The World's Reactors
No. 31 TRAWSFYNYDD

OWNER: Central Electricity Generating Board.

PURPOSE: Power production.

LOCATION: Trawsfynydd, Merionethshire, North Wales.

DESIGNER AND CONTRACTOR: Atomic Power Constructions, Ltd.

TYPE: Thermal, heterogeneous, CO_2 gas cooled, graphite moderated.

PROGRAMME: Entry to site: July 1959.
First reactor and associated plant on load: October 1, 1963.
Second reactor and associated plant on load: July 1, 1964.

CAPACITY: Net electrical output: 500 MW.
Number of reactors: Two.
Heat rate per reactor: 870 MW.

FUEL: Material: natural uranium metal rods.
Dimensions: 1⅛ in. diameter.
Elements in vertical channels—
Number per channel: 9.
Number of fuel element channels: 3,740.
Diameter of fuel element channels 3⅞ in.
Density of uranium: 18.78 g/cm³.
Total weight of uranium: approx. 280 tons.
Mean fuel rating: 3.11 MW/t.

CANNING: Material: magnesium alloy.
Extended surface: longitudinal spiral, 4 straight splitters.
Method of element support: stacked.
Maximum surface temperature: approx. 447°C.

MODERATOR: Material—active core: graphite "A" type:
—reflector: graphite "B" type.
Active core—height: 24 ft.
—diameter: 44.5 ft.
Dimensions over reflector: height: 27 ft 3 in.
plan: 48 ft over 24 flats.
Total weight per reactor: approx. 1,900 tons.
Method of support: ball bearings on plates on grid strutted from internal skirt.
Restraints: circumferential.

CORE DESIGN: Average temperature of graphite: ~310°C.
Lattice—arrangement: regular, square.
—pitch: 7⅞ in.
Resonance escape factor: p = 0.89.
Fast fission factor: ε = 1.03.
Multiplication factor: k_{eff} 1.054 hot poisoned.
Burn-up, individual elements: 4,500 MW d/t or 5 years max.
Method of flattening: steel bars in selection of 224 special holes.
Neutron flux (maximum): 2.0 x 10¹³ n/cm² sec (Westcott Convention).
3.2 x 10¹³ n/cm² sec (Story Convention).

PRESSURE VESSEL: Shape and size: sphere 61 ft i.d.
Thickness of plate: 3⅜ in.
Material: Si-killed C/Mn steel.
Working pressure: 240 p.s.i.g. at reactor inlet.
Support type: skirt.
No. of standpipes: 241.
Volume ratio: core and reflector/vessel: 41.5%.

COOLANT: Gas: carbon dioxide.
Inlet temperature to reactor: approx. 200°C.
Outlet temperature from reactor: approx. 400°C.
Mass flow: 9,000 lb/sec.
Number of circuits: 6.
Main duct diameter: 5 ft 6 in.; thickness: 15/16 in.

CIRCULATORS: Number: 6.
Type: axial S.R.S.
Drive: squirrel cage induction motor.
Speed: 2,950 rev/min.
Method of flow variation: linked throttle and by-pass valves, former never quite closed.

