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Construction of a Fast Neutron Generation Facility

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1. Introduction

The fast neutron generation facility based on a recently developed D-D neutron generator [1] is constructed at Seoul National University. The fast neutron generation facility will be used for the research and the education of undergraduate and graduate students. In this paper, the procedure of the constructing of the fast neutron generation facility is described.

2. Shielding and installation of neutron generator

The layout of the fast neutron generation facility is shown in Fig. 1. The fast neutron generation facility is allocated at the basement, whose dimension is 910 cm(L)×670 cm(W)×225 cm(H). The facility is divided into two compartments of fast neutron generation and nuclear detection. The D-D neutron generator is installed in the fast neutron generation section, being enclosed with the polyethylene(PE) and the borated polyethylene(BPE). The thickness of PE panels, BPE panels and the lead-lined concrete wall and the result of radiation dose rate calculation are described in a recent research meeting [2]. The neutron shield is constructed by laying the PE panels and BPE panels in the steel frame and covering with thin Al plates. Two neutron-shielding doors are opened horizontally by sliding. The lead-lined concrete wall is constructed by attaching lead plates to the concrete wall which is supported by steel frame and steel plates. Subsidiary equipments like control panels of D-D neutron generator, neutron detection modules and water chiller for cooling the generator are installed at the operation section which is allocated at the ground floor. An electronic thermo-hygrostat is installed at the fast neutron generation section in order to circulate air and maintain the temperature and humidity inside the facility. The neutron shield, the D-D neutron generator and subsidiary equipments are shown in Fig. 2.

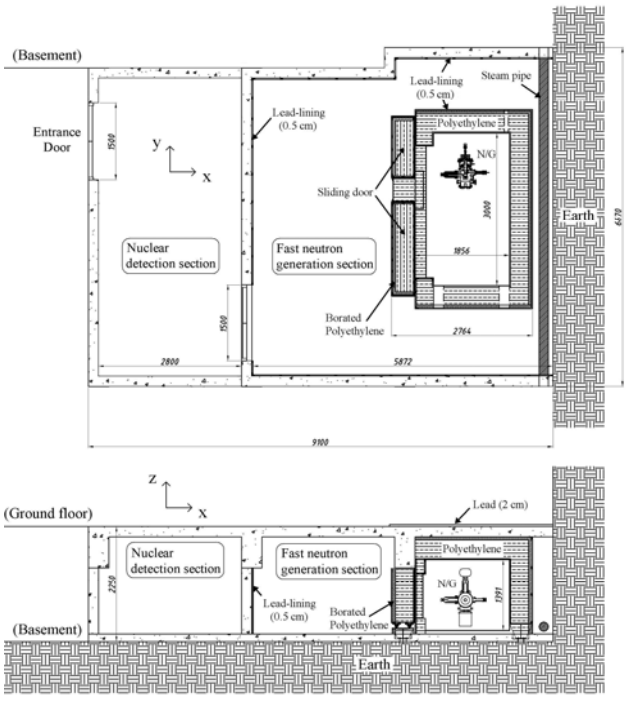
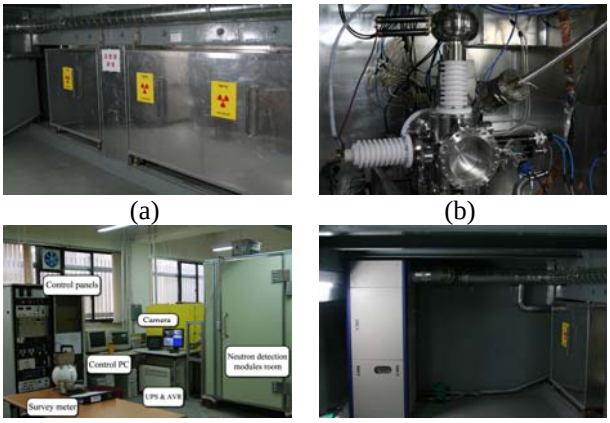


Fig. 1. Layout of the fast neutron generation facility (N/G : neutron generator)



(a) (b) (c) (d)

Fig. 2. (a): neutron shield, (b): installed neutron generator, (c): subsidiary equipments at the operation section (ground floor), (d): electronic thermo-hygrostat

