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RA-3

RESEARCH AND PRODUCTION REACTOR

GENERAL DESCRIPTION

REPUBLICA ARGENTINA
COMISION NACIONAL DE ENERGIA ATOMICA
BUENOS AIRES
1967

Report on the

RA-3 nuclear research and production reactor

Prepared by the
National Atomic Energy Commission
Buenos Aires, Argentine Republic

INTRODUCTION

The National Atomic Energy Commission has just put critical the RA-3 reactor, a description of which is given in the following pages of this booklet.

This, therefore, is a favorable moment to pause for a brief self-critical analysis on the meaning of this work and its inclusion in the argentine nuclear panorama.

The new instrument does not imply a special advancement insofar pertains to nuclear technology, but it certainly is a step forward towards obtaining self-experience and developing our capabilities. It also means opening new channels for national industry and an incentive for its perfectioning, but above all, it means faith in ourselves.

Under a cold economical analysis it probably could be argued that the cost of the reactor has been higher than was estimated in the previous calculations of the original project, as also, that building it has taken more time than foreseen.

But it is also true that certain imponderables of very difficult quantitative evaluation at the present moment would escape from this analysis. These fully compensate the investment and their important meaning can only be appreciated in the future.

These imponderables are given by the intangible profits produced by these works after long terms, in areas which apparently are not directly related to them, such as expansion of basic industries, technological qualification, scientific and technical research, full use of natural resources and, in all, modernization of the country.

In the process of evolution of nuclear industry, as in that of any other great industry, there are certain necessary stages to be compulsory fullfilled to attain the aforementioned self-experience, which constitutes the basis of all progress. Insisting on this concept, by definition experience is "practice and observation", and these are things which cannot be bought or loaned.

Such is the policy or philosophy which decided the building of RA-3, and which is the continuation of the one which impelled us to build and commission the RA-1 at the begining of 1958, the first nuclear reactor to be put in service in South America, followed by RA-0 and RA-2, and it is the same philosophy that will abet us tomorrow to build the first argentine power reactor or nuclear plant, which already has been studied and projected.

We could have bought a reactor like RA-3 in a foreign country. It would have been simpler and maybe more economical.

But we preferred to do it ourselves, with our technicians and our industry, to learn as we went along, assimilating and amending our mistakes.

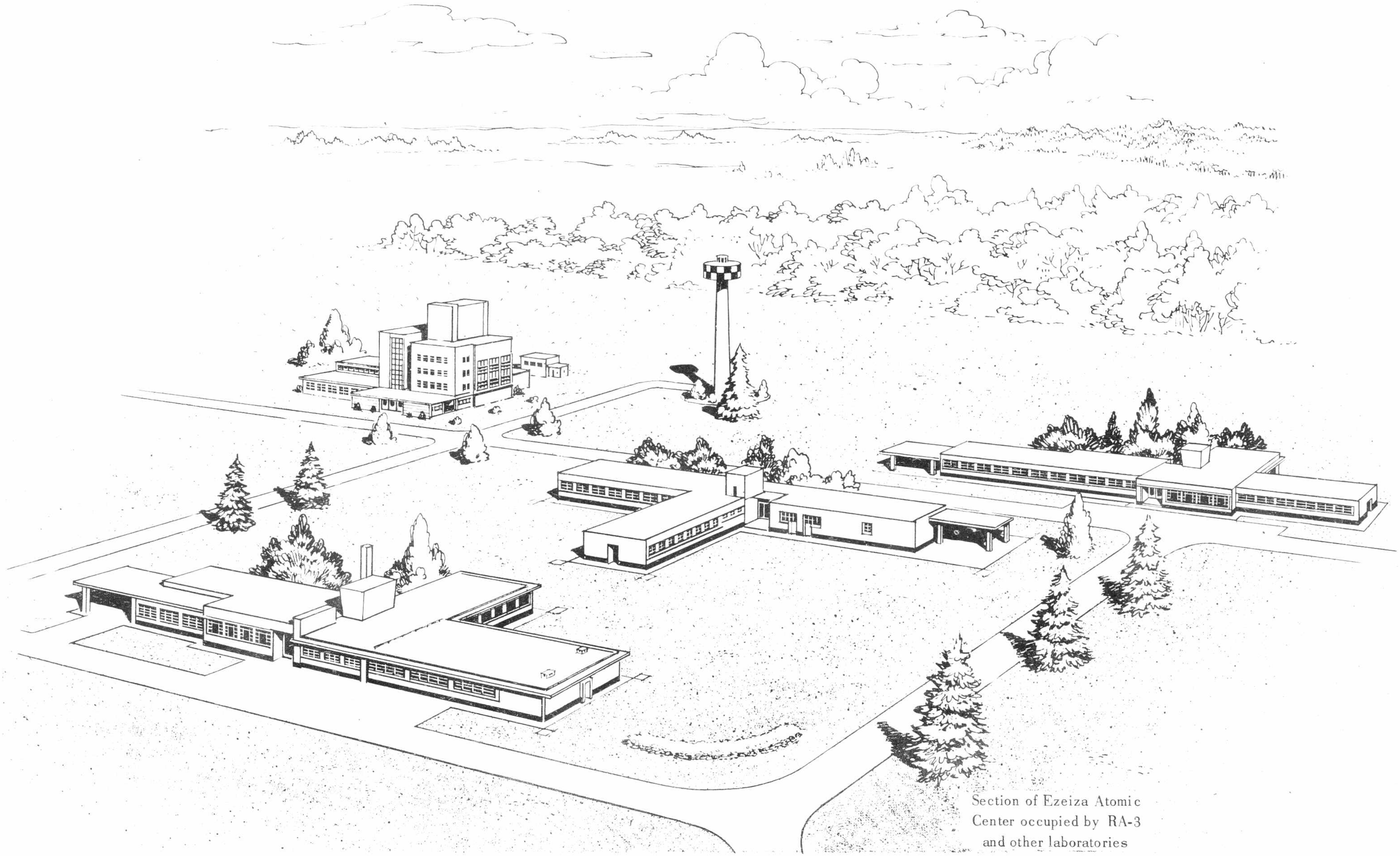
With the fruits of our work in our hands and on the basis of the blueprints and specifications presented, we then required and obtained from the United States Atomic Energy Commission a substantial grant for complementing the facilities and attending to the running expenses of the reactor. In this manner the professional qualifications of C. N. E. A. 's personnel in charge of the project has received the important guarantee emerging from the fact that it is the first and only time that the North American organization has given an amount to cover expenses of a unit which neither has been designed nor built in that country.

This same Institution, through the International Atomic Energy Agency and in connection with the program of cooperation and technical assistance the latter carries out, has donated to us 35, 000 dollars worth of enriched uranium, to be used as fuel for the reactor.

The RA-3 is part of the Ezeiza Atomic Center, where we are building other laboratories and important facilities and it is one of the achievements foreseen in the plan carried out by the National Atomic Energy Commission, under its permanent objective of progressive incorporation of the full range of peaceful applications of nuclear energy to the progress, health and welfare of the community.

In short, RA-3 constitutes a new stage, satisfactorily fullfilled, or a nuclear energy program conceived with a deep national sense.

