

# SFERA-III

## Solar Facilities for the European Research Area

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8<sup>th</sup> MBM  
15.12.2022 – meeting

WP title  
Speaker and organization



## JOINT RESEARCH ACTIVITIES

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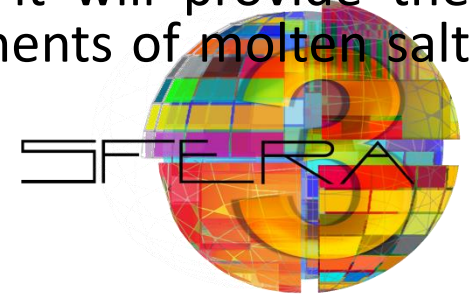
THIS PROJECT HAS RECEIVED FUNDING FROM THE EUROPEAN UNION'S HORIZON 2020 RESEARCH AND INNOVATION PROGRAMME UNDER GRANT AGREEMENT NO **823802**

### General objectives:

- The medium used in commercial large capacity storage systems for STE power plants is the so called solar salt. However, its specific features create technical issues and systematic failures in the hydraulic components and instruments through which this salt flows. The current standard procedures for testing hydraulic components do not take into account their real behaviour under the working conditions and type of fluid used in these commercial thermal storage systems. **In this task, it is intended to define specific tests for those components whose real behaviour cannot be extrapolated from current standards**

### Expected outcomes:

- The outcomes of this task will be of very much help for national and international standardization bodies, like IEEC and AENOR are, but mainly for the STE industry, since it will provide the necessary tools to verify the reliability of hydraulic components and components of molten salt loops, with the consequent reduction in maintenance cost of these systems



**Main achievements (Task 6.4 - Establishment of standard procedures for the characterization of components for commercial TES):**

- Particularly: **FISE (calibration of flow meters)**

Pretests performed:

- Pre tests were run with water at ambient temperature

Tests performed:

- One flow meter has been calibrated in the molten salt gauging station

Conclusions:

- Using a high precision scale in a gauging station was found to be suitable for the calibration of flow meters for molten salt.
- **Updates:**
- Tests regarding preventing material failure by mechanical and thermal stress begun in the first 6 months of 2022
- The high temperature strain gauges infrastructure were finalized and the first test run performed in the first 6 months 2022



### Main achievements (Task 6.4 - Establishment of standard procedures for the characterization of components for commercial TES):

- Particularly: FISE (calibration of flow meters)
- **Updates:**
- ~~Tests regarding preventing material failure by mechanical and thermal stress begun in the first 6 months of 2022~~
- ~~The high temperature strain gauges infrastructure were finalized and the first test run performed in the first 6 months 2022~~
- The tests with the strain gauges were not successful. The strain gauges did not provide plausible results even after intense interaction with the supplier.
- Tests with a second flow meter are planned for Q1 2023





### Technical progress Task 6.4 - Establishment of standard procedures for the characterization of components for commercial TES (using sensible and molten solar salts)

#### Motivation:

- Measure of the global heat exchange coefficient  $U$  of electrical heater immersed in the Molten salt tank
- to gain experience with measurement technology for industrial scale thermowells applications

#### Installation:

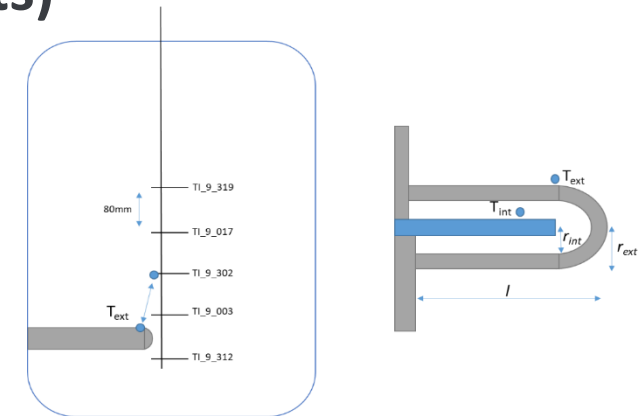
- 5 high-temperature thermal sensors inside of the MoSE MS tank;
- Electrical heater inside of thermowell feed with a AC power supply regulated in temperature;
- DCS tools to control tests and acquisition of the experimental data

#### Updates:

- test running



MoSE Molten salt



MoSE tank geometry: on the left, the measurement thermocouples positions, one of the six electric heating parts and, on the right, the heating systems illustrated in detail



External of the electrical MS Heater

**Technical progress Task 6.4** - Testing regarding the thermal performance of the flexibles will begin in Q3 2022. First experiments scheduled.

**Motivation:**

- Thermal characterization
- to gain experience with measurement technology for industrial scale thermowells applications and CSP management

**Installation:**

- 3 high-temperature thermal sensors one directly contact with internal surface of the flexible;
- DCS tools to control tests and acquisition of the experimental data

**Updates:**

- set up of the test section ongoing

**Main achievements (Task 6.4 - Establishment of standard procedures for the characterization of components for commercial TES):**

- Particularly: **UÉvora (new low-cost sensible and latent storage concepts)**

**Concept**

- Construction and testing of a concrete based Thermocline prototype for operation with Molten Salts and filler material

**Updates:**

- Several main elements have been installed. Electrical commissioning being prepared.



