

The World's Reactors

No. 9—THE SOUTH OF SCOTLAND ELECTRICITY BOARD STATION

DESIGN AND CONSTRUCTION

The G.E.C.-Simon Carves Atomic Energy Group, Erith, Kent.

comprising: The General Electric Co. Ltd.
Simon-Carves Ltd.
The Motherwell Bridge and
Engineering Co. Ltd.
John Mowlem (Scotland) Ltd.

CONSULTING ENGINEERS TO S.S.E.B.

Kennedy and Donkin, 12 Caxton Street, London, S.W.1.

TYPE:	Thermal heterogeneous.
PURPOSE:	Power production.
LOCATION:	South of Scotland (Site to be decided).
CAPACITY:	Max. continuous electrical rating: 360 MW from two reactors and six turbo-alternator sets. Net electrical output: 300 MW rising to 320 MW. Heat rating: 530 MW.
FUEL:	Natural uranium. U as rods 1.15 in. dia., 24 in. long. Weight of U per rod: 7.64 kg (16.8 lb). Weight of U per reactor: 51 tonnes. Elements in vertical channels: 10 per channel. Number of fuel element channels: 3288.
CANNING:	Magnesium alloy, Magnox A12. Method of support: graphite sleeves loaded with the cartridge.
MODERATOR:	Graphite. Core size: 44 ft. 6 in. dia., 23 ft. high. Overall size including reflector: 50 ft. 6 in. dia., 28 ft. high. Total weight per reactor: 2,150 tons. Graphite support: 4 in. steel plate on steel grid.
LATTICE:	Regular square, $8\frac{1}{4}$ in. pitch.
PRESSURE VESSEL:	Coltuf 28. Shape and dimensions: 70 ft. i.d. sphere. Thickness: $2\frac{7}{8}$ in., support course, 3 in. Maximum internal working pressure: 150 p.s.i.g. Weight of gas in vessel under operating conditions: 41.4 tons. Maximum shell temperature: 450°F. Inner shell: boiler plate, cylindrical sides, domed top.
COOLANT:	Carbon dioxide. Inlet temperature: 204 C. (400°F.). Outlet temperature: 396 C. (745°F.). Inlet pressure: 150 p.s.i.g. Outlet pressure: 145.8 p.s.i.g. Mean fuel rating: 2.11 MW/tonne. Flow: 5,640 lb/sec. Heat transferred to gas from reactor: 530 MW. Heat transferred from gas in heat exchangers: 540 MW. Number of ducts: 8 inlet, 8 outlet per reactor. Duct diameter: 5 ft. Gas transit time round circuit: 23 sec.



