, are fitted into angle seats in the roof slab. Roofing materials are applied over the roof and slab covers, effectively sealing the tank cells. There are removable, metal covered hatch covers over the wall ladder and the ion chamber locations in the tank cells as well as over small sections of the pipe gallery areas. Pipe handrails in 8 ft. removable sections are mounted around the perimeter of the tank farm roof.

A short distance from the east wall of the tank farm a 3 ft. wide metal catwalk extends from the north end of this installation to a point 12 ft. beyond the opposite end. This adjunct serves as a pedestrian walkway and pipe rack for service lines.

Loading Station - Bldg. #776-2A

Designed and constructed to accomodate especially equipped tank-trucks, one with 5000 gallon capacity for low-level waste and another of 4000 gallon capacity for high level waste, the loading station is an open, roofed structure 30 ft. wide by 42 ft. long and 21 ft. high. The concrete roof slab is supported by structural steel joists and corner columns. In the center of the station a metal stairway leads to a steel platform suspended from the steel roof members.

Control House - Bldg. #776-3A

The control house is a rectangular structure approximately 22 ft. wide by 82 ft. long by 11 ft. high. The building is divided into three principal sections; a control room, a fan room, and an equipment room. The level and condition of each tank are indicated by individual metering instruments on a control panel where facilities are also provided for operating the steam jets, agitators, and caustic valves. Other equipment in the building includes an air exhaust system which holds all tanks at a slight negative pressure to remove any gaseous products which might tend to pressurize the system, an air compressor for blowing out the liquid transfer lines, and a caustic storage tank located on the platform of a beam scale in one end of the control room.

BUILDING FLOOR SPACE

	Approx. Sq. Ft.
Tank Farm	
"High-level" tank	600
"Low-level" tank	1650
Gallery	1350
Control House	
Equipment room	500
Fan room	175
Control room	950

	Approx. Sq. Ft.
Corridor	30
Platform	160

Loading Station

BUILDING DETAILS

Class - III.

Size -

Tank farm:		Approx.
Area	-	4450 sq. ft.
Volume	-	86,540 cu. ft.
Control house:		
Area	-	2000 sq. ft.
Volume	-	19,750 cu. ft.
Loading Station:		
Area	-	1260 sq. ft.
Volume	-	26,400 cu. ft.

CONSTRUCTION DETAILS

Concrete foundation walls with spread footings and 18 in. square concrete piers extending to a maximum of 13 ft. below grade support the control house. Eighteen inch spread concrete footings and concrete piers 21 in. square and 6 ft. high support the loading station. The piers extend to a maximum of 2 ft. above grade. The tank farm is supported on a heavy concrete slab, provision having been made for the trenches in each cell by maintaining a minimum 18 in. slab under the trenches. Outside walls of the tank cells, which are largely underground, are 18 in. thick concrete. Partitions between the cells and the exterior foundation walls of the tank farm which form the pipe galleries are 12 in. thick concrete.

Walls and floors of the tank cells are covered with a

special impervious paint; the low-level walls to a height of approximately 5 ft. and the high-level cell walls to a height of approximately 7 ft. from the floor.

Each of the three structural components of this facility has a flat concrete slab roof. The tank farm roof is 8 in. thick and finished with roofing materials. The loading station has built-up roofing over a 4 in. concrete slab supported on steel beams. The control house roof is a 2 in. concrete slab on steel joists with fibreglass insulation and built-up roofing.

The concrete floors are covered only with a Class I finish.

Ceilings in the control house and the loading station are exposed, unpainted concrete and steel beams. The exposed underside of the concrete slab roof forms the ceiling over the tank cells in the tank farm.

Tank pit ventilation is provided to remove heat produced by the tank agitator motors. Air is filtered through CWS type elements before discharge into the atmosphere. No ventilation is required in the open loading station. Control house ventilation is accomplished by windows and roof ventilators.

Cooling air for the emergency diesel generator is supplied by an auxiliary radiator fan, operated in conjunction with the generator, and is exhausted through ductwork and louvers. Air movement is maintained by unit heater fans.

Fluorescent lighting is provided in the control room, all other areas have incandescent lighting. Emergency and blackout lighting circuits, with a control panel, are installed in the equipment room. All lighting circuits in the control house are on the emergency panel.

EQUIPMENT

Tank Farm

7 Vertical 5000 gal., type 304 ELC tanks - 10 hp. gear reducer.
3 Vertical 3000 gal., type 304 ELC tanks - 5 hp. gear reducer.

10 Vertical type s/s agitators (one per storage tank), s/s steam jets, process syphon, 25 and 75 g.p.m. (100 p.s.i. steam).

7 Low-level s/s samplers.

3 Low-level s/s samplers with carbon steel shielding box.

Truck-loading Station

Flexible s/s hose and quick-seal connectors between pipelines and trucks.

Control House

1 Control panel for recording tank content, alarms and remote control.

1 Carbon ring air compressor and motor, 61 s.c.f.m. at 100 p.s.i.g.

4 Industrial exhaust fans - Fan housing and wheel is Heresite coated, 250 c.f.m. capacity.

1 Compressed air receiver, forged steel, 4 ft. dia. 8 ft. high.

1 Caustic storage tank (mild steel) 4 ft. dia., 5 ft. high.

1 Nitric acid tilt stand, 55 gals.

1 Beam scale (caustic tank) 5000 lb. capacity.

Instrumentation

Instrumentation in Building #776-A is of four types - recording, alarm, control, and interlock. A summary of each of these systems follows.

Recorders

There are ten tanks in the tank section of the building and the following recorders are provided for each:

The liquid level from 0 to 12 feet is recorded for each tank,

A record is kept of the pressure in each of the tanks,

Records are kept of the specific gravity and the temperature of the liquid in each of the tanks,

Two recorders log the activity in each tank, in the truck area, and in the trade waste line. The four high-activity tanks are recorded on one four-point recorder and the other eight locations are recorded on one eight point recorder.

Alarms

The control panel board is supplied with one common alarm horn and one test light pushbutton for testing all alarm lights. Alarms are provided on the board for the following:

Each tank has a high-level alarm.

Each sump has a high-level alarm.

There is one common alarm for high activity in the four high-level tanks.

There is one common high activity alarm for each of the remaining six tanks, the truck area and the trade waste line.

Each tank has a high pressure alarm.

One alarm is provided for instrument air failure.

One common audible alarm sounds for all high-level, high pressure, or high activity alarms on the high activity tanks.

One common audible alarm sounds for all high-level, high pressure, or high activity alarms on the low activity tanks.

Control

Each of the tanks has individual start and stop buttons for its agitator and a red illuminated name plate to indicate "agitator stopped".

Each jet on tanks or sumps has its steam and air valve pheumatically controlled by an air switch. A pressure switch also is located in the common steam and air lines. This pressure switch illuminates a red name plate on the panel to indicate "jet in operation".

The NaOH valves are pneumatically controlled.

Interlock

Each high activity tank has a transfer permission light on the panel. A switch in the control room interlocks the four jets to prevent more than one or all from operating until the truck driver has made the desired pipe connection to his truck. A key must be used to unlock the switch.

DEVELOPMENT OF DESIGN

Determining factors in the final design of the Waste Concentration Building were the types and quantities of liquid wastes to be handled. The contamination potential of these wastes varies through many degrees, from relatively harmless to concentrations containing a critical proportion of radioactivity. Chiefly from a health physics standpoint maximum levels were set for three categories of wastes and the waste disposal system of the #700 Area was developed around these types. The Health Physics section of du Pont followed recommendations of the Atomic Energy Commission in establishing permissable activity of liquid wastes to be discharged into the surface drainage system. The limit of 1×10^{-8} curies/cc for differentiating between high and low level wastes was adopted by the Process Section of du Pont on the basis of safe operation levels in Building #211-F. Wastes which are innocuous so far as radioactivity is concerned specifically those containing less than 10^{-13} curies/cc, have been designated as "trade waste". Such waste material may or may not require neutralization before discharge into the natural surface drainage system. A second type of waste, designated "low-level" waste and containing up to 1×10^{-8} curies/cc, requires a minimum of special storage and transportation facilities, with some shielding. The third type, "high-level" waste, contains radioactivity exceeding 1×10^{-8} curies/cc and requires specially designed equipment for storage and transportation, with definite shielding.

In addition to the radioactive contaminated wastes resulting from the technical studies conducted in the #700 Area, there are other contaminating materials consisting of almost any known cation or anion reagents and solvents. These have all been anticipated by using the best available materials of construction in the design of the waste concentration and disposal system. Stainless steel type 304 ELC was used as an alternative to 309 which was not available.

The volume of liquid wastes originating in the #700 Technical Area has been estimated as follows:

Bldg. No.	Low Activity Gals/day	High Activity Gals/day	Uncontaminated Trade Waste
#773-A	10,000	5000	6,000
#735-A	5,000		35,000
Total	15,000	5000	41,000

The 41,000 gallons of uncontaminated trade waste originating in Buildings #773-A and #735-A can be discharged directly into the surface drainage system without monitoring or other treatment. Also, a large part of the low-level waste can be discharged quickly into the trade waste system. In designing the Waste Concentration Building it was assumed that only 5000 gallons per day of this low-level waste would require concentration, bringing to 10,000 gallons per day the total wastes to be transported to the #200-F Area. The volume of waste going to the #200 Area is expected to be kept low by recirculation and dilution of higher activity with low activity material and by storage for short periods to permit natural decay of radioactivity on material with low half life.

Three 4000 gallon tanks and one 5000 gallon tank were deemed adequate for the high-level waste system while six 5000 gallon tanks were provided for the low-level system. To meet the requirements for storage and the need for shielding, the tank cells were designed as underground pits with heavy concrete walls and a sealed roof. All pipe lines are enclosed in concrete trenches with removable covers and all pipe lines in the collection grid slope toward the storage tanks in order to utilize gravity drainage. The process sewers (Building #904-A) from Buildings #773-A and #735-A run in concrete trenches 15 ft. below the ground level. Trench drainage is provided as well as a sump from which the drainage can be removed to the proper waste system. All tanks are interconnected in such a way that the liquid can be pumped into or from any tank to the truck loading station if radioactive, or to surface drainage if not radioactive. As few valves as possible were incorporated into the high-level waste piping system due to the difficulty of making repairs and providing adequate shielding facilities for them. The bulk of the liquid is removed from the waste transfer pipes by blowing them out with compressed air.

Safety Considerations

Since the basic purpose of the waste concentration facilities is the safe disposal of material giving off radiation, protection against exposure to radiation was a primary factor in the design of the installation. The provision of 18 in. thick reinforced concrete walls and heavy concrete slab coverings for the tank cells incorporates the required protective measures in the structure. Tank cell design, pipe enclosures and liquid handling equipment in the loading station were all calculated to create operating conditions much below the allowable maximum exposure. To assure the safety of operating personnel the high-level system was designed for completely remote operation but for only partially remote maintenance and lubrication. Sampling of the

tank contents is also accomplished by remote control and individual, identical samples units are provided for each tank, both in the high- and low-level systems. The four sampling units serving the hot tanks, however, are completely shielded by 1 in. carbon steel plates. Liquid level alarms and tank cell pressure alarms have also been installed as safety measures. In the low-level area remote controls, liquid-level, activity-level and pressure alarms have also been included but the low-level facilities must be directly maintained and lubricated.

The loading station and the tank trucks were designed to effect safe removal of the radioactive wastes. Special hose and nozzle designs were developed and provision made to minimize the possibility of tank-truck over-flow.

In the event of accidental discharge of wastes as they are handled in the loading station, an emergency shower is available there. Two emergency showers are provided in the control house, one at the east platform near the nitric acid storage tank and another near the fan room door.

The lines carrying radioactive process materials are completely isolated from domestic service lines, which are outside the tank cells to the east of the tanks. The waste lines are completely shielded. This was accomplished by building two sections in the line trenches separated by a 12 in. concrete partition between the high-level and low-level lines and the 18 in. thick concrete walls between tanks and the pipe galleries.

No structural provisions have been made for expansion although the layout of the area is such that the tank farm can be readily expanded at either end.

Design Changes

The estimated storage requirements for high-level waste were originally for three 5000-gallon tanks, two to be used alternately and one as a spare. These estimates were based on the inclusion of the Physics Assembly Laboratory in the waste system. Relocation of this laboratory in the 300 Area, together with the conclusion that uncontaminated waste from the laboratory could be discharged directly into the surface system, combined to reduce tank capacity requirements. Adjustments in the estimated requirements somewhat reduced the size of the tank farm.

The dispersal of filtered exhaust air through a 25 ft. high stainless steel stack was at first considered necessary.

Further reviews of the exhaust problem developed data permitting the elimination of the stack and the substitution of a series of three ventilators in the roof of the control house.

Plans to include toilet facilities were dropped when the cost was estimated at $5000. To include these facilities it would have been necessary to increase the height of the tank farm walls, to elevate the control house itself and to construct a 400 ft. sewer line. Since the installation is a one man operation and toilet facilities are readily accessible, these facilities were not included in this area.

DRAWINGS

W-157184 - Plan at Lower Level, Architectural.

W-157185 - Plan at Upper Level, Architectural.

W-157186 - Roof Plan and Sections, Architectural.

W-157187 - Elevations, Sheet #1, Architectural.

W-157188 - Elevations, Sheet #2, Architectural.

W-157189 - Sections, Sheet #1, Architectural.

W-157191 - Sections, Sheet #3, Architectural.

PERSONNEL, MAINTENANCE AND STORAGE FACILITIES

BUILDING #701-1A - GATE HOUSE

FUNCTION

This Gate House group provides a security check point for the control of vehicular and pedestrian traffic to and from the technical section of the #700-A Area. It also functions as a center for the exchange and inspection of personnel health badges, the distribution of "pencil" meters, and the maintenance of records. Operation is on a three-shift basis.

PRINCIPAL COMPONENTS

Two buildings are provided for these purposes. One is a small sentry-box structure, located on a curbed and paved island between two traffic lanes, for vehicular traffic control. The other larger building contains a guard room and an adjoining waiting room, a badge alley with four personnel control lanes, two Health Physics mater and badge processing rooms and the necessary rest rooms and toilets.

BUILDING FLOOR SPACE

	Approx. Sq. Ft.
H. P. badge processing, etc.	290
Gate House	16
Rest and Toilet room	100
Badge alley	675
Guard room	135
Waiting room	85

BUILDING DETAILS

Both of the buildings are single-story and have a total area of 1424 square feet, and a combined volume of 18,950 cubic feet. The larger building is approximately 26 ft. by 54 ft. by 12 ft from floor to top of roof slab. The smaller building is approximately 5 ft. square by 9 ft. high from floor to top of roof slab. They are constructed on reinforced concrete foundations with spread footings and

have structural steel frames with open web roof joists and concrete roof slabs. The exterior and interior walls are covered with flat cement asbestos board except in the toilet room where concrete walls are carried to a height of 4 feet above the concrete floor, with flat cement asbestos board above. The ceiling in the larger gate house is suspended and finished with flat asbestos board. Doors are hollow metal, windows are double hung steel sash. Roofing is built-up. Exterior walls and roofs and interior walls of the badge processing section are insulated. Asphalt tile floor covering is provided in the badge processing area, the toilet and rest rooms and in the guard room. Fin-tube heating is installed in the waiting room and guard room, unit heaters in the badge alley, and forced air in the badge processing section in conjunction with air conditioning. The traffic control gate house has an electric heater. The Health Meter processing area is air conditioned and air exhaust is provided from the toilet and rest rooms. Lighting fixtures are incandescent except in the badge alley where fluorescent fixtures are used.

EQUIPMENT

2 Double badge counters.

Conventional office furniture.

Badge processing equipment.

Work bench, 18 lin. ft.

1 Air conditioning unit, 5-ton, with heating coil, duct work, etc.

1 Exhaust fan, 200 c.f.m.

4 Unit heaters, 42,000 B.t.u.

1 Electric water cooler.

1 Electric heater, 2-k.w.

1 Transformer, 15-kv.-a.

1 Electric water heater, 1000 watt.

DEVELOPMENT

Class III construction was designated for this building since it is expendable.

DRAWING

W-155157 - Plans and Elevations.

BUILDING #701-2A - GATE HOUSE

FUNCTION

This Gate House group functions as the control point for vehicular and pedestrian traffic at the main entrance to the shop buildings section of the #700-A Area.

PRINCIPAL COMPONENTS

Two buildings are provided for this operation. One is a small sentry-box located on a curbed and paved island between two traffic lanes and the other is a gate house with two personnel control lanes.

BUILDING DETAILS

Class III single story structures were erected for this security control function. One building is approximately 10 ft. by 15 ft. by 9 ft. high from the floor to the top of the roof slab, with a 2 foot overhang on the long sides. The other building is approximately 5 ft. square by 9 ft. high from the floor to the top of the roof slab. The total area of the two gate houses is 170 square feet, the combined volume 1700 cubic feet.

CONSTRUCTION DETAILS

Constructed on concrete foundations, these buildings have structural steel frames with open web roof joists and flat concrete roof slabs. Interior and exterior walls are covered with flat, cement asbestos board. The exposed underside of the concrete roof forms the ceilings, and roofing is built up. The exterior walls and roof are insulated. The floor is a concrete slab with no covering material. Doors are hollow metal, and windows are steel double hung sash.

Heating is by electric heaters and the lighting is incandescent.

EQUIPMENT

Electric water cooler.

Conventional office equipment.

2 Electric heaters, 2 and 7-1/2 kw.

DEVELOPMENT

The expendability of these buildings and the permanence and fire resistant properties of materials of construction were factors affecting their design.

DRAWING

W-156135 - Plans, Sections and Elevations.

BUILDING #701-3A - GATE HOUSE

FUNCTION

This building provides facilities for the control of vehicular traffic on the highway between the #300 and #700 Areas leading southward to other parts of the plant.

PRINCIPAL COMPONENTS

A one-story structure, it is located on a curbed and paved island between two single traffic lanes.

BUILDING DETAILS

Of Class III construction, approximately 10 ft. by 15 ft. by 9 ft. from the floor to top of the roof slab, the building has an area of 150 square feet and a volume of 1600 cubic feet.

CONSTRUCTION DETAILS

The Gate House is erected on a reinforced concrete foundation with wall footings and has a structural steel frame with open web roof joists. The roof is a concrete slab with built up roofing and its exposed under side forms the ceiling. Exterior and interior walls are of flat cement asbestos board. Floors are concrete, doors hollow metal and windows are steel, double hung. Electric heating and incandescent lighting is provided.

EQUIPMENT

1 Electric heater, 7-1/2 kw.

1 Electric water cooler.

Office Furniture.

DEVELOPMENT

The expendability of the facility and the permanence and fire resistant properties of materials of construction were factors influencing its design.

DRAWING

W-156238 - Plans, Sections and Elevations.

BUILDING #701-4A - GATE HOUSE

FUNCTION

This gate house is located on a curbed and paved traffic island between two single traffic lanes at the south entrance to the shop buildings section of the #700 Area and furnishes vehicular control for that point.

In all construction details it is a duplicate of Building #701-3A.

EQUIPMENT

1 Electric heater, 7-1/2-kw.

1 Electric water cooler.

Office furniture.

1 Transformer, 9-kv.-a.

DRAWING

W-156162 - Plans, Sections, Elevations.

BUILDING #702-A - TELEPHONE BUILDING

FUNCTION

The facilities and equipment for the central telephone exchange of the Savannah River Plant are provided in this building. Here are located the dial telephone system designed to handle 2500 intra-plant telephones and 1000 extensions, a manually operated switch board for outside calls, the TWX lines and a Western Union connection. The machines for these last two services are installed in the nearby Administration Building.

PRINCIPAL COMPONENTS

The main portion of the building is a Class I structure approximately 39 ft. wide by 119 ft. long by 17 ft. high from the floor to top of the roof slab. This section houses the telephone exchange equipment and operations personnel. A Switch Room 39 ft. wide by 81 ft. long occupies about two thirds of the space in the building, with the mechanical switching apparatus housed in it. Shop space for mechanics doing routine test and maintenance work is provided in one corner of this room. A cable vault, 6 ft. wide and 45 ft. long, is located below grade along the south wall of this area. Manholes at each end provide access to this vault. A shielded doorway separates the Switch Room from the rest of the Class I area. This smaller space is 39 ft. wide by 38 ft. long and is divided into three sections; a switchboard room with facilities for eight operators and space for a total of fourteen, a supervisor's office, and a utility room. At this end of the Class I structure, and connected to it by a baffled doorway, there is a Class III wing, approximately 22 ft. wide by 26 ft. long by 10 ft. from the floor to top of the roof slab. This area contains a rest room with lockers for the telephone operators, toilets, and a janitor's closet.

BUILDING FLOOR SPACE

	Approx. Sq. Ft.
Class - I	
Switch room	2960
Switch board room	620
Switch board room office	130
Utility room	310

Class III	Approx. Sq. Ft.
Rest room	285
(2) Toilet rooms	190

BUILDING DETAILS

A single-story structure, the combined area of the two sections is 5195 square feet. The total volume is 86,814 cubic feet.

CONSTRUCTION DETAILS

A concrete foundation with spread footings supports the structure. The walls and roof of the Class I portion are reinforced concrete with interior baffle walls for ray protection. Interior partitions are flat cement asbestos board on steel studs and the interior of exterior walls is sheathed with "Masonite" from the floor to the exposed concrete ceilings. Doors are hollow metal. There are no windows.

The Class III section has a structural steel frame with web roof joists supporting a concrete roof slab. The exterior walls are flat cement asbestos board and the same material on steel studs covers the interior of exterior walls and is used for interior partitions. Toilet room walls are concrete to a height of four feet with asbestos board above. Doors are hollow metal and windows are projected steel sash. Insulation is installed on exterior walls and in the roof of both sections. Roofing is built-up. The concrete floor is covered with asphalt tile except in the utility room and the janitor's closet.

Heating is by forced air throughout the building. In the Class I section it is in conjunction with the air conditioning system which serves this portion of the building only. The Class III portion has a separate heating and ventilating unit with a duct system. Air exhaust is handled by an exhaust fan and ductwork. Lighting in the switchboard room and office is fluorescent, with incandescent in all other areas. Normal electric power is supplied from Substation, Building #752-3A. An emergency feeder from the diesel generator in Building #703-A is also provided for emergency lighting. Black-out of exterior lights and area safety alarm in the building are controlled from Patrol Headquarters, Building #720-A.

EQUIPMENT

Telephone switchgear for 1500 lines with space for a total of 2500 lines on an eight-position switchboard.

1 Self-contained air conditioning unit - 10-ton capacity with two heating coils, 420 and 3920 c.f.m. capacity, and ductwork.

1 Heating and ventilating unit, 134 c.f.m., 8800 B.t.u. capacity.

1 Hot water tank, 60 gal. capacity.

1 Exhaust fan, 2300 c.f.m., and ductwork.

6 Lockers, conventional rest room equipment and office furniture.

DEVELOPMENT OF DESIGN

Since the continuous performance of all communications equipment is vital to the proper functioning of plant security control as well as a necessity in cases of plant emergency, a Class I structure was specified throughout except for the toilet and rest room area. In addition this section where the operators are located also provides a bomb shelter and protection against gamma rays. The building was designed to permit reasonable variation in the number of outside lines without interfering with building operations. Space is not provided for additions to the dial system installation but expansion up to 100 per cent may be effected by addition to the building as the need arised.

DRAWINGS

W-155686 - Floor Plan.

W-155687 - Elevations.

BUILDING #705-A - MOTOR POOL OFFICE

FUNCTION

This facility provides a control office at the motor pool parking lot for Building #703-A.

BUILDING DETAILS

A one story Class III structure, the building is approximately 10 ft. square and 9 ft. high from the floor to the top of the flat roof. It has an area of 100 square feet and a volume of 900 cubic feet.

CONSTRUCTION DETAILS

The building foundations are of reinforced concrete supporting wood framed walls sheathed both inside and out with flat cement asbestos board. There are no interior partitions. The concrete floor has no covering. Roofing is built up on wood sheathing, and the exterior walls and ceiling are insulated. Heating is electric and lighting is incandescent.

EQUIPMENT

1 5-kw. Electric unit heater.

1 9 kv.-a Transformer.

1 Electric water cooler.

Office furniture.

DEVELOPMENT OF DESIGN

No major problems arose in the development of the design for this building. Class III construction was considered adequate, since the building is expendable. Basic design criteria were followed to obtain economical construction and layout.

DRAWING

W-157619 - Plans, Elevations, Sections and Details.

BUILDING #706-A - FIELD OFFICE

FUNCTION

Permanent office quarters for the AEC Security Personnel group, supplementing space now occupied in Building #703-A, are furnished by this facility.

PRINCIPAL COMPONENTS

Four offices designed to accomodate an average of six persons and a maximum of sixteen persons, and sanitary facilities including a shower and toilet room are provided.

BUILDING FLOOR SPACE

	Approx. Sq. Ft.
Offices	1150
Sanitary Facilities	60

BUILDING DETAILS

This is a wood frame building, 32 ft. wide by 38 ft. long and 8 ft. high from floor to ceiling. Its total area is 1216 square feet and the volume is 9278 cubic feet.

CONSTRUCTION DETAILS

Building foundations are 12 in. square wood sills on concrete piers. The building frame and roof are wood with exterior walls sheathed with celosiding. Interior partitions are of sheetrock on wood stud and the interior of exterior walls is covered with sheetrock, as are toilet and shower room walls. Shower stalls are sheet metal. Ceilings are celotex, doors and window sash are wood. Corrugated aluminum roofing covers the wood roof structure. The building is not insulated. Floors are wood, covered with asphalt tile. An existing forced air oil burner supplies heat for the building. Two 3/4-ton window-type air conditioning units are provided for the main office. Lighting is fluorescent.

DEVELOPMENT OF DESIGN

The availability of this temporary construction building, its size, and its convenient location close to Building #703-A, determined its suitability for conversion and adaptation to permanent use. Only a few alterations and the provision of permanent service facilities were necessary to effect its economic conversion.

DRAWING

W-165096 - Plans, Elevations, Sections & Details

BUILDING #708-A - CAFETERIA

FUNCTION

Food preparation and cafeteria facilities for an estimated 1200 employees per shift in the #300-#700 Area, and facilities for the storage and preparation of food for an additional 1000 meals per peak shift to be served at the cafeterias in other plant areas are provided in this building. Food delivery from this main cafeteria to area cafeterias is by truck and food carts of the "Aervoid" type which have inserts for hot and refrigerated foods, trays for baked goods, and similar components. Maximum occupancy of the cafeterias is anticipated on the 8-4 and 4-12 shifts, when hot meals will be served. A breakfast menu is provided on the midnight to 8 AM shift.

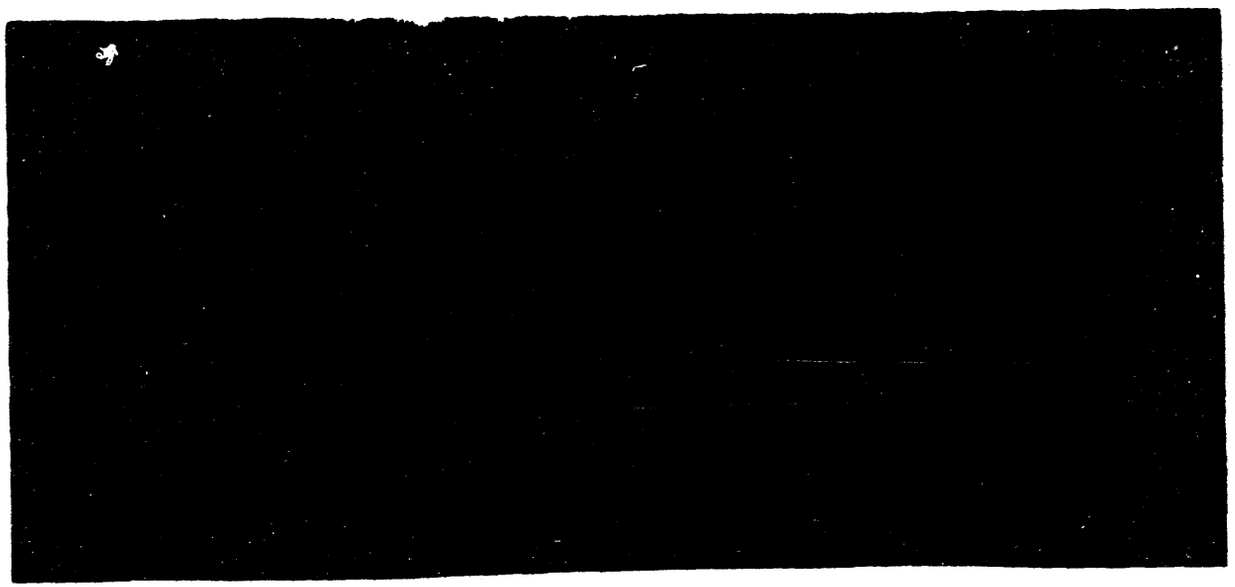
PRINCIPAL COMPONENTS

The main cafeteria dining room is equipped with skip-line service features and has a seating capacity of approximately 530. Adjoining this room is a secondary serving area and dining room for cafeteria personnel with a seating capacity of about 90. In addition to these two eating areas there is a canteen for the sale of cigarettes, candy, sandwiches and similar items.

The kitchen is equipped with the most modern and utilitarian apparatus for the preparation and cooking of food, and for baking and packaging food for distribution to the area cafeterias. Extensive food receiving and storage equipment, refrigeration facilities, dishwashing (which is initiated by self-bussing from the dining room), pot washing and garbage handling facilities are provided. There are locker, shower, toilet and change room facilities for approximately 140 male and female employees. Patron's toilet rooms are located off the lobby of the main dining room. At the building entrance is a bus platform with a canopy for the protection of patrons arriving from other parts of the plant.

BUILDING FLOOR SPACE

	Approx. Sq. Ft.
Main dining room	12,000



BUILDING #708 A··· CAFETERIA

	Approx. Sq. Ft.
Counter area	1600
Two vestibules, main dining room	740
Dishwashing	960
Canteen	400
Toilets	400
Dining room "A"	1580
Counter area	530
Receiving room and dry storage	2735
Two offices	265
Refrigerators (built in)	970
Baking area	385
Utility room	2250
Two cart washing areas	290
Garbage, refrigerator and can rooms	315
Linen room	75
Change rooms and toilets with rest rooms	1900
Coat rooms and toilets	420
Truck loading platform	775
Bus terminal	4600

BUILDING DETAILS

The building is a Class III, one story structure, approximately 266 ft. by 162 ft., with an additional 22 ft. by 27 ft. extension at the south end of the bus terminal. Building heights vary from approximately 14 ft. to 18 ft. between floor and top of roof slab.

Kitchen section - 120 ft. by 120 ft. by 14 ft. high.

Dining room section - 100 ft. by 122 ft. by 18 ft. high.

Storage and utility section- 142 ft. by 40 ft. by 14 ft. high.

Vestibule, Canteen, and Dishwashing sections- 20 ft. by 122 ft. by 14 ft. high.

Bus terminal section- 27 ft. by 184 ft. by 14 ft. high.

	Approx.
Total area	40,070 Sq. Ft.
Total volume	596,410 Cu. Ft.

CONSTRUCTION DETAILS

The building has a reinforced concrete foundation with spread footings. The superstructure is steel frame with open web roof joists and concrete roof on rib-lath. The exterior walls are of flat cement asbestos on light steel framing. Interior partitions and the interior of exterior walls are covered with flat cement asbestos board on steel nailing studs, and generally with metal lath and plaster, cement plaster, or ceramic tile on cement plaster according to the usage of the space. A wire mesh partition is installed around the receiving area. The walls of toilet, shower and change rooms, cart storage and employees rest rooms are concrete to a height of 4 ft. with flat cement asbestos board above. Ceramic tile to full ceiling height is used to finish walls in the dishwashing and baking areas, freezers and refrigerators, the main kitchen and the cart washing room.

Ceilings are suspended except in the utility room, the bus terminal and the loading platform where the basic structure is exposed. Metal lath and plaster ceilings are used in the baking area, main kitchen and the can storage and cart washing spaces. A perforated cement asbestos board ceiling with sound absorbent insulation is provided in the dishwashing area, the dining rooms and counter areas. In all other areas ceilings are of flat cement asbestos board.

Doors, generally, are hollow metal. Those in the freezer and refrigerator facilities are of specially laminated wood. Windows are fixed steel sash except in the service, dishwashing, food storage and utility areas where projected sash is installed. Roofing is built up. Insulation is provided in the roof, exterior walls, walls of toilet and rest rooms, and in the floors, walls, and ceilings of the freezer and refrigerator rooms.

Quarry tile is laid over concrete floors in the refrigerators, the baking, dishwashing, kitchen and associated

areas and in the rear of the cafeteria counters. Asphalt tile is used in the customer's toilets and the building employees rooms. Grease proof tile is installed in the dining rooms and counter areas, the kitchen offices and corridors, in the main dining room, vestibules and the canteen.

Except for the storage area where unit heaters are provided, heating is furnished by forced air in conjunction with the air conditioning systems for the dining areas and by coils through ducts in other areas. The utility room is not heated. The heat source is the #700 Area power plant.

Two separate systems of built-up air conditioning units service the two dining rooms. Chilled water for this operation is supplied by the #700 Area refrigeration plant. Ventilation from the dishwashing section and kitchen is through hood exhaust systems, and from the toilet areas through duct systems. Exhaust fans are roof mounted. Ventilation is provided in the food storage and utility areas through mechanical roof ventilators.

