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International Cooperation at RTNS-II

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Lawrence
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International Cooperation at RTNS-II*

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Presented to

Committee on International Cooperation in Magnetic Fusion

WORKSHOP ON INTERNATIONAL COOPERATION IN MAGNETIC FUSION

SECOND WORKSHOP

Lawrence Livermore National Laboratory
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The RTNS-II Facility

The Rotating Target Neutron Source-II (RTNS-II) facility at LLNL is a unique materials-test facility. It provides the most intense source of 14-MeV neutrons in the world. Dedicated operation in support of the fusion-materials-research community began in early 1979. Three years later, the Japanese Ministry of Education, Science, and Culture (Monbusho) and the U.S. Department of Energy agreed to jointly support the RTNS-II operation and to share in the use of the facility.

The RTNS-II contains two independent sources of 14-MeV neutrons. In each, an air-insulated, 400-kV Cockcroft-Walton accelerator produces a deuteron beam that is transported to a target room. There, the beam is focussed onto a 1-cm-diameter spot on a rotating, water-cooled target. This target, constructed from a copper alloy coated with titanium tritide, is 50 cm in diameter, rotates at 5000 rpm, and lasts for 100 hours. Samples are placed as near as is practical to the rotating target for irradiation.

Radiation Effects Studies at RTNS-II

The major role of RTNS-II in the fusion materials program is the study of spectral effects and to aid in the development of models of material response to neutron exposure. A significant contribution is also made in acquisition of engineering data for reactor sub-systems in which end-of-life doses are low and in experiments which support near-term machines.

Substantial progress has been made in understanding fusion neutron effects. Cryogenic measurements of resistivity have established damage production rates in metals for a wide range of atomic number. It is now well established that high energy primary recoil atoms create a damage cascade consisting of multiple lobes or branches. The survival rate (at 4K) of defects in cascades as a function of total cascade energy is known for copper and by analogy for other simple FCC metals. A reasonable understanding of the neutron response of superconductors and copper stabilizer is emerging. Recently, program emphasis is shifting to insulators and to mechanical properties of metals and alloys.

Japan/U.S. Cooperation

By 1981, a unique opportunity existed at RTNS-II for international cooperation. RTNS-II was the only dedicated fusion irradiation facility in the world and it was not fully utilized. Limited funds and other program priorities had permitted operation of only one of the two neutron sources by the U.S. fusion materials program. Interest in fusion materials research in the rest of the world was growing, especially in Japan where the national commitment to fusion was being strengthened.

Conversations and negotiations eventually led to an exchange of letters between the U.S. DOE and Monbusho in Japan. The Letter of Understanding provided for joint funding and shared utilization. Monbusho established post-irradiation test capability at RTNS-II and assigned Japanese materials scientists to the joint project.

The Letter of Understanding established an RINS-II Steering Committee composed of two U.S. and two Japanese members. The Steering Committee reviews and approves the program of work, the experiments to be conducted, as well as the operations and development plan for RINS-II. Meetings have been held about every six months.

Successful execution of this joint project has relied heavily on one person in each country designated as point-of-contact. These people, Don Doran, Westinghouse Hanford and Kenji Sumita, Osaka University, serve as a clearing office for irradiation requests and are our major interface with the materials research community.

In thinking back over the events which led to joining with Japan in the RINS-II project, it seems remarkable to me that it ever actually came to pass. There are so many cultural, political and institutional barriers to overcome that the odds seem low even when cooperation is to everyone's advantage. We spent hours discussing patents. One (almost humorous) example of an unforeseeable difficulty was the timing of payments. After discussions had progressed for several months, it was discovered that DOE required money before any work could begin and Monbusho had an equally ironclad rule that payment could be made only after work was completed. The method devised to overcome the hurdle demonstrates that the people involved are more flexible than their institutions.

Impact of International Cooperation

From the point of view of RINS-II Facility Manager, the most important result of the "internationalizing" of RINS-II has been its survival. It is doubtful that the Facility could operate today if financial support were limited to the present DOE budget. The high fixed costs of operation result in a situation where the increment in budget provided by Japanese support make a large difference in our capacity to produce neutrons and to support the materials research conducted here.

The flavor of our Japanese partners approach to fusion materials research differs from ours. Monbusho supports the national university system of Japan. The Japanese researchers involved in this joint program come from Japanese Universities. The Japanese effort utilizes many people with diverse interests. They have five times as many scientists conducting RINS-II experiments as we do. Japan has adopted a broad and fundamental approach emphasizing basic understanding. The range of materials studied is large. This contrasts with and complements the focussed shorter term emphasis of the U.S. program.

Collaboration improves the quality of experiments. Joint work is receiving a wider range of peer review and results in increased discussion. This results in better utilization of neutrons, more diversity in materials studied, and greater innovation in experiment design.