In-Pile Test Section

The prime unit is the pressure vessel which is a composite vessel consisting of a austenitic stainless steel tube of 3 in. (75 mm.) bore, with a spherical end of the same material and welded to a mild steel head. Bolted to the head of the vessel is the demountable head which is of mild steel and this part has branches and flanges to connect to the loop pipes at inlet and outlet. Removal of the demountable head facilitates handling of the vessel after it has become radioactive.

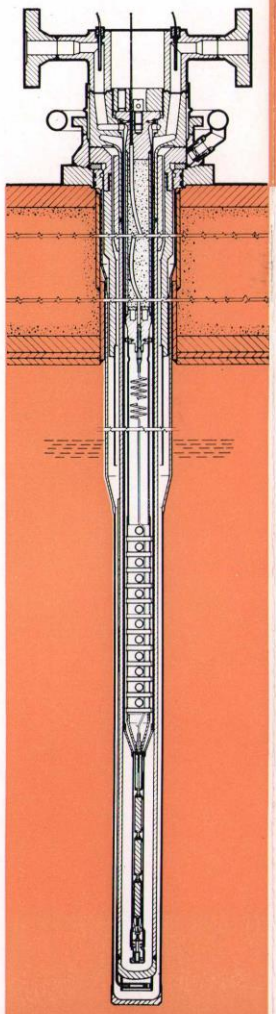
The vessel holds an inner assembly which incorporates a shield plug and a sample carrier Space in the sample carrier is arranged for both fuel elements and metallurgical specimens. The shield plug and sample carrier assembly is inside a flow divider tube and the arrangement of the channels in the head of the vessel allows the loop water to pass down over the fuel elements and up the outside surface of the flow divider tube.

The vessel is not in contact with the heavy water of the reactor but is inside a special stainless steel thimble. This special thimble replaces the standard aluminium thimble so that should the vessel develop a leak, the thimble would be subject to a pressure which the normal aluminium thimble would be unable to withstand. In the event of a complete failure of the vessel the thimble could see the full loop pressure and in this case bursting discs in the facility head would rupture and the contents of the thimble would be piped away to safeguard reactor personnel.

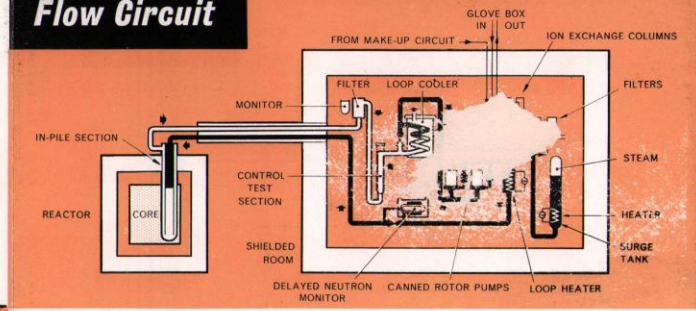
The vessel is seal welded into the facility head as this has proved to be the most reliable gas tight seal.

Leak detectors are fitted in the thimble void to detect leaks from the vessel or into the thimble.

The thimble void is maintained at approx. 10 p.s.i.g. (0·7 atm.) helium gas pressure.



Flow Circuit



Control Test Section

This is an autoclave included in the main loop circuit with a sample carrier similar to that in the in-pile test section.

Comparison of results obtained on identical specimens in the in-pile and in the control test sections enables the effect of irradiation to be isolated from corrosion/erosion effects on metallurgical samples and fuel canning materials.

The effect of radioactivity in the loop water on surface contamination of specimens of steel can also be studied.

Water Sampling and Dosing

The sampling and dosing points are arranged in the glove box, the atmosphere of which is extracted to the reactor shell extract system.

Sampling points are provided:—

(a) before the ion-exchange columns
(b) after the ion exchange columns
(c) from water phase in surge tank
(d) after the crud filter but before the mechanical filter
(e) from the main loop circuit just up stream of the pressure vessel.

A dosing bomb in the glove box is used for the injection of hydrogen mainly, but could be used for other substances.

Also in the glove box are a crud filter and two demountable test sections in mild steel, the surfaces of which are exposed to loop water at 50°C.

The temperature of the water in the sampling circuit is held at 50°C chiefly to prevent breakdown of the ion-exchange resins.

Conductivity probes give a direct reading of pH value of the water in the loop.

