SOUVENIR

of the inauguration of

THE ATOMIC ENERGY ESTABLISHMENT
TROMBAY

and

THE SWIMMING POOL REACTOR

by

THE PRIME MINISTER
JAWAHARLAL NEHRU

January 20, 1957

HISTORY

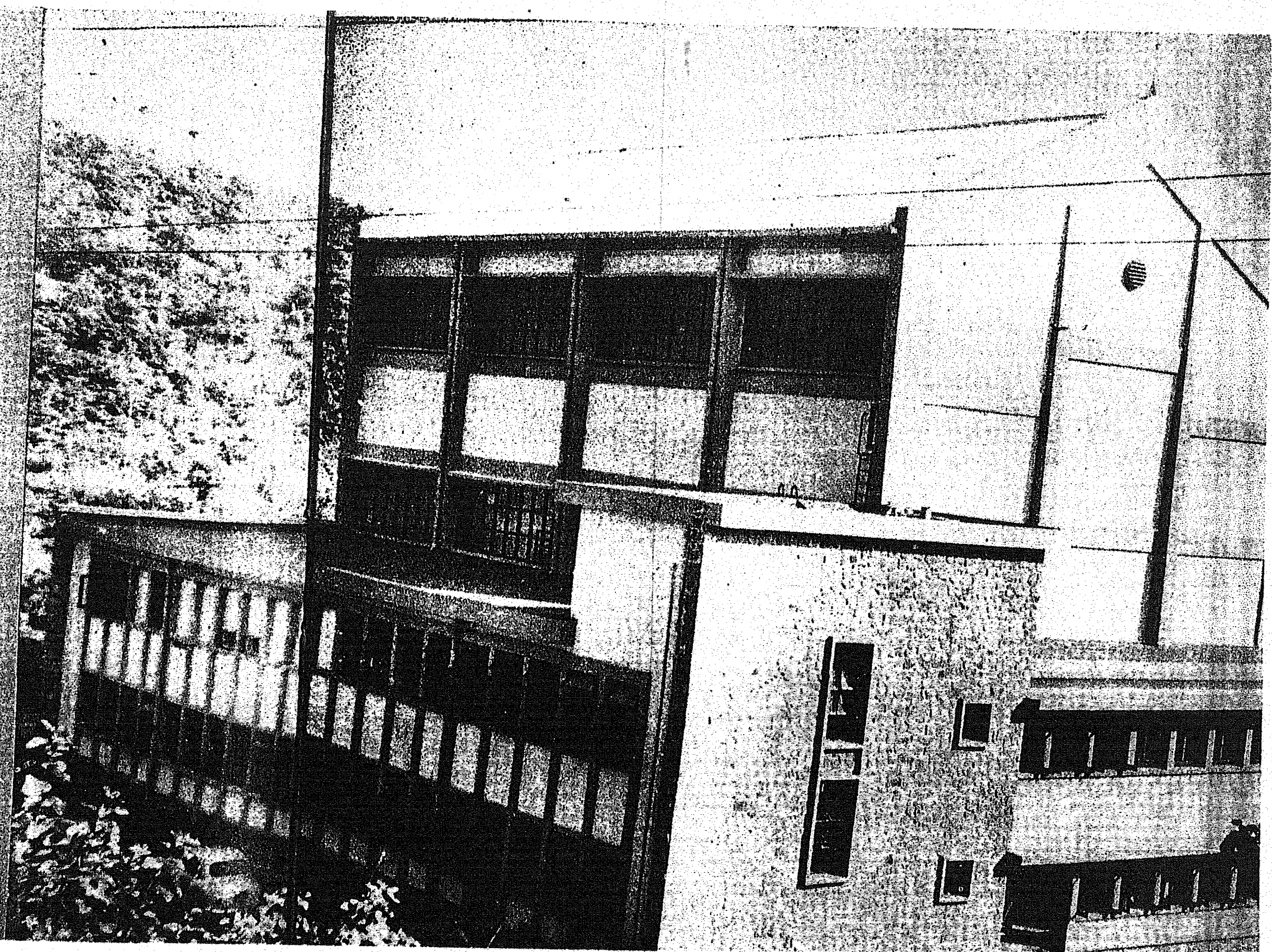
Towards the end of 1954, studies were undertaken on various types of research reactors and the availability of the materials necessary for these reactors. When the United Kingdom Atomic Energy Authority generously offered, under a cooperative agreement, to make available enriched uranium in the form of fabricated fuel elements, the Atomic Energy Commission resolved, at its meeting on March 15, 1955, to build a reactor of the swimming pool type. Though basically similar reactors are available for sale, the Commission considered that valuable experience would be gained, if its scientists and engineers were made entirely responsible for the design, erection and commissioning of India's first reactor. A small group was set up, presided over by Bhabha, to decide on the l design of the reactor, the pool experimental facilities. The l design was frozen by July 1955, the decision taken to build a actor operating at maximum p level of 1000 Kilowatts. The de and construction of the co system was immediately undert by the Reactor Control Div under Mr. A. S. Rao, while general engineering was done b Engineering Design Division u Mr. N. B. Prasad. It is a tri to the Staff who worked on project that it was succes completed within a period of over twelve months. The re attained criticality for the time on August 4, 1956.

