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FROM: W. L. Wright

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FORWARD

This memo has been prepared as the first step in collecting material for an overall report on the ORR Project.

Construction of the building is only partially complete and necessary changes and revisions in design are still being made, therefore this report will be revised and corrected as necessary before incorporation in the proposed overall project report.

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FIG. 1 ORNL. RESEARCH REACTOR PROJECT

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I. RESEARCH REACTOR BUILDING

1.1 GENERAL DESCRIPTION

The Research Reactor Building is a mill-type, semi-airtight, steel framed, insulated metal panel covered structure covering a first floor area 111' -8" long by 102' -10" wide. The floor level of the full basement is 20' -0" below the first floor level. Building height for the 60' wide center high-bay area is 64' -2" from first floor level to the bottom of the roof trusses. The height of the low-bay areas on each side of the high-bay area is 35' -6" from first floor to bottom of roof beams. The second floor is actually at street level on the west end of the building and extends the full width of the first floor, two bays long and 12' -6" above the first floor. The third floor is the top floor in the low-bay areas, extending the full length of the building, one bay wide on each side and 25' -6" above the first floor. The building is windowless to eliminate glare on the pool water surface and to ease the problem of making the building air-tight under emergency conditions. Fig. 1 shows a perspective and partial cut-away view of the structure.

Interior finish of the building is about equivalent to the standard for light manufacturing construction. Roof beams and steel framing are exposed, but painted. Utility conduit and pipe runs are exposed. Basement walls are painted only around the reactor substructure, and there for better light reflection characteristics. Floor finishes are hardened concrete, integrally color coded for safe floor loading identification. The third floor office and control room wing has a refined construction finish

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PLOT PLAN

FIG. 2

PLOT PLAN

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only to the extent that the floors have asphalt tile. Air conditioning in this area was necessary to insure proper operation of the reactor control equipment. Toilet areas have quarry tile floors and painted masonry walls.

1.2 SITE

The Research Reactor Building is located near the north-east corner of the X-10 area, approximately 140 feet west of the Rolling Mill (Bldg. 3012), 110 feet east of the Graphite Reactor (Bldg. 3001), 70 feet south of the LITR (Bldg. 3005), 90 feet southwest of the Swimming Pool Reactor (Bldg. 3010) and 150 feet northeast of the Physics of Solids Bldg. (Bldg. 3025). This site was chosen because of the convenience of integrating the new facility with existing similar installations, with respect to operating personnel, operational equipment, facility utilities, and accessibility by experimenters. See Fig. 2 for the area plot plan.

1.3 BASEMENT

The basement floor space is utilized for pool cooling and experiment cooling pumping facilities, pool water and reactor cooling water demineralizer units, pool fill and drain pumps, electric power distribution center, auxiliary ventilating fan and air filter bank, sub-pile room, plug storage facility, and experimental work and storage area. (See Fig. 3)

The water system components are located underneath the storage pools to take advantage of the shielding provided by the pool water. Shielding walls around the "hot" pumping equipment are of stacked barytes block with labyrinth doors where flexibility is necessary for removing or repairing pumps, and of cast-in-place reinforced concrete where permanent walls

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are required. The basement sump, (which is provided with a collection tank and a sump pump) is located in the water system area. All basement drain lines lead into the sump collection tank. Since gravity drain from the basement to the plant process system is impractical, the sump-pump discharges into the first floor drainage system.

The sub-pile room and adjacent pipe chase were designed on the basis of structural requirements to support the Reactor Structure and the necessary wall thickness to provide biological shielding. The latter requirement made necessary barytes concrete walls for the pipe chase to provide shielding from the reactor exit cooling water line. Since about 6' -0" of barytes aggregate covering was required where the 24" ϕ cooling water lines passed under the basement floor, the bottom of the pipe chase was established at an elevation 8' -6" below the basement floor. The sub-pile room footings could theoretically have been stepped up above the pipe chase footings to save some rock excavation, but in view of the sloping shelf rock formation prevailing in the area, this was deemed inadvisable. Therefore the 13' -6" x 10' -0" sub-pile room has an 8' -6" basement which is initially unused space.

The sub-pile room houses the mounting plate for all the reactor control mechanisms. Certain utilities are provided for experimental purposes, described elsewhere. The pipe chase contains most of the cooling system line inter-connections, and serves as a convenient location for cooling system instrumentation. The low points of all cooling system lines are in the pipe chase and draining of all lines for maintenance is from this point. The north wall of the pipe chase through which the cooling water lines pass is formed of stacked barytes concrete block above the first floor level.

FIRST FLOOR PLAN

FIG. 4

FIRST FLOOR PLAN

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A four foot square manhole filled with stacked barytes concrete block is provided in the opposite solid wall for pipe chase access. A removable instrumentation plug is located near the manhole.

Space is provided in the basement wall for storing 32 plugs used in the reactor beam holes and for 6 somewhat larger plugs provided for initial operation in the large-facility beam holes. Each plug-storage cylinder has an off-gas connection to the "hot" off-gas suction line leading to the 3039 area stack.

A water collection tank is located in a pit at the west wall near the low point in the off-gas system. Condensate in the off-gas system drains into the tank and is discharged into the "hot waste" line underneath the basement floor. The tank must be drained periodically by closing the valve on the line to the off-gas header, opening the line to the "hot waste" system and introducing compressed air reduced to 5 psig. A valve on the line from the off-gas header to the plug storage cylinders is also located in this drain pit.

All basement construction is reinforced concrete except for the 12" concrete block walls around the fan room and stair wells, and stacked block shielding walls. The floor is designed for a live load of 1000# p.s.f. Special service installations include a safety shower and two janitor's sinks with cold water only.

1.4 FIRST FLOOR

The entire floor area is free for experimental work except for the Reactor Structure, the stair wells and floor hatch for basement access. See Fig. 4 for a plan of the first floor area. The floor is of ordinary

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reinforced concrete construction, flat slab design except for framed openings, with the following slab thickness, design live load, and color code:

<u>Area</u>	<u>Thickness</u>	<u>Design Load</u>	<u>Color Code</u>
2 Bays A-B x 1-3	7"	200# psf uniform or a 5 ton concentrated load on 6 sq. ft in any bay	Terra Cotta
$\frac{1}{2}$ Bay A-B x 3-4	7"		
4 Bays A-C x 4-6	7"		
2 Bays B-D x 1-2	7"		
1 Bay C-D x 5-6			
3 Bays B-E x 2-3	54"	Floor designed for 3500# psf uniform load. Beams designed for 1/3 of this value.	Brown
1 Bay D-E x 1-2	11"		
2 Bays C-E x 4-5	54"		
1 Bay D-E x 5-6	11"		
3 Bays E-F x 2-5	11"	10 ton concentrated load on 10 sq. ft. adjacent to beam hole plus a *20 ton rolling load	Red
5 Bays F-G x 1-6	11"	*20 ton rolling load	Grey
1 Bay E-F x 1-2	11"		
1 Bay E-F x 5-1	11"		

*Note: The 20 ton design rolling load is based on a 5' long row of steel wheels carrying 16 tons and 4 tons concentrated on 1 steel wheel 7' from the main axle. This is an approximate description of the MTR type coffin.

The 54" slabs adjacent to the pool sides provide basement shielding from radiation emanating from experimental work being done in the "hot" cells that may be constructed on the first floor. The design load for this area represents the weight of a 16' high barytes block cell shielding wall.

The Reactor Structure covers an area 18' wide by 55' long west of the reactor centerline and to the east an approximate semi-circle of about 32' diameter. This structure is described elsewhere. Immediately in front of each of the two large-facility liners in the Reactor Structure is an

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8' -0" x 10' -0" hatch to the basement in a 17' -2" x 11' -0" x 2' -0" depression in the floor slab. The purpose of this design feature is to allow a cell of stacked block construction to be built around an experiment being done at the large-facility location on the first floor, and to make it possible to drop this experiment by remote control into a second shielded cell in the basement for dismantling or for storage during radiation decay. ORNL drawings D-16544 and D-16548 thru D-16558 show proposed details of how this operation could be performed. All details of actual building design in the large facility area, such as the beam pockets in the Reactor Structure, the large-facility liners, the basement hatch and depressed floor slab, and the floor loadings, are based on studies shown on the drawings listed above. Concrete plugs fitting flush with the depressed slab surface are provided for the hatch openings.