OSCAR A. QUIHILLALT
President of the
National Atomic Energy Commission



Section of Ezeiza Atomic
Center occupied by RA-3
and other laboratories

I - GENERAL DESCRIPTION

The RA-3 reactor has been projected and built by the National Atomic Energy Commission with cooperation from private industry and is located at the Ezeiza Atomic Center, at present under construction.

Its operation will enable radioisotopes to be produced in a commercial scale and therefore, to obtain a substantial reduction in the import of such elements.

It will simultaneously be a valuable working tool for experimentation in a wide range of subjects connected with basic research and technological applications, particularly in the fields of nuclear engineering and the development and testing of nuclear fuels.

This versatility of uses of the RA-3 made it necessary to forsee during the projecting stage a series of irradiation facilities and other auxiliary ones, some of which characterize this reactor from other similar ones at present under operation in different countries.

Its principal characteristics are the following:

Type:	Open tank
Normal power:	5,000 kW (thermal)
Thermal flux:	4×10^{13} neutrons/cm^2 sec
Fuel:	90% enriched uranium
Moderator:	demineralized water
Refrigeration:	forced circulation of water

II - THE BUILDING

Due to the harmonic distribution of its different floors and its simple design architecture, the building of the reactor is typically functional.

It has a cube-form central block, emerging from the rest of the building, with reinforced concrete walls and roofs and no external openings. In the central room or hall within it, the specific activity of the reactor is carried out.

In the middle of said space the fundamental elements of the reactor are located, that is to say: the stainless steel principal tank wherein the reactant core is contained, with its corresponding heavy concrete shielding, the control mechanisms and, laterally, the so called "hot cell".

The different complementary facilities of the reactor are located in six floors surrounding the central block already described.

The basement contains the pumping room and the reactors coolant circuits; the heating, hot water, compressed air, vacuum and air-conditioning systems; an emergency electricity generator and the master switchboard for distribution of electric power.

In the ground floor and close to the principal entrance of the building the dressing rooms for the personnel are found, which communicate with the central room of said floor and which is the experimentation area of the reactor.

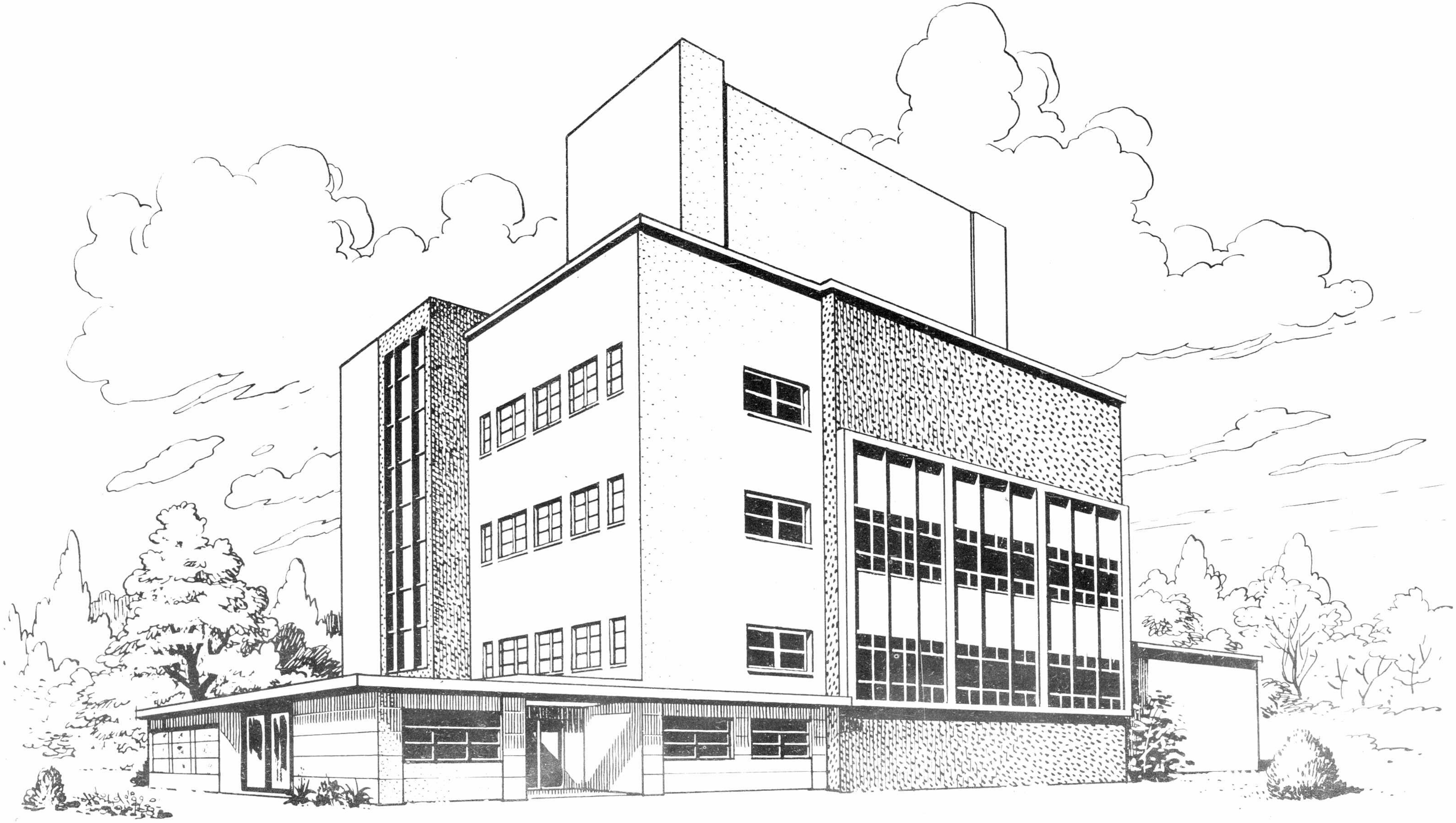
In the frontal part of the building there is an intermediate floor which contains the library and some administrative office-rooms.

The radiochemical laboratories occupy the whole of the first floor. This section is subject to the radiosanitary control demanded by the existant international regulations.

The second floor corresponds to the top level of the tank of the reactor. The control room is on this level, as also, on the opposite side, a room for technological experiments. This is connected with the principal hall through openings in the dividing wall for passing the ducts that eventually have to be placed in the reactor due to the experiments under way.

Finally, the third floor contains the room wherein all the ventilation equipment of the building is located, and specially, that of the sections in which radioactive contamination may occasionally occur.

The different sections of the building are complemented according to their specific functions, with office-rooms, bathrooms and other necessary facilities.



Reactor Building

Ventilation system: It comprises a conventional general installation with partial recirculation of the air treated, and a totally independent active circuit which corresponds to those sections susceptible of contamination (hot cell, top opening of the tank, active laboratories, irradiation ducts and thermal column), which extracts the 100% of the air and expels it to the outside after passing it through high efficiency filters, for particles of the order of 0.3 microns.

In cases of emergency the circuit can be altered with motorized shutters to permit a total recirculation of the air until the origin of the contamination is located and eliminated, to then expel the air to the outside in small volumes, diluted in a great quantity of non-contaminated air.

