

# The World's Reactors

No. 18 G1

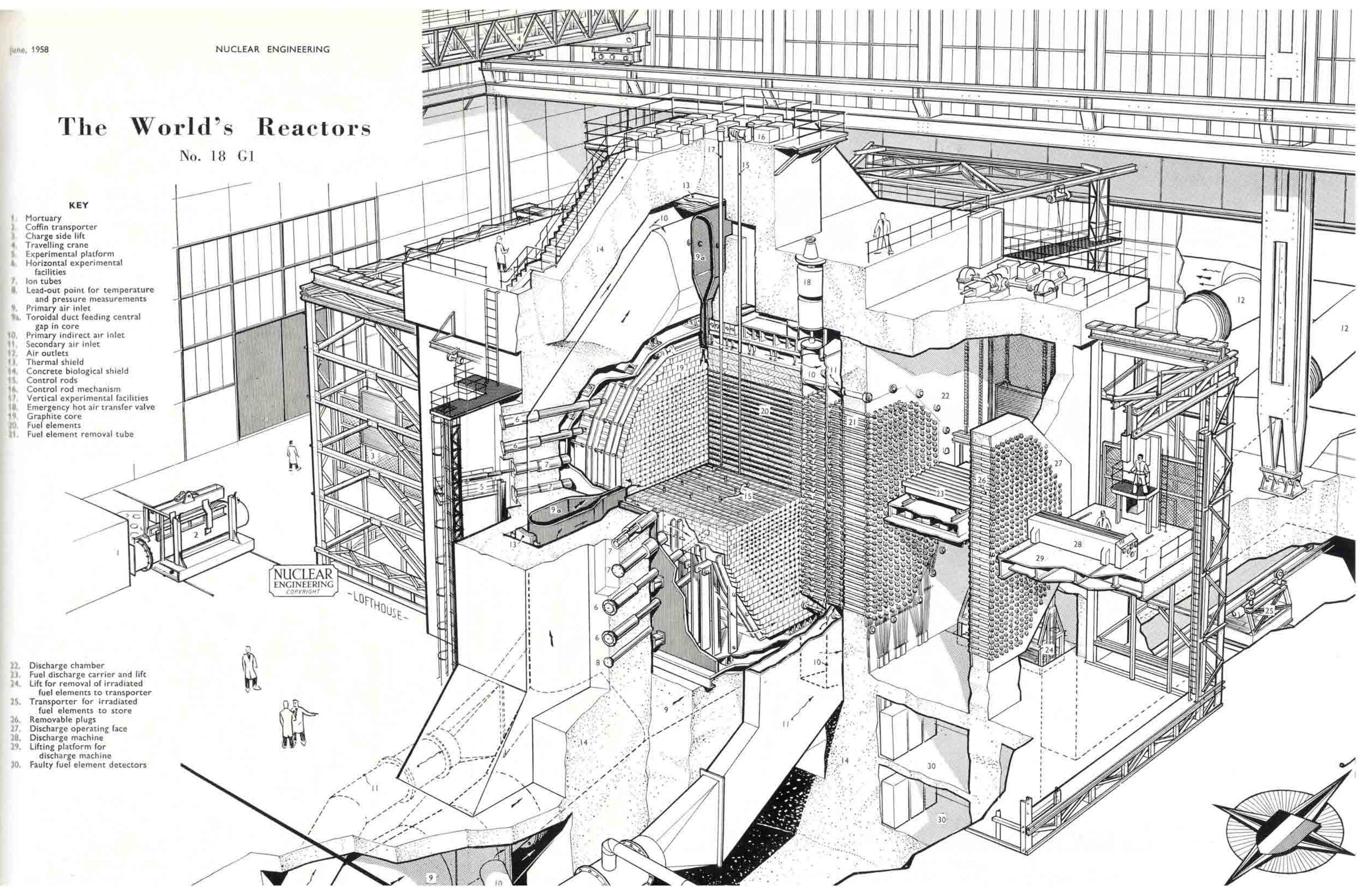
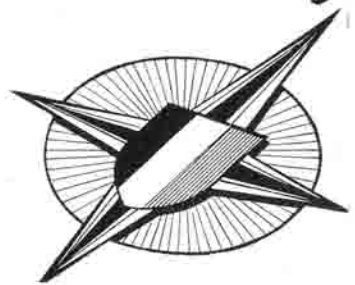
### KEY