Numerous sleeves are provided in the first floor for instrumentation, experimental, or utilities communication with the basement. 4" ϕ sleeves on about 9' -0" centers are located all around the walls. Six 12" ϕ sleeves are located about 15 feet from the face of the Reactor Structure, 2' -0" off each beam hole center line. Four additional 12" ϕ sleeves are located just off column line 2 in the beam hole experimental area for general purpose use. Four 6" ϕ sleeves are located in the depressed floor slab at each large-facility installation and two additional ones convenient to the floor depressions. Seven 6" ϕ sleeves and eight 12" ϕ sleeves are spaced at the base of the storage pools. The 4" ϕ sleeves along the wall project 3" above the floor level. All other sleeves are fitted with sealed covers flush with the floor.

A 10' -0" x 16' -6" hatch with steel hinged cover provides crane access to the basement. This hatch cover is to remain normally closed for

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SECOND FLOOR PLAN

FIG. 5

SECOND FLOOR PLAN
O.R.N.L. RESEARCH REACTOR BUILDING 3042
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fire retarding purposes. There is a 10' wide x 16' high truck entrance door in the east wall to facilitate transporting equipment to be used in the beam hole experimental area.

A four inch curb all around the first floor area is intended to prevent area contamination in case of a leak in the Reactor Structure or a water release from any other cause. There is a four inch ramp at all first floor doors. This curb will direct water flow to the basement except in the case of a catastrophic pool release.

Personnel doors are located in each side of the east face of the building for convenience; the personnel doors approximately in the middle of the north and south faces are intended as emergency escapes.

Special service installations include two service sinks with cold water only, two safety showers, and a drinking fountain.

1.5 SECOND FLOOR

The second floor is actually at ground level on the west side of the building. This floor space is utilized for an office, men and women's toilet facilities, a janitor's closet, space for a "rabbit" station, and a truck loading area to facilitate handling equipment to be placed in the storage pools. See Fig. 5 for a floor plan. The floor is a reinforced ordinary concrete slab on steel framing, with the following slab thickness, design live load, and color code:

END

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THIRD FLOOR PLAN

FIG. 6

THIRD FLOOR PLAN

O. R. N. L. RESEARCH REACTOR BUILDING 3042

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SCALE IN FEET

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<u>Area</u>	<u>Thickness</u>		
1 Bay A-B x 1-2	4"	75# psf	Tan
2 Bays A-B x 2-4	7½"	200# psf or a 5 ton concentrated load on 6 sq. ft.	Terra Cotta
2 Bays A-C x 4-5	8½"	25 ton highway truck or 10 tons concentrated on 10 sq. ft.	Maroon.
2 Bays A-C x 5-6	4½"	75# psf	*Tan

*The toilet areas have a quarry tile floor.

The janitor's service closet contains a service sink with hot and cold water, a hot water heater for the toilets, and space for cleaning equipment, floor polishers, etc. No change house facilities or showers are provided since these services are available in other nearby buildings.

4" Ø sleeves for service communication to the first floor have been provided along the west wall, similar to those on the first floor.

Walls around the toilet area are designed to be permanent and are of eight inch concrete block construction. Walls around the second floor office are of the removable metal partition type, as some degree of flexibility of area enclosure is desirable in this region.

Personnel doors are provided at each side of the west face for convenience. Steps up to the balcony walkway around the Reactor Structure are located on each side of the pool. The only special service installation on the second floor is one safety shower.

1.6 THIRD FLOOR

The third floor contains the reactor control room, equipment and instrument repair room, and four offices on one side of the high bay

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area, laboratory working space on the other side of the high bay area, space for a future "hot" cell to be constructed at the west end of the Reactor Structure, and a walkway all around the Reactor Structure.

See Fig. 6 . . A fixed steel walkway extends from the control room wing of the third floor to the third floor level walkway around the Reactor Structure. Adjacent to this walkway are fixed steel stairs down to the balcony walkway around the Reactor Structure. Although these fixtures make for awkward maneuvering of the pendant controlled crane, it was the opinion that this inconvenience was not serious and did not warrant providing removable stair and walkway connections. Furthermore, the location and size of the Reactor Structure itself made necessary a special treatment of the crane control pendant.

All of the third floor is of reinforced ordinary concrete construction on steel framing, with slab thicknesses, design live load, and color coding as follows:

<u>Area</u>	<u>Thickness</u>	<u>Design Live Load</u>	<u>Color Code</u>
6 Bays A-G x 1-2	7"	150# psf uniform load or 3 ton concentrated load on 6 sq. ft. in any bay.	Tile Red
3 Bays A-D x 5-6	4"	75# psf uniform load.	*No color code
3 Bays D-G x 5-6	4"	150# psf uniform load.	*No color code
1 Bay A-B x 2-3	7½"	160 ton load distributed over bay (shielded cell).	Green
Pool Walkway	7½"	200# psf uniform load or 5 ton concentrated load on 10 sq. ft in any bay.	Terra Cotta

*These bays have an asphalt tile floor covering.

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Since no clear concept of the exact nature of the work to be done in the laboratories was available at the time of design, no conventional laboratory equipment or furniture was specified to be installed initially. However, headers carrying building utilities, with tees in the lines for making connections, are provided and described elsewhere in this report.

The laboratory wing area is divided into individual rooms by removable type insulated metal partitions. After experimental work is underway in the completed Reactor Building, these partitions can be rearranged to suit work space requirements, if necessary. This same type of removable panel is used in the control room wing on the third floor to partition the four offices, the control room, and the equipment and instrument repair room. Insulated panels were chosen because the entire control room wing is to be air conditioned, and it is deemed quite probable that at least part of the laboratory wing will be air conditioned after the work areas have been assigned to the various experimenters. There was no basis for the small second floor office to have insulated wall partitions except to maintain conformity throughout the building. The front of the control room contains plate glass sections in the wall partition to enable the reactor operator to have a full view of the Reactor Structure. The glass panels have a 5° slope out from the top to eliminate glare from the building lights.

The area at the west end of the Reactor Structure where the future "hot" cell construction is anticipated is designed to support three feet thick barytes concrete shielding walls around a cell having clear inside dimensions 3' -6" wide x 7' -0" long x 7' -0" high.

The pool wall construction is such that additional shielded cells may be built directly over the pool. ORNL drawings D-22463 and D-22464 show

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details of how such a cell might be constructed. Beam pockets and wall recesses are provided in the structure to accommodate future cell construction.

4" $\emptyset$ pipe sleeves similar to those on the first floor are located along the outside wall in the laboratory wing and the "hot" cell area. Floor slots of varying width with steel cover plates are provided in the floor along the back wall of the control room and next two adjacent offices to facilitate pulling cable through conduits. In addition to the conduit sleeves in the control room floor required for initial installations, standby sleeves are provided in the control room and in the equipment and instrument repair room, where possible future control expansion is envisioned. These standby sleeves have flush plugs and are covered by the asphalt tile.

Special service installations include an emergency shower in the "hot" cell area, two drinking fountains and a service sink. Outside stairs for emergency exit are located at the east end of both the laboratory and control room wings. The crane access ladder is from the third floor.

1.7 CRANE

The high-bay area houses a 20 ton bridge crane with a 1 ton auxiliary hoist. The nominal crane span is sixty feet. The main hook capacity was established by the weight of the large-facility dummy-plug, and the beam hole coffin which weigh about twenty tons each. The 1 ton auxiliary hook is primarily for handling tools and small equipment around the reactor area, where mobility for light loads is necessary.

The original design criteria established a hook clearance of 30' -0" above the top of the pool. This was the height necessary to lift out of

WELLS

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the pool a handling tool extending to the pool bottom. During the course of the design period the elevation of the reactor pool bottom was revised and the depth of water above the reactor center line was increased 3' -0" for shielding reasons. Based on a representative specified dimension of 1' -8" from the high main hook position up to the top of the crane rails, the final hook clearance above the pool parapet is 26' -8 11/16". Since the depth from the top of parapet of the reactor pool is 29' -8" and of the storage pools, 27' -6", the hook clearance provided is considered satisfactory. The longest pool gate section is 15' -8" and the total reactor tank length is about 15' -3". Figs. 7 and 8 show longitudinal and transverse sections through the building which indicate the area having crane service.