III - THE REACTOR

It consists of a cylindrical shaped principal tank which is set vertically and has an open upper end. It is completely built with 3 mm thick stainless steel.

The total height of the tank is 10.90 m. Its diameter in the lower half is 3.02 m enlarging to 3.34 m in the upper half.

The bottom rests on a 1 m thick reinforced concrete slab, 1 m under ground floor level.

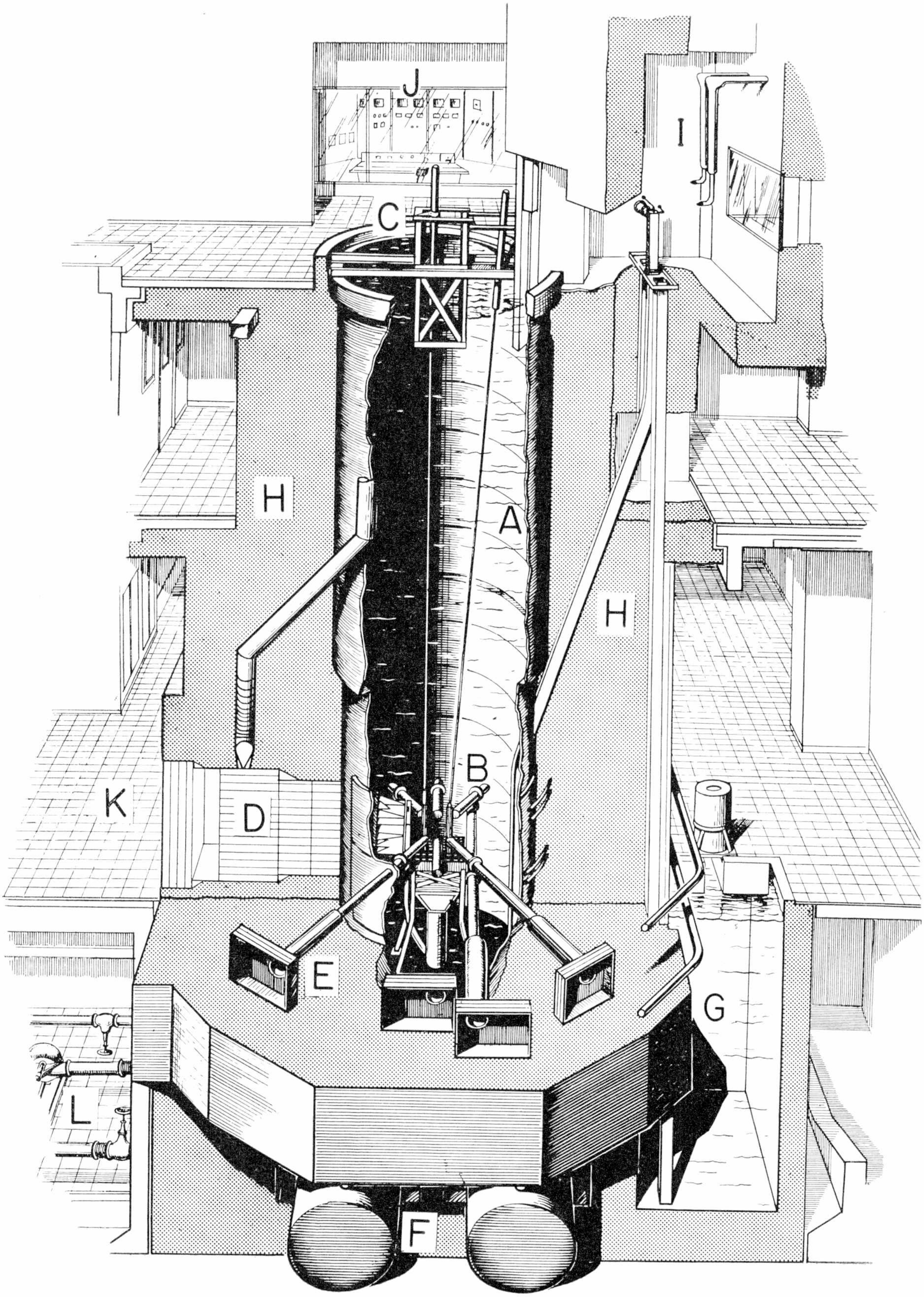
The core of the reactor (composed of the fuel elements containing the enriched uranium) is set inside the principal tank at a height of 1.90 m above the bottom, on which it rests by means of a supporting lattice with four legs.

With the object of stopping the radiations originated in the fission processes of the core, the principal tank is encircled by a heavy concrete layer of 3.5 g/cm density and a 2.50 m thickness, which acts as a biological shield and permits the presence of personnel in the outside part.

Within the concrete shielding there are different ducts which are part of the coolant system and the experimental facilities, such as the irradiation ducts, which radially pierce the wall of the tank and extend to the vicinity of the core and which are accessible from the outside. There also is the so called "thermal column" which is a 2 x 2 m metallic box which also pierces the shielding and the wall of the tank to reach the vicinity of the core. Inside this box there is a pile of graphite blocks of nuclear purity, destinated to expedite therein a flux of thermal neutrons used in different irradiation experiments.

Apart from the core, the irradiation ducts and the thermal column, inside the principal tank, at one side of the core, there is a platform with the object of supporting part of the neutron detection instruments, particularly, two compensated ionization chambers.

On a level with the upper end of the tank there is a projecting structure on which the control mechanisms of the reactor are fixed. At the side and on a parallel line with said structure there is a movable bridge to expedite the access to the inside of the tank and the vicinity of the core with extension tools.



Tank of the Reactor

(Schematic cut)

A - Principal tank
B - Core
C - Control rods mechanism
D - Thermal column
E - Irradiation ducts
F - Decay tanks
G - Decay pool
H - Concrete shielding
I - Hot cell
J - Control room
K - Experimentation hall
L - Pumping room

IV - THE CORE

It is formed by fuel elements which can be set up in 10 x 8 = 80 positions on an aluminum lattice which acts as their support.

Each element (of MTR type) has the appearance of a square section prism, of about 80 mm by side and a height of about 80 cm and is composed of 19 plates set in parallel form which are made of an aluminum and 90% enriched uranium alloy, covered w'th aluminum of a thickness in the order of 0. 4 mm. Each plate contains about 7. 8 g of 235 uranium.

At their lower section the fuel elements end in a cylindrical bushing which is inserted in the holes of the lattice, with which each element remains fixed and properly set in its corresponding position.

The core can adopt many varied configurations. For minimal criticality conditions it is composed of 16 elements set in a 4 x 4 square, with three graphite reflecting faces. For a normal operation and at full power the configuration of the core can be of 25 elements.

Five of the fuel elements are special as they are used as control elements, to which end, part of the fuel plates are taken from them to permit insertion of the control and safety rods.

During normal operation the tank of the reactor is completely full of demineralized water which acts as coolant, moderator and vertical shielding.

The heat generated in the core is transferred to the water which occupies the free spaces between the fuel plates and that circulates in a descending manner, passes through the lower bushing of the elements and the supporting lattice and then to the coolant system.

