

Profile LFR-16

CLEAR-S

CHINA

GENERAL INFORMATION

NAME OF THE FACILITY	Lead-based Engineering Validation Reactor
ACRONYM	CLEAR-S
COOLANT(S) OF THE FACILITY	Lead alloy (Pb, LBE, etc.)
LOCATION (address):	China, Institute of Nuclear Energy Safety Technology, Chinese Academy of Sciences
OPERATOR	INEST
CONTACT PERSON (name, address, institute, function, telephone, email):	Chao Liu, FDS Team, No.350 Shushanhu Road, Hefei, Anhui, China, INEST, CAS, +86 551 65593681, contact@fds.org.cn ;

STATUS OF THE FACILITY	In operation
Start of operation (date):	2017

MAIN RESEARCH FIELD(S)	<input type="checkbox"/> Zero power facility for V&V and licensing purposes
	<input checked="" type="checkbox"/> Design Basis Accidents (DBA) and Design Extended Conditions (DEC)
	<input checked="" type="checkbox"/> Thermal-hydraulics
	<input checked="" type="checkbox"/> Coolant chemistry
	<input checked="" type="checkbox"/> Materials
	<input checked="" type="checkbox"/> Systems and components
	<input checked="" type="checkbox"/> Instrumentation & ISI&R

TECHNICAL DESCRIPTION

Description of the facility

CLEAR-S is a pool type integrated test platform for China Lead-based Reactor (CLEAR). It is could validate non-nuclear key technologies and components for China LEAd-based Reactor (CLEAR), verify the specific thermal and security characteristics for liquid heavy metal pool-type reactor as well as perform integrated test with international advanced level for engineering verification and basic research of liquid heavy metal cooled reactor technology.

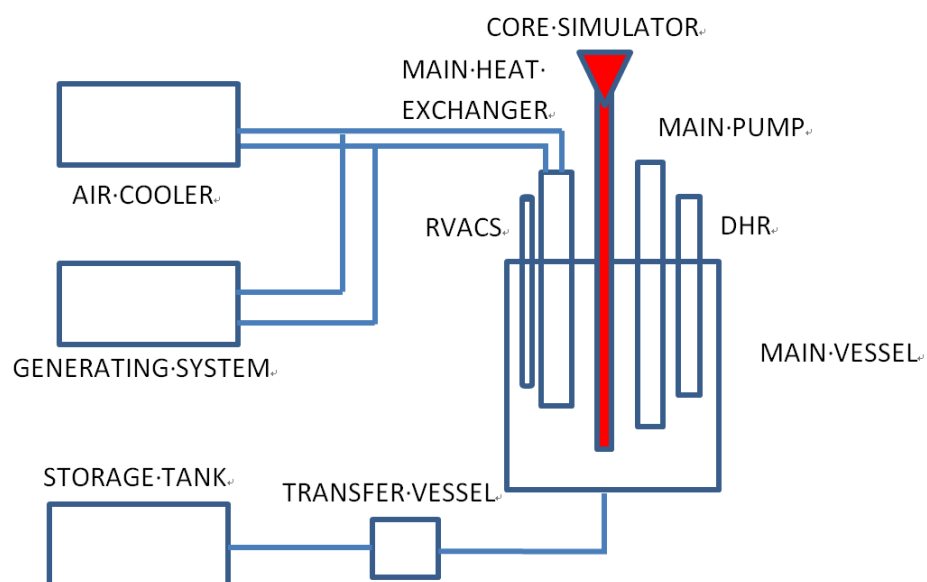
CLEAR-S would carry out a variety of test for separation or coupling integration of equipment based on the needs of different experiments, which mainly focuses on the following objectives:

- Test and validation of the LBE reactor key equipment performance in the pool-type lead-based alloy environments (heat exchangers, primary pump, refuelling system, control rod driven system, decay heat removal system, etc.)
- Research and validation of key non-nuclear technology (pool-type reactor coolant process technology, pool-type LBE environment measuring technology, integration and control technology, V&V of software)
- Obtain the experiment data to support the construction and operation license of CLEAR.

Acceptance of radioactive material

No

Scheme/diagram



3D drawing/photo



Parameters table

Coolant inventory	~200 ton LBE
Power	~3.5 MW
Test sections	
TS #1	<u>Characteristic dimensions</u> Dimensions of Main vessel: Diameter:~2.5m; Height:~7m
	<u>Static/dynamic experiment</u> dynamic
	<u>Temperature range in the test section (ΔT)</u> 200-500 °C
	<u>Operating pressure and design pressure</u> 2MPa
	<u>Flow range (mass, velocity, etc.)</u> 100m ³ /h
Prototype component test	<ul style="list-style-type: none"> ✓ Full scale of Primary pump test <ul style="list-style-type: none"> ● Flow resistance test, Vibration noise test ● Impeller materials test ✓ Full scale of heat exchanger test ✓ DHR and RVCAS test ✓ Coolant chemistry measurement and control <ul style="list-style-type: none"> ● Gas phase Oxygen Control ● Solid phase Oxygen Control ● Purification ✓ Refuelling system Structural design soundness verification <ul style="list-style-type: none"> ● Special material properties and corrosion test ● Control and detection technology verification ● Overall test ✓ Control rod driven system <ul style="list-style-type: none"> ● Performance qualification ● Hot life test
Instrumentation	Thermocouples; High temperature pressure transducers; Transient flow velocity measuring instrument; Transformer type and single point type level meter; Single point contacted type leak detector; High temperature strain gauge; Void fraction sensor; Oxygen sensor

COMPLETED EXPERIMENTAL CAMPAIGNS: MAIN RESULTS AND ACHIEVEMENTS

- ✓ Thermal hydraulic phenomena in the LBE pool
- ✓ Integral test of LBE in pool type facility
- ✓ Pump and heat-exchanger test

PLANNED EXPERIMENTS (including time schedule)

- 2018.03-2018.12:

- ✓ Decay heat removal system test
- ✓ heat-exchanger test
- ✓ Pool-type reactor coolant conditioning technology
- ✓ Pool-type LBE instrumentation technology
- **2019.01-2019.12:**
 - ✓ SGTR test
 - ✓ LBE Window target test
 - ✓ Refuelling system test
 - ✓ Control rod driven system test

TRAINING ACTIVITIES

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

REFERENCES (*specification of availability and language*)

Wu Y. CLEAR-S: an integrated non-nuclear test facility for China lead-based research reactor. International Journal of Energy Research. 2016.40:1951-1956