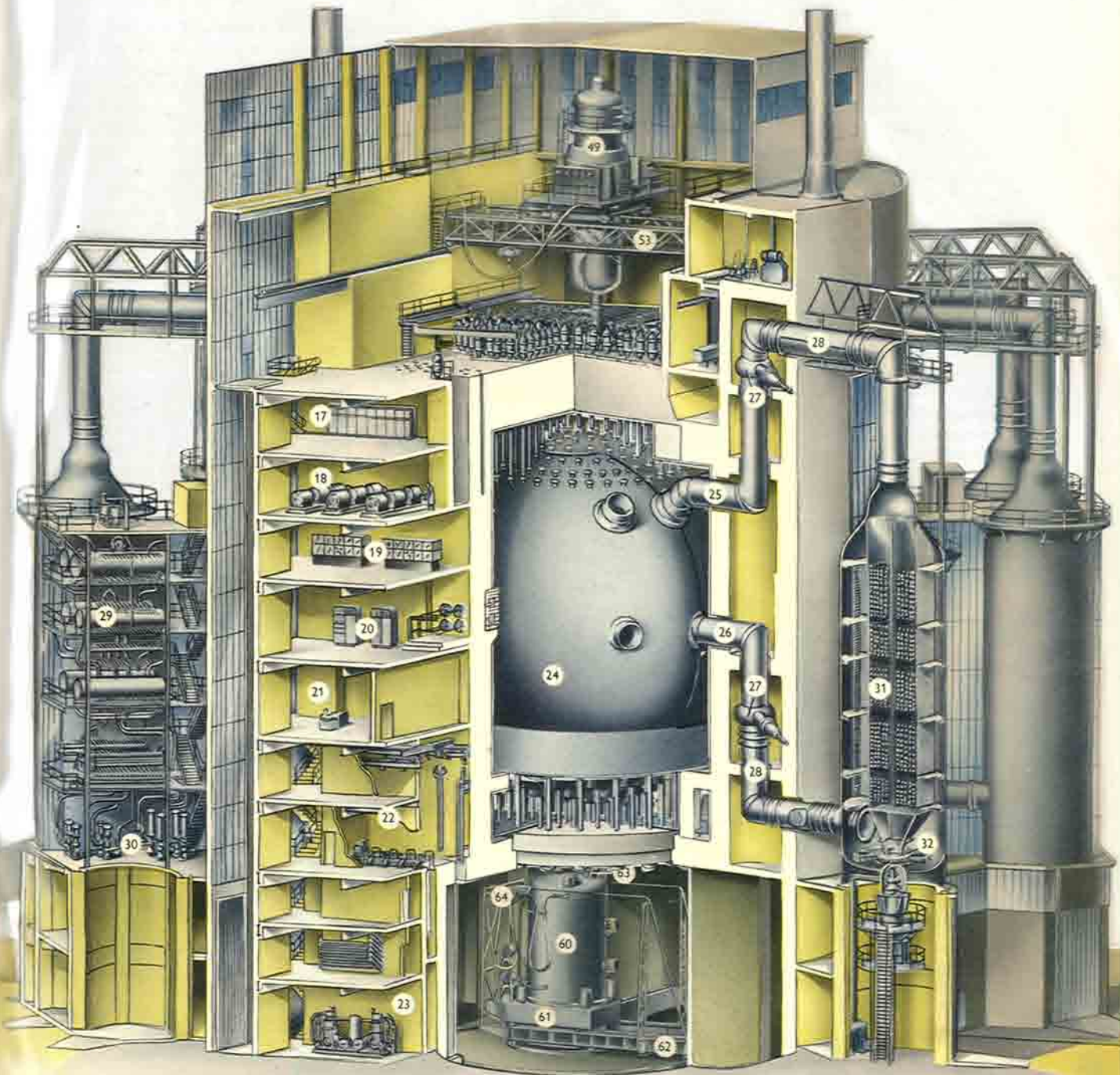
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1. Reactor building
2. Steam raising unit pressure vessel
3. Steam raising unit sub-structure
4. Inner concrete shield
5. Outer concrete shield
6. Duct chamber
7. Charge chamber
8. Hot gas duct nozzle

9. Cool gas duct nozzle
10. Control rod standpipes
11. Control rod mechanisms
12. B.S.D. precipitator room
13. Thermal column
14. Pressure vessel support columns
15. Main reactor support columns
16. Gas circulator motor

