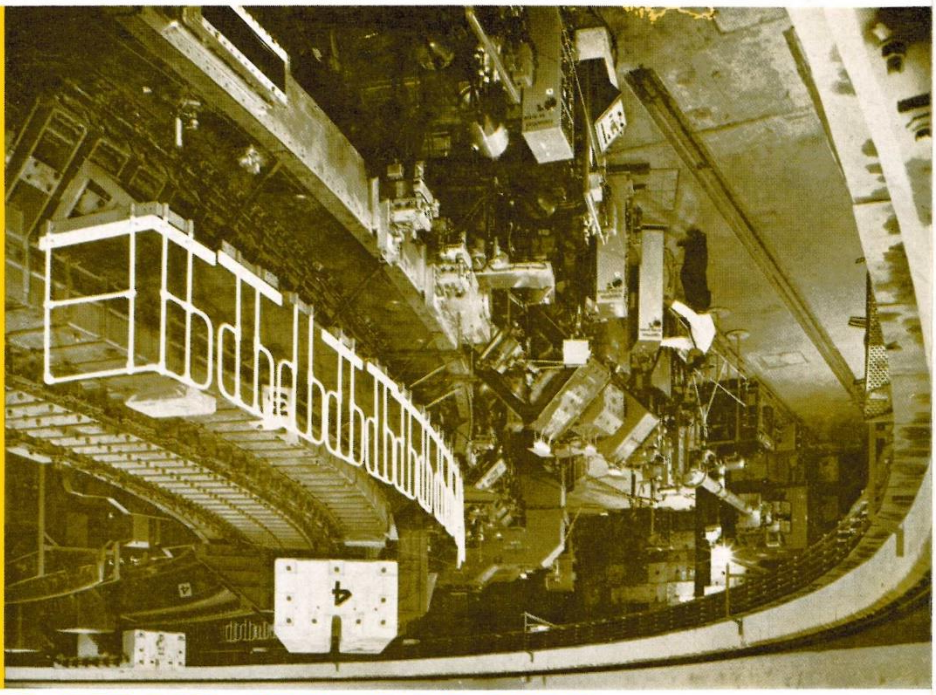
7GeV Proton Synchrotro

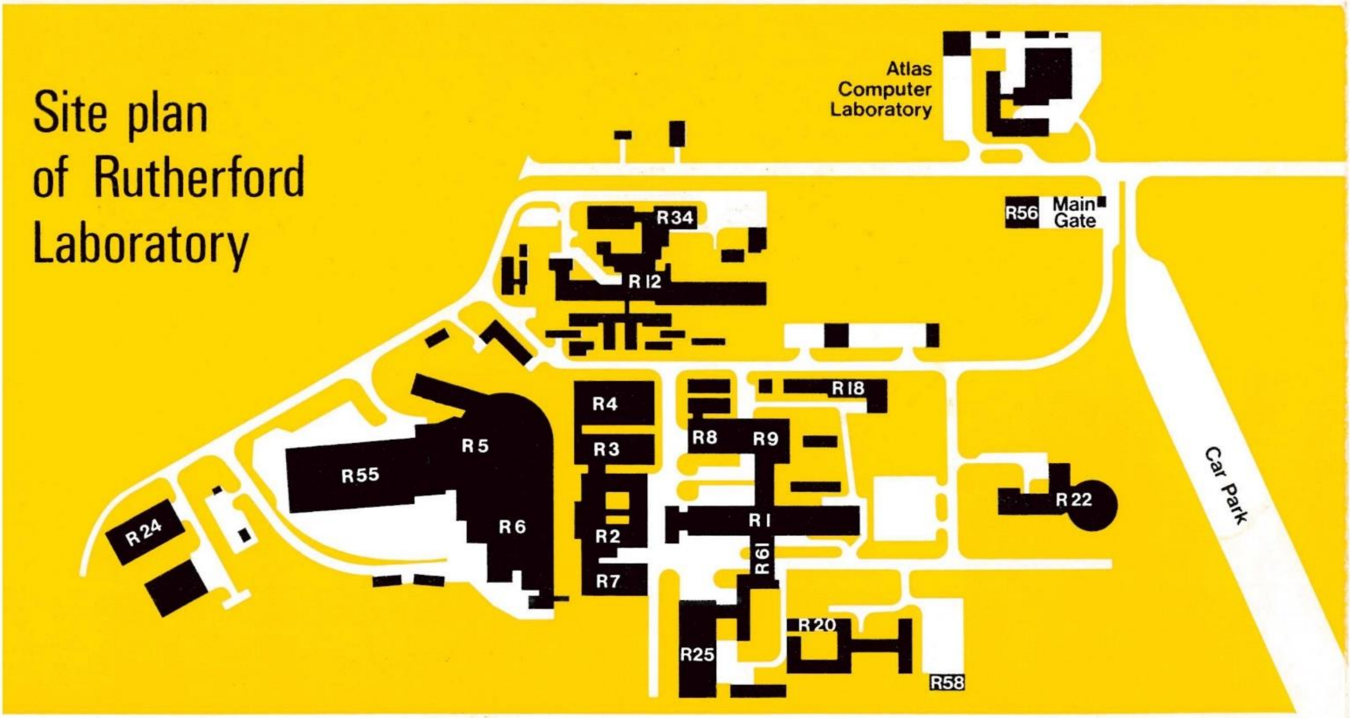
NIMRO



Science Research Cou

RUTHERFORD LABORATOR

Site plan of Rutherford Laboratory



R1	Offices and Laboratories	R5	Nimrod Injector and Magnet Areas	R9	Main Workshops	R24	Stores
R61	Library		Experimental Hall No 2	R12	Offices and Laboratories	R25	Offices and Heavy Duty Laboratory
R2	Nimrod Control, Offices and Workshops	R6	Experimental Hall No 1 and Bubble Chamber	R18	Ancillary Workshops	R34	Nuclear Chemistry Laboratory
R3	Motor Alternators	R7	Bubble Chamber Plant	R20	Offices and Radiation Protection	R55	Experimental Hall No 3
R4	Converter Hall and Ancillary Plant	R8	Assembly and Test Area	R22	Restaurant and Lecture Theatre	R58	Film Processing

NIMROD

7GeV Proton Synchrotron

The Rutherford Laboratory was founded in 1957 as a national research centre for nuclear science. It was particularly intended for the development and operation of nuclear research equipment for use by universities, where the size, complexity or cost of the equipment was beyond the resources of the universities themselves.

The first machine in this category to operate at the Laboratory was the 50 MeV Proton Linear Accelerator which commenced nuclear research in April 1960 and ceased operation in October 1969. The second was the 7 GeV Proton Synchrotron Nimrod which reached full energy in August 1963 and started its programme of high energy physics experiments in February 1964.

In April 1965, the Science Research Council was set up with wide responsibilities for research in the physical sciences in its own laboratories, at universities and in collaboration with international organisations. The Rutherford Laboratory and its sister establishment the Daresbury Nuclear Physics Laboratory were transferred to the Science Research Council. The Council is now responsible for the entire national effort in pure nuclear science, by its support of these two Laboratories, nuclear research in universities and also by participation in the European Organisation for Nuclear Research at Geneva.

200 physicists from universities, the Atomic Energy Research Establishment and from the Rutherford Laboratory itself, now base their research on Nimrod and on experiments at CERN, Geneva.

