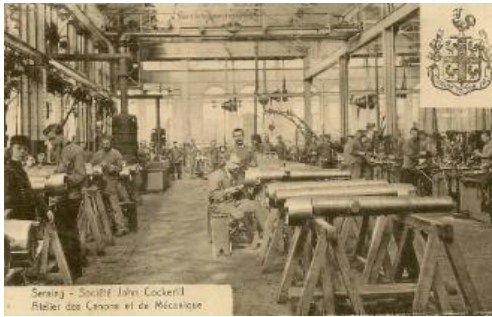
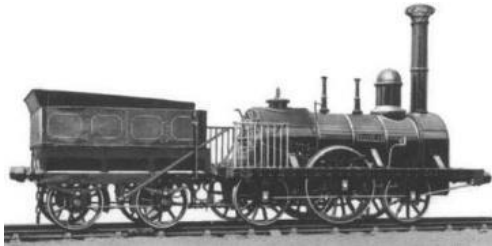


How to Design, Construct and Operate CSP Towers with molten salt storage

06/05/2020

200 years of industrial experience...

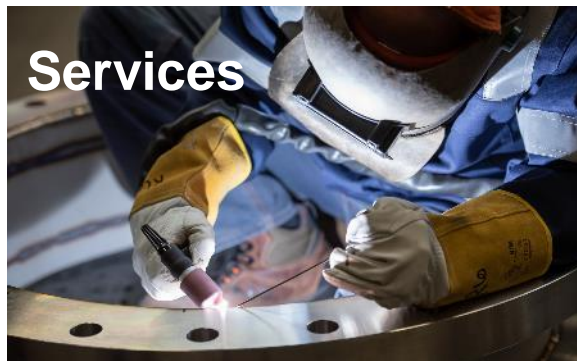
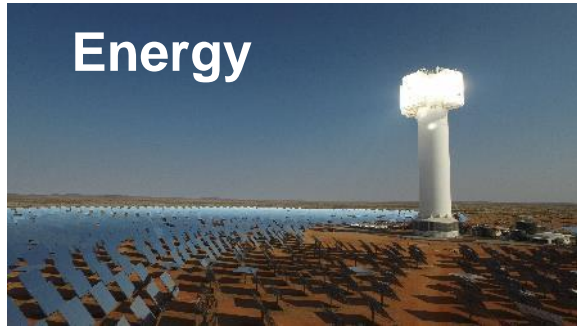
To respond to the needs of our time



Learning from the past to build a better future.