- 1 Mortuary
- 2 Coffin transporter
- 3 Charge side lift
- 4 Travelling crane
- 5 Experimental platform
- 6 Horizontal experimental facilities
- 7 Ion tubes
- 8 Lead-out point for temperature and pressure measurements
- 9 Primary air inlet
- 9a Toroidal duct feeding central gap in core
- 10 Primary indirect air inlet
- 11 Secondary air inlet
- 12 Air outlets
- 13 Thermal shield
- 14 Concrete biological shield
- 15 Control rods
- 16 Control rod mechanism
- 17 Vertical experimental facilities
- 18 Emergency hot air transfer valve
- 19 Graphite core
- 20 Fuel elements
- 21 Fuel element removal tube

- 22 Discharge chamber
- 23 Fuel discharge carrier and lift
- 24 Lift for removal of irradiated fuel elements to transporter
- 25 Transporter for irradiated fuel elements to store
- 26 Removable plugs
- 27 Discharge operating face
- 28 Discharge machine
- 29 Lifting platform for discharge machine
- 30 Faulty fuel element detectors

NUCLEAR ENGINEERING  
COPYRIGHT

-LOFTHOUSE-



# The World's Reactors

## No. 18 G1

**TYPE:** Thermal heterogeneous.

**PURPOSE:** Plutonium production.  
Prototype for central power stations.

**LOCATION:** Marcoule.

**CAPACITY:** Electrical rating: 5.75 MW normal 8 MW maximum.  
Distribution: 5.5 kV.  
Internal distribution: 380, 220, 127 and 48 V.  
Heat rating: 40 MW.

**OPERATION:** Diverged 7th January, 1956.

**FUEL:** Natural uranium.  
U as cast bars 26 mm (1.0236 in.) dia., 100 mm (3.937 in.) long, 37 bars in same sheath.  
Density 18.9 g/cm<sup>3</sup>.  
Elements in horizontal channels: two per channel.  
Total weight of fissile material: 100 tonnes.  
Number of fuel-element channels: 1,337.  
Diameter of channels: 70 mm (2.7559 in.).  
Maximum temperature: 400°C.

**CANNING:** Magnesium.  
Wall thickness: 1.6 mm (0.0629 in.).  
Diameter: 62 mm (2.441 in.).  
Extended surface: 8 longitudinal fins 16.3 mm (0.648 in.) high.  
Design maximum can surface temperature: 300°C.

**MODERATOR:** Graphite.  
Core size: 8.225 m (26 ft 11½ in.) dia., 8.4 m (27 ft 6½ in.) long.  
Thickness of reflector: 0.8 m (2 ft 7½ in.).  
Total weight: 1,200 tons.  
Blocks 200 mm (7.874 in.) square.  
Average temperature: 125°C.

**LATTICE:** Regular square 200 mm (7.874 in.).  
Thermal utilization factor,  $f$ : 0.895 ± 0.005.  
Resonance escape factor,  $p$ : 0.912 ± 0.006.  
Fast fission factor,  $\epsilon$ : 1.029.  
Thermal fission factor,  $\eta$ : 1.283.  
Multiplication constant,  $k_{\infty}$ : 1.077.  
Radial diffusion area, cm<sup>2</sup>: 376.  
Axial diffusion area, cm<sup>2</sup>: 395.  
Radial slowing-down area, cm<sup>2</sup>: 444.  
Axial slowing-down area, cm<sup>2</sup>: 465.

