

STATUS OF DOE/JAERI COLLABORATIVE PROGRAM PHASE II AND PHASE III CAPSULES –
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OBJECTIVE

The objective of the High Flux Isotope Reactor (HFIR) irradiations is to determine the response of various U.S. and Japanese structural alloys with different pretreatments and alloy compositions to the combined effects of displacement damage and helium generation.

SUMMARY

During this reporting period, the HFIR-MFE-RB-200J-1 and HFIR-MFE-RB-400J-1 spectrally tailored capsules were disassembled and the individual specimens recovered, sorted, and identified. Tensile testing and irradiation creep measurements will be performed during the next reporting period.

PROGRESS AND STATUS

Table 1 summarizes the progress and status of the capsules involved in the DOE/JAERI Phase II and Phase III irradiation programs. Details of the capsule design, assembly, and operation, specimen matrices and testing, and alloy compositions can be found in previous reports in this series. The locations of some of the more detailed reports are shown in the table, but this is not intended to be an exhaustive list.

The JP series HFIR target capsules (JP9-16, 20-22) contain primarily transmission electron microscopy disks (TEM) and SS-3 flat tensile specimens. A wide variety of alloys and thermomechanical conditions are included. Many of the TEM disks were made from isotopically tailored alloys to produce a range of He/dpa ratios (<0.1, 10, 20, 70 appm/dpa). The specimen temperatures are 300, 400, 500, and 600°C and the dose levels are 8, 18, 34, and 57 dpa.

The RB-60J-1, 200J-1, 330J-1, and 400J-1 experiments are a continuation of the Oak Ridge Research Reactor (ORR) spectrally tailored experiments. The capsules operated in the RB positions of the HFIR surrounded by a hafnium shield to simulate the expected fusion helium to damage (He/dpa) ratio in steel. The doses shown in the table are in addition to the 7 dpa accumulated during the ORR irradiation, bringing the total for the two-stage irradiation to 16-19 dpa. Dosimetry and helium measurements from specimens from the 60J-1 and 330J-1 capsules indicate that this experiment was successful in producing fusion relevant helium/dpa levels (approximately 11 appm He/dpa). The irradiation temperatures in these experiments were controlled at 60, 200, 330, and 400°C.

The RB-11J and 12J capsules are the first capsules scheduled for assembly in the Phase III program. These capsules will operate in the HFIR RB positions with a thermal neutron shield in place. They will achieve approximately 5 dpa at 300 and 500°C, respectively. The capsules will contain primarily low activation ferritic steel tensile, fracture, and TEM specimens.

The dose levels shown in the table are the peak capsule values achieved at the reactor centerline. The dpa values in the HFIR target are estimated by assuming 0.000873 dpa/MWd. The dpa values in the hafnium-shielded HFIR RB experiments are estimated by assuming 0.000245 dpa/MWd.

While a status of "testing complete" is listed for several of the capsules, it should be noted that data analyses and microscopy examinations are still in progress.

Table 1. Summary of Irradiation Capsule Parameters and Status

Capsule	Primary Research Objectives	Irradiation Start and End; Number of Cycles	Operating Parameters: MWd; dpa; temperature	Status	Most Pertinent Semiannual Report Numbers DOE/ER-0313/xx
JP10 JP11 JP13 JP16	isotopically tailored disks; tensile specimens	start: 7/90 end: 9/91 11 cycles	20161 MWd 17.3 dpa 300-600°C	testing complete	Design: 0313/3 Loading: 0313/5 Operation: 0313/16 Dosimetry: 0313/19
JP14	isotopically tailored disks; tensile specimens	start: 7/90 end: 9/92 21 cycles	38786 MWd 33.9 dpa* 300-600°C	testing complete	Design: 0313/3 Loading: 0313/5 Operation: 0313/16
JP9 JP12 JP15	isotopically tailored disks; tensile specimens	start: 7/90 end: 4/94 35 cycles	64904 MWd 56.7 dpa* 300-600°C	disassembly complete	Design: 0313/3 Loading: 0313/5 Operation: 0313/16
JP17	fracture toughness, tensile, TEM specimens	start: 12/91 end: 2/92 2 cycles	3702 MWd 2.9 dpa 250-300 °C	testing complete	Design: 0313/12 Loading: 0313/12 Operation: 0313/19 Dosimetry: 0313/19
JP18 JP19	fracture toughness, tensile, TEM specimens	start: 8/91 end: 10/91 2 cycles	3575 MWd 2.9 dpa 60-125°C	testing complete	Design: 0313/11 Loading: 0313/11 Operation: 0313/19 Dosimetry: 0313/19
JP20	isotopically tailored disks; tensile specimens	start: 12/93 end: 6/94 5 cycles	9367 MWd 8.2 dpa* 300-600°C	disassembly complete	Design: 0313/12 Loading: 0313/15 Operation: 0313/18
JP21	isotopically tailored disks; tensile specimens	start: 12/93 end: 4/95 11 cycles	21337 MWd 18.6 dpa* 300-600°C	irradiation complete	Design: 0313/12 Loading: 0313/15 Operation: 0313/18
JP22	isotopically tailored disks; tensile specimens	start: 12/93 end: 1/96* 18 cycles	38946 MWd* 34 dpa* 300-600°C	irradiation in progress	Design: 0313/12 Loading: 0313/15 Operation: 0313/18
RB-60J-1	spectrally tailored; tensile, creep, TEM specimens	start: 7/90 end: 11/92 24 cycles	44450 MWd 11.6 dpa 60°C	testing in progress	Design: 0313/3, 4 Loading: 0313/4 Operation: 0313/13 Dosimetry: 0313/17
RB-200J-1	spectrally tailored; tensile, creep, TEM specimens	start: 11/92 end: 1/95 20 cycles	37450 MWd 9.2 dpa* 200°C	testing in progress	Design: 0313/3, 6 Loading: 0313/14 Operation: 0313/15, 18
RB-330J-1	spectrally tailored; tensile, creep, TEM specimens	start: 7/90 end: 11/92 24 cycles	44450 MWd 11.6 dpa 330°C	testing in progress	Design: 0313/3, 5 Loading: 0313/5 Operation: 0313/11, 13 Dosimetry: 0313/17
RB-400J-1	spectrally tailored; tensile, creep, TEM specimens	start: 11/92 end: 1/95 20 cycles	37450 MWd 9.2 dpa* 400°C	testing in progress	Design: 0313/3, 6 Loading: 0313/14 Operation: 0313/15, 18
RB-11J RB-12J	spectrally tailored; tensile, fracture, TEM specimens	start: 6/96* end: 4/97* 10 cycles	5 dpa* 300, 500°C	design in progress	

*estimated