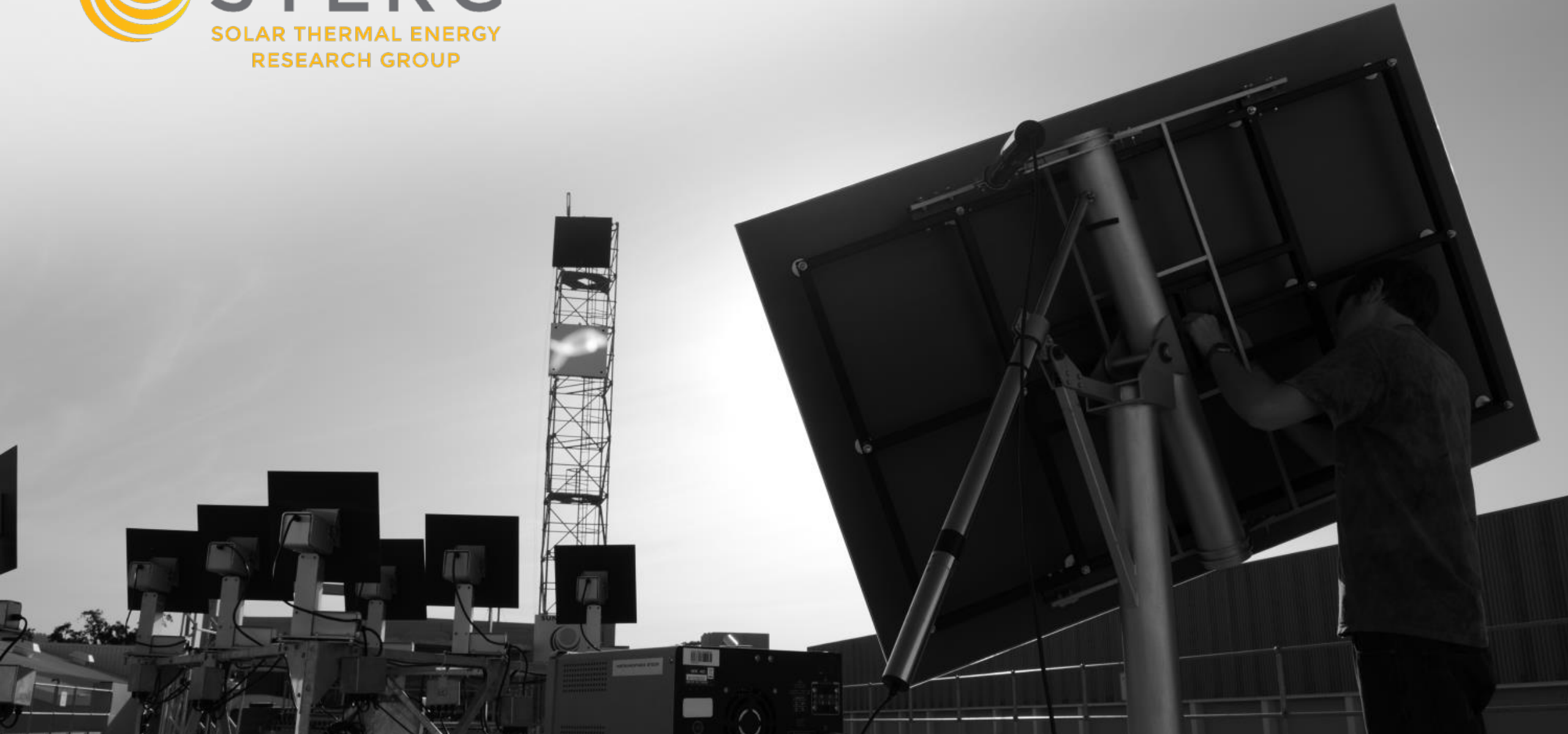




STERG

SOLAR THERMAL ENERGY
RESEARCH GROUP



Commissioning of an Experimental Test — Facility for Thermal Energy Storage in a Packed Bed of Rocks

