Profile LFR-33

ELEFANT

GERMANY

GENERAL INFORMATION

NAME OF THE FACILITY	Experimental LEad FAcility for Neutron production Targets
ACRONYM	ELEFANT
COOLANT(S) OF THE FACILITY	Liquid lead
LOCATION (address):	Helmholtz-Zentrum Dresden-Rossendorf (HZDR), Institute of Fluid Dynamics, MHD Department, Dresden, Germany
OPERATOR	HZDR
CONTACT PERSON (name, address, institute, function, telephone, email):	Sven Eckert, HZDR, Bautzner Landstr. 400, 01328 Dresden, Germany, Head of Department Magnetohydrodynamics, Tel. +49 351 2602132, s.eckert@hzdr.de

STATUS OF THE FACILITY In operation

Start of operation (date): 2002

MAIN RESEARCH FIELD(S)

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

TECHNICAL DESCRIPTION

Description of the facility

The facility ELEFANT is a forced convection loop operating with liquid lead.
The lead circulates inside a closed loop made of stainless steel. The main components of the loop are an induction pump, a heat exchanger, an expansion tank and a storage tank. The loop is designed to operate at a pressure of up to 6 bars and a maximum flow rate of 0.3 l/s. Typical dimensions of the pipes are about 5×30 mm^2, and 6×6 mm^2 in the target region. In the latter the mean lead velocity is up to 7 m/s. The volume of the loop is about 10 l. With

pure lead, the operating temperature is 350...500°C. The lead inventory of the loop can easily be substituted by lead-bismuth, thus operating in the range of 150…500°C.
The facility incorporates a test section for material tests or the applications of measuring techniques. Thermocouples are installed to monitor the temperature status of the loop. The flow rate is measured by an electromagnetic flowmeter. At the vertical test section, there is an induction heater by which a heat power of up to 15 kW could be injected into the circulating lead.

A special heat exchanger is installed at ELEFANT working with the liquid alloy GaInSn, which is liquid at room temperature, as intermediate medium between the hot lead and the cooling water. The cooling power can flexibly be controlled by changing the filling height of the GaInSn melt.

