# Conceptual Design of Fuel Building of SFR Demonstration Reactor Developed in KAERI

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## 1. Introduction

The conceptual designs of a SFR (sodium-cooled Fast Reactor) and key technological developments were promoted through the Korea national long term R&D projects.

The conceptual design of a SFR demonstration reactor of 600MWe capacity has been developed in 2012 through the project by KAERI[1]. The preliminary general arrangement of reactor building and fuel building have performed taking into account of the layout criteria of main systems, components, transport of equipments, and accessing paths to core assemblies inside the buildings[2].

In this paper, firstly the design concept of the SFR fuel building was explained. Second, the layouts of the main systems, equipments, and wall compartments are shortly described. Third, the import and export paths of the core assemblies to and from the fuel handling and storage buildings are represented and the vertical height variations of the paths are figured out to exam any technical issues. Finally, a three-dimensional conceptual solid model of the fuel handling and storage building was built for checking design availability.

## 2. Design concept of the SFR fuel building

There are distinct differences in fuel building of SFR compared with PWR like as the fuel exchange and storage system, an inert gas supply and processing system, etc. The facilities in fuel building have several kinds of requirements as follows[3];

- General and arrangement requirement
- Transfer requirements
- Civil requirements
- I&C requirements
- Safety requirements

The core assemblies are classified as driver fuel, control, shield and reflector. These are carried by a transfer cask between reactor and fuel buildings. The spent fuel assemblies taking out from reactor are stored in fuel building equipped with a long term cooling system of HVAC, washing and inspection equipments.

## 3. Layouts of the building and main systems

The reactor building arrangement of SFR demonstration building has been updated based on the reactor building of KALIMER-600. The basement area of reactor building is 36m x 52m, the height is 40.8m excluding the stacks. The reactor building is partly underground by about 10m, which is an equivalent level covering the top of reactor core in underground.

The fuel handling and storage building has been designed by using the experiences for PWRs and references of SFRs. The basement area of fuel building is 33.45m x 30.35m, the height is 44.75m.

These two building are seismically isolated by high damping laminated rubber bearings at the basements as shown in Fig.1. The elevation of the rail bridge between the reactor building and the fuel building is at 21.8m above ground.

Usually the spent and new fuel assemblies in SFR are high radiation sources, so they are stored at shield spaces of inert gas environments at underground of fuel building. Three gates are located at the first floor for transferring fuel assemblies to pyroprocess facility, and taking out reactor auxiliary equipments. The transit handling of core assemblies are done on the second floor. The loading and unloading of a transfer cask of core assemblies are performed on the third operating floor, which is connected to the reactor building by a strong bridge with a rail system.

## 4. Paths of core assembly in fuel buildings

When a cask containing new fuel assemblies is arrived at fuel building by a trailer, the cask is lifted up to the third operation floor by a heavy overhead ceiling crane, and the fuel assemblies getting from an open gate of the cask bottom are put down on second floor by an internal crane installed inside the cask. The fuel assemblies are transferred to underground storage rack by a vertical tube connecting basement and the second floor. For loading the core assemblies in reactor, they are loaded in a cask by a reverse operation procedure from a storage rack to the third operation floor, and transferred to the reactor building by a rail carter carrying the cask. The level changes of core assemblies in each fuel handling procedure are shown in Fig.2. The maximum level change of fuel assemblies is about 22m when they pass through the connecting tube between the second floor and the underground basement and a cask is moved by a ceiling crane.

The non-fuel assemblies are temporarily stored on the third floor when they are arrived at fuel building, a similar procedure from an import to loading in reactor is applied and the elevation variation in each step of the assemblies is also shown in Fig.2.

The spent core assemblies are lifted up from reactor through a fuel transfer port by a cask internal crane and loaded into a cask. The cask is transferred to fuel building by a rail cart, the core assemblies are put down on second floor through the bottom gate of the cask. After the assemblies are washed and inspected, then the core assemblies are transferred to underground storage rack by a vertical tube connecting basement and the second floor. For transferring the core assemblies stored at storage racks into a pyroprocess facility, they are lifted up on the second floor and loaded in another cask at first floor. The cask is lifted up to the third floor by a ceiling crane and then loaded on a trailer through a vertically open space at fuel building. The level variation of this procedure is represented in Fig.3.

The spent non-fuel assemblies are stored on the first floor, a similar procedure is applied and the elevation variations during the assemblies handling are also shown in Fig.3.