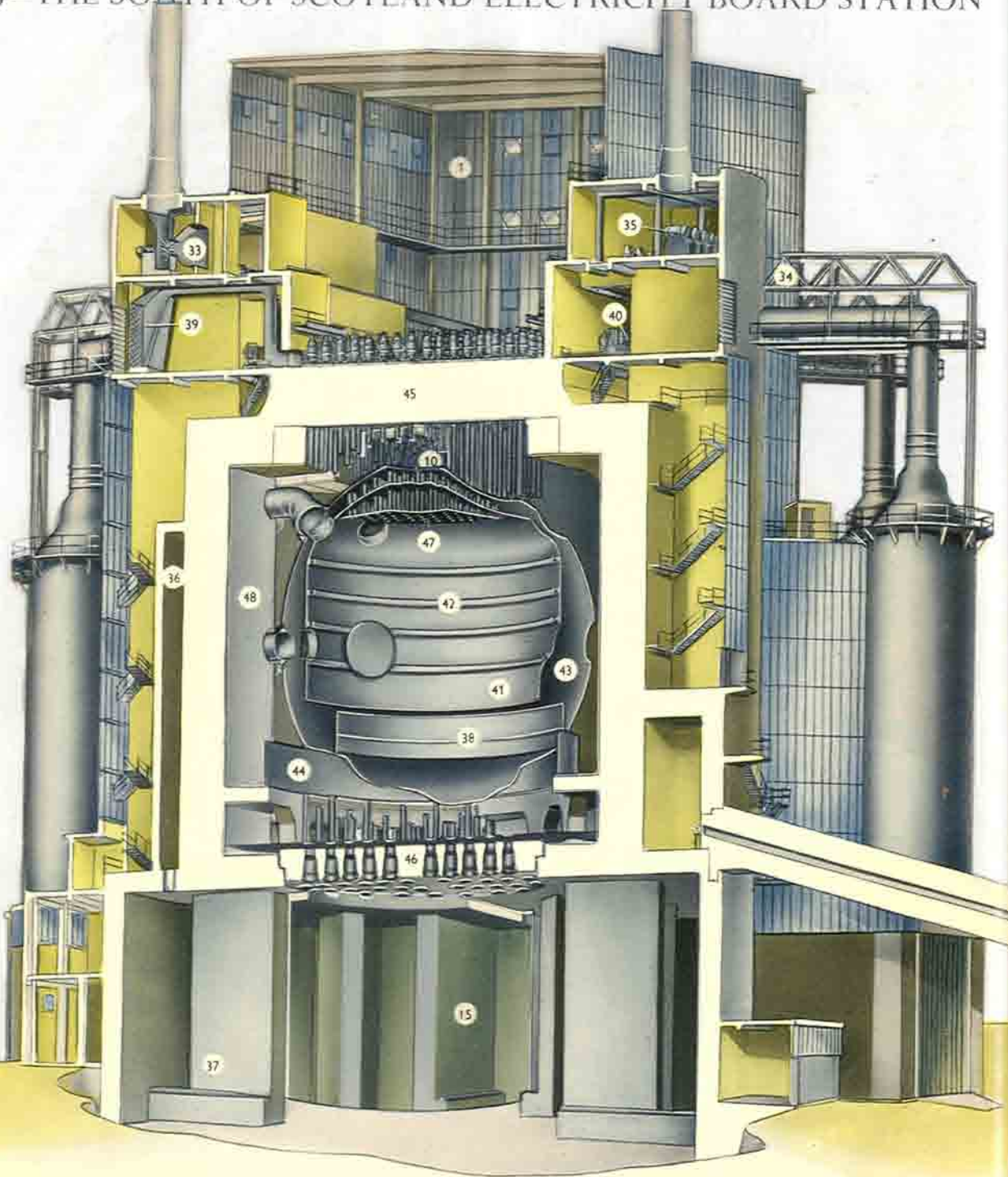


- 17. B.S.D. control apparatus
- 18. Control rod motor supply units
- 19. Switchgear
- 20. Ion chamber room
- 21. Charge-discharge control room
- 22. Charge preparation room
- 23. Compressor room
- 24. Spherical pressure vessel

- 25. Hot gas duct
- 26. Cool gas duct
- 27. Gas valves
- 28. Bellows joints
- 29. Boiler drums
- 30. Boiler circulating pumps
- 31. Steam raising unit tube banks
- 32. Gas circulator impeller