Acceptance of radioactive material
No

Scheme/diagram

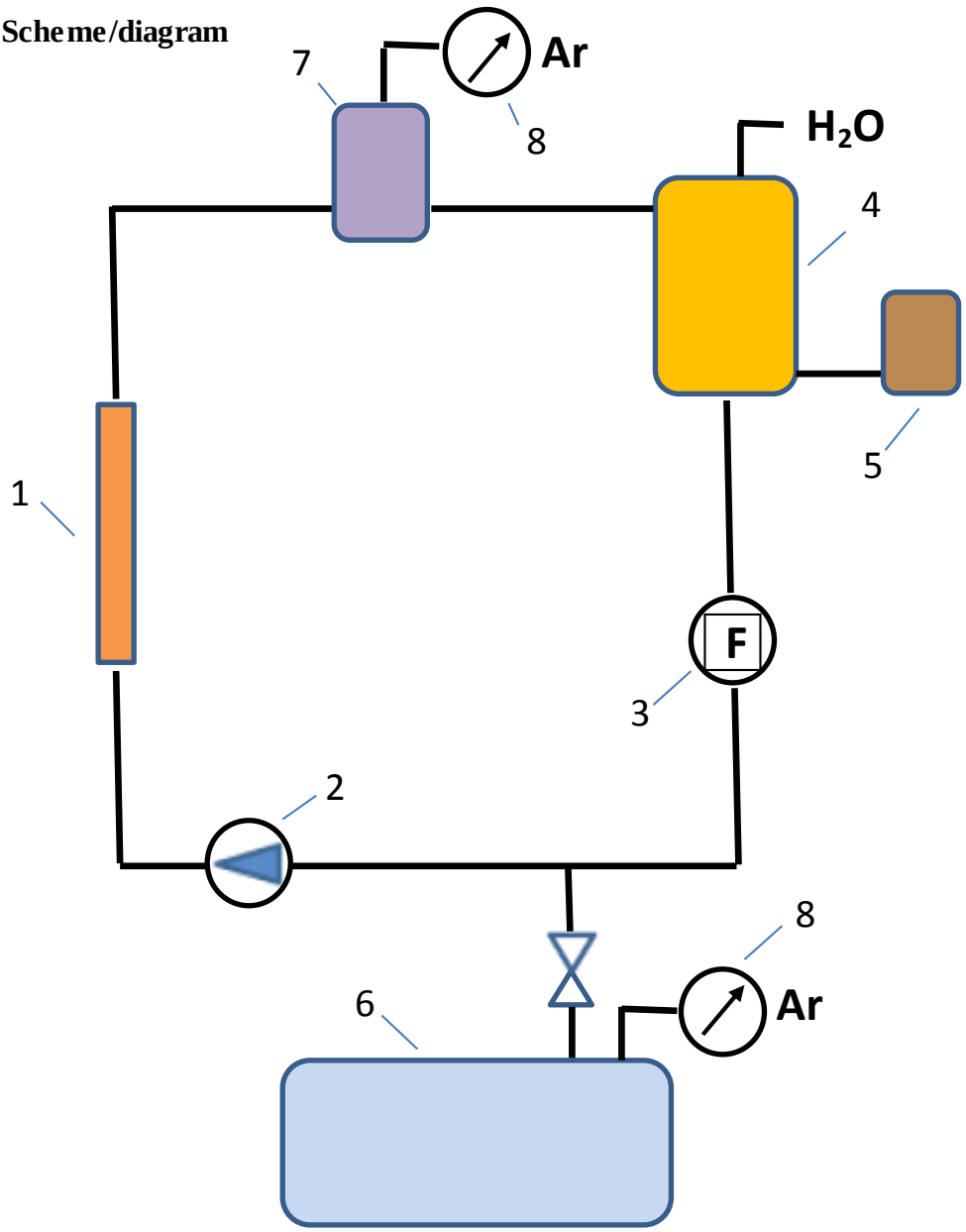

FIG. 1. Scheme of the ELEFANT facility

1 – test section, 2 – electromagnetic pump, 3 – flow meter, 4 – heat exchanger, 5 – GaInSn reservoir, 6 – supply tank, 7 – expansion tank, 8 – pressure meter.

