MASTER

WKNL-75

A CONCEPTUAL DESIGN of a SHIELD TESTING and MATERIALS IRRADIATION FACILITY

Consultants to industry on applications of nuclear technology

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WALTER KIDDE NUCLEAR LABORATORIES, INC.
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Garden City, New York

A CONCEPTUAL DESIGN OF A SHIELD TESTING AND MATERIALS IRRADIATION FACILITY

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For

GLENN L. MARTIN COMPANY
Baltimore, Maryland

Under

P. O. No. 56-60167
Navy Prime Contract NOa(s)56-891C

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FOREWORD

For the past five months, Walter Kidde Nuclear Laboratories, Inc. have been engaged in the preliminary design of a large-scale, fully-integrated nuclear test facility for the Glenn L. Martin Company of Baltimore, Maryland.

Recently, as a special assignment to be completed in a limited time, WKNL was asked to prepare a conceptual design and cost estimate for a smaller, less comprehensive nuclear test installation. This resulted in the design presented herein.

The preparation of this conceptual design within the short time available was made possible by drawing on the information developed during the engineering of the larger facility. However, it was not feasible because of time limitation to include in the present report much of this background information, which in any case will appear in the final report on the larger facility.

The work was performed under P. O. No. 06-60167, NOa(s)56-891C.

SUMMARY

A conceptual design is presented for a test reactor facility to be used for shielding experiments and component irradiations necessary for airframe development for the nuclear airplane program. To meet both requirements a modified swimming-pool reactor is used, with a dry irradiation cell of 320 cu. ft. of useful volume provided for component testing, while shielding experiments are performed in the pool in the usual manner. A BSR-type core is operated at 1 MW to provide a fast neutron flux in the irradiation cell of 10^{12} n/cm^2/sec at the core face and 10^{11} at a distance of 4 feet. The irradiation-cell facility is designed to avoid the need of remote operations in making up service connections to the experimental piece. The reactor is contained in a cylindrical building designed for 6 psi internal pressure to meet the conditions of the maximum credible accident.

For further flexibility, provision is made for carrying out dry shielding experiments in the drained pool. This would probably employ a second reactor core, of the ASTR type (not included in the cost estimate).

Supporting the reactor facility are a cold assembly and test area, a gamma pool, a hot laboratory, general laboratories including an instrument shop, and a radioactive waste treatment and storage system. Supporting facilities and outside services are assumed to be available at the site.

The estimated cost of the facility, including the reactor and the fabrication cost for an initial fuel charge, is $2,874,000.

Introduction

There are two broad objectives which this facility is intended to meet.

1. Provide for shielding experiments and measurements necessary in the design of air-frames for the nuclear airplane program.

2. Provide for component irradiations, dynamic as well as static, to determine the extent of radiation damage at fluxes which will be encountered in the nuclear airplane. Furthermore, the facility should have the inherent ability to produce higher fluxes than those encountered in the airplane for the sake of accelerated testing and for future component systems which may be required to operate at higher fluxes.

Following preliminary discussions the Glenn L. Martin Co. indicated that the facility should include the following basic features.

1. Swimming Pool Reactor(10^{12} fast neutron flux at core face) including dry irradiation space of approximately 300 cubic feet.

2. Gamma Facility - wet source handling.

3. Hot Laboratory providing one general purpose cut-up cell and one low-level laboratory module for inspection of irradiated samples.

4. Experiment Preparation Building

5. Laboratory module space for source work

6. Radioactive Waste Disposal System

7. Radioactive Storage Area

8. Instrument Laboratory

The facility would be located adjacent to an existing plant so that the following outside services and support facilities are assumed to be available.

a. Electric power supply

b. Boiler plant (heating, steam)

c. Sanitary sewage disposal system

d. Storm sewer system

e. Plant utilities distribution; such as, raw water, potable water, cooling water, gas, compressed air, etc.

f. Fire protection system

g. Plant security system

h. Cafeteria or canteen facilities

i. General Warehousing facilities

j. General maintenance shops and craft facilities

k. General administration facilities

The following report presents a conceptual design and cost estimate for an installation comprised of the facilities listed in items 1-8 above. It begins with a brief description of the overall layout. This is followed by a description of each facility in the order listed above. An architectural plot plan shows the overall arrangement of the entire facility. Preliminary plans and sections of the reactor facility are included, together with preliminary arrangements of the other principal units.

The report is completed with a breakdown preliminary cost estimate.

Facility Arrangement

The facility, as seen in Architectural Elevation drawing No. A-1000, is an integrated unit with the reactor housed in a cylindrical concrete building and adjoining wings for the various supporting facilities.

An overall layout of the facility is shown in drawing A-1001, titled Architectural Plan. Shown in the reactor containment building is the swimming pool, which is divided into a storage section and a main section. Not seen in this view is a dry-irradiation chamber located at a lower level adjacent to the storage-pool alcove. A canal extends from the storage section through the building wall and connects with a "wet" gamma irradiation pool where either spent-fuel elements or Co^{60} may be used as the source.

Also adjacent to the reactor building is the hot laboratory, for the examination of components following reactor irradiation. It includes a hot cell for the more highly activated components, as well as an area where low-level-activity work may be performed.

An assembly and cold test area which serves both the gamma facility and the reactor is located adjacent to both of them. A wing adjoining the assembly area contains supporting laboratories, including an instrument laboratory and general engineering offices.

North of the irradiation facility a waste treatment and storage area is provided which may be seen on drawing No. L-1009, titled Plot Plan.

Reactor Test Facility

Design Concept

In general, shielding experiments have been performed in swimming-pool type reactors. Component-irradiation testing on the other hand, requires fast neutron fluxes and this combined with the space requirements and complications associated with dynamic testing make a "dry" system preferable to a "wet" type.

In the present design we have combined both features by providing a swimming-pool with a dry-irradiation chamber adjoining one wall. The reactor core, of the BSR (Bulk Shielding Reactor) type can be operated at a position in the center of the main pool for wet shielding work. It can be positioned in the storage pool at a recess provided in the wall adjacent to the dry chamber for irradiation work.

For added flexibility another provision has been made which permits "dry" shielding tests to be made. This is done by closing off the main pool by a gate and draining it, installing a shield mock-up and lowering the reactor into position within it. Since, in this case, forced-convection cooling is required, it is proposed that an ASTR (Aircraft Shield Test Reactor) type reactor be used for this work. However, it is also feasible to use the BSR type for this purpose by providing a tank equipped with forced circulation, in the main pool.

It should be pointed out that the ASTR type is considered to be less suitable for use in the "wet" tests for the following reasons. For example, it has a lead gamma-shield surrounding the core tank. This lead shield would need to be made removeable for dry-irradiation tests so that the desired neutron-gamma flux could be attained. Also, the presence of the core tank means that the neutrons must traverse a longer water path before reaching the neutron window of the irradiation cell. Accordingly, lower fluxes than those desired would result from one-megawatt operation, or a power level in excess of one megawatt would be required to achieve the desired fluxes.

The main components of the reactor test facility are the reactor, the main swimming pool, the storage pool, the dry irradiation cell and the containment building. They are described below.

Reactor

A BSR-type reactor core will be used. For the present conceptual study no investigation of reactor design was necessary. The core is similar to those used at several installations, such as the ORNL swimming pool. It employs MTR-type fuel elements, and is suspended from a bridge, which also carries the control panel (see Dwg. P-1007).

To permit operation at one megawatt, forced circulation cooling is required, which will be accomplished as follows. A stream of water will be injected through an eductor mounted permanently below the BSR reactor-core location in the swimming pool. The mixed stream produced will remove the core heat and at the same time carry off N^{16} produced near the core and dilute it in the main body of the pool. The heat will be removed from the pool water by a circulating-water system exchanging against a cooling-water-stream in a cooling tower. This same loop will provide the means of demineralization of the purge stream through an ion-exchange unit before it is brought back into the pool.

For dry shielding experiments an ASTR-type reactor may be used, since the present application is similar to that for which it was designed. This is the type being used in the Convair shield-testing facility. It consists of a core made up of cylindrical fuel elements surrounded by a heavy lead gamma shield. The entire unit including the control mechanisms is self-contained in a tank and cooled by forced convection. A second bridge would have to be installed to support this reactor along with its own control center. Portable concrete planks to provide biological shielding would be placed across the drained pool to protect personnel from the flux outside the shield mock-up. This flux must be about 10 r/hr for proper functioning of the sensing instrumentation.

A BSR type may be used for this service by placing the core inside of a water-filled tank through which cooling water is circulated. The depth of water over the tank with some additional temporary biological shielding under the reactor bridge would suffice to protect personnel from direct "end-streaming" out of the core. The aircraft-shield mock-up would be placed around this tank in the region of the active core.

Main Pool

The main pool (see Dwgs. A-1001, A-1002, A-1003) is 20 ft wide x 30 ft long x 34 ft deep. The pool is tile-lined and illuminated by portable submarine lights. Here it will be possible to perform shielding mock-up experiments, or encapsulated component-irradiation experiments. There will normally be enough water shield between the walls and floor of the swimming pool and the operating reactor core so that their activation will be at or below tolerance. This means that with the reactor assembly removed from the swimming pool it would be feasible to drain the pool and manually assemble complex shielding mock-ups. Then with the pool once again filled with water, the reactor assembly may be brought back into the pool area to its desired position within the shield mock-up.

In order to facilitate measurement all around the shield (in a horizontal plane), the mock-up shield would be mounted on a turntable and rotated for alignment with the collimating instrumentation (see Dwgs. P-1002, P-1004). This technique provides an economy in space requirements because of the collimating-beam-tube length of approximately 15 feet. If one were to rotate this tube instead of the mock-up then the swimming-pool would need to be much larger.

If it is found desirable to perform shielding measurements directly in air, the pool could be drained to provide a dry facility. Shielding would be provided by portable concrete plank.

Reactor Storage Pool

The reactor storage pool (see Dwgs. A-1001, A-1002, A-1003, A-1007) is approximately 15 ft wide x 20 ft long x 28 ft deep and is separated from the main pool by a concrete shield wall and water-tight bulkhead gate. The main pool area may be drained after placing the reactor in the storage pool section and closing the bulkhead door.

A canal connects the storage pool through a lock to the gamma pool for the transfer of spent-fuel elements. Encapsulated -component irradiation experiments may be carried on in the storage-pool area while a dry shielding mock-up is being erected in the Main Pool area. The BSR has been used for this type of experiment at Convair, and has proven quite satisfactory. The wall at one end of the reactor storage pool is recessed to accommodate the reactor assembly. In this position the reactor is adjacent to neutron windows which "look" into the dry-irradiation cell.