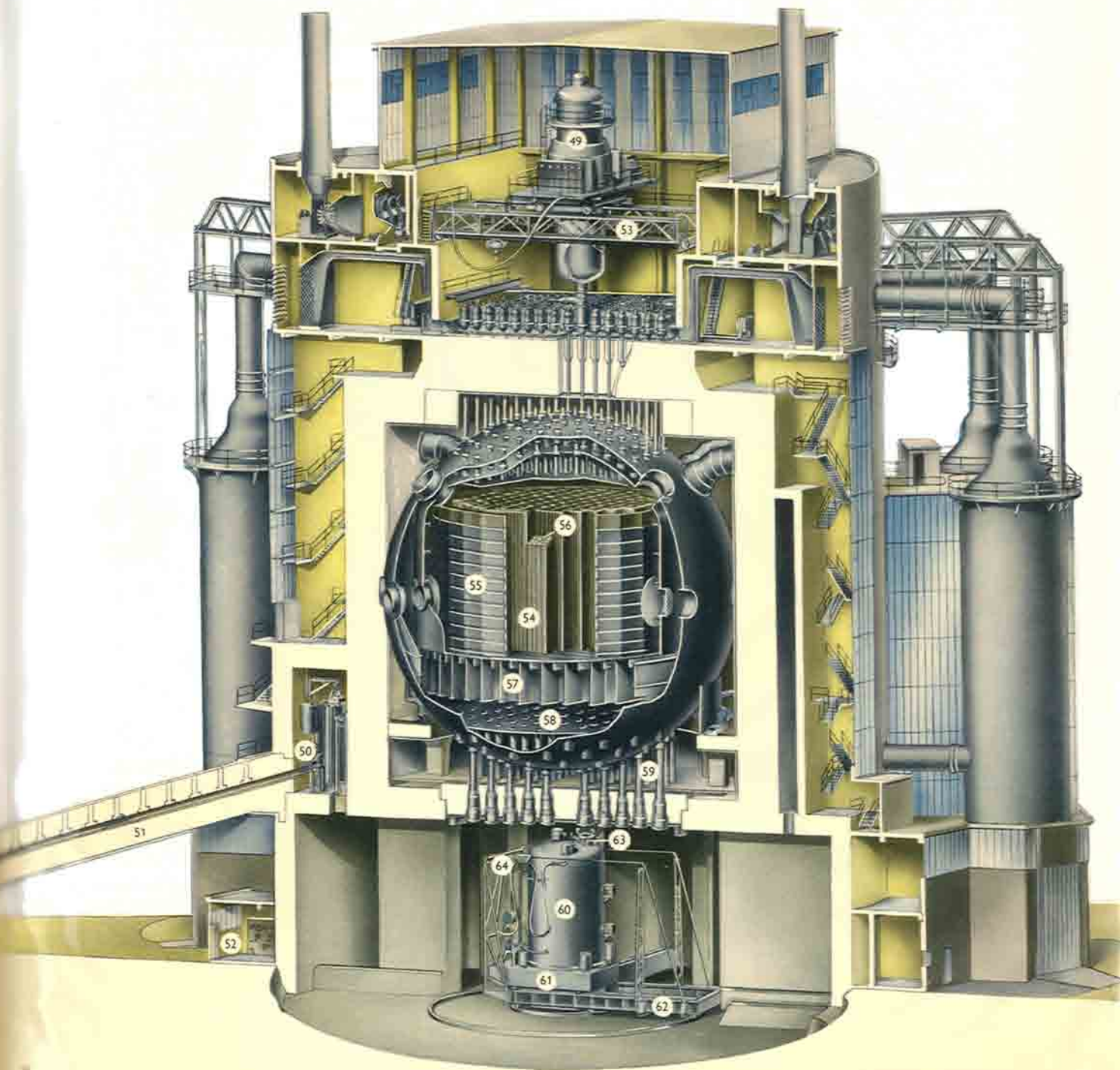
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- 33. Exhaust fan and chamber
- 34. Duct support structure
- 35. B.S.D. precipitators
- 36. Charge machine test shaft
- 37. Charge machine test bay
- 38. Grid support ring
- 39. Cooling air supply duct
- 40. B.S.D. cooler