Henk Laubscher

Supervisors: F. Dinter, T. W. von Backström
Solar Thermal Energy Research Group (STERG),
University of Stellenbosch

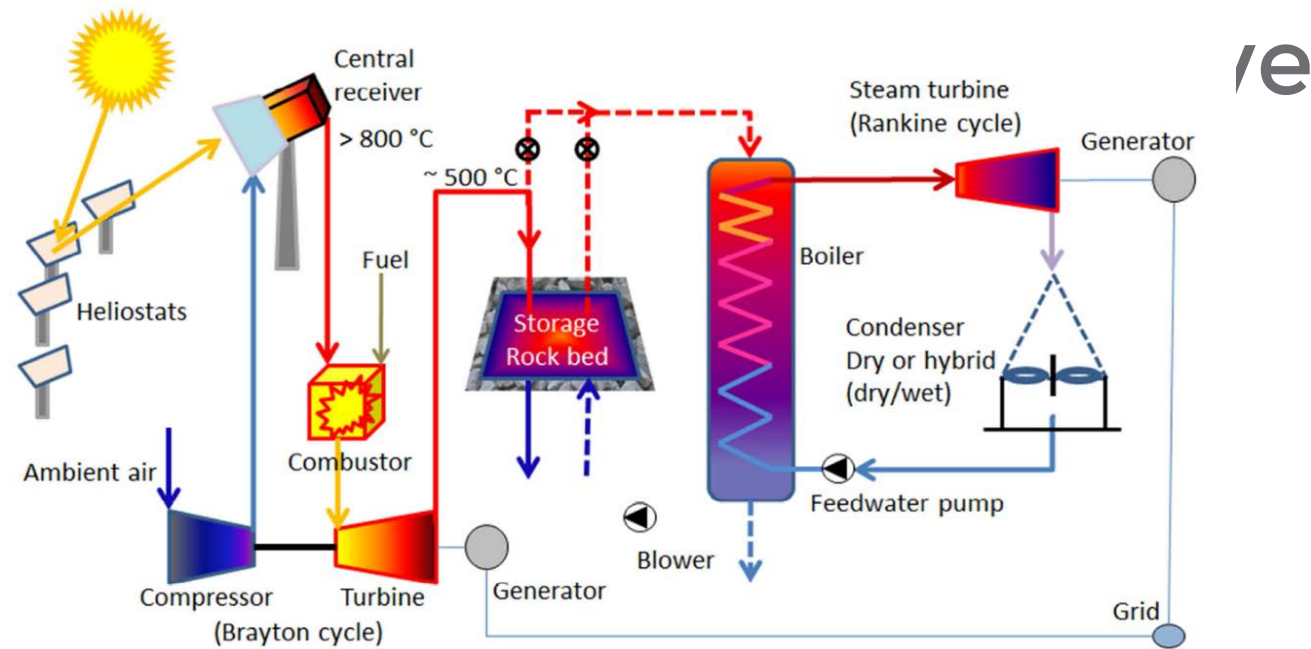
Introduction



- Thermal Energy Storage System (TESS)