Dry-Irradiation Cell

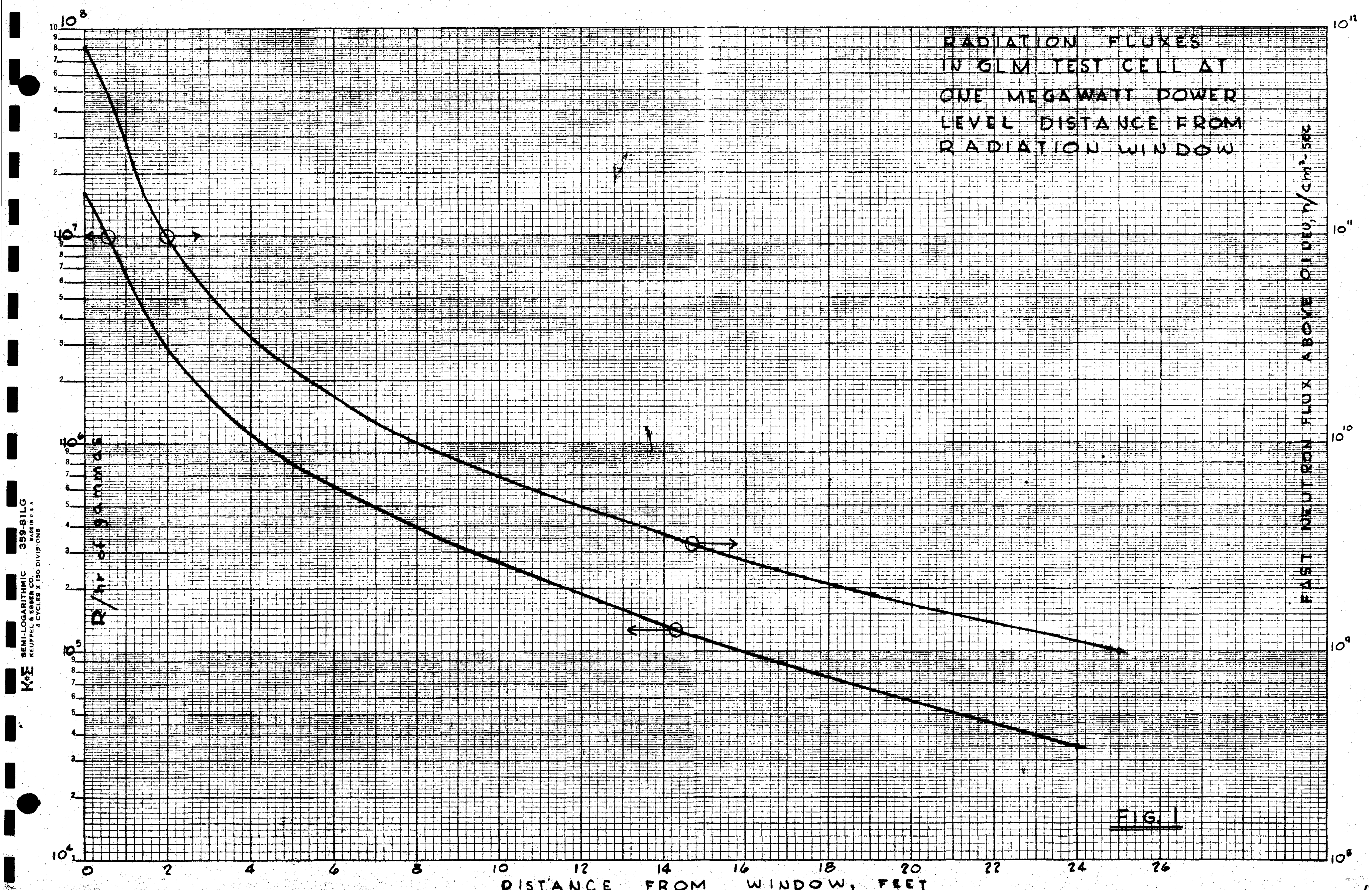
The "dry" irradiation volume in this design not only provides considerably more test space than in other existing reactor installations but is arranged to permit non-remote connections of test assemblies to their service leads, which is a novel feature. The cell is approximately 15 ft long x 6 ft wide x 5 ft high (see Dwg. P-1002). A chart (Fig. No. 1) and a neutron flux plot (Dwg. No. 1013) show the flux values which may be attained in this facility at a power level of 1 MW.

Components to be tested will be set up on conventional materials-handling pallets (see Dwg. P-1007). The palletized experiment will be completely assembled with the service and instrumentation leads brought out through a stepped shielding plug located at one end of the pallet. A shielded fork-lift truck may pick up the "cold" experiment and carry it to the dry-irradiation cell and insert the experiment into this room through one of three shielding doors. These doors, which move vertically, will be stepped at the bottom edge to match the plug on the pallet. After the fork-lift truck withdraws, the door may be lowered. It is then possible for a technician to make up all the service and instrumentation leads manually, even after the reactor has been brought up to the operating power level. The experiment may now be dynamically tested while in a neutron-gamma flux. Conversely, it is also possible to disconnect these leads manually at the termination of an experiment so that the pallet may be picked up by the fork-lift truck and carried away for further experiment-processing.

This processing will consist, in general, of transferring the experiment to a post-neutron test cell (Dwg. P-1002), where the operating characteristics of a dynamic experiment may be re-examined to determine whether the effects, if any, of neutron-gamma irradiation were transient or permanent. The equipment could next be carried to a hot hold-up area where it would remain until it could be accommodated in the hot cell or it had cooled sufficiently to allow non-remote handling methods to be employed.

Test Reactor Building

The entire test reactor facility is contained in a 90 ft diameter vertical cylinder, capped by a dished head and having an overall height of 34 ft (see Dwg. No. P-1005). Basically, the structure is a steel tank 1/4" thick, lined on the outside with 18" of concrete for shielding in the event of a maximum credible accident. The steel tank is designed to withstand the maximum internal pressure (6 lbs) which could be generated by such an accident. Personnel and equipment normally move in and out of



RADIATION FLUXES IN GLM TEST CELL AT ONE MEGAWATT POWER LEVEL DISTANCE FROM RADIATION WINDOW
R/hr of gammas
FAST NEUTRON FLUX ABOVE 0.1 MEV, n/cm²-sec
DISTANCE FROM WINDOW, FEET
0
2
4
6
8
10
12
14
16
18
20
22
24
26
10^8
10^7
10^6
10^5
10^4
10^12
10^11
10^10
10^9
10^8
359-81LG
SEMI-LOGARITHMIC
KEUFFEL & ESSER CO.
4 CYCLES X 150 DIVISIONS

FIG. 1

this containment building through air-tight locks. However, a service door (refer to Dwgs. P-1003, P-1004) has been provided to facilitate the movement of bulky equipment into and out of the containment building during reactor shut-down periods. It is through this door that the concrete covers for the "dry" pool operation will be brought into the building. Once inside the containment building, these covers will be stored, when not in use, in the swimming pool.

The proposed design shows two levels in the reactor building (see Dwgs. P-1002, P-1003, P-1004, P-1005, P-1006, P-1011, P-1012). One is at grade and permits access directly to the top of the swimming pool. It is at this floor level that personnel and equipment may enter or leave the building through the air-locks or service door. The second level, which contains the dry-irradiation-test and the hot-hold-up areas, is approximately 25 ft below grade. A freight elevator provides the means for moving experiments from one level to another. The palletized, irradiated experiments will be carried on this elevator to grade level and then brought through the air locks to the hot laboratory.

Floor space is provided in the reactor building for experiment control panels and other necessary test auxiliaries.

A small building wing adjacent to the reactor building houses the cooling system and the de-mineralizing equipment for the pool water. A 200,000 gallon underground retention-tank system adjacent to this area is provided for the storage of pool water when dry-shielding experiments are being performed.

Hot Laboratory

The hot laboratory is located adjacent to the reactor building in a building wing approximately 60 ft x 60 ft x 15 ft high (see Dwg. P-1011). It includes a hot cell and a low-level work area. The hot cell provides the means of examination of highly-activated components and is equipped with two lead-glass viewing windows, a hydraulic manipulator (General Mills type), four light manipulators (Argonne Model 8 type), optical equipment for close-up viewing and an overhead crane. Installed within the cell are a basic complement of remote machine tools such as cut-off saw, lathe, miller, ètc.

The hot cell is 12 ft wide by 15 ft long and 18 ft high. The cell walls are 5 ft thick and the roof is 4 ft thick. Bi-parting doors provide access to the cell. These doors are steel-clad and lead-filled, and provide shielding equivalent to that of the concrete walls. Storage wells for spent-fuel elements are provided in the floor.

A cell ventilating system exhausting through CWS filters is provided. The cell will be illuminated by sodium-vapor or mercury-vapor lights. Instrumentation for air-monitoring will be provided.

The low-activation area makes use of portable ferro-phosphate block for shielding. The shield consists of built-up walls and roof, and is provided with portable lead-glass viewing windows and manipulators. Conventional laboratory benches, tables and services are provided for bench experiments and examinations.

Gamma Facility

The gamma facility is joined through a canal and lock to the reactor storage pool. It is housed in a building wing 30 ft wide x 50 ft long x 14 ft high (see Dwg. A-1001). The gamma facility is a pool 10 ft wide x 35 ft long x 18 ft deep. One end of this pool is reserved as a storage area for spent-fuel elements. The balance of the pool area is available for encapsulated gamma-irradiation experiments. An over-head service crane is provided to facilitate the handling of heavy experiments and shipping containers.

The concrete pool is tile-lined and illuminated by a system of portable underwater lights. The necessary underwater handling tools are provided, as well as a lead casket which may be used for the shipping of spent-fuel elements or as an all-purpose coffin for the transfer of irradiated parts around the facility.

In addition to the gamma pool, the hot cell may be utilized as as "dry" gamma facility. The cell walls, viewing windows and doors are designed to accommodate a flux of approximately 10^6 r/hr (MTR spent-fuel elements).

Assembly and Cold Test Area

The assembly and cold-test area is adjacent to the reactor building and is 100 ft long x 60 ft wide x 15 ft high (see Dwg. A-1001) Space is provided for the assembly of experiments and for pre-irradiation check-out of dynamic experiments. Fully-equipped craft, light-maintenance, and machine shops are provided.

General Laboratory and Office Area

The laboratory and office wing is 100 ft long x 46 ft wide x 14 ft high (see Dwg. A-1001). It contains the following supporting offices and laboratories:

Instrumentation	Counting Room
General Physics	Health Physics
Radio-Chemical	Personnel Locker Rooms
Metallurgical	Engineering and General Offices

The laboratories are equipped with conventional laboratory benches, hoods and tables, and are completely outfitted with general service equipment and instrumentation. Normal services supplying these laboratories will include compressed air, gas, distilled water, steam, inert gas and 110 V and 440 V electrical service.

A partial basement provides space for all the normal building services such as heating and ventilating systems, electrical system, and general storage.

Waste Disposal

The waste disposal system will handle the waste production from the reactor and hot laboratory facilities. A set of underground storage tanks, located close to the hot laboratory, is provided for the collection and temporary storage of the radioactive liquid wastes originating in the hot laboratory and general laboratories.

The waste disposal facility is located some distance from the reactor and laboratory building (see Dwg. L-1009). It contains a packaging room for baling compressibles and encasing solids in concrete-lined drums; a process room for ion exchange, neutralizing, monitoring, etc.; a decontamination room for cleaning small tools and salvageable materials; a laundry room; and storage tanks for retention of liquids (see Dwg. P-1008). A radio-active storage building is located within the fenced area at the waste facility, and is separated from the waste-disposal building by an area used for storing drums awaiting disposal.

Liquid and solid wastes will be divided into three categories: high, intermediate and low-level.

The methods of waste disposal to be used are:

1. Collection, monitoring, and discharge to sewer of low-level liquids.

2. Collection, retention for natural decay to low level, monitoring and discharge of intermediate-level liquids.

3. Conversion of high-level liquids to a semi-solid condition by absorption in vermiculite or diatomaceous earth followed by storage.

4. Ion-exchange concentration of radioactivity for those intermediate liquids which do not decay to low level within a reasonable time.

5. Sea disposal or burial of low and intermediate-level solids.

6. Storage of high-level solids for decay to intermediate activity or eventual transfer to a national burial ground if decay is insufficient to allow sea disposal.

7. Filtration, scrubbing and absorption of gaseous wastes.

Gaseous wastes from hot cells, laboratory hoods, etc., will be filtered, scrubbed, and if required passed over activated carbon to remove radioactive gases, and then discharged to atmosphere through a stack.

Ventilating air from the dry-irradiation cell will be discharged (see Dwg. P-1002) to the stack to dilute the $argon^{41}$ concentration to tolerance levels. The stack will be approximately 50" in diameter and about 50 ft high.