**PRESSURE VESSEL:** There is no pressure vessel as such, the working pressure is practically atmospheric.

**COOLANT:** Air, distributed through a vertical gap 80 mm (3.1496 in.) wide in the centre of the core, fed by a toroidal duct.  
Working pressure: 2 mm (78.74 in.) w.g.  
Flow: 222 kg (488 lb)/sec with 3 blowers.  
Inlet temperature: 20°C.  
Outlet temperature: 200°C.  
Mean coolant velocity: 37.5 m (123 ft)/sec in central duct.  
There are three air circuits:  
**Primary direct**, cooling fuel elements.  
**Primary indirect**, cooling thermal shield and periphery of cylinder.  
**Secondary**, cooling front and rear faces, and minimizing leakage from the primary channels.

**BLOWERS:** Axial type, 4 primary, 4 secondary, coupled in pairs (1 primary, 1 secondary) each driven by 2,650 kW (approx. 3,500 h.p.) motor.  
Blower ratings. Primary: 240,000 m<sup>3</sup>/h (141,000 cu. ft/min) at 2,200 mm (78.74 in.) w.g. Secondary: 80,000 m<sup>3</sup>/h (47,000 cu. ft/min) at 650 mm (25.59 in.) w.g.

**CONTROL:** Number of rods: 36 (32 safety and compensating, 4 automatic control).  
Diameter: 43 mm (1.6929 in.).  
Rod construction: boron carbide in two concentric steel tubes.  
Length: 5 elements of 1 m (39.37 in.) per rod.  
Suspension: steel cable.  
Drive: ¼ h.p. motor.

**REACTIVITY:** Total excess 5.7%, made up of:  
Neutron capture: 3.5%.  
Temperature: 0.7%.  
Samarium: 0.7%.  
Xenon: 0.7%.  
Miscellaneous: 0.1%.  
Reactivity due to central channel: 0.01%.  
Control rod increment varies from 0.25% for the central rod to 0.04% for the outermost. Total 4%.

**SHIELDING:** Thermal: 80 mm (3.1496 in.) thick steel plates.  
Biological: concrete, 2 m (6 ft 6¾ in.) thick.  
density, 2.5.  
Cooling: blown air.

**HEAT EXCHANGER:** Total heating surface: 5,800 m<sup>2</sup> (62,428 sq. ft).  
Water tubes: Mild steel 21 mm (0.8268 in.) I.D., 26 mm (1.0236 in.) O.D., with 65 mm (2.559 in.) square fins.  
**Characteristics:**  
Gas side:  
Inlet temperature 180°C.  
Outlet temperature 80°C.  
Gas flow 257 kg (566.6 lb)/sec.  
Inlet duct diameter 4.5 m (14 ft 9½ in.).  
Water side:  
Flow 61.2 kg/sec (486,000 lb/h).  
Inlet temperature 60°C (140°F).  
Outlet temperature 170°C (338°F).  
Pressure 35 kg/cm<sup>2</sup> (497.82 p.s.i.).  
Heat transfer 31.5 × 10<sup>6</sup> cal/h.  
Efficiency 99% (i.e. 1% loss through walls).

**BOILERS:**

	Normal		Maximum	
	kg/sec	lb/h	kg/sec	lb/h
Flow:				
No. 1	61.2	486,000	92	730,000
No. 2	55.67	441,000	85.13	676,000
No. 3	50.69	400,000	77.06	612,000
Enthalpy	cal/kg	BTU/lb	cal/kg	BTU/lb
Inlet to No. 1	203.2	365.7	203.2	365.7
Outlet of No. 1	156.8	271.24	165.6	298.1
Outlet of No. 2	112.5	202.5	122.05	219.7
Outlet of No. 3	69.94	125.89	78.14	140.65
Steam pressure	kg/cm <sup>2</sup>	p.s.i.	kg/cm <sup>2</sup>	p.s.i.
No. 1	5.64	80	7	100
No. 2	1.57	22.4	2.14	30.4
No. 3	0.318	4.5	0.45	6.3

**TURBO-ALTERNATOR:** Vertical shaft.  
Continuous rating: 5.75 MW at a power factor of 0.8. Maximum rating 8 MW.  
Speed: 3,000 r.p.m.  
Generator voltage: 5.5 kV, three-phase, 50 c/s.  
Alternator efficiency: 96.7%.