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Introduction of Facility for Testing of Electromagnetic Flow Rate Transducer in KAERI

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1. Introduction

KAERI (Korea Atomic Energy Research Institute) will perform a test for a thermal hydraulic simulation with the STELLA-1 for a Component Performance Test Sodium Loop in the year 2012 and in the next stage it will test at the STELLA-2 for a Sodium Thermal-hydraulic Experimental Facility [1]. Also, KAERI constructed the facility for testing several instruments, for example, local velocity sensor, magnetic flow meter, induction level sensor, diaphragm pressure transducer and so on.

In this paper we introduce installed instrument, magnetic flow meter, at test facility.

2. Design features

It is necessary to measure the sodium flow rate in the natural circulation loop of the facility in different temperature conditions during experimental investigations. According to the performance specification, sodium temperature can vary in the range of 150~600ºC, and the velocity of sodium flow is in the range of 0.5~80cm/s, which is required in the sodium thermal hydraulic test facility.

The P&ID of the test facility is in Fig.1. The main equipment includes two buffer tanks, a magnetic pump, a cold trap, a plugging meter, a sodium storage tank with 2 tons of of sodium inventory, a vacuum pump for evacuation, an argon gas supply system and sodium valves.

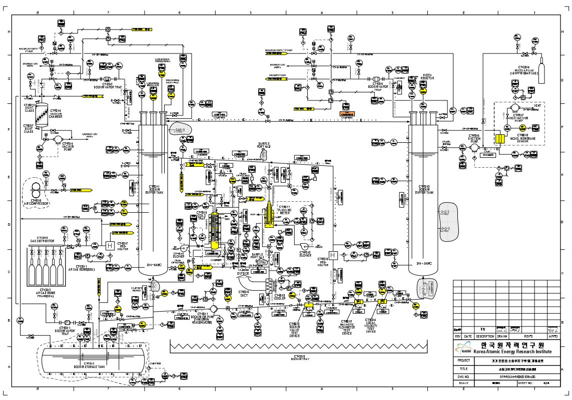


Fig. 1. P&ID of facility for testing of instruments.

3. Construction of Test Facility

In Fig. 2, the facility for testing of the instruments constructed in KAERI is shown.

In this facility, the manufacture and design of the prototypes of instruments for instrument development and measuring methodologies in KAERI were conducted which were then calibrated and tested in a sodium loop manufactured transducers and prototypes in KAERI.

This sodium loop for testing instrument consists of two buffer tanks, a cold trap, a plugging meter, an electro-magnetic pump, and a sodium storage tank containing two tons of sodium. The purification degree of oxygen concentration was about 10~30PPM.

Fig. 2. Facility for testing of instruments.

4. Results and Discussion

4.1Installation of magnetic low meter

The instrument installed in this facility is included with a magnetic flow meter. The magnetic flow meter is installed in Fig. 3.

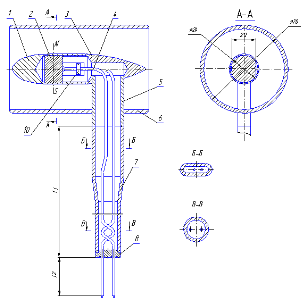
Fig. 3. Magnetic flow meter installed at the facility for instrument testing.

4.2 Design of transducer

In the real construction of transducers [2, 3], a transducer signal corresponds to velocity in an area with less dimension. This area can be defined if the real distribution of the magnetic field is measured, approximated by a proper function, which then can be used for substitution in Eq.1.

Also, the real transducers need experimental calibration because their output signal depends on both conductance of the medium measured (sodium) and pipe material (stainless steel). The conductance of these substances as magnetic induction depends on the temperature. In addition, because precise measurement of the magnetic induction in the area near small dimension magnets is practically difficult, calibration of transducers is required as well.

The transducer of a sodium low-flow rate design is presented in Fig. 4.



1- cowling, 2-magnet, 3-stem, 4-electrode, 5-support, 6-pipe, 7-extender, 8-plug, 10-clincher

Fig. 4. Drawing of magnetic flow meter.

4.3 Fabrication of transducer

The transducer consists of two details: cowling (1) and stem (3). A nearly cylindrically shaped permanent magnet (2) of the ALNICO alloy is located inside the cowling.

Fig. 5 is the transducer fabricated in KAERI. This transducer was installed in the test facility of KAERI for calibration of several kinds of sensors.

The transducer was fabricated with a magnet of ALNICO 9. The dimension of the previously designed size is applied.

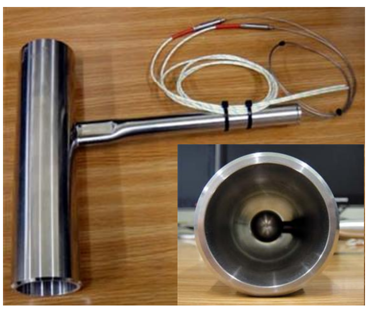


Fig. 5. The fabricated transducer of low flow meter in KAERI.

5. Conclusion

A magnetic flow meter having measurement uncertainty of the flow rate transducer within ± 1.9% was installed in the test facility in KAERI. Again, the measurement uncertainties will be measured experimentally, carried out within a range of 150 ºC to 600 ºC.

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