Fluorescent lighting is provided in the dining rooms and counter areas, the dishwashing room, canteen, kitchen offices, baking area and employees' rest rooms. Incandescent lighting fixtures illuminate the other areas including the food sections of the service counters where the fixtures are of the direct incandescent type. Normal electric power is supplied from Substation, Building #752-3A. An emergency feeder from the diesel generator in Building #703-A is also provided for emergency lighting. Black-out of lights and area safety alarm are controlled from Patrol Headquarters, Building #720-A.

EQUIPMENT

Serving Facilities

Counter, 20 ft. long, cases, and ice cream dispensing cabinet, milk refrigerator and sink in canteen.

Dining room tables with swing seats attached.

Water stations.

Portable tables and condiment shelves.

One serving counter section with tray rail approx. 32 ft. long for cafeteria employees, and two sections each 56 ft. (average) long, with rear wall equipment, shelving, sinks, and with sections for sandwiches, bread, cold pans, hot foods, griddle items, toasters, ice cream,

dish and glass lowerators, urn stands, desserts, display shelves, and cashier stations.

Standard, pass-through and walk-in refrigerators.

Kitchen

Includes ranges, ovens, hoods, tables, kettles, equipment, utensils, etc., for meat, salad and vegetable preparation, baking, cooking and pot washing. "Aervoid" food containers, inset pans; baker's carts, pan and utensil racks.

Garbage disposal refrigerator and cans, can washing facilities.

Dishwashing Room

Soiled dish table and garbage disposal unit.

Pre-wash and dishwashing tables and machines.

Dish tables, glass washing sink.

Chinaware, glassware, tableware.

Carts for soiled and clean dishes and trays.

Receiving and Storage Area

Conventional office furniture, platform scale, shelving and bins, 96 linear feet.

Change Rooms

142 lockers, with benches.

Heating, Ventilating and Mechanical

Hot water storage heater, 1900 gal. capacity, 1000 g.p.h.

Two air conditioning systems, with filter, heating and cooling coils, pumps, fans, casings, ductwork diffusers and controls:

1 at 18,360 c.f.m., 21.3 tons.

1 at 3200 c.f.m., 21.3 tons.

Four unit heaters, 600 c.f.m.

Six roof vents, motorized.

Centrifugal supply and exhaust fans for various systems:

1 at 18,070 c.f.m.

2 at 11,250 c.f.m.

1 at 4215 c.f.m.

2 at 3000 and 3100 c.f.m., respectively.

1 at 2155 c.f.m.

1 at 530 c.f.m.

Seven utility fans - 550 to 2500 c.f.m.

Nine refrigeration condensing units, - Capacity:

6300 B.t.u./hr.	(2)
8000 B.t.u./hr.	(1)
9500 B.t.u./hr.	(1)
11,000 B.t.u./hr.	(3)
17,500 B.t.u./hr.	(1)
46,210 B.t.u./hr.	(1)

Electric - Three transformers, 30 Kv.-a. -480/208-120.

Two transformers, 225 Kv.-a. -3 ph 480/120-208.

One transformer, 9 Kv.-a. - emergency.

DEVELOPMENT OF DESIGN

The building is considered expendable in the event of bomb blast, but the permanence and fire resistant properties of building materials were determining factors in its structural design.

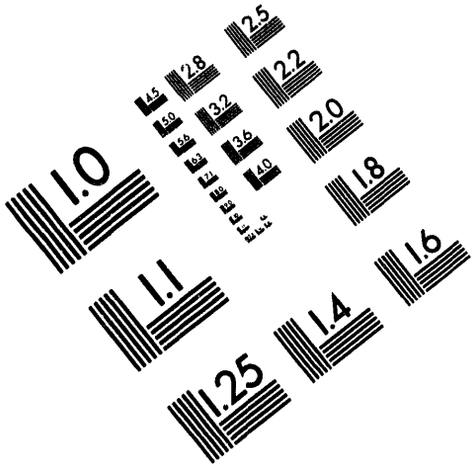
DRAWINGS

W-156622 - Key Plan.

W-156623 - Floor Plan, Part I.

W-156624 - Floor Plan, Part II.

W-156626 - Elevations.



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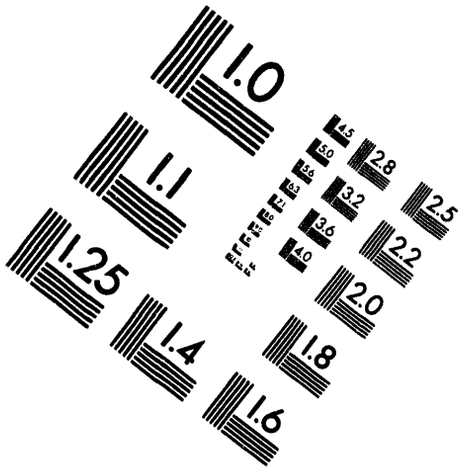

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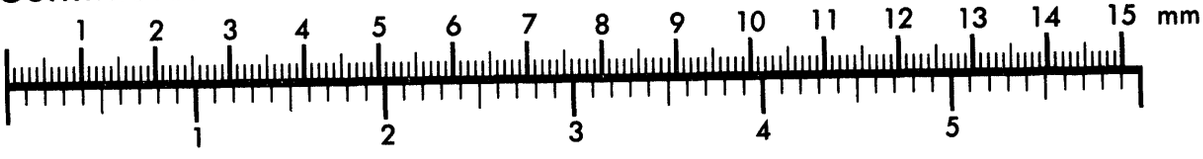

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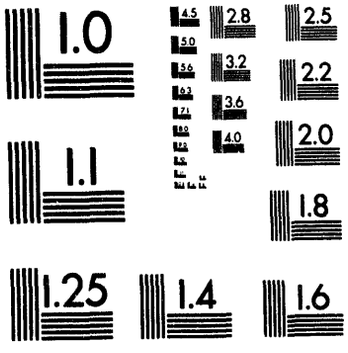

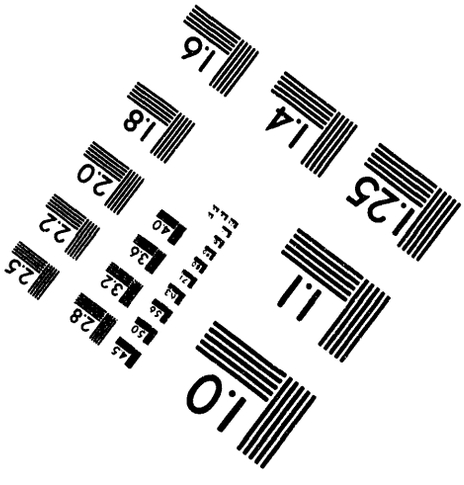

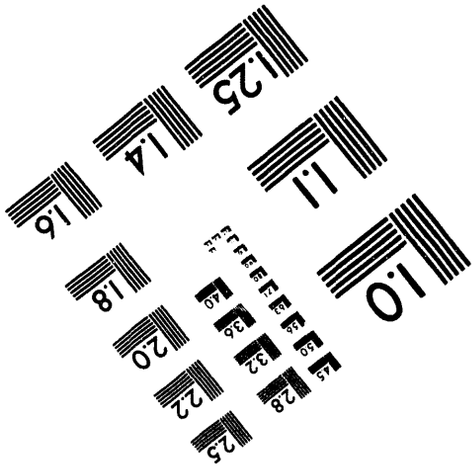

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BUILDING #710-A - WAREHOUSE

FUNCTION

This facility provides storage space for equipment and materials which are seldom used.

BUILDING DETAILS

A single-story, one room, Class IV rectangular structure, the building is approximately 50 ft. wide by 160 ft. long by 14 ft. high from the floor to the top of the eave.

CONSTRUCTION DETAILS

The warehouse is a prefabricated metal building with steel siding on steel framing. The floor is a 4 in. concrete slab reinforced with 6 in. by 6 in. wire mesh. Electric lighting is the only service provided.

DEVELOPMENT OF DESIGN

The transfer of Construction Warehouse, formerly TC Building #8320-M, from the temporary construction to the permanent account was authorized in order to utlize the building for specialized storage. The transfer entailed only the connection of the existing lighting system to the permanent power supply rather than continue its relation to the TC circuit. No other changes or adaptations were required.

DRAWINGS

W-161190 - Floor Plans - Architectural - Electrical

BUILDING #711-A - STEEL AND PIPE STORAGE

FUNCTION

This facility provides a sheltered storage space for pipe, large valves, steel bars, small shapes, and sheet metal. It is located near the Central Maintenance Shop, Building #717-A.

PRINCIPAL COMPONENTS

The plan comprises a roofed-over area, open on two sides, for the storage of steel stock and pipe, and two areas enclosed on three sides - one for sheet metal and one for large valves.

BUILDING FLOOR SPACE

	Approx. Sq. Ft.
Steel stock and pipe storage	440
Sheet metal storage	50
Valve storage	140

BUILDING DETAILS

Of single story, Class III construction, approximately 20 ft. by 125 ft., the building is 11 ft. high from the floor to the top of the flat roof which extends to form a 4 ft. overhang on two sides. The total area is approximately 680 square feet and the total volume is 8280 cubic feet.

CONSTRUCTION DETAILS

With foundation walls of reinforced concrete, the structure is of wood frame treated for fire resistance. Exterior walls and interior partitions are of corrugated cement asbestos board on wood studs left exposed on the interior of exterior walls and on one side of interior partitions. The ceiling is formed by the exposed under side of the roof sheathing. Roofing is built-up and the floor is a concrete slab. Lighting is incandescent. There are no doors or windows.

EQUIPMENT

Storage racks for steel stock and sheet metal.

DEVELOPMENT OF DESIGN

The development of the design for this structure was governed only by its classification as expendable and by its function as a storage facility.

DRAWING

W-155804 - Plans, Elevations.

BUILDING #712-A - LUMBER STORAGE

FUNCTION

This structure serves as a weather-protected partially enclosed area, close to the Central Maintenance Shops Building #717-A, for the storage of lumber and plywood.

PRINCIPAL COMPONENTS

The building is roofed but is open on two sides for accessibility to the lumber storage. An enclosed area provides protected storage of plywood.

BUILDING FLOOR SPACE

	Approx. Sq. Ft.
Lumber storage	480
Plywood storage	160

BUILDING DETAILS

A single story, Class III structure, the building is approximately 16 ft. by 43 ft. out to out of studs, by 14 ft. from floor to average height of top of sheathing of the flat sloping roof. The total area is approximately 680 square feet, and the total volume is 9940 cubic feet. There is a 4 ft. overhang on the two long sides of the roof for weather protection.

CONSTRUCTION DETAILS

The foundations, of reinforced concrete, support structural steel angle columns and wood rafters and joists. All wood structural members were treated for fire resistance. Exterior walls and interior partitions are of wood studs sheathed with flat cement asbestos board. No windows were installed. The floor is a concrete slab. The exposed framing of the under side of the built-up roof forms the ceiling. There is an overhead-sliding wood door giving access to the plywood storage section.

No heating was required, but electric lights are installed in both the open and enclosed areas.

EQUIPMENT

Storage racks (Uni-strut) steel for lumber and plywood storage.

DEVELOPMENT OF DESIGN

The plan for this structure was developed along the most economical lines consistent with its function and the design standards for the project.

DRAWING

W-156133 - Plans, Elevations.

BUILDING #713-A - CENTRAL STORES BUILDING

FUNCTION

Facilities for receiving, storing and dispensing materials and spare parts are provided in this building. Materials entering directly into production operations are stored at the point of consumption. Extra machinery, stored in Building #714-A, is under the same supervision as the material in this building. Special store rooms are provided at other points for the storage of flammable materials, automotive parts, and laboratory stores.

PRINCIPAL COMPONENTS

The building contains a receiving area and office, general storage and dispensing space, a safety shoe storage and fitting room, supervisory and electrical offices, a meeting room, and toilets, rest rooms and locker rooms for men and women employees.

Loading platforms are provided at the truck entrances.

BUILDING FLOOR SPACE

	Approx. Sq. Ft.
Stores receiving room	8100
Storage area	30,000
Dispensing room	670
Fitting room	265
Offices, two large, one small	1800
Meeting room	375
Toilets, locker and rest rooms	1200
Utility room	780

BUILDING DETAILS

The building is a single story Class II structure, approximately 150 ft. by 300 ft. outside to outside of foundations, by 16 ft. from floor to top of roof construction. The floor is 4 ft. 3 in. above the surrounding grade. There are two roofed-over loading platforms, one 110 ft. by 16 ft. by 13 ft. from floor to top of roof, and another 110 ft. by 16 ft. by 13 ft. from floor to top of roof. Three stairways, each 4 ft. wide, lead to platforms at office entrances. The total building area is 45,000 square feet and the total volume is 774,575 cubic feet. The platform area is approximately 3520 square feet and the volume 44,000 cubic feet.

CONSTRUCTION DETAILS

The structure rests on a reinforced concrete foundation with spread footings. The superstructure is flat concrete floor slab construction with skeleton structural steel framing for window and wall panels between exterior concrete piers. The roof is a flat concrete slab with built-up roofing. The exterior walls are of flat cement asbestos board between the concrete piers. The same sheathing material on steel studs is used for interior partitions except where wire mesh partitioning is employed in the stores area and around the receiving area. The interior of exterior walls is finished also with flat cement asbestos board except in the storage area and stores receiving room where quarter-inch masonite is used for protection against trucks. Toilet room walls are of concrete to a height of four feet, with flat cement asbestos board above. Ceilings are suspended flat cement asbestos board in the shoe fitting room, the offices, meeting room and corridors. In other areas the exposed concrete under-side of the roof forms the ceilings. Doors are hollow metal. There are five exterior doors 10 ft. by 8 ft. and two approximately 10 ft. by 14 ft. of sectional metal, overhead sliding type. Sash is steel, double hung and projected. Insulation is installed in the roof and under exterior wall panels between the concrete piers. Asphalt tile floor covering is provided in the fitting room, the supervisory and clerical office, the meeting room, rest room and toilets.

Unit heaters are installed throughout the storage and receiving areas. The meeting room and office areas are heated by forced air through ducts in conjunction with the air conditioning system, while the toilets, locker and rest rooms are heated by forced air through heaters and duct work. Steam for these services is supplied from the area power plant. The supervisory offices, group offices and fitting room are air conditioned by a single unit while a separate air conditioning system supplies the meeting room. Air exhaust is maintained by fans through ducts from toilets,

locker and rest rooms and by ventilators on the roof over the stores area. Fluorescent lighting is provided in the offices, rest rooms, meeting room and fitting room, with incandescent fixtures in the remaining areas.

EQUIPMENT

Approximately 3700 ft. of shelving and bins.

28 Roto bins, bar stock racks, etc.

36 ft. Dispensing counter unit.

60 Pallet racks.

18 Trucks (dispensing stock).

400 Pallets.

2 Pallet transporters, 3-ton capacity.

2 Battery charging sets.

1 Fork lift truck, 1-ton capacity.

4 Hand trucks.

1 40 lb. counting scale.

Conventional office furniture.

4 Water coolers.

31 Lockers with benches.

29 Unit heaters, 16 @ 24,600 B.t.u./hr;
13 @ 18,500 B.t.u./hr.

2 Self-contained air conditioning units, 10-ton and 5-ton.

2 Air Supply and exhaust fans, 400 c.f.m. and 2670 c.f.m. air heating units, ductwork.

4 Roof ventilators, 10,400 c.f.m. each.

1 Cabinet heater, 370 c.f.m.

DEVELOPMENT OF DESIGN

Development of the design and plan for this building proceded on the basis of the standards set up for the plant as a whole and upon the function of the structure as a

center of service activity. A requirement of the structural design was the provision of some protection to the building's contents in the event of a bomb blast. The use of Class II construction provided this protection and also permitted quick restoration of the structure after such an occurrence.

DRAWINGS

W-155669 - Floor plan.

W-155198 - Elevations and Sections.

BUILDING #714-A - SPARE MACHINERY STORAGE

FUNCTION

The purpose of this building is to provide for the receiving, storing and dispensing of spare machinery.

PRINCIPAL COMPONENTS

A general storage area, receiving and dispensing offices, toilet and locker room facilities for ten persons and a roofed-over loading platform are provided in this [illegible]lding.

BUILDING FLOOR SPACE

	Approx. Sq. Ft.
General storage	42,6[illegible]
Receiving office	[illegible]
Dispensing office	155
[illegible]ndividual [illegible]s	640
[illegible] locke[illegible]	[illegible]

BUILDING DETA[illegible]

The building is [illegible]ngle story Class II structure, approximately [illegible]50 [illegible] 0 ft. outside to outside of foundation by 16 ft. [illegible]or to top of roof slab. The loading platform is appro[illegible]ately 82 ft. by 14 ft. by 16 ft. from floor to top of [illegible]f. The area of the building 45,000 square feet, the volume 761,870 cubic feet. The loading platform area is approximately 1200 square feet and its volume 18,700 cubic feet.

CONSTRUCTION DETAILS

The building rests on reinforced concrete foundations with spread footings. It has reinforced concrete columns, wall piers and roof slab, with skeleton structural steel panels between the exterior wall piers. These exterior wall panels are sheathed with flat cement asbestos board and the interior partitions are of the same material on steel studs. Wire mesh partitions enclose the stores area opposite the offices. In this area a fiberboard protective wainscot on steel furring is used between the concrete piers for the interior of exterior walls. In the remaining areas, the interior of exterior walls is sheathed with flat cement asbestos board on steel furring. Toilet room walls are concrete to a height of four feet, with cement asbestos board above this level. Office ceilings are suspended flat cement asbestos board. In other areas they are formed by the exposed concrete roof slab. The hollow metal doors are 10 ft. by 12 ft. and of the sectional overhead sliding type. The steel sash is both double hung and projected. Roofing is built up and insulation is installed in the roof and in the wall panels between the piers of the office and toilet section, and in toilet and locker room interior partitions. Floors are concrete with asphalt tile covering in the offices only.

Heating is furnished by unit heaters in the storage area and by fin-tube type radiators in the locker room, offices and toilet. The steam source for this service is the area power plant. There is no air conditioning, but air is exhausted through fan ventilators on the roof of the storage area and fans and ducts discharging through the roof from the toilet and locker room. Lighting is fluorescent in the offices, incandescent in all other areas.

EQUIPMENT

1 Pallet rack and 50 wood pallets.

Locker, benches.

1 5-ton Hoist and Monorail.

26 Unit heaters, 19,700 B.t.u./hr.

4 Roof ventilators, 10,400 c.f.m. each.

1 45 kv.-a Transformer.

21 ft. of Dispensing counters.

2 Water coolers.

1 4000 lb. Fork lift truck.

1 Utility fan, 1250 c.f.m. (on roof).

DEVELOPMENT OF DESIGN

In developing the plan and design of this building it was necessary to provide a structure which could be restored and made usable again in the minimum of time following the possible occurrence of a bomb blast. It was desirable, also, to provide some protection from blast for the spare machinery within the structure, as well as assuring fire resistance. With these considerations, the plan was laid out on functional lines best suited to the building use.

DRAWINGS

W-156660 - Floor Plan, Part I.

W-156661 - Floor Plan, Part II.

W-156662 - Elevations and Sections.

BUILDING #715-A - GASOLINE STATION

FUNCTION

This facility is the central gasoline and diesel fuel storage and dispensing station for automotive vehicles of the plant. In the individual areas one gasoline fuel pump is located adjacent to the area shop for fueling cars or trucks in those areas.

PRINCIPAL COMPONENTS

There are three 10,000-gallon tanks above ground inside an earth dyke, one for the storage of diesel fuel and the other two for gasoline. Two 5000-gallon tanks provide underground storage for gasoline and another of the same size stores diesel fuel oil.

A small building provides office space for the station attendant as well as housing the transfer pump controls. The transfer pumps are located on an attached concrete pad. Three gasoline pump islands and one for diesel fuel, each approximately 2 ft. wide by 9 ft. long, permit direct fueling to vehicles. Air for tire service is supplied by a compressor located in a small shelter near the attendents' office.

BUILDING DETAILS

The station is a single story, Class III structure, approximately 12 ft. by 18 ft. outside of foundations, by 8 ft. high from floor to top of flat roof slab. Total area of the building is approximately 230 square feet and total volume is 2020 cubic feet, including 15 square feet and 70 cubic feet for the compressor housing. The area of the concrete apron around two sides of the building is 295 square feet. The area of the concrete pump pads is 400 square feet. The structural steel working platforms on the ten thousand gallon tanks plus the access stairs and platform have an area of approximately 415 square feet. The total area of the two tank truck, structural steel, filling platforms and the access stairs is approximately 85 square feet.

CONSTRUCTION DETAILS

Constructed on a reinforced concrete foundation with spread footings, the attendant's building has a structural steel frame and a concrete roof slab with built-up roofing. Exterior and interior walls are sheathed with flat cement asbestos board on steel studs. The exposed underside of the roof slab forms the ceiling. Doors are hollow metal with glass panels and window sash is double hung steel. Insulation is installed on the side walls and roof. The concrete floor has no covering. Heating is furnished by an electric heater and lighting is incandescent.

EQUIPMENT

Office furniture.

1 Electric heater (7-1/2 kw.).

1 Transformer (9-kv-a.).

4 Gasoline and diesel oil dispensing pumps.

Combination air and water reels.

Motor oil dispensing racks.

1 Air compressor (7.67 c.f.m.).

3 10,000 gal. Storage tanks - above ground.

3 5000 gal. Storage tanks - below ground.

2 Transfer pumps 150 g.p.m.

DRAWINGS

W-156607 - Plan and Elevations.
W-156609 - Plans and Details.

	Approx. Sq. Ft.
Eight general repair offices	1200
Lunch room	1000
Men's change room and toilet	1050
Unit overhaul	2500
Six general offices	900
Women's toilet	150
Body repair	5200
Two paint areas and steam cleaning	2000
Exterior concrete platform	2100
Concrete ramps and parking apron	11,500

BUILDING DETAILS

This is a single story Class III building of irregular shape with over-all dimensions of approximately 203 ft. by 359 ft. and varying heights from the floor to the top of the flat roof. The total area is 41,261 square feet and the total volume 910,235 cubic feet.

CONSTRUCTION DETAILS

The foundation is reinforced concrete with spread footings. The building has a structural steel frame, web roof joists, and a concrete slab roof on rib-lath. Exterior walls are of smooth cement asbestos board on steel framing and the same material is applied on steel nailing studs to the interior of exterior walls in the offices. Tempered fiberboard wainscot on wood nailers to a height of six feet, with a six inch concrete curb at exterior walls is used for interior of exterior walls in the shops. Interior partitions are of smooth cement asbestos board on steel nailing studs. There are wire mesh partitions at the small parts and unit overhaul areas. The toilet room walls are of concrete to a height of four feet with smooth cement asbestos board above this surface. Shower room walls are of concrete faced with glazed ceramic tile to a height of seven feet and with asbestos board above this level.

The offices, office corridor, change rooms and toilets, the paint spray, steam cleaning and diesel injection repair rooms have suspended, flat cement asbestos board ceilings.

There is a perforated type ceiling with sound absorbing insulation backing for acoustical treatment in the lunch rooms. All other ceilings are the exposed roof slab. Exterior doors are hollow metal and of the overhead sliding type. Nine are 12 ft. wide by 13 ft. high, two are 12 ft. by 14 ft. high, thirteen are 24 ft. by 14 ft. high and one is 8 ft. by 8 ft. high. Sash is steel projected with fixed panels. Roofing is built-up. Exterior walls of offices, paint spray and steam cleaning rooms, the walls of toilets and showers, and all other partitions separating body shops from the building, are insulated. The concrete floors are covered with grease resistant tile with a plain base in the general offices and corridor, the lunch room and the women's toilets. Ordinary grade tile with a base is laid in the diesel injector overhaul room. The shower room has a quarry tile floor and base.

Unit heaters are furnished in the shops and parts areas. The offices have fin-tube type radiators. Heat is furnished by forced air through heaters and duct work in the locker and toilets and paint spray room, and in conjunction with the air conditioning system in the lunch room. The steam source for heating is the area power house. Only the lunch room is air conditioned. Ventilation is maintained by fans through ducts from the paint spray room, toilets, steam cleaning room and diesel injection repair; from the underground motor exhaust ducts in general repair, tune-up, diesel and miscellaneous repair sections, and from pits; by motorized fan roof ventilators from the shop and office areas.

Lighting is fluorescent in the offices, lunch room and car washing and lubrication areas, and incandescent in all other areas. The paint spray room has vapor-proof lighting fixtures.

EQUIPMENT

Offices

Conventional office furniture.

Lunch Room and Meeting Room

Tables with swing seats attached, hot plate and table, sink, refrigerator, wall mounted blackboard.

Change Room

64 Lockers, with benches.

Routine Service Section

2 Overhead 360° swivel hose systems.

Brake tester.

Headlight tester.

3 Air compressors, 26 c.f.m. each.

2 5-ton and 6 12-ton Hydraulic jacks.

Tire changer, spreaders, tube inspection tank, repair and vulcanizing facilities.

Island reels for air, water, oil and high pressure lubrication.

5 Drum pumps for oil and grease.

Battery chargers and miscellaneous equipment.

Work benches, miscellaneous hand and portable tools.

Body Repair and Paint Shop

3 Spray paint outfits.

2 Gas welding and cutting outfits.

1 300 amp. Portable arc welding machine.

Electric sanders, soldering tools, miscellaneous hand and electric tools.

Infra-red drying lamps.

Portable steam cleaner.

Diesel and Miscellaneous Repair

1 2-ton Hand-operated overhead bridge crane.

Hydraulic jacks.

Work benches, miscellaneous hand and electric tools.

Underground Motor Fume Exhaust System

3 From general repair and tune-up section.

1 From diesel and miscellaneous repair section.

2 Pit exhaust systems- 1 from lubrication, 1 from exterior apron pit.

Alignment, Tune-up and Brake Repair

1 Front-end car service outfit.

Spark plug cleaning and testing equipment.

Car lifts - 13 car axle and 4 truck axle (distributed in all areas).

1 Front-end truck service outfit.

Grinders, drill press.

Brake drum lathe, and re-lining equipment.

General Repair and Unit Overhaul

Engine stands, slings.

Valve conditioning and testing apparatus.

Armature and small parts overhaul equipment.

1 80-ton Hydraulic press.

Dynamometer power unit.

Skid jacks, pedestal grinders, tool stands, work benches, floor cranes, cleaning tanks, miscellaneous portable pneumatic and electric equipment and hand tools.

Parts Section

Approximately 1000 linear feet of steel drawer, shelving bin and rack units, from 12 in. to 4 ft. deep.

2 Dispensing counters.

Heating, Ventilating and Mechanical Equipment

1 15-ton Air conditioner with duct work for lunch room.

Condenser water cooling tower (on roof).

4500 c.f.m. fan and 3 hp. conditioner water pump for lunch room.

1 Unit ventilator with coil and filter, 760 c.f.m. for change rooms and men's toilet.

2 Unit ventilators with coil and filter, 12,000 c.f.m. for paint spray room.

2 Exhaust fans, 12,000 c.f.m. for paint spray room.

24 Roof ventilators, 1440 to 4800 c.f.m.

27 Unit heaters, steam, from 24 to 115 lbs/hr.

4 Centrifugal fans for underground motor exhaust systems; two at 800 c.f.m., one at 2400 c.f.m., one at 3200 c.f.m.

6 Utility exhaust fans; one at 300 c.f.m., one at 520 c.f.m., two at 600 c.f.m., one at 955 c.f.m., one at 1425 c.f.m.

H.W. Storage tank - 530 gallons.

Oil separator set and sump pump.

8 Electric transformers, 3 ph 480/208-115, capacities from 30 to 75 kv.-a.

1 Electric transformer, 1 ph 480/120, 1kv.-a.

DEVELOPMENT OF DESIGN

The usual considerations for buildings of this Class, were factors influencing the building's design.

DRAWINGS

W-156202 - Key Plan.

W-156205 - Floor Plan, Part I.

W-156206 - Floor Plan, Part II.

W-156207 - Floor Plan, Part III.

W-156204 - Elevations.

BUILDING #717-A - MAINTENANCE CENTRAL SHOPS

FUNCTION

All major mechanical and electrical maintenance work for the entire plant is accomplished in this centrally located shop. Routine maintenance and inspection is taken care of in small shops located in each area. Major overhaul jobs, rebuilding of machines and other mechanical equipment, and new fabrication work requiring heavy shop facilities is

done in this central shop. Maintenance facilities for railroad locomotives, automotive equipment, and instruments of all kinds are provided in other buildings.

PRINCIPAL COMPONENTS

In addition to the main shop area, individual locations are provided in the building for machine, millwright, pipe and valve, welding, sheet metal, forge, carpenter and electric shops. A speciality shop, partitioned off in one corner of the machine shop area, is provided for specialized jobs of instrument repair or fabrication and any other critical work requiring segregation in order to prevent any possibility of radiation contamination of machine tools. Entrance to this shop is through a check station for determining radiation contamination of both personnel and material. Small tools and expendable items ordinarily needed in shop work are stored in a tool crib. Edged tools, drills and reamers are repaired and sharpened in an adjacent tool repair shop. Small offices for the various shop foremen are provided in the several shop areas, while the administrative section contains eight individual offices, a group office, and a meeting room accommodating fifty people. Locker and toilet facilities are provided for a maximum of two hundred men on one shift. There is a toilet and rest room for women employees in the administrative office area.

BUILDING FLOOR SPACE	Approx. Sq. Ft.
Speciality shop	1635
Machine shop	5050
Fabrication shop	1810
Millwright shop	1210
Pipe and valve shop	1810
Welding shop	1810
Sheet metal shop	3625
Forge shop	1260
Carpenter shop	2175
Electric shop	2835
Instrument and relay shop	370
Tool crib and repair shop	2870

	Approx. Sq. Ft.
Lapmaster room	90
Central shop area	15,100
Offices	1680
Meeting room	1260
Change room and toilets	3180
Women's toilet	150
Utility	315

BUILDING DETAILS

This shop is a single story, Class II structure approximately 172 ft. wide by 302 ft. long, with an elevated craneway, approximately 53 ft. wide, extending its full length. The clear height in the crane bay is 33 ft. 8 in. to the bottom of truss and 12 ft. 3 in. to the bottom of truss in the shops. Total building area is approximately 52,100 square feet and total volume is 1,391,800 cubic feet.

CONSTRUCTION DETAILS

The foundation is reinforced concrete on spread footings. The frame is structural steel with roof trusses supporting a flat concrete slab on steel. The exterior walls are sheathed with flat cement asbestos board, on light steel framing. The same material on steel furring is used for the interior of exterior walls in the meeting room and offices. In the shop areas the exterior walls have a fiberboard wainscot 4 ft. high. Flat cement asbestos board is used for interior partitions in each of these areas. Partitions 8 ft. high enclose the shop offices. Wire mesh 9 ft. high is used for this purpose in the tool crib and electric shop.

Toilet and change room walls are of concrete to a height of 4 ft. with flat cement asbestos board above. Ceramic tile to a height of 7 ft. is used to face the shower room walls. Flat cement asbestos board ceilings are installed in the meeting room, offices, instrument and relay shop, and in the lapmaster room. The exposed structure forms the ceiling in shop areas. Roofing is built up, with the roof and exterior walls, walls of toilets and shower rooms, and walls and ceilings of the meeting room being insulated. Asphalt tile covers the concrete floor in the meeting room, corridors and offices, except the shop offices. The showers have quarry tile floors.

The shop areas are heated by unit heaters. Offices, including shop offices, and women's toilet are heated by fin-tube type radiators. Heating by forced air through coils and ducts is provided in the men's change, toilet and shower rooms, and the instrument and relay shop. In the meeting room heat is supplied in conjunction with the air conditioning system. Ventilation is maintained by fan ventilators on the shop roof and by air exhaust systems through ducts from the forge shop's lathe and forges, the welding shop, carpenter shop, instrument shop, and the change room and toilets. Lighting is fluorescent except in the crane bay of the central shop, the tool crib, change rooms, toilets and utility room where fixtures are incandescent. Good general illumination is provided in shop area with provisions for local intensity fixtures mounted directly on machines. Plug-in bus duct is utilized to provide maximum flexibility for future alterations and equipment relocation. 440-volt electrical power service is from Substation, Building #752-1A. 120/208 volt lighting service is from Substation Building #752-9A.

EQUIPMENT

Specialty Shop

2 Lathes, 10 in. and 12 in.

1 Universal milling machine

1 5-ton Arbor press.

1 Shaper

1 Radial drill

2 1-ton Jib cranes

3 Grinders

1 Metal cutting band saw

Tool cabinets and work benches

Machine Shop

12 Lathes, all sizes and types, 12 in. x 30 in. to 60 in. x 156 in.

1 Horizontal boring mill

3 Shapers - 16 in. and 24 in.

1 Open side planer 36 in. x 96 in.

1 Pneumatic valve test bench.

1 Air compressor.

1 Pipe rotating roll.

1 2-ton Hoist and trolley.

4 Pipe machines, portable and stationary.

2 Valve reseating machines - globe and gate.

1 Pedestal grinder.

2 Sensitive drills.

1 Hydraulic valve test bench.

1 Hydraulic pump.

1 Bending table.

1 Pipe bender.

1 Lapping machine.

4 Adjustable pipe stands.

1 Lapping block.

1 Pipe and bar rack.

11 Work benches.

Welding Shop

4 Arc welders - a.c. and d.c., 400 and 500 amp.

2 400 amp. d.c. Portable welders, jeep mounted.

