

## GENERAL DESCRIPTION

### 1. In-Pile Section

This is suspended from a shielding plug suitable for insertion in a 10 VGR facility in the graphite reflector of the DIDO reactor. Consisting of a cluster of three furnaces, located at the level of the reactor core centre-line, it is suspended from the shield plug by a tubular aluminium stalk. Surrounding the in-pile section is an aluminium envelope filled with helium at a pressure slightly greater than atmospheric.

Services to the furnace region such as electrical supplies, thermocouples, helium sweep gas pipes etc., are spralled through the shield plug to eliminate shine from the reactor core.

As stated the design embodies three furnace assemblies, only one of which will be operated, the others being available if failures occur due to limited furnace life at these elevated temperatures. The specimen, which is of cylindrical form and approximately one gramme in weight, is suspended in the furnace from a plug which passes through the main shield plug, enabling specimens to be changed whilst the rig remains in the reactor.

The temperature of the specimen is measured and controlled by a primary Tungsten/Tungsten 26% Rhenium thermocouple, complementary to a secondary thermocouple, in a cooler zone of the furnace, and initially calibrated against the primary thermocouple.

Helium of high purity is passed over the specimen and acts as a carrier for the gaseous fission products released, this carrier gas being piped from the in-pile section to the iodine and xenon traps located in the reactor gallery and chemical console respectively. To prevent the deposition of iodine on their walls, the pipes are maintained at a temperature of 600°C.

Each furnace is constructed around a central molybdenum tube which contains the specimen and consists of a tungsten "hairpin" type electrical resistance heater surrounded by cylindrical radiation shields of molybdenum with alumina end plugs.

### 2. Chemical Console

The chemical console contains two helium circuits the first of which is a purification system for the helium carrier gas and the supply to the rig envelope. It is necessary to obtain helium of such high purity to prevent oxidation of the refractory materials in the furnace at elevated temperatures. Purification is by means of columns of established design suitable for removing moisture, oxygen etc.

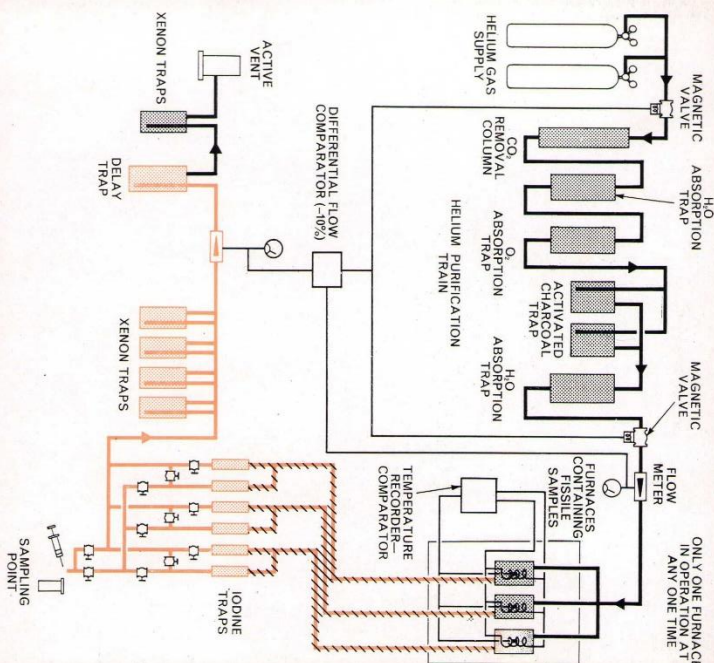
The second circuit receives helium carrier gas which contains fission products and these are removed in a series of permanent traps. Alternatively, demountable sampling traps may be utilised. A final safety trap is included through which the helium passes before discharge to the reactor building ventilation system.

### 3. Electrical Console

The majority of the electrical and instrumentation equipment is housed in a separate control console on which the state of the equipment is visually displayed and graphically recorded.

