Transactions of the Korean Nuclear Society Spring Meeting
Jeju, Korea, May 19-20, 2022

Preliminary Conceptual Design of In-Vessel Fuel Handling System in SALUS

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1. Introduction

SALUS (Small Advanced Long-cycled and Uranium -fueled SFR) is a long life sodium-cooled fast reactor under preliminary conceptual design by the Korea Atomic Energy Research Institute. The fuel handling method of the SALUS in-vessel fuel handling system was determined by the double rotating plug type [1]. This method handles fuel assemblies inside the reactor using a double rotating plug and two fuel handling machines. The arrangement design was performed for the SALUS in-vessel fuel handling system, and the preliminary conceptual design for driving unit and mechanical elements was performed for structural design of direct-lift machine (DM) not used in PGSFR (Prototype GEN-IV Sodium-cooled Fast Reactor).

2. Preliminary Conceptual Design of In-Vessel Fuel Handling System in SALUS

Fig. 1 shows the configuration for the arrangement design of SALUS in-vessel fuel handling devices. A fixed-arm machine (FM) and a direct-lift machine are installed in a small rotating plug, and the direct-lift machine is designed in consideration of geometric interference with the control rod drive mechanism. The direct-lift machine is located inside the upper internal structure, and vertically withdraws the fuel assembly of the inner core and moves it to the transition region of the reactor core.

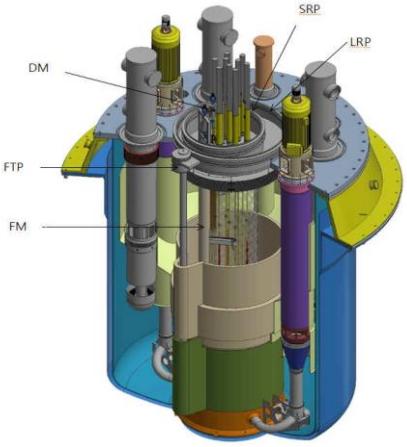

Fig. 1. Arrangement design of in-vessel fuel handling system in SALUS

The fixed-arm machine with a fixed arm rotates at a constant radius and moves the fuel assemblies of the transition region and the outer core to the fuel transfer port. Fig. 2 shows the preliminary conceptual design configuration of the direct-lift machine. As shown in the figure, the direct-lift machine is largely divided into two parts which are a motor driving unit installed on the top of the reactor head and a mechanical device unit installed inside the reactor. The direct-lift machine driving unit determines the performance of the driving unit in consideration of the load capacity, speed, gear reduction ratio, and design dimensions of the mechanical element.

The mechanical device unit driven by receiving power from the upper motor driving unit is composed of mechanical elements such as ball screw shafts and nuts, gears, spline shafts and nuts, spacers, bushings, and bearings. The direct-lift machine has four degrees of freedom operability, such as rotation of the gripper, vertical movement of the gripper, installation and detachment of the gripper fingers, and hold-down movement.

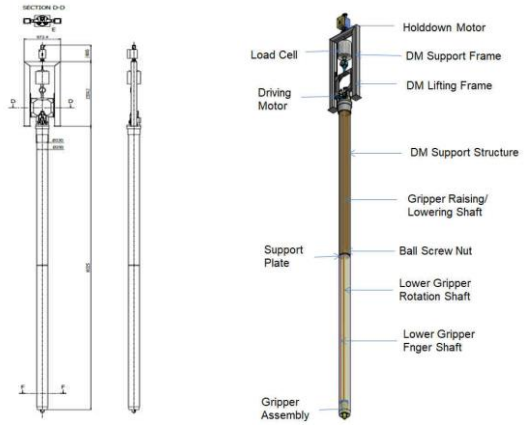

Fig. 2. Preliminary conceptual design of direct-lift machine in SALUS

3. Conclusion

The arrangement design for the SALUS in-vessel fuel handling system and the preliminary conceptual design for the direct-lift machine were performed.

Acknowledgements

This study was supported by the National Research Foundation of Korea grant funded by the Korea government (Ministry of Science, ICT and Future Planning).

REFERENCES

[1] S. H. Kim and C. G. Park, Structural suitability and preliminary conceptual design of fuel handling system for long life reactor, KAERI/TR-9002/2021, KAERI, 2021.