The 28' -6" high x 28' -0" wide Reactor Structure extending down the center of the crane bay made crane control somewhat of a problem. Because of infrequent crane use, operation from an attached cab was considered impractical. Consideration was given to push-button operation from fixed stations about the building, but this was rejected because of the installation expense and because the operator would not have an unobstructed view of the hook at all times. The control method selected employs a pendant push button station suspended from a motor driven hoist mounted on the crane trolley. The pendant has proper push buttons and limit switches, in addition to the crane control buttons, to raise or lower the pendant for convenient first floor or third floor operation. A "down" button is located on a building column at the third floor to lower the pendant should it inadvertently be allowed to swing out of reach from the third floor. The pendant has push buttons to obtain the following operating speeds at rated load capacity:

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SCALE IN FEET

FIG. 7

SECTION "A - A"

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FIG. 8

SECTION "B - B"

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Max.

Bridge	3 speed, reversible	50 fpm	3 fpm
Trolley	3 speed, reversible	50 fpm	3 fpm
Main Hoist	5 speed, reversible	25 fpm	3 fpm
Auxiliary Hoist	2 speed, jog, reversible	50 fpm	3 fpm
Pendant	Single speed, reversible	50 fpm	----

1.8 REACTOR STRUCTURE

1.8.1 Pool Construction

The Reactor Structure is actually a reinforced concrete, aluminum-lined, ten foot wide tank, with a 39' -0" long by 26' -6" deep storage section and a 21' -10" long by 28' -8" deep reactor section. The reactor section and storage sections are divided by a removable, two-piece, water-tight gate, and the storage section is divided into two equal size pools by another identical gate.

The length of the reactor pool section is sufficient to accommodate "Swimming Pool" type experiments on the side opposite the beam hole face of the reactor. The storage pool length was determined by the remaining distance to the west wall of the building, allowance being made for a passageway around the end of the pool. The space will be utilized to store fuel elements, all irradiated items of equipment, and will also serve as an experimental area involving high intensity sources. The separated storage area permits emptying and cleaning of the pools without the necessity for removing all the pool contents to another building for interim storage. The pool gates are of aluminum and stainless steel construction, rubber sealed, designed to withstand hydrostatic pressure for the full height of the gate, on either side, without leaking.

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The three pool sections are lined on the sides and bottom with 1/4 inch thick aluminum plate. An economic study was made of the relative costs of an aluminum liner versus an Amercoat paint coating, and the aluminum liner proved to be more economical on long term maintenance in addition to separating the problem of leakage from the concrete structural shielding problem. The liner on the pool sides is welded to aluminum structural members embedded in the concrete on about 3 ft. 6 in. centers. A 2" x 8" aluminum bar on each side of the pool is welded to these structural members at about the mid-pool depth to provide support for a false bottom in the pool sections. Although no immediate need is foreseen for this false bottom, it improves the flexibility of the pool-use potential. These support bars were installed at the time of initial construction in order to attach them directly to the liner structural members rather than the liner shell itself. The bars are designed to support a uniform live load of 3 tons per foot of pool length. In the reactor pool section two additional 2" x 8" bars are provided at an elevation 4 ft. 6 in. above the reactor center line. These additional bars are intended to support a temporary catwalk at a convenient height for working on the reactor tank, and as convenient supports for experiments placed around the reactor.

The Reactor Structure is of reinforced barytes concrete construction throughout, except for the balcony and third floor walkways. All thicknesses are based on shielding requirements. The pool width of 10 ft was more or less arbitrarily established on the basis of achieving an optimum economic combination shield of water and barytes concrete in the wall around the reactor. The pool bottom thickness is 4 ft. The storage pool sides are 4 feet thick up to elevation 844' -0", or 14 ft. above the reactor center line. This elevation is about 4 ft. above the future false

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bottom in the pool; thus shielding is provided from a radiation source that may be stored on this bottom. The wall thickness decreases from 4 ft. to 2 ft. 6 in. all around the Reactor Structure except underneath the future hot cell location on the third floor. The 2 ft. 6 in. thickness extends to the third floor level. The pool parapet is 3 ft high and 18 inches thick above the gutter, 24 in. thick below the gutter. The water level is 1 ft. below the top of the parapet. A 6" x $\frac{1}{2}$ " continuous aluminum plate embedded in the top of the concrete parapet extends along the pool sides. Aluminum was specified because the pool liner is welded to this plate to form a water seal. The function of the plate is to serve as a bed plate for trolley rails.

The 7 ft. width for the walkway around the top of the Reactor Structure was arbitrarily selected. This seemed to be a reasonable width for an experimental instrumentation cabinet and personnel walkway. The pipe handrails were arbitrarily made removable. Removable handrails at the balcony are necessary for placing equipment raised with the crane so removable railing was specified throughout.

2" ϕ sleeves on about 2' -0" centers through the third floor walkway at the outside edge provide service communication from the third floor to the balcony. Junction boxes on about 4' -0" centers located flush with the pool parapet face provide communication through 2" ϕ conduits either to the pools, just above the gutter, or to the balcony wall, just below the ceiling level. These conduits allow service communication to the pool without interfering with the pool bridge operations. 8" ϕ flanged sleeves through the pool walls on about 8' -0" centers are located 2' -6" above the balcony floor. These sleeves are more closely spaced in the reactor pool section, and are installed only for the anticipated future convenience of experimenters.

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Conveniently located 2 ft. square floor hatches through the third floor and balcony walkways make available to an experimenter any of the building utilities provided. These utilities, described elsewhere, are in headers running underneath the third floor and balcony. Sleeves through the pool gate walls make possible direct communication from the reactor proper to any part of the storage pools. A bridge capable of supporting at total load of 6000 pounds spans the pool and can be manually positioned at any point along the length of the pool structure.

1.8.2 Experimental Area Construction

The shape of the Reactor Structure around the reactor tank is designed to provide the maximum area for experimental purposes. It was possible to space six sleeves for reactor beam holes on one face of the lattice housing in the reactor tank by alternately staggering the sleeves on two horizontal center lines 9" apart, and by making the face of the Reactor Structure end semi-dodecagonal shaped. The large-facility installations consist of a 5' -5" diameter sleeve through the pool wall on each side of the reactor tank, concentric with the reactor fuel section center line. These sleeves provide direct access to each of the lattice housing side plates.

The six beam hole sleeves are of aluminum construction shaped as shown in Fig. 9. Each beam hole sleeve terminates in a 2' -6" deep x 2' -6" high x 2' -6" wide, steel-lined cubicle recessed in the face of the Reactor Structure. Just behind the back of the cubicle, each beam hole liner has a $1\frac{1}{2}$ " ϕ aluminum pipe branch connection for the introduction of cooling water into the beam hole sleeve. This branch terminates in a threaded and capped end in the reactor pool, about two feet

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below the pool gutter. Access to this cooling water branch from the beam hole cubicle is provided by means of a tee connection terminating in a plugged threaded coupling flush with the cubicle lining.

A 9" thick by 18" wide lead shielding door is installed in each cubicle, flush with the front of the Reactor Structure and centered on the beam hole center line. The door is designed to be opened by raising vertically, and a recess in the Reactor Structure above the cubicle accommodates the door in its open position. A $1\frac{1}{2}$ " $\emptyset$ steel shaft connects to the top of the lead door and terminates in an eyebolt just above the balcony curb when the door is in its closed position. A 1" $\emptyset$ threaded eyebolt through the third floor walkway curb lines up with each door operating shaft below. The shielding doors are opened by hanging a chainfall from the eyebolt on the balcony ceiling and lifting the door shaft. The chain fall hanger shaft and door shaft are in 2" $\emptyset$ pipe sleeves.

The large-facility liners connect on the inside of the pool to an aluminum dished head having an obround 19" x 25" connecting sleeve through the reactor tank walls to the reactor lattice side plates. Inside the pool walls, each liner has a $1\frac{1}{2}$ " $\emptyset$ aluminum pipe branch from the liner top for admitting cooling water, similar to the beam-hole cooling lines. These lines are accessible from the outside pool wall, just above the large-facility liners, through a tee connection terminating in a plugged coupling flush with the wall. The liners have a drain from the liner bottom to the vertical wall just below the liners. This drain is a $1\frac{1}{2}$ " $\emptyset$ aluminum pipe, terminating in a plugged coupling flush with the wall.

