Profile LFR-64

TT-1M

RUSSIA

GENERAL INFORMATION

NAME OF THE FACILITY	"TT-1M" liquid metal facility for heavy liquid metal coolant technology integrated studies
ACRONYM	TT-1M
COOLANT(S) OF THE FACILITY	Lead-bismuth (44,5% Pb – 55,5% Bi), lead (two independent loops)
LOCATION (address):	FSUE "State Scientific Centre of the Russian Federation – Institute for Physics and Power Engineering named after A.I. Leypunsky", State Corporation "Rosatom", Russian Federation
OPERATOR	State Corporation "Rosatom"
CONTACT PERSON (name, address, institute, function, telephone, email):	Storozhenko Aleksey Nikolayevich Bondarenko Sq. 1, Obninsk, Kaluga Region, 249033, Russia Head of Laboratory, Cand. Sc. (Physics and Mathematics) phone: +7 484 39 9-45-02, fax: +7 484 39 9-53-69, e-mail: anstor@ippe.ru.

STATUS OF THE FACILITY	In operation
Start of operation (date):	Commissioning: 1971, thorough retrofit: 1991, adaptation to new goals: 2011.

MAIN RESEARCH FIELD(S)

- ☐ Zero power facility for V&V and licensing purposes
- ☐ Design Basis Accidents (DBA) and Design Extended Conditions (DEC)
- ☐ Thermal-hydraulics
- X Coolant chemistry
- X Materials
- X Systems and components
- ☐ Instrumentation & ISI&R

TECHNICAL DESCRIPTION

The TT-1M facility is a set of three loops: a liquid metal loop for both LBE and Pb experiments, a water loop and a gas system.

The liquid metal loop allows Pb or LBE with flow rates up to 6.5m³/h (LBE) or 0.5m³/h (Pb), a maximum pressure of 1.8MPa and temperatures from 200°C to 550°C. The electrical power is 300kW, the loop inventory is 200l (LBE) or 50l (Pb). A secondary water loop with 2 heat exchangers is attached for heat removal. The facility also includes an inert gas supply system, a hydrogen supply system, a vacuum system, a system for gas injection into coolant, a dust removal system and a mixed gas regeneration system.

The main coolant circulation loop in the lead-bismuth loop consists of the following components: TsN-6.5/18 pump, recuperator-1, recuperator-2, heating loop, hot sections, recuperator-2,recuperator-1, heat exchanger "Harmonica", cold sections, TsN-6.5/18 pump. The main loop is made of stainless steel (08Х18Н10Т and ЭИ-732). The main loop pipe diameter is 48×4 mm.

The ejector, measuring tank, sampler and buffer tank are located in the by-pass lines and are cut off from the main loop by relevant valves. The by-pass lines are also made of stainless steel, with diameters of 32×3.5. The coolant from these by-pass lines is drained to the dump tank. The ejector is cut off from the loop gas system by the liquid metal valve.

The coolant flow rate in the by-pass lines and sections is controlled by means of the liquid metal valves from the upstream side, and in the main loop it is controlled by valve 1 and through adjustment of centrifugal pump motor shaft speed. The dump tank is cut off from the main loop by liquid metal valves. During the facility operation the dump tank and drain lines should be constantly heated up to t = 250-300°C in case of emergency dump of the coolant.

Coolant circulation loop in the lead loop consists of the following components: axial pump, buffer tank, liquid metal loop, axial pump. The loop is made of stainless steel. The loop pipe diameter is 48×4 mm.

The facility is heated by nickel-chrome heaters. Gas pressure in the pump reservoir, dump tank, sampler, buffer tank and gas header is measured by vacuum pressure gauges placed above the gas distributing header. The number of recorded parameters is determined by the task recorded in the facility operation log book.

