

The World's Reactors

No. 27 BR3

BR3



TYPE: Thermal heterogeneous (PWR).

LOCATION: Mol, Belgium.

PURPOSE: Power Experiment.

OWNER: Centre d'Etude de l'Energie Nucléaire (C.E.N.).

ARCHITECT ENGINEERS: Bureau d'Etudes Nucléaires (B.E.N.), Société Belge pour l'Industrie Nucléaire (BelgoNucléaire), Société de Traction et d'Electricité (T.E.).

MAIN SUPPLIER: Westinghouse Electric International Company (Gibbs and Hill, Architect Engineer for Westinghouse).

STATUS: Construction commenced November 1957. Criticality scheduled for the end of 1960.

OUTPUT: 40.9 MWt, 11.5 MWe (gross), 10.5 MWe (net).

FUEL: Enriched uranium oxide (inner zone 3.7%; outer zone 4.43%). Total loading at rated power 2,000 kg U₃O₈.

CORE: Cruciform prism 31.68 in. (80.5 cm) square, composed of 32 channels arranged in rows of 4-6-6-6-4 at 5.28 in. (13.41 cm) pitch. Active height: 56 in. (142 cm). Average power density: 50.45 kW/litre. $\epsilon = 1.034$. Excess reactivity for: $\rho = 0.81$. Temperature 9% $\rho = 50$ cm². Xe and Sm 5% k_{eff} (hot, clean) = 1.097. Burn-up 5% Maximum excess reactivity, cold, clean 19% Neutron flux: Thermal average: 1.8×10^{13} n/cm², sec. Thermal maximum: 5.1×10^{13} n/cm², sec. Fast, average: 1.1×10^{14} n/cm², sec. Fast, maximum: 2.7×10^{14} n/cm², sec. Temperature coefficients: Fuel: -2 to -5×10^{-4} $\Delta k/k$ /°F (-3.6 to -9×10^{-4} $\Delta k/k$ /°C). Moderator: -2 to -4×10^{-4} $\Delta k/k$ /°F (-3.6 to -7.2 $\Delta k/k$ /°C).

FUEL ELEMENTS: Two types, 111 and 110 rods, each rod 0.343 in. (0.87 cm) diameter, containing 91 pellets 0.300 in. (0.76 cm) diameter x 0.600 in. (1.52 cm) long. Cladding: type 348 stainless steel, 0.021 in. (0.053 cm) thick.

CONVERSION FACTOR: Inner region 0.469; outer region 0.435.

BURN-UP: 5,940 MWd/t (average).

CONTROL: Silver-indium-cadmium rods of cruciform section, 5.19 in. (13.18 cm) square x 0.250 in. (0.635 cm) thick. No. of rods: 12. Active length 56.75 in. (144 cm). Overall length: 122.44 in. (311 cm). Total worth of control rods: 20% $\Delta k/k$. Scram time 0.15 sec.

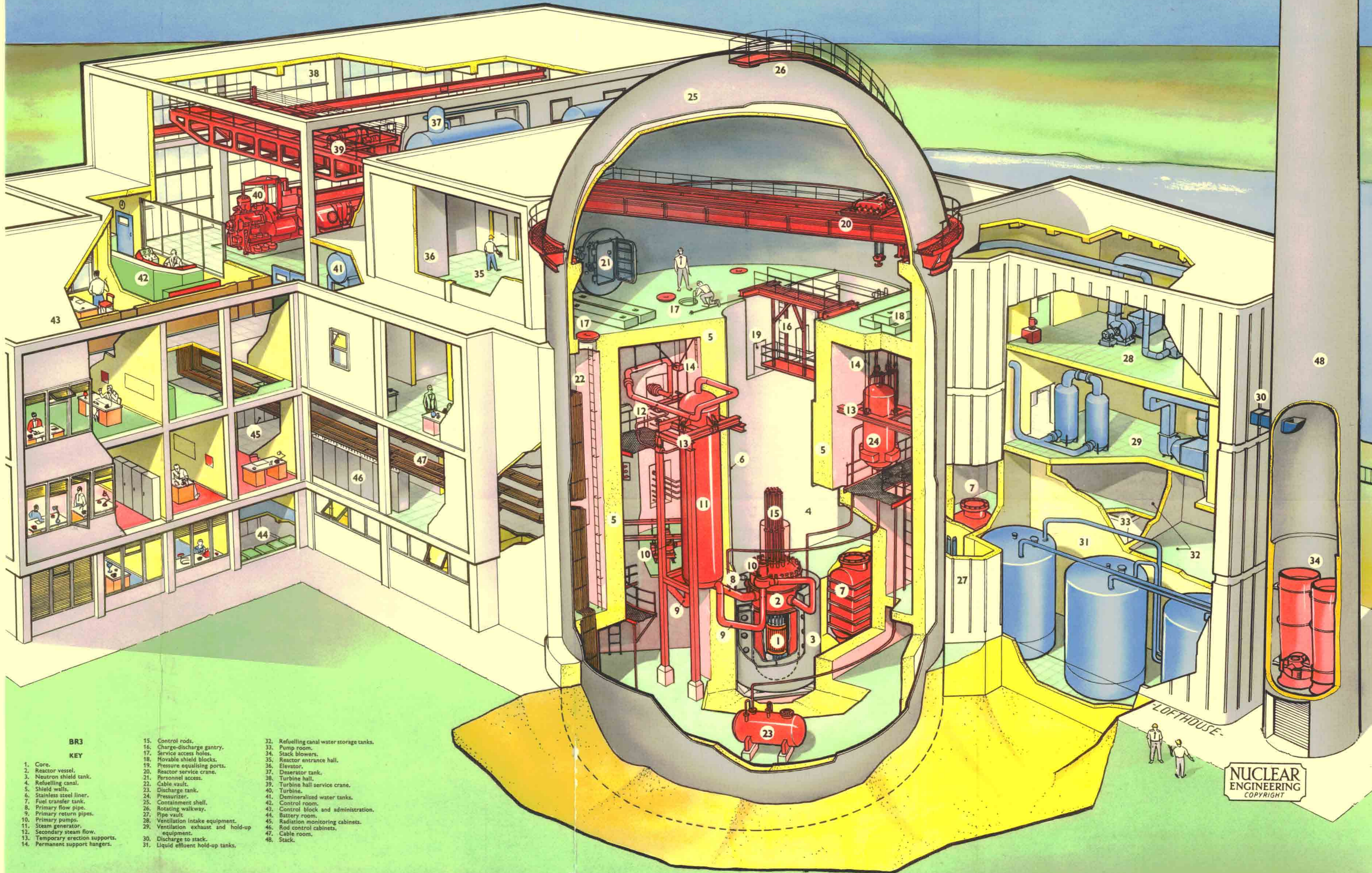
COOLANT: Pressurized water. Inlet temperature: 491°F (255°C). Outlet temperature: 515°F (268°C). Hottest channel: 586°F (308°C). Coolant pressure: 2,000 p.s.i.a. (140.6 Kg/cm² abs). Mass flow: 5×10^4 lb/h (2,268 Metric T/h). Heat transfer area: 1,482 ft² (137.7 m²). Channel velocity: 7.7 ft/sec (2.35 m/sec). Heat transfer coefficient: 3,440 B.t.u./hr, ft², °F (16,800 kcal/hr, m², °C). Maximum fuel element temperatures: Fuel: 3,930°F (2,166°C). Cladding: 657°F (347°C).