Cost Estimate

The total estimated cost of the facility is $2,874,000, as broken down in Table 1. This cost does not include land. It is also noted that the facility design includes only the irradiation facility, the waste-disposal facility, and a hot-storage building. It does not include the functions of general administration, power and services, sanitary and process sewer disposal, cafeteria, fire department, general warehousing, maintenance facilities and plant security. (see also the Introduction).

The estimate includes the cost of a BSR reactor and an initial fuel load. It does not include the cost of the alternate ASTR reactor or of the second bridge that would be required for it.

A slight reduction in cost may be realized in the hot cell. As outlined earlier, the design of the cell is such that it will shield a gamma source during dry-gamma experiments. If dry gamma work were not to be performed, the walls, windows and doors could be reduced in thickness, resulting in a savings of approximately $33,000.

Table 1

COST ESTIMATE

for

IRRADIATION FACILITY

REACTOR BUILDING

STRUCTURE

Excavation & Backfall for contained Building	$ 25,000	
Concrete Container & Foundation	125,000	
Steel Liner	82,000	
Concrete Floor Slabs & Walls	39,500	
Structural Steel & Miscellaneous Iron	60,000	
Swimming Pool, Storage Pool & Canal	107,500	
Turn-table	5,000	
Irradiation Room Concrete, Doors & Lift Mechanisms	90,000	
Elevator	7,500	
Other Shielding Doors	22,500	
Portable Pool Covers	30,000	
Crane Over Pools	15,000	
Personnel & Service Locks	7,500	
Service Door	4,000	
Interior Partitions	5,000	
Heating & Ventilating	48,000	
Lighting	7,500	
Power Wiring	15,000	
Painting	5,000	
	701,000	

EQUIPMENT

BSR Type Reactor & Controls (incl. 1 fuel loading)	83,000	
Reactor Operating Bridge, Rails, Drives, Etc.	10,000	
Pool Water System (Ion-Exchange & Cooling)	28,000	
Pool Lighting (Portable)	2,000	
Cell Ventilating System, Stack & Filters	18,000	
Shielded Lift Truck	17,500	
	158,500	
Sub-Total		$859,500

HOT LABORATORY AREA

STRUCTURES

Building Structure, including Services	93,000	
Cell Structure (less equipment)	48,000	
	141,000	

EQUIPMENT

Cell Equipment Including:

Windows	$ 26,000	
Shield Doors	18,000	
Manipulators (4-Argonne Model 8)	19,000	
Manipulator (1-Gen Mills)	50,000	
Optical Equipment	17,000	
Remote Machine Tools	5,000	
Crane	11,000	
Special Ventilating including Filters	4,000	
Special Lighting	3,000	
Special Painting	2,100	
Special Instrumentation (monitoring)	4,500	
Source Storage Wells (dry)	3,000	
Portable shields for Low Level Analysis including Window	40,000	
Portable Manipulators	8,000	
Benches, Lab Tables, Lab Services	10,000	
Service Crane	8,000	
	228,600	
Sub-Total		$369,600

ASSEMBLY & COLD TEST AREA

STRUCTURES

Building Structures, including Services	90,000	

EQUIPMENT

Machine Shop & Craft Shop Tools	42,000	
Sub-Total		132,000

LABORATORY & OFFICE AREA

Structures, including Services	150,000	
Lab. & Office Furniture	25,000	
Sub-Total		175,000

GAMMA POOL FACILITY

STRUCTURES

Structure, including Services	22,500	
Pool Excavation	5,400	
Pool Concrete & Tile Lining	32,000	
	59,900	

EQUIPMENT

Lead Caskets	$ 18,000	
Pool Lighting	2,000	
Tools - (underwater)	5,000	
Service Crane	15,000	
	40,000	
Sub-Total		$ 99,900

UTILITY AREA

Structure, including Services	20,000	
Equipment included in Reactor Equipment Costs	-0-	
Outside Tankage, Piping & Water Retention Basin	68,000	
		88,000

WASTE DISPOSAL FACILITY

STRUCTURE, including services	85,200	
EQUIPMENT:		
Packaging Area	10,500	
Process	26,600	
Laundry	6,900	
Decontamination Area	27,800	
Retention Area	60,000	
Instrumentation	21,000	
Misc. Blowers, Hoists, Truck, Furniture, etc.	24,000	
	176,800	
Sub-Total		262,000

HOT STORAGE BUILDING

STRUCTURES, Including Services	50,000	
Sub-Total		50,000

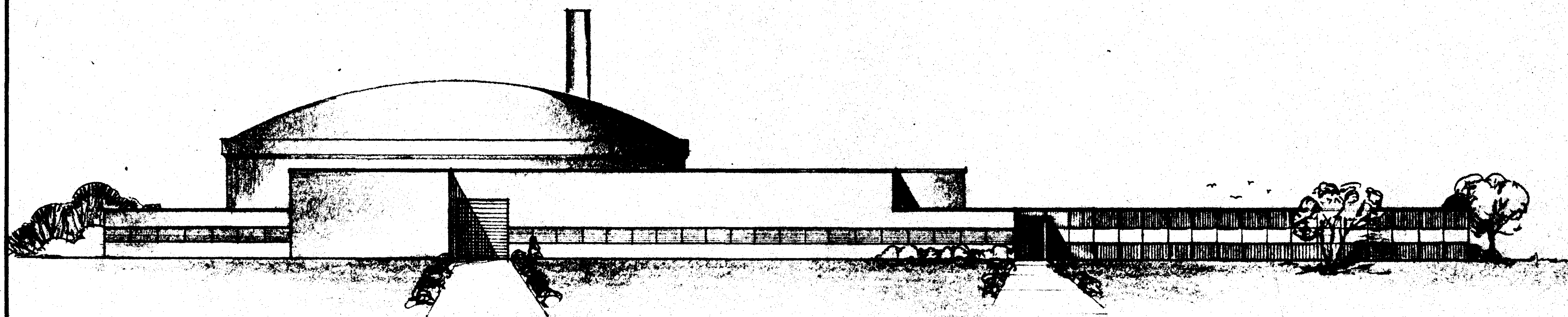
OUTSIDE FACILITIES EXTENSIONS (1000 ft. length)

Roads, Parking, Fences, Electrical Distribution, Steam Distribution, Water, Sewage, Etc.	111,000	
Sub-Total		111,000
		$ 2,147,000

Total Direct Cost	$ 2,147,000
Contingency	215,000
Construction Overhead & Fee	312,000
Engineering Cost, Including Fee	200,000
TOTAL COST	$ 2,874,000

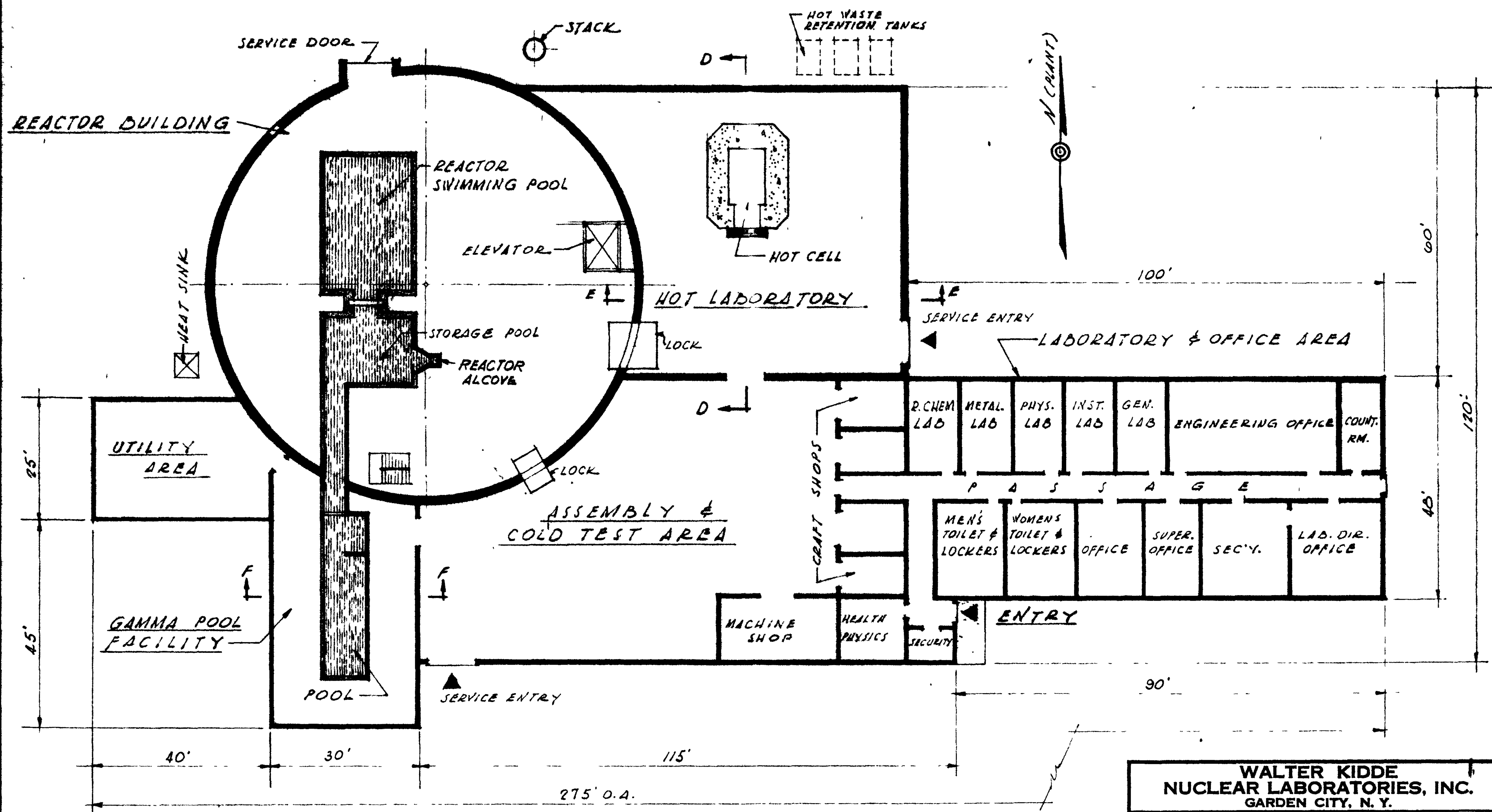
FACILITY DRAWING LIST

Drawing No.	Title
A-1000	Architectural Elevation
A-1001	Architectural Floor Plan
P-1002	Bldg. Arrgt. - Dry Test Level
P-1003	Bldg. Arrgt. - Reactor Operating & Wet Test Level
P-1004	Bldg. Arrgt. - Section "A-A"
P-1005	Bldg. Arrgt. - Section "B-B"
P-1006	Bldg. Arrgt. - Section "C-C"
P-1007	Irradiation Cell
P-1008	Bldg. Arrgt. - Waste Disposal
L-1009	Plot Plan
A-1010	Hot Storage Bldg. Arrgt.
P-1011	Bldg. Arrgt. - Hot Laboratory - Sections
P-1012	Bldg. Arrgt. - Gamma Bldg. - Section
D-1013	Flux Plot - Neutrons/Cm^2/Sec.