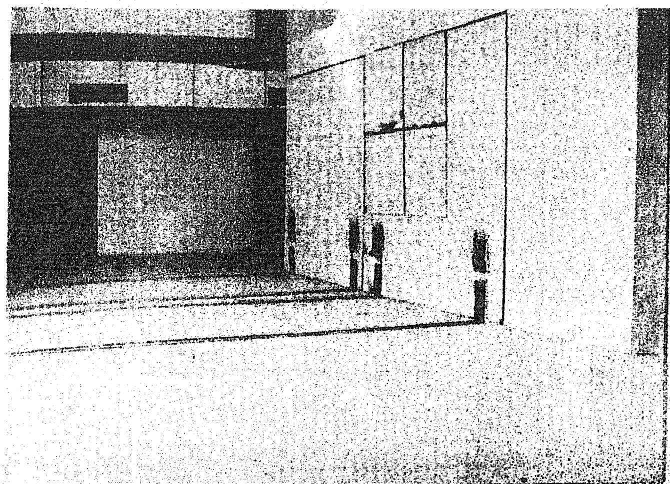
REACTOR

; reactor is of the 'swimming type and derives its name the fact that the core of the r is suspended in a large f ordinary water.

The core of the reactor consists of about 30 fuel elements closely positioned on an aluminium grid plate about 6 inches thick and is suspended in the pool from a trolley above. The fuel elements are made of an alloy of enriched uranium and aluminium sandwiched between two aluminium sheets. The size of the core is approximately 18"x18"x24" and requires nearly 3.5 kgms. of uranium 235 to reach criticality. Four of the elements are specially « that cadmium rods car in and out of the rea cally. As cadmium is neutron absorber, this changes the neutron cation, and the pow

e reactor is housed in a hall 100 feet long, et wide and 60 feet clear height. On one side s hall, on the ground floor, are located the imental rooms and the reactor auxiliaries like s, heat exchangers, etc. The control room is d just above the experimental rooms. On the side of the reactor hall, completely isolated it, is the graphite workshop.





SHIELDING CORNER FACILITY

The concrete blocks and trolleys pushed into position shutting off radiation.

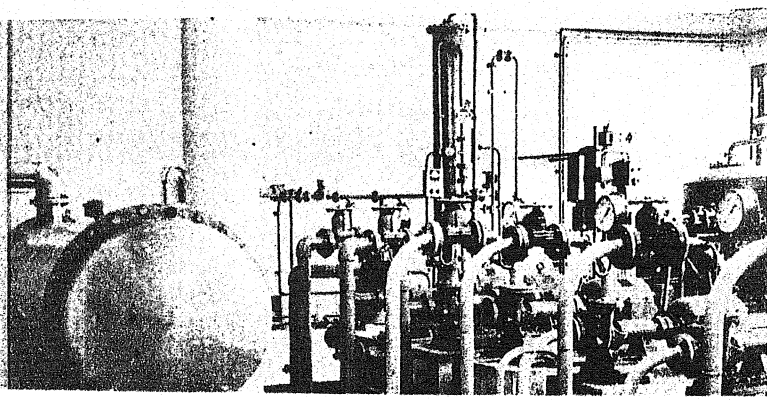
One of the trolleys moved out allowing access to the aluminium panel.

