

THE WORLD'S REACTORS No.54

THE DOUNREAY PROTOTYPE FAST REACTOR

PFR

PFR

OWNER AND OPERATOR

U.K. Atomic Energy Authority  
Reactor Group

LOCATION  
Dounreay, Caithness, Scotland

TYPE  
Sodium-cooled fast breeder reactor

SCHEDULE  
Start of construction  
Reactor critical and power operation

6-1965  
late 1972

GENERAL PERFORMANCE

Thermal power output  
Total  
From core  
From radial breeder  
From axial breeder  
Electrical power generation  
Gross output  
Net station output  
Net station efficiency

600 MW(th)  
550 MW(th)  
30 MW(th)  
20 MW(th)  
270 MW(e)  
254 MW(e)  
42.3%

FUEL & BREEDER SUB-ASSEMBLIES

No. of fuel pins per sub-assembly  
Outside diameter of fuel can  
Fuel can thickness  
Overall length of fuel pin  
Length of fuel in core pin  
Length of upper axial breeder section in core pin  
Length of lower axial breeder section in core pin

325  
0.23 in (5.84 mm)  
0.015 in (0.381 mm)  
88.75 in (2.25 m)  
36 in (914 mm)  
4 in (101.6 mm)  
18 in (457 mm)

CORE

Total length of sub-assemblies  
Lattice pitch (triangular)  
Total number of sub-assemblies  
No. of sub-assemblies in core's inner zone  
No. of sub-assemblies in core's outer zone  
No. of radial breeder sub-assemblies  
No. of radial breeder reflector sub-assemblies  
Control rods  
No. of control rod positions  
No. of shut-off rod positions  
No. of safety rod positions  
Core fuel  
Weight of mixed oxide fuel in core  
Weight of  $^{239}\text{PuO}_2$  equivalent in core

12 ft 6 in (3.81 m)  
5.70 in (144.8 mm)  
78  
31  
47  
51  
81  
5  
6  
1  
4.1 tonne  
1.1 tonne

PRIMARY & SECONDARY SODIUM HEAT TRANSFER SYSTEM

Reactor vessel inside diameter  
Temperatures  
At core inlet  
At core outlet  
At steam generator inlet  
At steam generator outlet  
Flows  
Through core and breeder  
Total for three secondary circuits  
Pump heads  
Three primary pumps  
Three secondary pumps  
Sodium weight  
In reactor vessel  
In secondary circuit

40 ft 2 in (12.24 m)  
400°C (752°F)  
562°C (1044°F)  
532°C (990°F)  
370°C (698°F)  
23.2 x 10<sup>6</sup> lb/h (2923 kg/s)  
23.2 x 10<sup>6</sup> lb/h (2923 kg/s)  
117 psi (8.22 kg/cm<sup>2</sup>)  
64 psi (4.50 kg/cm<sup>2</sup>)  
905 ton (919 t)  
222 ton (226 t)

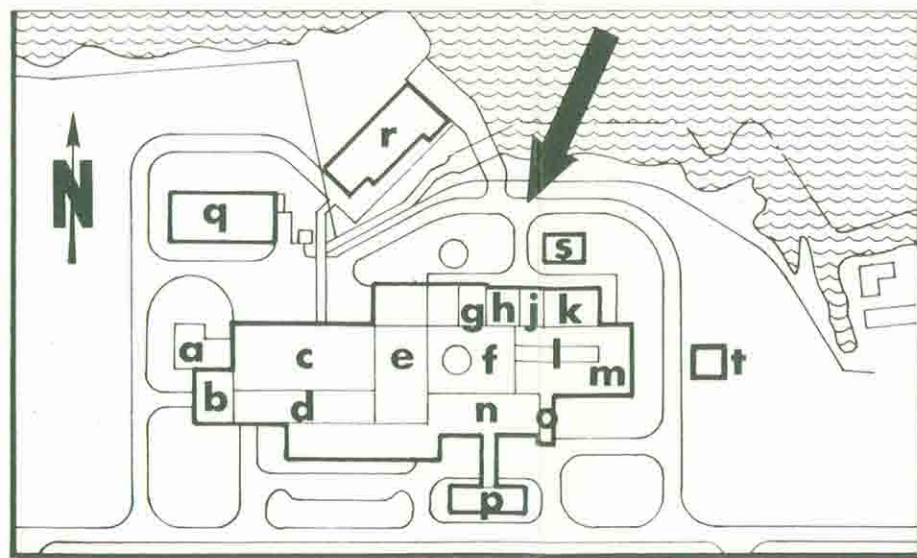
STEAM PLANT

Steam temperature at HP & IP TSV's  
Steam pressure at HP TSV  
Reheat steam pressure at IP TSV  
Steam flow in HP turbine  
Min. steam flow at which full superheat and reheat temps. are maintained  
Boiler feed water temperature  
Condenser pressure  
Condenser sea water temperature, inlet  
Condenser sea water temperature, outlet