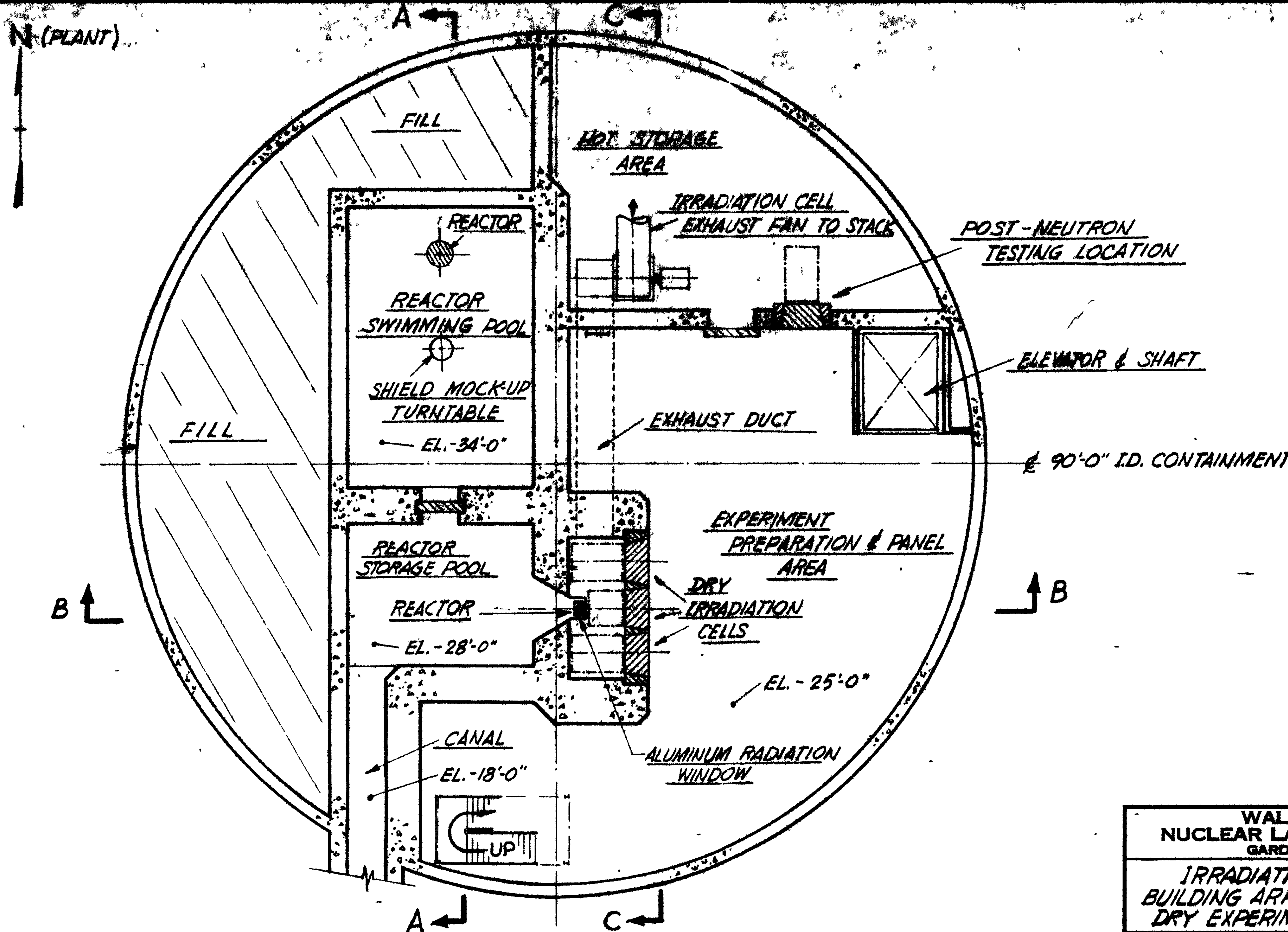
WALTER KIDDE NUCLEAR LABORATORIES, INC. GARDEN CITY, N. Y.					
IRRADIATION FACILITY ARCHITECTURAL ELEVATION					
DR. BY FCD DATE 11-7-56	APP. BY J.H.F DATE 11/13/56	SCALE 1"=20'	W. O. NO. 5608-B	DRAWING NO. A-1000	REV.

K-E ALBANENE 196L TRACING PAPER 10502



WALTER KIDDE NUCLEAR LABORATORIES, INC. GARDEN CITY, N. Y.					
IRRADIATION FACILITY ARCHITECTURAL PLAN					
DR. BY F.C.D DATE 11-7-56	APP. BY J.H.F. DATE 11-13-56	SCALE 1" = 20'	W. O. NO. 5608-8	DRAWING NO. A-1001	REV.

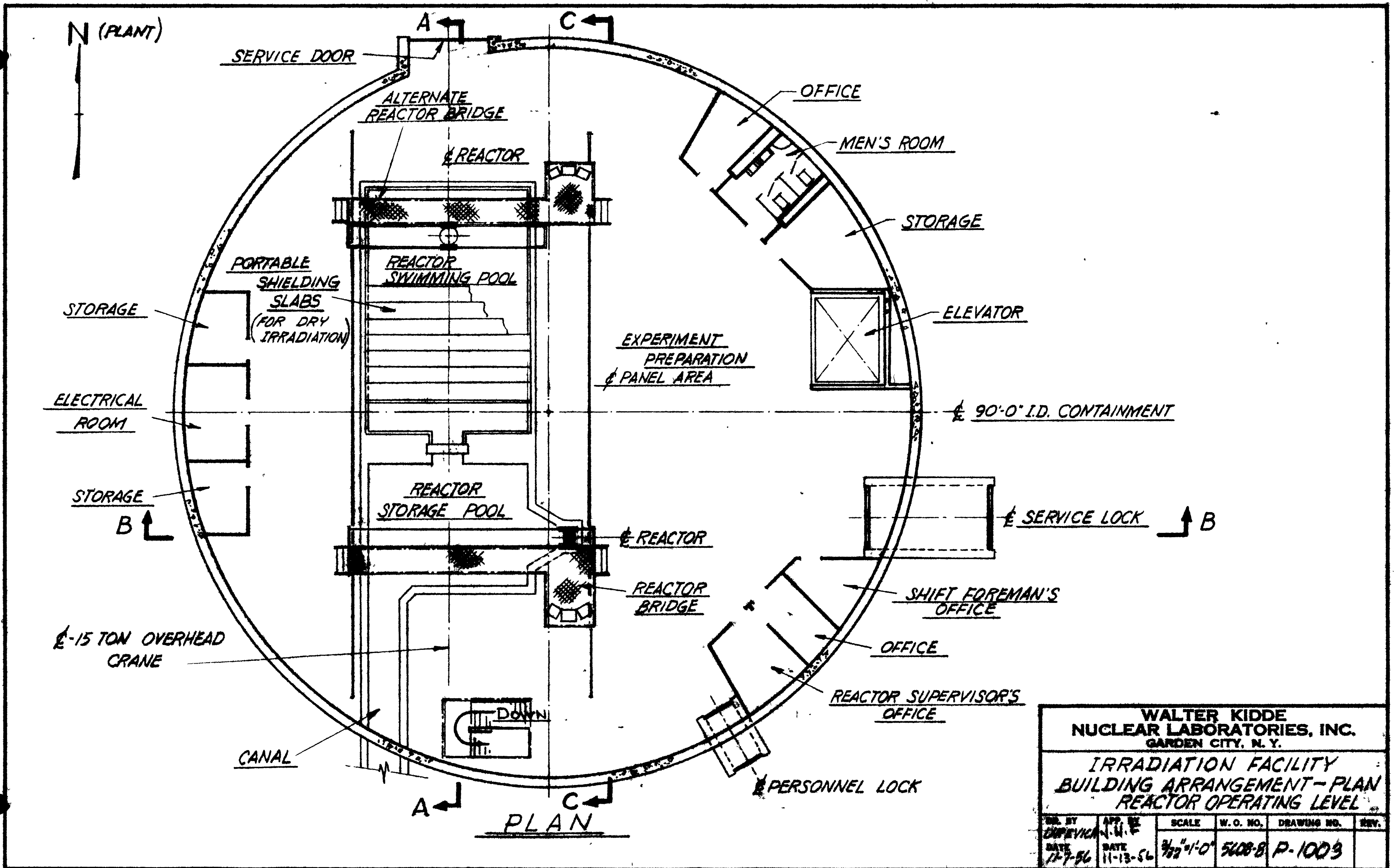
K+E ALBANENE 196L TRACING PAPER 10802



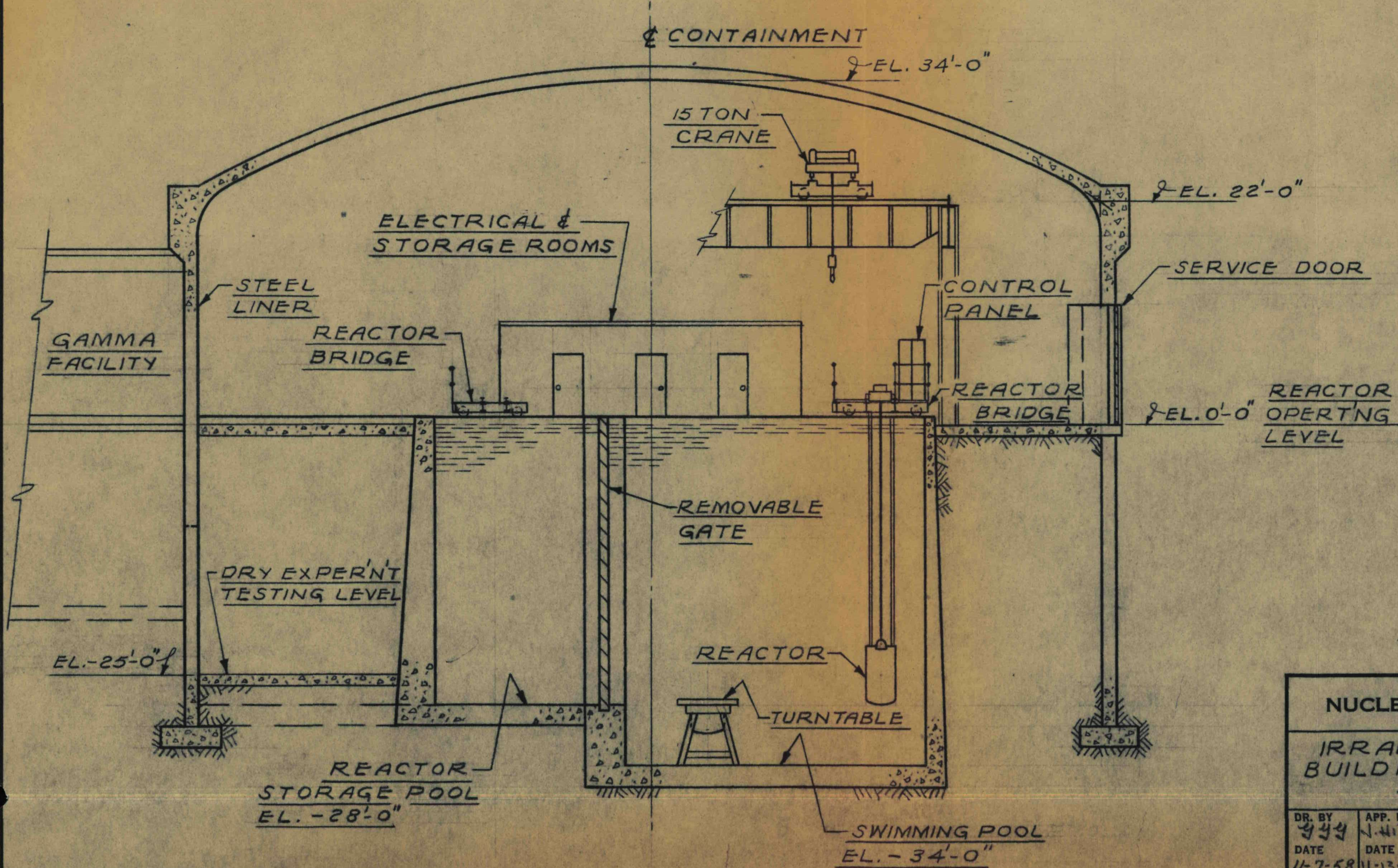
PLAN

WALTER KIDDE NUCLEAR LABORATORIES, INC. GARDEN CITY, N. Y.					
IRRADIATION FACILITY BUILDING ARRANGEMENT – PLAN DRY EXPERIMENT TESTING LEVEL					
DR. BY UREVICH DATE 11-7-56	APP. BY J.W.F DATE 11-13-56	SCALE 3/32"=1'-0"	W. O. NO. 5608-8	DRAWING NO. P-1002	REV.

