**Profile LFR-68**

**LINCE**

**SPAIN**

## GENERAL INFORMATION

| | |
|---|---|
| NAME OF THE FACILITY | LINCE |
| ACRONYM | LINCE |
| COOLANT(S) OF THE FACILITY | Molten lead-bismuth eutectic |
| LOCATION (address): | CIEMAT (Centro de Investigaciones Energéticas, Medioambientales y Tecnológicas). Avenida Complutense 40. 28040 Madrid, Spain |
| OPERATOR | CIEMAT |
| CONTACT PERSON (name, address, institute, function, telephone, email): | Francisco Javier Perosanz. Avenida Complutense 40. 28040 Madrid. CIEMAT, Structural Materials Division, Corrosion Unit Head<br>+34 913460876, franciscojavier.perosanz@ciemat.es |
| **STATUS OF THE FACILITY** | Standby |
| Start of operation (date): | 2006 |
| **MAIN RESEARCH FIELD(S)** | - Study of the long term corrosion behavior of materials in liquid lead-bismuth eutectic.<br>- Study of the oxygen control systems in flowing liquid lead-bismuth eutectic |

## TECHNICAL DESCRIPTION

### Description of the facility

The liquid lead-bismuth test loop LINCE is a dynamic loop for materials corrosion tests, and is designed to operate at temperatures up to 550 °C, with two test zones at different temperatures, Figures 1,2. The dimensions of the loop are: 11 m length, 4 m width and 5 m height

The main components of the loop are:

- Storage tank, with a diameter of 610 mm and 1500 mm. length.
- Sump tank, with a diameter of 550mm and 900 mm high.
- Centrifugal pump, submerged in the liquid metal in the sump tank, with a capacity of 2.5 m3/hour.
- Heat exchanger, formed by two concentric tubes: 1" and 1 1/2 ". The length is 25 m. In this component the liquid metal temperature is increased by 120 °C.
- Heater, formed by a 2" pipe with a length of 10 m. The heating medium is a series of electrical resistances wounded in the external surface of the pipe. This heater can increase the temperature by 30 °C at the maximum flow rate of the pump.
- Air cooler, formed by 10 tubes of 1", connected to 2" inlet and outlet tubes. The cooler decrease the temperature by 30 °C.
- Two test zones. The test temperatures are 550 °C and 400 °C in the hot and cold zones respectively. The test sections are pipes of 25 mm inner diameter and 500 mm length. The specimens to test are placed inside those pipes.
- Oxygen sensors in the two test zones.

The loop is also equipped with a cover gas system, level and flow rate measuring devices, valves, etc.
The loop and the main components are built of 2¼ Cr-1 Mo steel apart from the parts of the pump in contact with the liquid metal that are built of 9 Cr-1 Mo steel.

