Purposes

A programme was requested by the C.E.G.B. for type testing several novel and commercially available ion chambers for use in solving spatial instability problems in power reactors. There was a possible need for local control rods, and more accurate determination of flux patterns in such reactors generally. A series of eight rigs was built to expedite tests of these ion chambers at high temperatures.

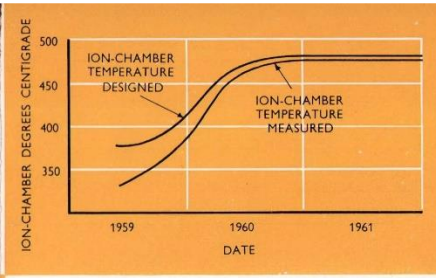
Development work on successive rigs in this series made possible a complete programme of testing, both of ion-chambers and other electronic equipment associated with researches into the use of magnetic elements as temperature measuring devices based on the Curie point effect.

MARK No.	LOADED INTO REACTOR	MODIFICATIONS INCORPORATED
1	June 1959	As designed. (Ion-chamber of 1¼ inches diameter fitted)
2	October 1959	(1) Self locating thermocouple spider for monitoring facility liner with temperatures fitted. (2) Stainless steel extension/expansion sleeve added to attach and test ion-chambers of 1¼ inches diameter.
3	December 1959	Identical with Mark 2
4	March 1960	(1) Heat shroud of thin high purity polished aluminium fitted round ion-chamber to increase temperature.
5	May 1960	(1) Heat shield anodised and made readily detachable against possibility of increase in pile-power during experiment.
6	September 1960	(1) Flux scan tube tapered at in-pile end to ensure positional reproducibility of cobalt wires used in dosiometer techniques for flux evaluation. (2) Leads tube enlarged to facilitate easier assembly of ion-chamber on to rig. (3) Mineral insulated stainless steel sheathed conductors fitted throughout to replace cotton covered wires. (4) Heat shield nickel-phosphorus alloy chemical wash plated for greater durability of polished reflecting surfaces under irradiation.
7	February 1961	Identical with Mark 6
8	May 1961	(1) Magnetic coil specimens attached to inside of end cup of heat shroud. (2) Heat shroud fitted with radial adjusting screws for more accurate centralisation on heat shield.

Development Features

Practical Outcome of Experiments

Tests were successfully carried out on the durability of insulators and the behaviour of both production and experimental ion chambers. Several types of chambers were, as a result of these tests, recommended to the C.E.G.B. for use in nuclear power stations which have in subsequent service fully justified their selection. Data obtained from testing magnetic alloys of probable application in novel temperature measuring devices proved to be of great value and has led to the formulation of more advanced experimental programmes.



Development of Ion-Chamber Temperature control using nuclear heating only

General description

Each rig consisted of a standard shield plug fitted with both in-pile and out-pile extensions. The in-pile extension carried the ion-chamber under test, and the expandable finger assembly locating the sensing thermocouple elements for monitoring reactor liner tube temperatures. Two more such temperature sensing elements were brazed to the ion chamber.

The out-pile extension accommodated instrumentation terminal connections and the mechanical actuating handle for the liner tube thermocouple fingers, thereby placing these items in an accessible place outside of the biological shield. The instrumentation consisted of a temperature recorder having provision for high temperature alarms.

Special care was taken to minimise the amounts of neutron absorbing materials in the rig to enable the ion-chamber to be subjected to relatively undisturbed flux. For example it was decided to rely upon nuclear heating only, to raise to temperature of the ion-chamber, thus dispensing with the need of an enshrouding furnace. The graph shows how progressive development of the aluminium heat shield gradually raised this temperature to the desired level.

Data

Experimental facility: 7H3R, Pluto.

Thermal neutron flux in region of specimen: $3{\cdot}8 \times 10^{13} n/cm^2/sec$.

Atmosphere: Helium gas.

Cooling: Plug tip only from reactor shield cooling water circuit.

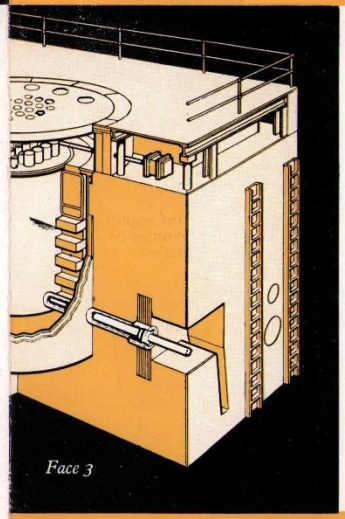
Specimen temperature: Up to 500° C.

Specimen heating: Nuclear only.

Reactivity absorbed: Negligible.

Size of largest ion-chambers tested $1\frac{7}{8}''$ dia. x 10″ long.