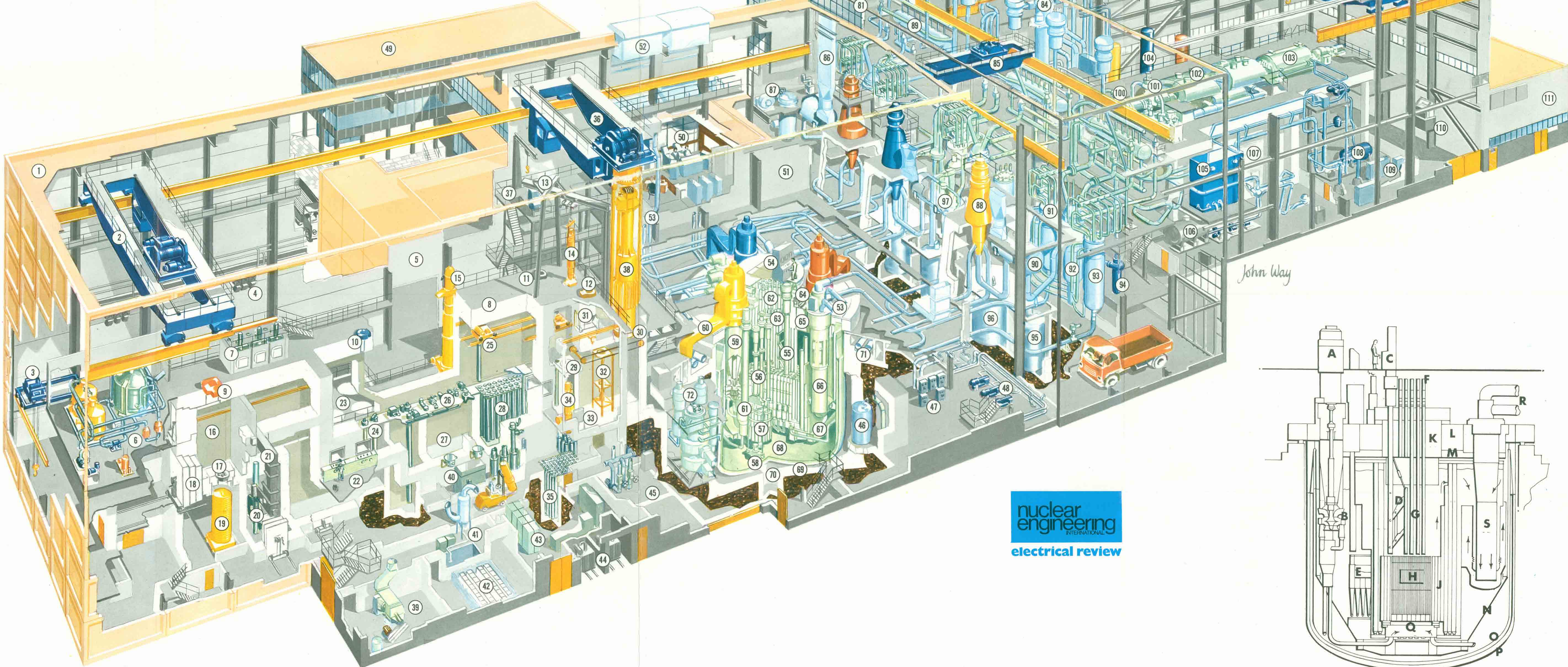
516°C (960°F)  
2300 psia (161.7 kg/cm<sup>2</sup>a)  
390 psia (27.4 kg/cm<sup>2</sup>a)  
1.983 x 10<sup>6</sup> lb/h (249.9 kg/s)  
20%  
288°C (550°F)  
1 in Hg (25 mm Hg)  
8.9°C (548°F)  
20°C (68.5°F)

