Establishment of i-SMR Fuel Assembly Hydraulic Test Facility

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1. Introduction

Nuclear power industry participants are developing small modular reactors to secure innovative power supply stability and diverse applications[1]. To accommodate these needs, the development of iSMR reactor is currently in progress. As a part of iSMR system, a new type of nuclear fuel is also developed. It is necessary to determine mechanical characteristics, sustainability and compatibility of newly developed nuclear fuels. These characteristics are obtained through mechanical tests performed in test facilities. The concept of a nuclear fuel test facility for underwater conditions is presented.

2. Concept of test facility

In this section some of the test methodologies are described.

2.1 Underwater nuclear fuel test facility

KNF had developed the underwater nuclear fuel test facility (TOFAS-W) in 2019. The test facility consists of pumps, a test section, a heater and a pressurizer. This test facility can provide over 15,000 LPM, 120 ºC and 2 MPa. The test section is designed to accommodate one nuclear fuel for various purposes.

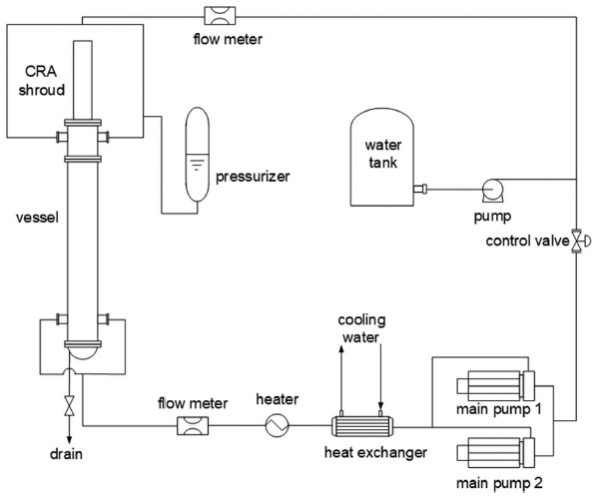

Fig. 1. Flow diagram of nuclear fuel test facility(TOFAS-W).

2.2 Pressure drop, vibration and underwater damping test

To conduct pressure drop, vibration and underwater damping tests, the nuclear fuel should be located in a test section with certain flow area which is the same as fuel pitch. The flow housing provides flow area for a nuclear fuel and restrict the location of the fuel through upper core simulator/lower core simulator.

Differential pressure gauges are used to measure pressure drop across each nuclear fuel component. And accelerometers are used to measure vibration of nuclear fuel. Linear actuator and linear displacement sensors are used for underwater damping test.

2.3 CEA drop test

CEA(Control Element Assembly) insertability is an important feature for both the CEA and the nuclear fuel[2]. It is planned to evaluate the CEA insertability under various conditions. To conduct these tests, KNF has developed a CEA test facility to control CEA position and drop sequence. The CEA test facility simulates core, CEA shroud and CEDM(control element drive module) of iSMR reactor. CEA Drive module is simulated with motor-driven gear system. Total height of the facility is around 12 m.

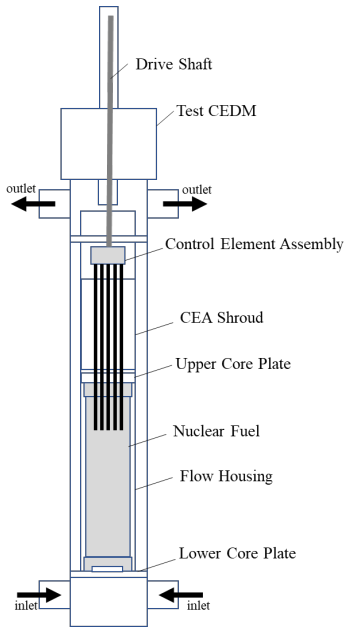

Fig. 2. Concept of CEA drop test facility

Fig. 3. Appearance of CEA drop test facility

3. Conclusions

Newly developed nuclear fuels require tests to verify their mechanical properties. The main underwater fuel tests are pressure drop test for hydraulic characteristics, vibration test for fuel stability and damping test for seismic performances. The underwater test facility for iSMR nuclear fuel has been developed to accommodate these requirements. The test facility will be utilized for pressure drop, vibration, damping, CEA drop and other purposes for iSMR nuclear fuel.

ACKNOWLEDGMENT

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