

## Profile LFR-54

### IMMORTAL

### JAPAN

#### GENERAL INFORMATION

NAME OF THE FACILITY	Integrated Multi-functional Mockup for TEF-T Real-scale Target Loop
ACRONYM	IMMORTAL
COOLANT(S) OF THE FACILITY	LBE
LOCATION (address):	2-4, Oaza-Shirakata, Tokai, Naka, Ibaraki, Japan
OPERATOR	JAEA
CONTACT PERSON	Hironari Obayashi
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<b>STATUS OF THE FACILITY</b>	In operation
Start of operation (date):	2015

<b>MAIN RESEARCH FIELD(S)</b>	<input type="checkbox"/> Zero power facility for V&V and licensing purposes
	<input type="checkbox"/> Design Basis Accidents (DBA) and Design Extended Conditions (DEC)
	<input checked="" type="checkbox"/> Thermal-hydraulics
	<input type="checkbox"/> Coolant chemistry
	<input checked="" type="checkbox"/> Materials
	<input checked="" type="checkbox"/> Systems and components
	<input checked="" type="checkbox"/> Instrumentation & ISI&R

#### TECHNICAL DESCRIPTION

##### Description of the facility

This is a demonstration test loop with same configuration/components of the primary cooling system of TEF target experimental facility. All component are actual scales, except a temperature conditioner simulating heat generation by the incidence of proton beam. Main components are as follows.

- **Target head**
- **Surge tank**
- **Continuous liquid level gauge**
- **Oxygen sensor and oxygen control unit**
- **Heat exchanger**
- **Filter**
- **Electromagnetic pump**

- Ultrasonic flowmeter
- Drain tank
- Temperature conditioner

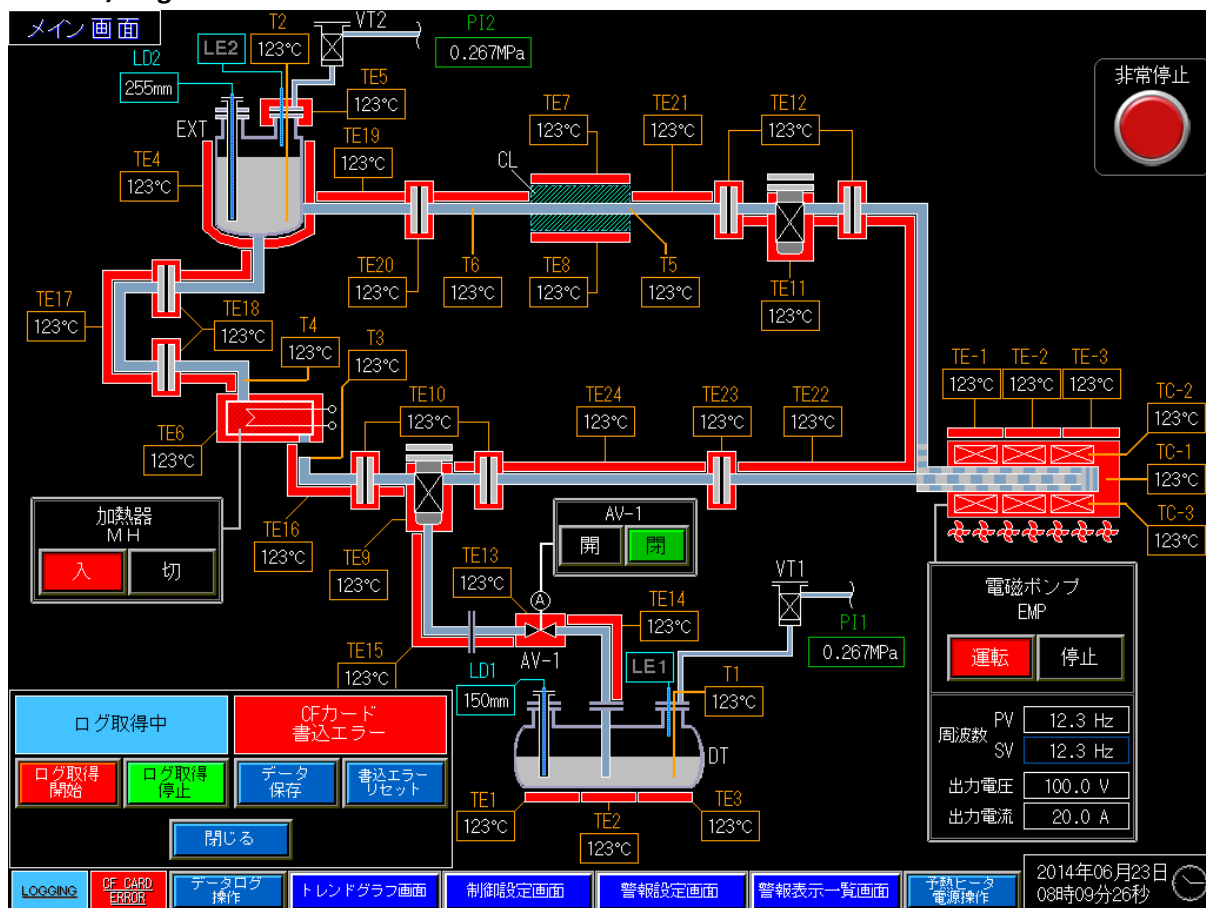
This loop is driven by an electromagnetic pump (EMP), and the reference flow rate is monitored by an ultrasonic flowmeter. Inventory of LBE is 260 liter, and maximum flow rate is 120 liter/min.