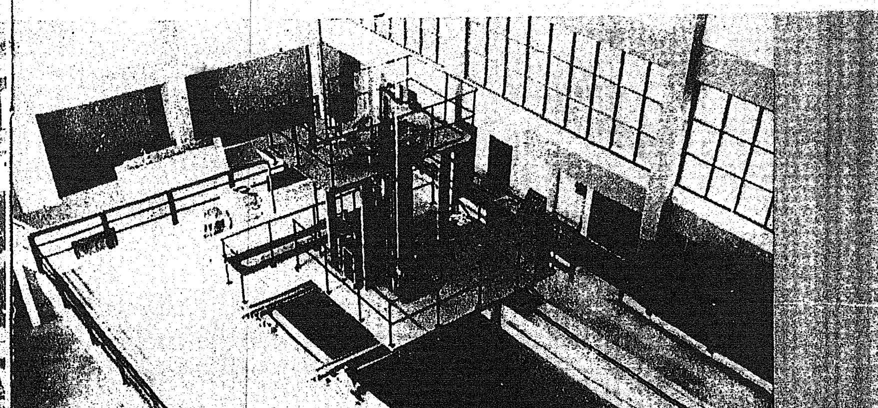
reactor can be maintained at any desired level. Two of these rods, each worth about 2% in reactivity, are designated as safety rods, and are dropped into the core for shut down of the reactor. A third rod, also worth about 2% in reactivity, is used as a coarse control rod. The fourth rod worth only about ½% in reactivity, is used for fine control and regulation of the reactor power.

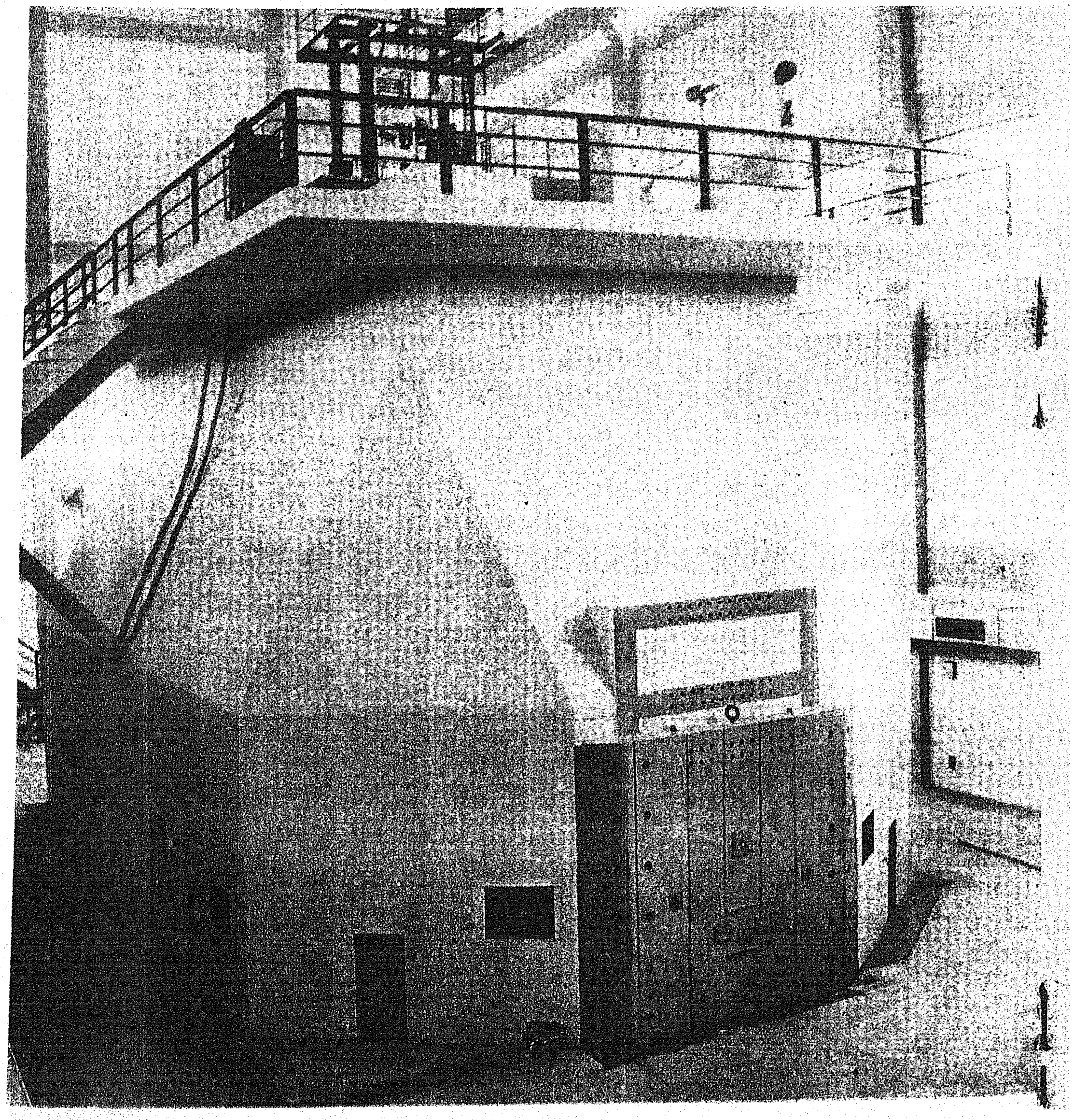
Four boron coated ionisation chambers are positioned above the core to one side, and these provide, in addition to linear and logarithmic flux measurements, signals to the safety or 'sigma' amplifiers. These sigma amplifiers control the excitation of the electromagnets which support the control and safety rods an[d] magnets in an e[...] dropping the sa[...] core. The enti[...] is designed on [...] principle.