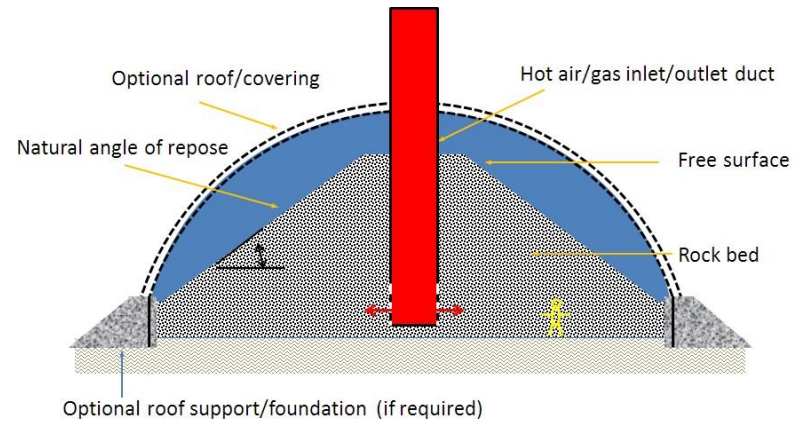
- Energy Storage application for CSP

- Packec
mediur

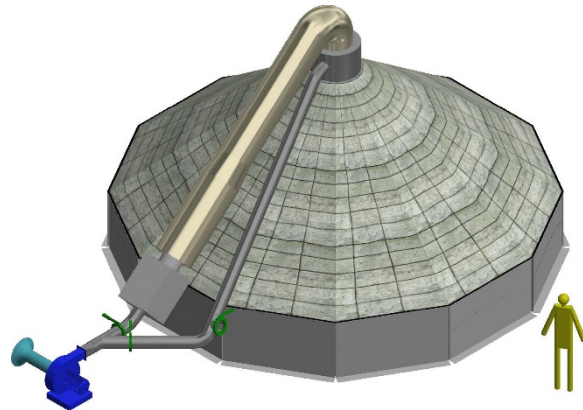


SUNSPOT Cycle (Kröger 2012)

Thermal energy storage project



Rock-Bed Thermal Storage: conceptual layout (Gauché, 2014)



Rock Bed Thermal Storage: experimental design: base diameter = 7 m



Rock Bed Thermal Storage: Construction Photos

Overview



- Motivation and Objectives
- Research Method
- Experimental work: Modus Operandi
- Results
- Lessons learnt
- Conclusion



Motivation and Objectives



- Potential for Cost reduction in CSP and other thermal storage applications
- Investment in STERG research facility
- Pioneering experimental data
- Comparison between CFD, analytic and experimental results

Initial design specifications

Research Method

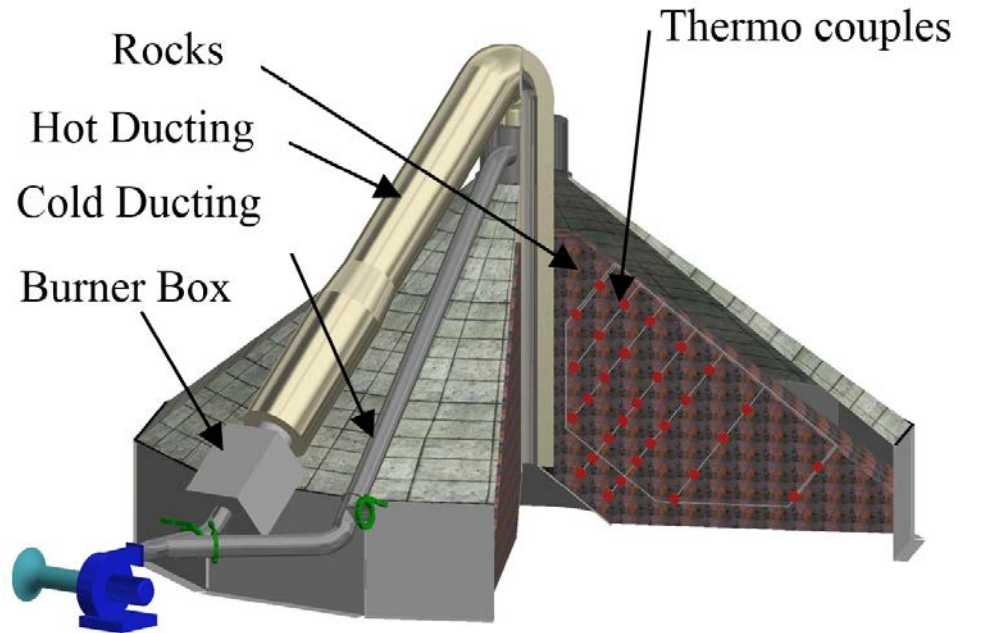


- Analytical calculation of the system
- CFD analysis via use of porous model
- Experimental data gathered from tests
- Validate CFD and analytical model with experimental results
 - Adapt model for simulation of real storage behaviour according to measurements