## LOAD AND UNLOAD OF SPECIMENS

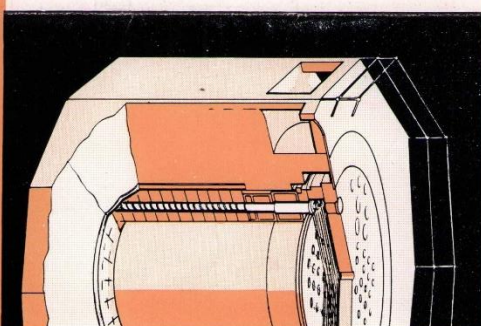
The design permits the specimens to be loaded or changed through the shielding plug whilst the rig remains in the reactor. Changes will only be made whilst the reactor is in a shut-down condition. As the specimens are active or removal, and consist of uncaned fissile material, a sealed, shielded mask is used.



## SAFETY ASPECTS OF THE EQUIPMENT

The principal hazard which could arise would be a release of fission products to atmosphere caused by a leakage or fracture of the pipework from the in-pile section to the chemical console. This would be detected by installed mass flow meters which monitor and compare the mass flow to and from the in-pile section. A variation of greater than 5% initiates a warning. A series of trip functions then stop the flow of helium, also switching off the operating furnace and heated pipework.

I.S. LEAFLET No. 305506

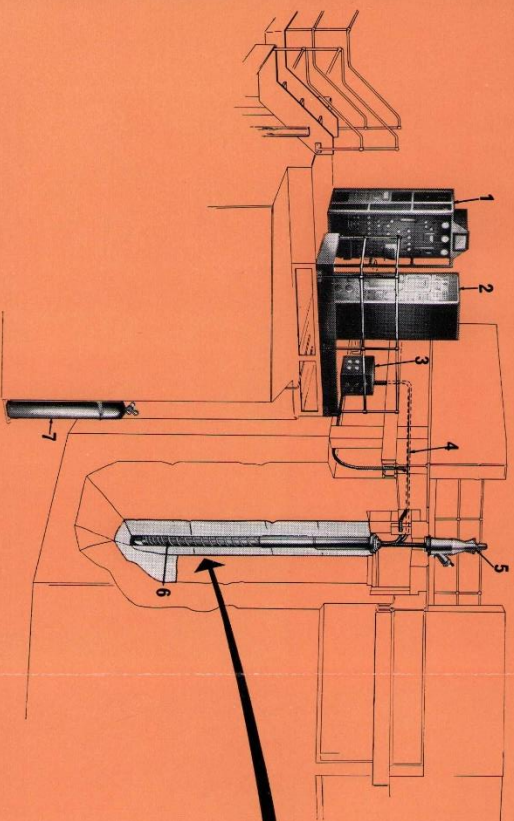


## 2000 °C Fission Product Rig

The equipment provides facilities for the investigation of phenomena associated with the retention of fission products in ceramic fuels at temperatures up to 2000°C.

Data will be provided on the following:

- Fission product release rates up to 1600°C.
- Effects on fission product release of the period and amplitude of transient changes in temperature which may be encountered in power reactor operation.
- Examination of the mechanism of the burst of activity which occurs with upward changes of temperature and which is not described by the normal diffusion laws.
- Effect of grain growth on fission gas release at temperatures from 1600-2000°C.