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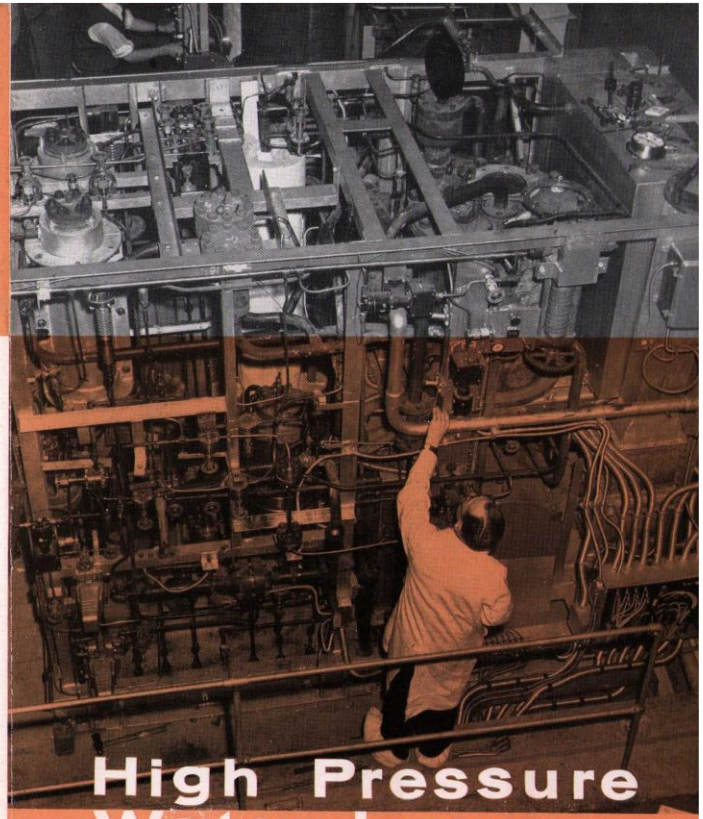


High Pressure Water Loop

DIDO HEAVY WATER REACTOR

Atomic Energy Research Establishment, Harwell

Data

Pressure range	1800-2000 p.s.i.g. (136 atm.).
Outlet temp., from in-pile test section	300°C.
Inlet temp., to inpile test section	295°C.
Flow rate	15 g.p.m. (68 l/min.).
Heat output from fuel	13 kW.
Reactivity absorbed by in-pile test section	~0·75%.
pH valve of loop water	~11·0.
Estimated fluxes in 6V-4 facility at 12½ Mw reactor power:-	
(i) On surface of specimens inside pressure vessel (thermal)	6×10^{12} n/cm.^{2} sec.
(ii) undisturbed thermal	1×10^{14} n/cm.^{2} sec.
(iii) fast	2×10^{12} n/cm.^{2} sec.
Total capacity of loop	30 gall. (136 l.).

Description

The main circuit is of 1½ in. (35 mm.) bore mild-steel piping and contains two Westinghouse A-150-D1 canned rotor/stator pumps, a main loop heater, a delayed neutron monitor, an in-pile test section, filters, an out-of-pile test section, and a main loop cooler. The water in the loop is circulated at 2000 p.s.i.g. (136 atm.) and 300°C. The pressure of the water is generated in the surge tank.