K+E ALBANENE 196L TRACING PAPER 19903



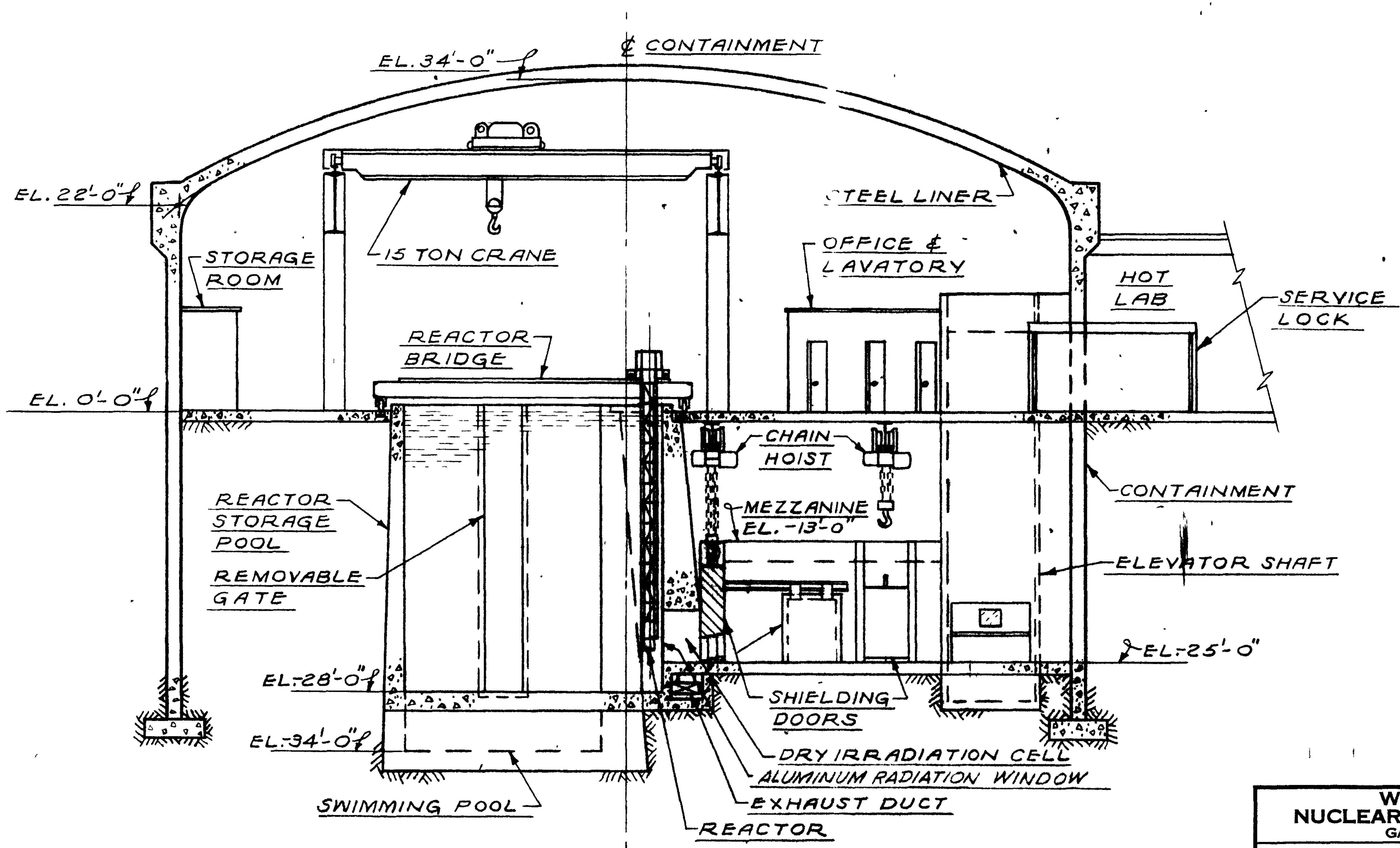
N (PLANT)
A
C
SERVICE DOOR
ALTERNATE REACTOR BRIDGE
℄ REACTOR
OFFICE
MEN'S ROOM
STORAGE
PORTABLE SHIELDING SLABS (FOR DRY IRRADIATION)
REACTOR SWIMMING POOL
ELEVATOR
STORAGE
EXPERIMENT PREPARATION & PANEL AREA
ELECTRICAL ROOM
℄ 90'-0" I.D. CONTAINMENT
STORAGE
REACTOR STORAGE POOL
B
℄ SERVICE LOCK
B
℄ REACTOR
REACTOR BRIDGE
SHIFT FOREMAN'S OFFICE
℄-15 TON OVERHEAD CRANE
OFFICE
DOWN
REACTOR SUPERVISOR'S OFFICE
CANAL
℄ PERSONNEL LOCK
A
C
PLAN
WALTER KIDDE NUCLEAR LABORATORIES, INC.
GARDEN CITY, N. Y.
IRRADIATION FACILITY
BUILDING ARRANGEMENT – PLAN
REACTOR OPERATING LEVEL
DR. BY
DATE 11-7-56
APP. BY J.H.F
DATE 11-13-56
SCALE 3/32"=1'-0"
W.O. NO. 5608-8
DRAWING NO. P-1003
REV.



WALTER KIDDE NUCLEAR LABORATORIES, INC.
GARDEN CITY, N. Y.

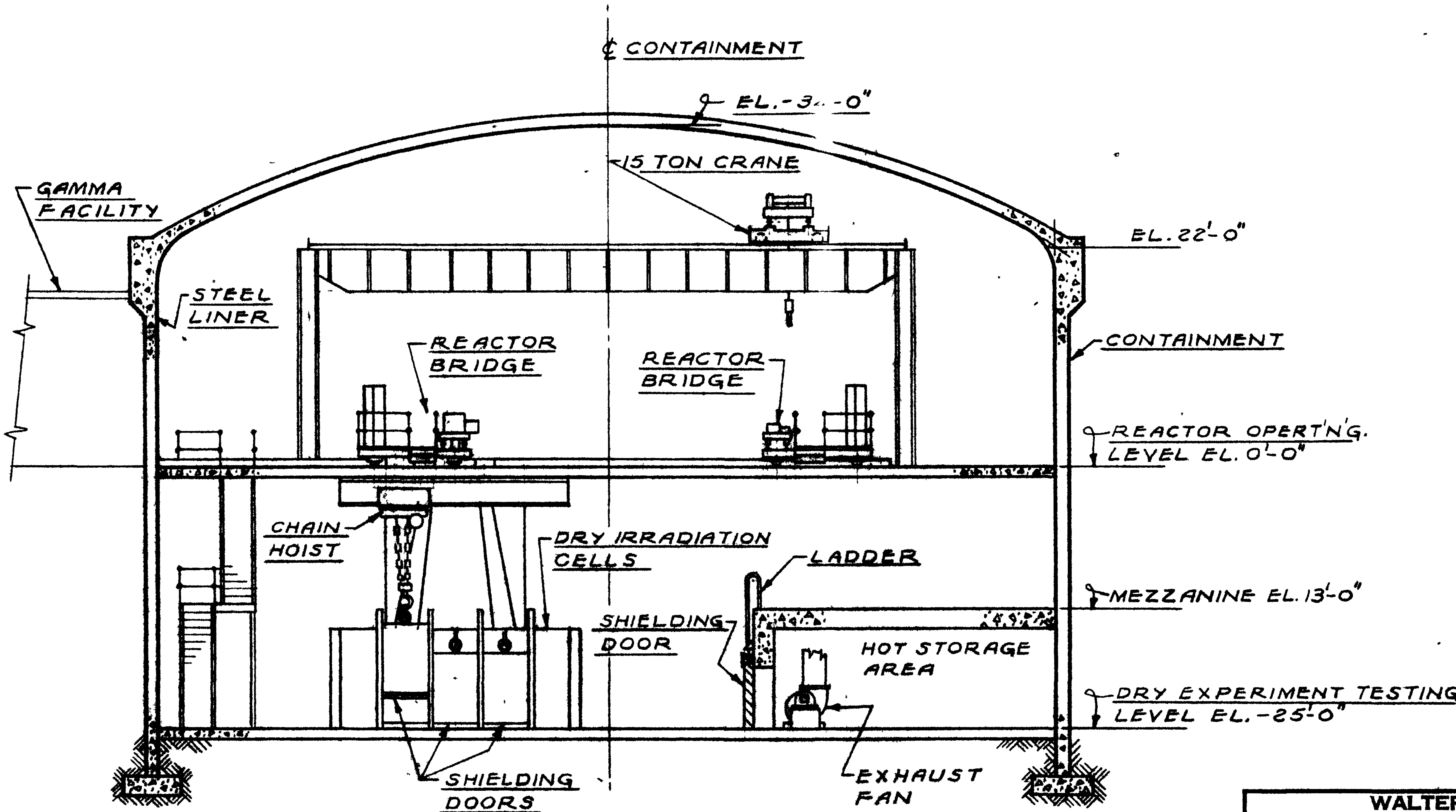
IRRADIATION FACILITY
BUILDING ARRANGEMENT
SECTION "A-A"

DR. BY	APP. BY	SCALE	W. O. NO.	DRAWING NO.	REV.
[illegible] DATE 11-7-58	N.H.F. DATE 11-13-56	3/32"=1'-0"	5608	P-1004	



WALTER KIDDE NUCLEAR LABORATORIES, INC. GARDEN CITY, N. Y.					
IRRADIATION FACILITY BUILDING ARRANGEMENT SECTION "B-B"					
DR. BY G. G. G. DATE 11-9-56	APP. BY J. H. F. DATE 11-13-56	SCALE $\frac{3}{32}$"=1'-0"	W. O. NO. 5608	DRAWING NO. P-1005	REV.