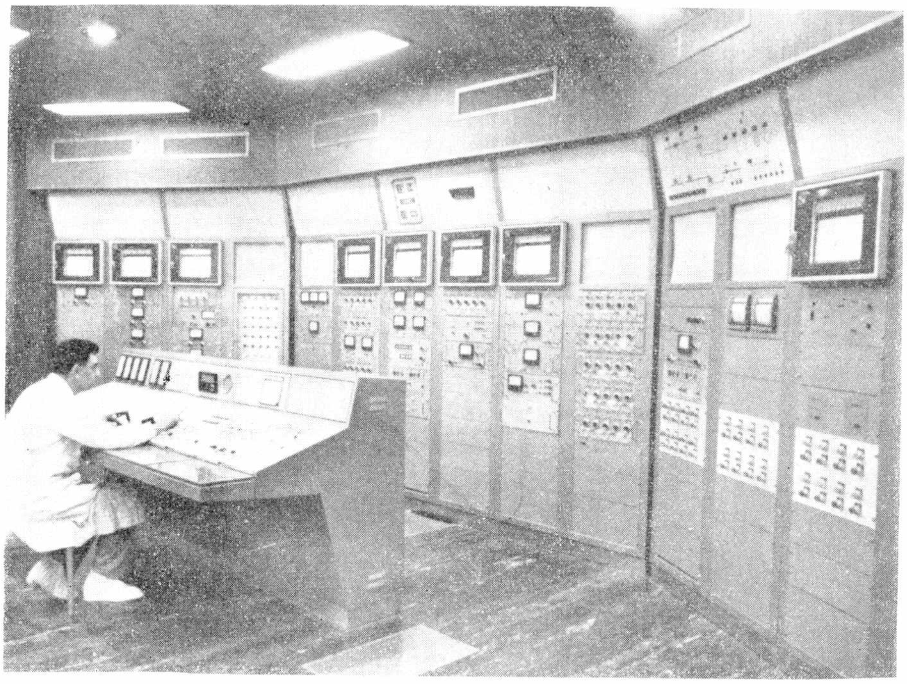
Underneath the lattice a funnel shaped chamber connects it with the 30 cm diameter duct of the primarv coolant circuit.

With the object of obtaining a better neutronic balance, the fuel elements, in their entirety, are surrounded by a reflector consistant of graphite bars of nuclear purity which have the same sizes and positional system as the former. The graphite reflects the neutrons that escape from the core, returning them to the same, to participate in the fission process.

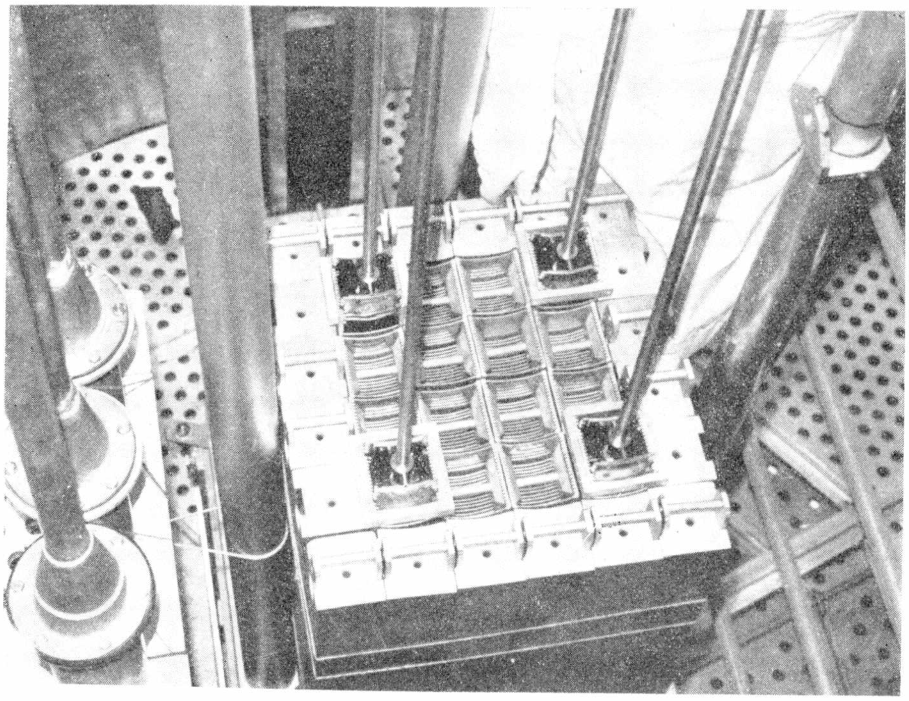
Some of the free holes of the lattice are used to place the container of the neutron source of americium-beryllium with which the fission process is started, as also, to hold two fission chambers which are the detectors of the neutron flux during the first stages of the putting in operation of the reactor.

Between the core and the inner face of the thermal column there is a 60 mm thick lead plate with the object of shielding the gamma radiation originating in the fuel elements and avoiding its diffusion to the graphite of the thermal column. Said plate has a coolant system to dissipate the caloric energy accumulated within it as a consequence of the radiation.

Also, between the side wall of the tank of the reactor and the concrete shielding that surrounds it on the outside there is a 50 mm thick and 2 m high lead casing (which is centered in height with the medium plane of the core) with the object of shielding the gamma radiation originated in the core to avoid heating of the concrete which could produce in it enough thermal gradients as to generate cracks. Within the lead casing there is a coil for dissipation of the heat generated, by forced circulation of water.