## 5. Solid modeling of fuel building

The general arrangement of the fuel handling and storage building has suggested[3]. A 3D solid modeling has done by the Autocad Inventor software. The solid model and the internal view of the fuel building are represented in Figs. 4 and 5.

## ACKNOWLEDGEMENT

This study was supported by the Korean Ministry of Education, Science & Technology through its National Nuclear Technology Program.

## REFERENCES

[1] Kim, Young-Il, et al., Conceptual Design Report of SFR Demonstration Reactor of 600MWe capacity, KAERI/TR-4598/2012, 2012.
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[3] Lee, Hee-Do, Conceptual Arrangement Design for a Fuel Building of a Sodium-cooled Fast Reactor, ACT Inc, 2011.

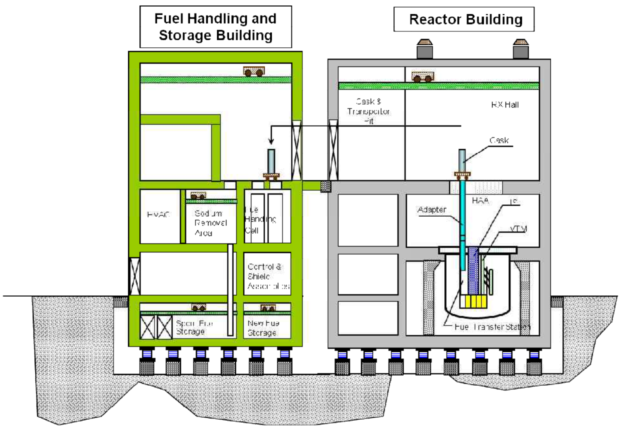


Fig.1 Concepts of Reactor and Fuel Buildings

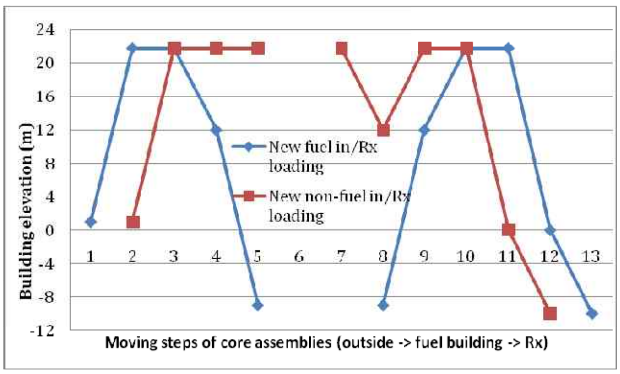


Fig.2 Import and Rx Loading Paths of New Core Assemblies

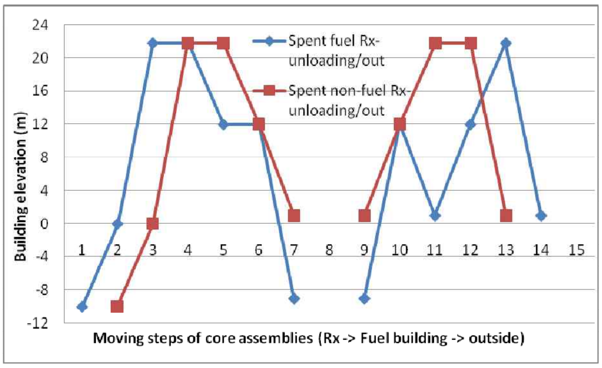


Fig.3 Rx Unloading and Export Paths of Spent Core Assemblies

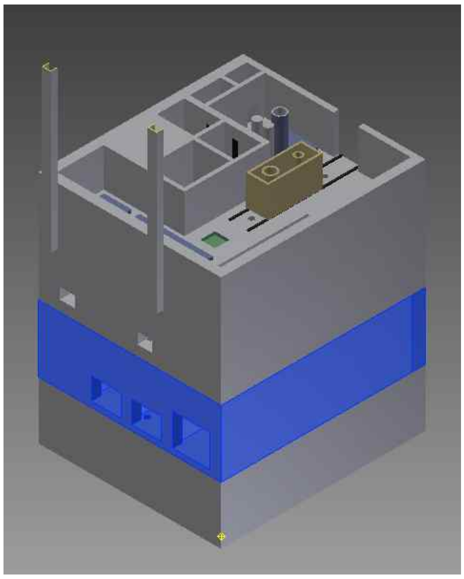

Fig. 4 Solid Models of Fuel Building

Fig. 5 Internal View of Fuel Building