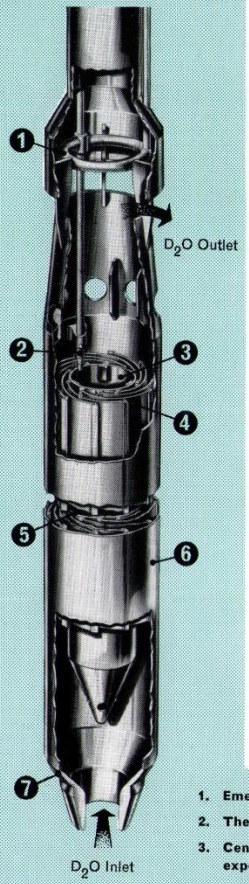
Fuel Element Mk. III



1. Emergency cooling Spray Nozzle
2. Thermocouple Tube
3. Central Hole which will accommodate a 2" experimental thimble
4. Fuel Plate
5. Inner aluminium tube
6. Outer aluminium tube
7. Spherical seat

DAPHNE is a zero-energy, heavy water moderated reactor which has been designed as an auxiliary to the high flux materials testing reactors DIDO and PLUTO. It can be loaded with fuel elements, rigs and beam tubes to simulate DIDO, PLUTO or other reactors of this class. By measuring the reactivity of particular core loadings and the flux distributions through rigs, the behaviour of the high flux reactors can be predicted and optimized with least waste of their operating time.

DAPHNE is also used to measure safety parameters such as prompt neutron lifetime, to compare calculations with measurement and to test improved designs of fuel elements, control mechanisms and rigs.

DAPHNE is operated at very low powers only so that the radioactivity of the fuel is kept to a minimum, thus facilitating the dismantling of the reactor for making changes in the core. There is no cooling system.

Data

TYPE	Thermal heterogeneous.
PURPOSE	Measurement of reactivity, fluxes and other data in DIDO or PLUTO cores.
OPERATION	First critical February, 1962.
FUEL	Enriched uranium aluminium alloy, aluminium clad. Plate size 23·6 ins.×2·36 ins.×0·058 ins. Mk. II: Ten curved plates set parallel in a 3 in. square box. Mk. III: Ten curved plates set in a 4 in. O.D., 2 in. I.D. annulus. Fuel content: Not more than 150g U235 per element.
MODERATOR	8 tonnes of heavy water, in aluminium tank 6 ft. 7 in. dia.×11 ft. high.
CORE	Approximately cylindrical 3 ft. dia.×2 ft. high. Lattice: basically square, 6 in. pitch. Up to 25 fuel elements for DIDO simulation. Up to 26 fuel elements for PLUTO simulation.
COOLANT	None.
FLUX	Maximum thermal neutron flux $2{\cdot}0\times10^{9}$ n/cm.^{2}-sec.
POWER	Up to 100 watts.
REACTIVITY	Maximum excess reactivity about 20% $\delta k/k$.
CONTROL	(a) Coarse control arms (6 for DIDO, 7 for PLUTO) arranged in two banks, each bank controlling up to 10% $\delta k/k$. They are preset before reactor is taken critical, for simulation purposes only. (b) 1 fine control rod (0·4 $\delta k/k$). (c) Variation of moderator height (1·2% $\delta k/k$ per cm. at criticality). (d) 4 safety rods (about 2% $\delta k/k$ each).
SHIELDING	Sides, 4 ft. normal aggregate concrete. Top, 2 ft. barytes aggregate concrete.
OVERALL SIZE	24 ft.×24 ft.×18 ft. high shield; dump tank and pump in pit beneath.
OPERATING TEMPERATURE	Ambient.

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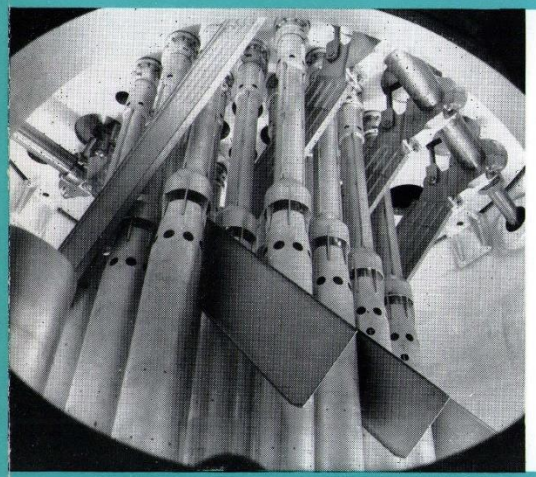


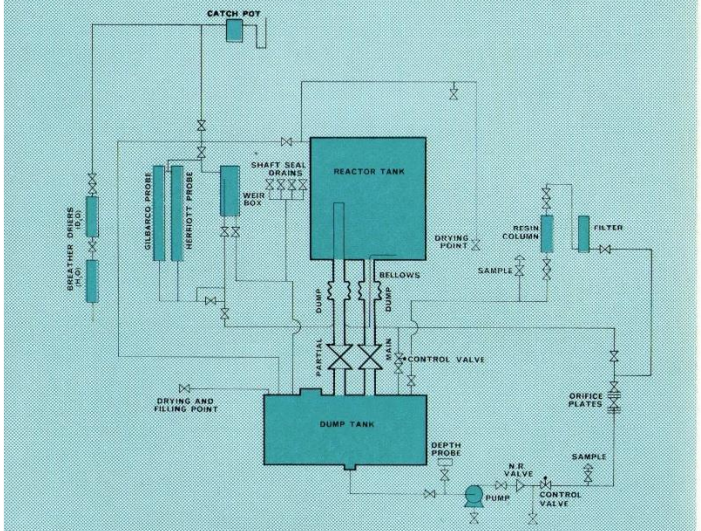
Reactor core with PLUTO lattice seen through an experimental facility.

DAPHNE

ZERO ENERGY HEAVY WATER REACTOR

ATOMIC ENERGY RESEARCH ESTABLISHMENT, HARWELL

1. Control Valve
2. Canned Rotor Pump
3. Graphite Reflector
4. Weir Box
5. Breather Drier
6. Oil Filled Manometer
7. Vertical Experimental Facility
8. Safety Rod Gearbox
9. Scanning Blocks
10. Travelling Top Shield
11. Sealing Plate
12. Fuel Element
13. Top Lattice Plate
14. Coarse Control Arm Drive Gearbox
15. Coarse Control Arm
16. Bottom Lattice Plate
17. Reactor Aluminium Tank
18. Gilbarco Level Gauge
19. Dump Valve
20. Dump Tank
21. Horizontal Experimental Facility



Flow Sheet

Cutaway View of Reactor