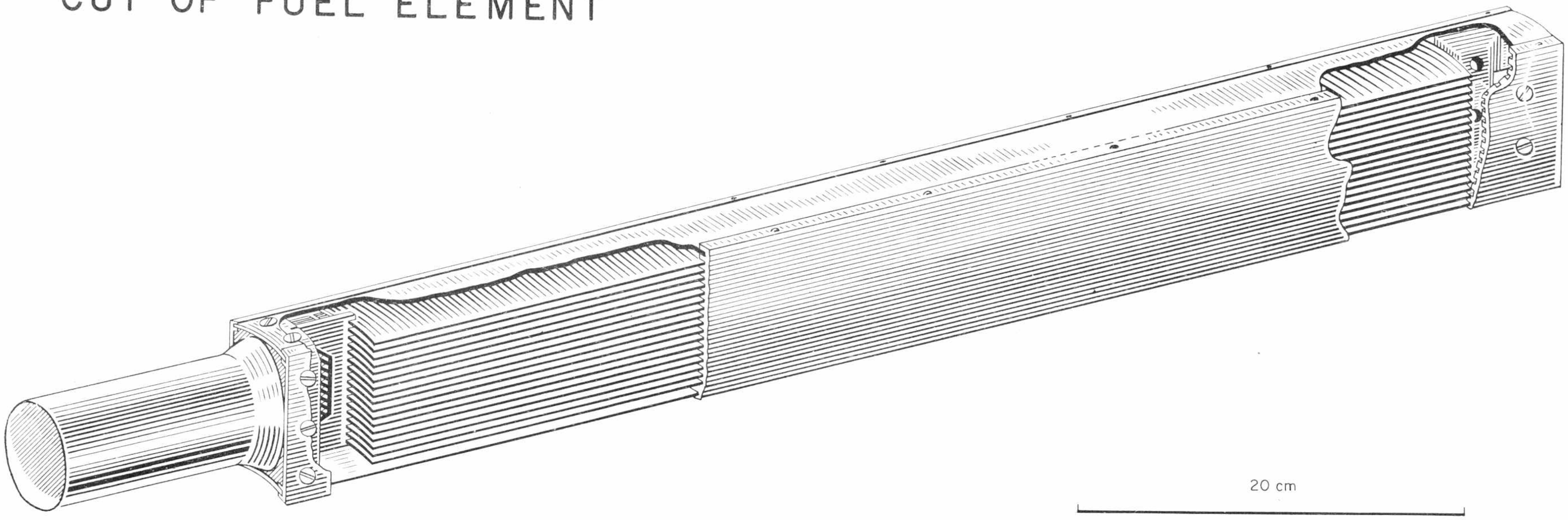


Control room of the reactor



Core of 16 boxes
Completely reflected with graphite and with 4 control rods.
Detectors: 2 fission chambers and 3 ionization chambers

CUT OF FUEL ELEMENT



V - COOLANT SYSTEMS

The refrigeration of the core is made by forced circulation of the demineralized water that fills the tank of the reactor, passing it through the fuel elements. The caloric energy carried by the same is dissipated in the atmosphere by means of cooling towers.

Primary circuit: The water is sucked through the lower part of the supporting lattice of the core and sent to two decay or disactivation tanks of 15 m^3 each, connected in parallel and located in the lower part of the principal tank of the reactor, under the plate that supports it. The object of these tanks is to delay passage of the water to allow the short half-life radioactive elements to decay, so that when the water reaches the pumping room, where it passes next, the radiation level shall be compatible with the presence in the room of operational personnel.

Between the decay tanks and the pumping room which is on the same level, the 30 cm diameter duct describes an inverted "U", acting as an anti-siphon, to avoid that the level of the water inside the reactor should descend below a certain level in case of a breakdown in the pumping room. In this manner it is insured that at all moments the core remains submerged in water.

The primary coolant system is completed with a split casing type stainless steel centrifugal pump, with a 300 m^3/h pumping capacity, a heat interchanger, also of stainless steel, with tubes in U; the respective valves; a duct for re-entry of the water to the principal tank and an inlet diffusion system which reduces the formation of whirlpools and therefore avoids that part of the water that has been in contact with the core shall rise to the surface.

The re-entry duct to the tank is located at mid-height of same. Within the tank it branches off into a "T", the ends of which descend to the vicinity of the bottom, where they end in two perforated semitores, through which the water coming from the heat interchangers enters the principal tank.

At levels of 0.50 and 1 m above the semitores there are two false bottoms that cover the floor of the tank and are so perforated that the passage sections increase gradually. Thus it is possible to slow down the entry speed of the water, which enters in a vertical ascent manner.

The temperature of the coolant water at entry and output of the core is respectively 38 and 45°C. The flow is measured with a 1% precision by a venturi.

In case the coolant water recirculation pump stops, the operation of the reactor is automatically interrupted by the insertion of the safety rods in the core and the remnant heat generated in the fuel elements is dissipated by natural convection of the water. For that reason, two of the faces of the funnel that connects the lattice with the suction duct are retractable and open when the pump stops, allowing a convective current to be established inside the core.

Secondary circuit: It comprises a heat interchanger, a recirculation pump and a cooling tower from which the heat originating in the primary is dissipated in the atmosphere.

Through a 15 m long tunnel the ducts of the secondary circuit go out of the pumping room of the reactor building and end in a pumping house where, apart from the recirculation pump, the water demineralization equipment for the reactors supply is installed.

The cooling tower is located alongside said pumping house.

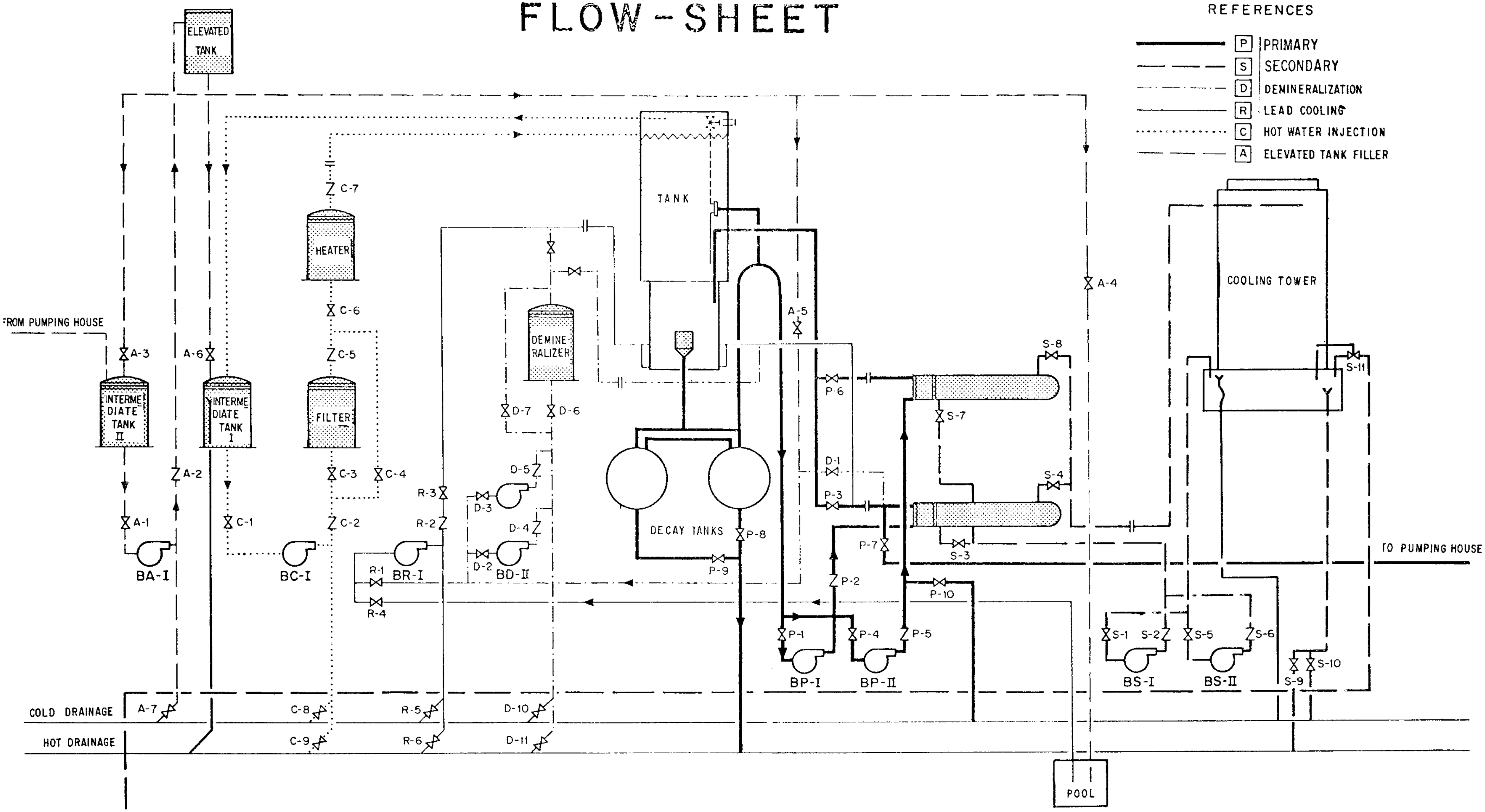
Demineralized water circuit: The treated water passes from the demineralizing equipment to an intermediate tank located in the pumping room, from where it is pumped to an elevated tank of a 20 m^3 capacity. The reactor is supplied from this tank.