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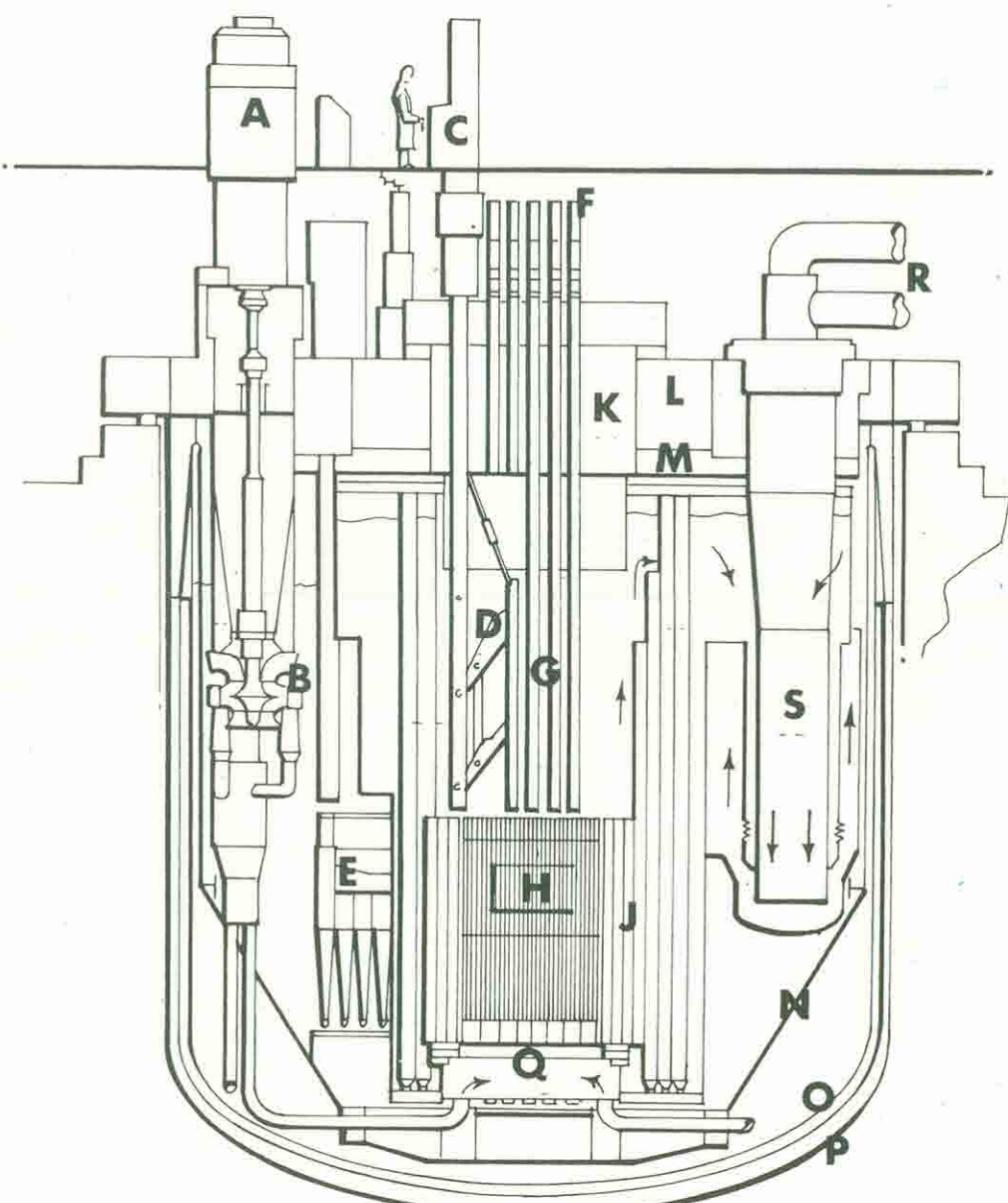
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- a. Generator transformer house
- b. Diesel generator building
- c. Turbine hall
- d. Mechanical annexe
- e. Steam generator building
- f. Reactor building
- g. Blanket gas plant
- h. Boiler house
- j. Ventilation plant switch room and transformers
- k. Ventilation plant
- l. Fuel handling caves
- m. Decontamination area
- n. Control room
- o. Loading bay air lock
- p. Administration block
- q. Sodium store
- r. Sea water pump house
- s. Oil tanks
- t. Effluent delay tanks