6 Portable welding screens.

2 Portable cylinder trucks.

1 Pedestal grinder.

3 Tool lockers.

1 Storage cabinet.

1 2-ton Trolley and hoist.

1 Welding positioner.

1 Heated cabinet.

Arc welding accessories.

1 Welding exhaust system complete with ducts.

Fans, motors, etc.

Welding booth frames.

6 Welding and 6 cutting tables.

5 Pair trunnion rolls (manual).

2 Inert gas torches.

Gas welding accessories.

Fire proof curtains.

Sheet Metal Shop

1 Sensitive drill press.

1 Power roll.

1 Shear.

1 Notcher.

1 Lock forming machine.

1 Sheet metal rack.

1 Pedestal grinder.

1 Portable shop welder.

1 15 kv.-a. Spot welder.

2 Squaring shears, bending breaks.

1 Bender and crimper.

30 Plate stands.

1 2-ton Hoist and trolley.

2 Bending brakes.

1 Bending roll.

4 Shelving units.

13 Work benches.

Forge Shop

1 Engine lathe, 24 in. x 144 in. with 200 c.f.m. centrifugal exhaust fan and ductwork.

1 Power hammer - 500 #.

1 Anvil.

2 Coal fired forges.

1 Electric heat treating furnace.

1 Atmosphere generator.

1 Metallizing outfit.

1 Oil temperature control unit.

1 Electric pre-heat hardening furnace.

2 Hardness testers with scales.

2 Quenching tanks, oil and water.

2 1-ton Jib cranes.

2 Forge and 1 lathe exhaust systems, complete with ducts, fans, motors, etc.

Storage cabinet, work bench and tool stand.

Carpenter Shop

3 Saws - cut off, rip and band.

1 Jointer.

1 Lathe.

1 Tool sharpener.

1 Dust collecting system, complete with fans, motors, duct work and exterior collecting bin.

1 Planer.

1 Drill press.

1 Sander.

4 Carpenter's benches.

2 Tool box lockers.

Electric Shop

2 Portable pipe machines.

1 Heated cabinet.

1 Cleaning booth.

1 Varnish tank.

1 Coil winder with accessories.

1 Insulation shears.

1 Coil taping machine.

1 2-ton Jib crane.

Electrical and electronic test instruments.

2 Counter sections.

1 Bender.

1 Drying oven.

1 Motor test pad.

1 Balancing ways.

1 Coil spreading machine.

1 2-ton Hoist and trolley.

10 Work benches.

3 Storage cabinets.

8 Bins.

Instrument and Relay Repair Room

1 Electric calibrator.

Unit ventilator coil and filter, 1100 c.f.m., with supply and exhaust system.

4 Work benches.

4 Bin units.

Tool Repair Room and Tool Crib

1 Pedestal grinder.

1 Probolog.

1 Optical comparator.

1 Grit blaster.

3 Grinders - universal tool carbide and drill type.

500 lin. ft. Steel shelving, bins and rack units for small tools and expendable items.

Service carts and work benches.

Lapmasters Room

1 Lapping machine.

Shop Areas

1 20-ton Bridge crane, 48 ft. clear span.

24 Hand trucks, large and small.

1 4000# Fork truck.

2 Manual skid lift trucks, skids and skid boxes.

Single section ladders and extension ladder.

Vices, practically all types.

Micrometer calipers, portable electric grinding tools and accessories.

Also, work benches, storage cabinets, tool stands and lockers, and full complement of miscellaneous hand and electric driven tools.

Compressed air system.

4 Drinking fountains.

Utility Room

Hot water tank.

Unit ventilator for toilet and change rooms.

Offices and Meeting Room

Conventional furniture.

Hot plate and table.

Drinking fountain.

Refrigerator.

Change Rooms, Toilets and Showers

275 Lockers with benches.

2 Drinking fountains.

Heating, Ventilating and Mechanical Equipment

Hot water storage tank - 1190 gal. capacity.

Air compressor, receiver, and distribution piping, capacity 130 c.f.m.

10-ton Self-contained air conditioner for meeting room; with fans and ductwork, etc. Capacity 3000 c.f.m.

2 Unit ventilators, coils, filters, fans and ductwork; capacity 1100 and 3810 c.f.m.

2 Centrifugal exhaust fans and ductwork, total capacity 3240 c.f.m.

1 Centrifugal welding shop exhaust fan and collecting ductwork, capacity 4000 c.f.m.

2 Industrial exhaust fans and ductwork from forges, capacity 1100 and 1718 c.f.m.

1 Cyclone dust collecting system and ductwork in carpenter shop, capacity 2350 c.f.m.

7 Roof ventilators - 20,500 c.f.m. each.

Electric bus-duct and plug connectors. (Transformers are located outside of building).

47 Unit heaters.

DEVELOPMENT OF DESIGN

Building requirements specified a structure with possibly expendable walls but one which had a frame designed to withstand bomb blast to facilitate prompt restoration of the building in the event of a disaster. On this basis, it was decided to provide a Class II structure for this facility. Other relevant factors affecting the initial design were incombustibility, permanence and provisions for expansion.

It was decided on April 4, 1951 to install a lapmaster room and the necessary auxiliary equipment for this operation in an enclosed, dust tight and air conditioned space to be partitioned off from the tool crib and tool repair area. On November 29, 1951 an instrument and relay repair room was added to the design and provisions were made for the inclusion of this facility. A separate room with solid, dust tight wall and ceiling and with forced draft ventilation was installed in one corner of the electrical shop for this purpose.

DRAWINGS

W-155340 - Floor Plan.

W-155342 - Elevations.

W-155345 - Equipment Layout Sheet 1.

W-155346 - Equipment Layout Sheet 2.

W-155347 - Equipment Layout Sheet 3.

W-155348 - Equipment Layout Sheet 4.

W-155349 - Equipment Layout Sheet 5.

W-155350 - Equipment Layout Sheet 6.

BUILDING #719-A - MEDICAL AND EMPLOYMENT BUILDING

FUNCTION

This building houses the medical service facilities for an estimated six thousand plant employees and the employment facilities for processing up to two hundred job applicants per day.

Included in the medical area are facilities for pre-employment examinations, annual examinations and health supervision; first aid facilities for the #700-A and #300-M areas; emergency hospitalization for the entire plant, except the #400-D area which is equipped to handle its own cases in Building #704-D; and medical records files.

Employment facilities and operations consist of interviewing, hiring, and orientation training of new employees; preparation and storage of personnel records; and the execution of termination clearances.

PRINCIPAL COMPONENTS

There are two sections to the medical facilities; the general medical area, and a separate emergency area.

The medical area proper consists of a reception and waiting room, first aid rooms, medical records files and complete facilities for physical examinations including X-ray, cardiograph and a medical laboratory. Doctors' offices, supervisory offices, stenographic rooms, a supply room, visiting nurses' rooms, a library and conference room, toilets and a women's rest room are also provided. There is a separate toilet and locker room for nurses.

There are two emergency rooms in the second section. One is for treatment necessary prior to sending patients to an off-plant hospital. A scrub-up and sterilization room and a doctor's dressing room adjoin it. The second emergency section handles isolation cases. It includes clean-up and Health Physics check-up rooms, separate shower facilities for doctors and nurses, special drainage disposal, four cot rooms to accomodate nineteen patients for emergency hospitalization, and an attendant nurse's room. Men's and women's toilets are provided in this area also. An ambulance entrance is located in this emergency area. Meal deliveries from the cafeteria also use this entrance to the service pantry.

The major space in the employment section is occupied by a waiting room which will accommodate fifty applicants. Twenty applicants can work on application blanks at one time.

There are five interviewing rooms, a separate room for test interviewing, a sign-up room, photography and badge preparation facilities, an orientation room with a fifty person capacity, personnel and security file space with an adjoining office for twenty stenographers, four supervisory offices, two stenographic offices, and men's and women's toilet facilities.

Mechanical utilities are housed in a basement service area.

BUILDING FLOOR SPACE

Employment Section	Approx. Sq. Ft.
Reception room and application area	1050
Four toilets (Reception area)	280
Test room and eleven interview and supervisory offices	2060
Office force toilets	160
Control desk, photography and badge section with dark room	510
Two sign-up rooms	400
Orientation room (Capacity 50 people)	565
File and stenographic room (Capacity 20 people)	1230
Medical Section	
Reception and waiting room	630
Medical files	420
Two first aid rooms	480
Physio-therapy room	160
Men's and women's toilets, also nurses' toilet and locker rooms	750
Cardiograph room	150
Six dressing booths	225
Eye and ear, blood test rooms	150

	Approx. Sq. Ft.
Medical laboratory with four toilets for urinalysis samples	370
Fourteen individual offices for medical staff, supervisory personnel and visiting nurses	2135
Medical library and conference room	300
Nurses' room	160
Scrub-up and sterilizing room	160
X-ray and dark room	390
X-ray viewing and file room	150
Emergency Hospitalization Section	
Emergency room	300
Supplies	150
Men's and women's toilets	330
Nurse station and utility rooms	250
Serving pantry	150
Special emergency and clean-up with supply areas	620
Health Physics check-up room (For medical staff)	170
Doctors' dressing room	190
Four infirmary rooms	1350
Corridors	
Medical and employment sections	3540

BUILDING DETAILS

A one-story, Class II building with a partial basement, the structure is approximately 372 ft. long by 152 ft. wide by 11 ft. high from finished floor to top of roof slab. Irregular in shape, it consists of four sections; a long central block approximately 143 ft. by 51 ft., two end wings 70 ft. by 41 ft. and 160 ft. by 46 ft. and a section 102 ft. by 41 ft.

The partial basement is approximately 50 ft. by 90 ft. average length (to center line of enclosing walls) by 12 ft. deep below first floor.

Total building area is approximately 26,490 square feet and the total volume is 333,525 cubic feet.

CONSTRUCTION DETAILS

The foundation is of reinforced concrete with spread footings. Reinforced concrete wall piers, columns and roof slab form the superstructure. Exterior walls are cement asbestos board on skeleton structural steel frame between the wide concrete wall piers and the same material, on wood nailers, forms the interior of the exterior walls and is used for interior partitions on steel nailing studs. Dividing firewalls are of 8 in. thick concrete construction. Toilet and locker room walls are concrete to a height of 4 ft. with asbestos board above. Suspended ceilings finished with smooth cement asbestos board are installed in the vestibules, test laboratories, toilets and dark rooms and form a false beam around the perimeter system air ducts and the piping at exterior walls of all spaces. The remaining ceilings, including those in the basement, are acoustic tile applied directly to the concrete structure. Doors are hollow metal and sash is double hung steel with some sections fixed.

Roofing is built-up, and the roof, exterior walls, and walls of the toilets and shower rooms are insulated. Asphalt tile is laid over the concrete floors in all areas except the basement.

Heating is furnished by a perimeter air conditioning system and by forced air through ducts in the employment section reception room, the eye, ear, and blood test rooms and laboratory, in the examination dressing rooms, the X-ray and dark rooms. Fin-tube radiators heat the toilet rooms and cabinet heaters the vestibules and corridor ends. Heat source is steam from the area power plant.

The entire building, except the basement, is air conditioned, with the chilled water being supplied from the area refrigeration plant. Ventilation is maintained, by supply and exhaust fans in the basement, through ducts from the examination dressing rooms, locker rooms, the attending nurses' rooms, utility rooms and toilets.

Lighting in the reception rooms, laboratory, examining spaces, offices and operating rooms is fluorescent. Incandescent lighting is provided in corridors, the infirmary, X-ray,

dark rooms, toilets and remaining areas. Under floor duct is provided for electric and telephone service in the office area. Emergency power is supplied from a diesel generator in the building. Blackout of all lighting and the area safety alarm system is controlled from Patrol Headquarters, Building #720-A.

EQUIPMENT

Office and Medical

Conventional office furniture.

Library with book stacks and conference tables.

Student type armchairs and waiting room benches.

Camera and film processing equipment for photo and badge preparation.

X-ray, photographic, dark room and viewing apparatus for pre-employment and annual physical examinations.

Sinks, work benches and cabinets for photo and badge preparation and X-ray dark room.

Eye and ear examination equipment.

Laboratory sinks, cabinets and equipment for blood counts and urinalysis.

Diathermy machine for heat treatment.

Electro-cardiograph.

Aspirators and oxygen supply.

19 Cots with mattresses, pillows and linen.

3 Medical examination and surgical tables, wheeled stretchers.

Miscellaneous equipment, instruments, apparatus, and supplies.

Service pantry sink with garbage disposal unit.

Service pantry dishwasher, refrigerator, table and cabinets.

2 Refrigerators for blood test and laboratory section.

7 Drinking fountains.

BUILDING #720-A - PATROL HEADQUARTERS

FUNCTION

The purpose of this building is to provide a central headquarters for plant patrol forces and an operating base for patrol force in the #300 and #700 Areas. The building is also the normal primary and emergency control center for the entire plant and for the #300 and #700 Areas. The secondary center is located in Building #701-1F in the #200-F Area.

Normal and emergency controls for the entire plant include: (1) fire alarm recording; (2) Radio communications for patrol system, connecting to Building #623-1G, health physics, transportation, railroad base system and process water mobile units: (3) army radio teletype receiver and control equipment for the transmitter located in Building #701-1F; and (4) regular teletype service equipment.

In addition, there are controls specifically for the #300 and #700 Areas which include, safety alarm, blackout, fire alarm, and audible and visual alarms indicating when any vault door in Building #703 is opened.

PRINCIPAL COMPONENTS

In the Class I section of the building there is an emergency control center which houses the basic equipment for radio communications, teletype service - both army and regular, the area safety alarm, blackout control and fire alarm register. There is also a conference room for use in an emergency by key management personnel. A mechanical utilities room is located also in this section.

The remainder of the building, of Class II construction, is an administrative section containing offices, ready room, women's toilet and rest room, and duplicate controls for plant and area patrol radio communications. This section also contains a training room, a mustering area for guards, uniform storage and dispensing space, a gun room, a mechanical utilities room, and a guards' change room with toilet and shower facilities.

BUILDING FLOOR SPACE	Approx. Sq. Ft.
Class I Area	
Conference room	240
Control room	420
Utility room	270

Class II Area	Approx. Sq. Ft.
Fourteen offices and one ready room	2280
Women's toilet and rest room	140
Training room	900
Uniform storage	570
Gun room	150
Mustering area	460
Utility room	360
Change, shower and toilet room	3300

BUILDING DETAILS

The building has a single story, ell-shaped plan of Class I and Class II construction. The overall dimensions are approximately 154 ft. by 143 ft. by 11 ft. high from the floor to the top of the roof slab in the Class II area and 12 ft. high from the floor to the top of the roof slab in the Class I section. At the end of the Class I portion of the building there is an emergency power generator enclosure of Class I construction approximately 10 ft. by 8 ft. by 8 ft. high.

The total area of the building is 11,180 square feet and the total volume is 138,255 cubic feet.

CONSTRUCTION DETAILS

The foundations are reinforced concrete with spread footings. In the Class I section the building walls and roof are of reinforced concrete, the exposed roof structure forming the ceiling, and the interior concrete baffle walls affording ray protection. Interior partitions are of flat cement asbestos board on steel studs and doors are of hollow metal. There are no windows in the Class I section. The Class II section has a structural steel frame with exterior walls sheathed with flat cement asbestos board. The same material, on steel studs, is used for the interior of exterior walls and for interior partitions. Toilet room walls are concrete to a height of 4 ft. with flat cement asbestos board above. The shower room walls are concrete faced with ceramic tile to a height of 7 feet. Doors are hollow metal and sash is steel, both double hung and projected.

The roofing in both sections is built up. The exterior walls and roofs and the interior partitions of the training

room are insulated. Insulation in the control and conference rooms has flat cement asbestos board protection to a 4 ft. height and to the ceiling in the utility room. The concrete floors are covered with asphalt tile in the offices, ready room, the women's toilet and rest room, the corridor and in the conference, control and training rooms. Quarry tile flooring is laid in the shower room.

Heating in the Class I section is by forced air in conjunction with the air conditioning system. In the Class II portion of the building heating is furnished to the offices and ready room by fin-tube radiators, by forced air in conjunction with air conditioning in the training room, and by a separate forced air system in all other areas. Air conditioning systems are installed for the conference and control rooms of the Class I section and for the training room in the Class II section. Air exhaust is provided in the change room, showers and toilets.

The offices, ready room, conference, control and training rooms have fluorescent lighting. All other areas have incandescent lighting. Normal electric power service is supplied from Building #752-2A via aerial lines. Emergency power is automatically available upon interruption of normal power from a 10-kw. emergency diesel generator set located in an adjoining Class I structure.

EQUIPMENT

Emergency Control Room

Army radio teletype equipment.

Control console for plant-wide radio communications to patrol.

30-Watt radio transmitter and receiver for area patrol.

Control console for plant-wide radio communications with health physics, transportation, process water mobile units.

Regular teletype unit.

Safety alarm, blackout control and fire alarm for #300-700 Areas.

Building #703 vault door alarms.

Conference Room

Conference table and accommodations for approximately 12 people.

Air Exhaust

In addition to the exhaust fans in the Class I Utility Room, there are two fans, 800 and 1100 c.f.m., mounted on the roof of the Class II area for exhaust from change room and women's toilet room.

Duct work for the above.

DEVELOPMENT OF DESIGN

The section of the building containing the emergency control center is a Class I structure designed to resist bomb blast and to provide gamma ray protection for the occupants. It is planned to become the command point for the entire plant in the event of emergency conditions. Certain key personnel will report to it during disaster control. The remainder of the building is of Class II construction in order to minimize damage to the structure in the event of a bomb blast.

The need for control facilities during an emergency and the housing of these facilities in a bomb resistant structure was the basic requirement affecting the design of this building. A pertinent factor in this requirement was the restoration of the building to a habitable condition for administration, training and locker room use in a minimum of time after damage by bomb blast.

DRAWINGS

W-155904 - Floor Plan.

W-155905 - Elevations and Sections.

BUILDING #722-A - INSTRUMENT SHOP

FUNCTION

This building provides centralized facilities for major maintenance work on all types of plant instruments, measuring devices and control systems, and for optical systems which cannot be repaired and tested satisfactorily at installed locations. Fabrication of new electronic instruments and quick assembly of simple optical devices from standard components also are effected in this building. Small shops for routine testing, inspection and preventive maintenance are located where required in the other areas.

PRINCIPAL COMPONENTS

Machine shop

Instruments shop - Pressure, temperature, flow control, pneumatic, thermocouples, scales, etc.

Optical shop

Jeweler's shop

Electronics shop

Chart preparation shop

Tool room

Steam, air and water test facilities

Supervisory offices

Conference room

Men's locker, shower and toilet facilities

Women's toilet and rest rooms

Basement for mechanical utilities

BUILDING FLOOR SPACE	Approx. Sq. Ft.
Shops	7000
Two shop offices	280
Two supervisory and two clerical offices	820
Conference room	270
Men's locker, change room and toilet	600
Women's toilet and rest room	170

BUILDING DETAILS

The shop is a single story, Class II structure approximately 82 ft. wide by 122 ft. long, with a partial basement. Over approximately 80 ft. of its length the flat concrete roof is at a height of 14 ft. above the floor, dropping to 11 ft. height over the remaining 42 feet.

The basement is approximately 22 ft. by 64 ft. by 12 ft. deep, with access provided only by outside stairs. The total

area of the building is approximately 11,440 square feet and the total volume 157,350 cubic feet. The basement area is approximately 1440 square feet and its volume is 17,300 cubic feet.

CONSTRUCTION DETAILS

The foundation is reinforced concrete with spread footings. The building has a structural steel frame and a concrete roof slab on steel framing. Exterior walls, both inside and out, are sheathed with flat cement asbestos board. This same material, on steel studs, is used for interior partitions. Toilet room walls are of concrete to a height of 4 ft. with flat cement asbestos board above this level. Shower room walls are concrete faced with ceramic tile to a height of 7 feet. Ceilings are suspended and finished with flat cement asbestos board in shop offices and chart room. They are suspended and acoustically treated in the supervisory and clerical offices. In other areas they are exposed painted concrete. Doors are hollow metal and sash is steel double hung. The roofing is built up, and exterior walls, roof and toilet room walls above the concrete are insulated. The concrete floors have asphalt tile covering in the office corridor, all offices except those in the shops, in the meeting room, toilet and rest rooms, and in the optical and jeweler's shops. Floors in the shower room are quarry tile.

Supervisory and clerical offices have fin tube radiators, while unit heaters are provided in shop areas which are not air conditioned. Forced air in conjunction with an air conditioning system provides heating in the jeweler's, electronic and optical shops, in the shop offices and chart room, and in the meeting room. Other areas are heated by a separate system of forced air through ducts. Forced air exhaust is maintained in the toilet rooms.

Lighting is fluorescent except in the tool room, locker, toilet and rest rooms, the corridor and basement where it is incandescent. An overhead electric trolley duct system is installed in the shop and electronic section to facilitate use of portable tools. Building lighting may be blacked out from Building #720-A and safety alarm speaker coverage is provided.

EQUIPMENT

<u>Shops</u>

A full complement of test instruments, machine tools, hand tools and portable tools.

1 12 in. by 54 in. lathe.

1 Jeweler's lathe.

1 #2 Universal milling machine.

2 Pedestal grinders.

1 Bench shear and 1 bench brake.

2 Constant temperature baths.

Muffle furnace.

Precision grinder.

Storage cabinets and shelving.

2 Sensitive drill presses, 1 in. capacity.

1 Hack saw.

1 Arbor press.

70 Work benches.

1 1-ton Monorail system.

1 Engraver.

1 Test pump.

1 Vacuum pump.

5 16,850 B.t.u. Unit heaters.

Offices

Conventional office furnishings.

Conference Room

Facilities for approximately 20 people.

1 7-1/2-ton Package air conditioning unit and heating coil.

Men's Locker Room

50 Lockers.

Refrigerator.

1 1935 c.f.m. Exhaust fan, on roof.

Basement

The bulk of the air conditioning, heating and ventilating equipment is located in the basement and includes:

1 25-ton Refrigeration condensing unit.

1 Water chiller and pump, 60 g.p.m.

1 20-ton Indoor cooling tower.

1 7930 c.f.m. Air conditioning unit and heating coil.

1 5950 c.f.m. Return air fan.

1 1630 c.f.m. Heating and ventilating unit.

Necessary duct work and controls.

1 150 c.f.m. Air compressor and dehydrator for shop air.

Electric power control, metering and lighting panels.

Hot water heater, 500 g.p.h.

DEVELOPMENT OF DESIGN

This shop was planned to give reasonable protection to the delicate and sensitive instruments, devices, equipment and material housed and stored in the building. Its design also allows for the rehabilitation of the structure in a short time in the event of partial destruction by bomb blast. Unless disaster conditions were 100 per cent effective, only the friable walls and windows would have to be replaced. These precautions were necessary since most of the equipment and parts are long term procurement items and replacement would prove time consuming.

DRAWINGS

W-155745 - Floor Plans.

W-155746 - Elevations.

The interior of exterior walls is finished with tempered fiberboard between columns on the inside perimeter of the shop area and with flat cement asbestos board in the meeting room, offices and the locker room.

Offices, toilets, showers, locker rooms, vestibules and corridors have suspended ceilings faced with flat cement asbestos board. The exposed ceiling structure forms the ceiling in shop areas. Perforated flat cement asbestos board with sound absorbent backing for accoustical treatment is used for the ceiling finish in the meeting room. The roofing is built-up, and insulation is installed in the exterior walls and roof and in the partitions above the concrete walls in the toilet and shower rooms. The concrete floors are covered with quarry tile in the shower rooms and with asphalt tile in the offices and meeting room.

Forced air through ducts supplies heat to the locker, shower and toilet rooms and, in conjunction with an air conditioning system, to the meeting room. Offices and corridors have fin-tube radiators. The shops are heated by unit heaters. Ventilation is provided by roof ventilators from the shop areas and offices and by fans and ductwork discharging through the roof from the toilets.

Lighting is flourescent in offices and meeting room, and incandescent in other areas. Lighting may be blacked out from Building #720-A and safety alarm speaker coverage is provided.

EQUIPMENT

Conventional office furniture

249 Lockers with benches

Hot water storage tank - 2040 gallons

1 Cabinet heater - 160 sq. ft. EDR

5 Roof ventilators, 2 - 4000 c.f.m., 3 - 900 c.f.m.

2 Toilet exhaust fans, 925 and 1075 c.f.m.

1 Heating and ventilating unit, coil and filters, 2000 c.f.m.

1 Self-contained air conditioner, 3100 c.f.m.

2 Transformers, 30-kv.-a.

6 Unit heaters, 3 - 1350 c.f.m., 3 - 310 c.f.m.

Hot plate, sink and refrigerator.

3 Water coolers

Shelving, racks, 1/2-ton monorail and hoist, hand tools and equipment required by several crafts such as chain-falls, rope and other minor items.

DEVELOPMENT

An expendable building, the pertinent design factors were permanence, fire resistance and minimum missile effect from bomb blast.

DRAWINGS

W-157009 - Floor Plan.

W-157011 - Elevations.

BUILDING #725-A - PAINT SHOP

FUNCTION

This building serves as headquarters for the painters working throughout the plant and as a shop for brush and spray painting of items which can be handled advantageously at this central location. Storage facilities are provided here for a working inventory of paints and supplies. Principal supplies are stored in Buildings #713-A and #733-A.

PRINCIPAL COMPONENTS

The building contains a work area, a storage room, a spray room, an office, and toilet facilities for an average occupancy of six male employees.

BUILDING FLOOR SPACE

	Approx. Sq. Ft.
Work area	900
Storage	210
Toilet	80
Spray room	310
Office	85

BUILDING DETAILS

This shop is a one story Class III building, approximately 41 ft. by 41 ft. by 19 ft. from the floor to the ridge of the double pitched roof. Total building area is 1680 square feet and total volume is 28,500 cubic feet.

CONSTRUCTION DETAILS

Foundations are reinforced concrete with spread footings. The building has a rigid design, structural steel frame with a double pitched roof. Much of the structural steel was provided from the cancelled portion of Building #704-D. Exterior walls are sheathed with flat cement asbestos board. Interior partitions in the toilet are concrete to a height of 4 ft. with cement asbestos board above this level. Those in other areas are flat cement asbestos board on steel studs. Corridor and work area sides have a fiberboard wainscot to a height of 6 feet. The interiors of exterior walls are sheathed with cement asbestos board in the office and spray room, 6 ft. high fiberboard in the work and storage areas, and flat cement asbestos board above a 4 ft. high concrete wall in the toilet. The exposed roof construction serves as the ceiling in all areas except the spray room and the office where there is a suspended ceiling of flat cement asbestos board. An overhead steel door opens to the work area and a steel sliding door gives access to the spray room from the exterior. The roofing material is corrugated cement asbestos board. Insulation is applied in exterior walls and the roof. There is no covering on the concrete floors.

Unit heaters are installed in each section of the building. A separate heating and ventilating unit with 7500 c.f.m. capacity is provided to supply a forced air exhaust for paint fumes through a 24 in. diameter stack over the spray booth. Circulation in the building is maintained by a power driven roof ventilator over the storage area.

Lighting is furnished by incandescent vapor-proof fixtures in all areas except the office where fluorescent lighting is installed. Lighting may be blacked out from Building #720-A and safety alarm speaker coverage is provided.

EQUIPMENT

Conventional office furniture

2 Paint shakers

1 Spray booth with complete accessories including exhaust fan and ductwork.

Brush cleaning bench and storage trough.

transformers back up on this mat to the storage racks constructed of 8-in. thick reinforced concrete walls approximately 4 ft. high. The side walls have rails mounted on them matching those supporting the transformers on the trailer carriers. The rack structure is approximately 10 ft. wide by 17 ft. long and is reinforced by steel bars which, if exposed, are painted for weather protection. The facility is equipped with the necessary electrical grounding and service connections and also has oil heater connections to maintain a suitable storage temperature for the transformers.

DRAWING

W-161167 - Foundations - Concrete - Steel - Electrical

BUILDING #728-A - GENERAL STORAGE BUILDING

FUNCTION

Originally erected for use by the construction forces as T. C. Building #8300-M, this structure was transferred to the capital account of Project 8980 to provide permanent facilities for the general storage of miscellaneous items.

PRINCIPAL COMPONENTS

The building is rectangular with two stories, each having an open storage space.

BUILDING DETAILS

Of Class IV construction approximately 50 ft. wide by 210 ft. long by 22 ft. high, the building has a total area of 21,200 square feet and a volume of 229,700 cubic feet.

CONSTRUCTION DETAILS

Foundations are of concrete with continuous wall footings. The superstructure is prefabricated steel with a pitched roof. Exterior walls and roof are of sheet metal, and interior partitions are of gypsum board on one side of wood studs. The second floor has a hung ceiling of homosote. Window sash is commercial projected steel. The first story has a concrete slab floor, with flooring of wood in the second story.

Forced air heating is supplied by oil fired furnaces through ductwork. Lighting is fluorescent.

6 Steam unit heaters, 2 - 40 lbs/hr.
2 - 10 lbs/hr.
2 - 5 lbs/hr.

Oil immersed switches and panels.

Heating and ventilating unit 7500 c.f.m. for spray room.

1/2-ton Monorail and hoist.

Air compressor - 35 c.f.m. - 100 lb.

Work benches, spray table, storage shelving.

10 Ladders, 14 ft. straight to 40 ft. extension.

Roof ventilator, 900 c.f.m.

DEVELOPMENT

The building's expendability in the event of a bomb blast, and the permanence and fire resistant properties of materials of construction were factors affecting the design of this shop.

DRAWINGS

W-155691 - Floor Plan, Wall Sections and Details.

W-155693 - Elevations and Sections.

BUILDING #727-A - TRANSFORMER STORAGE

FUNCTION

This installation provides storage facilities for spare 115-kv.-a. transformers.

PRINCIPAL COMPONENTS

The facility consists of a concrete pad serving as an approach and loading apron and three elevated, reinforced concrete racks equipped with rails designed to receive standard transformers from trailer carriers.

CONSTRUCTION DETAILS

The receiving and loading pad is a concrete mat approximately 20 ft. wide by 90 ft. long. Trailers carrying the

PRINCIPAL COMPONENTS

The structure is a roofed area, half of which is enclosed and the other half open. The enclosed section is designed to house twelve 55-gallon drums, placed on their sides while the contents warm up, and eighteen 55-gallon drums in racks in a dispensing position. The open portion of the shed provides protection from the sun for outside drum storage. There is a receiving slab adjacent to both areas and an additional outside storage slab. The capacity of the storage area, both roofed and exposed, is one hundred 55-gallon drums on their sides and fifty-two, empty, 55-gallon drums on end.

BUILDING FLOOR SPACE	Approx. Sq. Ft.
Enclosed portion	690
Open shed	610
Storage slab	1030
Receiving slab	400

BUILDING DETAILS

Of Class III construction, the building is divided into two sections; an enclosed roofed area approximately 42 ft. by 17 ft. outside to outside of foundations by 11 ft. average height of pitched roof, and an open, roofed shed 42 ft. by 15 ft. outside girt lines by 11 ft. average height of pitched roof. The outside storage slab is 24 ft. by 42 ft. and the receiving slab is 56 ft. by 7 feet.

Total area under roof	1326 square feet.
Total volume	15,820 cubic feet.

CONSTRUCTION DETAILS

The foundations for this structure are of reinforced concrete on spread footings. The frame is of rigid design, structural steel with a double pitched roof covered with corrugated cement asbestos board. The exterior of the enclosing walls is sheathed with flat cement asbestos board and the interior wall finish consists of a tempered fiber board wainscot, 3 ft. 9 in. high above a concrete curb. The ceiling is formed by the underside of the roof structure. All walls are insulated. The concrete slab floor has no covering. Doors to the enclosed portion are of hollow metal with fixed ventilating louvers. Heating is furnished by forced air heated by steam from the area

power plant. Ventilation is provided by an exhaust fan and ductwork system with a capacity of 23,000 c.f.m. There are no sanitary facilities. Lighting is vapor-proof incandescent with explosion-proof switches.

EQUIPMENT

Dispensing rack to hold eighteen - 55-gal. drums.

1 1/2 ton Monorail and hand-operated hoist.

1 Fixed post crane hoist - 1/2-ton capacity.

1 Stand-up type desk.

1 Barrel truck.

1 Unit heater with steam coil, 112,000 B.t.u.

1 Centrifugal exhaust fan, 2305 c.f.m., and duct work.

Fire extinguishers.

DEVELOPMENT OF DESIGN

An expendable building, the permanence and fire resistant properties of materials of construction were factors affecting the design of this facility.

It was also of importance in the design to provide against the possibilities of danger from fumes and fire. Adequate ventilation was provided by means of mechanical exhaust through a roof duct and fresh air intake through fixed louvers. The structure, drum racks and dispensing vessels also were electrostatically grounded as an additional safety precaution.

DRAWING

W-146175 - Plans, Elevations and Sections.

BUILDING #734-A - COMPRESSED GASES STORAGE

FUNCTION

This building is a receiving and storage center and reshipping point for cylinders of commercial grade gases used in Buildings #717-A, #717-D, and #704-CKLPR. Manifolds also

are located in this structure to supply oxygen and acetylene gas to the Maintenance Central Shops, Building #717-A.

PRINCIPAL COMPONENTS

A roofed and partially enclosed structure at truck level is designed to receive and store approximately six hundred gas cylinders, both full and empty. There are two separate areas for manifolds and their connected cylinders.