K+E ALBANENE 195L TRACING PAPER 19502

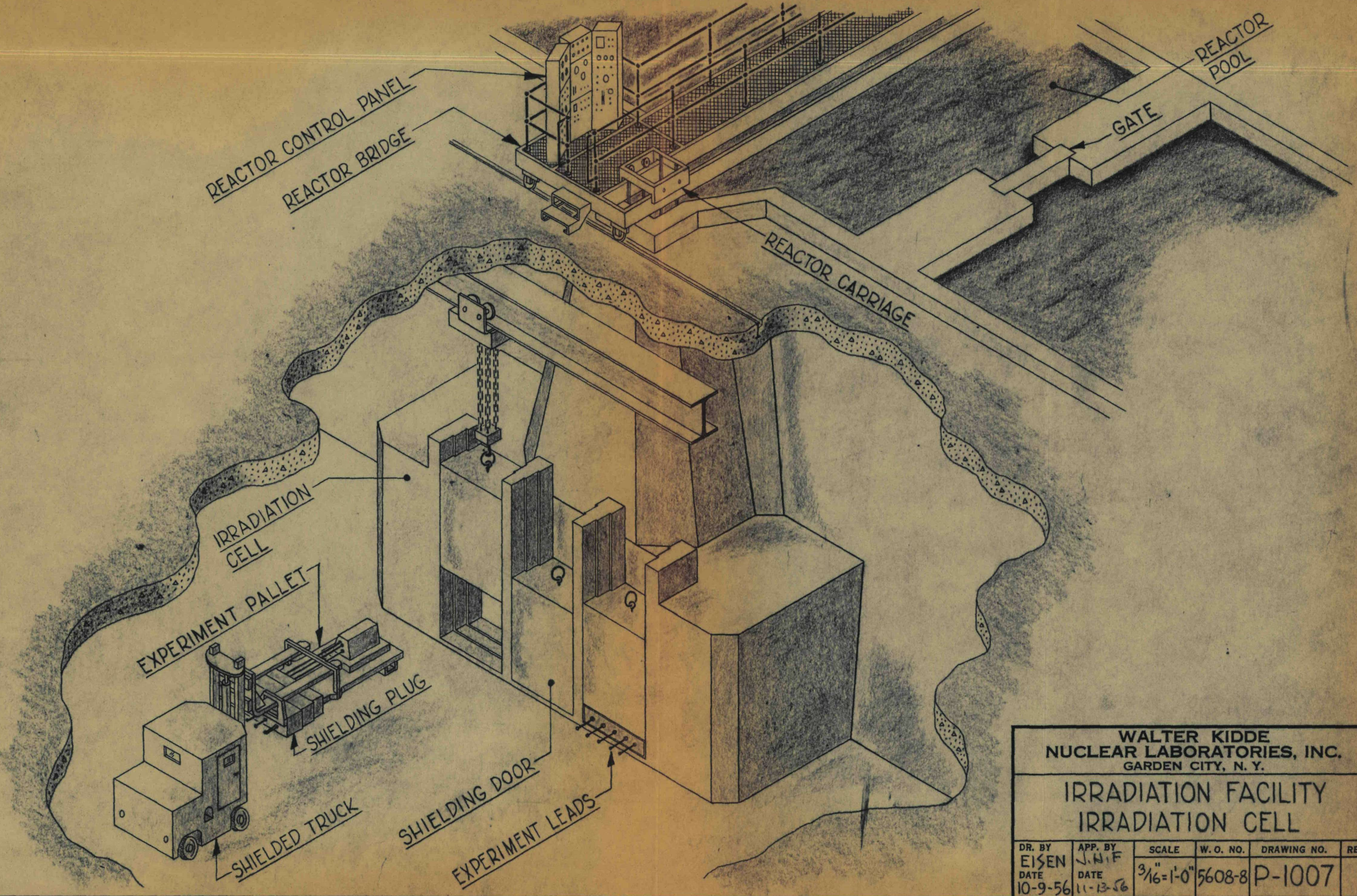


WALTER KIDDE NUCLEAR LABORATORIES, INC.
GARDEN CITY, N. Y.

IRRADIATION FACILITY
BUILDING ARRANGEMENT
SECTION "C-C"

DR. BY	APP. BY	SCALE	W. O. NO.	DRAWING NO.	REV.
G. J. H. DATE 11-12-56	J. H. F DATE 11-13-56	3"/32 = 1'-0"	5608	P-1006	

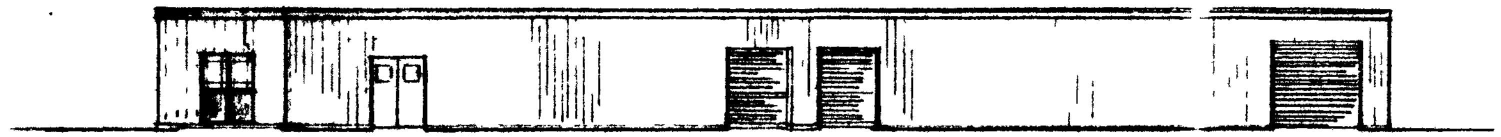
K+E ALBANENE 195L TRACING PAPER 19602



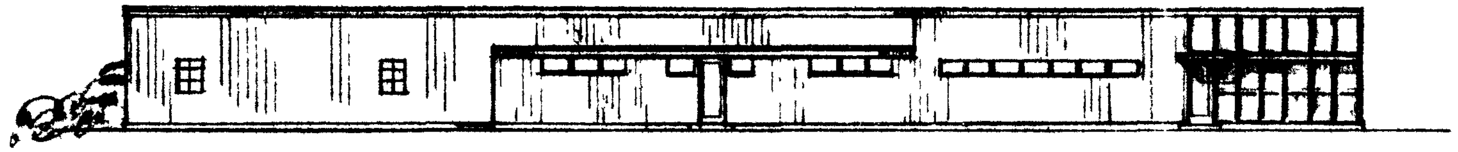
WALTER KIDDE
NUCLEAR LABORATORIES, INC.
GARDEN CITY, N. Y.

IRRADIATION FACILITY
IRRADIATION CELL

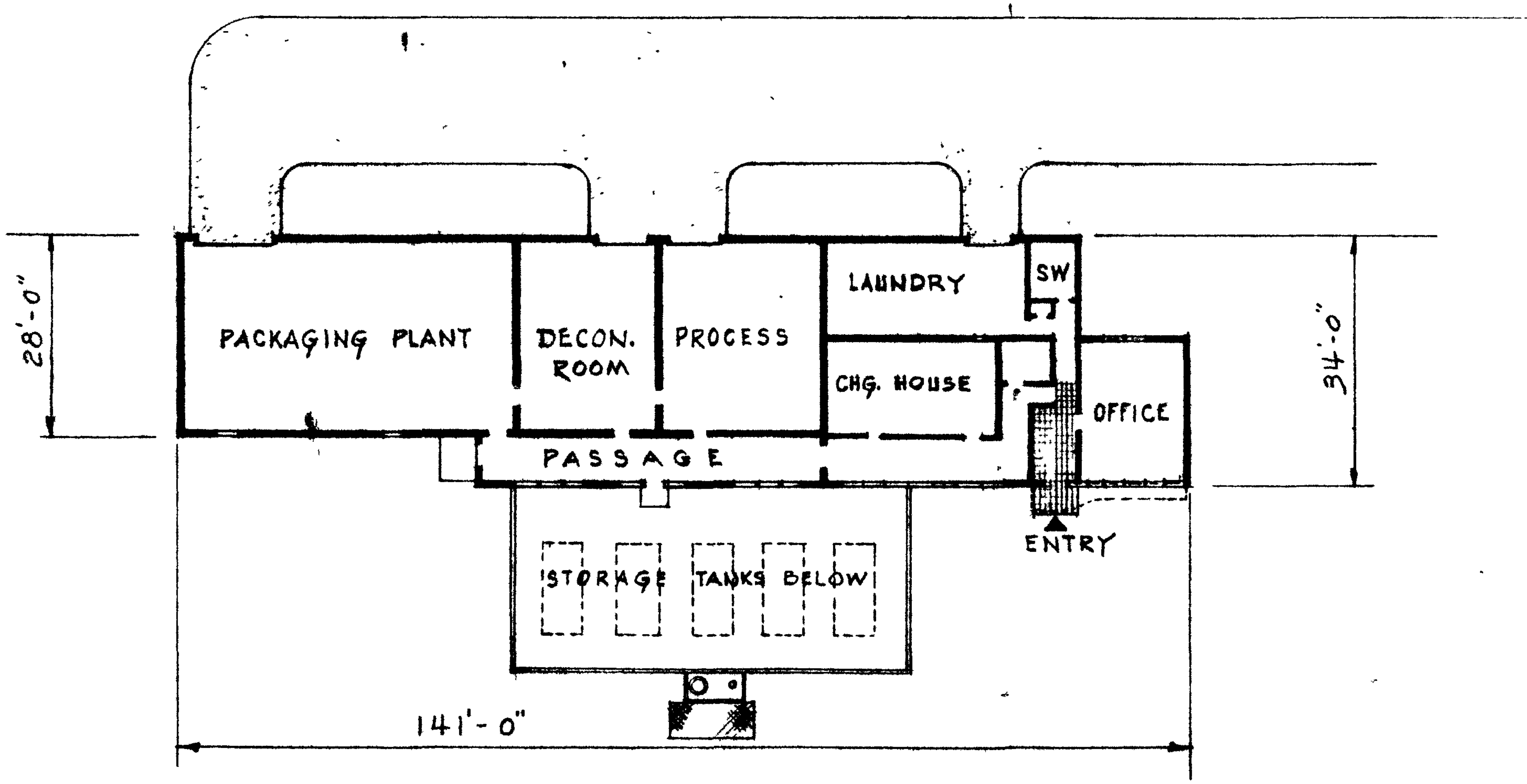
DR. BY	APP. BY	SCALE	W. O. NO.	DRAWING NO.	REV.
EISEN DATE 10-9-56	J.N.F DATE 11-13-56	3/16"=1'-0"	5608-8	P-1007	



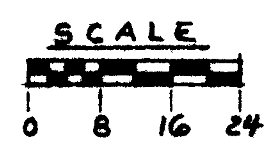
VIEW LOOKING WEST



VIEW LOOKING EAST



PLAN

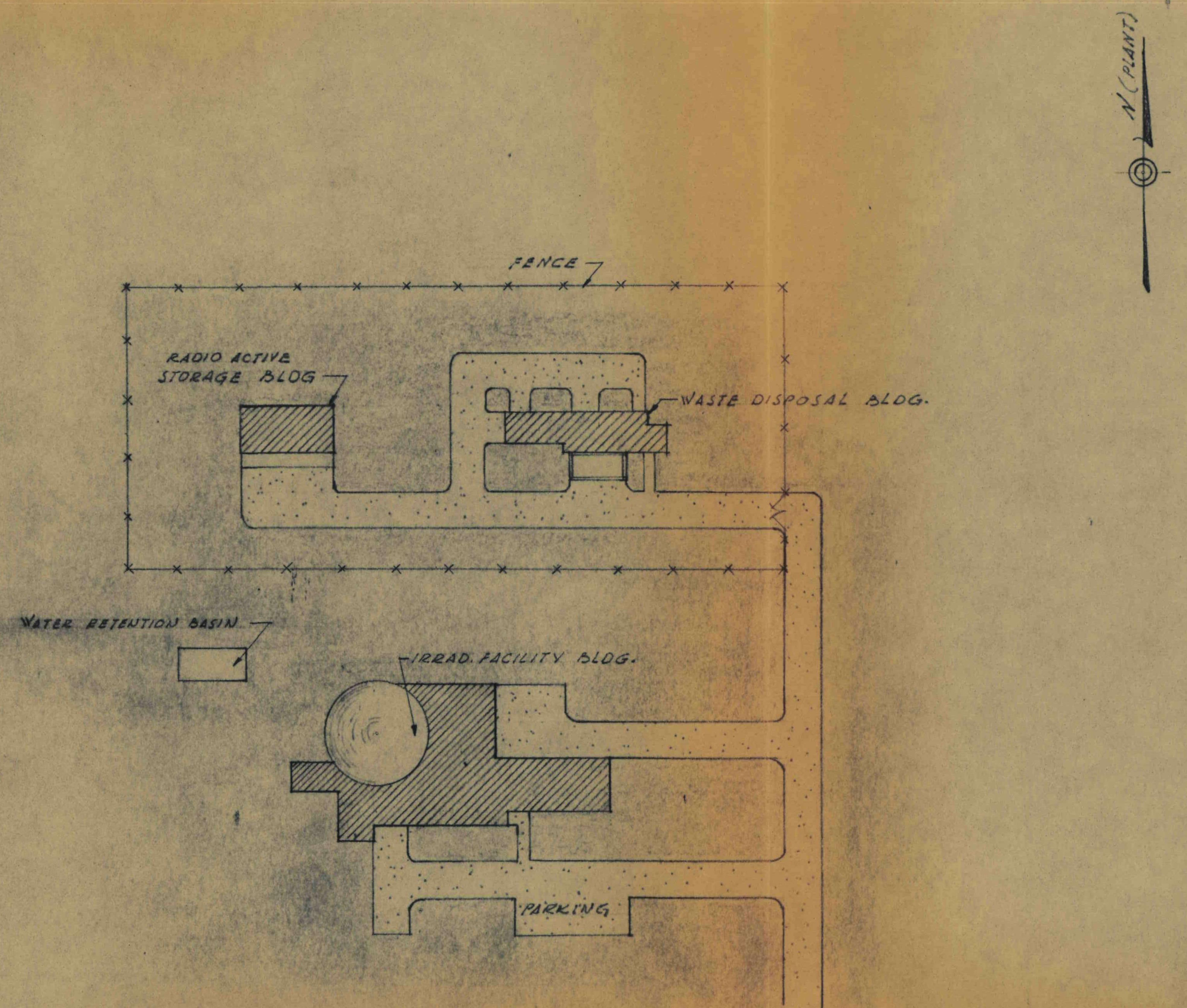


WALTER KIDDE NUCLEAR LABORATORIES, INC.
GARDEN CITY, N. Y.