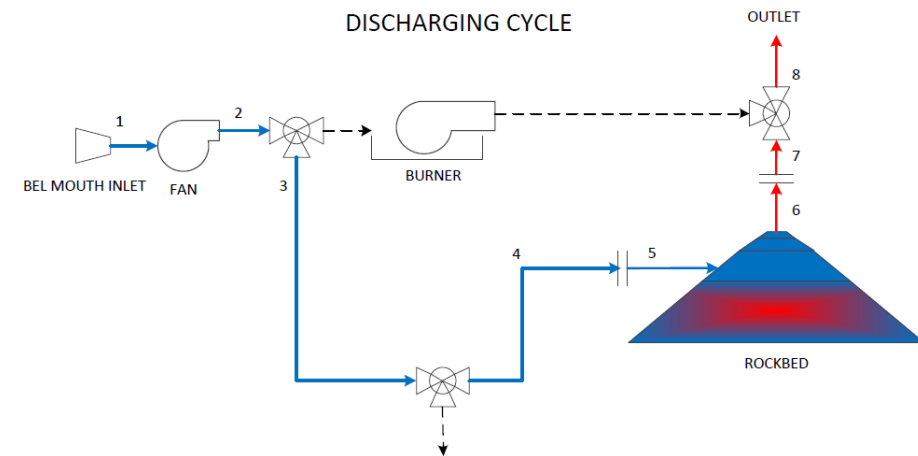
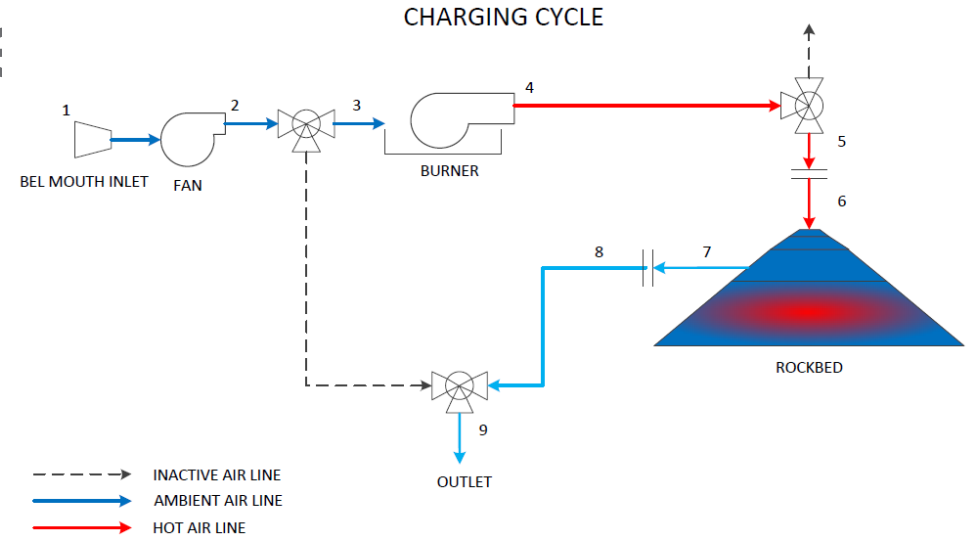
Experimental work: Modus Operandi