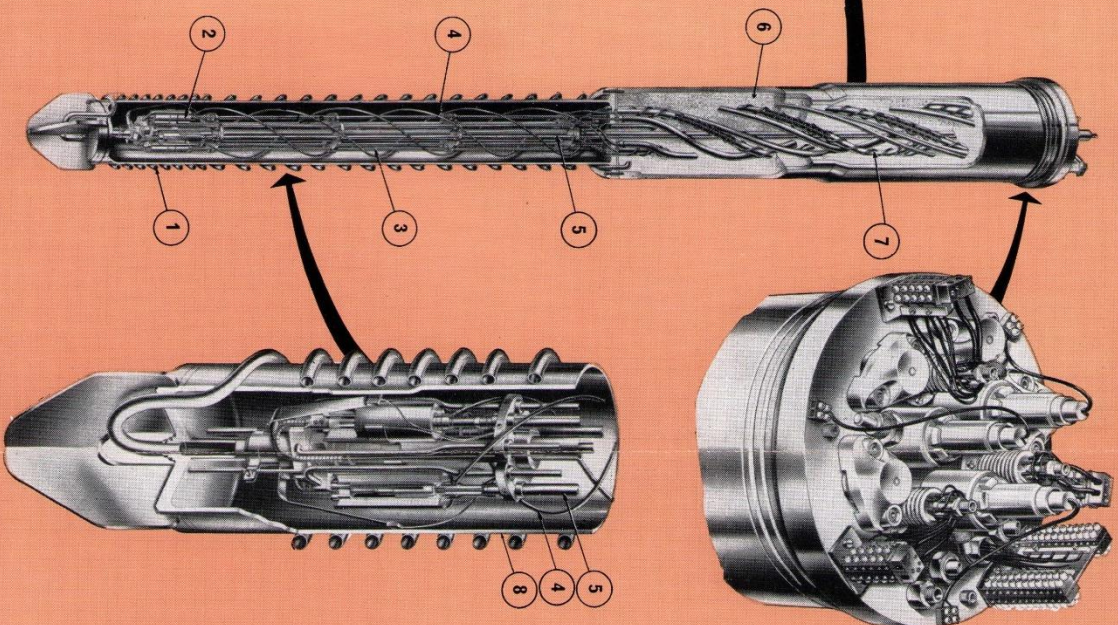


## HOW HOT IS 2000° CENTIGRADE?

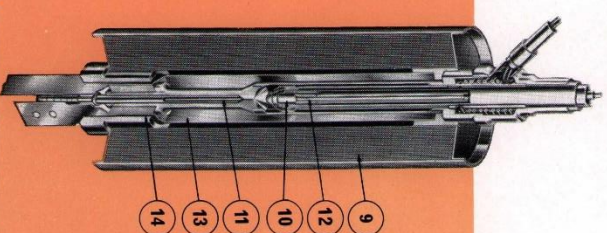


## DATA SHEET

|                             |    |                                                                                |
|-----------------------------|----|--------------------------------------------------------------------------------|
| Location of Experiment ..   | .. | 10 ins diameter Vertical Graphite Reflector facility hole in the DIDO reactor. |
| Neutron Flux at Specimen .. | .. | $0.5 \times 10^{12}$ neutrons/cm <sup>2</sup> sec. <sup>1</sup>                |
| Specimen Temperature ..     | .. | Up to 2000°C.                                                                  |
| Temperature Measurement ..  | .. | Tungsten/Tungsten Rhenium 26%,                                                 |
| Specimen ..                 | .. | 1 gramme of Uranium Oxide as a regular cylinder of 1 cm.                       |
| Furnace ..                  | .. | Tungsten heater element with molybdenum thermal radiation shields.             |
| Furnace Rating ..           | .. | 1 kW. (10V. at 100 amps).                                                      |
| Rig Atmosphere ..           | .. | Helium, with a content of less than 5 p.p.m. Oxygen.                           |
| Carrier Gas ..              | .. | As rig atmosphere.                                                             |
| Carrier Flow rate ..        | .. | 10-50 cu. cms./minute.                                                         |



- Key**
- 1 Cooling Water Coils.
  - 2 Furnace Assembly.
  - 3 Electrical Conductors to Furnaces.
  - 4 Heated Pipes (600°C).
  - 5 Specimen Suspension Tube.
  - 6 Radiation Shielding.
  - 7 Cooling Coils.
  - 8 Rig Envelope.
  - 9 Molybdenum Foil Radiation Shields.
  - 10 Uranium Oxide Sample.
  - 11 Secondary Thermocouple.
  - 12 Primary Thermocouple Tungsten/Tungsten Rhenium.
  - 13 Tungsten Heater.
  - 14 Alumina Insulator.



**FURNACE ASSEMBLY**