- 41. Inner steel shell
- 42. Stiffening rings
- 43. Pressure vessel interior
- 44. Steel supporting skirt
- 45. Upper concrete shield
- 46. Lower concrete shield
- 47. Inner shield plate
- 48. Shield cooling ducts

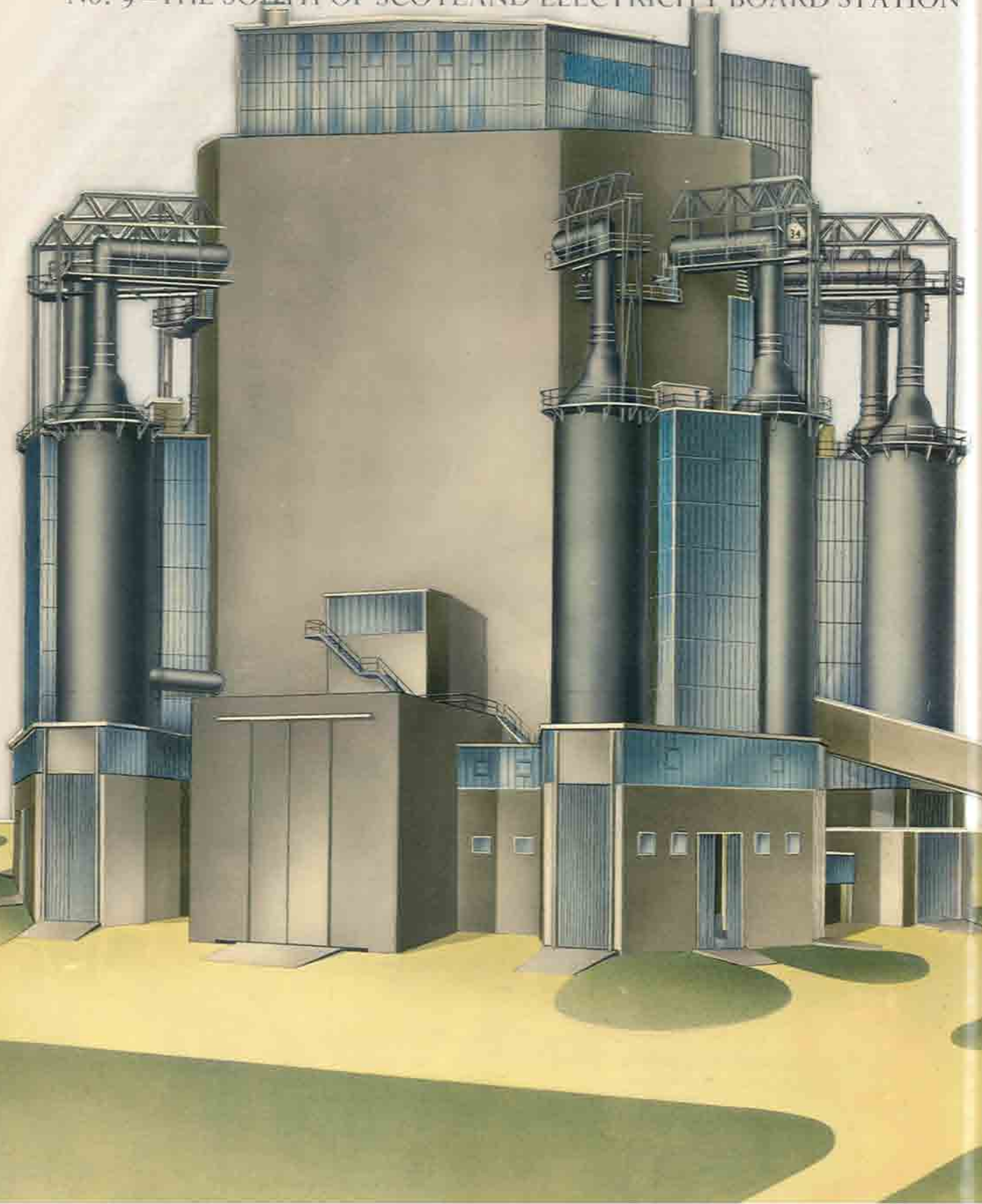


- 49. Reactor servicing machine
- 50. Spent fuel separating room
- 51. Spent fuel conveyor
- 52. Separating control room
- 53. Servicing machine gantry
- 54. Reactor core
- 55. Core restraints
- 56. Fuel channel

