

Post-Irradiation Examinations of the Irradiated HANARO Instrumented Capsule(02M-02K) in IMEF

Woong-Sup SONG, Yong-Sun CHOO, Ki-Nam JOO, Wan-ho OH, Seung-Je BAIK, Byung-Ok YOO
 Irradiated Materials Examination Facility, Korea Atomic Energy Research Institute,
 P.O. Box 150, Yuseong, Korea, 305-600

1. Introduction

The PIEs such a transportation, visual inspection, cut and dismantling, specimen classification including neutron monitors are carrying out for the instrumented capsule 02M-02K irradiated at CT test hole of HANARO during 6 days with 144 MWD in IMEF (Irradiation Materials Examination Facility) from the beginning of September, 2004. The neutron fluence of this capsule is predicted to 3.4×10^{19} n/cm² (E>1.0 MeV) assumed to the amount of the lifetime of nuclear reactor. This capsule consists of 5 specimen holders and contains several kinds of specimens- Charpy specimens, PCVN, small tensile specimens, 1/3 size Cv specimens, and small punch specimens- with neutron monitors to research and develop the advanced material characteristics of reactor material. The capsule was cut during 1 hour with Al₂O₃ cutting wheel under condition for chuck in 2.5 rpm, for wheel in 200 rpm with 0.15 mm/min feed. The PIE process is described in detail in this paper.

2. Transportation[3,4]

The instrumented capsule was transported from HANARO pool sites to IMEF by using a 10 ton shipping cask and a 11 ton truck. At cask receiving area of IMEF the shipping cask was unloaded by the 30 ton fixed hoist and loaded to the 30 ton transfer cart to move to intervention area. After unbolting the bolts of upper shock absorber, the shipping cask was transferred into the pool by 30/5 ton overhead crane. As the shipping cask was carefully put on the bottom of pool, the shipping cask cover was opened by special tool and the irradiated capsule was taken out of the cask. The capsule was moved to the basket of the bucket elevator, installed in the pool, and elevated into M1 hot cell. In M1 hot cell the capsule was lifted by the 1 ton in-cell crane and Model E-HDE master-slave manipulators shown in Fig. 1 and transferred to M2 hot cell to cut and dismantle.

3. Visual inspection

The visual inspection of outer shape for capsule was carried out by CCTV and naked eyes. As a result, there were no defects such a crack and a dimple. For a rod tip of bottom of capsule and three(3) branched as well as welded tip rods, the crack and losses were scrutinized by periscope.

4. Cut and dismantling[1,2]

The shape of capsule is cylindrical with 60 mm in outer diameter, 3 mm in thickness and approximately 1,000 mm in length as shown in Fig. 1 and Tab. 1. The material for outer capsule is the STS316. This instrumented material capsule consists of five(5) specimen holders with many kinds of specimens, five(5) insulating materials, five(5) neutron fluence monitors and etc., and each specimen holder is combined with heater lines and thermo-couples.

The top and the bottom parts of capsule were cut by capsule cutting machine as shown in Fig. 2, specially designed for cut the HANARO fuel assembly and capsule irradiated at HANARO. The revolution of wheel and the moving speed was 200 rpm and 0.15 mm/min respectively. It took about one(1) hour to cut completely top and bottom parts of capsule as summarized in Tab.1. After cutting outer capsule, the inner structure was also dismantled specimen holder by specimen holder by specimen holder press machine as shown in Fig. 3. The inserted test specimens were disassembled smoothly by specimen press machine in M5a hot cell.

All fluence monitors were gathered in a vial one by one to maintain the HANARO irradiation history. These are going to be transferred to the outside of M5a hot cell through glove box installed at roof of M5a hot cell. At this place the aluminum shielding cover is to be removed by edge-cutter and transported to the examination facility to analyze the amount of thermal neutron in KAERI

5. Examination

The quantity of V-notched Charpy(Cv) standard specimen is twelve(12). These are going to be tested to obtain the absorbed energy, lateral expansion, and fracture appearance around November, 2004.

The quantity of PCVN specimen is eighteen(18). These are planned to test to obtain raw data for fracture toughness around December, 2004. The quantity of small punch specimen is one hundred and eighty(180). These are difficult to be tested in IMEF, so all specimens are transported to other facility in KAERI. The 1/3 V-notched specimens are sixty(60). These are also to be transported to other facility in KAERI. The small tensile specimens including hardness specimens are planned to move to the other facility in KAERI.

6. Conclusion

The instrumented capsule 02M-02K was transported, inspected, and dismantled except the test in IMEF. All activities were carried out throughout the preserved quality assurance manual and procedure without meeting serious problems such as jamming, vibration and etc.

The tests for Cv and PCVN are planned around November or December in 2004.

Table 1. Specification of Capsule and dismantling condition of capsule cutting machine

Items	Values	Remarks
Material of outer	STS316	
Diameter(mm)	60	
Length(mm)	≈ 1,000	
Chuck(rpm)	2.5 ~ 3.0	
Wheel(rpm)	200	
Feed speed(mm/min)	0.15	
Working time(hr)	1.0	

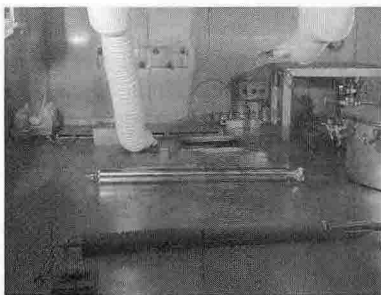


Figure 1. The appearance of 02M-02K transferred from pool to M1 Hot cell.

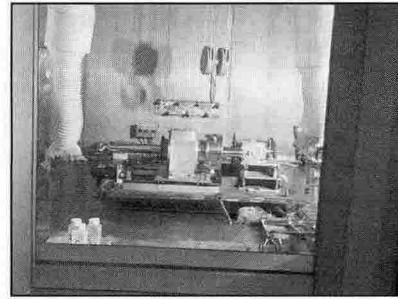


Figure 2. Cut and dismantle 02M-02K by capsule cutting machine in M2 Hot cell.

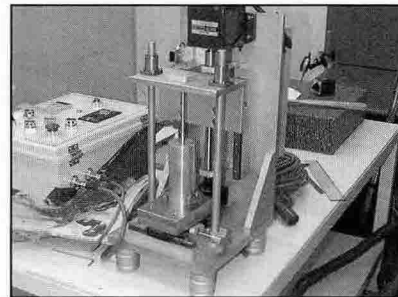


Figure 3. Specimen disassembling from specimen holder by specimen press machine in M5a hot cell.

REFERENCES

- [1] K.N Joo et al., "Design and Fabrication Report on Instrumented Capsule(97M-01K) for Material Irradiation Test in HANARO", KAERI/TR-1226/99, KAERI(1999).
- [2] Y.S Choo et al., "The Development of Dismantling Machine for Capsule and HANARO fuel bundle Irradiated at HANARO", KAERI/TR-1078/98, KAERI(1998)
- [3] Y.S Choo et al., "Post-Irradiation Examination of Nuclear Fuels and Materials Irradiated Capsule at HANARO in IMEF", Proceeding of KNS Autumn Meeting, Oct.25-26, 2002.
- [4] Y.S Choo et al., "The Status of Post Irradiation Examinations of HANARO Non-instrumented and Instrumented Capsules for Advanced Nuclear Fuels and Structural Steels in IMEF", Proceeding of KNS Spring Meeting, May.27-28, 2004.