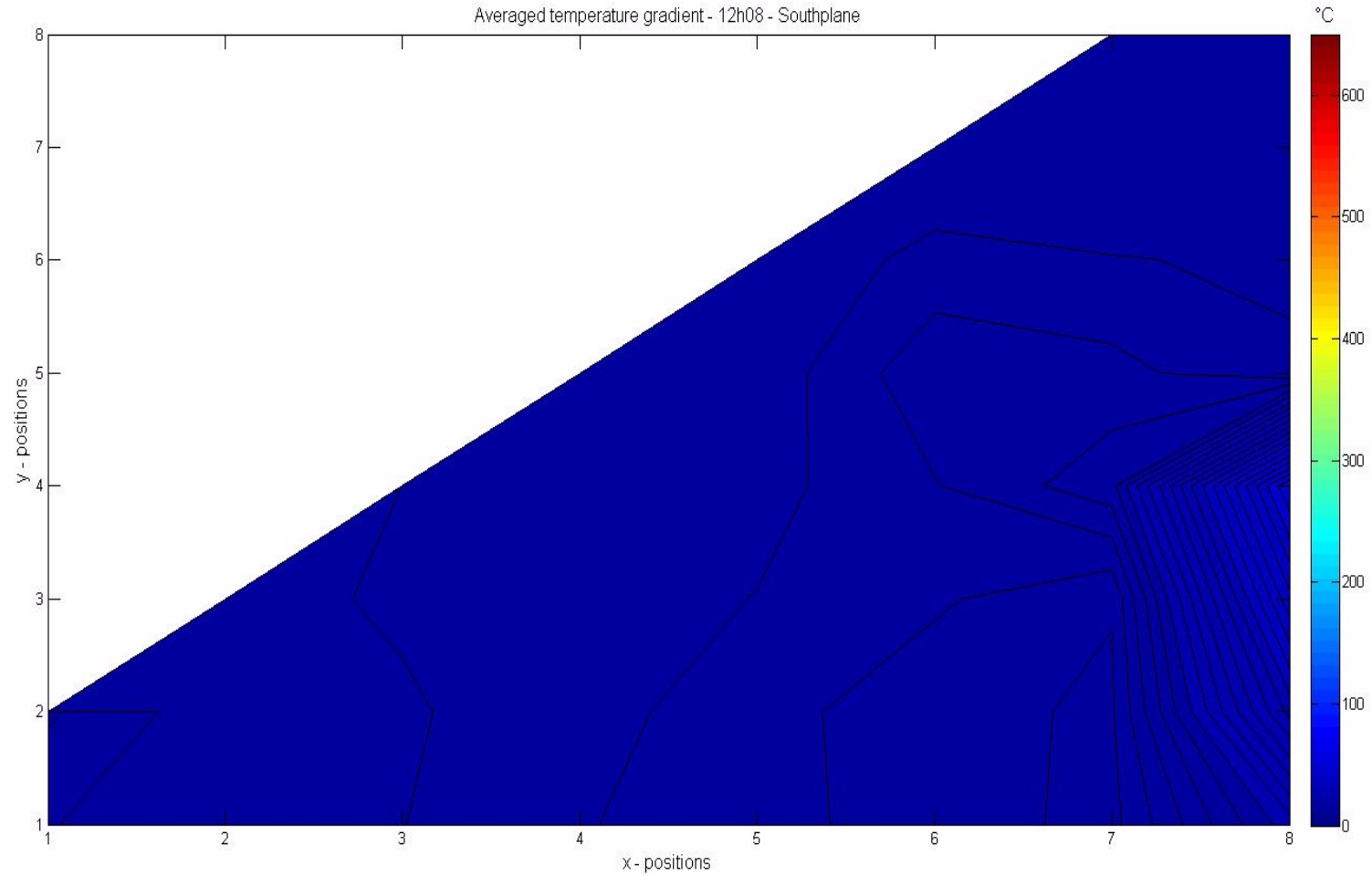
Experimental layout for thermal energy storage system