- 57. Grid
- 58. Collector pan
- 59. Charge-discharge standpipes
- 60. Charge-discharge machine
- 61. Charge machine carriage
- 62. Charge machine turntable
- 63. Charge machine nozzle
- 64. Charge machine supplies

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Data sheets in this series already published in "Nuclear Engineering" are:

- No. 1. BEPO (April, 1956)*
- No. 2. CP5 (May, 1956)*
- No. 3. NRX (June, 1956)*
- No. 4. DIMPLE (August, 1956)*
- No. 5. ZEUS (September, 1956)*
- No. 6. CALDER HALL
(October and December, 1956)*
- No. 7. Russian 5 MW (November, 1956)*
- No. 8. DIDO (January, 1957)*

- PUMPING:** Eight vertical shaft, centrifugal blowers per reactor.
Drive: d.c. motors supplied from grid controlled rectifiers.
Outlet gas pressure: 150.5 p.s.i.g.
Gas pressure rise across circulator: 7.5 p.s.i. max.
Circulator input: 2,190 b.h.p.
Electrical power consumption per reactor: 12.6 MW.
Running speed: 1,000 r.p.m.
Speed control: Grid controlled mercury arc rectifier: 10:1.
- FLUX:** Maximum thermal neutron flux: $2 \times 10^{13} \text{n/cm}^2\text{-sec.}$
Method of flattening: steel bars replacing fuel elements.
- CONVERSION:** Average initial conversion factor: 0.800.
- BURN-UP:** 2,500 MWD/tonne.
- REACTIVITY:** Excess reactivity: 4.5% in k at start-up.
- CONTROL:** Number of channels: 208 per reactor.
Diameter of channels: 3.5 in.
Rod-construction: Boron-containing inserts canned in thin stainless steel sheet and packed in stainless steel tubes.
Dimensions of rod: length 21 ft., diameter 2 in., weight 70 lb.
- HEAT EXCHANGERS:** Number per reactor: Eight.
Total gas volume: 18,000 cu. ft. per unit.
Total wt. of gas under operating conditions: 5.2 tons per unit.
Inlet temperature: 396° C. (745° F.).
Outlet temperature: 200° C. (392° F.).
H.P. steam flow: 143.1 klb/hr. per heat exchanger.
H.P. steam pressure: 575 p.s.i.g.
H.P. steam temperature: 700° F.
L.P. steam flow: 69.5 klb/hr. per heat exchanger.
L.P. steam pressure: 145 p.s.i.g.
L.P. steam temperature: 670° F.
- TURBO-GENERATORS:** Number of sets per station: six multi-stage, axial flow, impulse-reaction.
Continuous maximum rating per set: 60 MW.
Cooling: hydrogen at 30 p.s.i.g.
Speed: 3,000 r.p.m.
Generator voltage: 11.8 kV.
Power factor at C.M.R.: 0.8.
Steam pressure at H.P. stop valves: 555 p.s.i.g.
Steam pressure at L.P. stop valves: 135 p.s.i.g.
Steam temperature at H.P. stop valves: 690° F.
Steam temperature at L.P. stop valves: 660° F.
H.P. steam flow per set: 382 klb/hr.
L.P. steam flow per set: 186 klb/hr.
Final feed temperature at C.M.R.: 296° F.
- STEAM DUMPING:** Two condensers per station, operating at atmospheric pressure, with spray de-superheaters. Steam released to dump through automatic pressure controlled valves.