A Newly Developed Technique of Wireless Remote Controlled Visual Inspection System for Neutron Guides of Cold Neutron Research Facilities at HANARO

Hyung Huh*, Yeong Garp Cho, Jong In Kim
Korea Atomic Energy Research Institute, Research Reactor Design & Engineering Div.
10450 Deodeok-daero, Yuseong-gu, Daejeon, 305-353, Korea
*Corresponding author: hhuh@kaeri.re.kr

1. Introduction

KAERI developed a neutron guide system for cold neutron research facilities at HANARO from 2003 to 2010. In 2008, the old plug shutter and instruments were removed, and a new plug and primary shutter were installed as the first cold neutron delivery system at HANARO.

At the beginning of 2010, all the neutron guides and accessories had been successfully installed as well.

The neutron guide system of HANARO consists of the in-pile plug assembly with in-pile guides, the primary shutter with in-shutter guides, the neutron guides in the guide shielding room with secondary shutter, and the neutron guides in the neutron guide hall.

Three kinds of glass materials were selected with optimum lengths by considering their lifetime, shielding, maintainability and cost as well.

Radiation damage of the guides can occur on the coating and glass by neutron capturing in the glass. It is a big challenge to inspect a guide failure because of the difficult surrounding environment, such as high level radiation, limited working space, and massive hard work for removing and reinstalling the shielding blocks as shown in Fig 1.

Therefore, KAERI has developed a wireless remote controlled visual inspection system for neutron guides using an infrared light camera mounted on the vehicle moving in the guide.

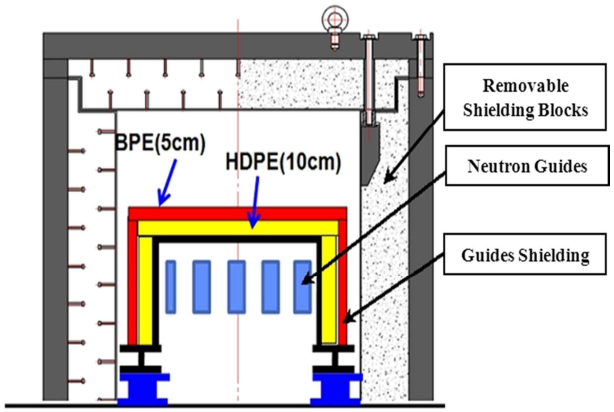


Fig. 1. Cross-sectional view of the neutron guides.

2. Neutron Guide Visual Inspection System

A neutron guide visual inspection system consists of a wireless video transmitter-receiver using infrared camera, and a wireless remote controller for vehicle moving in the guide.

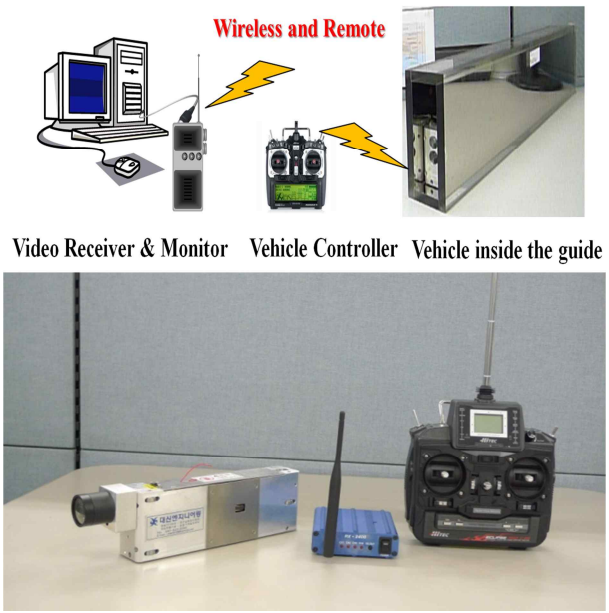
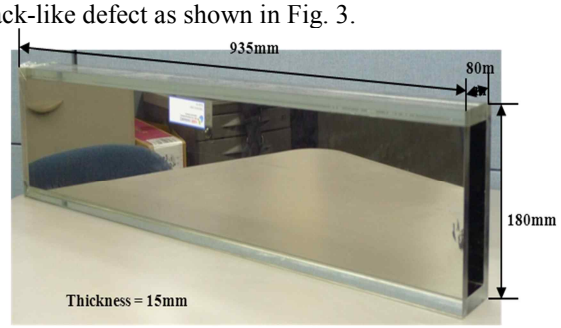


Fig. 2. A detailed view of the neutron guide visual inspection system.