**UÉvora**



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### Main achievements (Task 6.4 - Establishment of standard procedures for the characterization of components for commercial TES):

- All partners have been working for: i) setting up the experimental facilities ii) defining the experimental process iii) data collection and monitoring iv) data analysis based on the components that were defined during the first meetings.
- Particularly: **UÉvora (new low-cost sensible and latent storage concepts)**

#### Concept

- Construction and testing of a concrete based Thermocline prototype for operation with Molten Salts and filler material

#### Status

- Electrical components under installation and commissioning. Current electricity costs (increase of 800%) are causing delays in this activity. Nevertheless, it is expected to finished during the first half of 2023.





### Main achievements (Task 6.4 - Establishment of standard procedures for the characterization of components for commercial TES):

- Particularly: **PSA (Molten Salt Valves and Pressure Transducers)**

#### Tests performed:

- One valve has been tested at 565 °C maximum temperature, having in both cases similar stem packing configuration and materials.
- In the first test the open-close velocity was the initially given by the valve provider: the valve took 10 seconds to complete the opening process and 8 seconds to complete the closing process.
- In the second test a delay system was installed in the opening and closing process so that the valve took 40 seconds to complete the opening process and 25 seconds to complete the closing process.

- **Updates:**

- No test performed since the building where the BES test system is installed is being refurbished. Work started in November 2021 and is scheduled for completion in July 2022. (CIEMAT)



## Main achievements after 12 months

- CIEMAT
  - No test performed since the building where the BES test system is installed is being refurbished. Work started in November 2021 and is was scheduled for completion in July 2022. Due to problems in the supply of materials, with considerable delays in their receipt, the new schedule is January 2023.
  - CIEMAT has contacted a company interested in supplying a molten salt pressure sensor for testing.



**Main achievements (Task 6.4 - Establishment of standard procedures for the characterization of components for commercial TES):**

- Particularly: **CYI** (heat tracing and salt loop preheating elements)

**Tests performed:**

- Two different technologies have been / are tested: Mineral Insulated, flexible fiberglass heating tape
- Testing parameters: outdoor conditions / seasonal testing (humidity), continuous vs ON/OFF operation, contact with molten salt, corresponding time
- **Updates:**
  - Run tests on life cycling of the specific components
  - Characterization of the operation based on different environmental conditions.



CYI



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**Main achievements (Task 6.4 - Establishment of standard procedures for the characterization of components for commercial TES):.**

- **Updates:**

Local company specialized on heating elements has approached CYI and requested to test two of their components that are built in-house.

Particularly, they have requested to run some tests on their on design and manufactured:

- ) Polyimide Film Heaters (also know as Kapton Heaters)

- ) Ceramic Heating Elements

We expect to receive the prototypes in Q1 of 2023, and run some test in Q2 and Q3.



CYI



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### Overall status of implementation (II):

MS no.	Milestone Title	Lead beneficiary	Due date	Actual/ Expected date	Status / Comments
MS 16	Definition of commercial components	CYI	6	submitted	Brief Report
MSX					
MSX					

### Challenges and problems (if relevant):

#### In terms of WP Coordination and Management

#### In terms of outputs / results achievement

Given that this task is experimental and tests have to be performed, there were several challenges that we had to face / and still facing, regarding the construction of the facilities, and running the experiments. Indicatively:

1. The building where the BES test system is installed is being refurbished. Work started in November 2021 and is scheduled for completion in July 2022. (CIEMAT UPDATED DATE Early 2023)
2. Delay in the delivery time of the purchased elements.
3. UEVORA – Challenges related to electricity cost -> delay in the completion of the facility

### Challenges and problems (if relevant):

#### Deviations from Annex 1 –Part A

#### Solutions implemented

### Upcoming actions - Next steps in planning (M48-M60):

**ALL (Under the coordination of CYI):**

- Exchange information regarding the testing procedures and the outcome of the individual tests.
- Participate to the Round Robin Test and perform tests with the same transmitter in their facilities (depending on the negotiations between CIEMAT and the industry. Compare the results of the round robin and prepare a testing guideline for testing components

**UPDATE: Industry proposed to run only one test in CIEMAT's Facility.**

- Engagement and collaboration with Solar Paces Task III

**FISE:**

Continue the tests regarding preventing material failure by mechanical and thermal stress

Additional test run will be performed at the high temperature strain gauges infrastructure

**CIEMAT:**

1 additional pressure sensor it is proposed to be tested during 2023.

Collaboration with the SolarPaces Task III (Solar Paces TaskIII leader)

**UEVORA:**

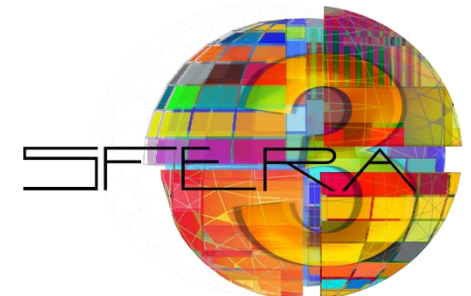
Finalization of the electrical commissions and preheat with hot air in parallel. Exchange experiences with CYI that has been working on hot air preheating in the past.

**ENEA:**

Perform the tests and finalize the on going test section

**CYI:**

Testing of the new heat tracing elements proposed by the local industry





THANK YOU FOR YOUR ATTENTION!  
ANY QUESTIONS?