Coolant circuit of the lead shielding: When necessary, the water is sent through this circuit from the pumping room and re-injected in the primary.

Continuous demineralization circuit: With the object of maintaining a 0. 5 pureness of the water of the primary circuit, a 10 to 15 m^3/h flow is taken from it by derivation, it is made to pass through a demineralizer that retains the radioactive impurities that may have been incorporated to the water by erosion and is again re-injected into the circuit.

Hot water layer circuit: Hot water is injected over the surface of the water of the reactors tank until a 1 m thick layer is formed, with the object of causing an inversion in the vertical thermal gradient of the water in the tank. In that manner it is avoided that bubbles or particles of water that have been in contact with the core can reach the surface in their ascent by natural convection, increasing the activity in the ambient air in that zone.

FLOW-SHEET


REFERENCES
P PRIMARY
S SECONDARY
D DEMINERALIZATION
R LEAD COOLING
C HOT WATER INJECTION
A ELEVATED TANK FILLER
ELEVATED TANK
TANK
HEATER
FILTER
DEMINE RALIZER
INTERME DIATE TANK II
INTERME DIATE TANK I
DECAY TANKS
COOLING TOWER
FROM PUMPING HOUSE
TO PUMPING HOUSE
COLD DRAINAGE
HOT DRAINAGE
POOL
BA-I
BC-I
BR-I
BD-II
BP-I
BP-II
BS-I
BS-II

VI - CONTROL

The reactor is controlled by moving absorbent elements in a vertical direction inside the core. These elements, in their entirety called control rods, are of two types: compensation rods or of coarse control, of which there are four, for introducing large reactivity values in a slow manner. The remaining type is one single rod, called of regulation or of fine control, which is used for introducing limited quantities of reactivity and for routine operation of the reactor.

The compensation rods act as the same time as safety rods as under any abnormal evolution of any variable of the system they quickly fall into the core, stopping the working of the reactor.

The following are the characteristics of the compensation-safety rods:

Length of stroke	645 mm
Soeed	1.1 mm/sec
Reactivity value	3,000 pcm (3%)
Speed of reactivity introduction	10 pcm/sec (10^{-4}/sec)
Accuracy of position indication	1/360

Same characteristics of the regulation rod are:

Length of stroke	645 mm
Maximum speed	21 mm/sec
Reactivity value	500 pcm
Maximum speed of reactivity introduction	45 pcm/sec
Accuracy of position indication	1/3600

Actioning of the rods is made through mechanisms located on the upper bridge of the reactor. The shank that supports the rods moves actioned by an electric motor, an appropriate reduction gear and a spiral screw. The motor of the compensation-safety rods is of direct current with independent excitation, which insures a practically constant speed of transfer. The motor of the regulation rod is biphase, fed by a 400 Hz alternating current.

Movement of the rods: Once a series of initial conditions indispensable for the safety of the operation are verified, the reactor can be started by raising the compensation-safety rods. When criticality has been reached, the operator adjusts their position to obtain an adequate rate of increase of power. After a certain level, in this case 1% of the nominal power of the reactor, the operation can continue automatically.

Manual control: The automatic control system actuates permanently on the regulation rod to keep the power of the reactor at a constant level without intervention of the operator. The latter can furthermore select another power to which the reactor is automatically taken, within the measuring range originally selected. The possible operation ranges in automatic control are:

Range III	15 to 150 kW
Range IV	75 to 650 kW
Range V	150 to 1500 kW
Range VI	300 to 3000 kW
Range VII	750 to 7500 kW

The actioning motor of the regulation rod receives the commanding tension from a calculating equipment, which produces a signal of fault, of the form

$$A\frac{P - P_o}{P_o} - B\frac{1}{P}\frac{dP}{dt}$$

A and B being constant, P the power of the reactor indicated by the linear measuring channel and P_o the desired power; a signal proportional to the second term of the expression is furnished directly by the logarithmic measuring chain.

Instrumentation: The entirety of electronic measuring chains enables measuring of the power level from the initial level corresponding to the neutrons source and up to the full power one. More than 10 decades extend between both. This ample gamut is covered by:

- Two measuring channels that use fission chambers as detectors and can, by automatic shift, occupy two positions to enlarge the extension of the measuring range. The indication is made between 1 and 10^5 cps on a logarithmic scale recorder.

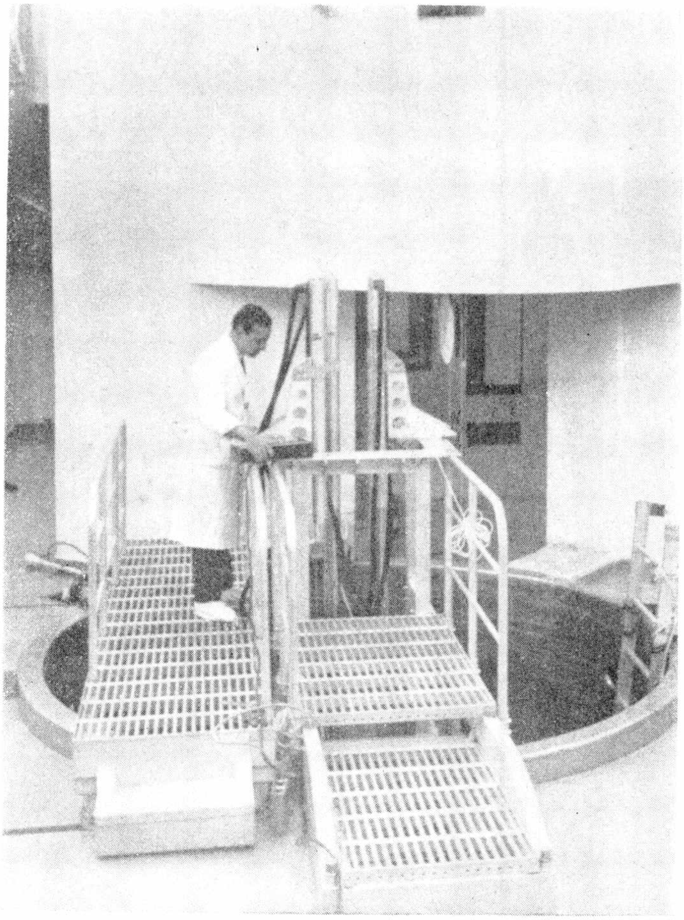
- A measuring channel which uses an ionization chamber and a logarithmic current amplifier, to cover from the intermediate range to that of maximum power. A logarithmic scale recorder and another that indicates the speed in the variation of power (Period), are the instruments set at the end of this chain.