Acceptance of radioactive material
No

Scheme/diagram

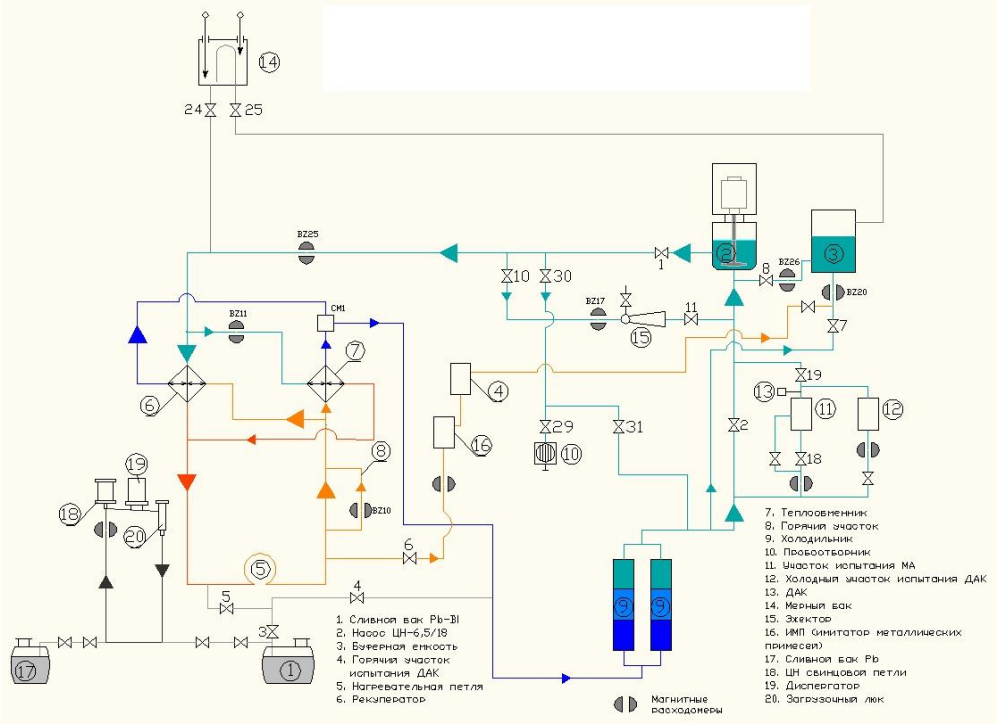

FIG. 1. Scheme of "TT-1M"facility:

1 – *Pb-Bi dump tank. 2 – TsN-6,5/18 pump. 3 – Buffer tank. 4 – OAS testing hot section. 5– Heating loop. 6 – Recuperator. 7 – Heat exchanger. 8 – Hot section. 9 – Heat exchanger. 10 – Sampler. 11 – Mass-transfer apparatus testing section. 12 – OAS testing cold section. 13 – OAS. 14 – Measuring tank. 15 – Ejector. 16 – Metal impurities simulator. 17 – Pb dump tank. 18 – Lead loop circulation pump. 19 – Disperser. 20 – Loading hatch.*

3D drawing/photo

FIG. 2. General View of "TT-2M" Liquid Metal Facility

Parameters table

Coolant inventory	Lead-bismuth (44.5% Pb – 55.5% Bi), lead (two independent loops)
Power	300 kW
Test sections	
TS #1	*Characteristic dimensions* Loop volume: 200 l (lead-bismuth), 50 l (lead)
	Static/dynamic experiment dynamic
	Temperature range in the test section (Delta T) 200^0C – 550 ^{0}C
	Operating pressure and design pressure P_{max} = 1.8 MPa (lead-bismuth), 0.5 MPa (lead)
	Flow range (mass, velocity, etc.) Coolant flow rate in the circulation loop: up to 6.5 m^3/h (lead-bismuth), up to 5.5 m^3/h (lead)
Coolant chemistry measurement and control (active or not, measured parameters)	In the course of the facility operation the following parameters are under control: consumed electric power, coolant flow rate, pressure and temperature, thermodynamic activity of oxygen in the coolant, hydrogen and oxygen concentration in the gas system, impurity contents in the coolant (by means of samplers), humidity level in the gas system.
Instrumentation	• thermal sensors of various designs; • electronic pressure sensors; • differential pressure sensors; • contact level meters (developed and manufactured in FSUE "SSC RF-IPPE"); • electromagnetic flow meters (developed and manufactured in FSUE "SSC RF-IPPE"); • sensors to measure thermodynamic activity of oxygen in the coolant; • flow switches; • gas phase humidity detector.

COMPLETED EXPERIMENTAL CAMPAIGNS: MAIN RESULTS AND ACHIEVEMENTS

During the last 5 years:

- R&D for justification of the coolant technology systems for SVBR-100 reactors.
- R&D for BREST-OD-300 reactors.
- Testing of oxygen thermodynamic activity sensor prototypes for CIRCE facility (ENEA, Italy).

PLANNED EXPERIMENTS (including time schedule)

To test pilot or prototype equipment models, namely: a sensor to measure oxygen thermodynamical activity in lead, a hydrogen detector to monitor hydrogen in gas, an oxygen sensor to monitor oxygen in gas, a mass-transfer apparatus, reactor primary coolant purification filter, gas filters (low-temperature, high-temperature). To conduct endurance tests (for SVBR-100).

TRAINING ACTIVITIES

Training activities for researchers at the liquid metal thermohydraulic facilities must be coordinated with "Rosatom" State Corporation.

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