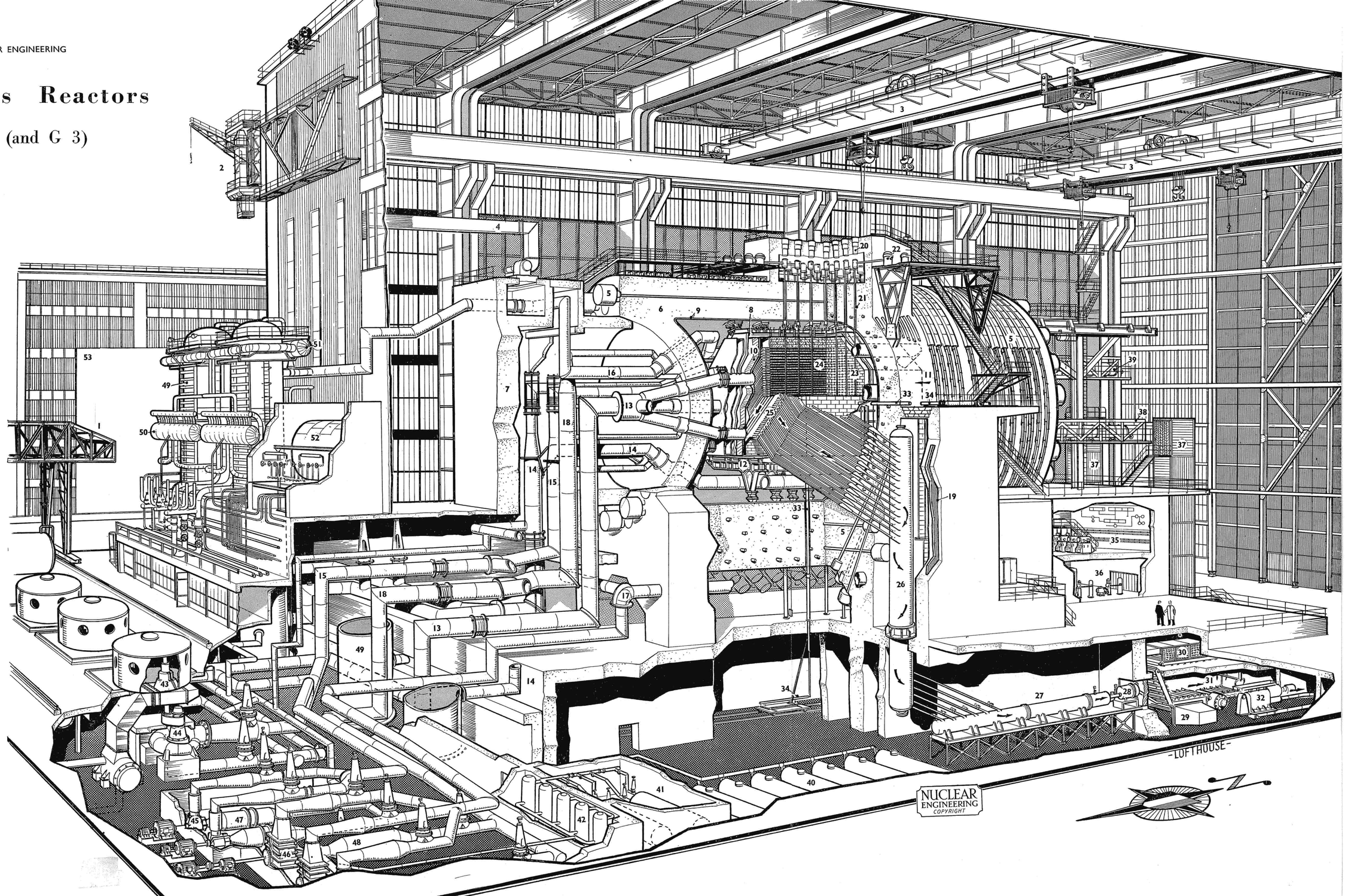
The World's Reactors

No. 24 G 2 (and G 3)