BUILDING FLOOR SPACE

	Approx. Sq. Ft.
Receiving and storage	1370
Acetylene manifold space	90
Oxygen manifold space	110

BUILDING DETAILS

This is a single story building of Class III construction with a double pitched roof. The concrete floor is 4 ft. above grade and the over-all dimensions are approximately 41 ft. by 41 ft. by 16 ft. from floor to top of the roof peak. There are two sets of access steps to concrete platforms. Total area is 1675 square feet and total volume is 27,485 cubic feet.

CONSTRUCTION DETAILS

Foundations are reinforced concrete on spread footings. The frame is structural steel of rigid design, a large portion of which was made available for use here by the cancellation of part of Building #704-D. Flat cement asbestos board on the skeleton steel frame, to within 3 ft. 6 in. of the floor on the sides and 8 ft. of the floor in the gables, is used for exterior walls. Interior walls are unfinished. Interior partitions are formed by an 8 in. concrete wall 8 ft. high separating the acetylene manifold space from the main floor area and by 14 gauge steel sheathing partition 8 ft. high between the oxygen-manifold area and the main floor. Roofing is corrugated cement asbestos board and the underside of the roof structure is left exposed. The shed is not heated but there are gravity type roof ventilators for air exhaust. There are no doors nor windows. The floor is concrete. Lighting is incandescent.

EQUIPMENT

1 Acetylene manifold for 8 cylinders.

1 Oxygen manifold for 16 cyliners.

6 Cylinder trucks.

1 Stand-up desk and stool.

DEVELOPMENT OF DESIGN

The nature of the materials to be stored in this building dictated the open-sided construction. In addition to this essential consideration, the expendability of the facility and the permanence and fire resistant properties of building materials were factors affecting its design.

DRAWING

W-156239 - Floor Plan and Elevations.

BUILDING #740-A - SALVAGE AND RECLAMATION

FUNCTION

Facilities are provided in this building for the reclamation and reconditioning of partially worn out equipment for further use in the plant. This salvaged material is routed to the central stores building for re-issue.

PRINCIPAL COMPONENTS

The building has a shop area and two supervisory offices.

BUILDING FLOOR SPACE

	Approx. Sq. Ft.
Supervisory offices (2)	330
Shop area	2570

BUILDING DETAILS

The building is a one story, Class III structure approximately 50 ft. wide by 60 ft. long by 23 ft. high to the peak of roof and 14 ft. 6 in. to the eaves. A concrete area approximately 11 ft. by 47 ft. with pads for four wash tanks is located adjacent to the exterior. The building contains 3025 square feet and the volume, based on the average height, is 59,500 cubic feet. The area of the exterior pad is 520 square feet.

CONSTRUCTION DETAILS

Building foundations are reinforced concrete with spread footings. The frame is prefabricated, structural steel of rigid design.

Flat cement asbestos board is used for exterior walls and the interior of exterior walls of the two offices. The exterior walls of the offices are insulated. Interior partitions are also flat cement asbestos board in the offices but masonite in the shops area. The offices have suspended ceilings finished with flat cement asbestos board. Roofing is corrugated cement asbestos board. Floors are concrete. Heating is furnished by unit heaters and air is exhausted by roof ventilators. Lighting is incandescent in the shop area, fluorescent in the offices.

DEVELOPMENT

Those factors contingent upon the use of Class III construction materials were the only items affecting the design of this building.

EQUIPMENT

1 1/2-ton Monorail system and supporting frame work.

Approximately 130 lineal feet of work benches.

4 Baths for acid, water and soda ash with electric immersion heaters.

Heavy duty shears, located outdoors.

Drill press, arbor press, bench grinder.

DRAWINGS

W-157332 - Floor Plan.

W-157333 - Elevations and Sections.

sides. There is a concrete working area outside of and adjacent to the building.

BUILDING DETAILS

The building is of single story Class III construction approximately 12 ft. wide by 36 ft. long by 16 ft. high from the floor to the peak of the double-pitched roof. The concrete working area is approximately 15 ft. wide by 36 ft. long. The area of the building is approximately 450 square feet and the volume 5970 cubic feet. The area of the paved section is 540 square feet.

CONSTRUCTION DETAILS

The building foundations and floor are of reinforced concrete. The frame is prefabricated, structural steel of rigid design with exterior walls of flat cement asbestos board and one long side open to a height of approximately 10 feet. Corrugated cement asbestos board is used for roofing. The lighting is incandescent.

EQUIPMENT

1 Portable sand blasting machine.

DRAWING

W-157368 - Plans, Elevations.

ELECTRICAL FACILITIES

No electric power is generated in this area, power requirements being supplied from the Plant high voltage network through substations installed in the area. Three secondary substations serve the #300 sector, while a primary substation and eight secondary substations serve the #700 sector. The following electrical facilities are discussed in detail in Volume VI of this history.

Bldg. #501-A - Fence and Road Lighting.

Bldg. #503-A - Distribution Lines.

Bldg. #505-A - Fire Alarm System.

Bldg. #506-A - Telephone Cable and Instruments.

Bldg. #507-A - Safety Alarm Systems.

Bldg. #751-A - Primary Substation (Supervisory Control for 115 kv.).

Bldg. #752-A - Secondary Substations.

STEAM FACILITIES

All of the process and heating steam requirements of both the #300 and #700 Areas are furnished by a single power house, Building #784-A. This facility contains two 60,000 lbs. per hour, 325 p.s.i.g., saturated, spreader stoker-fired boiler units. Coal is conveyed to the boiler bunkers from track hoppers via a belt conveyor, a vertical bucket elevator, and a screw conveyor to the bunkers. This system will handle 50 tons of coal per hour from track hoppers to coal bunkers or coal storage yards, and the feeder system from bunkers to stokers has a capacity of 66 tons per hour. An ash handling system, arranged for the removal of bottom furnace ash and fly ash from the dust collectors and stack, delivers ash pneumatically to an outside storage silo at a design rate of 10 tons per hour.

The following steam facilities are discussed in detail in Volume VI of this history.

Bldg. #784-A - Boiler House.

Bldg. #801-A - Pipe Supports.

Bldg. #802-A - Steam Lines.

WATER FACILITIES

The peak water requirements of this area are approximately 2000 g.p.m. which are supplied from three deep wells in the area, two rated at 1000 g.p.m. each and one rated at 450 g.p.m. The water from these wells is collected in a common line and discharged into a 500,000 gallon ground storage tank. This tank, designed to provide physical separation of domestic and service water, supplies water to the domestic, service and fire pumps for distribution throughout the area.

A central refrigeration plant, Building #789-A, supplies chilled water for use in the process and comfort air conditioning systems installed in the various buildings in the #700 Area. Water is circulated between the refrigeration plant and the various buildings through an underground piping system. The refrigeration condenser cooling water is provided by a separate recirculating system from a 22,000 g.p.m. cooling tower.

The following water facilities are discussed in detail in Volume VI of this history.

Bldg. #782-A - Reservoir (Ground Tank)

Bldg. #785-A - Cooling Tower

Bldg. #789-A - Refrigeration Building

Bldg. #901-A - Water Lines

Bldg. #902-A - Fire Lines

Bldg. #905-A - Wells and Pumps

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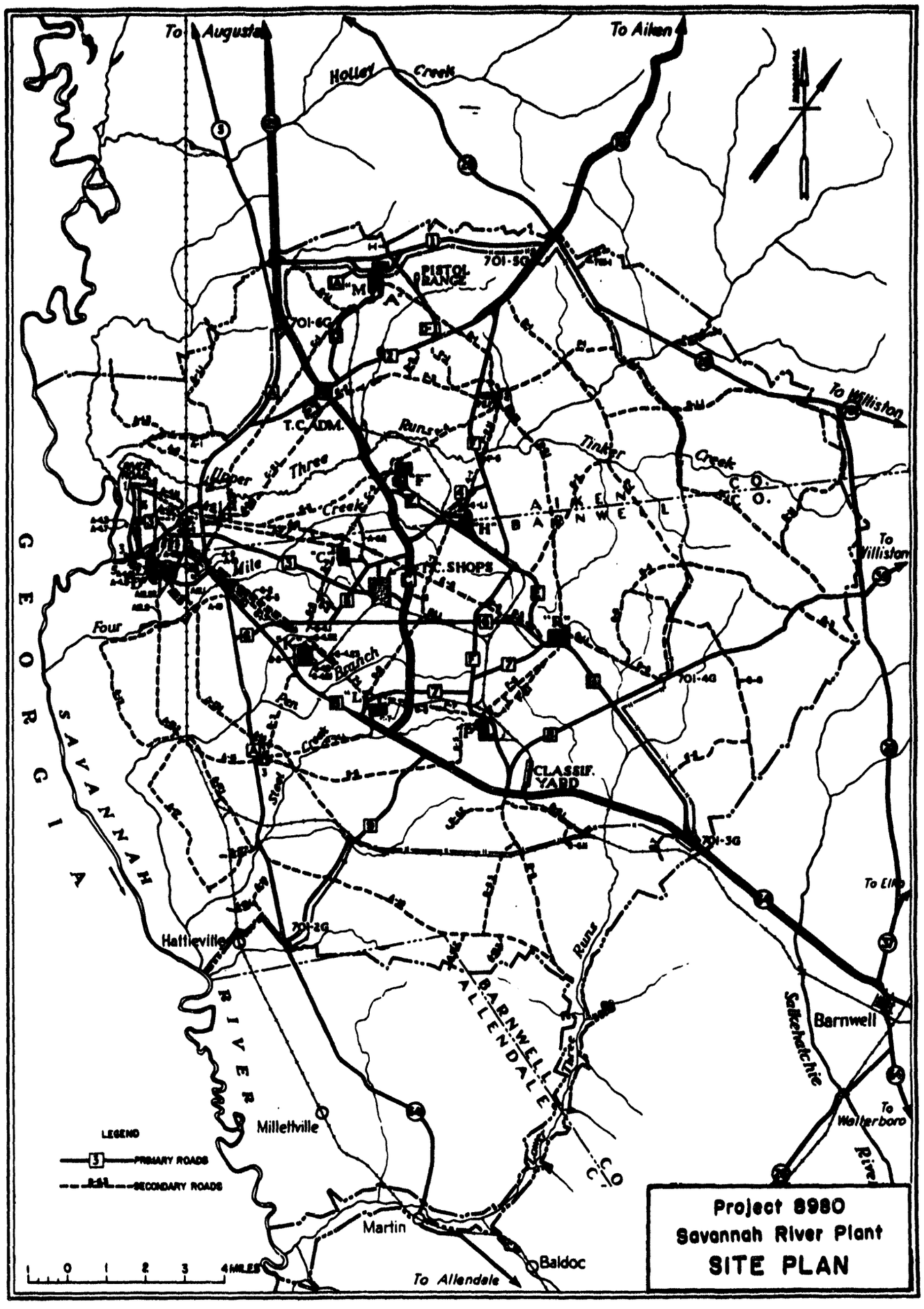
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To Aiken
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PISTOL RANGE
701-5G
701-6G
T.C. ADM.
Runs
Tinker Creek
Upper Three Creek
AIKEN CO.
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To Williston
To Williston
T.C. SHOPS
Mile
Four
Branch
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Stony
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CLASSIF. YARD
701-3G
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Runs
BARNWELL
ALLENDALE
Salkehatchie
Barnwell
To Walterboro
River
Millettville
Martin
Baldoc
To Allendale
GEORGIA
SAVANNAH RIVER
LEGEND
PRIMARY ROADS
SECONDARY ROADS
0 1 2 3 4 MILES
Project 8980
Savannah River Plant
SITE PLAN

VI - GENERAL SERVICES AND FACILITIES

DISCUSSION OF REQUIREMENTS

In designing the Savannah River Plant it was necessary to draw upon the knowledge and experience of security, sanitary and lighting specialists and to use the latest approved equipment in order to supply the required general facilities and at the same time to safeguard and protect both buildings and property.

As an area, in excess of 300 square miles, containing the equivalent of nine industrial plants within its boundary, the site demanded extensive road and railroad systems, inter- and intra-area communications through telephone and signal systems, and provisions for both sanitary and industrial waste disposal. Influencing the design of each of these was the amount of clearing and grading necessary to prepare the land for occupancy, and the final design of various areas with respect to the surrounding terrain.

The protection of plant buildings and property was a primary requisite under the rules of the Atomic Energy Commission to safeguard all equipment and material from harm, either through accident or sabotage. To this end a guard force was organized large enough to protect such cities as Boston, San Francisco or Washington, D. C. A fully trained and equipped fire department, with three strategically located stations, was on duty 24 hours a day throughout the year. This group of officers and men was mobilized to protect all of the plant and also to assist in extinguishing fires in neighboring communities off the reservation.

Because they are so closely related to various electrical installations, the telephone and radio communication and the signal and alarm systems have been discussed in Volume VI of this history under the section dealing with the development of electrical facilities.

DESIGN OF TRANSPORTATION FACILITIES

GENERAL

To expedite the flow of material and men to many points within the Savannah River site, during both the construction

and operation periods, an extensive network of highways and a complete railroad system had to be constructed. In contrast to a normal industrial plant which generally consists of a number of buildings located in relative proximity to each other, the Savannah River Plant contains eight production areas and one administrative area, each separated for safety reasons by two and one-half miles of unoccupied land. Naturally, such a layout requires numerous roads and rail lines for the transportation of freight and personnel.

As auxiliaries to these two main systems, a number of bridges and parking lots, and miles of walks, were also necessary. Because of the rolling nature of the terrain and the presence of Upper Three Runs, Tinker Creek, Four Mile Creek, Pen Branch, Steel Creek and Lower Three Runs, both highway and railroad bridges were required to permit direct and economical arrangement of transportation. Parking areas, Building #613, for each production or administrative site logically followed the construction of the road system, since all personnel and much of the freight had to move by automobile, bus or truck. The size and location of these parking lots were established after careful analysis of operating forces, area occupancy and traffic conditions in each specific area. The installation of pedestrian walks, Building #604, from the parking lots to the various buildings and from one building to another permitted inter-building communication within the various areas and also helped to guide pedestrian traffic through gate houses and check points for security control.

ROADS - BUILDING #603 (ALL AREAS)

During the early stages of design it was established that an entirely new road system would be required to link the several production and administration areas, and that any existing roads would, for the most part, have to be rebuilt or replaced before they could be incorporated in the plant system. One factor which made the installation of new roads imperative was the occurrence of "sinks". These natural depressions, or soil subsidences, were widespread and had caused pronounced settling in many roadbeds. Although the static or mobile condition of these depressions was indeterminate at the time of preliminary planning, it was considered definitely unwise and uneconomical to attempt regrading and repaving in these areas when new roads could be constructed at but slight additional cost on terrain free from such hazards.

When the plant site was acquired the existing road system consisted mainly of state and U. S. highways which, in general, formed a perimeter traffic belt. Route #28

from Augusta passed through Ellenton and Hattiaville on its course southeast to Savannah. Route #781 connected Augusta with Williston to the east of the plant area, and Route #39 began at Williston and terminated at Dunbarton on Route #64 which linked Barnwell with Ellenton. Route #19 entered the plant site from Aiken and joined Route #28 a few miles north of Ellenton.

The site survey report clearly recognized the inadequacy of the roads leading to the plant and, soon after the nucleus of the construction forces reached the area, negotiations were begun on road improvements. Much of the automobile traffic, bringing at the peak an estimated 35,000 construction workers to the field each day, was expected to originate in the Augusta and Aiken areas. For that reason a completely new dual highway from Augusta was proposed to handle approximately 5000 vehicles per hour during shift changes. This was constructed and, within the plant boundaries, feeds the heart of the manufacturing areas before it terminates at Route #64 near the #100-L Area. Route #19 from Aiken also was made a dual highway to a point a few miles within the plant boundary and a short distance from the #300/700 Areas. The important secondary feeder route from the Barnwell area, Route #64, was made a dual highway from Barnwell to a point just beyond its junction with the dual highway from Augusta. All of this construction was carried out by the South Carolina State Highway Department.

Inside the plant limits the existing secondary roads were improved and many new roads were built to connect the several areas. Completely new roads were constructed to give access to the river pump houses and the river loading dock and to connect the new dual highways from Aiken and Augusta. This latter road follows a course just inside the reservation boundary but outside the perimeter fencing, providing access both to the Administration Building and, by means of a loop passing behind the Administration Building, to the fence-enclosed, segregated #300/700 Areas. All construction on these roads was completed under du Pont supervision. Gatehouses, Buildings #701-2,3,4,5, and 6G, are situated at the points where outside roads enter the restricted reservation through the perimeter fence.

From a reference to the map preceding this section, a question may be raised concerning the apparent complexity and duplication of roadway approaches to the various areas. This occurred both by design and as a result of the sequence of construction. For strategic reasons, two or more approaches, completely independent of each other, were so located that quick entry or departure from a production area would be possible under normal or emergency conditions.

For example, the "F" Area may be entered or left to the north or south along Road C, to the north or south along Road E, and from the east or west along Road 4. Similar provisions were incorporated in each of the other areas. In addition, since the process in the #400-D Area is of such a hazardous nature, more than the usual complement of exit roads was considered advisable for the safety of personnel. Separate roads, oriented in the general direction of the prevailing winds where therefore designed as escape routes as well as normal access and egress routes.

Newly constructed permanent primary roads on the plant site total approximately 168 miles, including 13 miles of new dual-lane highway as 26 miles. In addition, a 2-inch asphaltic concrete treatment was applied to 42 miles of existing roads which were incorporated in the primary road system. Throughout the plant there is a total of approximately 500 miles of project, state, and county roads.

It was determined that the most suitable surfacing for the plant roads, traveled as they would be by heavy traffic each day, was 2-inch asphaltic concrete on a heavy-duty base. Parking areas in general were given a 1-inch asphaltic concrete surface, since they were not subject to the same heavy wear as the roads. In developing specifications for the guard rails along the highways it was found more economical to adopt the type in general use by the State of South Carolina than that established by du Pont Engineering Standards. The former consisted of sheet metal strips bolted to wood posts, and were required only at those points where the ground on either side of the right of way was six feet or more above the surrounding grade.

RAILROADS - BUILDING #601 (ALL AREAS)

Two railroads serve the area encompassed by the plant. The Charleston and Western Carolina crosses the plant boundary in the south near Hattieville, S. C. and follows a course a short distance from the river through the town of Ellenton to Augusta, Ga. The Atlantic Coast Line enters the plant at the southeast about six miles from Barnwell, S. C. and passes through Dunbarton to tie into the C&WC line a few miles from Ellenton. The ACL forms the main approach route for all passengers and freight from the north.

As a result of plant layout studies the #100 Areas were so located that the "P" Area was a little over a mile from the ACL track near Dunbarton. To eliminate this conflict with the separation criterion controlling the layout of the plant, nine and one-half miles of the ACL track were relocated between Meyers Mill and Snelling, increasing the

distance between the "P" Area and the track to approximately three miles. The existing portion of railroad became plant property and the Classification Yard was located just off this line near Dunbarton. In 1954 that portion of the old track not necessary for service to the yard was dismantled. From the Classification Yard, designed to handle approximately 700 freight cars at one time, the plant's railroad system serves the bulk of the plant through a trunk line and spurs. The #400-D Area receives shipments on a spur from the Charleston and Western Carolina at Ellenton and is the only plant area close enough to be observed from a public railroad line. However, it is rigidly guarded by SRP security patrols to prohibit any unauthorized approach. In excess of 50 miles of railroads are installed on plant property and, during the construction period, an average of 60 freight cars a day moved over the plant's system which then consisted of approximately 80 miles of track.

Shortly after the announcement of the location of the plant in South Carolina, the Southern Railway, with lines approximately 10 miles from the project boundary, petitioned the Interstate Commerce Commission for permission to construct a new line from the vicinity of Barnwell to connect with the ACL track near Snelling. The petition was denied by the ICC on the grounds that the ACL and C&WC could provide adequate service. The ICC also pointed out that there were several convenient locations where any shipments on the Southern could be transferred to the ACL lines.

The locomotive shop, Building #618-G, is located near the off-plant entrance to the Classification Yard and contains equipment necessary for the maintenance, repair and lubrication of the plant's rolling stock and the complete overhaul of the diesel electric locomotives. All movements of trains on the plant are directed and controlled from the dispatcher's and yardmaster's office in this building. The locomotives are equipped for two-way radio communication with the transmitter station at the Dunbarton fire tower, Building #627-G.

Rolling stock, Building #602-G, on the plant consists of four 120-ton diesel locomotives, used during the construction period and turned over to Operations, four 80-ton diesel locomotives, two gondola cars, sixteen flat cars, one steel box car, five hopper cars, five tank cars, and four well-type cask cars. Except for the tank and cask cars which were required to be of special design, used equipment was purchased.

Completing the railroad facilities are a track scale house, Building #608-G, on the main line into the Classification Yard, at which shipments are weighed, and the diesel

oil storage tanks, Building #619-G, filters and pumps which serve as a fueling station for the locomotives.

RIVER LOADING DOCK - BUILDING #662-G

Although operation of the plant anticipated no extensive use of river transportation in material delivery to the site, it was necessary during the construction period to receive reactor sections by barge. For this purpose a 225-foot long dock was constructed on the north bank of the Savannah River near the #400-D Area, and a hard-surfaced highway was built to connect this facility with the plant road system. A stiff-leg, 125-ton derrick, with an operating radius of 45 feet, was fabricated from four gin poles and mounted on 10-foot square concrete pads. The derrick was powered by a 174 hp., 6-cylinder diesel engine. Operations will continue to maintain these river unloading facilities.

DESCRIPTION OF TRANSPORTATION FACILITIES

Railroads, roads, walks and parking areas, Buildings #601, #603, #604 and #613 respectively, being common to all areas of the plant, have been described and discussed in the preceding section.

Specific buildings or facilities not common to all areas of the plant but of general service or use in the category of Transportation are described on the following pages.

BUILDING #602-G - STANDARD GUAGE ROLLING STOCK

FUNCTION

The standard guage rolling stock, consisting of two types of diesel electric locomotives and six types of railroad cars, is used to transport process, maintenance and construction materials between facilities on the plant site.

PRINCIPAL COMPONENTS

Motive power requirements of the plant's railroad system are filled by four 120-ton and four 80-ton diesel-electric locomotives. The four 120-ton locomotives were

purchased and operated by the Construction Division during the construction period and were made available to the Operating Department at start-up. The four 80-ton units were purchased from the General Electric Company on the basis of low bid, the capacity of the engines to operate within the load and grade limits of the plant, the satisfactory performance of similar engines at the Hanford Works and the Alabama Ordnance Works as well as the du Pont Company's Chambers Works, and on delivery by scheduled required dates.

After a complete review of estimated requirements two gondola cars, sixteen flat cars, one steel box car, five hopper cars, five high chrome tank cars, one stainless steel tank car, twenty section motor cars, and four well-type cask cars were purchased. With exception of the tank cars and the well-type cars, used equipment was acquired. Before purchasing this equipment, the du Pont Company employed an inspector from the Wilmington Shops of the Pennsylvania Railroad who examined the used cars being considered and submitted recommendations for reconditioning those selected. These repairs were completed by the vendors before delivery of the cars to the plant site.

Tank Cars

Required to transport 60% nitric acid to the #200 Area, the tank cars are fabricated of a high chrome iron alloy and have a capacity of 8200 gallons each. When it was found that no suitable equipment meeting the required standards could be obtained from the Army, Navy or the Defense Transportation Administrations, the Design Division was requested by the AED to proceed with the design and procurement of the cars. The original estimate of requirements and comparative costs indicated that five 10,000-gallon capacity cars should be purchased. The requirements were later revised to five 8200-gallon cars, based on the delivery of two cars per month with an allowance for one car out of service. The stock was purchased from the American Car and Foundry Company from a standard design which incorporated the du Pont specification No. 772-R-2 for high chrome iron.

Cask Cars

The design and procurement of well-type cask transfer cars to carry products of the #100 Areas to Buildings #221-F and H and to Building #232 presented the only major problem in the assembly of adequate rolling stock. Since the experience at Hanford with a two-compartment, depressed

center car had been favorable, preliminary consideration was given a similar car for the Savannah River Plant. As a result of studies of possible economies to be gained in equipment and transportation costs through the use of a three-cask car it became evident that definite advantages could be achieved by the use of a new and heavier car. Determining factors in the design of such a car were the length and width of the railroad tunnel and the switching set-up at the #221 buildings, the structural soundness and safety of a three-cask car and its use, without the tank, for hauling pipe assemblies to the #221 buildings. By using two-cask cars it was estimated that eight cars would be necessary to effect delivery of a total of eighteen buckets per day to the three buildings. By redesigning the cars the total number required for this performance could be reduced to six cars, four of which would be designed to carry three-compartment transfer tanks and two would be equipped only with guides or restrainers for the buckets to be moved to Building #232. When an examination of three well-type cars available at the Naval Ordnance Depot at Pocatello, Idaho, disclosed that these cars were not suitable, an order was placed with the Thrall Car Manufacturing Company for four of the newly designed cask cars.

These 100-ton capacity cars are of carbon steel plate, and have an overall length over couplers of approximately 46 ft. and a width of 9 ft. The well has a plain steel floor plate which is welded continuously around all edges and has four drain holes. This protection against spillage was incorporated to eliminate difficult decontamination of the structural elements of the cars. Clips are installed on the car for tank fasteners.

The four transfer tanks to be used with the special cars are constructed of welded steel plate. Each of the three compartments has a steel plate cover. Three brackets for handling are mounted on each side of the tank and each compartment has an overflow pipe. The tank is finished inside and out with four coats of Amercoat.

It was intended originally to purchase two 70-ton flat cars for transporting materials to Building #232, but this order was canceled after a decision was made to use tractor-trailers for this service. This decision was based on the lower cost of the tractor-trailers and their greater versatility.

BUILDING #608-G - TRACK SCALE HOUSE

FUNCTION

The Track Scale House, located just east of the Locomotive Shop on the main railroad line into the Classification Yard, serves as the weighing station for railroad freight shipments entering and leaving the plant site.

PRINCIPAL COMPONENTS

A one-story building, with a front bay projecting from the center of the long side, houses the control and recording mechanisms of the track scale. The concrete floor extends three feet beyond the bay to form an open platform between this building and the track scale.

Under part of the building and the adjacent track scale is a track scale pit divided into two sections. The smaller section is under the building bay and the open platform; the larger space is under the entire four-section track scale which is installed in the railroad track in front of the Track Scale House.

BUILDING DETAILS

The Class III structure is approximately 11 ft. wide by 26 ft. long and has an average height of 10 ft. from the floor to the flat roof. The projecting bay, 6 ft. deep by 16 ft. wide, has a 4 ft. by 14 ft. opening in the concrete floor, covered by removable plank flooring with a trap door, giving access by means of a wall mounted steel ladder to the reinforced concrete pit below. Exterior walls in the pit under the track are sloped on the outside and reduce from a 20-in. base to 15-in. width at the top. The pit floor is a reinforced concrete slab sloping to a drain which empties into a sump, in one corner of the pit under the Scale House.

There are four lever piers of reinforced concrete, into which "U" anchor bolts are set, along each long wall in the main pit. Five main lever piers, with set-in "U" anchor bolts, are constructed on the center line of the main pit. The long walls of this pit are topped on the inside edge by an offset scale rest. A track approach at each end of the pit is 13 ft. long.

CONSTRUCTION DETAILS

The building has reinforced concrete foundations, structural steel framing and corrugated cement asbestos board roof and walls. The doors are hollow metal and windows are double-hung, steel sash. The building is neither heated nor insulated, and there is no covering material on the concrete floor. Lighting fixtures are incandescent.

EQUIPMENT

Office furniture.

Duplex sump pump.

Track Scale mechanism.

DRAWINGS

W-155670 - Plans and Elevations

W-155671 - Structural

BUILDING #609-G - TRACK MAINTENANCE CREW BUILDING

A prefabricated metal structure 40 ft. wide by 100 ft. long by 12 ft. high, this building was erected in the Railroad Classification Yard for the storage of track maintenance cars, sand, lubrication oils, tools and supplies for maintenance crews.

Electric lighting and power wiring were the only services installed.

BUILDING #615-G - AUTOS, TRACTORS, TRUCKS AND TRAILERS

This account covers approximately 1200 units of diverse automotive equipment such as cranes, earth moving equipment, road building and repair equipment, portable air compressors, welding machines, portable light plants, pumps, farm machinery, fire trucks, ambulances, and a mobile X-ray unit.

The bulk of this equipment is of standard design for general plant use, but some is of special design for process or other specific use.

Twelve Dempster apartment-type 4 cubic yard drop bottom containers were included in this account to provide handling facilities for waste from Buildings #772-F and #773-A.

BUILDING #616-G - TRUCK SCALE HOUSE

FUNCTION

Located to the west of Building #719-A on the road leading to the #300/700 Area, this station provides facilities for weighing truck shipments into or from the plant.

PRINCIPAL COMPONENTS

Control and recording instruments for this operation are housed in a small building, with the truck scale platform installed over a long pit below the road surface next to the truck scale house.

BUILDING DETAILS

The scale house is a flat-roofed, Class III structure, 8 ft. sq., with a volume of 530 cubic feet. It is constructed over a lever pit 8 ft. by 10 ft. which is connected with the scale-platform pit under the road.

The scale platform is 10 ft. wide by 40 ft. long and is mounted on steel I beams.

CONSTRUCTION DETAILS

The pits walls which form the foundation of the truck scale house are of reinforced concrete 8 in. thick. The house has a wood frame treated for fire resistance and walls sheathed with flat cement asbestos board. The roofing is built-up over flat wood sheathing. The floor is a concrete slab, and in one corner a manhole, with removable cover, provides access to the pit below by means of a wall mounted steel ladder. The building has no heating facilities, but is equipped with fluorescent lighting.

The truck scale pit has concrete foundation walls and is connected to the lever pit by an opening in the common wall. The floor slats of both pits slope to a floor drain on the center line of the installation.

EQUIPMENT

Shop type desk and stool.

Truck scale mechanism, 30-ton capacity.

Transformer, 1-kv.-a.

DRAWING

W-156602 - Plan, Elevation, Foundations and Details

BUILDING #618-G - LOCOMOTIVE SHOP

FUNCTION

Situated near the off-plant entrance to the Classification Yard, the Locomotive Shop provides the mechanical and structural facilities necessary for the maintenance, repair and lubrication of the plant's rolling stock and for the complete overhaul of the diesel electric locomotives.

Movement of trains, on the plant site and in the Classification Yard adjacent to this shop, is directed and controlled from a dispatcher's and yardmaster's office in this building.

PRINCIPAL COMPONENTS

The building is a rectangular structure consisting of a high bay containing the locomotive shop, with two tracks from a spur in the Classification Yard, and a low bay containing three offices for supervisory personnel, and other rooms for various services. These latter include a signal equipment room, a store room and tool crib, a mechanical utility room, and combination change rooms and lunch rooms with adjoining toilet facilities on the ground floor. A dispatcher's and yardmaster's office is located on the second floor over the signal equipment room.

Building Floor Space	Approx. Sq. Ft.
Locomotive Shop	6700
Offices (3)	400
Stores and Tool Crib	850
Signal Equipment Room	700

Utility Room	350
Change, Lunch Rooms and Toilets	1600
Dispatcher's and Yardmaster's Office	700

BUILDING DETAILS

The building is a Class III structure approximately 86 ft. wide by 142 ft. long with the main shop area housed in a bay 50 ft. by 142 ft. by 26 ft. high from the finished floor to the bottom chord of the truss of the gable roof. A low bay along the long wall of the building is 37 ft. wide by 142 ft. long by 13 ft. high from the ground floor to the top of the flat, reinforced concrete slab roof. The dispatcher's and yardmaster's office is on the second floor of the low bay over the signal equipment room and is 21 ft. wide by 37 ft. long by 10 ft. high from the floor to the top of the roof slab.

The ground floor area is approximately 12,200 square feet and the volume is 290,300 cubic feet.

CONSTRUCTION DETAILS

The foundations are of reinforced concrete with wall footings, supporting a building frame of structural steel. Exterior walls are sheathed with corrugated cement asbestos board and interior partitions and the interior of exterior walls, in the low bay and dispatcher's office, are of flat cement asbestos board on steel studs. Toilet room walls are concrete to a height of 4 ft. with asbestos board above. Ceilings in the shop, tool crib and utility room are formed by the exposed, underside of the structure. In all other areas ceilings are suspended and finished with flat cement asbestos board.

The double-pitched truss room of the high bay is covered with corrugated cement asbestos board. The built-up roofing over the low bay and the dispatcher's office is of flat, reinforced concrete slab construction supported by rib lath and web roof joists.

Exterior walls and the roof of the low bay only are insulated.

The concrete floor is covered with asphalt tile in the ground floor offices and the dispatcher's office.

The change rooms and toilets are heated by air forced through ducts and the offices by fin-tube radiators in convector enclosures. Other areas have unit heaters. All heating is supplied from the oil burning boiler in the building. Fan ventilators on the roof of the high bay and toilet exhaust fans on the roof of the low bay maintain air exhaust.

The seven roof-mounted ventilators exhaust approximately 40,000 c.f.m. from the high bay area. A 745 c.f.m. exhaust fan is installed to ventilate the track pit. Servicing the boiler in the utility room is a 12-in. diameter metal stack, 26 ft. high, mounted on the roof over the utility room. There are also vents for the boiler safety valve, the blow down tank, the condensate receiver and the oil storage tank.