The most practicable solution to the problem of providing utilities to experimenters was determined to be by making these utilities accessible for use in any desired manner rather than having them "built-in", with

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limited flexibility. For this reason, there is a horizontal chase 1' -0" wide by 1' -0" deep beneath the beam hole cubicles, extending all around the end of the Reactor Structure. This chase provides space for any piping arrangement between the beam hole cubicle area and plugged tees in the compressed air, plant process water and demineralized water headers on the basement ceiling just below the beam hole area. Power also is available in the basement header area from two 440 volt 3 ϕ bus ducts. Access from the chase to the basement is through twelve 4" ϕ open pipe sleeves or through a 12" x 12" vertical chase near each end of the horizontal chase. The vertical chases through the floor continue up the Reactor Structure face as slots for utility piping to the balcony floor. There are covered floor hatches on the third floor walkway over each of these slots. Other utilities available in the horizontal chase described in detail elsewhere in this report are cubicle cooling water supply from the main reactor cooling loop supply side, plant process drains, "hot" waste drains and off-gas connections.

Each beam hole cubicle connects to the horizontal chase wall through eight 1 $\frac{1}{2}$ " ϕ stainless steel pipes, suitably plugged at each end. An additional 1 $\frac{1}{2}$ " ϕ stainless steel pipe connects a drain in the bottom of the beam hole cubicle to the horizontal chase ceiling. One 1 $\frac{1}{2}$ " ϕ standard conduit leads from the top of each cubicle up to the balcony floor and terminates in a flush plug connection. An off-gas line, and a branch from the cubicle cooling water return line terminate in 1 $\frac{1}{2}$ " ϕ flush plugged connections inside each cubicle.

Utilities are supplied to each large-facility installation through sleeves leading from the back wall of the vertical chase to the face of the Reactor Structure wall forming the large-facility recesses. Five 2" ϕ sleeves and five 1" ϕ sleeves are provided for this purpose. Sleeves are stainless steel, fitted with threaded couplings and brass plugs at each end.

Ten feet above the first floor level the reactor pool wall thickness increases from 4' -0" to 7' -0". The thickened wall section goes up to the balcony floor, and from the wall forming the large-facility recess to a point 15' -0" west of the reactor center line. This increased wall thickness forms a 3' -0" wide by 20' -6" long overhang over the large facility opening. Sleeves from the bottom of this overhang and terminating on the vertical face of the wall above are provided for communication to a large-facility experiment enclosed in a shielding cell. Two 4" ϕ sleeves and four 2" ϕ sleeves are provided for this purpose - all stainless steel terminating in threaded couplings with flush plugs at both ends. Two additional 4" ϕ sleeves and four additional 2" ϕ sleeves, similarly constructed, extend from the bottom of the large-facility overhang to the balcony floor. These lines have off-sets, which minimize radiation streaming from a shielded experiment. Three 6" ϕ sleeves from the overhang ceiling extend directly up to the balcony floor, offset to 8" ϕ sleeves about midway up to prevent annular radiation streaming. These sleeves terminate on the balcony floor in sealed plate covers flush with the floor. These sleeves look straight down on an extension of the large-facility liner centerlines, and must be fitted with shielding plugs if a "hot" experiment is being conducted on the first floor in front of the large-facility openings.

Varying lengths of "Unistrut" are embedded in the Reactor Structure east face, both above and below the first floor, and on the pool wall area above each of the large-facility liners. There is also a "Unistrut" insert on the walls of each vertical chase. These "Unistrut" inserts are provided for convenience in attaching piping, instruments, experimental equipment, etc., to the Reactor Structure walls. Pockets in each side of the Reactor Structure walls between column line D and E are to accommodate roof beams for a future "hot cell" that may be built in front of the large-facility sleeve.

REACTOR AND POOL STRUCTURE
HORIZONTAL SECTION

FIG. 9

REACTOR AND POOL STRUCTURE
HORIZONTAL SECTION

O. R. N. L. RESEARCH REACTOR BUILDING 3042
OAK RIDGE NATIONAL LABORATORY

II BUILDING UTILITIES

2.1 PLANT PROCESS DRAINAGE SYSTEM

An 8" ϕ plant process drain sewer leaves the building on the east side near column line 3 at invert elevation 818.6', or about 7' -10" below the first floor level.

All basement process drains lead to a tank sump, from which a sump pump actuated by a float switch discharges waste to the first floor drain network. The sump pump is rated at 50 gpm against a 40' head. The bottom of the 4' -4" square by 6' -0" high sump is at elevation 793' 46", thirteen feet below the basement floor level.

All basement floor drains and piping are of Duriron construction for corrosion resistance. The floor drains have traps and stainless steel covers. Adequate floor drains are installed on the basement floor, including drains in the ventilating air intake shafts, the sub-pile room, basement, and in the pipe chase behind the sub-pile room. A by-pass piping system enables the main reactor cooling loop and pool cooling loop demineralizer unit waste to be pumped into the basement floor drain system, or into the "hot waste" drain system. The steam condensate pump in the basement pumps condensate directly up to the outside roof-drain sewer.

All floor drainage above the basement floor is by gravity flow to the outside plant process sewer. Drinking fountains drain into the roof drain system and service sink waste drains into the plant process drain.

All floor drains except those in the toilet area and in the Reactor Structure are of Duriron, with traps and stainless steel covers. The drain piping embedded in the concrete, except in the above mentioned

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areas, is of Duriron. Drain lines not embedded in concrete are extra heavy cast iron. Drain piping in the Reactor Structure is galvanized malleable iron and stainless steel.

Floor drains are provided at a number of points on the first floor, second floor, and on the third floor at the west end of the pool. No floor drains are located in the third floor laboratory wing, offices or control room. There is one floor drain in the equipment and instrument repair room near the air conditioning unit, and a connection for the air conditioning unit condenser cooling water disposal into the roof drainage system. A 3" ϕ plant process drain header extends along the outside walls of the laboratory wing just above the floor. This runs the full length of the building and has been installed to meet the future anticipated need for service sink drains. This header has capped tees at about twelve foot intervals which the experimenters may utilize in any manner desired. The header is pitched from each end of the building to drain to a 3" ϕ riser along the south wall from the first floor drainage network.

Process drain lines buried in the Reactor Structure are of stainless steel. Three process drain branches terminate in threaded couplings with brass plugs flush with the horizontal chase floor below the beam hole cubicles. A similar process drain is located on the first floor directly in front of the large facility station on each side of the Reactor Structure. These five outlets are divided between two headers emerging from the east face of the Reactor Structure and connecting to the first floor drainage network.

On the third floor walkway there is one floor drain at the east end of the pool, one floor drain on each side of the pool near the first gate section, and one floor drain on the south side of the pool walkway near

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the west end. There is a plant process drain at the three "pool side utility group" stations on the third floor. These drains are threaded couplings of $1\frac{1}{2}$ " $\emptyset$ galvanized malleable iron pipe fitted with steel covers flush with the floor. The process drain headers branching to these third floor outlets run along the balcony ceiling, one on each side of the Reactor Structure. There is a plugged $1\frac{1}{2}$ "x $1\frac{1}{2}$ "x $1\frac{1}{2}$ " tee on each header opposite the third floor pool walkway hatches. These plugged outlets are intended for experimenters convenience.

The headers at the balcony ceiling drop vertically to run underneath the balcony floor at a point about on a line with the first gate section, at the outside edge of the pool walkway. From this point the headers run toward the west end of the pool, and again drop vertically about on a line with column line B, and lead into the second floor process drain network. There is one floor drain on the balcony floor on each side of the pool, about on a line with the second pool gate section. The process drain in the second floor "pool side utility group", at the west end of the pool, is the same as described above for the third floor "pool side utility groups".

2.2 DEMINERALIZED WATER SUPPLY

Demineralized water, both for cooling system use and experimental use, enters the building through the basement wall near the northwest corner. The supply is through a 2" $\emptyset$ stainless steel line. Just inside the building the supply line has a gate valve, and beyond the valve all the piping is aluminum.

The 2" $\emptyset$ demineralized water supply main connects through an automatic valve to the 400 gallon reservoir in the basement. A 1" $\emptyset$ branch from the supply main leads to the pool cooling system demineralizer, and a 2" $\emptyset$ branch connects to the main reactor cooling loop demineralizers.