IRRADIATION FACILITY
BLDG. ARRGT. WASTE DISPOSAL

DR. BY	APP. BY	SCALE	W. O. NO.	DRAWING NO.	REV.
E.H.D. DATE 11-7-1956	J.H.F. DATE 11/13/56		5608	A-1008	

K-E ALBANENE 1951 TRACING PAPER 10000

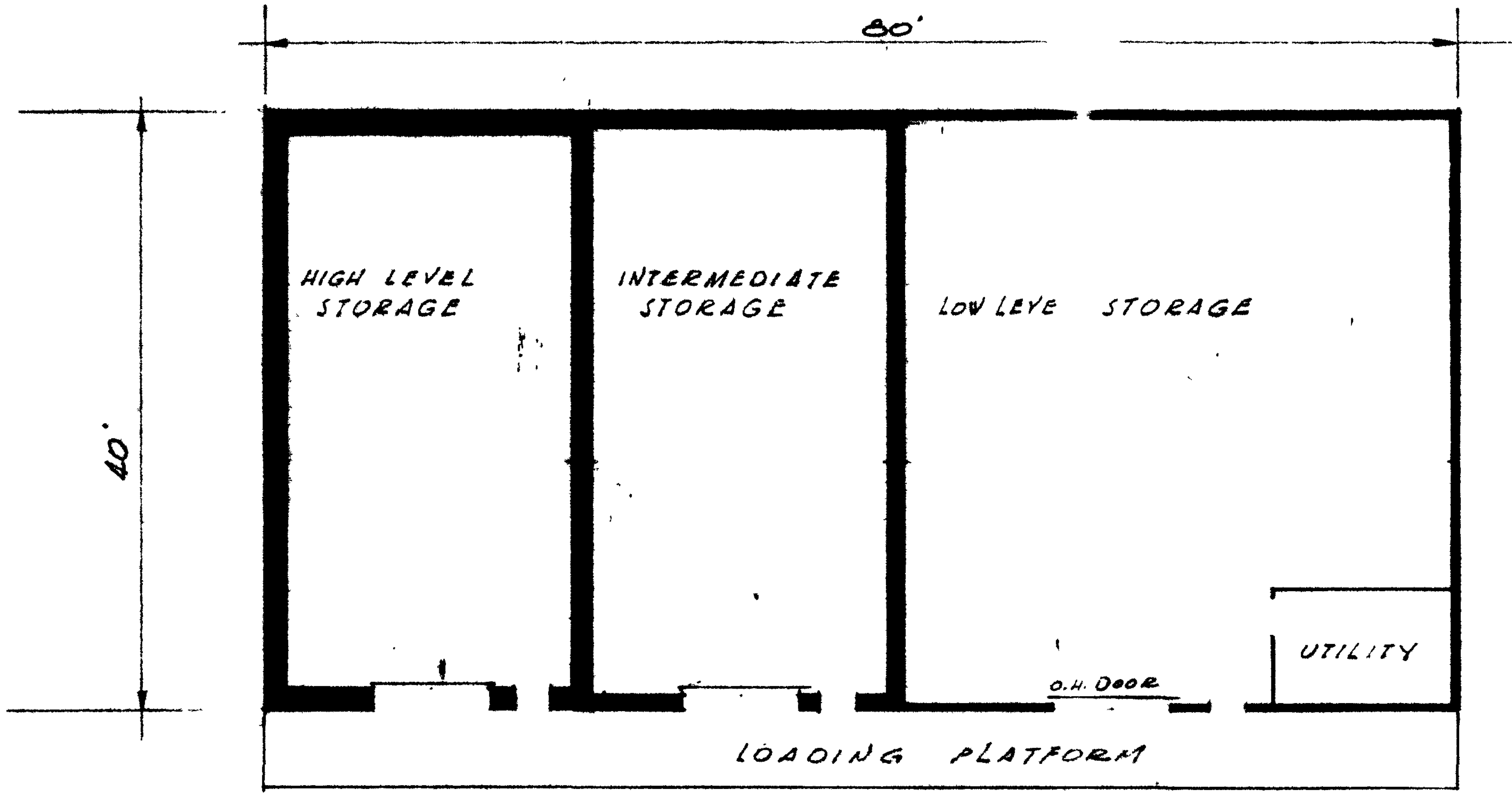


WALTER KIDDE
NUCLEAR LABORATORIES, INC.
GARDEN CITY, N. Y.