Incandescent lighting fixtures for general illumination are used in all areas except the offices where fluorescent lighting is provided. There is a single fluorescent fixture over each of the work benches in the shop area and seven special 150-watt lighting fixtures in the track pit. Emergency and blackout lighting is provided.

The two railroad track extensions from the Classification Yard spur enter the building at the north end and dead-end in the shop area. The tracks are of 90 lb. rail anchored in the concrete floor with anchor bolts and standard rail clamps. There is a track pit under one section of the inside track, with concrete steps built in at one end and a sump at the other.

From the shop floor near the entrance to the signal shop, a metal stairway provides access to the dispatcher's and yardmaster's office.

EQUIPMENT

Locomotive Repair Shop

2 Tracks, full length of building.

2 5-ton Monorails and hoists.

Battery charger.

Arc welder, gas welding and cutting equipment.

Pedestal grinder, drill press.

Work benches, vises.

Parts cleaner.

Complement of hand tools, portable tools, etc.

Water supply equipment:

Tank, 800-gallon, 2.8 c.f.m.

Air compressor.

Accessories.

8 Unit heaters, 144,500 B.t.u. each, 1725 c.f.m.

7 Roof ventilators, motor-driven, 5700 c.f.m.

1 Pit exhaust fan, 745 c.f.m.

Change Rooms

74 Lockers, benches.

2 Refrigerators.

2 Sinks, stainless steel.

2 Tables, with hot plates.

4 Lunch tables, seats attached (2 for six, 2 for eight persons).

Dispatcher's and Yardmaster's Office

Office furniture.

Remote control console, connected to equipment in Building #623-2G for radio transmission and reception.

Tape recorder for radio messages.

Signal and Communications Room

Miscellaneous electrical equipment including:

1 7-1/2 kv. Transformer.

1 75 kv. Transformer.

Supervisory Offices

Office furniture.

Stores and Tool Crib

Steel shelving.

Bins.

Dispensing counter.

Utility Room

Heat and ventilating unit, 1500 c.f.m., 135,000 B.t.u. and ductwork.

Hot water tank, 430 gallons.

Fuel oil tank, 250 gallons, outdoor, above ground.

Steam boiler, oil fired, 2760 lb./hr., with steel stack.

Make-up water pump, 22-1/2 g.p.m., motor driven.

DEVELOPMENT

Although the design of a locomotive shop especially suited to the particular needs of the Savannah River Plant railroad operations presented no unusual problems, specialists responsible for similar shops at the Hanford Engineer Works, the Alabama Ordnance Works, the Pennsylvania Railroad and General Electric were consulted and recommendations from these experts were incorporated in the design of Building #618-G.

Originally the locomotive shop and the auxiliary service functions were to be housed in separate buildings, but it was decided to centralize the two operations in one building. This decision resulted in the final building plan of a high bay to accommodate the shop and an adjoining low bay housing the service operations. This also made possible and practicable the installation of a combined dispatcher's and yardmaster's office in the same location.

Suggestions and recommendations from outside engineers which were incorporated in the final design included the provision of 10 feet of working space between the tracks and adequate working space on the outside of these two

installations. The length of the track pit was increased and it was decided to utilize jacks instead of overhead cranes in removing the body of a locomotive from its chassis whenever required during repair and overhaul.

Heating was another important factor in design. The site of the building in relation to available plant sources necessitated the provision of an integral heating system. A steam generating unit in the mechanical utility room develops a maximum of 2760 pounds of steam per hour. It is oil fired and has an electronic programing type of burner and flame failure controller. The heat is distributed in the high bay by eight unit heaters, each with a capacity of 114,500 B.t.u. and 1725 c.f.m., and by two unit heaters with a capacity of 24,000 B.t.u., 370 c.f.m. Three unit heaters, each 12,500 B.t.u. and 420 c.f.m. capacity, serve the signal equipment room and the stores and tool crib. Two unit heaters, capacity 12,300 B.t.u., 420 c.f.m., are provided in the dispatcher's and yardmaster's office.

DRAWINGS

W-155196 - Plan

W-155197 - Elevations

BUILDING #619-G - DIESEL OIL STORAGE TANKS

FUNCTION

This installation, with its loading and unloading tank car spot on a spur in the Classification Yard, serves as a fuel storage and fueling station for the diesel locomotives of the plant's railroad system and a source of fuel supply for the steam generating unit in the nearby Locomotive Shop.

PRINCIPAL COMPONENTS

Two steel storage tanks, each approximately 10 ft. in diameter by 36 ft. long and of 20,000-gallon capacity, are mounted on reinforced concrete cradles a short distance from Building #618-G. No shelter or structural enclosure is provided for this facility. There is a steel platform, reached by steel stairs, on top of each tank. Pumping equipment together with filters, gauges, and a pump control panel is mounted on a concrete pad at one end of the tanks. Separate stations are provided for unloading tank cars and for fueling locomotives. Oil is pumped from tank cars through a double swing-joint swivel unloading assembly and

a strainer by a rotary type displacement pump equipped with a 3 hp. explosion-proof motor. Before discharge into the tanks the oil passes through an air release, is filtered and metered. By-passes are incorporated on the strainer and filter lines. A double swing-joint swivel assembly is provided for engine loading. The top loading tanks are equipped with liquid level gauge boxes, manholes and vent units. Two tank gauges, panel mounted, are illuminated by an incandescent lighting fixture. A piping system drawing from both tanks supplies fuel oil for the boiler in Building #618-G. This system is equipped with two 4-1/2 g.p.m. pumps and two 1/3 hp. weatherized motors.

EQUIPMENT

2 Steel tanks.

3 Pumps, motor-driven, 2-4-1/2 g.p.m., 1-50 g.p.m.

1 Air release.

1 Cartridge type filter.

1 Meter.

Necessary piping up to 3 in. diameter, valves, gauges, and other accessories.

DRAWINGS

Map 3315 - Layout Map, Classification Yard

W-155333 - Diesel Oil Storage Tanks, Piping and Details

BUILDING #622-G - ROAD MAINTENANCE EQUIPMENT

These facilities, originally used by Construction, were transferred to the capital account for use in the storage of asphalt needed for road maintenance. The equipment was left at its original location mounted on existing concrete foundations.

EQUIPMENT

2 Storage tanks - 20,000-gal. capacity each.

1 Storage tank - 2,000-gal. capacity

1 Heater.

1 Circulating pump with motor.

BUILDING #623-2G - TRANSPORTATION RADIO TRANSMITTER STATION

FUNCTION

The equipment installed for this facility is an integral part of the radio communications system maintained by the dispatcher and the train crews engaged in railroad operations throughout the plant.

PRINCIPAL COMPONENTS

Fixed transmitting-receiving equipment and rack-assembled remote control equipment, complementing other radio equipment installed in the railroad dispatcher's office in the Locomotive Shop, Building #618-G, are installed in a small shed located at the base of the Dunbarton fire watch tower. Mobile transmitting-receiving sets are mounted in each of the plant-operated locomotives and are a part of this facility. The antenna is mounted on the top of the fire watch tower.

BUILDING DETAILS

The station is a small Class III shelter designed and erected by the Field Construction Force, with a floor area of 64 square feet.

CONSTRUCTION DETAILS

The building rests on a concrete slab foundation and has a wood frame sheathed with transite siding. The roofing is built-up and supported by wood rafters. The structure is not insulated and no heating is provided. There is an incandescent lighting fixture.

EQUIPMENT

1 60-watt Transmitter - dual receiver with remote control equipment rack assembled in Building #623-2G.

1 3.5 kw. Emergency power generator, gasoline-powered, mounted without shelter outside of Building #623-2G.

8 30-watt Transmitter-receiver mobile units mounted in four 80-ton Operations locomotives and in four 120-ton Construction locomotives.

1 Remote control console, with monitoring and magnetic tape monitoring functions, located in Dispatcher's Office, Building #618-G.

8 Automotive mobile units - 10 watt, single package transmitter-receiver units.

DEVELOPMENT

The extent and topography of the area to be served by this radio system and the relation of the station to other fixed stations on the plant were the fundamental conditions affecting the design of this facility. Design was largely a matter of selecting the proper and most satisfactory site. Extensive surveys were conducted to establish the range and pick-up potential of the radio equipment in relation to high and low elevations inherent in the railroad system. A second major influence was the availability of the Dunbarton fire watch tower, an existing structure 100 ft. high, which could be utilized as a transmitting tower. This structure was on high ground, afforded the best possible transmitting conditions for the operation to be effected, was centrally located and was near enough to the building in which the railroad dispatcher had his office to warrent the installation at this spot.

Seven automotive mobile units were included in this system in November, 1953, making a total of one base station, eight locomotive and eight automotive mobile units.

DRAWINGS

No drawings were made for the Construction-built shelter which became Building #623-2G. Drawing W-13771 is a functional drawing of the radio systems.

BUILDING #623-4G - AUTOMOBILE TRANSPORTATION - RADIO SYSTEM

FUNCTION

This system provides central radio dispatching of the automotive transportation system.

EQUIPMENT

2 Base station receiver-transmitters located in Building #716-A.

75 Mobile units for cars and trucks.

BUILDING #662-G - RIVER UNLOADING DOCK

FUNCTION

This facility provides suitable berthing and unloading for barges carrying special units for the #105 Buildings. It was a temporary Construction building, but was taken over by Operations for permanent use.

PRINCIPAL COMPONENTS

This installation consists mainly of a dock, a stiff-leg derrick, and a hoist engine building.

BUILDING DETAILS

The dock is a sheet piled headwall capped with 12-in. channel iron and is approximately 225 ft. long. It has end sheet piling ties of ten piles each, lateral timber piling ties, twenty timber fender piles, and protective timber dophin piles of four piles each at either end of the dock. Eleven timber anchor piles were placed 50 ft. back and spaced 20 ft. apart in line with headwall. A removable chain guard rail with angle iron supports is mounted on the headwall which was "burned off" at an elevation of plus 100 ft. and the ground in front excavated to elevation plus 75 ft. M-166 piling, 50 ft. long is used for both headwall and end ties.

The stiff-leg, 125-ton derrick was fabricated from four gin poles and mounted on 10 ft. pile-reinforced concrete pads.

Principal characteristics of this derrick are:

Boom length	79'-7" usable
Mast height	65'-8" usable
Stiff legs	95'-11" each
Bull wheel	16' diameter

Counter-balance	—	160,000 pounds
Hoist capacity		125 tons
Operating radius		45'

Entire dock area - approximately 375 ft. long by 140 ft. wide - 52,500 square feet

CONSTRUCTION DETAILS

The hoist engine building, a temporary structure, has a reinforced concrete slab foundation and a wood frame super structure of the shed type, with corrugated aluminum sheathing and roofing. It is approximately 24 ft. wide by 36 ft. long by 18 ft. high at the front sloping to a height of 12 ft. at the rear of the building. The open front is equipped with a tarpaulin cover. The dock area is lighted by twenty-five 1500 watt flood lights on 50 ft. and 30 ft. poles. An asphalt access road, 20 ft. wide, connects with River Road which is about two tenths of a mile east of the installation. Class B tar and gravel surface covers the service area.

EQUIPMENT

Hoist - Diesel powered, 18,000 pounds, 123 f.p.m. capacity for each drum (third drum added).

Engine - Diesel, 6-cylinder, 4-cycle, water cooled, 174 hp. at 1800 r.p.m.

Lines - 14 Parts in topping lines, 20 parts in head line, 1 in. steel cable.

DRAWINGS

TC Field Drawings

BUILDING #705-G - TRAFFIC AND TRANSPORTATION SHOP

FUNCTION

This structure, formerly T.C. #8302-4Z, was transferred to the capital account of Project 8980 to provide permanent housing and facilities for the Heavy Equipment Maintenance Group of the Traffic and Transportation Office.

PRINCIPAL COMPONENTS

Facilities include a change room for 120 persons with lockers, showers, and toilets. There are, also, a lunch room with tables and chairs to accommodate 50 persons, two offices, a boiler room for hot water supply to both Building #705-G and Building #706-G, and the shops area utilizing the existing similar area in the original layout.

Building Floor Space	Approx. Sq. Ft.
Offices (existing)	630
Change Room and Toilet	1680
Lunch Room	1000
Shop (existing)	7500
Boiler Room	935

BUILDING DETAILS

A single-story Class IV structure, the building is approximately 60 ft. wide by 196 ft. long by 25 ft. high. The total area is 12,250 sq. ft. and the volume is 245,000 cubic feet.

CONSTRUCTION DETAILS

The building has concrete foundations with continuous wall footings, sheet metal siding on exterior walls, and a sheet metal covered pitched roof. Interior partitions are of gypsum board on wood stud except around boiler room where concrete block partitions are used. Ceilings are of gypsum board except in the boiler room where plaster on metal lath is used. Shower room walls are faced with ceramic tile. Doors are of wood and window sash is steel commercial projected. The existing pitched metal roof, all exterior walls except in the shop and boiler room, and the air conditioned lunch room are insulated with fiber glass batts. The concrete floors have no covering, but the floor in the lunch room has a painted finish.

Air exhaust is maintained by roof ventilator fans. Lighting is both incandescent and fluorescent.

EQUIPMENT

Offices	- Conventional office furniture.
Lunch Room	- Combination tables and chairs, refrigerator, hot plate, and sink. One 7-1/2 ton air conditioner with ducts.
Change Rooms	- Lockers and benches.
Shop	- Two ice cube makers - 450 lb./day capacity.

BUILDING #706-G - TRAFFIC AND TRANSPORTATION OFFICE

FUNCTION

This building, formerly T.C. #8302-5Z, was transferred to the capital account of Project 8980 to provide office, change room and lunch room facilities for the supervisory and clerical personnel of the Traffic and Transportation Office.

PRINCIPAL COMPONENTS

Facilities provided include eleven individual offices, a radio transmitter room, a group office for clerical use, a lunch room for fifty persons, a women's rest room for six people, a men's change room and toilet facilities for 147 persons, and a janitor's closet.

Building Floor Space	Approx. Sq. Ft.
Offices	1600
Radio Room	145
Clerical Space	1200
Lunch Room	690
Women's Rest Room	145
Men's Change Room and Toilets	2300
Janitor's Closet	80
Corridors	1045

BUILDING DETAILS

A single-story Class IV structure, the building is approximately 60 ft. wide by 120 ft. long by 25 ft. high. The total area is 7248 square feet and the volume is 144,960 cubic feet.

CONSTRUCTION DETAILS

The building has concrete foundations with continuous wall footings, and a steel frame with exterior walls of sheet metal siding. Interior partitions are gypsum wall board on wood studs, with the interior of exterior walls and all ceilings also of gypsum wall board. Shower room walls are faced with ceramic tile to a height of 7 feet. Doors are wood and window sash is steel commercial projected. Roofing is sheet metal. All exterior walls are insulated with fiber glass batts. The concrete floor is exposed in all areas except the lunch room where grease resistant tile is used.

Existing oil-fired unit heaters with automatic controls and ducts modified to adapt to permanent function supply forced air heating. The lunch room and radio room are air conditioned, and air exhaust is maintained by roof ventilator fans. Both incandescent and fluorescent lighting is installed.

EQUIPMENT

Offices	- Conventional office furniture.
Lunch Room	- Combination tables and chairs, refrigerator, sink, and hot plate. One 7-1/2 ton package air conditioner with ducts.
Radio Room	- One 1-ton window unit air conditioner.
Change Rooms	- Lockers and benches.

BUILDING #710-G - EQUIPMENT SHED

FUNCTION

This structure, formerly T.C. #8338-Z, was transferred to the capital account of Project 8980 to provide permanent storage facilities in connection with the Traffic and Transportation Shops and Office, Buildings #705-G and #706-G.

PRINCIPAL COMPONENTS

This facility consists of a large roofed one-story shed open on all sides except where a small office is located at one end.

CONSTRUCTION DETAILS

Constructed of timber framing on concrete pier foundations, the shed is 80 ft. wide by 192 ft. long by 14 ft. high to the eaves. The floor area is 15,360 sq. ft. and the volume 215,040 cu. ft. Adjacent to this shed is a surfaced area for use as a parking lot and a fenced area for protected storage.

BUILDING #715-G - GAS STATION

This installation, formerly T.C. #8491-2, was transferred to the capital account of Project 8980 to provide servicing for automotive equipment in connection with Buildings #705-G and #706-G.

DESIGN OF PLANT PROTECTION FACILITIES

GENERAL

Because of the nature and extent of the Savannah River Plant, it was necessary to identify the site as U. S. Government property and a national security area. In early conferences with the Atomic Energy Commission, the du Pont Company was advised that, because of the magnitude of the land area, there would be no attempt made to place a restrictive barrier around the entire site. Instead, the various production and service areas within the site would be enclosed by physically impassible fences, Building #605, the whole group of areas surrounded by a three-strand barbed wire fence, and the overall property would be posted with "No Trespassing" signs.

As soon as the plant boundary had been established, therefore, the entire perimeter was posted with "No Trespassing" signs which clearly indicated that the area was closed to general vehicular and pedestrian access. Site boundary signs also were posted near the perimeter gate houses on the main roads leading into the reservation. Other off-plant

roads which terminated in a dead-end at the site boundary were marked with signs mounted on posts in the middle of the roads except where this could interfere with plant patrol. In the latter case signs were placed conspicuously at the side of roads. Some roads within the plant boundaries were left open to general traffic, but this passage was confined to the highway right-of-way with frequent and effective signs indicating these limits.

When the several plant areas had been laid out within the site, the three-strand barbed wire perimeter fence was put up to enclose all of these areas. The extent of this fence may be indicated by starting at one end on the left bank of the Savannah River a short distance above the town of Hattieville, South Carolina, and following the site boundary until it crosses Route #28. From this point on the fence is some distance inside the boundary limits until it crosses Route #64 where this highway enters the plant from Barnwell. The fence then extends, again well inside the site limits, northward to the point where Route #19 from Aiken enters the reservation. From here it runs along the connecting Route #1 westward between Routes #64 and #28 and then southeast until it again joins the river, well above the #400-D Area.

Security segregation for the individual areas was effected by the erection of chain-link fences totally enclosing each area. Gates of similar construction were incorporated in the fences at walk, road, and railroad entrances to the areas. Within these specific limits certain special buildings were enclosed individually by chain-link fences.

Early design considerations provided for elevated guard houses to be located strategically along the fence at each production area. However, these were deleted from the scope of work in view of the planned regular and constant patrol of each area by the guard force.

A second important phase of the plant protection program was the security lighting of fences, roads, and many individual installations.

Numerous and extensive engineering tests were conducted to determine the most effective types of outdoor lighting for the special security requirements of the plant and its facilities. It was found that Fresnel fixtures were most satisfactory for fences along patrol roads, but at gates and where roads outside the area were near the fence IES Type IV fixtures were utilized. Tests had disclosed that the glare from the Fresnel fixtures could present a hazard to persons driving in the vicinity. The Fresnel fixtures were installed

in the #100, #200, and #400 Areas and at Building #679. Special process buildings in the #100, #200, and #300 Areas, which were protected and enclosed by individual chain-link fences, were illuminated by IES Type IV wide, symmetrical type, fixtures. The fence lighting for the #300 and #700 Areas was the same as that for the special process buildings on the inner sides facing other fences and to the same specifications as those for the #100, #200, and #400 Areas and Building #679 on the outer side away from other fences.

Special lighting was developed for Building #703-A to provide an illuminated zone 100 ft. wide on either side of the security fence surrounding this building.

Area fences and restricted building fences were, in general, illuminated to an intensity of 0.2 ft.-c. minimum. A zone 50 ft. or more outside the fence was lighted to an intensity of 0.1 ft.-c. minimum. Lower intensity light was provided just inside the fence but not far enough inside to illuminate the patrol road. Lighting was designed and installed so that light striking the fence mesh did not mask visibility outward through the fence, and all fence and gate lighting was powered by an emergency as well as a normal electrical supply. Where it could be accomplished without appreciable additional wiring and equipment, area fences were illuminated from two circuits, alternate fixtures being connected to alternate circuits so that failure or leakage of one circuit would not darken a whole segment of fence. The spread of light from alternate fixtures gave a reasonable, though lower, intensity of illumination to the whole fence and apron area. All fence lighting, in common with other outside light, was designed to be extinguished from the area blackout control pilot circuit in addition to the normal astronomical clock control.

Periphery and area gate houses were illuminated by a high intensity, 30 ft.-c., system sufficient to enable guards to perform their duties.

In addition to the guards stationed at all entrances to the plant and in all exclusion or restricted areas, there is on duty at all times a mobile force traveling in two-way radio equipped cars. Building #720-A is the central headquarters for this plant force and the guard units operating in the #300 and #700 Areas. Containing radio communication, teletype, and fire alarm recording equipment, the building is the normal primary and as well the emergency control center for the entire plant. A secondary control center is in Building #701-1F. A 60-watt transmitter and relay equipment for plant-wide communication is located in Building #623-1G and controlled from a console in Building #720-A. In an emergency the transmitter can be controlled from a

console in Building #701-1F. Each of the areas aside from the #300 and #700 Areas has a gatehouse, designated Building #701-1, which is used as the central headquarters for the area patrolmen and to house area communications equipment. Firearms practice by the security force is conducted at Building #661-G, the Rifle and Pistol Range.

To establish a general policy on fire protection for buildings throughout the plant, a review was made early in the design period and agreement reached among the AEC, AED, Design, and du Pont's Safety and Fire Protection Division on design principles to be followed. In the three classes of construction to be used on the plant most of the materials would be incombustible. Also, from a fire standpoint, most of the buildings would have a non-hazardous occupancy. Except for the Paint Shop, Building #725-A, no sprinklers were installed. Miscellaneous portable fire fighting equipment was provided in each building and alarm systems were installed in many locations to warn of temperature rises. Combustible waste is stored in metal containers outside the buildings and regularly transported to the burning grounds.

The plant's inter-area communications system forms an all-inclusive network through which the three fire stations on the plant can be notified of fires or other emergencies. The stations in the #700 Area and the #200-F Area are similar and house a 750-gallon triple combination Howe pumper plus the auxiliary equipment necessary for maintaining fire fighting apparatus and gas masks. Each building contains locker facilities for 25 men. The station in the #400 Area is a former TC building used as a fire station but now converted into a permanent structure. It also houses a 750-gallon Howe pumper.

Another vital component in plant protection facilities is the general monitoring buildings in the #200, #400, #600 and #700 Areas. Eleven such installations house equipment which operates automatically and continuously to sample and analyze the atmosphere and record any evidence of radioactive particles of matter or gases. Temperature and relative humidity also are recorded constantly at these stations to provide data used in interpreting contamination sources. The equipment is unattended, but periodic pick-up of chart records is made. Rainwater samples also are collected at these installations, when required, for analysis in Building #735-A. Nine of the monitoring stations are permanent installations constructed on concrete slabs. The remaining two, Buildings #614-4G and #614-5G, are mounted on wood skids to permit moving them to different locations when desirable. The initial placement of #614-4G was at the base of the Dunbarton Fire Tower, Building #627-G. Here the

instrument detector heads were mounted on the fire tower, with recording devices located in the station building. Building #614-5G was placed near the southeast corner of the CMX Laboratory Area. The other stations are of standard construction and identical design. Those in the #200, #400, and #700 Areas are located at key points within the security fence enclosures of these areas. Of the remaining stations, all considered as buildings in the #600-G Area, three were built at off-site locations. Building #614-1G is situated on the Burke County Farm about three miles south of Waynesboro, #614-2G is on the property of M. C. Mixon some two miles south of Allendale, and #614-3G is installed in the southeast corner of the Aiken Airport approximately six miles north of Aiken. The two remaining stations, #614-6G and #614-7G, are on the plant site at the Talatha and the Williston Gates, respectively.

DESCRIPTION OF PLANT PROTECTION FACILITIES

BUILDINGS #260-1F&H AND -2H - MONITORING STATIONS

FUNCTION

These three buildings provide monitoring facilities for personnel entering and leaving regulated areas. One, located at the northeast corner of Building #221-H, handles both truck deliveries in and out of the Building #211-H Area and personnel delivering samples to the pick-up point at the north end of Building #221-H. The other two stations, located near the railroad gate in the "F" Area and in the railroad cut of the "H" Area, are used by the train crews when delivering and removing cask cars from Buildings #221-F&H.

BUILDING DETAILS

Each station is a one-room flat-roofed Class III structure of wood frame sheathed with corrugated cement asbestos board. Erected on a concrete slab foundation with continuous wall footings, each station is 8 ft. wide by 10 ft. long. Interior walls and ceiling are covered with gypsum board. A wooden door at each end provides access, and ventilation is obtained through a screened opening on the underside of the roof overhang. Electric service is provided for lighting. The concrete floor is covered with asphalt tile, and the roofing is built-up.

EQUIPMENT

Each station is furnished with built-in hampers for soiled clothing, shelves for the storage of clean clothing, and a cabinet for monitoring instruments.

DRAWINGS

W-162729 - Architectural, Concrete and Electrical

BUILDING #614-F - GENERAL MONITORING BUILDING

FUNCTION

This building houses equipment which operates automatically and continuously to sample and analyze the atmosphere for radioactive gases and particles and to record the results. Temperature and relative humidity are also recorded constantly to assist in interpreting the causes of contamination. The equipment is unattended but periodic pick-up of the charts is made. Rainwater samples are collected here, when required, for analysing in Building #735-A.

BUILDING DETAILS

This is a single-story, Class III structure, approximately 8 ft. wide by 10 ft. long by 8 ft. average height from the floor to the top of the plank, single-pitch roof. A cupola, 4 ft. sq. by 3-1/2 ft. high, with screened louvers on four sides is mounted at the center of the high end on the sloped roof. The total area of the building is 86 sq. ft. and the volume is 920 cu. ft.

CONSTRUCTION DETAILS

The foundation is reinforced concrete with wall footings. The wood used in the frame, roof and roof joists is treated for fire resistance. The exterior walls are of corrugated cement asbestos board and the interior of exterior walls is masonite on wood studs. Masonite is used also over wood studs for the ceiling. Louvers are built into the wood door. There are no windows. The roofing is built-up, and the exterior walls and roof are insulated. The floor is a concrete slab which has no covering material. An electric unit heater is installed and the air is exhausted by a wall fan. The lighting is incandescent.

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EQUIPMENT

1 Beta window ionization chamber.

1 Micro-microammeter.

2 Air filter assemblies.

2 "Motoair" vacuum pumps.

2 G.M. tube air monitor probes.

2 Scaler with curve drawing attachments.

1 Temperature detector.

1 Humidity detector.

1 Paragon 1/4 hp. time switch.

1 Recorder.

2 Elapsed time meters.

1 Exhaust fan and motor with limit controls.

1 5 kw. Unit heater with limit controls.

Wood work bench along two walls.

Power supply and control for instruments.

DEVELOPMENT OF DESIGN

The expendability of the structure, its location in a spot remote from other buildings and the necessity for a free flow of outside air to the recording instruments were factors affecting the design of this facility.

DRAWING

W-155928 - Plans, Elevations

BUILDING #614-1D - GENERAL MONITORING BUILDING

FUNCTION

This building houses equipment which operates mechanically and continuously to sample and analyze the atmosphere for radioactive gases and particles and to record the results. Temperature and relative humidity also are recorded constantly to assist in interpreting the source of contamination. The equipment is left unattended, but periodic pick-up of the charts is made. Rain water samples are collected here, when required, for analysis in Building #735-A.

BUILDING DETAILS

A single-story, Class III structure, the building is approximately 8 ft. wide by 10 ft. long with an average height of 9 feet from the floor to the top of the plank, single-pitch roof. A cupola approximately 4 ft. sq. by 4 ft. high with screened louvers on four sides is mounted at the center of the high end on the sloped roof. The total area of the building is 86 sq. ft. and the volume is 920 cu. ft.

CONSTRUCTION DETAILS

The foundation is reinforced concrete with wall footings. The wood used in the frame, roof and roof joists is treated for fire resistance. The exterior walls are of corrugated cement asbestos board, and the interior of exterior walls is masonite on wood studs. Masonite also is used over wood studs for the ceiling. Louvers are built into the wood door. There are no windows. The roofing is built-up and the exterior walls and roof are insulated. The floor is a concrete slab which has no covering material. An electric unit heater is installed and the air is exhausted by a wall fan. The lighting is incandescent.

EQUIPMENT

1 Beta window ionization chamber.

1 Micro-microammeter.

2 Air filter assemblies.

2 "Motoair" vacuum pumps.

2 G.M. tube air monitor-probes.

2 Scalers with curve drawing attachments.

1 Temperature detector.

1 Humidity detector.

1 Paragon 1/4 hp. time switch.

1 Recorder.

2 Elapsed time meters.

1 Exhaust fan and motor with limit controls.

1 5 kw. Unit heater with limit controls.

Wood work bench along two walls.

Power supply and control for instruments.

DEVELOPMENT OF DESIGN

The expendability of the structure, its location in a spot remote from other buildings, and the necessity for a free flow of outside air to the recording instruments were factors affecting the design of this facility.

DRAWING

W-155928 - Plans, Elevations

BUILDING #614-2D - WIND INDICATORS

FUNCTION

Thirteen illuminated windsocks have been provided to furnish indication of wind direction to personnel in the #400-D Area.

PRINCIPAL COMPONENTS

The windsocks are attached to the tops of 35 ft. to 40 ft. poles, depending on the location, and each is illuminated by two 150-kw. flood lights.

DRAWINGS

Map 3311 - Sheets 695, 696, 725, 726

Map 3319 - Sheets 696, 725

W-136456 - Bldgs. #501, #503, #506, #507 - D - Electrical Drawing - Pole Staking Schedule - Sheet #2

W-136458 - Bldgs. #501, #503, #506, #507 - D - Electrical Drawing - Pole Staking Schedule - Sheet #4

W-136459 - Bldgs. #501, #503, #506, #507 - D - Electrical Drawing - Pole Staking Schedule - Sheet #5

W-136460 - Bldgs. #501, #503, #506, #507 - D - Electrical Drawing - Pole Staking Schedule - Sheet #6

W-136523 - Bldgs. #501, #503, #506, #507 - D - Electrical Drawing - Pole Staking Schedule - Sheet #8

W-136524 - Bldgs. #501, #503, #506, #507 - D - Electrical Drawing - Pole Staking Schedule - Sheet #7

W-141686 - Typical Pole Assemblies - Sheet #1

BUILDING #614-G - GENERAL MONITORING BUILDINGS

FUNCTION

These buildings, located off the project site, house the equipment for continuously sampling and analyzing the atmosphere for radioactive gases or particles and continuously recording the results. Temperature and relative humidity also are recorded to assist in interpreting the source of contamination.

The equipment at each location is designed to be left unattended, but periodic pick-up of the charts is required.

Rain water samples are collected in a container, when required, for analysis in Building #735-A.

The locations of the seven facilities are as follows:

#614-1G - at Waynesboro, Georgia

#614-2G - at Allendale, South Carolina

#614-3G - at Aiken, South Carolina

#614-4G - at Dunbarton Fire Tower

#614-5G - at #679-G

#614-6G - at Talatha Gate

#614-7G - at Williston Gate

BUILDING DETAILS

Class - III

Size - Single story, approximately 8 ft. wide by 10 ft. long by 9 ft. average height to the top of the plank, single-pitch roof. A cupola, approximately 4 ft. square by 4 ft. high is provided with screened louvers on four sides.

Area - 86 sq. ft.

Volume - 795 cu. ft.

CONSTRUCTION DETAILS

Foundations - Concrete.
Superstructure - Wood frame treated for fire resistance.

Roof - Wood on wood joists, treated for fire resistance.
Exterior Walls - Corrugated cement asbestos board.
Interior Walls - Masonite board.
Ceiling - Masonite on roof joists.
Door - Wood.

Roofing - Built-up.
Insulation - In exterior walls and roof.
Floor - Concrete.
Heating - Electric unit heater.
Air Exhaust - Wall fan.
Lighting - Incandescent.

EQUIPMENT

1 Ion chamber and micro-microammeter.

2 Air filter assemblies.

2 "Motoair" vacuum pumps.

2 Scalers with curve drawing attachments.

1 Temperature detector.

1 Humidity detector.

1 Recorder.

1 Exhaust fan and motor with limit controls.

1 Unit heater, 5 kw., with limit controls.

Steel work bench along two adjoining walls.

DRAWING

W-155928 - Plans and Elevations

BUILDING #614-A - GENERAL MONITORING BUILDING

FUNCTION

This building houses the mechanical equipment which continuously samples, analyzes and records any radioactivity in the atmosphere from contaminated gases or particles. Temperature and relative humidity also are recorded constantly to assist in interpreting the records and in determining the source of contamination. The equipment is not attended, but periodic pick-ups of the charts are made. When required, rain water samples are collected for further analysis in Building #735-A.

BUILDING DETAILS

A single-story, Class III structure, the building is approximately 8 ft. wide by 10 ft. long on the outside of foundations and has an average height of about 8-1/2 ft. from the floor to the top of the plank, single-pitch roof. A cupola, approximately 4 ft. square by 4 ft. high, with screened louvers on four sides, is mounted on the high side of the sloped roof. The building has a total area of 86 sq. ft. and a volume of 920 cu. ft.

CONSTRUCTION DETAILS

The foundation is of reinforced concrete with wall footings and the wood frame, roof and roof joists are treated for fire resistance. The exterior walls are of corrugated cement asbestos board and the interior is lined with masonite on wood studs. Masonite also is used over wood studs for the ceiling. The roofing is built-up and the exterior walls and roof are insulated. The floor is an exposed concrete slab. An electric unit heater is installed and the air is exhausted by a wall fan. The lighting is incandescent.

