**Profile LFR-88**

**ELF**

**ROMANIA**

**GENERAL INFORMATION**

NAME OF THE FACILITY: European Lead Fast facility  
ACRONYM: ELF  
MEDIUM (COOLANT(S)) OF THE FACILITY: Lead  
LOCATION (address): RATEN ICN, Campului Street, no.1, Mioveni, Romania  
OPERATOR: RATEN ICN  
CONTACT PERSON(S) (name, address, institute, function, telephone, email):  
Ing. Mariano Tarantino, ENEA FSN-ING C.R. Brasimone 40032, Camugnano (Bo) Tel. +39 0534 801 262, mariano.tarantino@enea.it  
Dr. Daniela Gugiu, RATEN ICN, Mioveni, Arges, Romania, Tel. +40 248 213 400, daniela.gugiu@nuclear.ro

**STATUS OF THE FACILITY**

Start of operation (date): Choose an item.

**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**

ELF is a Lead integrated test platform, pool type facility cooled by pure lead, conceived to be operated for long run (endurance and reliability test) both under forced and natural circulation, with a total power installed of 10 MW.

The facility consists of a main vessel which contains the Fuel Pin Simulator, the four Steam Generators Bayonet Tube (SGBTs), the DHR (Decay Heat Removal System) and two mechanical pumps for the forced circulation, positioned symmetrically inside the pool. The facility main components are represented by:

- The main ELF vessel;
- A Fuel Pin Simulator (FPS) composed by 31 Sub-Assemblies (S/As) of which 19 are Fuel Assemblies surrounded by 12 Dummy Assemblies (DAs). Each FA is composed by a central dummy pin and 36 electrical pins placed in a hexagonal lattice;
- Four Steam Generators Bayonet Tube (SGBTs) positioned symmetrically inside the main vessel, coupling the primary lead side with the secondary water side and represented by a shell with double wall bayonet tube bundle operating in a counter flow and fed by a total mass flow rate of 7.2 kg/s of pressurized water at 180 bar in order to remove a total power of 10 MW from the lead with a temperature drop along the water tubes of 75°C;
- A Decay Heat Removal System (DHR), composed by two Heat Exchangers positioned symmetrically inside the cold pool, each one constituted by 37 double walls tubes fed by water at room temperature at 3.5 bar aiming at removing the simulated decay heat (about 5-7% of the nominal power);
- Two prototypical centrifugal vertical pumps placed symmetrically, installed in the hot pool of the main vessel operating at about 480°C, each one with a nominal volumetric flow rate of about 150 m³/h;
- The secondary water loop, basically composed by a centrifugal pump, air coolers designed to remove 10 MW, a pressurizer acting also as expansion vessel, the heating elements to heat the water during the startup phase, 3 ½ inches pipes Sch. 80 and valves (safety, regulation and on/off);
- The Melting tank, to melt the lead necessary to fill the main vessel, with a proper filter section installed in the pipeline that connect the melting tank to the storage tank and the valves necessary to correctly operate the system;
- The Storage tank, for the storage of the melt for the short- or long-term (to hold the melt for maintenance or for storage);
- The Transfer tank to transfer the lead from the main vessel to the storage tank. During the filling/draining operations, the lead is gradually transferred from the storage tank to transfer tank vessel. Then, by pressurization of the transfer tank cover gas, the liquid metal gradually fills the test vessel from the bottom.

ELF will be instrumented in a consistent manner in order to investigate different physical phenomena:
- Around 650 thermocouples (TCs) will be installed inside the FPS at four different elevations aimed to investigate heat transfer phenomena inside the core simulator, including the thermal coupling between different fuel assemblies. Moreover, to monitor the temperature at the entrance of the core simulator six TCs are installed in the inlet region of the FPS.
- The main heat exchanger will be instrumented with about 60 TCs for the investigation of the heat transfer in different sub-channels including side channel at five different elevations and a number of 45 TCs will be devoted to the study of HX bayonet element (water and LBE sides). The heat transfer in the DHR will be monitored along five different elevations (including inlet/outlet sections) using around 30 TCs.
- Mixing and stratification phenomena will be also investigated in both hot and cold pool with about 20 TCs along two different vertical lines in the hot pool and about 290 TCs along 4 different vertical lines in the cold pool (also radial temperature distribution will be monitored). The mixing in the annular region between the exit section of the active length of the FPS and the entrance section in the hot pool will be analysed by considering 20 vertical sections that will be
instrumented along the annular region with thermocouples placed at 120°C (three TCs for each section, meaning a total number of 60 TCs).

- Three TCs will be installed along the pump shaft (the exact positioning will depend on the pump design), the rpm measurement being also available.
- The coolant chemistry will be investigated with at least three different oxygen sensors while the conditioning will be assured by oxygen getter, mass exchanger (solid sphere made of lead oxides (PbO)) and Ar/H2 bubbling system (foreseen both in the main vessel and in the storage tank).

Acceptance of radioactive material
No

Scheme/diagram

ELF General Layout
Distribution of the components inside ELF main vessel

Parameters table

<table>
<thead>
<tr>
<th>Medium (Coolant) inventory</th>
<th>270 tons of Lead</th>
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<tbody>
<tr>
<td>Power</td>
<td>10 MW</td>
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Test sections

ELF Main Vessel

**Characteristic dimensions**
Diameter 1.8 m, Height 10.0 m

**Static/dynamic experiment**
Dynamic

**Temperature range in the test section (Delta T)**
450°C

**Operating pressure and design pressure**
Design pressure: 1.2 MPa

**Flow range (mass, velocity, etc.)**
150 m³/h in nominal conditions, forced circulation

Medium (Coolant) chemistry measurement and control (active or not, measured parameters)

- Oxygen monitoring using various types of oxygen sensors;
- Oxygen control using Ar/H₂ bubbling system is foreseen for ELF main vessel;
- Temperature monitoring;
- Lead flow monitoring.

Instrumentation

Thermocouples, oxygen sensors, pressure transducer, gas injection system

**COMPLETED EXPERIMENTAL CAMPAIGNS: MAIN RESULTS AND ACHIEVEMENTS**

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PLANNED EXPERIMENTS (including time schedule)
The experimental campaigns to be performed on the ELF facility are devoted to the thermal-hydraulic characterization of ALFRED layout, in particular:

- the evaluation of the axial thermal stratification of the coolant fluid along the cold pool;
- characterization of the thermal-hydraulic system behaviour in steady state conditions and during transients from natural circulation to gas-enhanced circulation and vice versa, analysing the system response in terms of mass flow rate, pressures and temperatures;
- demonstrate the long-term operation of LFR primary system with an active OCS;
- demonstrate the long-term reliability of the main components of the primary systems.

TRAINING ACTIVITIES
Training activities could be planned in the frame of the proposed experimental campaigns.

REFERENCES (specification of availability and language)