Profile LFR-38

THEADES

GERMANY

GENERAL INFORMATION

NAME OF THE FACILITY	Thermal-hydraulics and ADS Design
ACRONYM	THEADES
MEDIUM (COOLANT(S)) OF THE FACILITY	LBE
LOCATION (address):	Karlsruhe Institute of Technology (KIT) Institute for Nuclear and Energy Technologies (IKET) Hermann-von-Helmholtz-Platz 1, Bldg 415 76344 Eggenstein-Leopoldshafen Germany
OPERATOR	KIT
CONTACT PERSON (name, address, institute, function, telephone, email):	Prof. Thomas Wetzel Karlsruhe Institute of Technology (KIT) Head of Karlsruhe Liquid Metal Laboratory (KALLA) +49 721 608 23462 thomas.wetzel@kit.edu

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

THEADES is a forced-convection loop for thermal-hydraulic experiments in LBE at temperaturs between 180°C - 450°C. Depending on experimental conditions in the test section, a flow rate up to 42m³/h and a pressure head of 6 bar can be achieved.

It basically consists of a centrifugal pump, an expansion tank, an oxygen control system, four test ports for mounting experimental test sections and an air cooler with a maximum cooling capacity of 500kW.

THEADES is made of austenitic stainless steel (DIN W.-Nr 1.4571) with an inner diameter of the piping of105mm. The complete inventory of LBE is 4m³. Electrochemical oxygen sensors are mounted to measure the oxygen content in the LBE. Oxygen is added or removed in the oxygen control system by exposing the LBE to a flowing gas atmosphere with variable oxygen partial pressure. Flow velocity is measured by a vortex flow meter, depending on the experimental test section additional flow meter and pressure sensors can be mounted in the test section area.

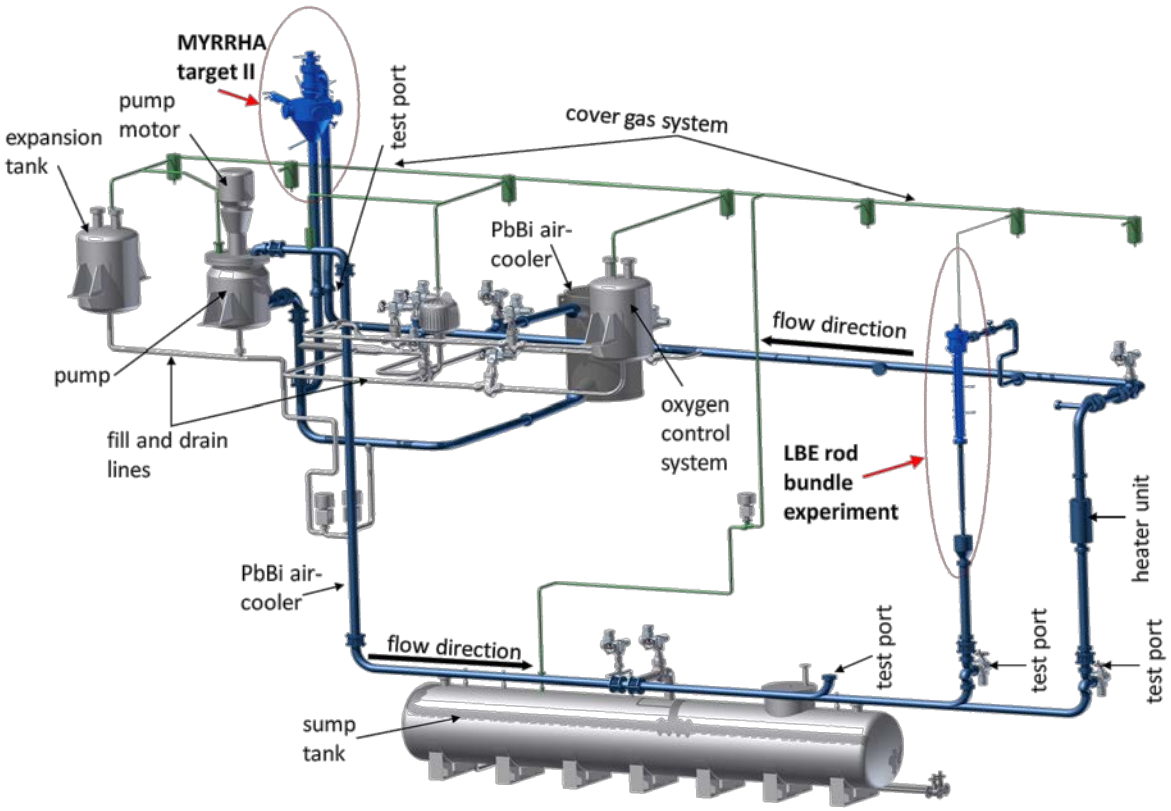
Main research interest of THEADES is:

- Thermal-hydraulic single-effect investigations of ADS components
- Flow field of a windowless target configuration
- Cooling of fuel elements
- Heat transfer characteristics of a LBE/air heat exchanger
- Set-up of thermal-hydraulic data base for physical model and code validation

Acceptance of radioactive material

No

Scheme/diagram



3D drawing/photo

Parameters table

Medium (Coolant) inventory	4m³
Power	500kW
Test sections: 4	
TS #1-3	*Characteristic dimensions* height: ~3500mm
	Static/dynamic experiment dynamic
	Temperature range in the test section (Delta T) 180°C - 450°C
	Operating pressure and design pressure 6 bar / 10 bar
	Flow range (mass, velocity, etc.) 42m³/h
TS #4	*Characteristic dimensions* height: ~2000mm
	Static/dynamic experiment dynamic
	Temperature range in the test section (Delta T) 180°C - 450°C
	Operating pressure and design pressure vacuum / 10 bar
	Flow range (mass, velocity, etc.) 42m³/h
Medium (Coolant) chemistry measurement and control (active or not, measured parameters)	active oxygen control system by Pt/air oxygen sonsor and gas phase oxygen exchange
Instrumentation	annubar flow meter vortex flow meter

	Thermocouples pressure transducer

COMPLETED EXPERIMENTAL CAMPAIGNS: MAIN RESULTS AND ACHIEVEMENTS

Rod bundle experiment in EU-Project DEMETRA

Rod bundle experiment in EU-Project THINS

Free surface target experiment in EU-Project THINS

Rod bundle experiment in EU-Project SEARCH

Rod bundle blockage experiment in EU-Project MAXSIMA

PLANNED EXPERIMENTS (including time schedule)

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TRAINING ACTIVITIES

PhD Thesis on experimental campaigns are possible.

Training activities are possible, depending on availability and after prior agreement under supervision of KIT.

REFERENCES (*specification of availability and language*)

R. Stieglitz, J. Knebel, C. Fazio, G. Müller, J. Konys, Heavy liquid metal technologies development in Kalla, paper-Id 6277, Proc. ICAPP, 2006.

K. Litfin, A. Batta, A.G. Class, Th. Wetzel, R. Stieglitz, Investigation on heavy liquid metal cooling of ADS fuel pin assemblies, Journal of Nuclear Materials, Volume 415, Issue 3, 31 August 2011, Pages 425-432, ISSN 0022-3115, http://dx.doi.org/10.1016/j.jnucmat.2011.04.048

J. Pacio, M. Daubner, F. Fellmoser, K. Litfin, L. Marocco, R. Stieglitz, S. Taufall, Th. Wetzel, Heavy-liquid metal heat transfer experiment in a 19-rod bundle with grid spacers, Nuclear Engineering and Design, Volume 273, 1 July 2014, Pages 33-46, ISSN 0029-5493, http://dx.doi.org/10.1016/j.nucengdes.2014.02.020.

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J. Pacio, M. Daubner, F. Fellmoser, K. Litfin, Th. Wetzel, Experimental study of heavy-liquid metal (LBE) flow and heat transfer along a hexagonal 19-rod bundle with wire spacers, Nuclear Engineering and Design, Volume 301, 2016, Pages 111-127, ISSN 0029-5493, https://doi.org/10.1016/j.nucengdes.2016.03.003.

J.Pacio, M.Daubner, F.Fellmoser, K.Litfin, T.Wetzel, Heat transfer experiment in a partially (internally) blocked 19-rod bundle with wire spacers cooled by LBE, Nuclear Engineering and Design Volume 330, 15 April 2018, Pages 225-240, https://doi.org/10.1016/j.nucengdes.2018.01.034