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Injector

Energy of protons entering Linear Accelerator	0·6 MeV
Energy of protons entering Synchrotron	15 MeV
Linac output current	5–30 mA
Linac operating frequency	115 MHz
Estimated pulsed R.F. power dissipated	700 kW
Overall length of Linac tank	14m (46ft.)
Diameter of Linac tank	2·43m (8ft.)
Number of pumps Mercury	10

Magnet

Beam radius mean	23·4m (77·5ft.)
Normal peak magnetic field at injection	0·28 tesla
Peak magnetic field	14 tesla
Useful magnetic aperture	0·23m (9in.) vertical 0·91m (36in.) horizontal
Number of magnet sectors	336
Weight of each magnet sector	19·4 tonnes (19 tons)
Number of turns in coil	42
Weight of magnet coil total	357 tonnes (350 tons)
Pulse rise time	0·72 sec
Pulse decay time	0·8 sec
Repetition rate of magnet pulse	22 pulses/min
Normal peak current in coil	9150 amps
Stored energy in magnet at peak field	40 megajoules
Number of protons accelerated	2×10^{12} per pulse

Magnet Power Supply

Number of Motor-alternator-flywheel sets	2
Alternator ratings nominal	60 MVA
Alternator ratings maximum	91 MVA
Alternator ratings thermal	42 MVA
Weight of rotors	61 tonnes (60 tons)
Weight of stators	73 tonnes (72 tons)
Motor rating	3·81 MW
Motor speed	16·2 rps
Flywheel diameter	3·2m (10·5ft.)
Flywheel weight	30·5 tonnes (30 tons)
Stored energy in each flywheel at 1000 r.p.m.	535 MJ
Speed reduction during pulse	4%

Vacuum System

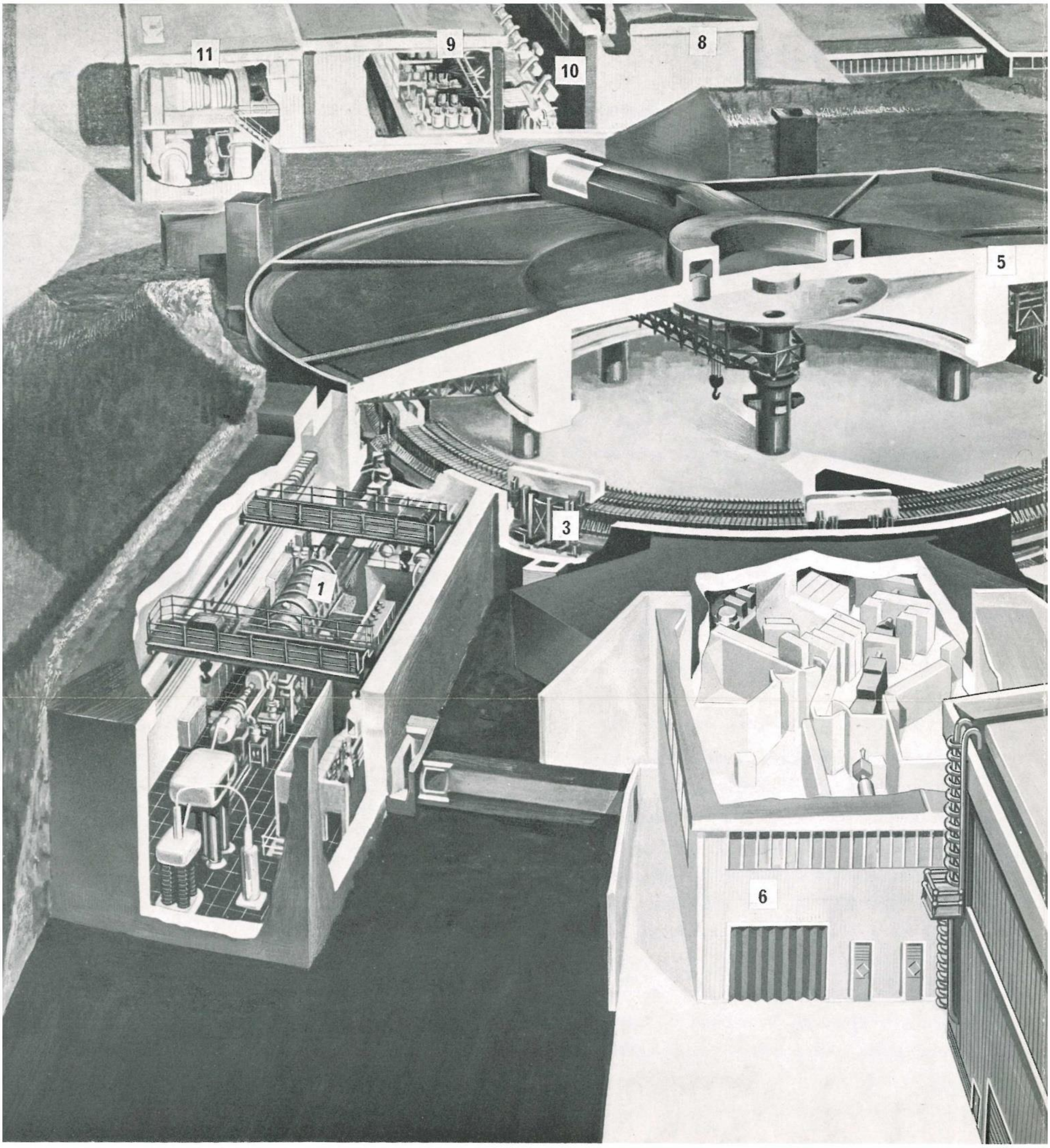
Vertical Beam, aperture	0·24m (9·5in.)
Pressure in inner vessel	10^{-4} Nm^{-2}
Pressure in outer vessel	100 Nm^{-2}
Pumping volume of inner vessel	$99m^3$ (3500 cu.ft.)
Number of pump units for inner vessel	40
Pump type	0·6m (24in.) oil diffusion
Vacuum vessel material	Epoxy glass laminate
Overall peak speed of diffusion pumps	200,000 litres/sec (approx)

