

Component performance tests at DLR's TESIS:com molten salt test facility

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Motivation

- Molten salt is an established storage medium and prospective working fluid in solar power plants with thermal energy storage [1]
- The harsh operating conditions in solar power plants together with the distinct physical properties of molten salt exert considerable stress on valves, fittings and measuring instruments
- Existing standards for component design and testing do not reflect these specific operating conditions (e.g. [2])
- Scientific work to investigate the behavior of molten salt components and to develop improved standards is, with some exceptions [3-4], hardly available
- Detailed investigations under relevant boundary conditions are the key to develop best practice test guidelines

The MSComp project

The MSComp project offers manufacturers an opportunity to qualify products for molten salt applications:

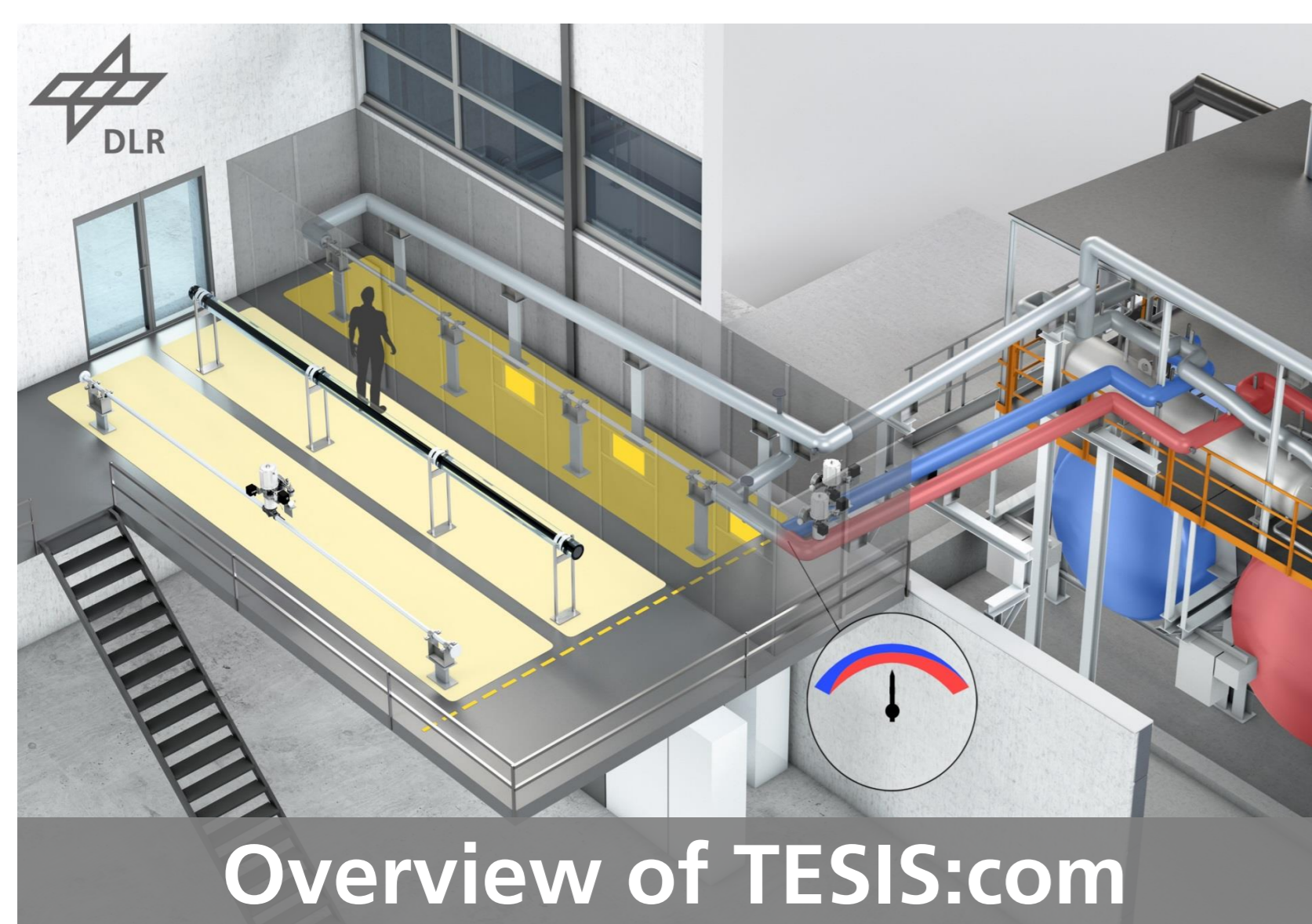
- Determine accuracies and improve reliability
- Derive best practice test guidelines from experimental data

Some of the common TESIS:com tests are e.g.:

- Mass flow ramps
- Temperature ramps and shocks
- Long-term experiments at various operating conditions
- Continuous open/close cycles for valves
- Pressure tests with leakage detection
- Molten salt freezing and melting experiments
- **Next test campaign with open slots for manufacturers is planned for spring 2021**

The TESIS:com molten salt test facility

DLR's Test Facility for Thermal Energy Storage in Molten Salt for component tests



Overview of TESIS:com



Interior view of TESIS:com

Description and technical details of TESIS:com:

- 2 x 8 m U-shaped DN50 pipe loop equipped with thermal insulation and trace heating (see image above on the right)
- Other pipe diameters can be easily realized with reducers and expanders
- Test components can be readily welded or flanged into the pipe loop
- Required measurement and control equipment is available on site
- Solar salt (60% NaNO₃, 40% KNO₃) is fed into the test section from a hot and/or a cold storage tank (marked red and blue, respectively, in the image above on the left)
- Mass flow rates between 0.5 kg/s and 8.0 kg/s can be produced
- Inlet temperatures between 290 °C and 560 °C can be realized
- Strong thermal gradients (shocks up to 50 K/s) can be imposed

References

- [1] Islam et al., "A comprehensive review of state-of-the-art concentrating solar power (CSP) technologies: Current status and research trends," *Renew. Sustain. Energy Rev*, vol. 91, pp. 987-1018, 2018.
- [2] EN 12266-1: Industrial valves – Testing of metallic valves – Part 1: Pressure tests, test procedures and acceptance criteria - Mandatory requirements, 2012.
- [3] Rodriguez-Garcia et al., "Procedures for testing valves and pressure transducers with molten salt," *Appl. Therm. Eng.*, vol. 101, pp. 139-146, 2016.
- [4] Welch, "Salt valve and instrumentation test using the nagle long shafted pump: final report," Sandia National Laboratories, 2013.

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