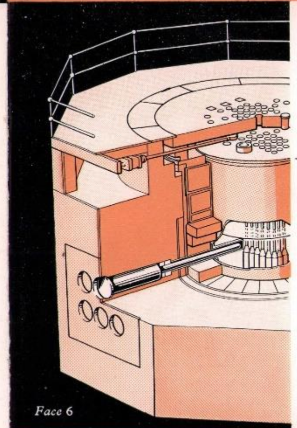
Research Reactors Division, A.E.R.E. Harwell

Equipment for Conducting Irradiation Experiments in A.E.R.E. Reactors

Rare Gas Fission Product Rig in DIDO (S/D 366)

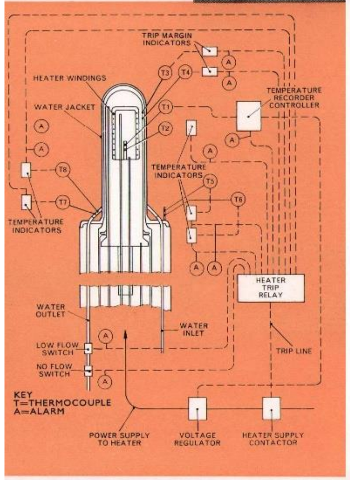


Face 6

Rare Gas Fission Product Rig

Design started in mid-1959, manufacture in January 1960 and works testing in May 1960. The rig was loaded into the reactor in October 1960. Fairey Engineering Ltd. was the main contractor.

Instrument panel



Schematic diagram

Purpose

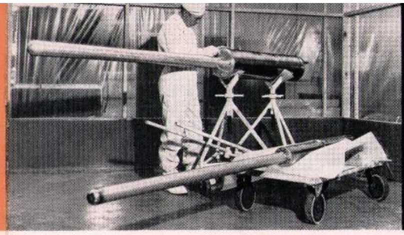
This rig was built for studying the emission of rare-gas fission products, particularly the short-lived variety, emitted from fissile materials at various temperatures up to 1000°C.

Details of Experiments carried out to date

Chemistry Division, A.E.R.E., have used this rig to analyse the release of krypton and xenon fission product gases from UO_2 in pellet form and to relate the rate of release to specimen temperature, on which it is markedly dependent. Using small carrier gas flows the shorter lived activities decayed away before reaching the counting chamber and Xe^{133} ($T_{\frac{1}{2}}$ 5·2 days), Xe^{135} (9·2 hours) and Kr^{85m} (4·4 hours) predominated. With larger gas flows shorter lived active gases were more prominent. Quantitative estimation of the active gas emission utilised the gamma scintillation spectrometer.

Data

Specimen material	UO_2 (natural)
Mass of specimen	2·0 gm.
Heat output of specimen	24 watts
Water flow through the jacket	15 gall/hr.
Max. rise in cooling-water temperature	25°C.
Pressure drop across the circuit	1·25 lb/in.²
Hydraulic diameter of the helical cooling path	0·0147 ft.
Max. capacity of H20 cooling circuit	7·5 kW.
Carrier gas flow rate	2-30 c.c./min.
Reactivity absorbed	0·05%
Thermal neutron flux at 12·5MW in empty 4H3 thimble	$7{\cdot}2 \times 10^{13}$ n/cm.² sec.
Thermal neutron flux at 12·5MW on the specimen surface	$4{\cdot}1 \times 10^{13}$ n/cm.² sec
Nuclear heating at 12·5MW over the length of the silica cell:	
Stainless steel thimble	43 watts
Heater wire	3 watts
Silica cell	15 watts



Completed inner and outer sections.

General Description

The in-pile section occupies the 4H3 experimental hole in DIDO and consists of an electrically heated silica reaction cell contained in a stainless steel thimble surrounded by an aluminium cooling-water jacket. Purified helium carrier gas passes at a controllable flow rate over the fissile specimen in the reaction cell and then to a lead shielded counting chamber in the out-of-pile section.

A separate supply of purging gas enters the stainless steel thimble and passes over the outside of the reaction cell. This gas may be helium or nitrogen as appropriate and the flow rate is controllable down to zero, to enable the widest range of temperatures to be achieved.

For economy the in-pile section comprises two components, an inner expendable unit consisting of a shield plug to which is attached the stainless steel thimble containing the reaction cell, and an outer unit, which is semi-permanently installed in the reactor, comprising an annular shield plug and aluminium water jacket.