CONTROL: Number of channels usable for control rods: 241.
Diameter of control rod channels: 3.5 in.
Total number of rods: up to 185.
Safety rods: 12.
Number of control sectors: 9.
Control rod material: boron steel in S.S. tube.
Rod length: approx. 26 ft.
Rod diameter: 2¼ in.
Method of suspension of rods: cable.
Method of drive: static-type low frequency a.c.
Automatic control of sector rods: error signal from sector outlet gas temp.
Automatic control of coolant flow: error signal from turbine HP inlet pressure.
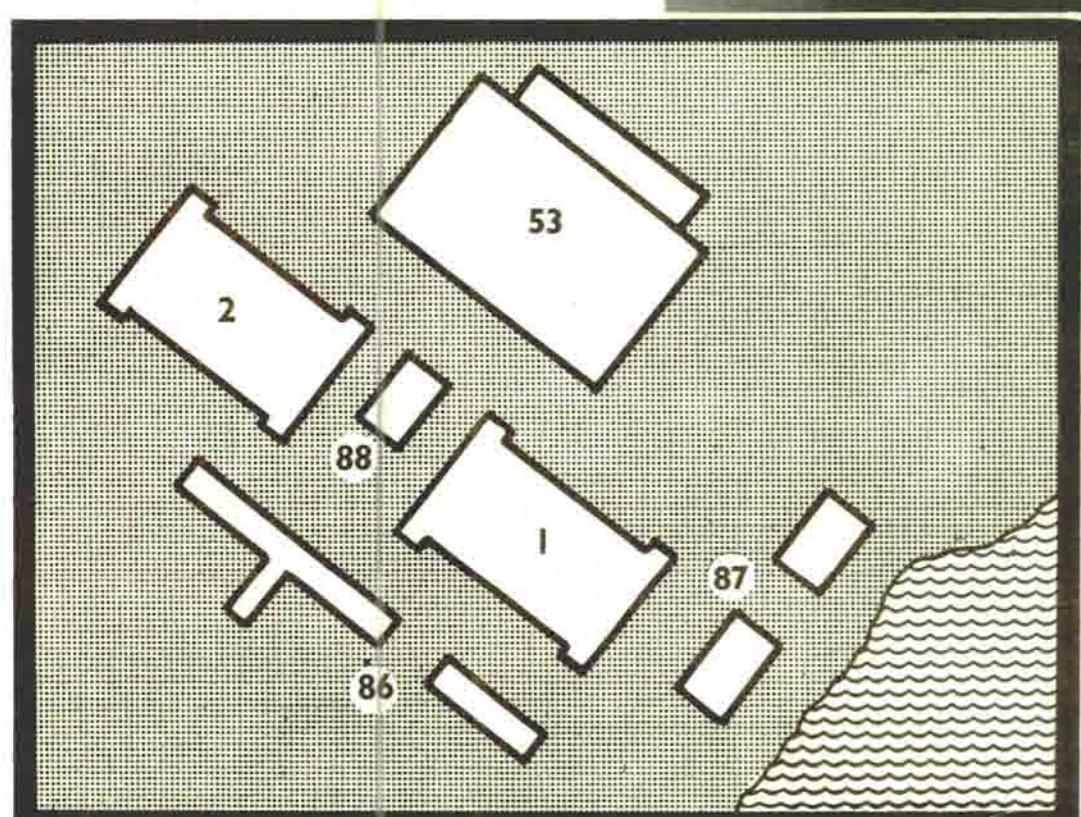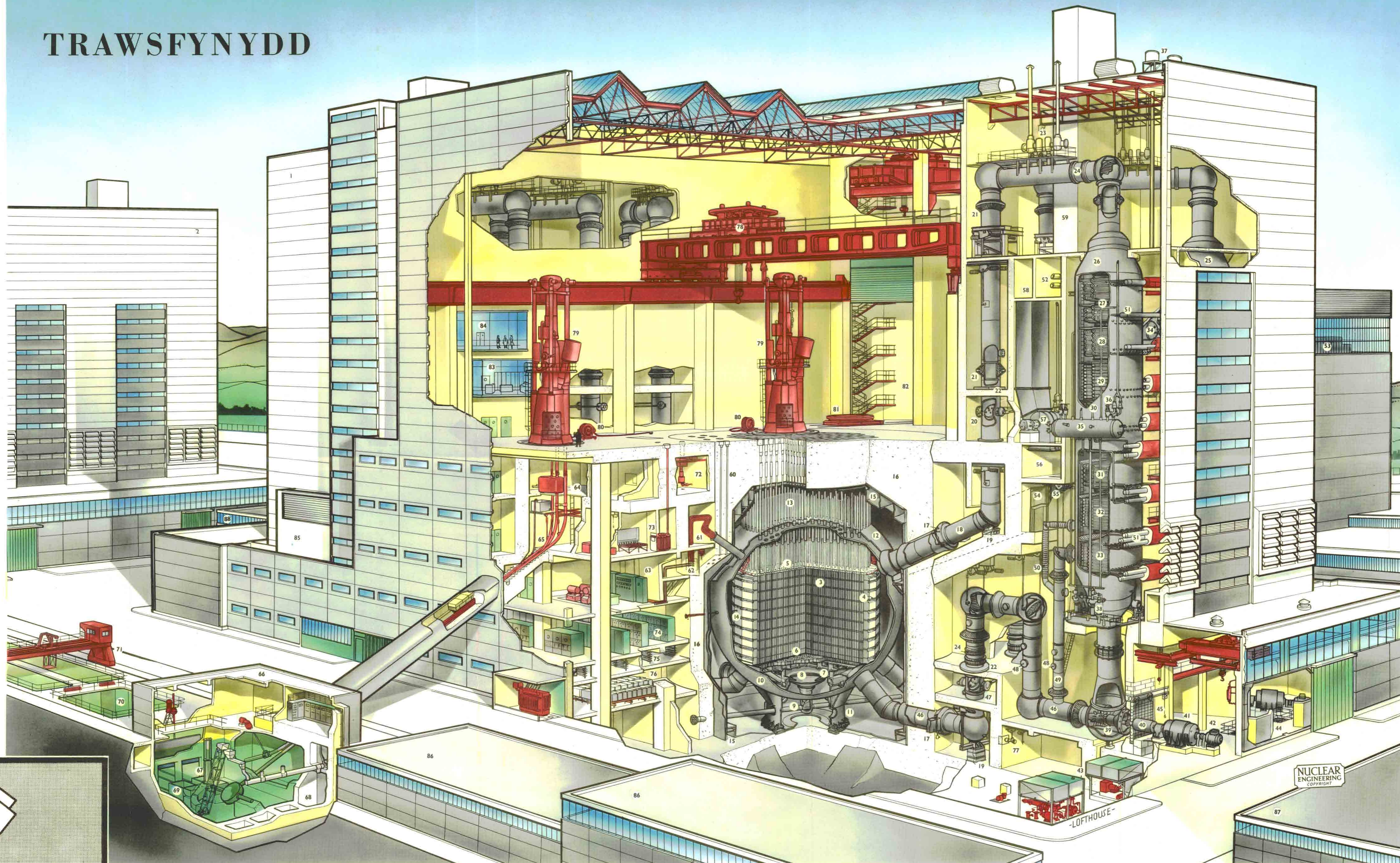
SHIELDING: Thermal shield: two ½-in steel plates form air passage.
Biological shield sides, max. thickness: 10 ft 6 in; min. thickness: 10 ft.
Biological shield top thickness: 11 ft 6 in.
Shield cooling: induced draught air.