John Way



- 1. Reactor building
- 2. Reactor building crane
- 3. Wet area facilities crane
- 4. Building heaters
- 5. Loading bay air lock
- 6. Cave argon plant room
- 7. Filter bank
- 8. Fuel handling caves
- 9. Cell waste discharge valve
- 10. Metallurgical specimens discharge valve
- 11. New fuel entry valve
- 12. New fuel exit valve
- 13. New fuel flask gantry
- 14. New fuel sub-assembly transit
- 15. Equipment flask

- 16. Discharge station
- 17. Irradiated fuel discharge valve
- 18. Cell roll-out doors
- 19. Irradiated fuel transport flask
- 20. X-ray cell
- 21. Sliding door casing
- 22. Cave operating floor
- 23. Mortuary
- 24. Vacuum testing station
- 25. Fuel transfer hoist
- 26. Cutting and slitting machines
- 27. Sub-assembly breakdown

- 28. Primary storage tank
- 29. Change-over tank
- 30. Cave transfer port
- 31. Change-over tank control window
- 32. Change-over tank transfer trolley
- 33. New fuel cell
- 34. New fuel cell cannister lifting gear
- 35. New fuel store
- 36. Flask transporter
- 37. Maintenance tower and charge machine test facility

- 38. New and irradiated fuel transfer flask
- 39. Decontamination fan
- 40. Thermex cooling system
- 41. Post incident scrubber plant
- 42. Post incident filter cell
- 43. Ventilation plant switch room
- 44. Transformers
- 45. Boiler house
- 46. Blanket gas plant
- 47. Control cubicles for gas blanket heating
- 48. Ancillary gas blanket plant

- 49. Administration building
- 50. Control room
- 51. Reactor building
- 52. Thermal syphon cooling air ducts
- 53. Thermal syphon vent system piping
- 54. Charge machine control console
- 55. Charge machine
- 56. Fuel discharge guide tube
- 57. Rotor
- 58. Shock absorber
- 59. Primary sodium pump (3)
- 60. Primary sodium pump air cooling duct

- 61. Primary sodium pump valve
- 62. Control rod drives
- 63. Rotor drive
- 64. Rotating shield
- 65. Biological shield
- 66. Intermediate heat exchanger (3)
- 67. Diagrid support structure
- 68. Primary vessel
- 69. Leak jacket and insulation
- 70. Vault cooling duct
- 71. Reactor vault roof cooling nitrogen pipes
- 72. Primary cold trap loop

- 73. Deaerator tower
- 74. Foam head tank
- 75. Vermiculite fire fighting storage tanks
- 76. Reserve feed water tank
- 77. Domestic water tank
- 78. DC heater (No. 2)
- 79. Make up water treatment plant
- 80. Demineralization tanks
- 81. Steam generating building
- 82. Sodium-water reaction outlet vents
- 83. Reheater and superheater silencers
- 84. Steam generator drain vessel vent

- 85. Steam generating building crane
- 86. Cell ventilation fans (3)
- 87. Secondary cold trap loop
- 88. Secondary sodium pumps (3)
- 89. Steam drums (3)
- 90. Sodium expansion tanks (3)
- 91. Reheater (3)
- 92. Evaporator (3)
- 93. Superheater (3)
- 94. Boiler circulation pumps (3)
- 95. Dirty sodium dump tanks (3)
- 96. Clean sodium dump tank
- 97. Sodium dump vent stack and cyclone

- 98. Turbine hall
- 99. Turbine hall crane
- 100. HP turbine
- 101. IP turbine
- 102. LP turbine
- 103. Generator
- 104. HP heaters
- 105. Main oil tank
- 106. Filling oil tank
- 107. Condenser
- 108. Seal oil unit
- 109. Hydrogen control panel
- 110. Building space heater
- 111. Generator transformer building

- A. Sodium pump motor (3)
- B. Primary sodium pump (3)
- C. Charge machine console
- D. Charge machine
- E. Rotor
- F. Control rod drives
- G. Control rods
- H. Core
- J. Neutron shield
- K. Rotating shield
- L. Biological shield
- M. Stainless steel insulation
- N. Diagrid support structure
- O. Primary vessel
- P. Leak jacket and insulation
- Q. Diagrid
- R. Secondary sodium pipes
- S. Intermediate heat exchanger