EQUIPMENT

1 Beta window ionization chamber.

1 Micro-microammeter.

2 Air filter assemblies.

2 "Motoair" vacuum pumps.

2 G.M. tube air monitor probes.

2 Scalers with curve drawing attachments.

1 Temperature detector.

1 Humidity detector.

1 Paragon 1/4 hp. time switch.

1 Recorder.

2 Elapsed time meters.

1 Exhaust fan and motor with limit controls.

1 5 kw. Unit heater with limit controls.

Wood work bench along two walls.

Power supply and control for instruments.

DEVELOPMENT

The expendability of the structure, its location in a spot remote from other buildings, and the necessity for a free flow of outside air to the recording instruments were factors influencing the design of this facility.

DRAWING

W-155928 - Plans, Elevations

BUILDING #623-1G - PATROL RADIO TRANSMITTER STATION

FUNCTION

This building houses the transmitter and relay equipment for controlling the activity of plant patrol cars. The transmitter is controlled by a central console in Building #720-A, Patrol Headquarters. In an emergency it may be controlled also by a console located at the secondary center, Building #701-1F, Main Gate House and Patrol Headquarters, also 709-F, 709-A, 703-A and 720-G. Ordinarily Building #623-1G will not be occupied.

PRINCIPAL COMPONENTS

The building is a one-room, single-story structure housing a transmitter and auxiliary equipment. An attached generator structure houses an emergency electric power diesel-driven generator.

DESIGN

The design of this facility was affected largely by the need for emergency facilities in a building resistant to bomb blast. Such a structure would be operable during disaster conditions or other emergencies since its proper functioning would be a vital factor during emergency control as well as during normal operations.

BUILDING DETAILS

The transmitter station is a Class I structure, 12 ft. by 14 ft. by 11 ft. from the floor to the top of the flat roof slab. The adjoining generator housing is approximately 7 ft. by 8 ft. by 11 ft. from the floor to the top of the flat roof slab.

Area including generator housing	-	228 sq. ft.
Volume including generator housing	-	2510 cu. ft.

CONSTRUCTION DETAILS

Building foundations are of reinforced concrete with spread footings. The walls and roof are reinforced concrete. The interior of the exterior wall and the ceiling are the exposed concrete of the superstructure. The door is hollow metal and there are no windows. Roofing is built-up, and the roof of the main building is insulated. There is no insulation in the generator housing. There is no covering on the concrete floor. The building is not heated, but air exhaust is maintained by a fan and a short section of duct through the roof. Lighting is incandescent.

EQUIPMENT

60 watt Transmitter and auxiliary equipment including an antenna.

3.5 kw. Diesel-drive emergency electric power generator, a trickle charger and a 55-gallon buried oil tank.

270 c.f.m. Air exhaust fan.

Cupboard and bench.

DRAWING

W-155153 - Floor, Roof Plan and Elevations

BUILDING #627-G - FIRE OBSERVATION TOWER

The Dunbarton Fire Observation Tower, a structure existing prior to the acquisition of the plant site, was retained as a permanent facility. It was equipped with two radio transmitter-receivers, one on Savannah River Plant Channel 1 and the other on the channel of the South Carolina Forestry Commission.

BUILDING #661-G - RIFLE AND PISTOL RANGE

FUNCTION

This installation was made a part of the Construction facilities and was used for the training of patrolmen and guards. Operations took over the range for shotgun and pistol practice by the patrolmen and guards.

PRINCIPAL COMPONENTS

The range building contains a retaining room, a "new men" and "special groups" room, a gun cleaning room which serves also as a classroom, a supply room, two offices, and toilet facilities.

There are two pistol courses. The entire area, approximately 270 ft. by 540 ft., is graded and enclosed within a chain link fence.

Building Floor Space	Approx. Sq. Ft.
Retaining Room	680
"New Men" and "Special Groups" Room	445
Gun Cleaning and Classroom	480
Supply Room	355
Offices, two	250
Toilet Room	200
Heater Room	55
Pistol Course, one, Coal Provia paved paths, with seeded areas between	1300 square yards
Completely paved Pistol Range, Coal Provia, 120 ft. by 180 ft.	2400 square yards

BUILDING DETAILS

The range house is a one-story, Class III building with a trussed, double-pitched roof. It is approximately 43 ft. by 69 ft. by 17 ft. high from the floor to the roof peak. The bottom chord of the truss at ceiling height is 9 ft. above the floor line.

The building area is 2697 square feet and its volume is 45,700 cubic feet.

CONSTRUCTION DETAILS

The building is supported on concrete foundation piers 12 in. square. The frame is wood, with wood roof trusses and floor joists on wood beams. Celo siding is used for

exterior wall sheathing. Interior partitions and finish on the interior of exterior walls and ceilings are of sheet rock on wood studs. The doors are wood and the sash is wood, double-hung. Roofing material is corrugated aluminum. The building is not insulated. Floors are tongue and groove planking on wood joists. There is no floor covering.

The building is heated through ductwork by forced air from an oil fired heater in the building. Lighting is fluorescent.

When this building was taken over as a permanent facility, a 5 g.p.m. well with pump and water treating equipment was provided to give potable and sanitary water. A hot water heater, drinking fountain, toilet facilities and a 2000-gal. septic tank with necessary accessories also were installed.

EQUIPMENT

Office furniture and conference room equipment.

Oil-fired heating unit, 200,000 B.t.u., 2400 c.f.m. with ductwork, fan and other accessories.

Fuel oil tank, 550-gallon capacity, underground.

Targets, barricades, stake tables, markers and auxiliary target practice supplies.

Hot water heater, 30-gal. capacity.

Unit electric drinking fountain.

DRAWINGS

C-8491-G - Sheets A to E (Construction Division Drawings).

W-161186 - Architectual

W-161188 - Plumbing and Heating

BUILDING #701-1G - GATE HOUSE

FUNCTION

This building provides facilities for the control of personnel and vehicular traffic at the entrance to the CMX Area.

PRINCIPAL COMPONENTS

Located on an island between two traffic lanes, there is a single personnel control lane with a badge rack and counter in the building.

BUILDING DETAILS

Of one-story, Class III construction, the building is approximately 13 ft. by 15 ft. by 9 ft. high from the floor to the top of the roof sheathing. The total building area is 206 square feet and the volume is 2280 cubic feet.

CONSTRUCTION DETAILS

Building foundations are of reinforced concrete. Constructed on a concrete slab floor, the wall and roof framing is fire resistant treated wood. Exterior walls are sheathed with flat cement asbestos board and the interior walls and ceiling are covered with gypsum wall board. The doors are wood and window sash is double-hung steel. The roofing is built-up, and walls and ceiling are insulated. Heat is furnished by an electric unit heater and lighting is fluorescent. Air is exhausted by a gravity roof ventilator.

EQUIPMENT

Badge rack and counter.

Office furniture.

Telephone connection.

Electric heater, 7.5 kw.

Gravity roof ventilator, 16-inch.

DEVELOPMENT

Class III construction was specified for this building since a permanent structure was not required. Its expendability affected design to the extent that fire resistance and the missile effect of construction materials were pertinent considerations. It was decided, in March 1951, to install batt-type insulation in the walls and ceiling of this building to permit a more economical heating installation.

DRAWING

W-155195 - Plan, Elevations, Sections and Details

BUILDINGS #701-2G, 3G AND 4G - GATE HOUSES

FUNCTION

These perimeter gate houses provide outer check points for the control of personnel and automotive traffic in and out of the plant reservation.

Operation is on a three-shift basis.

PRINCIPAL COMPONENTS

Each building contains a guard room and toilet in a small structure located on a curbed and paved island, 21 ft. by 60 ft. in the center of an approach highway. Control is maintained over single traffic lanes on each side of the gate house just inside 10 ft. gates in the periphery fence.

BUILDING DETAILS

These buildings are Class III structures, 12 ft. by 12 ft. by 9 ft. high from the floor to the top of the flat roof. The area of each one is 146 square feet and the individual volume is 1250 cubic feet.

BUILDING FLOOR SPACE

	Approx. Sq. Ft.
Guard Room	116
Toilet	30

CONSTRUCTION DETAILS

Building foundations are of reinforced concrete with wall footings and a 6-in. curb. The wood frame is treated for fire resistance and covered with flat cement asbestos board on both exterior and interior walls and ceiling. Doors are wood and window sash is wood, double-hung. Roofing is built-up, and batt-type insulation is provided in the walls and ceiling. There is no covering on the concrete floor.

Electric unit heating is furnished, and lighting is incandescent. Street type lighting fixtures are used to illuminate roadways in the vicinity of these gate houses.

EQUIPMENT

Office furniture.

Electric water cooler.

Electric heater.

Telephone connection.

Two-way radio apparatus.

Hot water heater.

DRAWINGS

#701-2G W-157072 - Plans, Elevations, Details and Schedules

#701-3G W-157888 - Plans, Elevations, Details and Schedules

#701-4G W-157890 - Plans, Elevations, Details and Schedules

BUILDINGS #701-5G AND 6G - GATE HOUSES

FUNCTION

These perimeter gate houses provide outer check points for control of personnel and automotive traffic in and out of the plant reservation.

Operation is on a three-shift basis.

PRINCIPAL COMPONENTS

Three buildings are provided at each of these two control points. There is a main guard house located on a curbed and paved island, 21 ft. by 60 ft., and two sentry-box type guard houses on similar islands, 13 ft. by 38 ft. Control is maintained over single traffic lanes which pass through gates in the periphery fences.

BUILDING DETAILS

These gate houses are all of Class III construction. The guard house at each installation is 12 ft. by 12 ft. by 9 ft. from the floor to the top of the roof. The sentry box shelters are 4 ft. square and the same height as the main guard houses. The area of the guard houses is 146 square feet and the volume 1250 cubic feet. The smaller shelters are each 16 square feet in area and 135 cubic feet in volume.

BUILDING FLOOR SPACE

	Approx. Sq. Ft.
Guard Room	116
Toilet	30
Sentry Box Shelter	16

CONSTRUCTION DETAILS

Building foundations are of reinforced concrete with wall footings and a 6-in. concrete curb. The frame is wood treated for fire resistance. Exterior walls, interior partitions in the guard house, interior walls, and ceilings are covered with flat cement asbestos board. Doors are wood with glass panels and window sash is wood, double hung. Roofing is built-up, and walls and roofs are insulated with batt-type insulation. There is no covering on the concrete floor slab.

Electric unit heaters are furnished for each building, and incandescent lighting fixtures are installed.

EQUIPMENT

Office furniture.

Electric water cooler.

Electric heater.

Telephone connection.

Two-way radio apparatus.

Hot water heater (in Guard Houses only).

DRAWINGS

#701-5G W-157892 - Plans, Elevations, Details and Schedules

#701-6G W-157074 - Plans, Elevations, Details and Schedules

BUILDING #709-F - FIRE HOUSE

FUNCTION

This building provides housing for equipment and personnel engaged in fire fighting of a general nature such as forest or brush fires, and motor vehicle fires. The equipment also supplements fire fighting operation on the whole project. Equipment for the maintenance and repair of fire extinguishers and gas masks for the #100 and #200 Areas is located in this building also and working stocks of such equipment are stored here.

PRINCIPAL COMPONENTS

The majority of the space in the building is devoted to a garage for the fire truck. There is a repair shop for the maintenance of fire extinguishers and gas masks, an office for supervisory personnel, a lunch room with a seating capacity of six, and a locker and toilet room for twenty-five men.

Building Floor Space	Approx. Sq. Ft.
Garage	930
Repair Shop	420
Office	165
Lunch Room	140
Locker and Toilet Room	225

BUILDING DETAILS

The fire house is a one-story Class III building approximately 34 ft. wide by 62 ft. long by 14 ft. high from the floor to the top of the flat roof slab. The total building area is 2075 square feet and the volume is 32,845 cubic feet.

CONSTRUCTION DETAILS

The foundations are of reinforced concrete with spread footings. The building has a structural steel frame with web roof joists and a flat concrete slab roof. Exterior walls are of corrugated cement asbestos board, with interior partitions of flat cement asbestos board on steel studs. The interior of the exterior walls is faced with fiber board to a height of 6 ft. in the garage and repair shop and with flat cement asbestos board from floor to ceiling in other areas. Toilet room walls are of concrete to a height of 4 ft. with cement asbestos board above this level. Suspended ceilings finished with flat cement asbestos board are installed throughout the building except in the garage and repair shop where the ceiling is formed by the exposed underside of the concrete roof. Doors are hollow metal and windows are steel, both projected and double hung. The roofing is built-up and the exterior walls and roof are insulated. There is no covering on the concrete floor. Heating is supplied by unit heaters in the garage and repair shop and by fin-tube radiators in the remaining areas. The steam source for these services is the area power house. Air exhaust is maintained from the toilet, repair shop sink, office and locker room by exhaust fans and duct work. The lunch room is air conditioned. Fluorescent lighting fixtures are installed in the office and the repair shop, with other areas having incandescent lighting.

The garage space is large enough to allow ready access around the truck for cleaning and light maintenance work. A hose-drying rack is located on a concrete platform outside the building adjoining the garage.

A driveway between the road and the building is designed to permit washing the fire truck directly in front of the garage doorway without blocking access to the nearby parking lot.

EQUIPMENT

Garage

1 Dry chemical fire truck. (This equipment was procured against Building #615-G, Automotive Equipment.)

1 Outdoor, horizontal, wood drying rack for hose.

1 Air compressor - 5 c.f.m. capacity.

Repair Shop

3 Work benches.

Supply cabinets, shelving.

1 Scale, 500-lb. capacity.

CO_2 Converter for charging solid CO_2 as liquid into extinguishers.

Dry ice box, 400-lb. capacity.

Vises.

Buffing machine.

Office

Conventional furniture.

Lunch Room

Table with chairs attached, 6 persons.

Refrigerator.

Sink, hot plate, table.

1 Air conditioning unit, 1-ton window type.

Locker and Toilet Room

25 Lockers, benches.

Heating and Ventilating

2 Exhaust fans and ductwork, approx. 2500 c.f.m.

3 Unit heaters.

DRAWING

W-156989 - Floor Plan and Elevations

material. Doors and double hung sash are wood. Heating is provided by an oil-fired hot air heater through ducts and grilles to the office-locker room section.

Lighting fixtures are fluorescent except in the toilet and shower room where incandescent lighting is installed.

The garage provides ample work space around the fire truck for cleaning and light maintenance work. A septic tank and drain field are provided for the disposal of sanitary waste. Other services supplied include water and electric power.

DEVELOPMENT OF DESIGN

This building originally was selected for conversion to permanent status since it was designed for and had served as a fire house during area construction and was, consequently, of suitable size and well situated to serve as the area fire house. Only the simplest changes were required to make the facility suitable for transfer from temporary to permanent use.

DRAWINGS

W-161202 - Sections and Details - Architectural

W-161203 - Foundations, Floor Plan and Details - Architectural

W-161207 - Plans and Details - Electrical

BUILDING #709-A - FIRE HOUSE

FUNCTION

This facility provides housing for fire fighting equipment and serves as a base of operations for fire fighting personnel in this area. Equipment for repair and replacement of plant fire extinguishers and gas masks is available here and working stocks of such equipment are stored in the building.

PRINCIPAL COMPONENTS

The major portion of the building is devoted to garage space for a plant fire truck. Other areas accommodate a repair shop for gas mask and fire extinguisher maintenance,

BUILDING #709-D - FIRE HOUSE

FUNCTION

This facility provides housing for fire fighting equipment and serves as a base of operations for fire fighting personnel for the #400-D Area.

PRINCIPAL COMPONENTS

More than half of the building floor space is taken up by an equipment room, essentially a garage for the fire truck. An office, a ready room, a locker and change room, and toilet and shower facilities are adjacent to the equipment room along one side of the building.

Building Floor Space	Approx. Sq. Ft.
Equipment Room	1850
Office	120
Ready Room	120
Locker Room	220
Toilet and Shower Room	145

BUILDING DETAILS

The fire house is a one-story building of Class IV construction, approximately 49 ft. wide by 51 ft. long and 12 ft. high from the floor to the ceiling in the partitioned area. The total building area is approximately 2500 square feet and the volume 45,000 cubic feet.

CONSTRUCTION DETAILS

Building foundations are of reinforced concrete with wall footings. The frame is wood and the roof is of corrugated metal on wood joists. Three exterior walls are sheathed with celo-siding, while the garage entrance end and the gable on the opposite end of the building are finished with shiplap siding. The floor is 4 in. thick reinforced concrete. The interiors of exterior walls, interior partitions, and the ceilings in the office and locker room section are sheathed with celotex. The walls and ceiling of the equipment room are the exposed framing members and the underside of the wood roof and side walls sheathing

an office for supervisory personnel, a lunch room for six men, and a locker and toilet room for twenty-five men.

Building Floor Space	Approx. Sq. Ft.
Garage	930
Repair Shop	420
Office	165
Lunch Room	140
Locker and Toilet Room	225

BUILDING DETAILS

The building is a Class III, single-story structure, approximately 34 ft. wide by 62 ft. long by 14 ft. high from the floor to the top of the flat roof slab. The total area is 2075 square feet, the total volume 32,845 cubic feet.

CONSTRUCTION DETAILS

The building has reinforced concrete foundations with spread footings, a structural steel frame with web joists and a flat concrete slab roof. The exterior walls are sheathed with flat cement asbestos board. The interior of the exterior walls is covered with fiber board to a height of 6 ft. in the garage and repair shop and with flat cement asbestos board from floor to ceiling in the other areas. Toilet room walls are of finished concrete to a height of 4 ft. with flat cement asbestos board above this height to the ceiling. The ceilings are suspended, flat cement asbestos board except in the shop and the garage. Doors are hollow metal and sash is steel, both projected and double hung. Roofing is built-up.

The exterior walls and roof are insulated. No covering material was used on the concrete floors. The garage and shop are heated by unit heaters, other areas having fin-tube radiators with steam supplied by the #700 Area power house. The lunch room is air conditioned. Ventilation air exhaust is provided from the toilet room, the repair shop sink, garage, office and locker room. Fluorescent lighting is installed in the office and locker room, as well as in the office and repair shop. Other areas have incandescent lighting.

EQUIPMENT

Garage

1 Triple combination Howe pumper, 750 g.p.m. equipped with hose and other accessories. This equipment was procured under Building #615-G, Automotive Equipment.

1 Outdoor wooden horizontal drying rack for hose.

1 Air compressor - 5 c.f.m. capacity.

Office

Conventional furniture.

Lunch Room

Table with attached seats, 6 persons.

Refrigerator.

Sink, hot plate, table.

Air conditioning unit, 1-ton window type.

Locker and Toilet Room

25 Lockers, benches.

Heating and Ventilating

2 Exhaust fans and ductwork, approximately 2500 c.f.m.

1 Exhaust fan and ductwork, 320 c.f.m.

3 Unit heaters.

DRAWING

W-156999 - Floor Plan and Elevations

BUILDING #720-G - PATROL TRAFFIC OFFICE

FUNCTION

This building, formerly T.C. #3, was transferred to the capital account of Project 8980 to provide permanent office facilities for the Traffic Patrol Section of the plant guard forces.

PRINCIPAL COMPONENTS

Originally a facility erected for use during the construction of the plant, offices, storage facilities, and general services were installed consisting of:

		Approx. Sq. Ft.
Offices (7)	Total	1725
Off-Season Uniform		
Storage Room		800
Patrol Central		
Supply Room		1280
Traffic Section		
Laundry Room		320
ffic Section		
Supply and Storage Room		320
Laundry Delivery Room		480
Locker Room		1325
Shower Room		135
Men's Toilet		215
Women's Toilet and Lounge		160

BUILDING DETAILS

A single-story Class IV structure, the building is approximately 40 ft. wide by 200 ft. long by 12 ft. high from the finished floor to the eave line.

CONSTRUCTION DETAILS

This is a prefabricated metal building of steel framing and aluminum siding. Interior partitions are of wood stud with "Sheetrock" on one side only. All outside walls are furred and sealed with Celotex. Heating is provided by a forced hot air system.

DRAWINGS

W-161200 - Plans and Details - Architectural and Plumbing

W-161209 - Details - Architectural

W-161214 - Plans and Details - Heating and Plumbing

W-161220 - Plan - Electrical - Lighting and Power

DESIGN OF WASTE DISPOSAL AND DRAINAGE FACILITIES

GENERAL

Most of the disposal problems typical of an industrial trade waste installation are present at the Savannah River Plant, but there exists also the unusual problem of disposing of solid and liquid wastes contaminated by radioactivity. It was in connection with these that comprehensive plans had to be made to safeguard the health of the surrounding area and the population centers bordering on the river below the plant site.

Contaminated solid materials such as valves, piping, and even complete vessels which are discarded, are buried at a location not far from the #200-F and H Areas and near the railroad and main connecting road between the two areas. This burying ground, Building #643-G, is approximately 800 feet by 3000 feet, is enclosed by a 7-foot high fence, and is posted "Radiation Danger Zone - Keep Out". Surface drainage from the area is provided by Four Mile Creek. Any combustible contaminated materials of low activity are disposed of in incinerators in the #200-F Area.

For the many categories of uncontaminated waste there are collection points in each area from which the materials are transported to a central salvage and reclamation area

adjacent to the plant railroad line near the #300/700 Area. This particular location was selected for its accessibility to outside buyers wishing to inspect materials offered for sale.

Uncontaminated combustible materials, having no salvage value, are disposed of at the burning grounds close to the salvage and reclamation area. Standard design was followed in providing storm drainage and in disposing of sanitary wastes. Open ditches were constructed in all areas to carry storm water into streams normally draining the plant site. For the disposal of sanitary wastes, septic tanks were constructed in areas of low population, and a conventional sewage treatment plant complete with primary settling tank, sludge digester, comminutor and sludge drying beds was provided in the higher populated areas such as #200-F and #700-A Areas. Sewage lift stations were provided as required.

A batch release method was evolved to dispose of most of the normal industrial liquid wastes. On the basis of an anticipated release of approximately 6600 gallons per month, it was planned to discharge batches of 100 to 150 gallons at a time throughout the month with the exception of neutralized nitric acid where the batch volume might be as high as 600 gallons. Contained in these discharges would be methanol, nitric acid, neutralized nitric acid and neutralized hydrofluoric acid, phosphoric acid, hydrofluorisilicic acid and caustic. In addition there would be a continuous release of hydrogen sulfide solutions and sodium sulfate solutions. It was estimated that concentrations of these chemicals following mixture with the river water, would range from 0.004 p.p.m. for the hydrogen sulfide to 1.1 p.p.m. for the sodium sulfate. Ash sluicing water would be settled in lagoons before discharge to the river, and any other discharges would be treated similarly or given special treatment as required.

Three categories were established for contaminated liquid wastes. Innocuous wastes containing less than 10^{-13} curies/cc. were designated as "trade waste", and might or might not require neutralization before discharge to the surface drainage system. Wastes containing up to 1×10^{-8} curies/cc. became known as "low level wastes". These would require a minimum of special storage and transportation facilities, and some shielding. A third type, "high level wastes", in excess of 1×10^{-8} curies/cc., could be handled only in specially designed equipment and discharged to any drainage system only after processing to eliminate the radioactivity. In the #700 Area, the drains from the Main Technical Laboratory, Building #773-A, and the Health Physics Headquarters, Building #735-A, are tied to a system leading

to the Waste Concentration Building, Building #776-A, where the wastes are stored temporarily and monitored. Some wastes can be neutralized safely and discharged through the trade waste system to surface drainage. The more potent wastes, however, are neutralized with caustic and transported in special tank trucks to the Tank Farm, Building #211-F, in the #200 Area.

The six underground tanks of the waste handling facilities at Building #211-F receive and temporarily store wastes from Buildings #776-A, #772-F and #221-F. High activity wastes are neutralized and then pumped to an evaporator in Building #221-F. Low activity wastes are pumped, without neutralization, through several intermediate tanks to an evaporator in Building #211-F.

Condensate from the evaporators is monitored and, if free of activity, discharged to surface drainage. If activity is present the condensate is recycled through the evaporators, the residue from which is discharged to the waste storage tanks of Building #241-F.

In Building #221-F, the major process building, liquid waste streams coming off the process for discard are monitored and either neutralized or evaporated to concentrate contamination. All liquids that cannot be processed to make them safe for release to surface drainage are piped to Building #241, Waste Disposal Building, for permanent storage. There eight steel tanks are installed in each of the "F" and "H" Areas to hold radioactive liquids. Although the intent of this facility is permanent storage, it is expected that quantities of the wastes will dissipate their radioactivity in from 8 to 10 years, after which they may be discarded. In the construction of Building #241, all tanks were set in concrete vaults which were waterproofed to prevent any seepage of radioactive liquids into the underground water courses. (For detailed data on Building #241 see Volume III of this history.)

Two earth seepage basins were installed in each of the #200 Areas primarily to divert certain process waste from Upper Three Runs Creek since that stream discharges to the Savannah River at a point upstream from the intakes serving the river pump houses.

The basins are constructed in such a fashion that the sewer outfall discharges into the smaller of two basins which acts as a settling chamber. The overflow from this basin then discharges to a larger basin from which the waste water seeps into the soil.

From the standpoint of quantity, the most difficult problems grew out of the continuous discharge of approximately 90,000 g.p.m. of cooling water from each of the five #100 Areas. Fortunately the plant site is drained by a number of tributaries to the Savannah River within the plant boundaries. The location of the #100 Areas near the georgraphic center of the reservation placed them near the headwaters of these creeks and permitted access for the cooling water effluent to existing drainage channels. This condition supported the policy adopted by the Atomic Energy Commission under which all discharge would reach the river within the limits of the plant.

Of interest in connection with the discharge of cooling water is the fact that there was no prolonged concern felt over the level of contamination in the water. It is true that initially designers planned to pipe the cooling water into a two-part retention basin, each part capable of holding 2,000,000 gallons or enough to retain the effluent for about one-half hour at a flow of 90,000 g.p.m. This was to be a precaution taken against the leakage of contaminated moderator into the cooling water system. As design progressed, however, confidence in the "tightness" of the system increased and plans for the large retention basin were canceled. In its place a process effluent sump, with a capacity of 11,000 g.p.m. was constructed to serve as a reservoir from which cooling water could be pumped back to Building #105, should an emergency water supply be required. Normally, the cooling water flows from the reactor building to the sump and then through an outfall structure to one of the streams draining to the river. Similar design is used in all #100 Areas.

Only in the "R" Area did a question develop on the selection of a tributary for effluent drainage. The nearest creek, Lower Three Runs, did not flow into the river until it reached a point approximately 10 miles downstream from the plant boundary. As an alternative, Four Mile Creek could be used but would require the installation of a pump house to lift the drainage to an elevation that would permit gravity flow through an open ditch or a concrete pipe line to the creek. The cost of providing such discharge facilities, except for the construction of a pipe line, roughly compared with the use of Lower Three Runs and the purchase of land bordering on that creek. Aside from considerations given to possible contamination, the AEC was desirous of owning bordering land on the streams carrying the effluent because the small streams carrying an additional 90,000 g.p.m. flow of warm water might be subject to flooding, could cause low lying fogs in colder weather, could lose some of their potability so far as cattle watering was concerned, and would make it necessary to improve stream

beds and protect some bridge supports. In the "R" Area, therefore, the AEC approved the plan to use Lower Three Runs and to purchase land along the stream, since substantial operating savings would be realized over the use of Four Mile Creek. Approximately 6000 acres were purchased, enough to give the AEC rights over a half-mile strip along the stream and a much wider strip at the stream mouth. Along Lower Three Runs and other streams used for #100 Area effluent, some stream channels were straightened near bridges, riprap was placed around bridge supports, and some trees were cleared from the banks of streams.

A small discharge of deionized water, approximately 6 g.p.m., has a radioactive level that prohibits its direct release to the surface drainage system. In each of the #100 Areas a retention basin has been constructed which delays this water approximately 12 hours in which time the radioactive material has decayed sufficiently to permit its release.

Throughout the development of waste disposal plans, all phases which might affect the general welfare of the area surrounding the plant were discussed with and approved by the South Carolina State Board of Health and the Stream Pollution Board.

DESCRIPTION OF WASTE DISPOSAL AND DRAINAGE FACILITIES

The #100-CKLPR, #200-H, #400-D and #600-G Areas are provided with septic tanks, Building #607, of sufficient size to dispose of the sanitary sewage. However, the population required to operate the #200-F and #300-M and #700-A Areas dictated the installation of sewage treatment plants and comminutors, and because of the topogrophy, with sewage lift stations.

All areas of the plant are equipped with sanitary sewers, Building #903, and storm sewers, Building #907, to provide adequate conduction of waste to specific disposal points. All areas also have systems of process sewers, Building #904, to take care of the disposal of industrial wastes. These piping systems are of standard design to serve existing conditions, so they have not been given individual descriptions. However, it was found desirable in the #200-F and #200-H Areas to install seepage basins to provide delayed disposal of regulated process wastes. Similar seepage basins are installed, also,

near Building #678-G and #776-A to permit control of process waste in those areas.

The following descriptions of facilities cover those buildings or installations not common to every area but of service specifically in the disposal of waste and drainage.

BUILDING #607-1F - SEWAGE TREATMENT PLANT

FUNCTION

The purpose of this installation is to provide the means for sewage disposal.

PRINCIPAL COMPONENTS

The sewage treatment plant is composed of a sludge digestion tank, a primary sedimentation tank, a valve chamber and a stair enclosure giving access to the pit floor.

The sludge digestion tank is 20 ft. deep and has an inside diameter of 20 ft. A gas dome surmounts the floating wood cover which is finished with built-up roofing. The primary sedimentation tank is 10 ft. wide by 25 ft. long and has an 8-1/2 ft. extension at the outside end which houses a weir box and a meter float well. The pump room between these two tanks is 15 ft. wide by 23 ft. long by 12 ft. deep. It has a concrete slab roof. These three principal components are constructed of reinforced concrete.

The stair enclosure over part of the valve chamber is approximately 8 ft. wide by 16 ft. long and is of Class III construction with corrugated asbestos siding and roofing on a wood frame. Northwest of the plant is a sludge drying bed with reinforced concrete walls, approximately 23 ft. wide by 83 ft. long by 2 ft. deep, divided by wood partitions into four sections, approximately 20 ft. each.

Lighting fixtures are incandescent. The facility is not heated.

EQUIPMENT

Sludge collector.

Sludge pump.

Sump pump.

Explo-proof switches and receptacles.

Necessary piping and valves.

DRAWINGS

W-156164 - Ground Floor, Plan and Elevations

W-156166 - Plans, Sections and Details

BUILDING #607-3F - SEWAGE LIFT STATION

FUNCTION

This facility functions as a lift and booster for sewage from #200-F Area facilities to the sewage treatment plant.

PRINCIPAL COMPONENTS

The station consists of a reinforced concrete pit, approximately 15 ft. wide by 16 ft. long by 12 ft. deep, housing the mechanical equipment. A Class III stair enclosure over the pit gives access to the equipment. Electrical control panels also are installed here. The stair enclosure has a wood frame with cement asbestos siding and roof. The walls and roof of the enclosure are insulated, and ventilation is maintained by wood louvers installed in opposite corners on two sides of the structure. Lighting fixtures are incandescent. The building is not heated.

EQUIPMENT

The equipment consists of a standard air storage tank, sewage storage tanks, pumps, piping, valves and electrical controls, a sump pump, and explosion-proof switches and receptacles.

DEVELOPMENT OF DESIGN

The topography of the area required that a number of the buildings be located in such a manner that gravity flow of sewage was not economical. As a result, it was necessary to provide a lift station to move the sewage from these buildings to the treatment plant and disposal field.

DRAWING

W-155176 - Plan, Sections and Details

BUILDING #607-5F - COMMINUTOR

FUNCTION

This machine cuts coarse sewage into small, settleable solids to induce better digestion of sludge in the Sewage Treatment Plant, Building #607-1F. Its installation eliminated possible mechanical difficulty in the pumps of the sewage treatment system.

PRINCIPAL COMPONENTS

The comminutor is a motor-driven vertical revolving drum having horizontal slots which is capable of continuously and automatically cutting coarse material in the raw sewage to a consistency more readily handled by the pumps and auxiliary machinery. The apparatus is set in an open concrete pit located in the trunk line of the sanitary sewage system at a point just before the trunk line enters the sewage treatment plant.

DEVELOPMENT OF DESIGN

The installation of the comminutor was required to improve the operations of the sewage treatment plant. The necessary permanence of the mechanism was a major factor in its design.

DRAWINGS

W-161682 - Comminutor Building

W-156167 - Plot Plan and Miscellaneous Details

Map 3309 - Sheet 854, Outside Sewer Lines

BPF 120769

BUILDING #607-1A - SEWAGE TREATMENT PLANT

FUNCTION

This installation provides for the disposal of sewage from both the #300 and #700 Areas.

PRINCIPAL COMPONENTS

The treatment plant is composed of a sludge digestion tank, a primary sedimentation tank, a valve chamber and a stair enclosure covering the access to the pit floor.

The sludge digestion tank, 25 ft. deep and 20 ft. in inside diameter, has a gas dome surmounting the wood deck, floating cover. The primary sedimentation tank is 10 ft. wide by 30 ft. long, with a 9 ft. extension at one end to house a weir box and meter float well. The valve chamber between these two tanks is 16 ft. wide by 23 ft. long. All three of these principal components are constructed of reinforced concrete. The stair enclosure over part of the valve chamber is of Class III construction with corrugated asbestos siding and roofing.