BOILERS: Number per reactor: 6.
Type: shell and tube; forced recirculation.
Main shell diameter: 18 ft; height: 116 ft.
Plate thickness: 2½ in max.
Plate material: boiler quality steel.
Element construction: resistance welded external fins throughout.
Rating: 150 MW heat.
Steam conditions at turbine stop valves:—
HP: Pressure: 927 p.s.i.g.
Temp.: 715°F.
Flow rate: 65%.
Flow rate: 290,000 lb/h.
LP: Pressure: 290 p.s.i.g.
Temp.: 685°F.
Flow ratio: 35%.
Flow rate: 115,000 lb/h.
Feed temperature: 226°F.

TURBINES: Number per station: 4.
Construction: four cyls, six exhausts.
Type: one impulse stage, rest reaction.
Maximum continuous rating: 145 MW.
Speed: 3,000 rev/min.
Condensers per turbine: 2.
Conditions at water separator between HP and LP cyls.: 7 p.s.i.a.
115%, wet.
Vacuum: 28.85 in Hg.

ALTERNATORS: Rating/power factor/S.C. ratio: 170 MVA/0.85/0.4.
Generation voltage: 16.5 kV.
Cooling—stator winding: water.
—stator iron and rotor: hydrogen 30 p.s.i.g.

DUMP CONDENSERS: No. and type: 2 vacuum.
Capacity: each 10% of reactor heat.

TRAWSFYNYDD

—LOFTHOUSE—

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KEY

1. Reactor building No. 1
2. Reactor building No. 2
3. Core
4. Core restraint structure
5. Charge pans
6. Diagrid
7. Core support structure
8. Internal debris fairing
9. Debris removal ducts
10. Pressure vessel
11. Support skirt
12. Shield cooling hood
13. Standpipes
14. Wigner probe
15. Shield cooling ducts
16. Biological shield
17. Shield cooling air inlet sleeves
18. Hot gas duct
19. Hanger failure emergency supports
20. Hot gas duct isolation valve
21. Bellows unit
22. Containment seals
23. Ducting safety valves and filters
24. Removable spool piece
25. No. 1 steam raising unit
26. No. 2 steam raising unit
27. H.P. superheater
28. L.P. superheater
29. H.P. evaporator
30. L.P. evaporator
31. H.P. economizer
32. L.P. economizer
33. Mixed economizer
34. H.P. steam drum
35. L.P. steam drum
36. L.P. drum safety valves
37. L.P. drum safety valve silencers
38. L.P. recirculating pumps
39. Gas circulators
40. Flywheel
41. Circulator main motors
42. Circulator pony motors
43. Circulator lub. oil plant
44. Control panels
45. Shield door
46. Cooled gas duct
47. Cooled gas duct isolation valve
48. Throttle valves
49. Recirculating duct
50. By-pass duct
51. Headers
52. Steam pipe race to turbine house
53. Turbine house
54. Shield cooling extract duct
55. Shield cooling air filters
56. Shield cooling plenum chamber
57. Shield cooling fans
58. Shield cooling discharge duct
59. Shield cooling stack
60. Storage tubes
61. Burst can detection pipes
62. B.C.D. selector valve
63. B.C.D. room
64. Irradiated fuel disposal room
65. I.F.D. chute
66. I.F.D. acceptance bay
67. Volume reduction equipment
68. Magnox storage vaults
69. Irradiated element skips
70. Cooling pond
71. Skip handling crane
72. Active handling cell
73. New fuel magazine
74. Essential services room
75. Cable race
76. Battery room
77. Debris probe
78. Charge hall crane
79. Fuelling machines
80. Fuelling machine service trolleys
81. Fuelling machine transporter
82. Fuelling machine maintenance bay
83. Charge face control room
84. Visitors viewing room
85. Shield cooling air inlet filter room
86. Ancillary buildings
87. New fuel store
88. Main store