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A 2" ϕ valved header runs from the supply main, horizontally along the pool sub-structure, and extends across the front face of the sub-pile room. This header has two plugged tees symmetrically arranged on each side of the sub-pile room face, which provide for easy access by experimenters in the beam hole area to a demineralized water connection. Access from the first floor is through floor sleeves in the horizontal chase below the beam hole cubicles.

Another 2" ϕ valved branch from the basement supply main supplies demineralized water to the second floor "pool side utility group" and the three third floor "pool side utility groups". The branch to the third floor group runs along the balcony ceiling and has a plugged tee at each floor hatch in the third floor walkway. On the north side of the pool a valved branch admits demineralized water directly into the pool at about the midpoint of each of the three pool sections, just below the balcony ceiling. These three terminals are 2" ϕ threaded couplings, extending $\frac{1}{2}$ " inside the pool, and are for experimenters' use.

The supply of demineralized water to any user around the reactor structure will be considerably curtailed if any of the three demineralizer units in the basement are being regenerated, or if the 400 gallon storage tank in the basement is being filled from the building supply header.

2.3 COMPRESSED AIR

Compressed air at 90 psig from the plant distribution system enters the building through the north basement wall at column line B in a $1\frac{1}{2}$ " ϕ header. Immediately inside the building, the header enters an air filter. From a tee stem just following the filter a $1\frac{1}{2}$ " ϕ valved branch runs along the basement ceiling of the north wall, feeds a $1\frac{1}{4}$ " ϕ vertical riser at column line C, then reduces to 1" ϕ and continues out the east wall of

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the basement in the electrical duct. The air line in the electrical duct is for instrumentation purposes in the reactor cooling system.

The $1\frac{1}{4}$ " vertical compressed air riser at column line C has a 1" ϕ valved outlet just above the first floor for penumatic ventilation controls. Above this valved outlet the branch reduces to 1" ϕ and continues along the north wall of the building terminating in two valved outlets for penumatic controls just above the third floor - one in the control room and one adjacent to it in the equipment and instrument repair room.

From the exit side of the tee cross just following the filter at the building entrance, a second $1\frac{1}{2}$ " ϕ header extends across the building on the basement ceiling and feeds the following branches:

1. A valved $1\frac{1}{2}$ " ϕ branch, extending horizontally along the pool sub-structure and across the end of the sub-pile room, having two plugged tees accessible to experimenters through first floor sleeves in the horizontal chase below the beam hole cubicles.

2. A $\frac{1}{2}$ " ϕ branch up to the second floor and terminating just above the floor in a valved outlet for pneumatic door-closer controls.

3. A valved $1\frac{1}{4}$ " ϕ branch up to the top of the Reactor Structure, terminating in $3/4$ " ϕ valved outlets just above the floor at one second floor and three third floor "pool side utility group" stations. The lines feeding the third floor pool side utility groups run along the balcony ceiling and there is a plugged tee in the line at each of the seven hatches in the third floor walkways, provided for the anticipated convenience of experimenters.

4. A $\frac{3}{4}$ " ϕ branch to the main reactor cooling loop demineralizers, which connects through individually valved lines to both the mixed bed units and both the cation exchange units.

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Just beyond the $\frac{1}{4}$ " ϕ branch to the demineralizers, the basement header is valved, and reduced in size to $1\frac{1}{4}$ " ϕ . This header continues across the basement ceiling to the south wall. At the wall, the $1\frac{1}{4}$ " ϕ header continues east from a tee stem. The exit side of the tee cross reduces to $3/4$ " ϕ , and rises vertically along the south wall midway between column lines A and B to a point just above the third floor in the laboratory wing. This $3/4$ " ϕ branch runs along the outside laboratory wall for the full length of the building and has valved outlets on about twelve foot centers for anticipated laboratory use.

The $1\frac{1}{4}$ " ϕ header from the tee stem is valved just following the stem, and continues along the wall to column line C. At this point the header branches, one 1" ϕ branch rising vertically and terminating just above the first floor in a valved outlet for pneumatic operator control, and one valved $3/4$ " ϕ branch continuing across the basement and terminating at the valve on the east wall admitting air to the off-gas drain tank.

2.4 PLANT PROCESS WATER

A 6" ϕ cast iron plant process water header to the building connects to the plant process water distribution system about 65' north of the Research Reactor Building. The header has a valve and roadway box just following the connection to the plant distribution system.

This header enters the building on the north side at the northeast corner of the building at the basement ceiling. Inside the building the header turns toward the west end of the building at the ceiling to about column line C. At this point the 2" ϕ aluminum emergency cooling line to the reactor connects to the plant process header. There is a replacable cathode protector in the aluminum line at the aluminum and cast iron

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junction to prevent galvanic corrosion. The valve stem opening the reactor emergency cooling line extends above the first floor and is operated through a bevel gear arrangement by a hand wheel located on the wall outside the building.

The 6" ϕ process water header continues along the basement ceiling near the west wall to a point about on a line with column line 4. At this point a 4" ϕ valve riser comes up through the first floor and continues up to the top of the Reactor Structure, where branches lead to the second floor and three third floor 1½" ϕ valved outlets in the pool side utility groups. These branches run along the balcony ceiling and have plugged tees at the third floor hatches.

A 4" ϕ valved branch header from the basement main extends along the pool substructure and across the sub-pile room face. This branch has a plugged tee on each side of the sub-pile room face, for plant process water supply to experimenters on the first floor beam hole area.

A 1" ϕ branch from the basement main leads to the pool cooling system demineralizer, and another 1" ϕ branch leads to the main reactor cooling loop demineralizers. These lines are wrought steel to the control gate valve on each header, and stainless steel from the gate valve to the demineralizers.

Just following the second demineralizer branch, the basement header decreases in size to a valved 1½" ϕ line, and continues across the basement ceiling to the south wall where it rises vertically to just above the third floor laboratory wing floor. The line then extends along the entire length of the outside laboratory wall just above the floor, with plugged tees about every twelve feet.

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2.5 POTABLE WATER SUPPLY

The potable water supply to the building is through a 3" $\emptyset$ line entering through the west wall of the building just underneath the second floor level. The potable water line is actually a branch from the 6" $\emptyset$ fire main, connecting to the fire main at a tee approximately 15' west of the building face. The potable water line and fire main enter the building side by side, two feet apart. The potable water line has a gate valve and valve box just outside the building.

All hose bibs, safety showers, drinking fountains and janitor's sinks are on the potable water line. Cold water only is supplied to all janitors' sinks, except in the second floor janitor's closet, which has both hot and cold water. All water supplied to the second floor toilets is from the potable water main, as is the water for condenser cooling in the third floor air conditioning unit.

2.6 FIRE PROTECTION

Structural features in the building specifically intended for fire protection are fire proof enclosures around the basement stair wells and a hinged hatch cover to remain normally closed on the 10' -0" x 16' -6" first floor opening.

The principle mechanical fire-protection feature consists of a fire main system in the building for hose units. Each hose rack cabinet contains 75' of 1 $\frac{1}{2}$ " $\emptyset$ fire hose, an all-purpose nozzle and a 15# CO₂ fire extinguisher. Two hose rack cabinets are located on the basement, first and third floors, and one on the second floor. 15# CO₂ extinguishers are located in the control room and in the instrument repair and equipment room.

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Two portable 100# CO₂ extinguishers are provided for both the basement and first floor areas. A siamese-pumper connection is located on the outside of the building at the second floor main entrance on the west side.

Six fire alarm boxes are located in the building as follows:

Basement - Col. A-4

1st Floor - Col. C-2, C-5

2nd Floor - Col. A-5

3rd Floor - Col. A-2, D-5

The master alarm box and annunciator are located on the outside of the building on the west end near column A-5

All ventilation fans in the building are interlocked with the fire alarm system to automatically stop ventilation when the fire alarm is sounded from the building. All air intake and exhaust openings in the building have automatic louvers which close when the fan motor stops.

2.7 BEAM-HOLE CUBICLE COOLING

A 4" ϕ header in the Reactor Structure provides beam-hole cubicle cooling water from the return side of the main reactor cooling loop. The 4" ϕ cubicle cooling return header connects to the exit side of the main reactor cooling loop. The capacity of the facility cooling pump is 400 gpm at 35 feet dynamic head. At rated capacity this provides a flow of 20 gpm to each of six beam hole cubicles, a flow of 100 gpm to each of the large facility installations and a by-pass flow of 80 gpm through the demineralizers.