3. Experimental Results

3.1 Neutron guide Specimen

A neutron guide specimen is 80 mm wide, 180 mm high and 935 mm long. There are several artificial flaws in the specimen, such as Ni-coating exfoliations and crack-like defect as shown in Fig. 3.



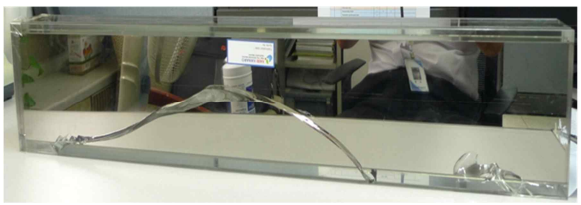


Fig. 3. The dimension of NG specimen.

3.2 Results

A neutron guide visual inspection system has managed to capture Ni-coating exfoliations and crack-like defects of the NG specimen as shown in Fig. 4 and Fig. 5.

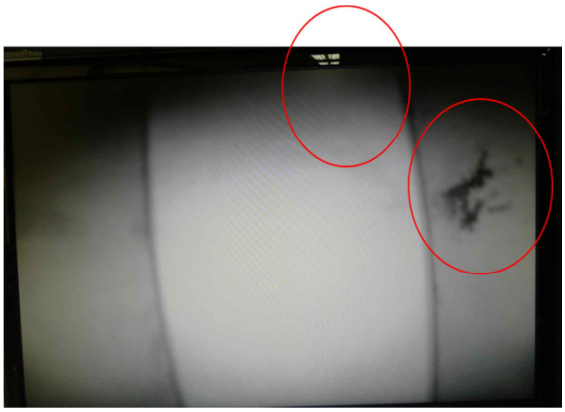


Fig. 4. A wide angle shot of NG Ni-coating exfoliations which are detected from NG visual inspection system.

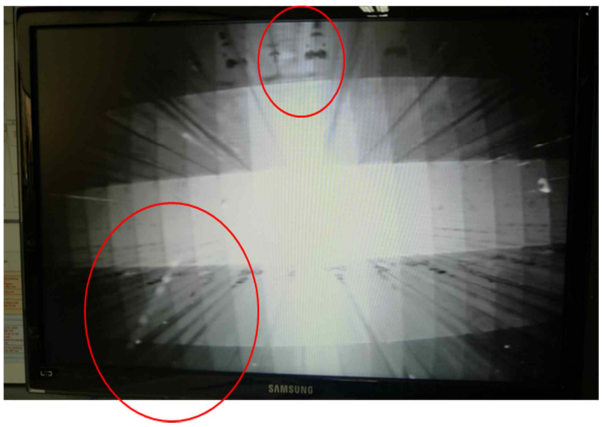


Fig. 5. A wide angle shot of NG crack-like defects which are detected from NG visual inspection system.

3. Conclusion

The main results from development of wireless remote controlled visual inspection system are as follows:

(1) A prototype of wireless remote controlled system for visual inspection of neutron guide has been developed.

(2) A newly proposed system aims at detecting classes of surface flaw, such as Ni-coating exfoliation and crack-like defect.

(3) This proposed system does not need any special illumination system since the inspected images are acquired by infrared digital camera.

(4) This system could contribute to the automated and low cost visual inspection for neutron guide.

REFERENCES

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[2] J.W. Shin and Y.G. Cho, "Method for a neutron guide alignment in guide cassette using a laser tracker," Transaction of the KNS Autumn Meeting, pp. 645-646, 2008