PRESSURE VESSEL: Carbon steel, clad internally with stainless steel. Outside diameter: 5 ft 7 in. (170 cm). Height: 18 ft (549 cm). Thickness: 4.5 in. (11.4 cm). Design pressure: 2,500 p.s.i.a. (175.8 Kg/cm² abs).

HEAT EXCHANGER: U-tube type, with stainless steel tubes. Heating surface: 6,220 ft² (578 m²). Steam pressure: 525 p.s.i.a. (36.9 Kg/cm² abs). Steam temperature: 472°F (244°C). Feed temperature: 325°F (163°C). Steam flow: 154,500 lb/h (70.1 Metric T/h).

SHIELDING: Internal stainless steel thermal shield, 3 in. (7.62 cm) thick. Biological shielding of barytes concrete (density 3.4) to a minimum thickness of 3 ft 10 in. (1.17 m).

CONTAINMENT: Cylindrical steel building, with spherical roof. Outside diameter: 54 ft 3 in. (16.54 m). Overall height: 107 ft (32.6 m). Thickness: 1.12 in. (2.85 cm). Design pressure: 45 p.s.i.g. (3.16 Kg/cm² eff). Test pressure: 57 p.s.i.g. (4 Kg/cm² eff).



- BR3 KEY**
- 1. Core.
 - 2. Reactor vessel.
 - 3. Neutron shield tank.
 - 4. Refuelling canal.
 - 5. Shield walls.
 - 6. Stainless steel liner.
 - 7. Fuel transfer tank.
 - 8. Primary flow pipe.
 - 9. Primary return pipes.
 - 10. Primary pumps.
 - 11. Steam generator.
 - 12. Secondary steam flow.
 - 13. Temporary erection supports.
 - 14. Permanent support hangers.
 - 15. Control rods.
 - 16. Charge-discharge gantry.
 - 17. Service access holes.
 - 18. Movable shield blocks.
 - 19. Pressure equalising ports.
 - 20. Reactor service crane.
 - 21. Personnel access.
 - 22. Cable vault.
 - 23. Discharge tank.
 - 24. Pressurizer.
 - 25. Containment shell.
 - 26. Rotating walkway.
 - 27. Pipe vault.
 - 28. Ventilation intake equipment.
 - 29. Ventilation exhaust and hold-up equipment.
 - 30. Discharge to stack.
 - 31. Liquid effluent hold-up tanks.
 - 32. Refuelling canal water storage tanks.
 - 33. Pump room.
 - 34. Stack blowers.
 - 35. Reactor entrance hall.
 - 36. Elevator.
 - 37. Dissipator tank.
 - 38. Turbine hall.
 - 39. Turbine hall service crane.
 - 40. Turbine.
 - 41. Demineralised water tanks.
 - 42. Control room.
 - 43. Control block and administration.
 - 44. Battery room.
 - 45. Radiation monitoring cabinets.
 - 46. Rod control cabinets.
 - 47. Cable room.
 - 48. Stack.

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