

Profile LFR-3

E-SCAPE

BELGIUM

GENERAL INFORMATION

NAME OF THE FACILITY European SCAled Pool Experiment
ACRONYM E-SCAPE
COOLANT(S) OF THE FACILITY Lead-Bismuth Eutectic (LBE) – Oil - Air
LOCATION (address): SCK•CEN, Boeretang 200, 2400, Mol, Belgium
OPERATOR SCK•CEN
CONTACT PERSON Katrien Van Tichelen
(name, address, institute, function, telephone, email): SCK•CEN
Nuclear Systems Research
Unit head LBE-Components and Experiments
Tel. +32 (0) 1433 8006
Email kvichel@sckcen.be

Cc to:

Fabio Mirelli
SCK•CEN
Nuclear Systems Design
Project engineer Primary System Design
Tel. +32 (0) 1433 8014
Email fmirelli@sckcen.be

STATUS OF THE FACILITY Under Construction
Start of operation (date): 2015

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 E-SCAPE (European SCAled Pool Experiment) facility at SCK•CEN is a 1/6-scale model of the MYRRHA reactor, intended to simulate the main thermal hydraulic phenomena occurring in a Heavy Liquid Metal Reactors (HLMR). It is provided with an electrical core simulator and cooled by Lead Bismuth Eutectic.

The facility has been designed and built within the framework of the MYRRHA R&D programme; it is currently under construction and it will be commissioned during the second half of 2015; when fully operative, it will enable designers to have feedback on the forced and natural circulation flow and temperature patterns and to validate the computational methods for their use with LBE.

Acceptance of radioactive material

No

Scheme/diagram

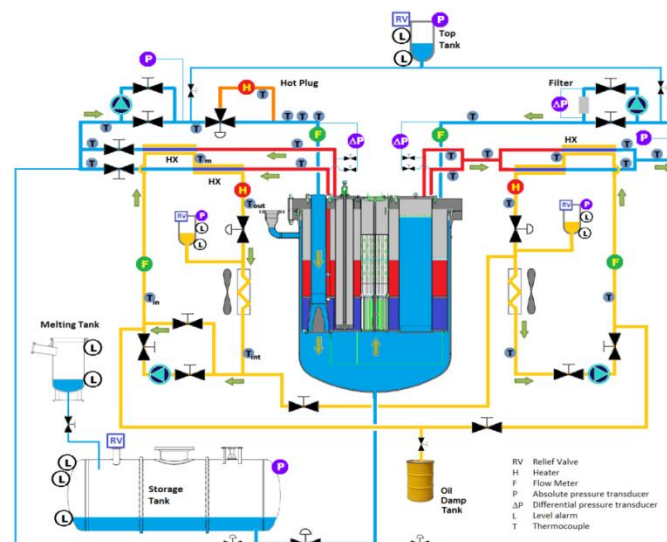


FIG. 1. Scheme of the CE-SCAPE facility

3D drawing/photo



FIG. 1. View of the CE-SCAPE facility

Parameters table

Coolant inventory	Primary: 27 tons of LBE. Secondary: 400 kg oil
Power	~100 kW main heater + ~100 kW auxiliary (heat tracing, pumps, air coolers)
Test sections	
TS #1	<u>Characteristic dimensions</u> Main vessel diam. ~1.5 m, height ~2 m.
	<u>Static/dynamic experiment</u> Dynamic
	<u>Temperature range in the test section (ΔT)</u> LBE 200°C-320°C
	<u>Operating pressure and design pressure</u> Cover gas operating pressure 3-4 bar, design 7 bar
	<u>Flow range (mass, velocity, etc.)</u> Total up to 120 kg/s in forced circulation
Coolant chemistry measurement and control (active or not, measured parameters)	<p>The loop is made oxygen “free” prior to usage with LBE, by pulling vacuum and flushing it with argon. Argon is kept as cover gas in the main vessel and storage tank, always at least slightly above ambient external pressure.</p> <p>Coolant chemistry control is possible via gas surface interaction in main vessel and storage tank. However, due to the low efficiency of active oxygen control this feature is only installed on an as-required basis.</p>
Instrumentation	<ul style="list-style-type: none"> Coriolis flow rate sensors for LBE Vortex flow rate sensors for oil Absolute pressure sensors with diaphragm seal for LBE Absolute pressure sensors for gas cover Differential pressure sensors with diaphragm seal for LBE Level switches Level guided radar sensors Thermocouples Ultrasonic Doppler Velocimetry probes Pitot tube for measure of pump jet velocity (foreseen for a later stage)

COMPLETED EXPERIMENTAL CAMPAIGNS: MAIN RESULTS AND ACHIEVEMENTS

The facility will be operational second half of 2015.

PLANNED EXPERIMENTS (including time schedule)

Planning of the proposed experimental campaign:

CASE	Power	Pumps	HX	Model
0 Isothermal	Zero	2	4	1 st quarter 2016
1 Forced circulation	Maximum	2	4	1 st quarter 2016
2 LOF Long term decay	Decay heat (7% to 0.5%)	C*	4	4 th quarter 2016
3 LOF	Constant decay heat (7%)	C*	4	3 rd quarter 2016
4 Pump Failure	Constant decay heat (7%)	1	4	2017
5 Partial LOHS	Constant decay heat (7%)	2	2	2017
6 Partial LOHS + LOF	Constant decay heat (7%)	0	2	2017
7 Hot plug	Maximum	2	4	2 nd quarter 2016

*C = Coastdown

TRAINING ACTIVITIES

Training activities are possible, availability allowing and after prior agreement under supervision of SCK•CEN qualified staff.

REFERENCES (*specification of availability and language*)

1. VAN TICHELEN K., GRECO M., MIRELLI F., VIVIANI G., E-SCAPE: a scale facility for liquid-metal, pool-type reactor thermal hydraulic investigations. Nuclear Engineering and Design, NED-S-14-00985, 2014.
2. GRECO M., MIRELLI F., KEIJERS S., VAN TICHELEN K. Pre-test computational fluid dynamics and system thermal hydraulics calculations of the E-SCAPE scaled LBE pool facility. NURETH-16, August 30-September 4, 2015, Chicago, USA.
3. GRECO M., MIRELLI F., VAN TICHELEN K., ECKERT S., Report on the HLM pool experiments: facility description and pre-test analysis. 2015, Deliverable 2.1.08, FP7 Collaborative Project THINS N° 249337, EURATOM.