The water in

A view of the pump [...]m showing the cir[cul]ating pumps and the [hea]t exchanger with the [de]mineraliser and filter







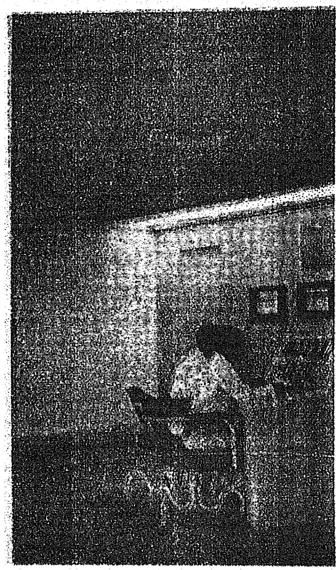
moderator for slowing down eutrons to thermal energies and s a coolant for removing the ıeat of fission. It also serves as hielding against radiation. The eactor pool is 10 feet wide, 28 feet long and 28 feet deep. The core of the reactor can be moved to any position in the tank by means of the trolley from which it is suspended. The sides of the tank are made of 8½ feet thick concrete walls which act as protection against radiation to personnel around the reactor.

The reactor is designed to operate at a maximum power level of 1000 kw. At a power level of over 100 kw forced convection cooling is necessary to remove the heat of fission, and vertical diffusors connecting with the bottom of the grid plate, are provided in 3 positions where the reactor can be operated at high power levels.

It is necessary to remove all the dissolved solids from the water in the reactor pool as many of them become under radiation. demineralised water impurities of less tha million is used. This corrosion of the alu ponents used in th continuous overflow at the rate of nearl per hour is provided water surface clear. exchangers and an cooling tower are removal of the he reactor. A dump ta

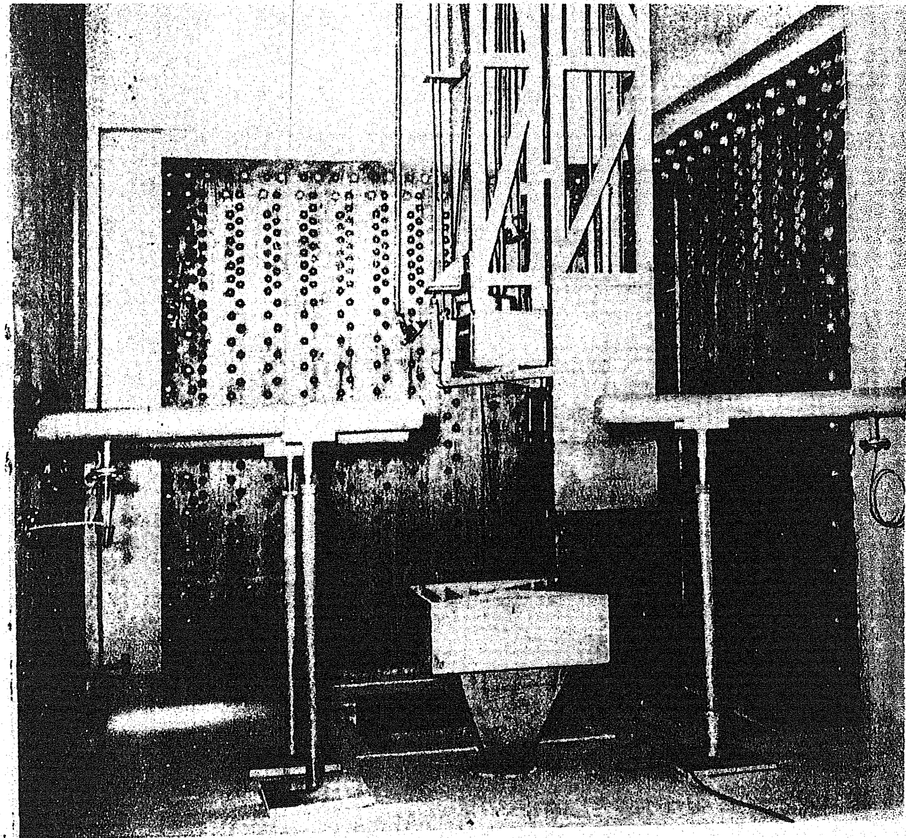
Left : A view of the reactor. In the foreground can be seen the lead door of the thermal column. Along the face of the wall are the outlets for the neutron channels.