Rigs for testing Ion-Chamber and other electronic equipment in Pluto



Ionisation Chamber Test Rig Mk. 8

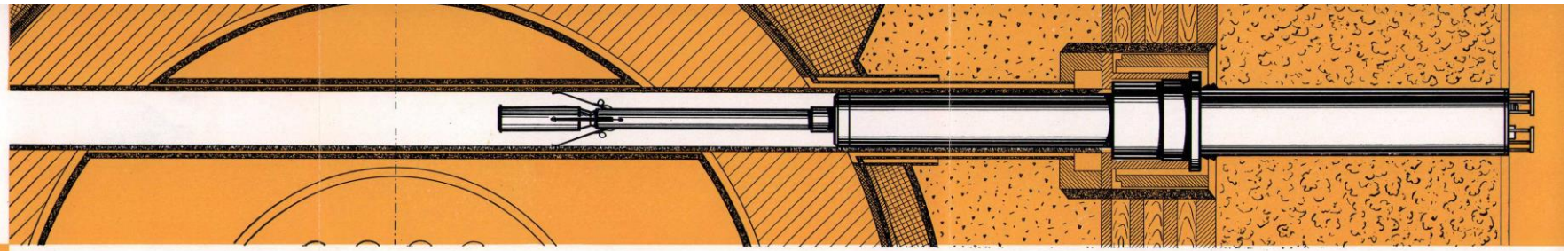
Atomic Energy Research Establishment, Harwell

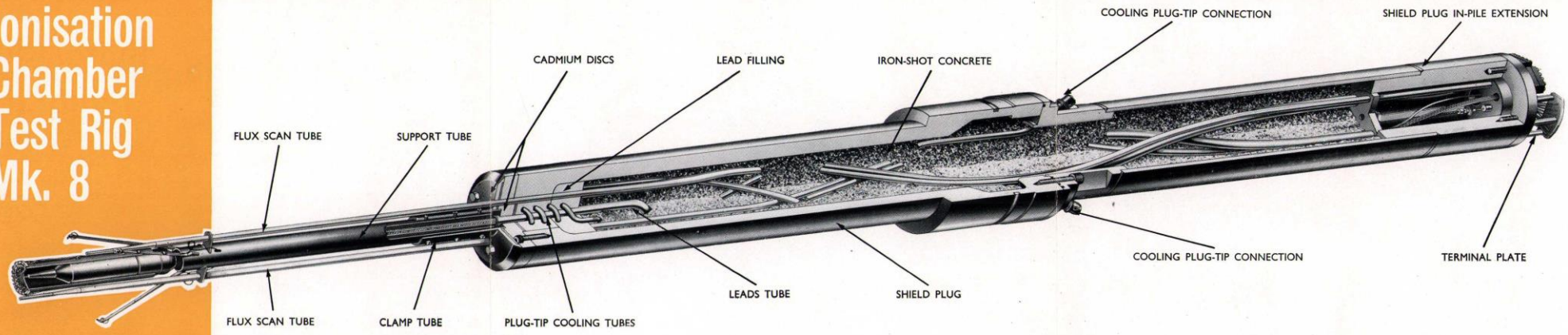
The original specification was published in April 1959 and the first rig, installed in the reactor two months later, was designated Mark I of the general series.

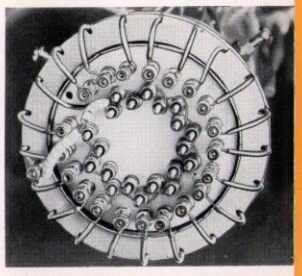
Subsequent marks were built and loaded into PLUTO between then and May 1961. The table shows the course of development of the rigs up to and including Mark 8, the last of the series, unloaded on completion of the experimental programme in March 1962.

Ionisation Chamber Test Rig Mk. 8

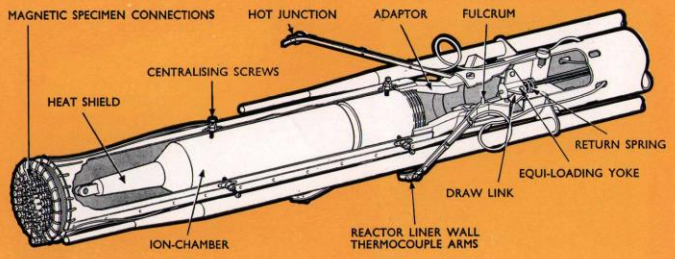
Sectional plan view showing Rig in Reactor

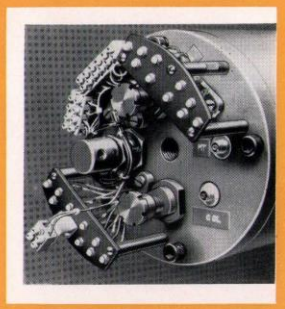






End of Mk.8 Heat-Shield





Mk.8 Terminal Plate