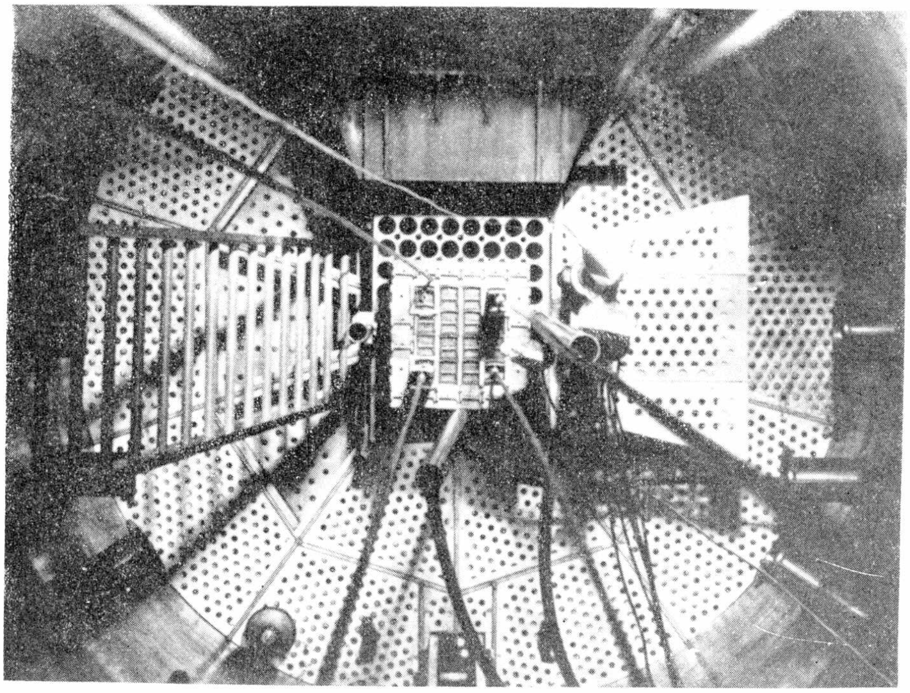
- A linear scale current measuring channel with a compensated ionization chamber and an amplifier with operation gamut selector, for precise reading of the power level. The automatic system receives the information on the power of the reactor through this measuring channel. A linear scale recorder graphs the variation of the power level.

- Three identical current measuring channels, with non-compensated ionization chambers supply the signals used by the safety system to set the maximum value of power.

Safety: The safety system actions the rods of the reactor to limit abnormal evolution of any of the variables connected to it. Before automatic safety action is produced, a sound alarm warns the operator of the abnormality, previous to reaching the dangerous value.

Control rods actioning mechanism and upper hot cell





General view of core and experimentation accesses

The safety actions, in order according to their effectiveness, are:

Power reduction	(Set back)
Rod introduction	(Reverse)
Total fall of rods	(Scram)

Any one of them can be manually started by the operator.

The total fall of rods, as an extreme action, only happens in case of any of the following circumstances:

- Excess of power
- Excessively short period
- Excess of temperature of the coolant water
- Excessive indication of any ambient air detection equipment
- Excessive activity of the coolant water

Sanitary control of radiation: The ambient air radiation level is controlled in a centralized manner from the control room of the reactor by means of different types of detectors and measuring equipments. The following are the measurements that are made:

- Gamma radiation, in eight different parts of the building, by means of Geiger-Müller detectors which cover a margin of 5 decades and work by impulsion in the low ranges and by current in the high ones.

- Aerosols activity, through four monitoring equipments with crystal scintillation detectors and impulse amplifier and integrator equipment, which give reading in a margin of 3 decades.

- Activity due to fission products in the air, by detection of radioactivated particles deposited in appropriate filters placed opposite a scintillation detector and with a spectrometer equipment calibrated for detection of I_{131}.

- General activity due to the presence of A_{r41} in the ventilation system, with a similar equipment as the former.

- Activity due to thermal and fast neutrons, through local monitoring.

VII - EXPERIMENTAL FACILITIES

Irradiation ducts: At mid-height of the core, the reactor has six radially disposed horizontal ducts, each of which has an access opening in the external face of the concrete shield. The other end, which is closed, reaches the vicinity of the core.

There is a seventh duct, set parallelly to one of the faces of the supporting lattice of the core, and which goes through, that is to say, has access openings at both ends.

Each of these ducts has systems of air suction and filling and drainage of water. Furthermore, when they are not used in experiments, they remain shielded with concrete plugs.

Pneumatic circuit: Two 38 mm diameter ducts reach the vicinity of the core. These are part of a pneumatic system for introducing and taking out samples from the reactor in a fast and simple manner. The samples are sent or received inside capsules from two stations located in the building of the reactor.

Thermal column: In the ground floor experimentation hall, in one of the faces of the concrete shielding, there is a cavity full of graphite blocks of nuclear purity, which reaches the vicinity of the core and constitutes a thermal neutrons irradiation source. The thermal column is shielded by a thick and heavy door, which can be taken away for carrying out experiments and which has various openings. These are of different diameter and their object is to allow access to the graphite by the mere taking out of the concrete plugs that close them.

Hot cell and sample extraction system: On the top floor of the reactor, at the side of the opening of the tank there is an inclosure called the "Hot Cell", with 90 cm thick heavy concrete walls. Its object is to allow handling and storage of highly irradiated elements coming from the reactor, without any risks for the personnel in charge of such operations.

The hot cell communicates with the principal tank of the reactor in two ways. One, through its frontal part, where the door is, and which projects over the opening of the tank. The other is a square section duct which reaches the floor of the cell from the vicinity of the core inside the tank, passing through the concrete shielding.

A metallic basket actioned by a cable mechanism moves inside this duct. In it the irradiated elements are taken from the core to the hot cell.

On the floor of the cell there are two other ducts of the same section, set laterally to the former. One reaches a decay pool on the ground floor of the reactor where the elements may be stored for their radioactivity to decay in order they may be taken out of the building of the reactor. The other duct connects the cell with the first floor of the building where the radiochemical laboratories are located.

Transport of irradiated elements is also done within these ducts inside a cable actuated metallic basket.

These ducts, in their entirety, are called "sample extraction system".