Right : A view of the control room.

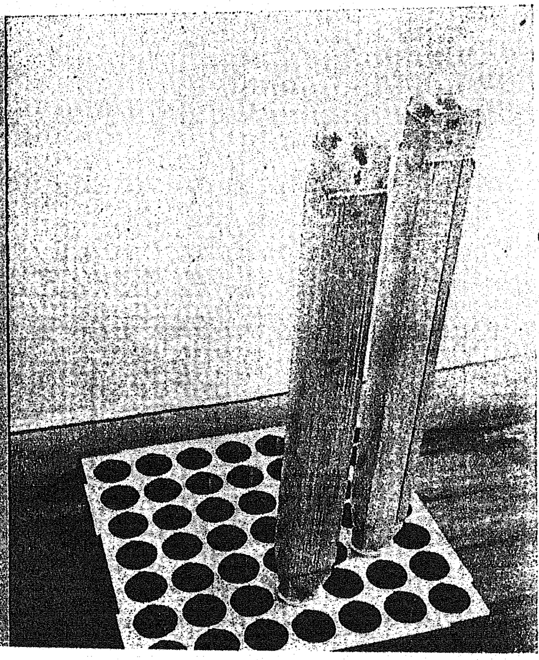


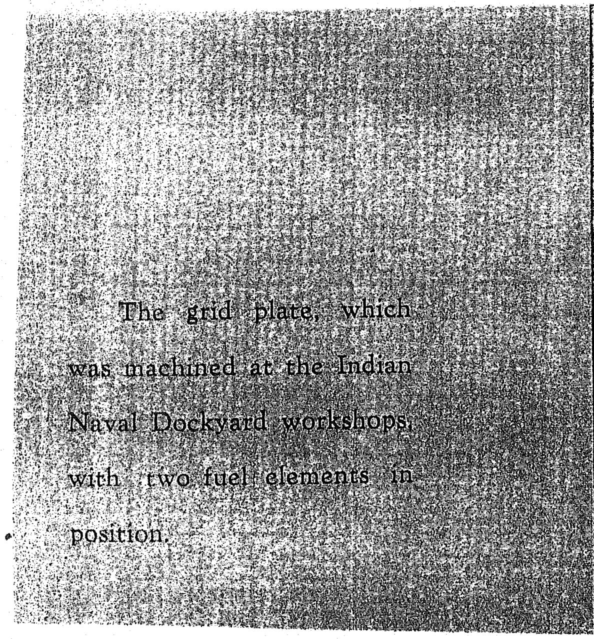
or transferring the pool water in ase of any radioactive contamina-ion. This water is then passed hrough a non-regenerable ion-xchange unit where the radio-ctive contamination is absorbed. This can then be conveniently lisposed off by burying it under ground at a suitable depth.