Temperature range is 200-500 °C and  $\Delta T$  is 100 °C. The Overall size of this loop is approximately 8000×3500×5000(D/W/H) mm.

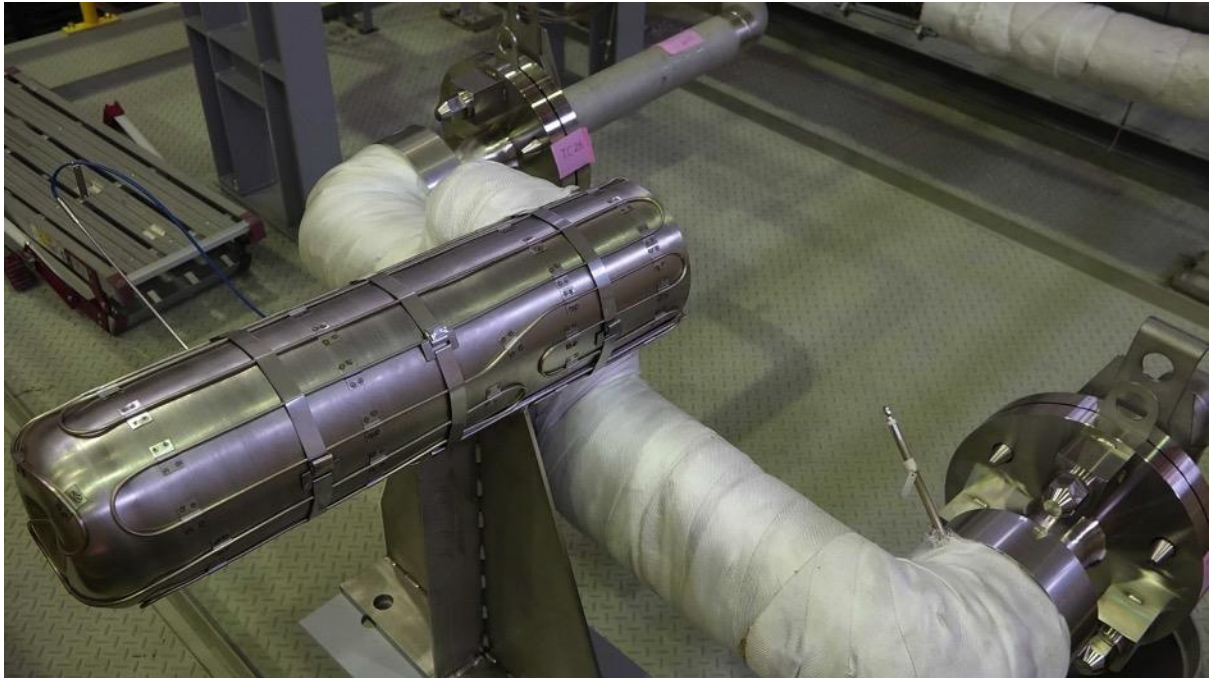
### Acceptance of radioactive material

No

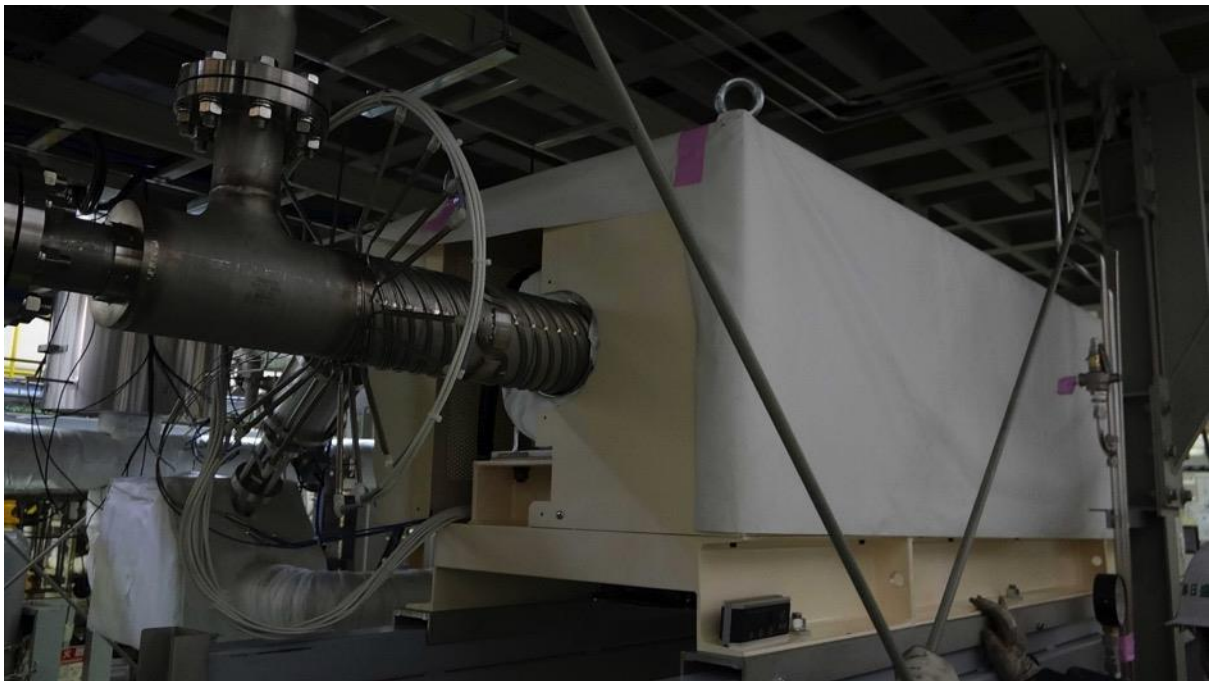
### Scheme/diagram



### 3D drawing/photo



**Fig. 1 Photo of Target head**



**Fig. 2 Photo of electromagnetic pump**



**Fig.3 Photo of temperature conditioner**



**Fig.4 Photo of heat exchanger**





Fig. 5 Photo of panoramic view

**Parameters table**

Coolant inventory	2660 kg
Power	<a href="#">Click here to enter text.</a>
Test sections	
TS #1	<u>Characteristic dimensions</u> Diameter of main pipe → 76.3 mm Overall size of target head → $\phi 150 \times 600$ mm EMP (D/W/H) → 1800×750×750 mm Heat exchanger unit → Fin-tube type, $\phi 165 \times 2400$ mm, 67kW Temperature conditioner → $\phi 210 \times 2100$ mm, 67kW Overall size of loop (D/W/H) → 8000×3500×5000 mm
	<u>Static/dynamic experiment</u> Dynamic experiment
	<u>Temperature range in the test section (Delta T)</u> Temperature range → 200-500°C Delta T → about 100°C
	<u>Operating pressure and design pressure</u> Operating pressure → max. 0.1MPa (gauge) Design pressure → 0.5 MPa (gauge)
	<u>Flow range (mass, velocity, etc.)</u> 0-120 liter/min, Maximum velocity in the target head of about 2.4 m/s
Coolant chemistry measurement and control	Oxygen concentration are measured and controlled.

(active or not, measured parameters)	