R.F. System

R.F. frequency at injection energy	1·4 MHz
R.F. frequency at peak energy	8·2 MHz
Weight of ferrite	5·4 tonnes (12000lbs)
Weight of cavity	20·4 tonnes (20 tons)
Peak R.F. volts per gap	7 kV
R.F. power dissipation	45 kW
Ferrite working temperature	25°C
D.C. bias winding ampere turns	8000

General Parameters

Diameter of magnet building	60·9m (220ft.)
Weight of concrete in building	approx. 100,000 tons
Radiation shielding wall thickness	9·1m (30ft.) of concrete (equivalent)
Roof thickness	4·9m (16ft.) of concrete (equivalent)
Distance travelled by particles during acceleration	100,000 miles



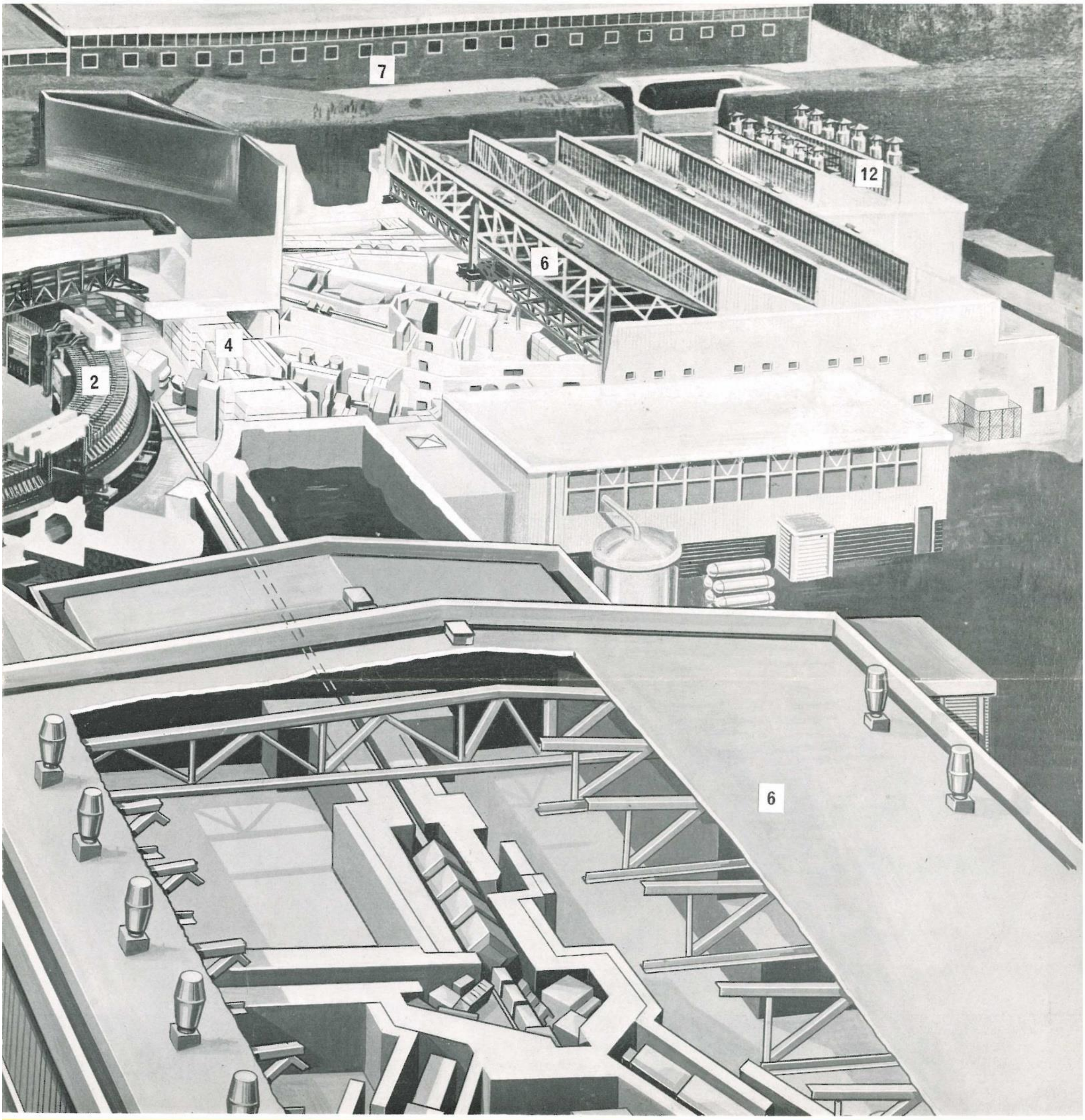
7 GeV Proton Synchrotron

1 **Injector.** This unit gives an initial acceleration to the protons up to an energy of 15 MeV.

2 **Electro-magnet.** The large magnet guides and focuses the protons in an orbit of constant radius.

3 **R.F. System.** The radio-frequency accelerating unit gives the protons a peak 7 KV kick on each orbit.

4 **Shielding Wall.** This is made of steel and concrete giving radiation protection to the Experimental Halls.



5 **Shielding.** The synchrotron is enclosed in a shield of concrete with additional earth shielding on the roof and around the sides.

6 **Experimental Halls.** Beams of protons are admitted to the Halls through 'beam lines'.

7 **Control Room.** Contains all the instruments controlling the operation of NIMROD.

8 **Alternator House.** The rotating plant comprises two 60 MVA, 16 r.p.s. alternators and two 30·5 tonne (30 ton) flywheels driven by two 3·81 MW induction motors.

9 **Converter House.** Contains the 96 water cooled single anode, grid controlled mercury arc converters.

10 **Transformer Yard.** Eight 12 MVA phase splitting transformers.

11 **Plant Room.** Contains the air-conditioning plant for the Magnet Room.

12 **Bubble Chamber.** Chamber containing liquid hydrogen used for the study of collisions between elementary particles.