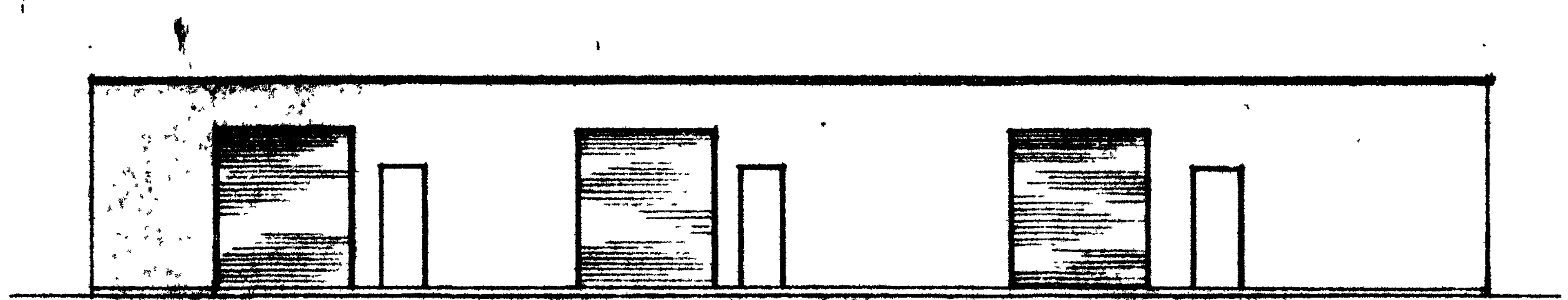
IRRADIATION FACILITY
PLOT PLAN

DR. BY	APP. BY	SCALE	W. O. NO.	DRAWING NO.	REV.
FCB	J.H.F	1" = 100'	5608-8	L-1009	
DATE 11-7-56	DATE 11-13-56				

K+E ALBANENE 196L TRACING PAPER 19902



P L A N

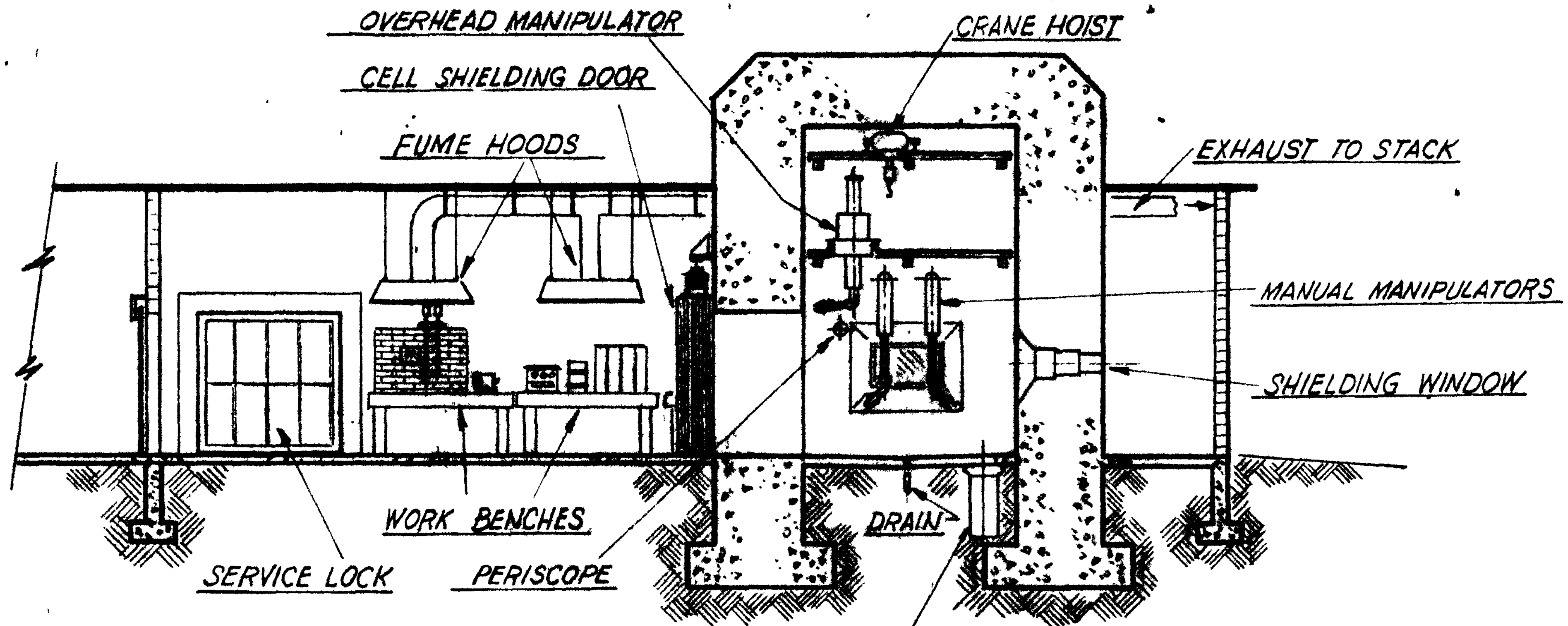


E L E V A T I O N

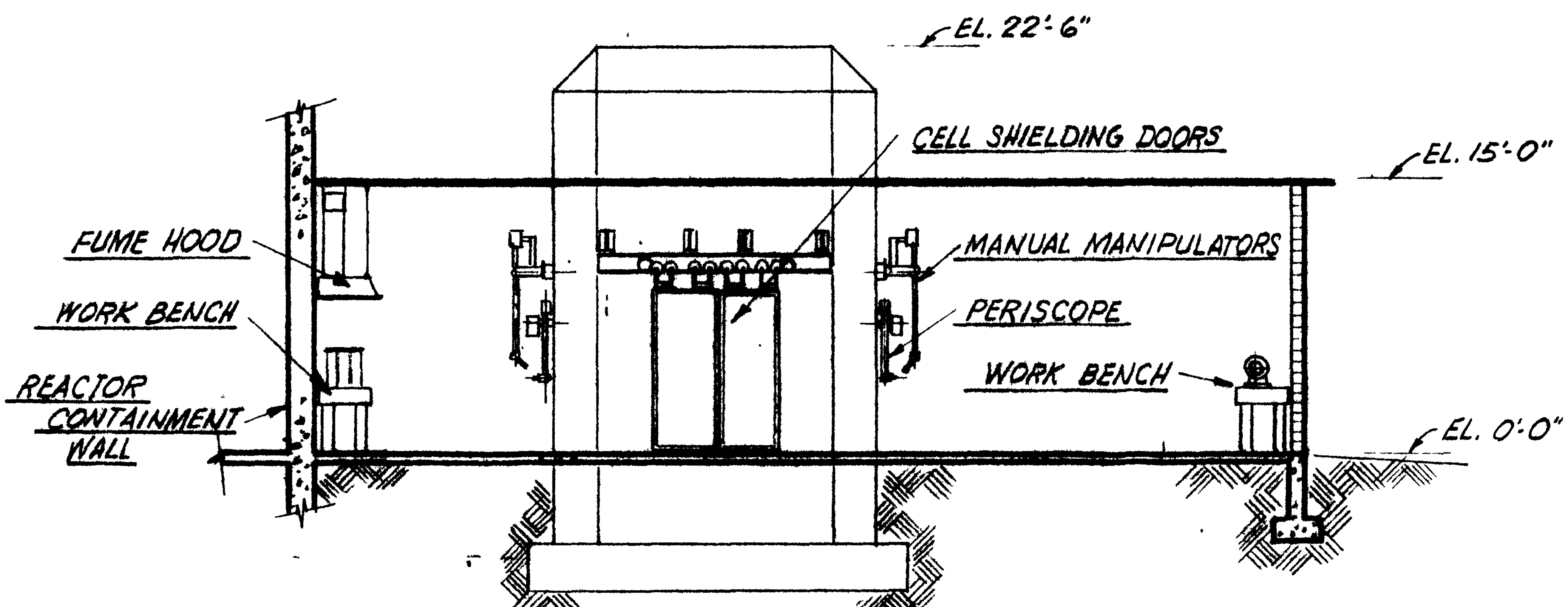
WALTER KIDDE NUCLEAR LABORATORIES, INC.
GARDEN CITY, N. Y.

IRRADIATION FACILITY
HOT STORAGE BLDG - ARRG'T

DR. BY	APP. BY	SCALE	W. O. NO.	DRAWING NO.	REV.
FCD DATE 11-7-56	J.H.F DATE 11-13-56	3/32"=1'-0"	5608-B	A-1010	



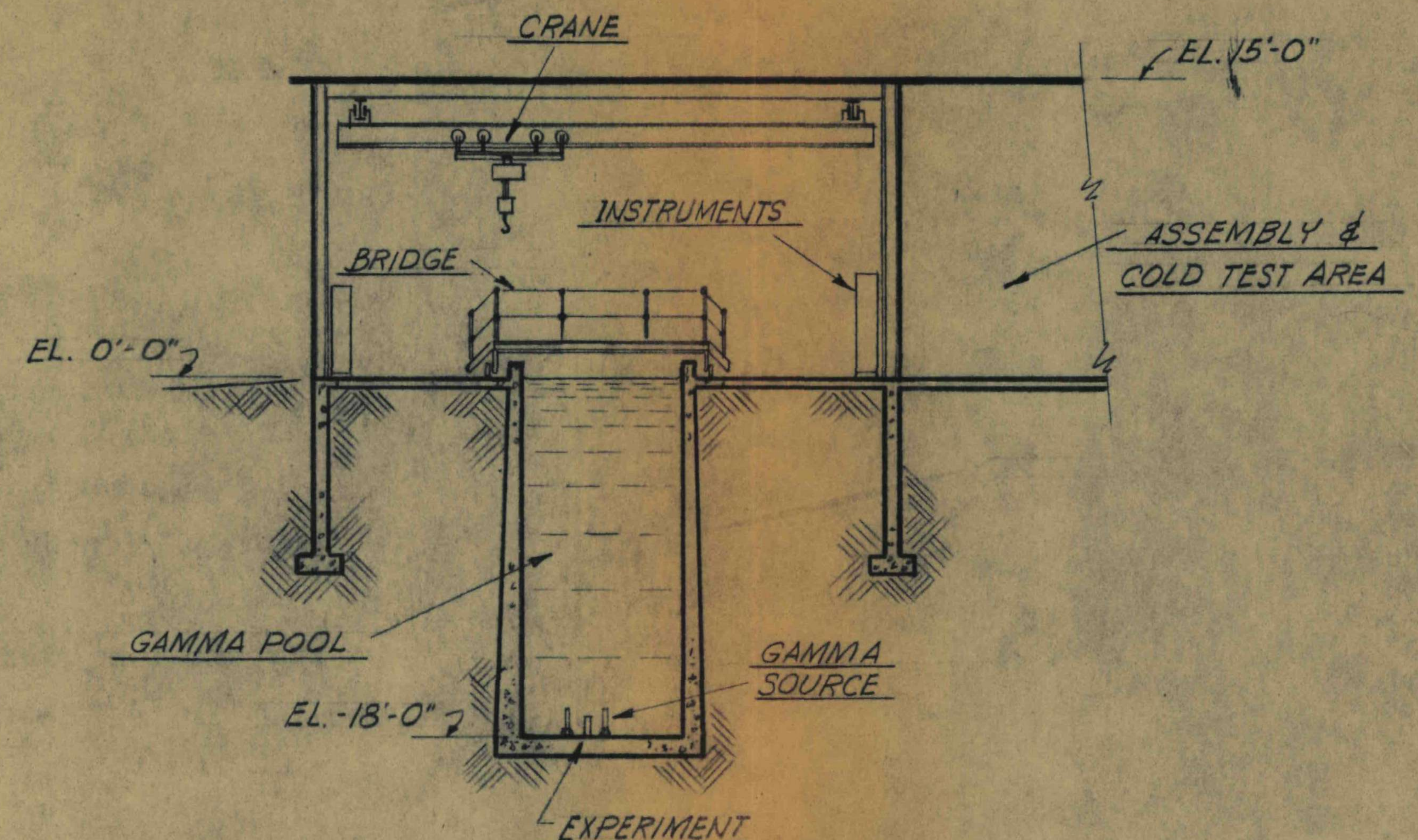
SECTION D-D



SECTION E-E

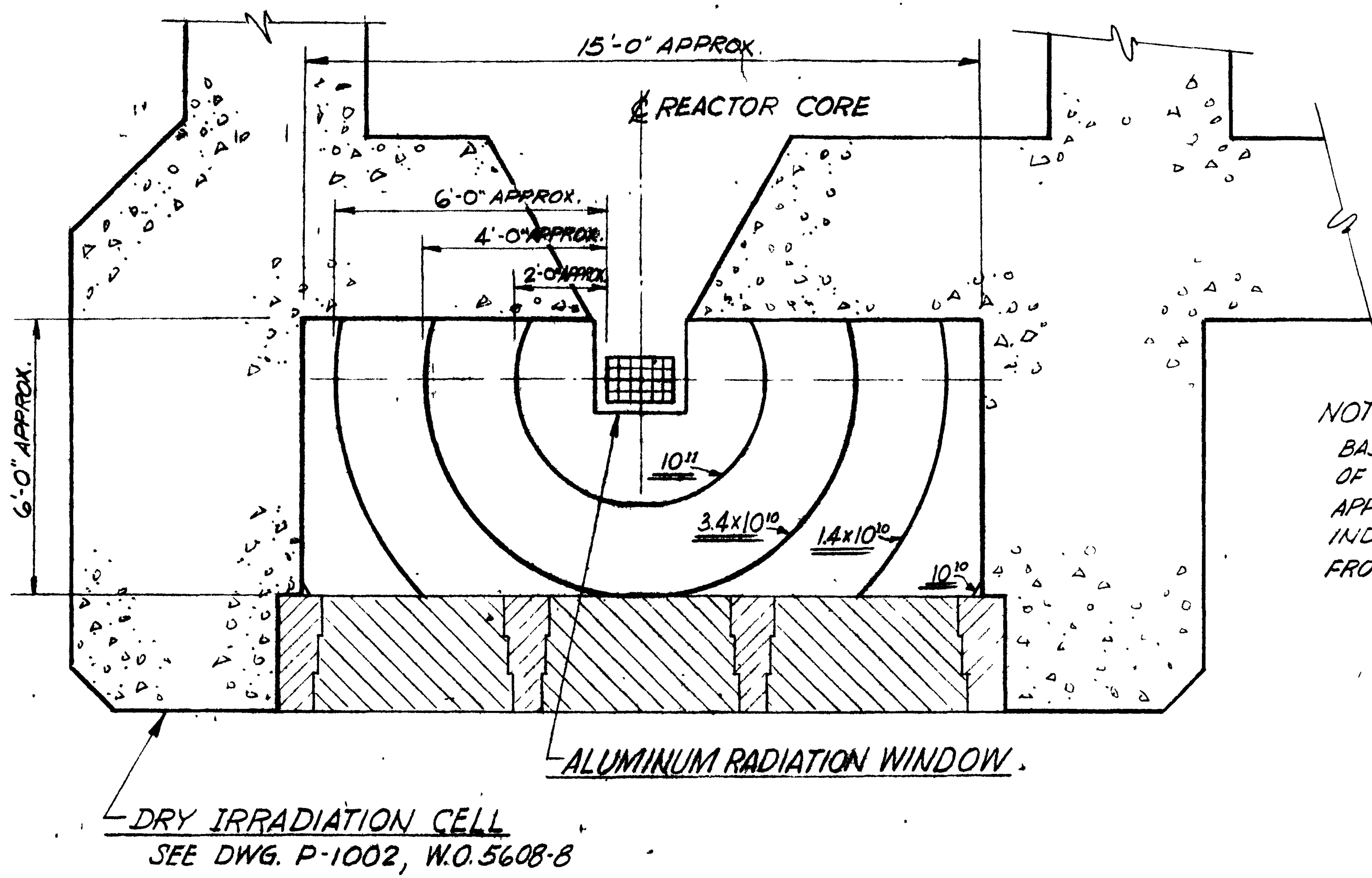
WALTER KIDDE NUCLEAR LABORATORIES, INC. GARDEN CITY, N. Y.					
IRRADIATION FACILITY HOT LABORATORY SECTIONS					
DR. BY URLEVICH DATE 11-9-56	APP. BY J.H.F DATE 11-13-56	SCALE 1/8"=1'-0"	W. O. NO. 5608	DRAWING NO. P-1011	REV.

K·E ALBANENE 196L TRACING PAPER 10602



SECTION F-F

WALTER KIDDE NUCLEAR LABORATORIES, INC. GARDEN CITY, N. Y.					
IRRADIATION FACILITY GAMMA BUILDING SECTION					
DR. BY UREVICH	APP. BY J.N.F	SCALE	W. O. NO.	DRAWING NO.	REV.
DATE 11-9-56	DATE 11-13-56	1/8"=1'-0"	5608	P-1012	



NOTE:
BASED ON REACTOR POWER LEVEL OF 1 MW. FLUX LINES ARE APPROXIMATE; THEY DO NOT INDICATE DISTORTION RESULTING FROM RECTANGULAR CORE SHAPE.

WALTER KIDDE NUCLEAR LABORATORIES, INC.
GARDEN CITY, N. Y.

IRRADIATION FACILITY
FLUX PLOT-FAST NEUTRONS/cm^2/sec

DR. BY	APP. BY	SCALE	W. O. NO.	DRAWING NO.	REV.
UREVICH DATE 11-19-56	J. H. F DATE 11-13-56	~	5608-8	D-1013	