West of the plant the sludge drying bed, approximately 30 ft. wide by 80 ft. long, has 8-in. reinforced concrete walls and is divided into four 20-ft. sections by intermediate plank partitions.

EQUIPMENT

Approximately 300 linear feet of 6-in. vitrified pipe laid at intervals in the sludge drying beds.

DRAWINGS

W-155289 - Ground Floor Plan and Sections

W-155290 - Plans, Sections and Details

W-155291 - Plans, Sections and Details

W-155292 - Plot Plan and Miscellaneous Details

BUILDING #607-2A - SEWAGE LIFT STATION

FUNCTION

This facility functions as a lift and booster for sewage from the Administration Area to the sewage treatment plant.

PRINCIPAL COMPONENTS

The reinforced concrete structure is approximately 15 ft. wide by 16 ft. long by 22 ft. deep, with the pump floor 14 ft. below finished grade. A Class III stair housing of structural steel and corrugated asbestos siding, located above ground, provides access to the mechanical equipment.

EQUIPMENT

The equipment consists of a standard air storage tank, sewage storage tanks, pumps, piping, valves, and electrical controls, a sump pump, explosion proof switches and receptacles and ventilating facilities.

DEVELOPMENT OF DESIGN

The topography of the area required that a number of the buildings be located without regard to the gravity flow of sewage. As a result, it was necessary to provide a lift station to move the sewage from these buildings to the treatment plant and disposal field.

DRAWING

W-155326 - Plans, Sections and Details

BUILDING #607-3A - COMMINUTOR

FUNCTION

This machine cuts coarse sewage into small, settleable solids to induce better digestion of sludge in the Sewage Treatment Plant, Building #607-1A. Its installation eliminated possible mechanical difficulty with pumps of the sewage treatment plant.

PRINCIPAL COMPONENTS

The comminutor is a motor-driven vertical revolving drum having horizontal slots which is capable of continuously and automatically cutting coarse material in the raw sewage to a consistency more readily handled by the pumps and auxiliary machinery. The apparatus is set in an open concrete pit located in the trunk line of the sanitary sewer system at a point just before the trunk line enters the sewage treatment plant.

DEVELOPMENT

The installation of the comminutor was required to improve the operations of the sewage treatment plant. The necessary permanence of the mechanism was a major factor in its design.

DRAWINGS

W-161682 - Comminutor Building

W-156167 - Plot Plan and Miscellaneous Details

Map - 3309, Sheet 854

BUILDING #625-G - GAGING STATION

FUNCTION

This facility, requested by AEC, provides the means for recording, for a period of years, the relationship between the natural flow of Lower Three Runs Creek and the effluent flow contributed by the plant.

PRINCIPAL COMPONENTS

Standard type gaging station equipment used by the United States Geological Survey (design supplied by U. S. G. S.) is installed in a concrete house and well on the bank of the creek.

BUILDING DETAILS

The house and well structure is of reinforced concrete with walls 6-in. thick. It rests on a concrete pad 6 ft. square. The house and well structure is 5 ft. square.

EQUIPMENT

Standard flow-gaging instruments and recorder.

DRAWINGS

W-162008 - Plans, Sections and Details, Sheet #1

W-162009 - Plans, Sections and Details, Sheet #2

BUILDING #643-G - BURYING GROUND

FUNCTION

This area, situated along the railroad and reached by a connecting road between the #200-F and H Areas, provides facilities for the disposal of contaminated solid waste from the entire plant.

PRINCIPAL COMPONENTS

The site is a cleared and fenced area 800 ft. wide by 3000 ft. long, graded and ditched for good surface drainage to Four Mile Creek. The north side of the area is parallel and immediately adjacent to a railroad line, and a spur from this track provides rail access into the burying ground. The road divides the area from east to west and 20-ft. gates control both road and rail traffic into the area. The 7 ft. high chain link fence encloses the area for safety rather than security reasons and is posted with signs reading "Radiation Danger Zone - Keep Out". Concrete markers set into the fence at 200 ft. intervals on the short sides and 500 ft. intervals on the long sides form a grid system used in maintaining records.

The skid-mounted, frame building provided by the construction forces serves as an office and working headquarters.

BUILDING DETAILS

The Class III building is set on skids and placed at the road entrance at the west end of the area. It may be moved to any other desired location. It is 10 ft. wide by 14 ft. long and approximately 8 ft. high on the front edge and 7 ft. high at the rear. The wood frame is covered with celo-siding.

A telephone is installed in the building, and there are single phase plug outlets inside and outside for portable instrument operation. An electric unit heater is provided for the building.

EQUIPMENT

Two cranes are supplied for materials handling, both being transferred to Operations from Construction. One is a 10-ton capacity, crawler type, self-propelled crane which handles the smaller and lightly contaminated waste items and digs the holes and trenches required for burying this waste.

The other is a 50-ton capacity, crawler type, self-propelled Maniwotoc #3900 Speedcrane equipped with an extra heavy 100 ft. beam. The heavier crane was rebuilt extensively by Construction to provide protection for the operator from the highly radioactive material being handled. The cab of the crane was replaced by one of steel plate 1-in. and 1-1/2-in. thick. The existing framework was removed and a new one fabricated strong enough to hold the steel plate shielding the top, sides, front panel and floor. An opening in the front panel contains a 24-in. by 24-in. lead glass window with protective qualities equal to the steel plate. The door was moved as far to the rear of the new crane cab as possible. Ventilation and circulation is maintained in the cab by a circulating fan, powered by a 24-volt generator in the crane.

DRAWING

Map 3302 - Sheets 824, 825 and 854

SITE WORK, GRADING AND LANDSCAPING

GENERAL

Construction of the widely dispersed Savannah River Plant necessarily led to several broad policies on earth moving for excavation, final grading for suitable surface drainage, and open area planting to maintain the desired grades and to prevent soil erosion.

Where practical all top soil at excavation sites was stock-piled for future use in finishing grading and all excavated earth was used as fill in grading nearby areas. For all final grading and planting, the Atomic Energy Division of the du Pont Explosives Department formulated, in June, 1952, the basic criteria for controlling the dust problem and obtaining an acceptable appearance with a minimum original investment and a minimum maintenance expense. In this plan the reservation was divided, for purposes of specification, into four categories - lawn, field, forest, and steep cuts or grades. Lawn treatment was limited to areas adjacent to the principal process, technical or administrative buildings where it was desirable to maintain a neat appearance and to curtail dust. In many of the production areas dust control became a very important consideration since it could form a serious hazard through product or process contamination. While this program had no serious contamination aspect in the various administrative areas, it nevertheless added much to improve working conditions and good housekeeping practices.

Plant areas disturbed by construction which were not to be seeded as lawns were graded and planted as fields to give a ground cover that could be kept in condition without excessive maintenance. On steep grades or in cuts and fills where roads or railroads had been constructed, the principal aim was to prevent erosion and maintain established grades. In this case extensive use was made of emulsified asphalt sprays to hold graded surfaces in place until a suitable ground cover was established.

The remaining undisturbed general areas of the reservation were planted, on a long-range basis, as forest. In cooperation with the Forest Service of the U. S. Department of Agriculture, the Savannah River Operations Office of the AEC arranged a program in which 10,000,000 seedlings were to be planted during the 1952-53 season and an equal number in each of the next two years. It was estimated that 90,000 acres would be included eventually in the forestry program. In about 12 years from the time of the initial planting and through carefully controlled cutting, this would yield to the U. S. Government an estimated annual income of about $1,500,000. Aside from its monetary value, the reforestation of the plant would utilize otherwise idle land, would control erosion, would help to control weak and scrub growth, and would provide a protective screening.

In its broadest aspects the site work included the removal of old and unused structures on the property, and the control of dust and erosion. Several structures, however, were preserved by general agreement because of their historic interest. This included the Bush House, the Ashley

House at Ellenton, the family home on the Ashley plantation, the Dunbarton School building, and the Old Stagecoach Inn. These were kept in repair by du Pont Construction until accepted for maintenance by Operations.

DESIGN OF PILOT PLANT FACILITIES

GENERAL

With the primary concept of the Savannah River Plant, it was recognized that several mechanical and chemical problems as well as certain other process information would require development and confirmation through the medium of pilot plant or semi-works operation before firm design could be established. It was felt necessary to test certain equipment and operating variables for the #200 Areas, and the entire design of the water cooling for the #100 Areas required substantiating from the point of view of corrosion, erosion, and heat exchanger capacity.

It would have been possible to erect facilities for such testing at any one of the existing AEC installations, but it was decided that such equipment as necessary could be installed within the required time at the Savannah River Plant. At this site, also, the facilities could be used to better advantage not only for the accomplishment of the various tests and experimental runs, but also for the purpose of training future operating personnel.

Therefore, two buildings were designed and erected near the Savannah River where water and utilities could be made available immediately. Building #678-G, or TNX, was designed to test the mechanical and chemical equipment for the #200 Areas, and Building #679-G, or CMX, was equipped with facilities for water treatment, hydraulic testing, and health physics experiments.

DESCRIPTION OF PILOT PLANT FACILITIES

BUILDING #678-G - PILOT PLANT

FUNCTION

This building provides facilities to test equipment and study operating variables for the #200 Area.

Its primary function was to develop an efficient liquid - liquid extraction process through experimental non-nuclear test runs of equipment. The secondary function consists of furthering the development of the separations process by mechanical research with a centrifuge, decanter, jets, vessel agitators and gang-valves.

In addition, other prototypes with auxiliaries have been added to the Pilot Plant for experimental purposes. These include an enriched uranium fuel (LM) type dissolver and ion-exchange facility for the "25" separations process and a thermal diffusion column for the tritium purification process.

PRINCIPAL COMPONENTS

Administrative

This section is composed of two offices, locker, shower and toilet rooms, a janitor's change room, and an air compressor room.

First Floor Process Area

This area consists of one large room housing most of the process equipment. A small lean-to, used for the storage of dry chemicals, is connected to this at one side.

Second Floor Balcony

A concrete-floored balcony, located above the administrative area, provides space for an electrical control room, two laboratory rooms, and an instrument area. A checkered plate platform, level with this balcony and extending over part of the first floor process area, supports some additional equipment and gives access to the top of first floor equipment which extends through and above the platform level.

LM Dissolver Building

This four-story open steel structure is located to the west of Building #678-G. It contains the LM dissolver, its digester, tanks, and a thermal diffusion column with auxiliaries.

Outside Facilities

Facilities outside Building #678-G include a neutralizing pit and pump, LM ion exchange tanks mounted on a 10 ft. by 26 ft. reinforced concrete slab, LM waste retention basin, and organic waste ejector.

BUILDING FLOOR SPACE

Administrative

	Approx. Sq. Ft.
Offices (2)	435
Corridors	155
Locker, toilet and shower area	640
Janitor's rooms	90
First Floor Process Area	
Process room	4780
Lean-to	320
Second Floor Balcony	
Laboratories (2)	580
Electrical control room	270
Instrument area and aisles	650
Steel platform	1140
LM Dissolver Building	900

BUILDING DETAILS

Class - III.

Size - Approximately square, 80 ft. by 80 ft.-6-1/2 in. by 37 ft. from top of finished floor to top of peaked roof, the building is essentially of one story construction except for the balcony and equipment platform over part of the ground floor. This so-called second floor is 15 ft. above the ground floor with the roof eaves 9 ft. above this level. The lean-to for chemical storage is 16 ft. by 20 ft. by 11 ft.-3 in. high to lower edge of sloped roof.

The LM dissolving facilities as well as the thermal diffusion column are mounted on a 39 ft. by 30 ft. reinforced concrete slab and are housed in a 12 ft. by 14 ft. by 38 ft. high open structure.

Total Area - 8160 sq. ft.

Total Volume - 204,020 cu. ft.

CONSTRUCTION DETAILS

Foundations

Reinforced concrete with spread footings.

Superstructure

Prefabricated structural steel frame and trussed roof with corrugated galvanized metal siding and roofing.

The administrative area has concrete block partitions, with concrete block also used for walls to separate the laboratories from the remainder of the second floor balcony. The walls of the laboratories are covered with masonite and a masonite partition also separates the two rooms.

A 3 in. thick concrete plank ceiling is used over the laboratories, but elsewhere in the building the roof structure is exposed.

Windows are commercial projected steel sash. Doors are either 10 ft. by 12 ft. double sliding or 3 ft. by 7 ft. steel, some with glass panels, and some with louvers.

There is no insulation in the building. Floors are of concrete except for that part of the balcony which is checkered steel plate.

Heating and Ventilation

There are four exhaust ventilators on the roof of the Pilot Plant and the laboratories also have hood exhaust stacks. The electrical control room is vented through a room exhaust fan, and a tempered air unit is provided on the balcony near the laboratories.

Lighting

All lighting in the process area is vapor-tight and all other electrical installations are explosion-proof.

Both fluorescent and incandescent lighting fixtures are used.

LM Dissolver Building

This facility is an open steel structure with steel roof mounted on a reinforced slab. Safety ladders are provided within the structure.

Neutralizing Pit

Of reinforced concrete construction, 11 ft.-4 in. by 14 ft. by 5 ft.-10 in. deep, this pit is divided into two sections by a concrete wall and covered with 2 in. thick planking.

LM Retention Basin

This 125 ft. by 75 ft. earth dyke is provided with a primary limestone base and is situated southwest of Building #678-G.

EQUIPMENT

Administrative Area

Conventional office furniture.

1 Refrigerator.

1 Water heater, 2'-6" x 6'-0".

42 Steel lockers.

1 Instrument air compressor, 50 c.f.m., (with drive).

1 Instrument air dryer, 50 c.f.m.

Process Area

3 Mixer-Settlers, stainless steel.

1 Solvent weigh tank, 27" x 5'.

1 Organic feed tank, 3800 gal.

1 Aqueous feed tank, 2600 gal.

1 Distilled water tank, 10' x 11'.

1 Condensate hold tank, 10' x 11'.

1 Nitric acid weigh tank, 27" x 5'.

2 1AF feed tanks, 659 gal.

1 Aqueous catch tank, 2100 gal.

1 Evaporator hold tank, 2100 gal.

1 Organic feed and catch tank #2, 3800 gal.

1 Recycle acid tank, 170 gal.

1 Organic waste tank, 6' x 8'.

1 CU hold tank, 3500 gal.

1 Organic surge tank, 4' x 5'.

1 Aqueous surge tank, 4' x 5'.

5 Standard stock agitators.

1 Evaporator column, stainless steel, eight tray.

1 Evaporator, stainless steel, 6' x 5'.

1 Centrifuge, 40" x 24".

1 Decanter, 1-1/2' x 1-1/2' x 7'.

3 Standard types of rate jets.

5	Standard types of transfer jets.
1	Evaporator bottom pump, 10 g.p.m.
10	Duriron feed pumps, 10 g.p.m.
3	Duriron transfer pumps, 50 g.p.m.
1	Duriron recycle pump, 50 g.p.m.
1	Duriron spare rate pump, 10 g.p.m.
2	Duriron sump pumps, 20 g.p.m.
1	Agitator mock-up.
1	Gang valve mock-up.
1	Monorail and hoist, 1/2-ton.
2	Platform mounted floor type scales.
1	Bench scale.
12	Panel boards.
1	Radiation instrument.

<u>LM Pilot Plant</u>

Step #1 - Dissolving (West of Building #678-G)

1	"D" Column, 9" I.D. x 21'-6" high, S.S., (with spanner wrench)
1	Digester, 8' x 8', S.S.
2	Condensers, S.S.
1	Ejector, S.S., 200 c.f.m.
1	Jet ejector separator, S.S.
1	"D" Column feed tank, 6' x 6', S.S.
1	"D" Column catch tank, 6' x 6', S.S.

Both tanks are provided with heating coils, shaft, impeller, and slinger, 3 hp. motoreducer, and anti-spark sleeve.

1 Acid storage tank, 8' x 8', S.S.

1 Centrifugal acid transfer pump, S.S., 5 g.p.m. (30' head) with 1 hp. motor.

1 Vertical catch tank pump, S.S., 25 g.p.m. (75' head) with 3 hp. motor.

1 Air hoist, 40' lift, 250 lb. capacity.

1 Waste retention basin, 125' x 75'.

1 Transformer, 10 kv.-a., 480/120-208 volt, 3-phase dry type.

1 Twelve-circuit oil immersed light panel.

Step #4 - Ion Exhange

Process Area Facilities

1 Resin column, S.S., 7" I.D. x 2'-7-1/2" high.

1 Eluate feed tank, 12" x 13", S.S., 6 gal. capacity, with 400 w., 12" x 12" hot plate - and 100 lb. scale.

1 Eluate displacement tank, 12" x 13", S.S., 6 gal. capacity with 100 lbs. dial scale.

1 Product catch tank, 12" x 13", S.S., 6 gal. capacity.

1 Regeneration feed tank, 14" x 16", S.S., 10 gal. capacity, with 400 w., 12" x 12" hot plate and 100 lb. dial scale.

1 Centrifugal eluate feed pump, S.S., 2 g.p.m. (33' head) with 1/8 hp. motor.

1 Bench, 30" x 30" x 9'-6", carbon steel.

Exterior Facilities (East of Building #678-G)

1 Decontaminated feed tank 3' x 3' with heating coil, mixer, shaft, impeller, and 1-1/2 hp. motor.

1 Decontaminant waste tank, 3' x 3'.

1 Displaced feed waste tank, 4' x 6'.

1 Product feed tank 4'-6" x 6', with heating coil, mixer, shaft, and impeller, and 1-1/2 hp. motor.

1 Centrifugal product feed pump, S.S., 5 g.p.m. (50' head) with 3 hp. motor.

1 Centrifugal decontaminated feed pump, S.S., 2 g.p.m., (33' head) with 1/8 hp. motor.

1 Centrifugal waste tank pump, S.S., 10 g.p.m., (35' head) with 3 hp. motor.

Isotope Purification Testing Facilities (West of Building #678-G)

1 Thermal diffusion column, 14" I.D. x 36' high, stainless steel with support and electrode.

1 D.C. power supply system.

1 A.C. - D.C. conversion unit housed in a 10' x 10' steel frame structure located approximately 30' from Building #678-G.

1 Sub-station, 300 kv.-a., consisting of three 100 kv.-a. transformers, one 480/120 v. potentiometer transformer, and auxiliary equipment.

Laboratories

Laboratory furniture and equipment.

Neutralizing Pit and Raw Water Supply

1 Raw water supply tank, wood, 4000 gal.

1 Water pump, 220 g.p.m. (with drive).

1 Pit pump (with drive).

INSTRUMENTATION

Instrumentation in Building #678-G was installed primarily to test and aid in the development of the mixer-settler, the evaporation equipment, and other test runs. However, additional instrumentation was provided for the

evaluation of specific problems which possibly would be applicable to the remote type of operation in Building #221. The instrumentation related to the Purex process may be classified as operational, evaluational and general. In addition, experimental testing with LM equipment and the CO vessel also required the installation of other types of instrumentation.

Operational

Except for the temperature indication and recording instruments, the instruments used in pilot plant operations are activated pneumatically. Flow control of feeds is accomplished by means of orifices, differential pressure transmitters, recorder controllers and diaphragm control valves. Level recording systems used on the tanks and the evaporator consist of dip tubes, differential pressure transmitters and recorders. Evaporator instrumentation includes specific gravity record, steam flow control, and boil-up recording devices. Specific gravity recording is accomplished by dip tubes, differential pressure transmitters and recorders. Steam flow control is maintained by means of an orifice, a differential pressure transmitter and a recorder controller control valve. Boil-up records are outlined by a differential pressure transmitter across the evaporator column and by a recorder.

The mixer-settler interface level control system entails differential pressure control between the outlet weir box (aqueous end) and static pressure in the unit itself. The M-S units are provided with differential pressure transmitters, dip tubes, recorder controllers, control valves and bleed orifices. The control valves provide a means of admitting and exhausting air to maintain this differential pressure. Temperature indication of feed, run and storage tanks are recorded by simple bi-metallic local indicators, while temperature records in the evaporator are forecast by an electric resistance thermometer recorder controller.

Evaluational

Mixer-settler feeds are evaluated by control of the steam jet syphons which transfer the process liquids at a constant rate. Jet evaluation and control is assured by the use of an orifice and stand pipe for metering liquid flow by orifice differential in the mixer-settler "feed hat". This system resets the steam pressure on the feed jet.

Mixer-settler interface level is determined by a multi-electrical probing device connected to an electronic

resistance bridge-type recorder. However, this device is affected adversely by changes in the specific gravity of the solutions. The deficiency has brought the re-evaluation of the electrode and the development of two other devices to assure absolute interface measurement. These consist of a differential resistance thermometer connected to an electronic resistance bridge recorder and a dip tube specific gravity instrument for SPG of upper and lower phase solutions.

General

Steam jets were evaluated in Building #678-G to determine their fabrication according to specifications. Close adherence to flow versus steam pressure was required to assure proper instrument performance.

Skimmer controls of the centrifuge were evaluated in the pilot plant to assure proper functioning in the Canyon Building.

In general, all instrumentation is standard mill type equipment except the multi-electrical probing device used to sense the aqueous-organic interface. Development of interface instrumentation was achieved through research by KAPL.

LM Pilot Plant

Instrumentation of the LM Pilot Plant was made as simple as permitted by the requirements for test data, stability of operation, and protection of equipment and personnel from the hazards of operational mistakes. The majority of the instruments were of the simple, locally mounted type. No instrument panels were provided. Pneumatic and electrical devices were applied only where necessary for control of the process, for protective interlocks, and to bring measurements to safely accessible points for observation.

Isotopic Purification Testing Facilities

The instrumentation provided on the experimental thermal diffusion column was held to a minimum. For instance, top electrode temperature is recorded as is the wire current through a 50 mv. shunt. In addition, local dial thermometers and a low flow switch, which alarms in the electrical control room, have been installed on the cooling water lines. Provision has also been made for mass spectrometer testing of samples from the bottom, middle, and top of the column.

PROCESS

The process in Building #678-G consists primarily of experimental test runs with a prototype mixer-settler and an evaporator to develop an efficient liquid-liquid extraction system and further to develop the separations process by additional testing with a centrifuge, decanter, steam jet syphons, vessel agitators and gang valves. In 1954, LM and isotopic purification testing facilities were added to Building #678-G.

Mixer-Settlers

The extraction process is tested with natural uranium in two multi-stage mixer-settlers which simulate the conditions under which Banks 1A, 1B, and 1C are operated in the Canyon Building. One unit serves the dual purpose of simulating process Banks 1A and 1B while the other is a prototype of Bank 1C. In addition, another 1C mixer-settler has been installed for mechanical endurance testing only.

Test runs through the mixer-settlers include 1A, 1B, organic waste, and 1C.

The 1A test run is identical to the process in Bldg. #221 except that plutonium fission products, ferrous sulfamate, and sodium nitrate are not present. This run transfers uranium in the acidified aqueous feed stream into the organic phase. The aqueous feed stream passes into Bank 1A where it is mixed with controlled amounts of an organic extractant, tributyl phosphate in kerosene, and an equal volume of aqueous scrub consisting of dilute nitric acid. After mixing, the organic phase rises to the top and the aqueous settles to the bottom. Differences in the specific gravities, and mutual insolubility, of the organic and aqueous liquids effect the actual phase separation. After separation, the organic and aqueous phases are pumped out of fixed weirs on either side of the bank by the impeller in the next stage.

The non-uranium aqueous stream is collected in the aqueous catch tank and later transferred to the evaporator hold tank while the uranium bearing solvent is collected in the organic feed and catch tank #2 until fed to Test Bank 1B.

The 1B test run simulates a part of the first cycle extraction in Building #221 which separates plutonium and uranium. Since plutonium and ferrous sulfamate are not used in the Pilot Plant, there is no transfer of material.

In this run the uranium remains in the organic solvent after it is contacted with dilute nitric acid which acts as an aqueous extractant and the TBP solution which serves as an organic scrub. Once again the aqueous product is transferred back to the aqueous catch tank and eventually sent to the evaporator hold tank. The uranium bearing solvent, in both 1A and 1B runs, is diverted to the organic waste tank to insure that the uranium concentration reaches equilibrium before it is returned to the organic feed and catch tank.

The organic waste and 1C runs are identical, both transferring uranium from the organic phase to the aqueous phase. The runs are done in two steps to allow the use of a smaller aqueous feed tank and aqueous catch tank.

These runs begin when the organic phase from the organic waste tank is combined in the mixer-settler with a batch of water from the condensate hold tank and aqueous wastes from the aqueous waste tank. After separation, the uranium-bearing aqueous phase and the organic phase pass to the aqueous catch tank and cold organic feed and catch tank, respectively.

These runs complete one normal cycle for the mixer-settlers as the solvent in the cold organic feed and catch tank is returned for reuse in the test while the aqueous phase passes to the 1CU hold tank.

In addition to test runs with natural uranium, facilities are provided for mechanical duration test runs in an additional three-stage, full-scale 1C mixer-settler with control amounts of tributyl phosphate in kerosene and water which simulate the organic feed and aqueous extractant, respectively.

1CU Evaporator and Column

This evaporator concentrates the aqueous streams collected in the aqueous catch tank or those diverted to the evaporator hold tank or 1CU hold tank in order to recover uranium, water, and nitric acid for recycle through the mixer-settler test runs or the centrifuge and decanter.

The aqueous streams from the various runs first are fed batchwise into the evaporator. When boiling begins, the feed is made continuous. The overhead vapors are condensed, some of the condensate being returned for reflux while the remainder is sent to the condensate hold tank until eventually reused in the process. Bottoms are drawn off at the end of the operation and transferred for recycle through the

process. The column serves as a rectifying column when concentrating nitric acid in the bottoms while maintaining 99.9% water in the overhead product. Using a small reflux, the column also serves as an entrainment separator during other evaporations.

Centrifuge

Testing of the centrifuge aided in assuring satisfactory operation of this unit in the head end process of Building #221-F&H. The testing program demonstrated the feasibility of removing head-end cake with sprays, of establishing feed rates, skimmer settings, and time cycles, and provided also a means for studying uranium losses, washing operations and bowl design.

Decanter

The decanter is the most important part of the solvent recovery mock-up installed in the Pilot Plant to retrieve tributyl phosphate and kerosene on a full-plant scale. Installation of this key vessel enabled those concerned to check general operations by controlling separation of the heavy aqueous solution from the light organic solution in order to establish settling time and flow rates.

The tests on this unit established the suitability of the remaining decanters on order for the proposed process.

Jets

Two types of steam jets are tested in the Pilot Plant, constant rate jets and transfer jets. Constant rate jets are installed in the lines feeding the mixer-settler and decanter in order to propel the liquids through expansion loops and achieve actual production plant results. All rate jets and approximately 10 per cent of the transfer jets are installed in jet stands and operate on solutions handled in Building #678-G.

Vessel Agitators

This installation reproduced the degree of agitation and the speeds necessary in the canyon vessels and provided a portion of the solvent recovery operation.

Gang Valves

Tests with the gang valve mock-up established the required steam pressure necessary to make the jets operable and minimized the possibility of sucking active solutions back into the gang valves.

LM Pilot Plant

Small scale LM dissolving and ion exchange facilities were added to Building #678-G to develop full scale, remotely operated equipment needed to recover enriched uranium on a production plant basis. Operation of these prototypes on an experimental basis provided the data needed to design full scale LM processing components.

Isotopic Purification Testing Facilities

The thermal diffusion column at Building #678-G was installed to improve the mechanical design of similar equipment used for isotopic purification in Building #232-F.

DEVELOPMENT OF DESIGN

Building

Savannah's pilot plant was erected to develop a full scale mixer-settler from experimental units developed by KAPL for its SPRU installations. Inasmuch as there was no previous plant experience with mixer-settlers, Building #678-G was designed without a backlog of previous knowledge.

The problems faced in the design of the experimental plant at Savannah included (1) locating the building without interfering with other SRP installations, (2) developing the building design to meet the space requirements, and (3) emphasis on speed of construction.

The location of the pilot plant in the #600 Area, adjacent to the CMX Building, was established in a preliminary scope of work issued March 16, 1951. This area was selected because here the test program could be carried out without interfering with vital construction work in other areas and because required services could be obtained.

Once the site was selected, a building had to be designed to house full-scale models of the KAPL prototypes. Original design provided the layout of a 40 ft. wide by 80 ft. long building with all tanks located outside. This

idea was discarded in favor of two 40 ft. by 80 ft. structures, one housing offices and laboratories and the other housing all tanks. Finally, it was decided to place all facilities under a common roof in the present 80 ft. square prefabricated metal building because it was available for immediate erection and would facilitate expansion.

Originally the major exception to this design was the exterior heater building. Early in 1953, the 1CU evaporator was, for safety reasons, relocated outside the building behind a three sided concrete barricade. Then, in the middle of 1954, the heater building was dismantled by Operations to make room for additional exterior test facilities. A four-story, open steel structure on a reinforced concrete slab was added west of the building to contain the LM dissolving facilities and a thermal diffusion column, space being provided for its power facilities. An LM waste retention basin is southwest of the Pilot Plant, while between the east building wall and the 1CU evaporator barricade, a reinforced concrete slab has been provided for LM ion exchange tankage which serves the resin columns inside Building #678-G. Because of the height of the columns involved, and the limited space within the building, these facilities were placed outside of the Pilot Plant.

Acceleration of construction was an important factor because equipment testing was needed prior to installation in the Building #221-F&H extraction process. This process, the mainstay of the Purex process, had to be proven to guarantee the primary function of the #200 Area.

Safety problems faced in the design of Building #678-G consisted of the removal of natural uranium process dusts, liquid waste disposal, and personnel protection against the handling of hydrocarbons and nitric acid.

Dust removal was accomplished by means of a vent system in the process area, while the liquid waste problem was solved through the use of sewers draining into a sump. Wastes entering this sump are monitored and, if the uranium content is high, the liquids pass to a process evaporator for further decontamination. Personnel protection against process hazards is assured by the use of special protective clothing.

In the original building design it was believed that no shielding or remote maintenance problems had to be considered because the exclusion of fission products from the pilot plant operation classified this building as a "cold" area. However, an explosion of the 1CU evaporator on January 12, 1953, brought about a relocation of the replacement

evaporator and the consequent construction of a three-sided explosion-proof barricade on the outside of the building to shield it.

Equipment

Mixer-Settlers

The key experimental process includes three individual motor-driven mixer-settlers principally fabricated from 3/16-inch stainless steel plate. Each mixer-settler, a rectangular-shaped box mounted on an "I" beam platform, is a multi-stage contactor. The prototype chosen for the 1A and 1B combined test run has 14 stages. The two 1C Banks have three stages.

The extraction process performed by the mixer-settlers originated from KAPL studies made for their SPRU installations. This information and the flow sheets were interpreted by du Pont's Engineering Research Laboratory so that separation by extraction could be accomplished in full scale mixer-settlers at Savannah.

Design problems solved by the "M-S" units paved the way for a proven operational extraction process in the Canyon Building.

Key problems, such as equipment standardization, fabrication metals, individual vs. gang drive motors, stationary vs. movable weirs, and equipment surfaces were overcome by development of the pilot plant mixer-settlers.

Pilot plant banks served as a basis of design by gathering information on the extraction process. Operational studies, supplemented by factual data from KAPL, assured the standardization of the mixer-settler stages as prescribed for the Canyon Building.

Solutions used in the experimental plant demonstrated that all process equipment should be fabricated from stainless steel because of its non-corrosive characteristics.

The problem of individual vs. gang drive motors was solved by using an individual motor with each mixer-settler so that mechanical failure of the gang drive motor would not mean complete stoppage of the extraction process.

The original design called for mechanical movable weirs on each mixer-settler as the means of controlling interface. This idea gave way to the present stationary weir in order to eliminate the employment of moving parts which, under remote conditions, would present an operating difficulty and hazard.

All stainless steel surfaces within the mixer-settlers were sand blasted with clean silica sand to remove all scale from the welds. The inside surfaces then were swabbed with a nitric acid solution and flushed out with water. This procedure was developed as a result of test runs which showed a tendency for the solutions to collect in rough spots or corners.

Tanks

The mixer-settler test runs require the use of a series of stainless steel tanks. These include the solvent weigh tank, organic feed tank, aqueous feed tank, distilled water tank, condensate hold tank, nitric acid weigh tank, 1AF feed tanks #1 and #2, aqueous catch tank, evaporator hold tank, organic feed and catch tank #2, recycle acid tank, organic waste tank, 1CU hold tank, raw water supply tank, organic surge tank, and the aqueous surge tank.

All of the tanks were designed on the basis of process requirements, economy, and availability of adequate materials. The mixer-settler tanks were constructed of Type 347 stainless steel. The thin gage metal available at the time of fabrication created many problems and, in many ways, dictated design. All tanks were provided with lugs for electrical grounding, while flat bottom vessels were mounted on concrete pads. Agitators on tanks are of a standard, commerical type.

1CU Evaporator

The evaporator is a stainless steel 1400 gallon vessel with 3 ft. pot welded to the bottom head. Inside the evaporator are eight helical coils with a draft tube and a spray is inserted for decontamination and wash down.

A connection in the top head of the evaporator serves to seat an eight-tray bubble cap column which contains a draft tube and four pipe coils.

Oak Ridge National Laboratory provided the general principals which guided the design of the evaporator. The basis of design stressed simplicity in conjunction with the space required for the fixed heating coils.