Branches from the supply header terminate in five threaded couplings with brass plugs in the horizontal chase below the cubicles, each extending 2" above the floor of the chase. Three of these terminals are 1½" ϕ ,

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located between pairs of cubicles, and one 2" ϕ terminal is located at each end of the horizontal chase to provide cooling for the large-facility experiments.

The cubicle cooling return header is located approximately 3' -6" minimum inside the Reactor Structure to insure shielding from activity in the cubicle cooling exit line. Branches from the return header terminate inside each of the six beam hole cubicles in 1½" ϕ threaded couplings with recessed plugs, flush with the cubicle wall. A 3" ϕ branch terminates in a threaded coupling and brass plug located 7' -6" above the first floor flush with the wall forming the large-facility recess on both the north and south side of the Reactor Structure.

Both supply and return cubicle cooling headers have single valves to cut off the water flow. These valves are located in the shielded facility cooling pump cubicles, and have extension handles through the shielding wall. Operation is from the basement floor.

There is a 1½" ϕ branch from the cubicle cooling supply header to the sub-pile room, terminating in a stainless steel gate valve. There is no cubicle cooling return outlet in the sub-pile room.

2.8 OFF-GAS

An underground 8" ϕ stainless steel off-gas header connects the building services to the 12" ϕ off-gas duct leading from the 4500 building to the 3039 stack. The estimated vacuum available at the connection is 40 inches of water. A pull-handle slide valve is located in the building header just before it enters the 4500 duct. The distance from this connection to the point where the header passes underneath the building wall is approximately 170 feet.

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The off-gas header enters the building below the basement floor and comes up through the Reactor Substructure on the south side of the sub-pile room entrance. Two 4" ϕ pipes fitted with threaded couplings and brass plugs connect to the 8" ϕ header at a point 5' above the basement floor, one terminating inside the sub-pile room and one terminating outside. The outside sleeve terminates in a 4" deep by 18" square recess for lead brick shielding should the off-gas flow become "hot". Both these plugged pipes are provided for anticipated future experimenters use.

At elevation 825' -2 $\frac{1}{2}$ " the main off-gas header decreases in size to 6" ϕ and has a 6" x 6" x 3" tee, the 6" ϕ line extending up toward the top of the reactor and the 3" ϕ branch header extending in a horizontal plane approximately four feet inside the face of the Reactor Structure to pick up the branches from the experimenters' station around the Reactor Structure face. Near its end, the 3" ϕ header bends up and terminates in a threaded coupling fitted with a brass plug located 7' -6" above the first floor, flush with the wall forming the north side large-facility recess. Three 1 $\frac{1}{2}$ " ϕ branches from the 3" ϕ header terminate in threaded couplings fitted with brass plugs extending 2" above the bottom of the horizontal pipe chase in the Reactor Structure at the first floor level. These plugged pipe terminals are located approximately midway between pairs of beam hole cubicles. Also, a 1 $\frac{1}{2}$ " ϕ branch terminates inside each beam hole cubicle. These terminals have threaded coupling fitted flush with the cubicle wall and have recessed brass plugs. All plugs are solid brass and all couplings are stainless steel.

From the 6" ϕ header extending up, there is a 3" ϕ branch to the wall forming the south side large-facility recess, similar to that on the opposite side.

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Approximately 15" below the third floor level the 6" ϕ header going up connects to two 4" ϕ headers, one running horizontally along each side of the pool walls. Directly above the 4" ϕ branch connections, the main 6" ϕ header reduces to 3" ϕ and terminates in a valved outlet 1' -6" below the top of the pool parapet, on the third floor walkway at the end of the pool.

The 4" ϕ headers embedded in concrete along each side of the pool wall each have three short 2" ϕ branches terminating in threaded couplings just above the gutter in the reactor pool section. These couplings are fitted with recessed plugs. 3/4" ϕ branches are connected to the ball-float traps on the main reactor cooling circuit for venting the cooling system and the reactor tank.

There is a plugged 3" ϕ branch just under the third floor walkway level at each of the seven floor hatches located on the third floor for balcony communications. On the south side of the pool wall the horizontal header terminates at the west floor hatch.

One additional 3" ϕ valved outlet is provided on each pool walkway approximately in line with the first pool gate section. These two stations, plus the third floor outlet at the reactor pool end and the second floor outlet at the west end of the storage pool are a part of the "pool-side utility group".

The valved 3" ϕ outlet at the west end of the pool located 6' -0" above the second floor is the terminal point of the north side horizontal header. All parts of the off-gas system are sloped to a drain point, except for the short length of vertical pipe from the second floor valved outlet to the horizontal header above.

Except for the branch to the ball-float trap in the reactor cooling system, all outlets installed in the Reactor Structure are for the use of experimenters.

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A $1\frac{1}{2}$ " ϕ off-gas line runs from the demineralizer area to the 8" ϕ entrance header, connecting to it underneath the basement floor just before the header bends upward into the Reactor Substructure. This $1\frac{1}{2}$ " ϕ line is installed to vent the two main cooling loop demineralizer units and the pool cooling system demineralizer units. $\frac{1}{2}$ " ϕ branches from the $1\frac{1}{2}$ " ϕ header to the two main cooling loop mixed bed exchangers and cation exchangers come up from underneath the basement floor inside the demineralizer shielding cells. Valves from extension handles through the shielding walls control the flow from each of the four demineralizer component units. From the main cooling loop demineralizer area the $1\frac{1}{2}$ " ϕ header reduces to 1" ϕ and continues underneath the basement floor to the pool cooling loop demineralizer near the west basement wall. The line comes up from underneath the floor at a point near the unit and branches from a $\frac{1}{2}$ " x $\frac{1}{2}$ " x 1" tee enters the top of the anion exchanger and cation exchanger. A valve is installed on the branches between the tee and the exchangers. No off-gas line shielding is provided in this area.

A $2\frac{1}{2}$ " ϕ header leads from the two plug storage envelopes to the 8" ϕ entrance header at a point just within the building line. This line passes through the off-gas drain pit, where a valve is located for flow regulation. $3/4$ " ϕ branches from this header connect to each of the thirty-eight plug storage sleeves.

There is a 1" ϕ off-gas line from the eleven thousand gallon decay tank to the 8" ϕ entrance header, connecting at the elbow where the pipe bends underneath the building. This line connects to the decay tank through a ball-float trap, valved on each side of the trap. An additional branch from the 1" ϕ header connects to the main reactor cooling loop exit line

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at the 36" x 24" reducer, just before the line enters the expansion pit. This branch connects to the water main through a ball-float trap similar to that installed on the decay tank.

All off-gas lines in the entire system are stainless steel, and are shielded to some extent, except as noted. The system is sloped to drain, except as noted, to the elbow in the 8" ϕ entrance header where the line bends to come underneath the basement floor. A gravity flow line is installed from this low point to a five gallon capacity storage tank in a pit in the basement floor at the east wall, between column lines 2 and 3. Discharge from this tank is into a 1" ϕ "hot waste" line, achieved by admitting 5 psig air into the tank. Valves on the entrance and exit line have extension handles for operation from basement floor level. The air line valve is located six feet above the basement floor as an added safety precaution to insure that the drain line is closed and the discharge line open before air is admitted to the tank.

2.9 HOT WASTE SYSTEM

A hot waste system is provided for the experimental area and demineralizer area as a means of disposing of radioactive or corrosive waste. All the hot waste is discharged to a collection and monitoring tank which also serves the LITR and the BSF, with connections to the tank farm for disposal.

A 2" ϕ hot waste line and 2" ϕ spare line from a collection tank in the plant hot waste system enter the Research Reactor Building underneath the basement floor in the cooling water trench. These lines are stainless steel, as are all the hot waste lines in the building. The spare line is plugged at the inside face of the pipe chase wall.

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A 2" $\emptyset$ line from the pipe chase header extends up through the walls of each side of the pool. Near the third floor level, a horizontal line extending the length of the pool on each side connects the vertical risers to experimental stations. Each of the three third floor and single second floor "pool-side utility group stations" include a hot drain branch outlet from the horizontal lines. These outlets are 1 $\frac{1}{2}$ " $\emptyset$ threaded couplings, flush with the floor and fitted with recessed plugs. Recessed plugs in threaded couplings flush with the wall are installed on the pool wall just below each of the seven third floor hatches.