Instrumentation	Thermocouples, Gas pressure gauge, Ultrasonic flow meter, Pressurized water-cooled heat exchanger, Continuous level gauge, Temperature conditioner. Oxygen control unit(planning), Liquid pressure gauge(planning)

### **COMPLETED EXPERIMENTAL CAMPAIGNS: MAIN RESULTS AND ACHIEVEMENTS**

The conditioning test was completed. Functional tests have already been performed, and it has been confirmed that elemental components such as EMP and various instrumentation functions sufficiently under temperature condition up to 500°C. As a result of the application test on the large flow rate condition of prototypical ultrasonic flowmeter, it showed sufficient performance to apply TEF facility. During the experiment, flow coast-down behaviour was measured.

### **PLANNED EXPERIMENTS (including time schedule)**

- Verification of primary cooling system in TEF target facility (2015-)
- Assessment of thermal-fluid behaviour in mock-up scale (2015-)
- Production of non-irradiation sample for material experiment in TEF facility (planning)
- Development of ultrasonic flowmeter for high-temperature LBE flow (2015-)
- Measurement of oxygen concentration and development of automatic control system in flowing LBE by using oxygen sensors (2020-)
- Development of LBE technologies including remote operation procedure(2015-)
- Acquire V&V data for safety analysis code (2019-)

### **TRAINING ACTIVITIES**

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### **REFERENCES (*specification of availability and language*)**

H.Obayashi, M.Hirabayashi, T.Wan and T.Sasa: Experimental Application of Ultrasonic Flowmeter for TEF-T LBE Spallation Target System, Proc. of NURETH-17, 2017.