KEY

1. Service crane
2. Heat exchanger service crane
3. Reactor cranes
4. Ventilation duct
5. Concrete pre-stress cables
6. Vessel and biological shield
7. Secondary shield
8. Thermal shield
9. Vessel liner
10. Graphite wall
11. Charging face
12. Core supports
13. Primary central inlet
14. Primary central outlet
15. Primary peripheral inlet
16. Primary peripheral outlet
17. Secondary inlet
18. Secondary outlet
19. Steel sub-shield
20. Removable plugs
21. Control rods
22. Control rod mechanism
23. Graphite core and reflector
24. Fuel elements
25. Fuel element discharge guides
26. Toboggan run
27. Vibro transporter
28. Fuel element feed
29. Fuel element cooler
30. Can storage
31. Fuel element canning machine
32. Hydraulic conveyor to storage pool
33. Ion chamber
34. Ion chamber tube carriers
35. Burst element detection room
36. Compressor room
37. Charge lifts
38. Charging platforms
39. Charge machine
40. CO_2 storage cylinders
41. Refrigeration plant
42. Filter room
43. Blower turbines
44. Primary blowers
45. Primary auxiliary blowers
46. Secondary blowers
47. Primary start-up heaters
48. Secondary start-up heaters
49. Heat exchangers
50. High pressure steam drum
51. Medium pressure steam drum
52. Water feed reservoir
53. G 3 reactor



The World's Reactors

No. 24 G 2 (and G 3)

OWNER: Commissariat à l'Energie Atomique.

LOCATION: Marcoule, France.

TYPE: Thermal heterogeneous.

PURPOSE: Plutonium production; power production.

RATING:
205 MW (t); 27 MW (E).
Installed capacity: 45 MW.

OPERATION:
G2 diverged: July 21, 1958.
Electricity generated: April 22, 1959.

FUEL:
Natural uranium metal rods.
Some central rods, U/0.4% Al alloy.
15–20 channels loaded with Th.
Uranium density: 18.9 g/cm³.
Maximum temp.: 550°C.
Loading: 110 tons.

FUEL ELEMENTS:
Canning material: Mg/0.7% Zr alloy.
Max. temp: 400°C.
Wall thickness: 1.5 mm.
Overall length: 30 cm.
Extended surface: 16 fins, 4 high, 12 low.
U rod dimensions: 28.2 cm long, 2.8 or 3.1 cm dia.
Thickness of end caps: 0.9 cm.
Dia. across high fins: 6.63 cm.
Dia. across low fins: 5.13 cm (2.8 cm rod),
5.43 cm (3.1 cm rod).

MODERATOR:
Graphite.
Density: 1.7 g/cm³ (core),
1.67 g/cm³ (reflector).
Total number of blocks: 14,902.
Standard block size: 150×20×20 cm.
Total weight: 1,207 tons.

CORE:
Horizontal octagonal cylinder, surrounded by reflector, base extended to be parallel with sides.
Length: 8.4 m.
Distance across octagon flats: 8.0 m.
No. of fuel channels: 1,200.
Channel dia.: 7 cm.
No. of elements/channel: 28.
Mean channel rating: 1.82 MW/t U.
Max. channel rating 3.3 MW/t U.
Lattice: regular square, 20 cm pitch.

REFLECTOR:
Lower-grade graphite.
Radial: 40 cm grade 2+40 cm grade 3.
Longitudinal: 60 cm, charge face only.
Maximum stack dimensions: 9.4 m high, 9.53 m across, 9.05 m long.

CONTROL:
Boron carbide rods canned in steel.
No. of rods: 46.
Dimensions: 500 cm×4.0 cm o.d.
Channel section: 12 cm×7.2 cm.
Reactivity controlled: 5.5%.