Rock Bed Thermal Storage experimental layout



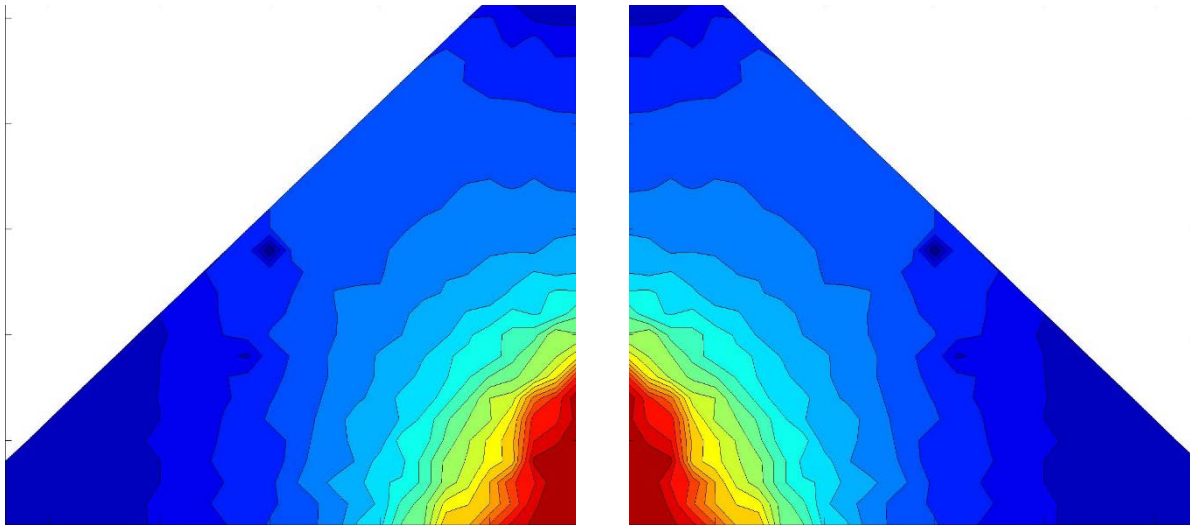
Results: Charging



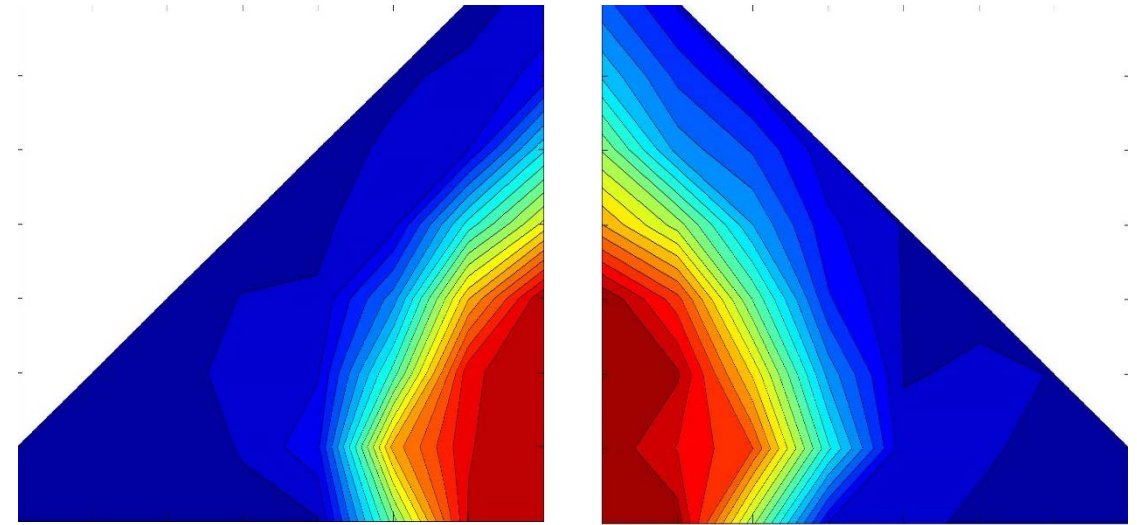
Results continued



Temperature distribution: comparison of simulated and measured data

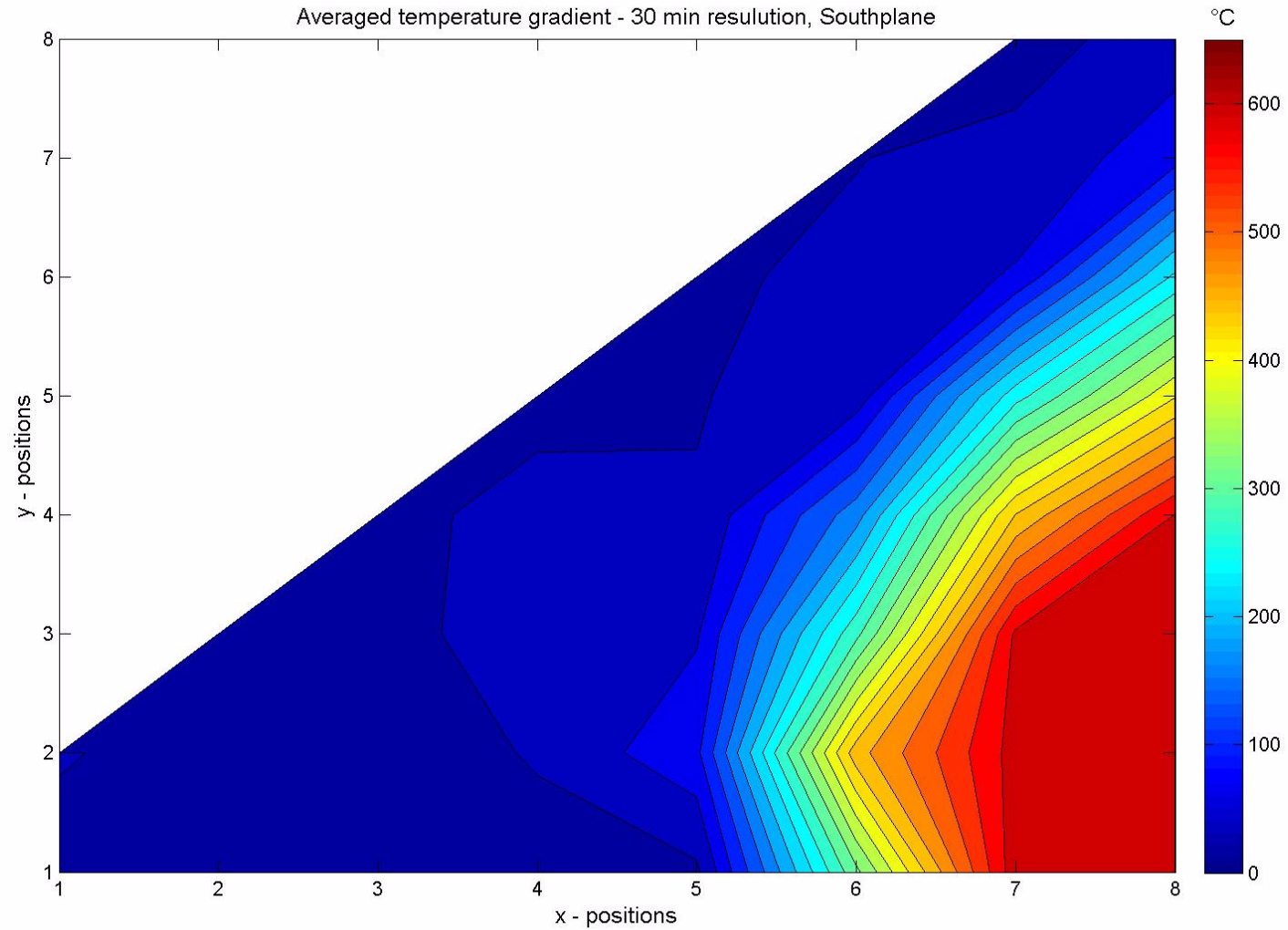


Simulated qualitative temperature profile in a cross sectional plane



Measured qualitative temperature profile in a cross sectional plane

Results: Idling thermal profile



Lessons learnt during experiments



- Significant buoyancy effect in packed bed
 - Temperature profile during idling
 - Effectivity of the discharging method
 - Energy storage potential for long periods
- Wind effects on the temperature profile

Conclusion



- Cost effective concept for thermal energy storage
- Simulated results validated with experimental results
- Future work: improved design on the storage medium configuration
- Improved operational strategies

Thank you

ACKNOWLEDGEMENTS:

My supervisors for giving me the opportunity and believing in me. Great thanks to the NRF for funding.