The out-of-pile equipment is located in two consoles adjacent to the reactor face and includes carrier and cooling gas controls, filters and gamma radiation counter. Rig instrumentation consists of thermocouples indicating temperatures of the specimen, stainless steel thimble, cooling water at outlet, also water flow switches and leak detectors. These operate heater control, warning and trip circuits, and a reactor power set-back should serious fault conditions develop.

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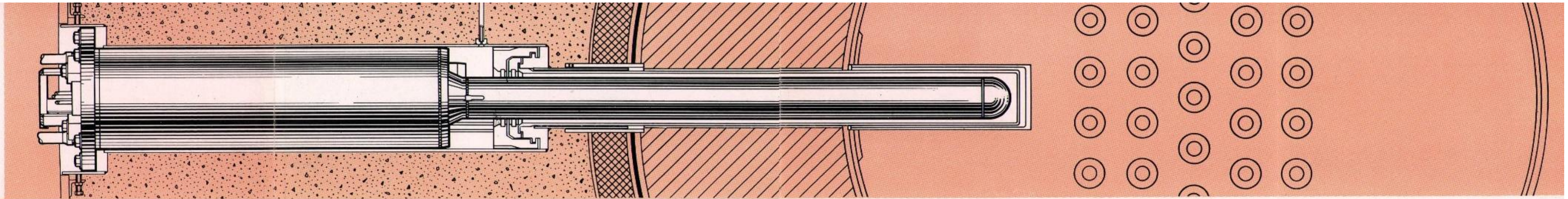
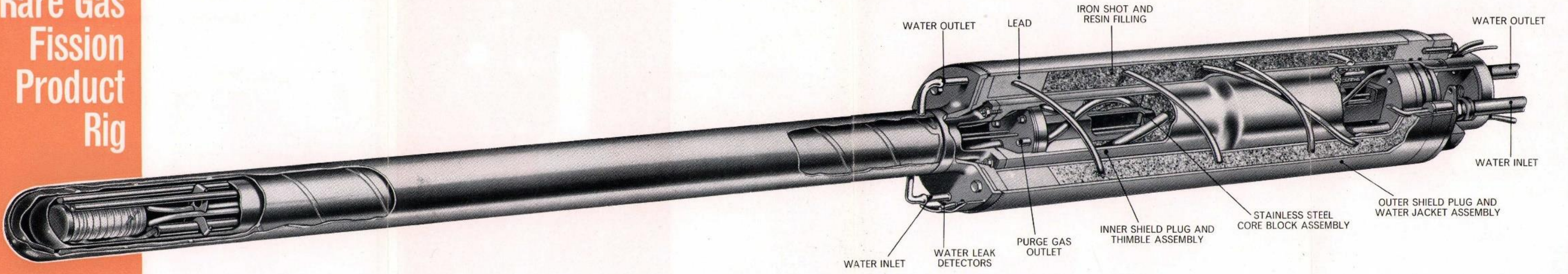
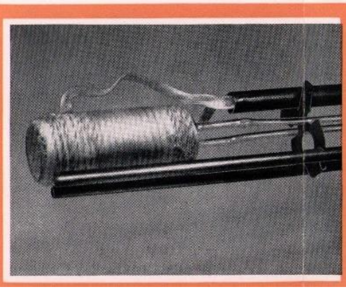
Sectional plan view showing Rig in Reactor

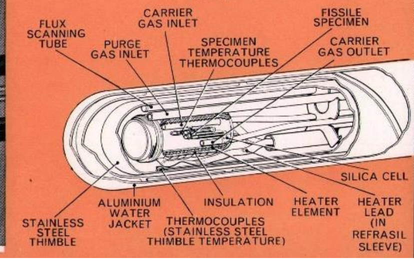


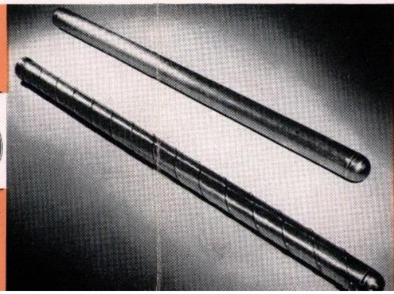
Rare Gas Fission Product Rig





Details of in-pile section





Enlarged view of water leak detector