**Acceptance of radioactive material**
No

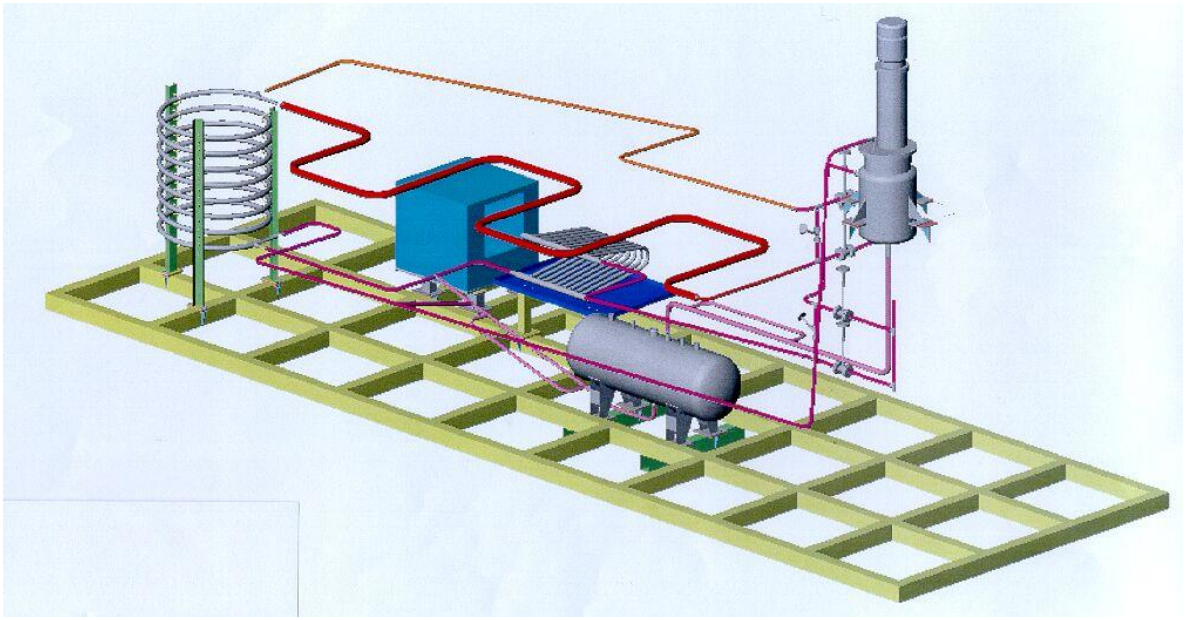

*FIG. 1. Scheme of the Pb-Bi LINCE loop*

*FIG. 2. View of the Pb-Bi LINCE loop*

**Parameters table**

| | |
|---|---|
| Coolant inventory | Max LBE inventory → 0.3 m3 aprox 3000 kg |
| Power | 80 kW |
| Test sections | |
| Two test sections | *Characteristic dimensions*<br>Inside pipe diameter 25 mm<br>Overall height → 500 mm<br>Active length 500 mm |
| | *Static/dynamic experiment*<br>Dynamic |
| | *Temperature range in the test section (Delta T)*<br>550 °C in the hot zone<br>400 °C in the cold zone |
| | *Operating pressure and design pressure*<br>Operating Pressure → 8 bar (gauge)<br>Design pressure → 10 bar (gauge) |
| | *Flow range (mass, velocity, etc.)*<br>Aprox 1 m/s |
| Coolant chemistry measurement and control | The oxygen activity in the loop is measured in situ using oxygen sensors implemented in both test sections (two in each of them).<br>The oxygen concentration in the range of 10-8wt% ~ 10-6 wt% is controlled by the chemical equilibrium between the mixture gas of |

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| | hydrogen-argon and the water vapour |
| Instrumentation | Thermocouples, pressure transducer, Gas injection system, Induction flow meters. |

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

The LINCE loop has accumulated 12000 hours of operation in different projects, as TECLA, HeLiMnet and DEMETRA.

See references

**PLANNED EXPERIMENTS (including time schedule)**

none

**TRAINING ACTIVITIES**

none

**REFERENCES (*specification of availability and language*)**


1. WEISENBURGERA A., SCHROERA C., JIANUA A., HEINZELA A., KONYSA J., STEINERA H., MÜLLERA G., FAZIOA C., GESSIB A., BABAYANC S., KOBZOVAC A., MARTINELLID L., GINESTARD K., BALBAUD-CÉLERIERD F., MARTÍN-MUÑOZ F.J., SOLER CRESPO L.. Long term corrosion on T91 and AISI1 316L steel in flowing lead alloy and corrosion protection barrier development: Experiments and models. Journal of Nuclear Materials, 415, pp. 260-269 (2011)
2. MARTÍN-MUÑOZ F.J., SOLER-CRESPO L., GÓMEZ-BRICEÑO D.. Corrosion behaviour of martensitic and austenitic steels in flowing lead–bismuth eutectic. Journal of Nuclear Materials, 416, pp. 87-93 (2011).
3. MARTÍN-MUÑOZ F.J., SOLER L., LAPEÑA J., PEROSANZ F.J. GÓMEZ-BRICEÑO Y D.. Corrosion behaviours of steels in flowing lead-bismuth eutectic (LBE): LINCE LOOP. Proc. HLMC-2008, Obninsk, Russia.
4. MARTÍN-MUÑOZ F.J., SOLER L., LAPEÑA J., PEROSANZ F.J. GÓMEZ-BRICEÑO Y D. Corrosion behaviour of stainless steels in flowing lead-bismuth eutectic: LINCE loop., Proc. HLMC-2007, Rome, Italy.