

# ***Nuclear and technical consultancy***



HARWELL



# *Research Reactors Division*

The Research Reactors Division is an integral part of the Harwell Laboratory with specific responsibility for the safe and efficient utilisation of the Harwell research reactors. It has accomplished this task over a number of years and in doing so has brought together a highly skilled, multi-disciplined team of engineer/scientist experts not only in the field of operating reactors but also in the design, manufacture, and commissioning of the complex equipment required for conducting experiments in the reactors. The work is broad-based and calls for high technology allied to basic engineering with the application of the latest project control and management techniques.

In common with other Harwell Divisions, Research Reactors Division has made its expertise available to industry and other organisations both in the U.K. and abroad. Work is undertaken

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## *Design Services*

Successful operation of the high-flux research reactors requires substantial engineering support, which is provided by the Design department.

Project engineering teams are responsible for all stages of the engineering of irradiation experiments from the scientific concept to full operation in the reactor. They also provide engineering back-up for the Reactor Operations department, covering many aspects of development and all major modifications to the reactor plant.

Work is also carried out for other UKAEA establishments and on a commercial basis for outside customers. Examples are major loop engineering and many smaller items of irradiation

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## *Irradiation Engineering*

Irradiation experiments in materials-testing reactors demand a high standard of precision mechanical engineering and advanced instrumentation. Specimens of reactor fuel or structural material are subjected to intense neutron fluxes at controlled temperatures from that of liquid nitrogen up to 2000°C and may also be simultaneously subjected to closely controlled high-pressure or mechanical straining forces. Temperature, pressure, load etc. must therefore be continuously and accurately recorded.

Apart from the radiation-damage effects of neutrons and gamma-rays on the specimens being irradiated the structure of

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## *Technical Section*

The Technical Section provides a consultancy to the RRD Design Department and to customers elsewhere.

Technical expertise acquired by RRD in areas such as heat-transfer and stress analysis has been deployed effectively in consultancy work for UK and overseas customers. All work is fully documented on completion with interim and final reports as appropriate. The same checking procedures are applied to all work undertaken by the Section so that an equal standard is available to all customers.

Where it is necessary or desirable to back up theoretical analysis the Technical Section mounts appropriate experiments in conjunction with RRD Test and Commissioning Section. Recent examples have included a quarter-scale



not only in nuclear science and engineering but in many other more conventional areas where the facilities of the Division and the specialised knowledge of its staff can be put to good use.

Research Reactors Division also has access to a wide range of equipment, facilities, and specialist knowledge within the parent body, the United Kingdom Atomic Energy Authority, with its four main Establishments and a staff of some 2,500 professional scientists and engineers.

Work which the Division has completed or is currently engaged upon covers a wide range and varies from minor consultancy to overall responsibility for design, manufacture, procurement, assembly, commissioning, and safety analysis of contracts worth several million pounds. All the work is carried out to the highest standards of safety and reliability, and where applicable full Quality Assurance procedures are used.

The Division has provided services to other Establishments within the UKAEA, to government ministries and departments, to foreign government-funded organisations and universities, and to many industrial concerns at home and abroad.

The degree of autonomy which the Division enjoys within its parent organisation permits a technical and contractual relationship between the customer and those carrying out the work which ensures rapid and efficient progress at minimum cost.

equipment. Special expertise built up in support of these activities is also available to other Divisions at Harwell in aid of the commercial programme.

A wide range of work is undertaken in the fields of mechanical, electrical/electronic and chemical engineering. Close links are maintained with other groups at Harwell, e.g. the Heat Transfer and Fluid Flow Service (HTFS), and other UKAEA laboratories who have specialist knowledge.

an experimental rig will also be heated by the energy deposited from the absorption of neutrons and gamma-rays. This poses many problems and demands complex calculations to predetermine heating rates, temperatures and stresses in the rig's structure.

Experiments to be installed in a reactor, which are often complex pieces of engineering, must therefore meet very demanding design criteria and employ the highest engineering quality. However, notwithstanding these problems and the constraints of size and shape imposed by the limited access available through the radiation shields of the reactor, a wide range of experiments have been successfully carried out.

model of part of the Joint European Torus vacuum vessel for bake-out simulation, and flow testing of a quarter-scale perspex model of the heavy-water vessel of a Japanese research reactor.

Should consultancy work extend beyond the resources of the Section those of other Divisions at Harwell or other UKAEA establishments are called upon.

The Technical Section maintains a suite of computer programs for use in design calculations and technical assessment work, which are continually improved to meet new requirements.

**Examples of work undertaken by the Section include:**

- Heat flow and temperature mapping in one, two and three dimensions and in steady and transient conditions; problems include combined conduction, convection, and radiation effects.
- Forced and natural convection heat and mass flow with various fluids.
- Hydraulic analysis of closed-loop flow systems.
- Detailed stress analysis, including thermal stress, using inputs from temperature-mapping calculations for metallic and non-metallic structures.
- Nuclear calculations, including neutron activation, activity burden, reactivity absorption, nuclear heating etc.

**Research Reactors Division, Harwell  
offers —**

- Wide-ranging irradiation facilities for —  
experiments  
isotope production  
bulk irradiations
- Over 99% availability of neutron fluxes  
from the two high-flux reactors
- Precise determination of nuclear  
cross-sections in the GLEEP oscillator
- Project engineering service — design,  
manufacture, performance analysis
- Specialist technical services
- System services — instrumentation,  
safety and reliability analysis

*For further information about the Research  
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