FLUX:
Maximum thermal: 2.8×10^{13}n/cm², sec.

PRESSURE VESSEL:
Prestressed concrete; horizontal cylinder with concave ends, on massive base.
Internal diameter: 14 m.
Minimum internal length: 15.65 m.
Radial thickness: 3 m.
Minor radius of concave ends: 7 m.
Maximum dimensions: 27.5 m high, 17.5 m across, 33.7 m long.
Total assembled weight: 75,000 tons.
Reinforcing: 46 cables longitudinally,
58 cables tranverse,
56 cables banding, over 250°.
Cable tension: 1,200 tons.
Internal cladding of vessel: 3 cm steel.

PRIMARY COOLANT:
CO_2 at 214 p.s.i.
Central zone feed to 420 channels.
Inlet temp.: 80°C.
Flow: 854 lb/sec.
Peripheral zone feed to 780 channels.
Inlet temp.: 150°C.
Flow: 796 lb/sec.
Central zone outlet from 820 channels.
Outlet temp.: 309°C.
Flow: 1,420 lb/sec.
Peripheral zone outlet from 380 channels.
Outlet temp.: 348°C.
Flow: 230 lb/sec.

SECONDARY COOLANT:
Vessel and structural cooling:
Inlet temp.: 25°C.
Outlet temp.: 29.5°C.
Inflow: 1,100 lb/sec.
Heat removed: 1.85 MW.
Fraction bled into thermal shield, peripheral reflector:
Inlet temp.: 27°C.
Outlet temp.: 90°C.
Flow: 88 lb/sec ejected into primary peripheral stream.

CIRCULATORS:
Primary: 3 turbo-driven single-stage centrifugal.
One retained as stand-by.
Power consumption: 2×3.7 MW+1×2.25 MW.
Primary auxiliary: 2 motor-driven single-stage centrifugal.
One used at 1,000 r.p.m. (60 kW) for shut-down cooling.
Two in parallel at 1,500 r.p.m. (170 kW) for start-up.
Secondary: 3 motor-driven single-stage axial.
Two as stand-by.
Power rating: 2×1,000 h.p., 1×140 h.p.

DUCTING:
Primary central entry: 4×80 cm dia.
Primary peripheral entry: 4×80 cm dia.
Primary central outlet: 4×100 cm dia.
Primary peripheral outlet: 2×80 cm dia.
Primary manifolds: 1.6 m dia. max.
Secondary inlet: 2×1.2 m.

HEAT EXCHANGERS:
No. of heat exchangers: 4.
Type: shell/tube divided into three vertical sections in series.
Shell dimensions: 32 m high×3.5 m dia., 3.1 cm wall.
Peripheral gas enters first inlet at 348°C.
Central zone gas enters at end of first stage at 309°C.
Part extracted at 140°C.
Part at 71°C.
Heat transfer surfaces: H.P. superheater: 450m².
H.P. evaporator: 2,540 m².
M.P. evaporator: 1,360 m².
L.P. boiler and common economizers: 1,760 m².
M.P. fraction superheated by H.P. drum loop.

STEAM CONDITIONS:

	H.P.	M.P.	L.P.
Pressure	153 p.s.i.	31 p.s.i.	7 p.s.i.
Temp.	334°C.	171°C.	81°C.
Flow	105 lb/sec	14.5 lb/sec	7.1 lb/sec

SHIELDING
Minimum 3 m concrete, 2.4 g/cm³.
Charge face: 4.8 m.
Thermal barrier: 15 cm steel.
Discharge face: additional 80 cm graphite.
Max thermal flux to concrete: 7 mW/cm².

THE WORLD'S REACTORS
No. 22 Latina (October, 1959)

We regret that in printing, the figure 5 indicating the core support diagrid became displaced. Revised annotations have also been received for the following:

15. High-pressure steam drum
16. Low-pressure steam drum
17. } Low-pressure evaporators
18. }
19. Low-temperature economizer

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