

Profile LFR-53

JLBL-4

JAPAN

GENERAL INFORMATION

NAME OF THE FACILITY	JAEA Lead Bismuth Loop-4
ACRONYM	JLBL-4
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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STATUS OF THE FACILITY	In operation
Start of operation (date):	2010

MAIN RESEARCH FIELD(S)	<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 type="checkbox"/> Materials
	<input type="checkbox"/> Systems and components
	<input checked="" type="checkbox"/> Instrumentation & ISI&R

TECHNICAL DESCRIPTION

Description of the facility

The objective of this loop is development of LBE flow visualization technique and the other elemental LBE technologies. This loop is driven by an electromagnetic pump (EMP), and the reference flow rate is monitored by an electromagnetic flowmeter (EMF). Inventory of LBE is 20 liter, and maximum flow rate is 40 liter/min. The diameter of test section is 40 mm, and the length is 430 mm. This loop is operated on a constant temperature condition. Temperature range is 200-500 °C. Oxygen control system in the LBE. Basic studies related to the oxygen control under flowing LBE condition are also performed in this loop.

Acceptance of radioactive material

No

3D drawing/photo



Parameters table

Coolant inventory	204 kg
Power	
Test sections	
TS #1	<u>Characteristic dimensions</u> Diameter of main pipe → 18 mm Size of test section → $\phi 40 \times 430$ mm Overall size of loop (D/W/H) → 2550×2200×2000 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 → constant temperature operation
	<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> 0-40 liter/min, Maximum velocity in test section of about 0.55 m/s
Coolant chemistry measurement and control (active or not, measured parameters)	Oxygen concentration are measured. Oxygen control unit is installed.

Instrumentation	Thermocouples, Gas pressure gauge, Ultrasonic flow meter, EMP, EMF, Oxygen control unit(under experiment)
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COMPLETED EXPERIMENTAL CAMPAIGNS: MAIN RESULTS AND ACHIEVEMENTS

The development of flow visualization technique by using ultrasonic was performed. As a result, three-dimensional vortex flow structure related was observed by developed system. From 2013-2014, development of ultrasonic flowmeter for LBE flow was started. The developed flowmeter showed its performance satisfactory with accuracy of less than 3% in high temperature and flowing LBE environment more than 4,500 h.

PLANNED EXPERIMENTS (including time schedule)

- Development of multiple-dimensional velocity vector profiling system by using ultrasonic (2010-2013)
- Development of high-temperature ultrasonic transducer for LBE flow (2010-)
- Development of ultrasonic flowmeter (2014-)
- Measurement of oxygen concentration and development of oxygen control system in flowing LBE by using oxygen sensors developed by JAEA (2014-)

TRAINING ACTIVITIES

REFERENCES (*specification of availability and language*)

- H.Obayashi, T.Sugawara, K.Nishihara: Design study for beam window of ADS and development of LBE flow measurement technique, Proc. of ICONE-19, 2011.
- Y.Takeda, et al., Ultrasonic Doppler Velocity Profiler for fluid flow, Elsevier, 2012.
- H.Obayashi, K.Yamaguchi, S.Saito, T.Sugawara, H.Takei, T.Sasa: Elemental Technologies for Lead-Bismuth Spallation Target system in J-PARC, Proc. of 13imept, 2014.
- H.Obayashi, M.Hirabayashi, T.Sasa, and K.Ara: Development of Plug-in Type Ultrasonic Flowmeter for Lead-Bismuth Spallation Target System, Proc. of NUTHOS-11, 2016.