3D drawing/photo

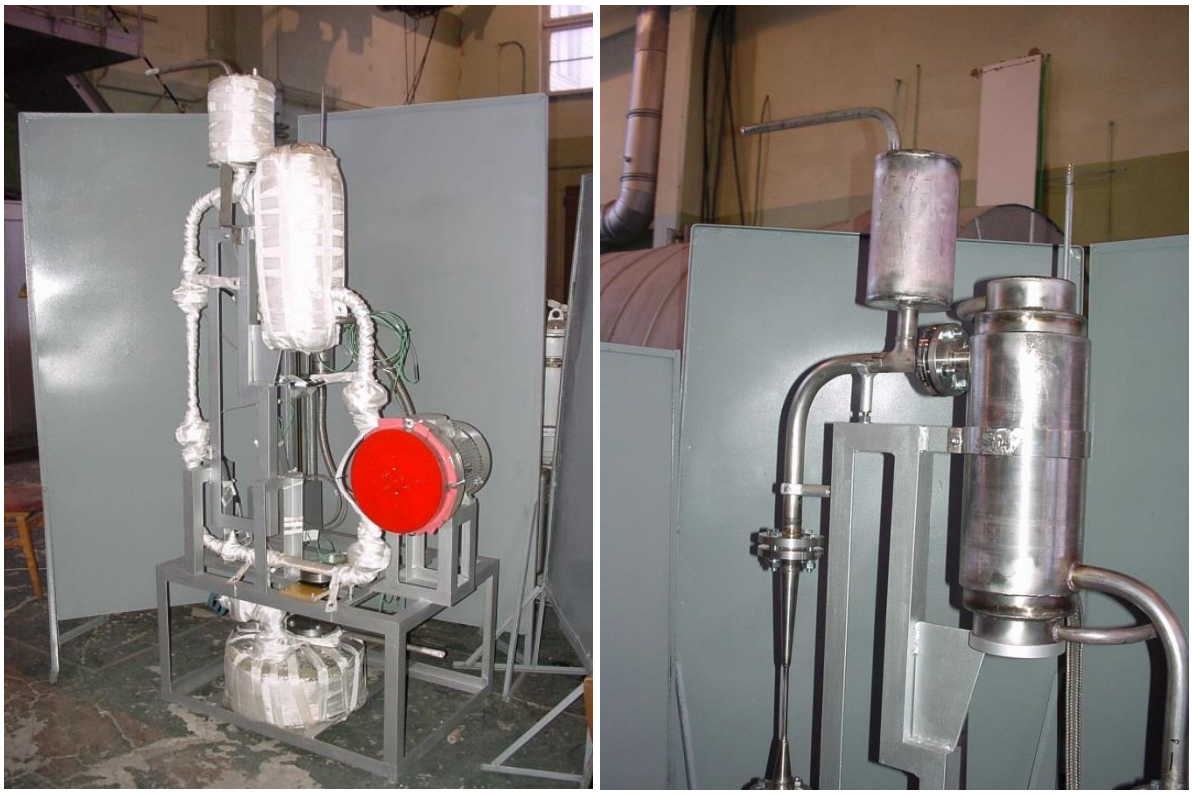

FIG. 2. View of the ELEFANT facility (left) and heat exchanger and expansion tank (right)

Parameters table

Coolant inventory	lead inventory about 100 kg
Operation temperature	< 500°C
Components	Storage vessel, expansion tank, electromagnetic pump (5.5 kW, f = 50 Hz), heat exchanger up to 30 kW with intermediate liquid metal, induction heater for heat input
Pipes, flow rates	Typical pipe diameter: 33 mm, flow rate up to 0.3 L/s driven by an electromagnetic pump
Test sections	
TS 1	Vertical, square cross section of 6×6 mm^2, heat input of up to 15 kW by induction heating

TS 2	Horizontal, pipe diameter 33 mm, local UDV velocity measurements, material tests possible
Instrumentation	Thermocouples, pressure transducer, electromagnetic flow meter, ultrasound Doppler velocimetry (UDV)

COMPLETED EXPERIMENTAL CAMPAIGNS: MAIN RESULTS AND ACHIEVEMENTS

- Long-term tests of the lead flow for the neutron production target nELBE at HZDR (see entry nELBE)
- Test of the dynamics of the installed heat exchanger with an intermediate liquid metal between the lead and water loops; heat input realized using an induction heater; cooling power is regulated by controlling the height of the intermediate GaInSn melt in the vertical cylindrical annulus between the hot lead and the external cooling water
- Long-term test and demonstration of a permanent magnet based pump delivered by an industrial partner for a PbBi facility in India
- Test and demonstration of the ultrasonic Doppler velocimetry (UDV) at a flow of hot liquid lead: reproducible UDV measurements, good agreement with integral electromagnetic flow-rate measurement.
- Tests of diverse materials in flowing liquid lead

PLANNED EXPERIMENTS (including time schedule)

- Tests and qualification of various measuring techniques and instrumentation

TRAINING ACTIVITIES

Training activities can be agreed with HZDR for the operation of the experimental campaign under the supervision of HZDR qualified staff.

REFERENCES (*specification of availability and language*)

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2. PLEVACHUK YU., SKLYARCHUK V., ECKERT S., GERBETH G., "Measurement of the electrical conductivity of Pb-Bi alloys in the melting-solidification region", J. Nuclear Materials 376, 363-365, 2008. (En)
3. ROELOFS F., JAGER B. DE, CLASS A., JEANMART H., SCHUURMANS P., CIAMPICHETTI A., GERBETH G., STIEGLITZ R., FAZIO C., "European research on HLM thermal hydraulics for ADS applications", J. Nuclear Materials 376, 401-404, 2008. (En)
4. PLEVACHUK YU., SKLYARCHUK V., GERBETH G., ECKERT S.,. NOVAKOVIC R, "Surface tension and density of liquid Bi-Pb, Bi-Sn and Bi-Pb-Sn eutectic alloys", Surface Science 605, 1034-1042, 2011. (En)
5. BUCHENAU D., ECKERT S., GERBETH G., STIEGLITZ R., DIERCKX M., "Measurement technique developments for LBE flows", J. Nuclear Materials 415, 396-403, 2011. (En)