CONF-830942--21

Note: This is a preprint of a paper to be presented at The Third Topical Meeting on Fusion Reactor Materials, Albuquerque, New Mexico, September 19-22, 1983 with the proceedings to be published in the Journal of Nuclear Materials. Contents of this paper should not be quoted nor referred to without permission of the authors.

DISCLAIMER

A NATIONAL LOW-TEMPERATURE NEUTRON-IRRADIATION FACILITY

R. R. Coltman, Jr., C. E. Klabunde, and F. W. Young, Jr.

CONF-830942--21

DE84 000729

SOLID STATE DIVISION
OAK RIDGE NATIONAL LABORATORY
Operated by
UNION CARBIDE CORPORATION
FOR
U. S. DEPARTMENT OF ENERGY

AUGUST 1983

A NATIONAL LOW TEMPERATURE NEUTRON IRRADIATION FACILITY*

R. R. Coltman, Jr., C. E. Klabunde, and F. W. Young, Jr.

Oak Ridge National Laboratory, Oak Ridge, Tennessee 37830

The Materials Sciences Division of the United States Department of Energy will establish a National Low Temperature Neutron Irradiation Facility (NLTNIF) which will utilize the Bulk Shielding Reactor (BSR) located at Oak Ridge National Laboratory. The facility will provide high radiation intensities and special environmental and testing conditions for qualified experiments at no cost to users. This report describes the planned experimental capabilities of the new facility.

1. INTRODUCTION

In accordance with the recommendations of a Working Group on Low Temperature Neutron Irradiation,[1] and after considering its programmatic needs, the Division of Materials Sciences of the United States Department of Energy has decided to establish a National Low Temperature Neutron Irradiation Facility (NLTNIF). The report specifically noted the need for a low temperature neutron irradiation facility in the development of materials for fission and fusion reactor technologies and in fundamental radiation effects research. The goals for the NLTNIF are to provide a combination of high radiation intensities and special environmental and testing conditions that have not been previously available in the U. S. The Bulk Shielding Reactor (BSR) at Oak Ridge National Laboratory has been chosen as the site for the new facility, which will be available for qualified experiments at no cost to users.

2. THE BULK SHIELDING REACTOR

The core of the BSR is a rectangular array of square fuel elements resting upon a grid plate which is supported by a bridge and carriage assembly that allows the core to be positioned at almost any location in a 6 x 12 m open pool of demineralized water. The exposed core is fully accessable on three faces. The reactor can be operated for indefinite periods at any power up to 2 MW. At full power the fast neutron flux at an in-core position intended for the NLTNIF's use will be of the order of $1.5 \times 10^{17} n/m^2$ ($E > 0.1$ MeV). Primary control of the BSR is available for the operation of the NLTNIF.

Two features of the BSR will aid NLTNIF experimenters. First, the core fuel loading provides sufficient excess reactivity to permit restarting after any operating history - xenon poisoning is not an operational limitation. This is an asset for experiments that require frequent on-off reactor operations. Second, the open pool provides the opportunity to construct almost unlimited ambient and cryogenic storage facilities for radioactive experiment assemblies and specimens. Such facilities will be located close to the irradiation cryostat, and they make use of pool water for biological shielding.

3. LOCATION OF THE IRRADIATION CRYOSTAT

Figure 1 shows a sketch of the irradiation

*Research sponsored by the United States Department of Energy under contract W-7405-ENG-26 with Union Carbide Nuclear Corporation.

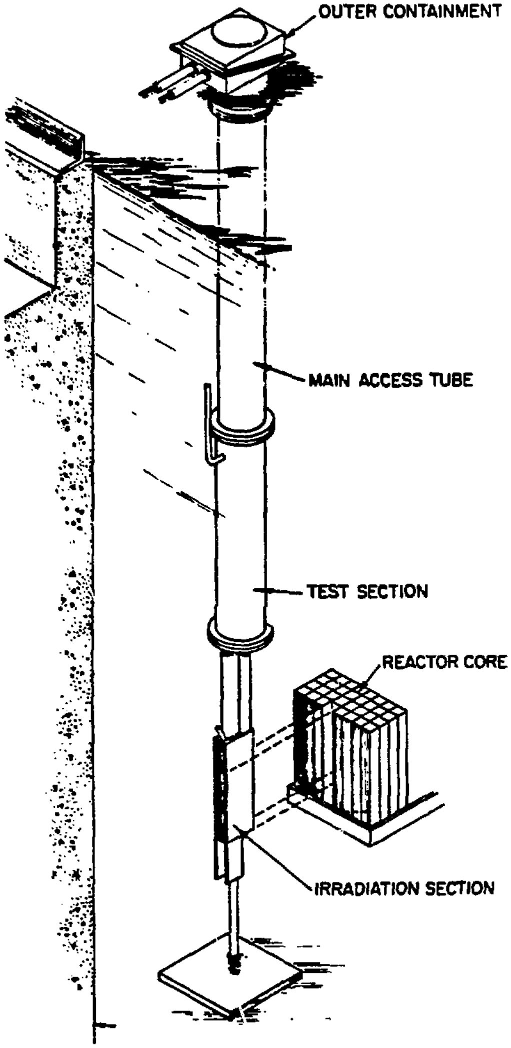

FIGURE 1
A sketch of the NLTNIF cryostat and its relationship to the BSR pool and reactor core.

cryostat and its relationship to the BSR pool and the reactor core. The lower end of the cyrostat is a rectangular parallelepiped which fits into a vacant fuel element position when the reactor is moved towards the cyrostat.

This design has two advantages for experimenters. First, many in situ postirradiation studies must be made in the absence of residue nuclear heating. With the BSR there is no delay for core decay since the core can be moved out of radiation range of the cyrostat within a few minutes after shutdown. Second, because of the mobility of the core and its accessibility, radiation-modifying devices can be moved easily in and out of position between the fixed cryostat and a core face. Such devices will provide modified fast neutron spectra, highly thermalized neutrons or other special radiation conditions at the cryostat.

4. PLANNED CAPABILITIES OF THE NLTNIF

In the primary cryostat, irradiation temperatures from 3.5 to 500 K can be obtained; irradiation at temperatures up to 800 K can be realized in an auxiliary facility. The primary irradiation zone will be 40 mm diam. x 250 mm long. Located 1.5 m above the irradiation zone will be a 200 mm diam. x 300 mm long test chamber into which specimens can be moved without warmup. The test chamber can be equipped with devices for property change measurements; for example, a 12 Tesla magnet. Provisions will be made for the transfer of specimens at 4.2 K into test devices or into vessels for shipment to other laboratories. On-line data acquisition and computer capability will be provided.

Designs for this facility are now being prepared; it is scheduled that the NLTNIF will be in operation late in 1985. Researchers interested in using the NLTNIF should contact one of the authors.

5. REFERENCES

1. "Report of the Working Group on Low Temperature Neutron Irradiation," U. S. Department of Energy, DOE/ER-0136, July 1982.