Following the evaporator explosion of January 12, 1953, a duplicate evaporator was procured and installed outside the building. Investigations into the cause of the explosion determined its origin as the spontaneous oxidation of the solvent (tributyl phosphate) by nitrogen dioxide in

the vapor phase. Considerable thought was given to this situation and a revised operating procedure, as well as the elimination, addition and rearrangement of equipment, was determined to be desirable for the installation of similar equipment in Building #221-F (See Volume III for a discussion of Building #221-F Equipment).

Centrifuge

This basket type machine is identical to the two centrifuges in the head end treatment in Building #221-F&H except that standard type connectors and manual controls are used in place of remote type connectors and hydraulic operation. The pilot plant centrifuge, a reconditioned unit from ORNL, is a duplicate of the Bird Machine Company's design used at Hanford except for the installation of a d.c. braking type system which prevents the reverse action of the machine.

Decanter

This vessel, rectangular in shape, is constructed of 1/4-inch stainless steel plate. It is identical to those in Building #221-F&H except that standard connections are used in the pilot plant.

Design of the decanter was made possible through the work of du Pont and Blaw-Knox engineers who were supplied with factual data by KAPL and ORNL. Testing in the pilot plant produced the submergence of the decanter liquid inlets and the measurement of temperature to regulate the steam at the gang valve in the event the temperature became excessive. This change brought the lines in at a different point and modified the internal baffling.

Jets

The steam jets tested in the pilot plant consist of transfer jets and constant rate jets. The transfer jets are used for intermittent bulk transfer of liquid while the rate jets provide a constant feed stream to the mixer-settlers at a controlled rate. Jet transfer is used at Savannah because it proved most feasible for remote operation. The jets are simple in construction, reliable in operation, contain no rapidly rotating parts, require little maintenance and are easy to install.

The two types of jets are similar except that all transfer jets are run at the same steam pressure while the

rate jet feeds are controlled by a liquid level instrument in a receiver stand pipe which in turn sets the control point of the steam pressure. In addition, provision has been made to control the solution temperature of the rate jets below an established flash point and to eliminate lag in the rack piping between the rate jets and the "M-S" units by use of "dams".

The transfer jets were based on Hanford design while the rate jets were developed for the Savannah River Plant. The initial Blaw-Knox specifications indicated the need for 25 different jet sizes. After a review by du Pont and Blaw-Knox engineers, it was agreed for various reasons (standardization, economy, interchangeability, etc.) to reduce the number of jet sizes to a minimum. In the case of the 11 sizes of constant rate jets, standardization could be accomplished if the lower rate shown for each of these jets could be eliminated and the jets operated at the maximum. It was also established that the number of transfer jet sizes could be reduced from 14 if the maximum steam dilution were increased to three per cent.

Initial development work on transfer jets was done by the Schutte-Koerting Company, while rate jets were developed through the joint efforts of S-K and the Penberthy Injector Company. At first a satisfactory prototype could not be produced in any of the required sizes. Problems were created by many specification changes, including the wide range over which jets had to operate, and by the unavailability of test data on fluids other than water. The water tests by du Pont's Engineering Research Laboratory finally were abandoned but the jet development program was expanded by providing test facilities at the pilot plant. In addition, a Jet Committee of du Pont specialists was set up to meet weekly to discuss and formulate a design from test results. Final results permitted the consolidation of transfer jets and rate jets into standard types.

Vessel Agitators

Each agitator consists of an impeller, shaft, and variable speed drive identical to those used for mixing in the canyon vessels of Building #221-F&H.

The agitator layout in the pilot plant was modeled after Hanford design.

Gang Valves

The gang valve mock-up consists of a series of gang valves served by a control globe valve and a strainer. A gang valve consists of four Crane globe valves connected to a manifold with the valves being opened and closed by means of cams.

The gang valves were modeled after Hanford design and modified for Savannah through disc tests by ERL.

LM Pilot Plant

The LM (enriched uranium fuel) program was instituted on an experimental basis at the Savannah River Plant when it seemed apparent in February, 1954, that irradiated enriched fuel would have to be processed to meet a possible request by the AEC for an increase in tritium production.

Prototypes of the LM dissolver and ion exchange facilities were added to Building #678-G to develop these specific steps of a unit operation whereby enriched uranium could be recovered and purified on a production basis.

Step #1 was installed to investigate the continuous-trickle type dissolver when difficulty at other AEC installations was encountered in applying conventional acid batch dissolution to the U-Al slugs.

Step #4, ion exchange, is similar to that of the plutonium recovery operation in #221 Building, but was installed for study of its variables in concentration of enriched uranium solutions.

Experimental equipment as well as tests of the LM facilities were minimized when de-emphasis on tritium production was ordered by AEC in the middle of 1954.

Isotopic Purification Testing Facilities

The isotopic purification testing facilities at Building #678-G were originally to be installed to perfect the design of a modified "F" type thermal diffusion in Building #232-H. When the latter building was placed on a standby basis, the CO vessel was erected for mechanical testing to improve the standard type column in Building #232-F.

Initially, Building #776-A was also considered as a site for this experimental facility. However, Building #678-G was selected because of its suitability for the column and its auxiliary power equipment.

Safety Considerations

Safety in Building #678-G was not a major problem. Radiation shielding was not required because natural uranium was used as a basis of the test runs. Small amounts of uranium bearing dusts are vented to the atmosphere from all tanks and mixer-settlers by four fan-type roof ventilators which discharge outside the building. Safety precautions for handling hydrocarbons and nitric acid include a monorail for drum handling and a drum truck for transporting drums from the storage area to the process area. Chemicals used in the test runs are then pumped to their respective areas. Personnel working in Building #678-G are protected from process hazards by wearing specially designed overalls and shoes.

DRAWINGS

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LM Pilot Plant

W-161686 - Floor Plans - Steel Framing

W-161726 - Floor and Roof Framing - Steel

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W-161688 - Floor and Roof Plan

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W-161614 - P. and I. Diagram - Step #4

Isotopic Purification Testing Facilities

W-161539 - "CO" Vessel Arrangement

W-161595 - "CO" Vessel Column Assembly

W-161617 - "CO" Vessel Support - Steel

W-144326 - 300 kv.-a. 13.8 kv.-a./480 Volt Substation - #678-G

BUILDING #679-G - CMX

FUNCTION

This building houses the equipment and facilities for treating river water and conducting continuous tests on types of equipment considered or adopted for plant use.

PRINCIPAL COMPONENTS

Water Treatment

The 1600 g.p.m. water treatment plant and 800 g.p.m. filtration facilities are located adjacent to the building.

Water Laboratory

This section of the building houses the heat exchangers, converter, heater, pumps and instrumentation required to pass process water through the tube side of the exchangers and the quatrefoils in the converter assembly and river water through the shell side of the exchangers.

A water analysis laboratory contains facilities for analyzing river water at various stages in the treating plant and for analyzing the effluent from the shell side of the heat exchangers. General office space and a storage room are included.

Health Physics

These facilities include a sample preparation room, a counting room, dark room, instrument repair room, offices, and rooms for evaluating and testing electronic and mechanical instruments.

Building Service and Miscellaneous

A package-type 15,000 lbs./hr. steam generator is installed and two small utility rooms house service equipment for heating and ventilating. Change room facilities for 35 men and 10 women are provided. Solvents are stored in small buildings adjacent to the main structure.

BUILDING FLOOR SPACE

Water Laboratory	Approx. Sq. Ft.
Pilot Room	4732
Water Laboratory	600
Water Laboratory Storage	240
CMX Office	1276
Health Physics	
Sample Preparation Laboratory	535
Counting Room	335
Instrument Repair Room	169
Dark Room	121
Instrument Storage Room	210
Electronic Instrument Room	326
Mechanical Instrument Room	428
H.P. Group Offices	326
Building Services and Miscellaneous	
Change Rooms and Toilets	795

Utility Rooms	322
Corridor	976
Outside Storage Sheds, Pits, etc.	1737

BUILDING DETAILS

This is a single-story, ell-shaped, Class III building. One leg of the ell is 155 feet 2 inches by 49 feet 10 inches and the other is 69 feet 4 inches by 51 feet 2 inches. The 11-foot high building is surmounted by a tower 3½ feet square and 20 feet 10 inches high. This tower is capped by a trolley tower 21 feet high, 6 feet wide at the base, 8 inches wide at the top and 17 feet 6 inches long. The building's area is 13,240 square feet, its volume, 206,660 cubic feet.

CONSTRUCTION DETAILS

The wood frame structure is supported on a reinforced concrete foundation with spread footings. Only the support structure for the tower is of steel. Exterior walls are 2 in. by 4 in. studs on a 4-in. by 4-in. shoe. Exterior siding is corrugated asbestos and interior partitions are 3/8 in. gypsum boards. The toilet room walls are of concrete block to a height of 4 feet in some locations and cement asbestos in other locations and in the locker rooms. Exposed construction is used in the pilot room, utility rooms, storage room No. 3, the pump pit, chlorinator room and alcohol storage. All other rooms have 3/8 in. gypsum board. All doors are of wood, the windows have steel, double hung sash and insulating glass. The roofing is built-up. The roof and exterior walls are insulated except in the pilot room, utility room, storage room No. 3, pump pit, chlorinator room and alcohol storage. Insulation is also installed in the interior partitions of the counting rooms, health instrument repair shop and storage room No. 2. The floors are concrete. Rubber tile floor covering is installed in the dark room. In the health instrument repair shop, counting room, storage room No. 2, corridor and sample preparation rooms the floor is liquid dust proofed. The floors are cement topped in the locker rooms, toilets and janitor's closet.

Fin-tube radiators are used for heating in all areas except the pilot room where unit heaters are installed. Steam is supplied from the steam generator adjacent to the building. The counting rooms, health instrument repair shop and dark room are air conditioned. Ventilating air

is exhausted by fans through ducts except in the pilot room and in the air conditioned rooms by fans through each fume and range hood. Supply is by fans through filters, heaters and ducts. Incandescent lighting is used except in the water laboratory offices and the health physics laboratory where fluorescent lighting is used.

EQUIPMENT

Water Treatment

Mechanical type treatment plant including chemical feed equipment, flash mix chamber and two precipitator units with a total capacity of 1600 g.p.m.

Two gravity filter units with a total capacity of 800 g.p.m.

Filtered water clearwell which can also be used as a settling chamber.

Chlorination facilities for domestic water purposes.

Water Laboratory

Pumping facilities for process and domestic water.

Heat exchangers.

Chemical feeders.

Process water heater.

Converter assembly.

Laboratory benches.

Instruments.

Office furniture.

Health Physics

Fume hoods.

Laboratory benches.

Furnaces.

Centrifuge table.

Vibration test machine.

Instruments.

Humidity chamber.

Office furniture.

Building Services and Miscellaneous

15,000 lbs./hr., 250 p.s.i.g. operating, oil fired package type steam generator.

Hot water generator.

Conventional change room and locker equipment.

1	7-1/2 Ton air compressor and air conditioning unit.
2	Supply fans, 1800 c.f.m. each, 3/4 hp. for hood supply.
1	Supply fan, 7420 c.f.m., 3 hp. general supply.
1	Exhaust fan, 2470 c.f.m., 1/3 hp. range hood.
1	Exhaust fan, 2180 c.f.m., 1/2 hp. range hood.
2	Exhaust fans, 2000 c.f.m., each, 1/3 hp. fume hoods.
8	Exhaust fans, 270 to 1845 c.f.m., 1/20 to 1/4 hp.
1	Exhaust fan, 3500 c.f.m., 1/2 hp., general exhaust.
6	Unit heaters, 125,000 B.t.u. each.
1	Condensate pump, 9 g.p.m., 1/2 hp. motor.
1	Condensate pump, 6 g.p.m., 1/4 hp. motor.

DEVELOPMENT OF DESIGN

Building

When a water and equipment testing station was authorized in January 1951, it was believed that a temporary facility would suffice and for this reason off-site locations were considered. Continuing studies of the serviceability of the testing station had by February 1 increased its functions to a point where a location on the plant proved advisable and it was placed approximately one mile south of the mouth of Upper Three Runs Creek on the north bank of the Savannah River.

By the end of February a building design had been developed substantially the same as that erected. For a time it was planned to include a temporary biological laboratory in the building but for security reasons the plan was changed and the allotted space was devoted to much needed storage. Shortly thereafter the building was selected as the temporary quarters of the Health Physics Group and approximately 1300 square feet of space was incorporated for this purpose. By April two additional rooms were made a part of the building, one serving as the electronic instrument evaluation room and the other as the mechanical instrument evaluation room. The latter facilities were needed to determine the effects of South Carolina climate on instruments and the effects of normal and rough handling on instrument efficiency. It was also planned to use the equipment in these rooms to train operating personnel in the use and maintenance of instruments.

Since the CMX building was one of the first completed on the project an effort was made to use testing opportunities there for a number of equipment categories considered for plant adoption. As an example, a demonstration of types of fence lighting equipment was held in September, 1951, attended by personnel from the AEC and the du Pont AED and Design divisions. As a result of the demonstration a Fresnel-lens wide angle flood unit giving illumination to about 300 feet out from the mounting poles was adopted for plant-wide use.

Equipment

As designed and constructed CMX contains three principal equipment installations. One section consists of the water treatment equipment with its associated pumps, tanks, piping and instrumentation. A second section contains the closed process system including the process pumps, converter assembly, heater, heat recovery units, the banks of test

heat exchangers, the cooling water pumps and the necessary instrumentation and piping. The third section includes the steam generation unit and associated equipment. A fourth section contained the laboratory equipment essential to the Health Physics Group's investigation and test program. This phase of the CMX program was removed when Building #735-A, Health Physics Headquarters, was occupied.

Water Treatment Equipment

Before the selection of the Savannah River location for the new Atomic Energy Commission plant, the characteristics of the river water had been studied well enough to confirm its suitability as a coolant in the #100 Areas. In this phase of the survey, municipal and industrial water treatment facilities had been inspected to secure a general understanding of local treatment problems. Before jacketed equipment could be placed in service on the plant, however, it was necessary to compile specific information that would insure maximum performance of the heat exchangers with minimum fouling and corrosion. This became the principal function of CMX. Whether raw, clarified or filtered water would best serve in the #100 Areas remained to be experimentally proven and for this reason complete flexibility was built into the CMX system. At the beginning it was also undetermined whether one type of coagulant would serve better than others and plans were made to test all candidates at CMX.

Decision on Mechanical vs. Conventional Type of Treatment

The erection of the CMX plant came at a time when a complete review was being made of the merits to be found in both the conventional and mechanical types of settling plant. Advantages were inherent in each and either could supply water of a quality good enough to satisfy requirements in the #100 Areas and other plant-wide requirements. Related considerations of initial cost, cost of operation and compactness were important factors in the ultimate selection of a type for plant-wide adoption. In CMX the mechanical type was selected in the belief that it would best provide operating experience with the poorest quality of clarified water that might eventually be used in the #100 Areas. At that time it was generally recognized that the conventional type would probably produce a consistently better quality of water than the mechanical type. On the other hand, it appeared that for the #100 Areas conventional settling would cost much more and because of the larger areas such a type would cover, would present a more vulnerable bombing target.

To meet the requirements of process cooling, boiler feed and service water, a clarification system of 1600 g.p.m. capacity is installed. It consists of two solids contact clarifiers each with an inlet capacity of 880 g.p.m. Water is fed through the flash mixing unit into a central mixing compartment in the tanks. From this compartment the water flows upward through a sludge blanket maintained in the annular space surrounding the mixing compartment. The clarified water is drawn off at the top perimeter of the tanks through submerged orifice weirs. Variable rates of feed are built into the system for adding alum, lime and clay as coagulants. The system is designed to produce an effluent with a turbidity not exceeding an average of 10 p.p.m.

Filtering is accomplished by two 800 g.p.m., 16-foot diameter wood tanks. Reduced here to a turbidity of 2 to 4 p.p.m., the water flows to the filtered water clearwell which has a working capacity of 100,000 gallons. Four chemical feed tanks supply through four stainless steel proportioning pumps, two 10 g.p.m. and two 2 g.p.m., the ratios of chemical treatment desired for experimental work in progress and for the various building services. Piping arrangements are such that any type of water can be passed through the test heat exchangers. Only hold-up for filtered water was originally provided but with minor piping rearrangements it is possible to hold up either raw or clarified water in the clearwell. Special one-inch lines are also installed to draw samples for test purposes from any part of the water treatment plant. Complete instrumentation is included to give accurate controls and recordings of flow, coagulant feeding, chlorine feeding and pH.

Heat Exchangers and Closed Process System

To test heat exchangers and fuel components under simulated plant conditions, a closed process system consisting of a converter assembly, a heater, two heat recovery units and a system of pumps was designed. Process liquid, in this case light water, is continuously recirculated. A purge system maintains purity of the stream by deionization. The secondary, or cooling water system, includes the heat recovery unit, circulating pumps and heat exchangers. All cooling water is used on a once-through basis. For convenience and economy, the test process and cooling systems are sized at approximately one per cent of the designed plant systems.

Heat Exchangers

In establishing the test program for heat exchangers the Atomic Energy Commission and du Pont had several objectives in mind. Information was needed on the heat transfer and pressure drop characteristics of several exchanger designs under consideration; the extent and rapidity of fouling by several types of water had to be measured; corrosion of equipment had to be determined; and, more specifically, the relative efficiency of the selected 1/2-inch cored tube design as against proposed alternatives had to be verified.

When procurement was initiated on the test exchangers, a design had been developed by du Pont for the process exchangers and inquiries had been submitted to possible fabricators. Of those contacted, four responded. Only one, Foster Wheeler, did so on the basis of the design proposed by du Pont. Each of the others, Griscom-Russell, the Alco Division of American Locomotive Company, and Trane submitted alternative designs which, in their opinion, offered definite advantages. Although du Pont believed firmly in the special merits of its own design, a careful analysis of proposed alternatives was undertaken. The planned tests at CMX were, therefore, broadened to include small units duplicating the designs of du Pont, Griscom-Russell, Trane and Alco. Foster Wheeler agreed to fabricate the du Pont designed exchanger. Four Trane and three exchangers of each of the other types were installed at various times and so connected that each bank of test units operated in series. The building's test capacity is three sets at one time, making it necessary to replace sets from time to time. A fifth type of exchanger, the Andale, was introduced for testing later in the program by the Operations staff.

The units constructed by Foster Wheeler on du Pont design are horizontal coolers with removable tube bundles. The 162 tubes, arranged in a triangular pattern, are 19 feet 6 inches long and have an outside diameter of 1/2-inch. The effective surface of the exchanger is 383 square feet. Tubes, tube sheets, heads, shell, baffles and core rods are of Type 304 stainless steel. The designed water flow through the shell is 200 g.p.m. with a maximum temperature of 64 degrees C. Maximum temperature in the tubes is set at 70 degrees C.

Similar specifications were followed by Griscom-Russell with these exceptions. Tubes are of two types and four sizes. One group consists of 3/8-inch and 1/2-inch O.D. tubes of admiralty metal and a second group consists of 3/4-inch and one-inch tubes of Type 304 stainless. The

208 tubes are arranged in a square pattern and the tube bundle is fixed. The effective surface is 454 square feet. Designated by Griscom-Russell as a "Quad-tube exchanger", the design was believed preferable by the fabricators for four reasons (1) minimum tube side volume for passage of process liquid, (2) maximum provisions against leakage, (3) maximum heat transfer efficiency, and (4) simplified fabrication.

The third type, that designed and fabricated by Alco, has the same general specifications but has an effective surface of 402 square feet, 363 tubes 18 feet long, and a tube O.D. of 1/4-inch. The tube bundles are brazed and removable. The pattern is square. Design flow rate for the shell is 180 g.p.m. at a maximum temperature of 64 degrees C.

The four Trane exchangers are completely different being a brazed aluminum, corrugated plate type. Also horizontal coolers, they have a design flow rate in the shell and in the tubes of 200 g.p.m. The design inlet temperature for the shell is 70 degrees F. and the outlet temperature is 104 degrees F. For the tubes the design inlet temperature is 114 degrees F. and the outlet temperature, 80 degrees F.

For a detailed review of the exchanger design problem and the development of a design eventually selected for process use, refer in Volume II to "Heat Exchangers, Development of Equipment Design, Building #105".

Pumps

The two cooling water pumps, one a spare, are each 600 g.p.m. centrifugal pumps operated at 3500 r.p.m. and equipped with 75 hp. motors. The two process pumps, one a spare, are 600 g.p.m., double suction, two-stage volute type. Parts in contact with the process liquid are stainless steel.

Converter Assembly

For accurate corrosion and erosion testing of reactor components it was believed that they should be exposed to hydraulic process conditions in a full-scale segment of the reactor. As part of its contract, (AXC 8-1/2), American Machine and Foundry Company designed a vertical tank, 21 feet 5-9/16 inches high with a minimum inside diameter of 23-1/2 inches. The unit accommodates five full-size quatrefoils. A simplified form of plenum and top tube sheet

serves as a water inlet and positions the tubes. No bottom tube sheet is included in the design, the fuel tubes resting on special pins bolted to the bottom plate. Process water enters near the top through a 6-inch inlet, passes down through the annular spaces of the tubes and leaves the tank near the bottom through a 6-inch outlet. Three 4-inch sight glasses capable of withstanding a 200 p.s.i.g. pressure are built into the sides of the tank near the bottom to permit observation of tube behavior under flow pressures.

Special side inlets in the tube sheet portion of the tank are installed for the feed-back of deionized water and for instrument connections to the pH cells. Liquid level in the tank can be controlled at any point through a 14-inch range within the upper portion of the top tube sheet and the gas chamber. The tank bottom is easily removable for pin changes and thermocouple replacement or servicing.

The entire assembly is constructed of stainless steel, Type 304 or 316, being used. Except for the top and bottom tank heads, water connection flanges, sight glass mountings and pin attachments, all of which are bolted to the unit, the assembly is of all-welded construction.

In operation, process water is pumped through the heat exchangers, through the heat recovery units, through the heater where its temperature is raised to 140 degrees F., into the top of the assembly, withdrawn at the bottom and then recycled through the heat exchangers. To maintain purity of the process stream from 1 to 5.5 g.p.m. are passed through a replaceable cartridge type filter which removes all particles 10 microns or larger and then through a mixed bed demineralizer which removes the ionizable materials.

Heat Recovery Units

To reduce process steam needs two heat recovery units are installed. These are single-pass horizontal units with fixed bundles each with an effective surface of 1149 square feet. All parts in contact with the process water are Type 304 stainless. Cooling water drawn from the test heat exchangers passes through each of the heat recovery units on the shell side. Process water is pumped through the tubes counter-currently and is heated sufficiently to cut steam requirements by approximately one-half.

The method of welding tubes to the tube sheets, proposed for the process exchangers in Building #105, was used

in the fabrication of these units. This served to demonstrate the feasibility of the method and to give a preliminary check on performance under operating conditions.

Heater

This is a vertical, one-pass unit with a removable tube bundle. Its tubes, tube sheets, and heads are of Type 304 stainless; the shell is of carbon steel. Operating at 100 p.s.i.g. steam pressure it raises the liquid temperature from 108 degrees F to 140 degrees F. With an approximate demand of 10,000 lbs./hr. at 250 degrees F, the heater represents the largest steam consumer in the building.

Instrumentation

Instruments installed at CMX are the same as those adopted for plant use. This makes it possible to use the instruments in the plant after termination of the tests, it simplifies the maintenance and spare parts problem and gives a check on the dependability of the selected instruments.

Temperature recorders on the water streams to and from the test exchangers provide the data necessary to calculate heat transfer coefficients. Measurements are accurate within plus or minus two degrees C.

The pressure drop on the shell and tube sides of the exchangers are measured to within one or two per cent by indicating differential pressure measuring instruments. Pressure losses in the process stream filter are measured in the same way. On the converter assembly, high accuracy dial test gauges are used. Flows of both the process and cooling streams are measured and controlled by instruments activated by pressure drops across orifices.

A temperature controller is installed in the exit line from the heater to maintain the temperature of the process water. Coarse control of this temperature can be obtained by regulating the level of the condensate in the heater, fine control is obtained by throttling the steam to the heater.

Conductivity cells connected through a manually operated switch to a single recorder and located in the exit line from the demineralizer and in the main process stream between the exchangers and heater measure purity of the water.

Other instrument installations measure the pH of cooling and process water, maintain the liquid level in the tank of the converter, and inlet and outlet temperatures and pressures of each of the fuel tubes installed in the converter.

Exchanger Cleaning

After the equipment was installed, attention turned to the requirements for cleaning experiments on the exchangers. Equipment installed for this purpose include a 200-gallon glass-lined tank for storage of cleaning solutions and a pumping system for injecting the solution into the streams flowing through the exchangers.

Steam Generation

In compiling figures on the required capacity of the steam plant to be erected at CMX, the estimated demands of the nearby pilot plant of the #200 Area, Building #678-G, were included. From the beginning it had been agreed that it would be most efficient to size the one boiler for the two buildings with only a short steam run necessary from one building to the other. In Building #678-G the extensive testing necessary for development work on efficient steam jets posed the greatest demand for steam. In CMX the largest user of steam was the closed process system heater. The following requirements were established for the two buildings:

Building #679-G	
Process	10,000
Heating	1,700
Hot water Heating	200
Building #678-G	
Process	2,350
Hot water Heating	200
Total	14,450 lbs./hr.

To supply this demand a package-type steam generator, oil-fired, with a capacity of 15,000 lbs./hr. was purchased. Originally the operating pressure of the boiler was 100 p.s.i.g. This was later changed to 150 p.s.i.g. as demands for additional pressure increased in CMX.

Shortly after the boiler purchase order had been issued a review of requirements raised the question of heating in Building #678-G. Since the CMX boiler was fully loaded and it was essential to maintain delivery and construction schedules, it was decided to install an oil-fired heater in Building #678-G for space heating purposes.

Health Physics Group

On a purely temporary basis a total of approximately 1300 square feet of area in CMX was set aside at the beginning for use by the Health Physics Group. For its work the group had available a counting room, instrument repair shop, laboratory sample preparation room, instrument storage room, an office and dark room. The counting room and instrument repair shop were air conditioned, the temperature being maintained at 75 degrees F, plus or minus 2 degrees. The relative humidity was kept at 45 per cent, plus or minus 5 per cent.

The development program of the Health Physics Group is discussed in detail in this volume under "Building #735-A, Health Physics Laboratory".

TEST RESULTS

The results of the CMX testing program which affected the design of equipment throughout the plant are more properly correlated with the development review of that equipment and are found in other sections of this history. Only a brief summary is presented here. This covers the period to July 9, 1952 when Operations accepted the building.

Water Treatment

Initial difficulties were encountered with the chemical feeders but after these problems were solved the performance of the precipitators leveled out. By November, 1951, satisfactory results were being obtained. The operating technique and control of the clarifiers had been refined to the extent that an effluent of 10 p.p.m. of turbidity was consistently obtained. Turbidities of 5 p.p.m. or less were not unusual for several consecutive days when the turbidity of the river water ranged below the average of 100 p.p.m.

These results were obtained when operating the clarifiers at 50 per cent of the design flow rate, with an alum dosage of 35 p.p.m., and with the pH of the water adjusted between 6.8 and 7.1. Experience with the filtering system early

indicated that with a high quality effluent from the precipitators it was possible to have a filter effluent consistently below 0.5 p.p.m.

Test Exchangers

The earliest process run, a very limited one, consisted of pumping filtered water through the Griscom-Russell exchangers which were the first delivered to the site. As was expected the results from a film formation standpoint were good. The same exchangers were then subjected to the first extended run with clarified water of about 5 p.p.m. Covering a period of 265 hours, the test disclosed a deposit near the water inlet and least near the outlet, and enough generally to interfere with efficient process operation. An unusual amount of "large-size" debris was found in the strainer ahead of the process equipment and some similar material was found in the equipment itself. This raised the question of screen sizes to be used in the pump suction well of Building #190.

By the end of January, 1952, the first test run using raw river water through the shell-side of the Griscom-Russell units was begun. After 120 hours of test there was no evidence that rapid film formations would result from the use of chlorinated raw water. On the other hand it appeared that the water was removing shell-side film deposited by previous runs with precipitator effluent.

The four Trane exchangers were placed on test in January. Earliest results indicated a much more rapid film build-up resulting from increased water turbidity than in the G-R units.

By the middle of February the Foster Wheeler exchangers were placed on the test line with chlorinated raw water. After a 303-hour test the hot F-W exchanger showed a uniform rate of film deposit. No deposit was observed in the warm and cold exchangers. This duplicated the performance of the hot, warm and cold G-R exchangers after 604 hours of test. By April continuation of the tests had indicated that a cleaning cycle of about 9 months would be necessary with the chlorinated raw water in the full-scale process exchangers to prevent serious drops in pressure and heat transfer. A month or so later experiments with the use of oxalic acid in cleaning the exchangers indicated that it might be possible to add the cleaning agent to the coolant and treat the exchangers without a process shutdown.

By mid-1952 tests with settled but unclarified river water had been favorable. Tests had also proven the

ineffectiveness of straight hydraulic cleaning methods and the effectiveness of oxalic acid cleaning. Examination of the exchangers had, in addition, emphasized the importance of thorough cleaning before and after use to remove iron from the surfaces and to hold iron content of the circulating water to a minimum.

At about the time Operations accepted the building, the Alco exchangers were placed on the test line. The mechanical seals of one process pump, which had been in operation for six months, were continuing to leak at the rate of four gallons a day and tests were about to begin with the new babbit-impregnated carbon seals.

On June 1 the stainless steel Andale exchanger started operating on raw river water to establish a film formation base point to be used in testing bactericides. After a dirt coefficient of 1000 had been built up, copper sulfate and chlorine bactericides were added to the raw water circulating through the exchanger. After 250 hours of operation with the bactericides it was apparent that these had no effect on film formation. It was, therefore, concluded that the raw water did not deposit an appreciable bacteriological film in the exchangers.

Reactor Component Tests

First tests of canned fuel slugs in ribbed tubes were scheduled to begin July 7, 1952. Late in June an agreement was reached between the CMX staff and Design and AED personnel of du Pont on methods to be used in hydraulic testing of plate-type fuel elements. A one-foot section of the proposed assembly was to be fabricated in Wilmington and tested at CMX in special facilities to be designed by the CMX staff.

DRAWINGS

W-155090 - Floor Plan

W-155097 - Equipment Layout

W-155100 - Elevations

STORAGE FACILITIES

BUILDING #707-G - JIG AND DIE STORAGE BUILDING

FUNCTION

This structure, formerly T.C. #8302-1Z, was transferred to the capital account of Project 8980 to provide permanent storage facilities for certain jigs and dies desired to be held for future use.

PRINCIPAL COMPONENTS

This facility consists of a single-story, one-room building.

BUILDING DETAILS

Of Class IV construction, the building is approximately 60 ft. wide by 196 ft. long by 25 ft. high, with a total area of 12,250 sq. ft. and a volume of 245,000 cu. ft.

CONSTRUCTION DETAILS

Foundations are of reinforced concrete with continuous wall footings. Walls are prefabricated metal with sheet metal siding and a pitched roof. There are no interior partitions and no ceiling. The floor is concrete with a Class II finish. Heating is provided by the existing forced air unit heaters, and air exhaust is maintained through roof ventilators. Lighting is fluorescent.

FURNITURE AND FIXTURES

The procurement of all office furniture for all buildings on the project was carried out by arrangement between du Pont and its subcontractor, Voorhees, Walker, Foley & Smith, in which the latter made all purchases. This procedure, decided upon at the beginning of the project, was followed, with few exceptions, to the completion of the program.

The du Pont Atomic Energy Division submitted preliminary estimates of requirements and established the types of furniture to be purchased for various levels of personnel located at the plant. On the basis of this information VWF&S designated code numbers for the more frequently used items and ordered the quantities required. This quantity purchase formed a pool from which furniture could be drawn to supply the miscellaneous early requirements. As construction progressed, du Pont and its several subcontractors, including VWF&S, issued a "Request for Purchase" on VWF&S for the items needed for a particular building or group of buildings. This Request for Purchase was then processed as a normal order and VWF&S issued alterations to the pool orders to allocate furniture to the various buildings involved. From these alterations the design subcontractor entered in his M & E List the order number and its alteration number to cover the transfer of the items to the specific building.

By the Spring of 1951 a further review resulted in the addition of other non-operating equipment to the list to be purchased by VWF&S. This included lockers and locker benches, mirrors, electric fans, clocks, vacuum cleaners, waste receptacles, step ladders, mop buckets and squeezers, janitor service wagons, canvas bags, hand trucks, dispensers, uniforms, photographic and movie equipment, medical equipment, mechanics tool kits, linens, refrigerators, first aid and fire equipment, drinking fountains, and a number of miscellaneous items.

No typewriters, automotive equipment or printing equipment were purchased under this arrangement since these were procured by the Atomic Energy Commission from a list of requirements submitted by du Pont.

EXISTING BUILDINGS RETAINED ON SITE

Building #761-G Bush House

Building #762-G Ashley House (Ellenton)

Building #763-G Ashley Plantation

Building #764-G Dunbarton School

Building #765-G Old Stage Coach Inn

The above buildings were existing facilities on the plant site and were maintained by Construction until accepted by Operations. Some were used for offices and others maintained as historical landmarks. All were accepted on December 21, 1953, with the exception of Building #765-G, Old Stage Coach Inn, which was accepted on December 22, 1954.

DATE
FILMED
7/12/94

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