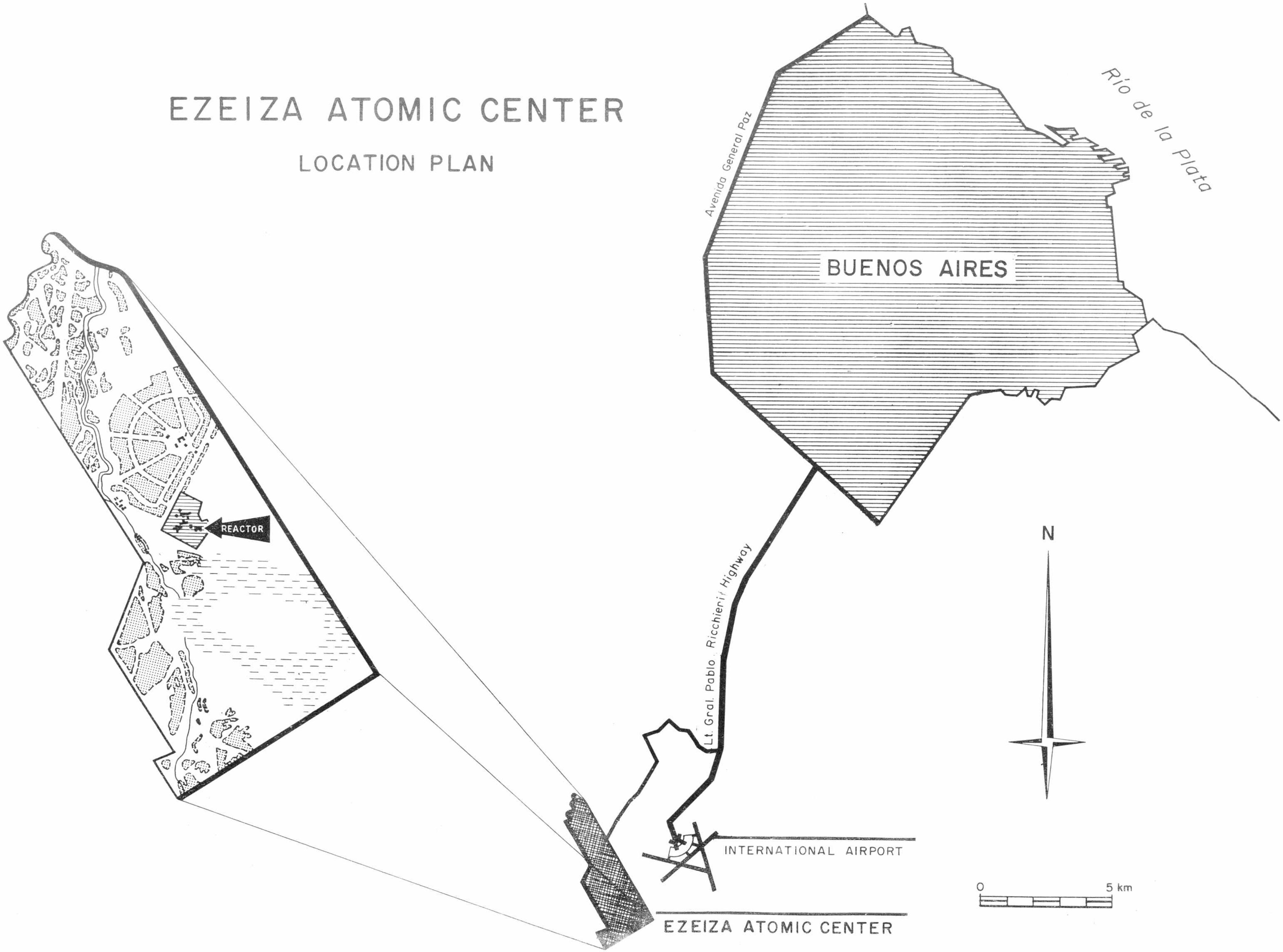
CORPORATIONS THAT PARTICIPATED IN THE BUILDING OF RA-3

ACEROS SIMA S. A. I. C.	Building materials
ADELCO S. A. I. C. A.	American blinds
AGAR CROSS & Co. LTD.	Stainless steel centrifugal pumps
ALDO FRESCHI	Floor polishing
ARRIETA Y CABANNE S. R. L.	Electricity
AUTOMATIC SPRINKLERS ARGENTINA	Cooling towers
BAVA, SEERY Y LIJTMAER S.A.I.C. y F.	Building contractors
BOHOGU Y LANZA S. R. L.	Thermodynamic installation
BRUNO SCHILLIG	Flow meters
CALERA "VILLA DEL PARQUE" S. R. L.	Building materials
CAMEA S. A.	Aluminum profiles
CARLOS IERMAN Y ARMANDO BARRASA	Building finishers
CELOCROM S. A. I. C.	Antioxides
C. I. M. E. T.	Coaxial cables
CLERIS Y NIKLISON	Sanitation
COAMCO S. A.	Building contractors
COMPAÑIA ARGENTINA DE MEDIDORES S. A.	Industrial relevators
CONSTANTA S. A.	Carbon deposit resistors
DEGREMONT S. A.	Water demineralization
DROSA S. A.	Flow meters
DUTECNICA S. A.	Special paint treatment
EL HORNERO S. R. L.	Building materials
EMAG S. R. L.	Stainless steel valves
ENCAR	Signal lights
ERNESTO SCHEER	Building contractors
FAPESA S. A. I. C.	Components for electronic control equipments
FAUSTINO G. ROMO	Metallic carpentry
FITZNER HNOS.	Stainless steel tubing
FLORCALDE S. A.	Stainless steel boilers
FRANCISCO VISSANI	Glassware
GERMAN BIANCO S. A. I. C. I. A. G.	Marblework
GIMENEZ HNOS.	Plaster
IGGAM S. A. I.	Building materials
IMDO S. A.	Carpentry
IMPERTOID (ARGENTINA) S. A.	Insulating floors
INDUSTRIAS PIRELLI S. A. I. C.	Conductors and coaxial cables
IRUMA S. A. I. C. F. I.	Hydraulic pumps
ISOLIT S. R. L.	Special floors and revetment
JUAN PERISSINOTTI	Interconnection binding posts
LEYDEN ARGENTINA	Electrolytical capacitors
LUIS SOLARI Y RAMON CASEREZ	Floors and revetments
LUIS VARGAS	Paintwork
MADERERA CONSTRUCTORA RUIZ S.R.L.	Carpentry
MARSETTI S. R. L.	Building materials

METALURGICA GIACOBINO Y CIA.	Metallic carpentry
MILOZ, GUTIERREZ Y MILLEFANTI	Metallic carpentry
MONTES DE OCA HNOS. Y CIA. S. R. L.	Sanitation and gas
NONIS Y CIA. S. R. L.	Mosaics
ORGANIZACION CAX I. C. F.	Building materials
OTIS ELEVATOR COMPANY	Elevators
PHILIPS ARGENTINA S. A.	Components for electronic control equipments
PLASTIDUCTO	Polyethylene tubing
RENCA	Power recorders
ROSMAR	Panel instruments
R. Y. C. A. S. A.	Acoustical ceilings
S. A. I. M. S. A. I. C.	Thermodynamical installation
SAIRE S. A. C. I.	Air conditioning and ventilation
SCHMIDBERG Y FISZER S. R. L.	Building contractors
SCHMITT	Stainless steel centrifugal pumps
SERRANO S. A. C. I. e I.	Building materials
SIEMENS ARGENTINA S. A.	Automatic switches
SODINEL	Electrical switchboards and control desks
STANDARD ELECTRIC ARGENTINA	Relevators
TALA S. R. L.	Building materials
TELESPEAKER	Intercomunicators
TOPECO	Wire resistors
VICTORIO MOLTRASIO E HIJOS S. A.	Mosaics and revetments

EZEIZA ATOMIC CENTER

LOCATION PLAN



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