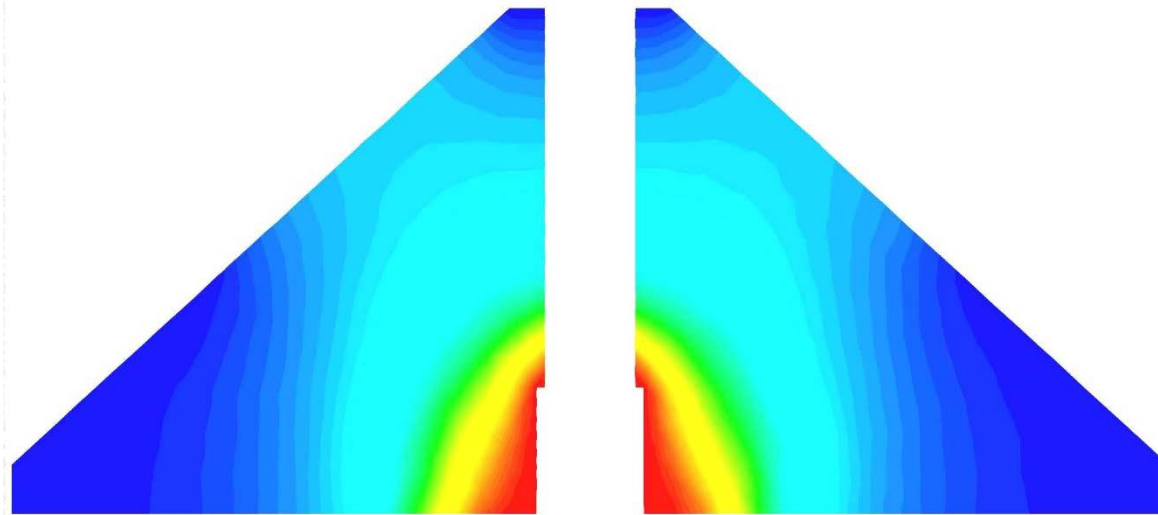
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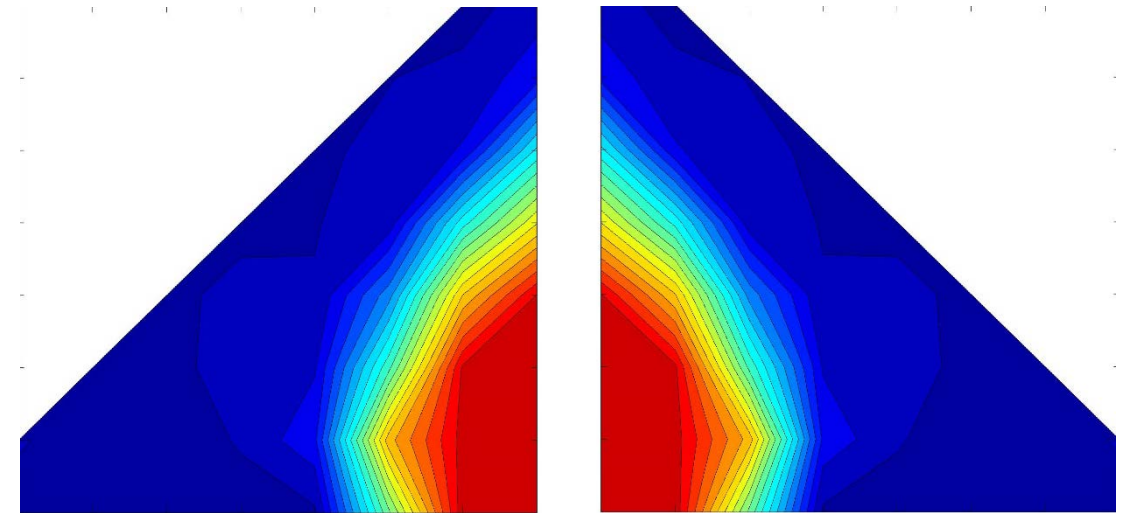
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Simulation Results Comparison



Raw CFD results



Measured results