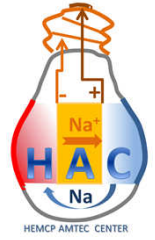


High Temperature Liquid Metals for Energy Technology

Overview of HAC facilities

W. Hering, W. Jäger, A. Jianu, A. Onea, N. Diez-de-los-Rios Ramos,
R. Stieglitz, P. Moster, M. Lux, S. Scherrer

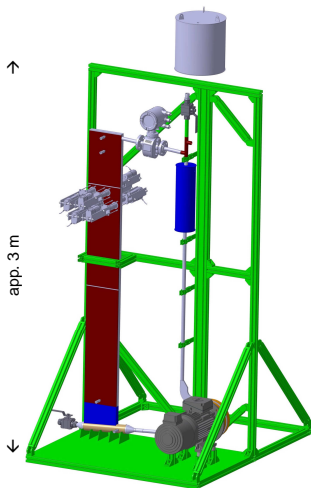


Scientific frame

- Efficiency enhancement of thermal energy systems (storage)
- Development of components in prototypical scale (performance & safety)
- Demonstration of combined cycles (thermal and thermo-electric)
- Fundamentals of single and two phase fluid dynamics
- Component interaction and dynamics

Objectives

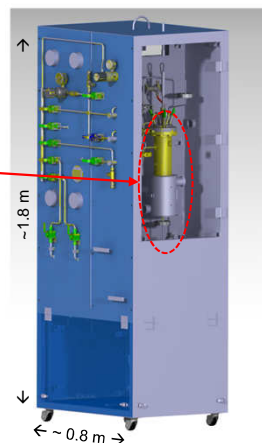
- Experimental data base from local to system scale
- Code validation and safety assessment of liquid metal operated systems (JASMIN, ESNII+, SESAME)
- Provision of a liquid metal design toolbox
- Liquid metal instrumentation development and qualification



Fundamental research: GaInSn test loop: DITEFA

Purpose:

- Qualification of instrumentation
- Proof of principle for high temperature LM designs
- Pre-test bed for thermal hydraulic experiments
- Validation experiment for operational and safety systems
- Education and training

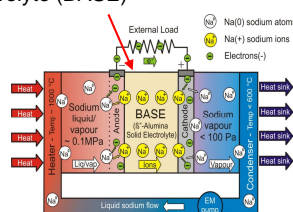


AMTEC Test Facility (ATEFA)

- Test device designed for 1000 °C
- Controlled Na-flow
- Safety related design:
 - Contained in an thermally isolated metallic container
 - Na and Ar installations separated
 - Emergency Na drainage
- Status: in construction

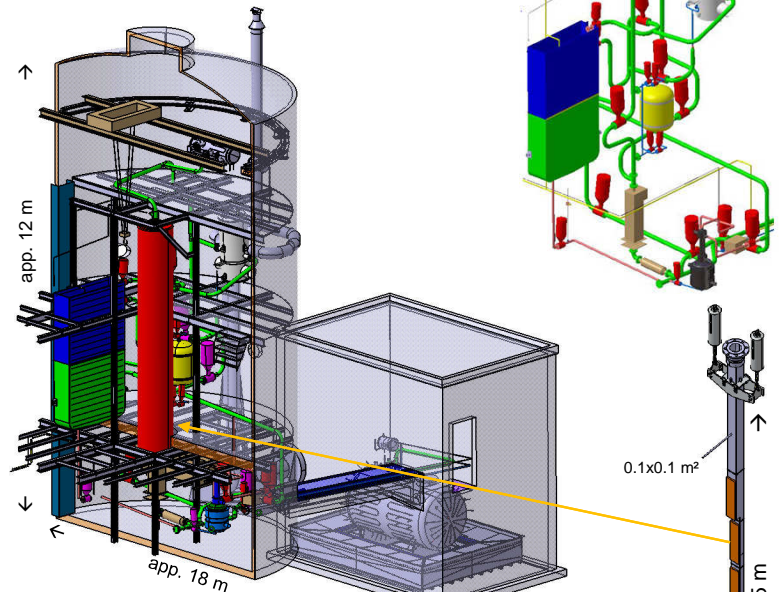
AMTEC operating principle

- Direct conversion of thermal energy into electricity
- Key component: β'' -Alumina Solid Electrolyte (BASE)
- Key process: Na-ionization (Δp across BASE)
- Recombination of Na^+ and e^- only at 3-phase boundaries: BASE – electrodes – Na



Current R&D fields

Renewable Energy (CSP), nuclear fission & fusion, thermo-electric conversion, thermal storage, accelerator application (target), ...



Karlsruhe Sodium Laboratory: KASOLA

- Medium scale facility: ~7 m³ Na, T_{max} : 550 °C, flow_{max} : 150 m³/h.
- 2 test ports for LIMTECH A1 and B1
- Integration of AMTEC and thermal storage (LIMTECH B4)
- Status:
 - Final integration and set into operation in Q3/15
 - First experimental work planned for Q4/15

Sodium Loop to test materials and corrosion: SOLTEC

- Family of three small scale facilities: ~12 l Na, T_{max} : 900 °C, flow_{max} : 0.3 m³/h
- Status:
 - Detailed design and construction in work
 - Set into operation planned for Q4/15
 - First experimental work Q4/15
- Detailed objectives:
 - Low cycle fatigue and corrosion for high temperature materials
 - Thermal transient loads with different temperature ramps
 - Long-term AMTEC test facility