The vertical risers embedded in the walls of each side of the pool have a branch just below the first floor level. Five 1 $\frac{1}{2}$ " $\emptyset$ threaded coupling terminals with brass plugs - three in the bottom of the horizontal chase below the beam hole cubicles, and one in front of each of the two large experimental facility plugs - provide for hot waste disposal from the first floor experimental area through these two horizontal branches.

A single 1" $\emptyset$ line leads from the hot waste header in the pipe chase to the demineralizer areas in the basement. This line is buried beneath the basement floor for shielding, and comes up into the main cooling loop demineralizer areas inside the cubicle shielding walls. Valve extension handles through the shielding walls allow the waste from the mixed bed exchange unit or the cation exchange unit from either of the demineralizer units to be discharged into the hot waste line or the plant process drain.

The 1" $\emptyset$ line to the pool cooling loop demineralizer runs underneath the basement floor. No shielding is provided for this hot waste after it comes up from underneath the floor in the vicinity of the demineralizer. Valved cross connections allow the demineralizer waste to be discharged either into the hot waste line or the plant process drain.

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A 1" ϕ hot waste line runs along the east side of the building underneath the basement floor from the off-gas drain pit and connects to the 2" ϕ entrance header just inside the building line. Periodic discharge of the water collected in the off-gas system is obtained by closing the off-gas drain line, opening the valve on the hot waste line, and admitting air into the off-gas drain tank at 5 psig.

2.10 HEATING AND VENTILATING

2.10.1 Main Space

The heating and ventilating of the main space above the first floor level is accomplished by a general ventilating fan located in the basement providing summer ventilating only and by two air handling units located above the first floor level which bring in 100% outside air to provide winter heating and ventilating and auxiliary summer ventilating.

The general ventilating fan in the basement is enclosed in an 18' x 20' fan room. Air enters a plenum chamber through a below-grade 4' -6" x 15' -0" intake shaft and three 48" diameter stacks extending 20' above grade to reduce the amount of "hot" dust collected in the filters. This fan delivers 61,200 cfm @ $1\frac{1}{2}$ " of water, static pressure, and is powered by a 20 HP motor. Air is filtered through a 19' wide by 12' filter bank framed for 24" square filter units. A mechanical filter loader is provided for refilling of the filter frame. A filter change schedule must be determined from operating experience.. A combination magnetic starter for the fan motor is located in the fan room. Also, a push button station for starting and stopping the motor is provided on the first floor near column C-1 adjacent to panel "PA".

The two heating and auxiliary ventilating fans suspended above the first floor level each deliver 15,600 cfm of air at $3/4$ inch of water,

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static pressure, and are powered by $7\frac{1}{2}$ HP motors. Combination magnetic starters for these fans are located on the walls approximately underneath the fan units. The intake openings for these fans are 100" x 42" and are about thirteen feet above grade, again to reduce contaminated dust collection on the screens. Filters are "V", throw-away type. The heating units for these fans are each designed to produce 1.4×10^6 Btu/hr with 1500# of steam per hour at 15 psig with entering air at 0°F and 83°F at exit. Temperature control is obtained by regulating the thermostats on columns D-2 and D-5, which control pneumatically operated modulating steam valves.

Air from both the basement fan unit and the first floor auxiliary units is distributed through registers or diffusers from separate duct systems for each fan unit. The correct damper setting to obtain the design air flow rate is marked at each damper location. No seasonal regulation requirements are anticipated in the ventilation system other than keeping the proper combination of units in operation and admitting steam to the heating coils in winter.

Six exhausters in the high bay area are rated at 16,000 cfm each, at $1/8$ " of water, static pressure, and are driven by 2 HP motors. Exhausters numbers 3 and 6 are designed to operate during the heating season, and all six to operate in summer. Combination magnetic motor starters for all six exhausters are located on the west wall of the first floor, near column C-1. In addition, push button control for exhausters 1, 2, 4 and 5 is provided in the basement fan room.

All air handling units, both intake and exhaust, have two-position, automatic pneumatic dampers in the building opening interlocked with the motor circuit to open and close when the motor is started and stopped.

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An emergency cut-off circuit is provided to stop all air intake and exhaust fans and the air conditioning units. This circuit is opened automatically in case of a fire alarm by a set of contacts in the master fire alarm box located outside the building on the west wall near column A-5, and also can be opened manually by either of two push buttons, one located beside the master fire alarm box and the other in the control room. Each of these two push button stations has, in addition to the "stop" button, a "start" button, which when pressed after all fans are stopped, will start the six exhaust fans in the roof over the pool and also the basement exhaust fan. All other supply and exhaust fans, including the air conditioning unit in the equipment and instrument repair room, must be started by manually operating pushbuttons located near those units.

2.10.2 Basement

The basement heating and ventilating unit is a separate system from the remainder of the building but similar to the first floor auxiliary units. Air enters through a below-grade intake shaft and a single 36" stack. The fan motor is 5 HP, 12,000 cfm capacity at 3/8" water, static pressure. Combination magnetic motor starters for both the blower motor and exhaust motor are located in the basement approximately underneath the blower unit. A push button station for both blower and exhaust motor control are on the south wall of the first floor, near column C-1.

The heating unit for the basement fan is designed to provide $.972 \times 10^6$ Btu per hour with 20 psig steam, 100% outside air entering at 0°F and leaving at 75°F.

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The 2 HP exhaust fan is rated at 12,000 cfm capacity at 1/8" water, static pressure. The exhauster is located at the top of a below-grade exit air shaft.

The emergency controls and automatic pneumatic dampers in the entrance and exit openings are as specified in the section on main space heating and ventilating.

The sub-pile room has a small 217 cfm exhauster for ventilation, which discharges out through the sub-pile room wall into the basement main space.

2.10.3 Laboratory

The work labs are heated, ventilated, and humidified by two air handling units, each servicing three labs. The unit at the west end of the building also serves the second floor office. The west end unit has a design heat capacity of 116.1×10^3 Btu per hour and a discharge rate of 1280 cfm at 1/4" of water, static pressure. The east end unit, servicing a slightly larger volume, has a design heat capacity of 132.5×10^3 Btu per hour and a discharge rate of 1,410 cfm at 1/4" of water, static pressure. Both units deliver 100% outside air, have steam humidifiers, and distribute the air to the work labs through a duct system. A thermostat operating a modulating steam valve for temperature control is located on the lab wall nearest each heating unit. Air intake openings have two-position automatic pneumatic dampers as described previously.

Each lab has a power roof exhauster. The roof openings have the typical two-position automatic dampers.

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2.10.4 Third Floor Offices and Control Room Wing

A 15 ton, self-contained air conditioning unit provides heating, ventilation and humidifying for the entire office and control room wing of the building.

The design heating capacity of the unit is 167×10^3 Btu per hour. A heating coil is located in each of two discharge ducts - one for the equipment and instrument repair room and offices, and one for the control room. A separate thermostat operating a modulating steam control valve regulates each of the heating units. The design discharge rate is 5,560 cfm of air. The return air damper design setting is balanced with the fresh air intake damper to admit a maximum of 25.8% outside air. Both dampers are two-position, automatic pneumatic operated, interlocked with the 3 HP blower motor circuit, controlled as described in the section on main space heating and ventilating.

The cooling thermostats are in the return air plenum. An outdoor thermostat regulates the unit change over from summer to winter conditions. Cooling capacity is 182×10^3 Btu per hour. The compressor motor is 15 HP. Condensor cooling is achieved by use of plant water at the rate of 45 gpm. Cooling by means of a continuous flow of plant water was recommended by the ORNL Engineering Department in preference to providing a cooling tower for coolant re-circulation.

All supply diffusers and return registers will be adjusted for design conditions when installed, and the settings marked. All operations automatic and no periodic or seasonal adjustments need be made. The steam supply must be continuous in summer to operate the humidifier.

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2.10.5 Emergency Ventilation System

A building design criteria accepted by the Advisory Committee on Reactor Safeguards was that the building should be made sufficiently airtight that the accidental release of all gaseous fission products from the reactor would not give rise to harmful internal exposure to personnel outside of the building. The most feasible way of meeting this requirement was determined to be by controlled evacuation of air from the building at a sufficient rate to insure that any air leakage would be into rather than out of the building.