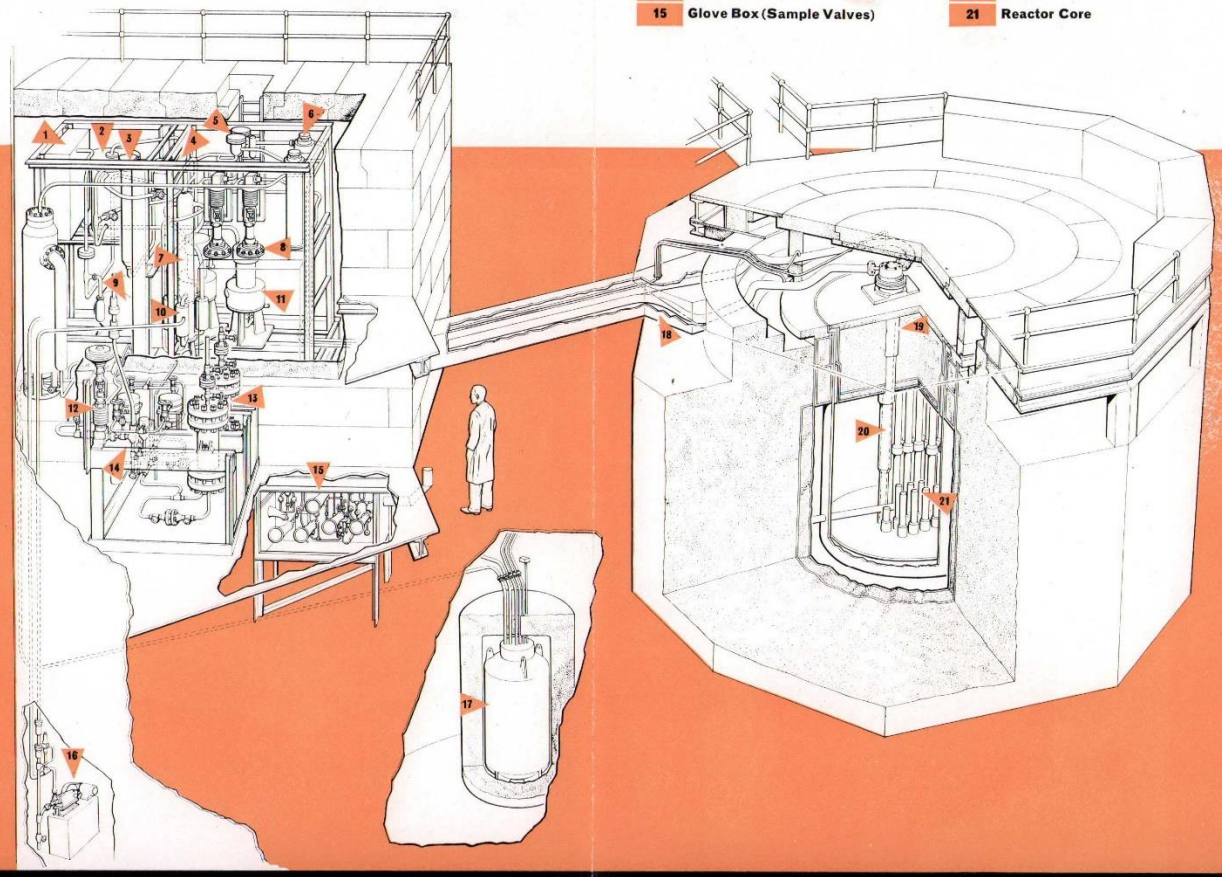
A by-pass circuit known generally as the sampling circuit includes ion exchange columns which maintain the required water conditions. The make-up system provides water of the correct pH value automatically as the water level in the surge tank drops. It may be necessary, at some time, to decontaminate the loop and a stainless steel tank is provided for storing a decontamination solution. If fuel elements are in the in-pile test section this tank is held full of loop-quality water in readiness to provide emergency cooling to the fuel elements should the loop dump. This emergency cooling could prevent excessive rise in temperature of the fuel elements.

Instrumentation and control equipment allows for fully automatic operation during steady conditions and ensures reactor safety. Several fault conditions bring about complete reactor trips thus allowing for "fail safe" conditions. A loop dump, which also initiates a reactor trip, occurs should certain fault conditions arise. In the event of a dump action the water of the loop is allowed to rush out into a quench tank containing sufficient cold water to prevent the loop water flashing to steam.

The main circuit of the loop and the sampling circuit (generally known as the Package Unit) is contained inside a shielded room which has 2 ft (0·6 m.) thick concrete walls. The shielded room is made up of interlocking blocks such that it is possible to remove the blocks and dismantle the room for complete access to the loop. Normally access to the room is by removing one smaller block in the roof. The control/instrument panel is situated beneath the shielded room. All valves essential to the operation of the loop can be operated from the vicinity of the control/instrument panel or by using an extension key through liner tubes cast into the roof blocks.

The main items of interest on the loop are the in-pile test section, the control test section and the various water sampling and dosing arrangements.

1. Loop Heater
2. Loop Cooler
3. Sample Carrier (Control Test Section)
4. Condenser
5. Filters
6. Ion Exchange Columns
7. Surge Tank
8. Dump Valves
9. Delayed Neutron Monitor
10. Surge Tank Heater
11. Canned Rotor Pumps
12. Emergency Cooling Water Inlet Valve
13. Potter Columns
14. Make-up Circuit
15. Glove Box (Sample Valves)
16. Make-up Pump
17. Catch Tank
18. Lead Shot Pipe Bridge
19. In Pile Test Section (6 V. Hole)
20. Sample Carrier
21. Reactor Core



HIGH PRESSURE WATER LOOP IN DIDO