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Conceptual Layout of an AHR Building and Facilities

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1. Introduction

A research reactor has been widely utilized in various fields such as industry, engineering, medicine, life science, environment etc., and now application fields are gradually being expanded together with the development of technology. The utilization of research reactor is related to necessary and essential technologies of IT, NT, BT, ET and ST.

KAERI has considerable experiences on research reactor technology through the TRIGA MK II, TRIGA MK III, and the HANARO. They have largely contributed to the development of nuclear technology and lead to the nuclear industry. Through the design, construction, operation and utilization of these research reactors, lots of human resources have been developed and the basic and applied technologies in nuclear research fields have been developed step by step. In particular, the HANARO (High-flux Advanced Neutron Application Reactor) of 30MWth [1], which began to operate from 1995, is a landmark and a nuclear milestone in Korea. The design, construction and operation of the HANARO has allowed for a large progress in the research reactor technology. The active uses of many experimental facilities in the HANARO have enhanced the advancement of nuclear technology and spread the benefits of nuclear R&D results.

KAERI is preparing for another leap, i.e., incorporating the experience and nuclear technology accumulated during the design, construction, operation and utilization of the HANARO. KAERI also has human resources who have comprehensive experiences in the design, construction, commissioning, operation and utilization of a research reactor through the HANARO project. Hence, based on such considerable experience and human resource, an advanced HANARO research reactor (AHR) is being developed by KAERI for the future needs of research reactors [2]. Its overall concept is basically similar with the HANARO, but a much improved one. The AHR will be a light water cooled and heavy water moderated and reflected pool type research reactor with a 20 MWth.

In this study some descriptions on the conceptual layout and basic design features of the reference AHR building and facilities with a 20MW are given.

2. Conceptual Layout of an AHR Building and Facilities

The AHR building and facilities consist of a reactor building, a radioisotope production building, irradiated material examination facilities, a CNS building, office building, etc. To verify the conceptual layout design of them, the master plan and bird's eye view drawings were prepared. These layouts are shown in Figure 1 to Figure 4.

The features of the AHR buildings and facilities are as follows; 1) Effective layout to consider the characteristics of a building, 2) Center of the reactor building, 3) Safety door and walkway to access the reactor building, 4) Entrance gate in the south direction, 5) Effective traffic system for staff, visitors, trucks, etc. The front of this layout is a space to install the symbol of a nuclear park and exhibition events. The side and rear of it is the space for parking lots and facilities (electric station, water tank, cooling tower, etc).

The reactor building located in the center of the layout is made of a reinforced concrete structures as a cubic form, which can provide enough and convenient spaces for experiments. It contains the reactor, the reactor and service pools, the spent storage pool, the new fuel storage, the major operation systems, the experimental facilities and spaces, 1 hot cell, the control room and office space, etc. As the building is a final physical barrier to protect the society and environment from a radiological hazard, it is designed to protect the reactor systems from internal and external effects such as a seismic event or an aircraft crash. The reactor concrete island is built using high-density concrete to enhance its efficiency as a radiation shield.

All reactor building rooms are divided into two zones, a controlled access zone and a free access zone. Further measures of a protection include a segregation of active and non-active areas, separation and segregation of redundant components, as well as a strict access control to the containment areas.

This reactor building is a very leak-tight confinement with an emergency ventilation system to vent radioactive gases to a stack through a high efficiency filter during an accident. It is designed as a seismic category I structure. The pressure inside the reactor hall is maintained slightly negative to prevent an uncontrolled release of the rector hall air to the outside environment by a once-through HVAC (heating, ventilation, air conditioning) system during a normal operation.

The control room is located in the office space side, i.e., outside the reactor hall. Work activities near the pool level and important work area are monitored by a remote camera network system. Emergency control room, which is a second control room against emergency events and is remote from the control room, is required to assure a safe shut down of the reactor

when the control room is unavailable due to hazards such as fire, radiation etc.

3. Basic Design Features of an AHR Reactor Building

3.1 Reactor Pool

- Internal pool diameter (m) 4
- Internal pool height (m) 13.4
- Reactor pool volume (m^3) 150
- Power/Pool volume (kW/m^3) 200
- Liner Stainless steel
- Shielding material Pool water and heavy concrete
- Service pool for various works
- Spent fuel storage pool with separate cooling system
- Radiation level over reactor pool < 1.25 mrem/hr

3.2 Reactor Building

- Type Confinement (leak tight)
- Leakage rate 200 m^3/hr (2%V/a day)
- Reactor pool 4 m dia., with stainless steel liner
- Shielded room Housing equipments
- Hot cell 1 hot cell for field work

4. Conclusion

The conceptual layout of the AHR building and facilities including a reactor building, a radioisotope production building, irradiated material examination facilities, a CNS building, an office building, etc was proposed. To verify the conceptual layout design of them, a master plan and bird's eye view drawings were prepared. Reactor building is improved for an easy maintenance by considering the interferences between structures. In a future study, the basic design for them will be performed by considering a more easy and convenient operation and utilization.

Figure 1 Layout of the AHR building and facilities

Figure 2 Bird's eye view of the AHR building and facilities

Figure 3 Front View of the AHR building and facilities

Figure 4 Right View of the AHR building and facilities

REFERENCES

[1] http://hanaro.kaeri.re.kr
[2] C. Park et.al, "Design Approach to the Development of an Advanced HANARO Research Reactor", HANARO symposium, Daejeon, Korea, April, 2005.