An accidental release was postulated of all gaseous fission products from an MTR type core after thirty-nine days continuous operation at twenty megawatts power level, and a study was made of the hazards involved in discharging air so contaminated into the atmosphere. For details of this study see ORNL CF-55-3-8.

The hazard study showed the evacuated air could be safely released to the atmosphere, provided a scrubber would be installed in the exhaust system primarily for the removal of the iodine nuclides.

Special attention has been given building design and construction to insure as airtight a building as practicable. As it was not possible to determine at the time of design what pumping rate from the building would be required to maintain the necessary vacuum in the building, an upper limit of 10,000 cfm was arbitrarily selected as a basis for sizing the special exhaust system. This exhaust system in the building consists of a duct network with a design intake of 5,000 cfm through five registers in the high-bay roof trusses, 3,000 cfm through five registers in the vertical runs between first floor level and the high-bay roof at each end of the building, 2,000 cfm through two registers in the basement at each end of the building. Capacities are based on there being 2" of water vacuum at the point where the duct leaves the building.

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The exhaust system connects to a 24" $\emptyset$ underground duct, leaving the building about four feet below grade on the south building face. This underground duct extends about 135' south of the building and terminates in the vicinity of the 3039 stack.

After the building is erected and made tight in accordance with design specification, an air handling test facility will be constructed near the duct terminal, and the necessary pumping rate to maintain approximately $\frac{1}{2}$ " of water vacuum in the building will be determined experimentally. From this information, the necessary scrubber and filter capacities will be ascertained. Finally, the exhaust duct terminal will be connected through the scrubber and filter to the breeching around the 3039 stack.

The blowers at the base of the 3039 stack normally discharge in excess of 100,000 cfm up the stack. Under emergency conditions the stand-by blower steam turbines have about 100,000 cfm capacity. The breeching vacuum is normally about 12" of water. The stack actually used for the discharge of contaminated gases meets the physical requirements outlined in ORNL CF-55-3-8.

2.11 TELEPHONE

Conduits only for telephone service are initially provided for the building, with the intent that operating personnel will determine the communication system ultimately required.

One terminal board is located in the control room. Conduits leading to this terminal board are as follows:

- 1 - 1" $\emptyset$ One outlet, from column E-5.
- 1 - 1" $\emptyset$ Stubbed at floor level from control console.
- 1 - 1" $\emptyset$ From outlet on east wall of control room.
- 1 - 1" $\emptyset$ 3 outlets servicing two offices.

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- 1 - 1" $\emptyset$ 2 outlets servicing two offices.
- 1 - 1 $\frac{1}{4}$ " $\emptyset$ From control room terminal board to terminal board located on the west wall of the laboratory wing.

Conduit leading to the terminal board on the west wall of the laboratory wing are as follows:

- 1 - 1 $\frac{1}{2}$ " $\emptyset$ To entrance box for outside connection.
- 1 - 1" $\emptyset$ 3 outlets servicing three laboratory offices.
- 1 - 1" $\emptyset$ 3 outlets servicing three laboratory offices.
- 2 - 1 $\frac{1}{4}$ " $\emptyset$ From laboratory terminal board to terminal board on first floor located near column G-2.

Conduit leading from the first floor terminal board are as follows:

- 2 - 1" $\emptyset$ To junction box on reactor substructure.
- 1 - 1" $\emptyset$ First floor outlet on column A-3, second floor outlet on column A-5.
- 1 - 1" $\emptyset$ To junction box in basement on column B-2.
- 1 - 1" $\emptyset$ To junction box in basement on column F-2.
- 1 - 1" $\emptyset$ To first floor outlet on column E-5.

Conduit from an outlet on each side of the reactor pool on the reactor centerline at the third floor level and at the balcony floor level terminate in the junction box on the reactor substructure. Conduit from the basement junction box on column B-2 lead to a basement outlet on column 3a-2 and to the second floor office on the south side of the building. Conduit from the basement junction box on column F-2 lead to a basement outlet on column F-3 and to a first floor outlet on column F-2.

All conduit are installed with pull wires left inside.

2.12 ELECTRICAL

The main power supply enters the building on the west side and near the southwest corner and connects to 440 volt, 3 phase, 60 cycle switch-gear having a 1600 Ampere main breaker. From the switch-gear in the basement, feeders are run to panel "PA" on the first floor near column C-1, to panel "PB" in the basement near column B-2, and to a dry type 300 KVA, 440/120/208 volt, 3 phase, 4 wire, 60 cycle transformer in the basement near column B-2.

Panel "PA", 440 volts, 3 phase, supplies power to the high bay exhaust fans, all basement and first floor heating and ventilating units, the third floor air conditioning unit, the bridge crane, the two (2) 225 Ampere bus ducts at the basement ceiling in the utilities header area around the Reactor Structure, the four (4) 440 volt, 3 phase receptacles - one each on column C-3 basement, column C-2 and C-5 first floor, and on column B-5 second floor, the 1 KVA - 440/110 volt transformer for control power, and to the basement sump and condensate pumps.

Panel "PB", 440 volt, 3 phase, supplies power to all reactor cooling and pool cooling system pumps within the building.

The 300 KVA, 440/120/208 volt transformer in the basement supplies power to panel "L-1" in the basement near column C-2, and to panel "L-2" in the basement near column C-1.

Panel "L-1" supplies power to a total of seven lighting panels designated "A", "B", "C", "D", "E", "F", and "G". These lighting panels serve all lighting circuits in the building - except those served from the emergency panel -, and all the 15 Ampere, 120 volt convenience outlets for general service. (Convenience outlets for experiments, tests, and special uses are served from seventeen (17) twin distribution panels described hereinafter). In addition to lighting, panel "B" serves the laboratory wing

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heating and ventilating unit motors and electric-pneumatic switches; panel "C" serves the electric-pneumatic truck door operator on the second floor and the electric water heater and ventilation fan in the toilet area; and panel "D" serves the electric-pneumatic truck door operator on the first floor.

Panel "L-2" serves power to one side of the twin distribution panels which are installed for the convenience of experimenters. Panel "L-2" also serves a control cabinet in the reactor control room.

The above noted twin panels consist of a 50 ampere single phase, 3 wire, 115/230 volt panel supplied from a "Special Use" service feeder, and a 50 ampere, three phase, 4 wire, 120/208 volt panel served from panel "L-2". One of these twin panels is located in each of the six laboratories on the third floor, and in the equipment and instrument repair room. Similar twin distribution panels are located around the Reactor Structure at the following places:

Basement:	One (1) - Flush with the north face of Reactor Sub-structure.
First Floor:	Two (2) - One each on columns E-2 and E-5
Beam Hole Area:	Three (3) - Each flush with the Reactor Structure and about level with the beam hole cubicles, and located midway between Beam Hole Nos. 1 and 2, 3 and 4, 5 and 6.
Balcony Walkway:	Two (2) - One each flush with the Reactor Structure on each side of the pool near column line D.
Third Floor Walkway:	Two (2) - One each on outside edge of walkway on each side, mounted on steel frame, midway between columns D and E.

The ten (10) twin distribution panels around the Reactor Structure serve receptacles immediately adjacent to the panels. From the seven (7) twin panels in the laboratories and in the equipment and instrument repair

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room, no branch circuits to equipment or receptacles are now installed. However, conduit only has been provided along wall to properly serve future fixed laboratory equipment when such is installed.

The "Special Use" service line, served from a transformer having no other distribution, is 115/230 volt, single phase, 3 wire, 60 cycle, enters the building parallel to the main power supply conduits and terminates in panel "S" which has a 400 Ampere main breaker. This service line is intended strictly as a separate source of instrumentation power supply for experimenters and for the control system.

A 115/230 volt, single phase, 3 wire, 60 cycle, emergency power line enters the building parallel to the main power supply conduits and terminates in panel "H", which has a 100 Ampere main breaker. Panel "H" is located on the basement wall of the southwest stairwell enclosure and serves seven (7) emergency lighting circuits and one circuit to the public address amplifier, building evacuation horns, and to certain reactor system emergency controls, all inclusive. Three additional circuits are available in the panel. However, the emergency generator presently installed limits the total building emergency load which may be used to 5 kilowatts.