3. Installation of the security and safety system

Flashing lights, cameras, limit switches, neutron area monitor, gamma area monitor, neutron survey meter, gamma survey meter, hydrogen gas leak detectors and fire alarms are installed as the security and safety system. Position of the security and safety system is shown in Fig. 3. Flashing lights are installed in front of the main entrance door of facility and the door between the fast neutron generation section and the nuclear detection section to warn the operation of D-D neutron generator. Four cameras are installed to watch the intrusion of outsiders and check the condition of neutron generator during the neutron generation. During the neutron generation, two entrance doors are locked with key. Limit switches are installed at the sliding neutron shielding doors. If the neutron shielding door is opened, the neutron generation will be stopped immediately. Neutron and gamma area monitors are

installed at the fast neutron generation section to monitor the radiation dose rate inside the facility, and hydrogen leak detectors and fire alarms are installed. The security and safety system is shown in Fig. 4.

4. Permission to use the neutron generator

After the construction of neutron generation facility, the facility inspection is performed by the Korea Institute of Nuclear Safety. Accordingly the official permission to use the D-D neutron generator is followed. In the facility inspection, the construction according to radiation shielding design, the installation of security and safety system and warning sign are checked. Also the radiation dose rate is measured by using survey meters under the neutron generating with an intensity of 1.2×10^{8} n/s. Measured radiation dose rate of neutron and gamma is below 1.0 μSv/h and it does not exceed 2.5 μSv/h which is the dose limit in the area adjacent to the boundary of the facility.

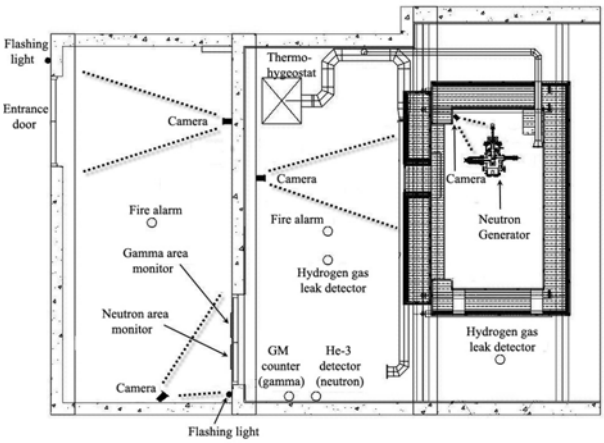
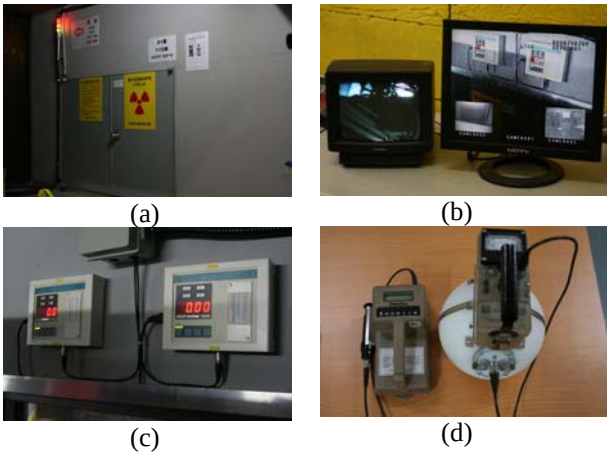


Fig. 3. Security and safety system of the fast neutron generation facility



(a) (b) (c) (d)

Fig. 4. The security and safety system; (a): flashing light in front of main entrance door, (b): camera monitor, (c): neutron and gamma area monitor, (d): neutron and gamma survey meter

5. Conclusion and further work

Construction of a fast neutron generation facility is completed. Radiation shielding structure is constructed according to the design. The D-D neutron generator, subsidiary equipments and the security and safety system are installed. The permission to operate and use the D-D neutron generator is issued and the D-D neutron generator is now applied for studies. Thermal neutron and fast neutron irradiation devices are being developed.

ACKNOWLEDGEMENTS

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REFERENCES

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[2] N.S. Jung and H.D. Choi, Radiation Shielding for the Fast Neutron Generation Facility, Transactions of the Korean Nuclear Society Spring Meeting, May 28-30, 2008, Gyeongju, Korea.