Various experimental facilities passing through the concrete are provided at the three operating positions. A thermal column with an opening 6' x 6' is provided at one end of the pool. This is filled with graphite of nuclear purity for thermalising the neu-trons, and a pure beam of thermal neutrons can be obtained for experiments in neutron physics. Various neutron channels of cast iron with diameters of 4" and 6" are provided in the concrete, through which neutron beams can

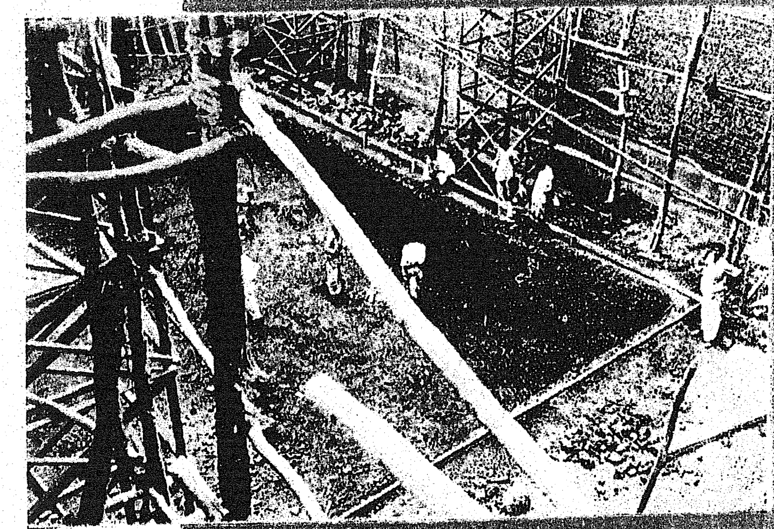


The grid plate, which was machined at the Indian Naval Dockyard workshops, with two fuel elements in position.

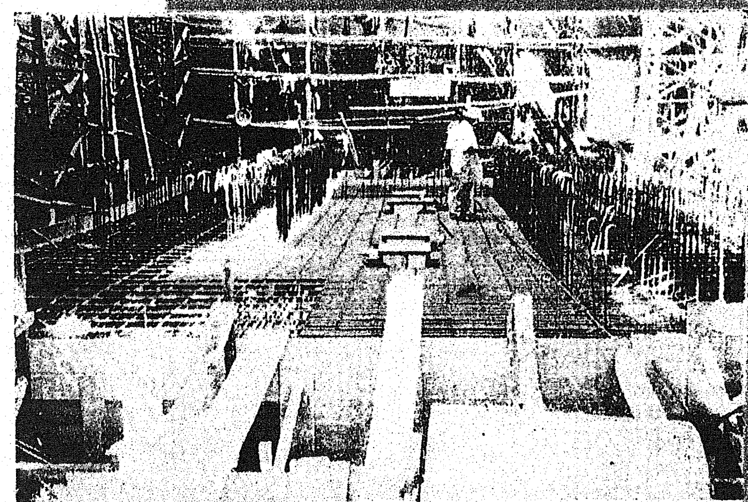




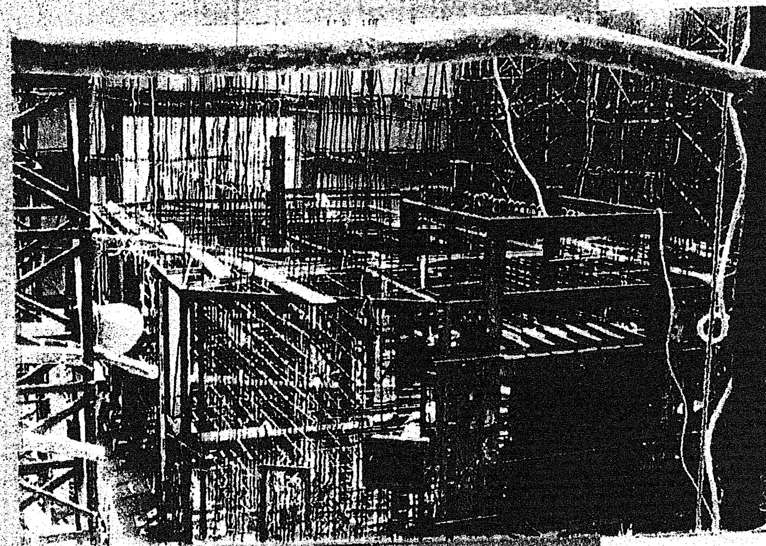
be obtained. When not in use, large steel plugs are inserted in these beam holes shutting off radiation. At the other end of the pool, an experimental facility known as the shielding corner is provided. Here the concrete wall is replaced by a one inch thick aluminium panel. Shielding pro-perties of various materials can be found by bringing reactor next to panel and placin under study on the aluminium blocks each wei tons can be mov to the panel, wh not in use.



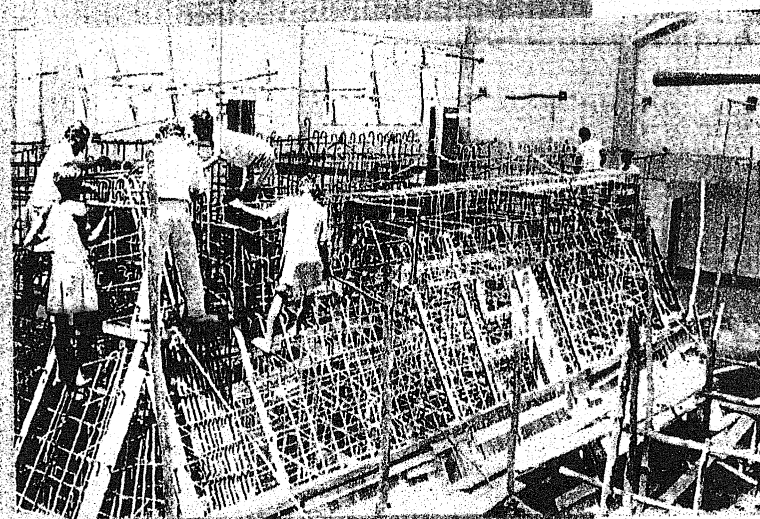
December 24, 1955



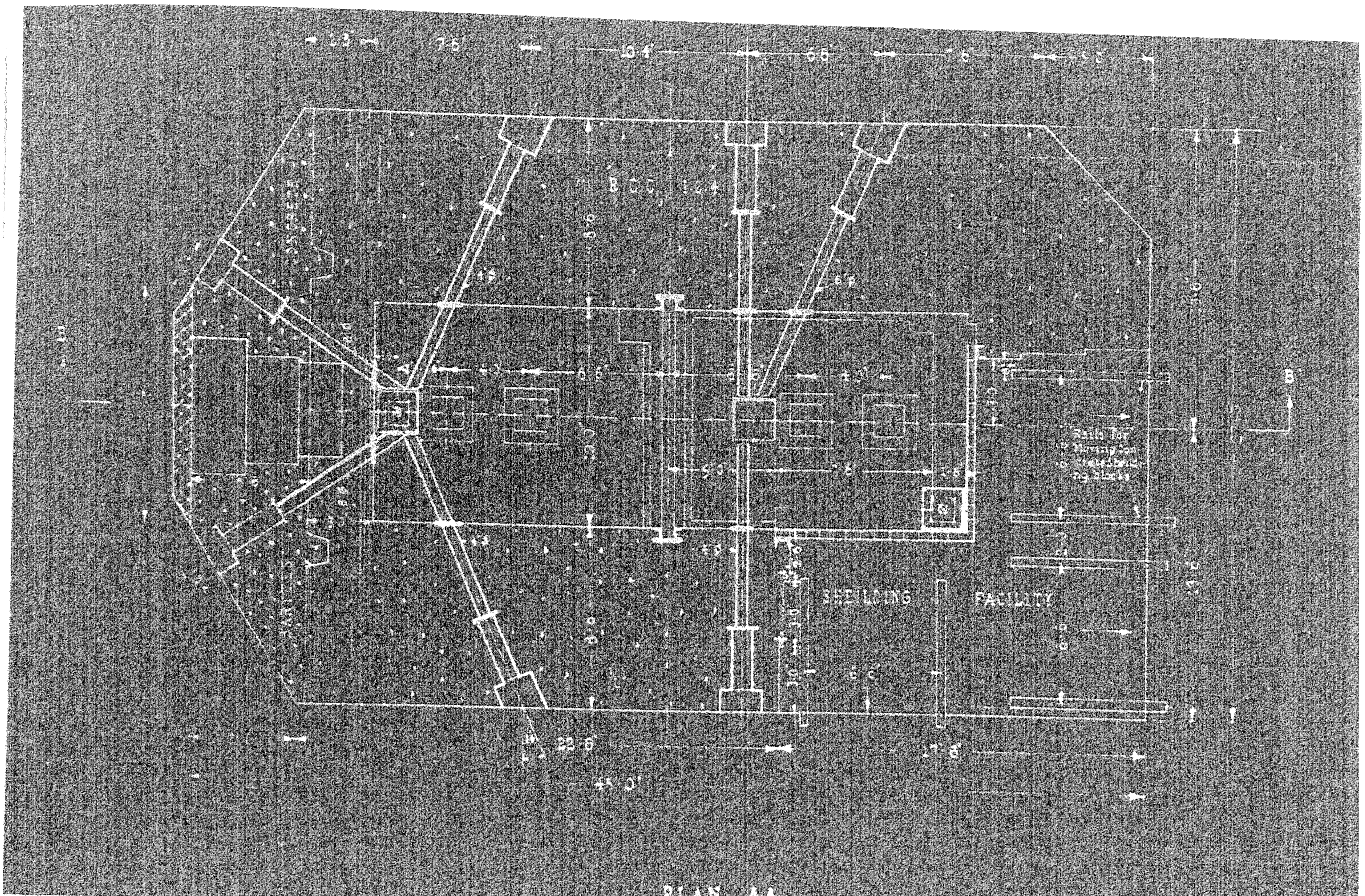
February 2, 1956



April 7, 1956

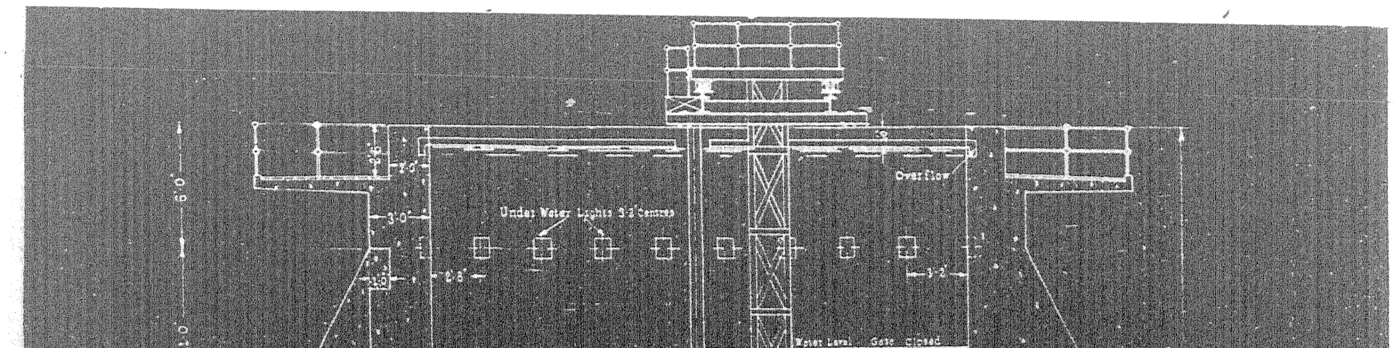


April 27, 1956



R.C.C. 1:2:4
CONCRETE
BARYTES
SHEILDING
FACILITY
Rails for Moving Concrete Sheilding blocks
B
B'
22·6"
17·6"
45·0"

PLAN AA



Under Water Lights 3'3" Centres
Overflow
Water Level Gate Closed
From Heat Exchanger
From Heat Exchanger
Diffuser
Drains
Diffuser
Racks
A
A

RESEARCH FACILITIES

This reactor will be used for training of personnel in reactor technology, and for research in a wide range of experiments in the fields of physics, engineering and biology. In addition, small quantities of radio isotopes will be produced.

The reactor will provide a strong source of neutrons as the thermal neutron flux at the edge of the core is about 10^{12} neutrons/cm^2/sec, when the reactor is operating at a power level of 100 kw. The thermal column can be used for the study of nuclear reactions, and determination of neutron scattering and absorption cross-sections. It can also be used as a neutron source in connection with exponential assembly experiments for determining the buckling of various new combinations of reactor materials. At the other neutron channels, experiments can be conducted on neutron diffraction crystallography and solid state physics by the use of crystal spectrometers and choppers.

At the 'shielding corner', experiments can be conducted on the bulk shielding properties of various reactors, particularly for package or propulsion units where weight and volume are important considerations.

In addition, various other experiments pertaining to reactor technology can be conducted. As the fuel elements can be handled easily under water, various lattice configurations can be studied by rearrangement of the fuel elements. This also permits a study of the effect of voids in the core on reactivity. Various moderators canned in aluminium can be placed around the core, and their effect on the critical mass studied.

The reactor can also be used for the so-called 'Danger Coefficient' type of experiments. In these, a fuel element, after long irradiation in more powerful reactors, can be compared for its effect on reactivity with an identical element which has not received long irradiation, by placing it in the core of the reactor and measuring the change of reactivity. This can then be correlated in terms of burn-up of uranium 235, conversion of uranium 238 to plutonium 239 and the accumulation of