Our sectors of activity



Energy sector



Heat recovery
steam generators



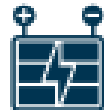
Industrial
boilers



Concentrated Solar
Power energy



After-sales expertise
& services



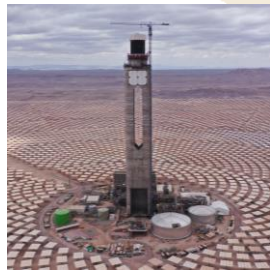
Storage of
energy



Hydrogen
Solutions



Solar receivers all around the world



*Cerro Dominador, Chile
Molten Salt Receiver
2014*



*Khi Solar I, South Africa
Direct Steam Generation
2012*



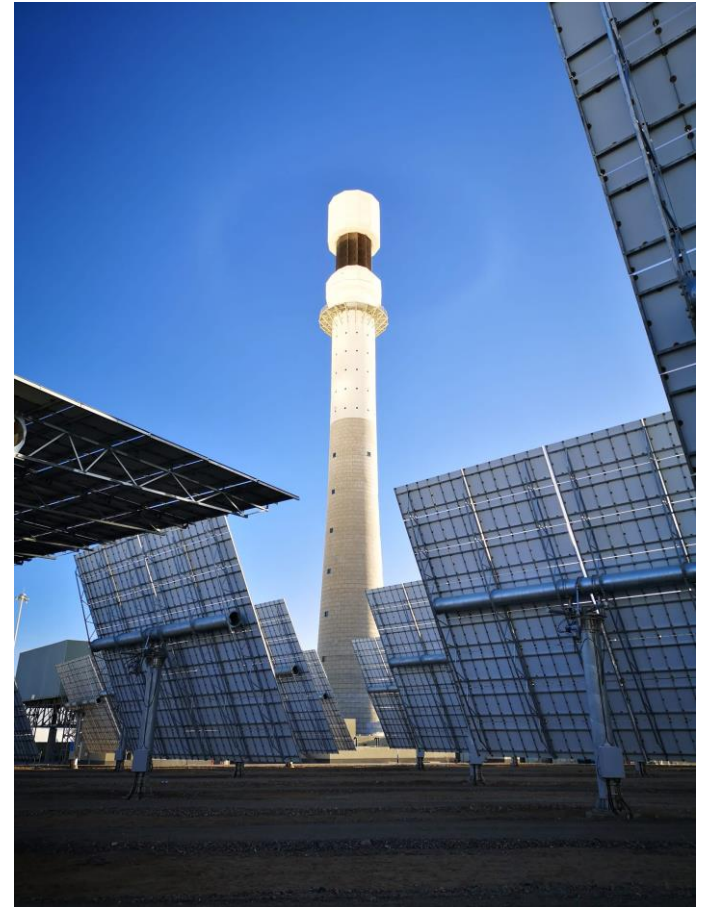
*DEWA, Dubai
Molten Salt Receiver
2018*



*Haixi, China
Molten Salt
Receiver
2017*



Haixi Project



Molten Salt Steam Generator

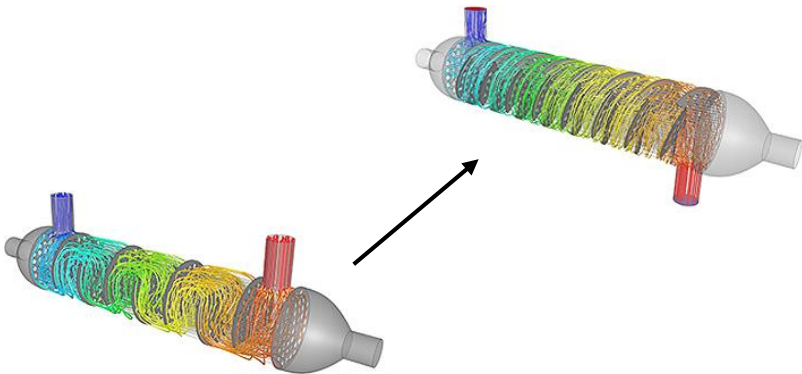
General arrangement



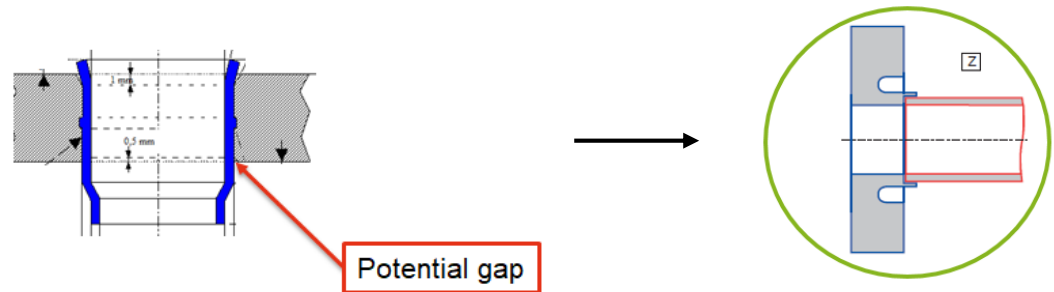
Mock-up



Helical baffles



Internal bore welding



Solar Receiver Design challenges

Stress

Fatigue

Corrosion

Strain

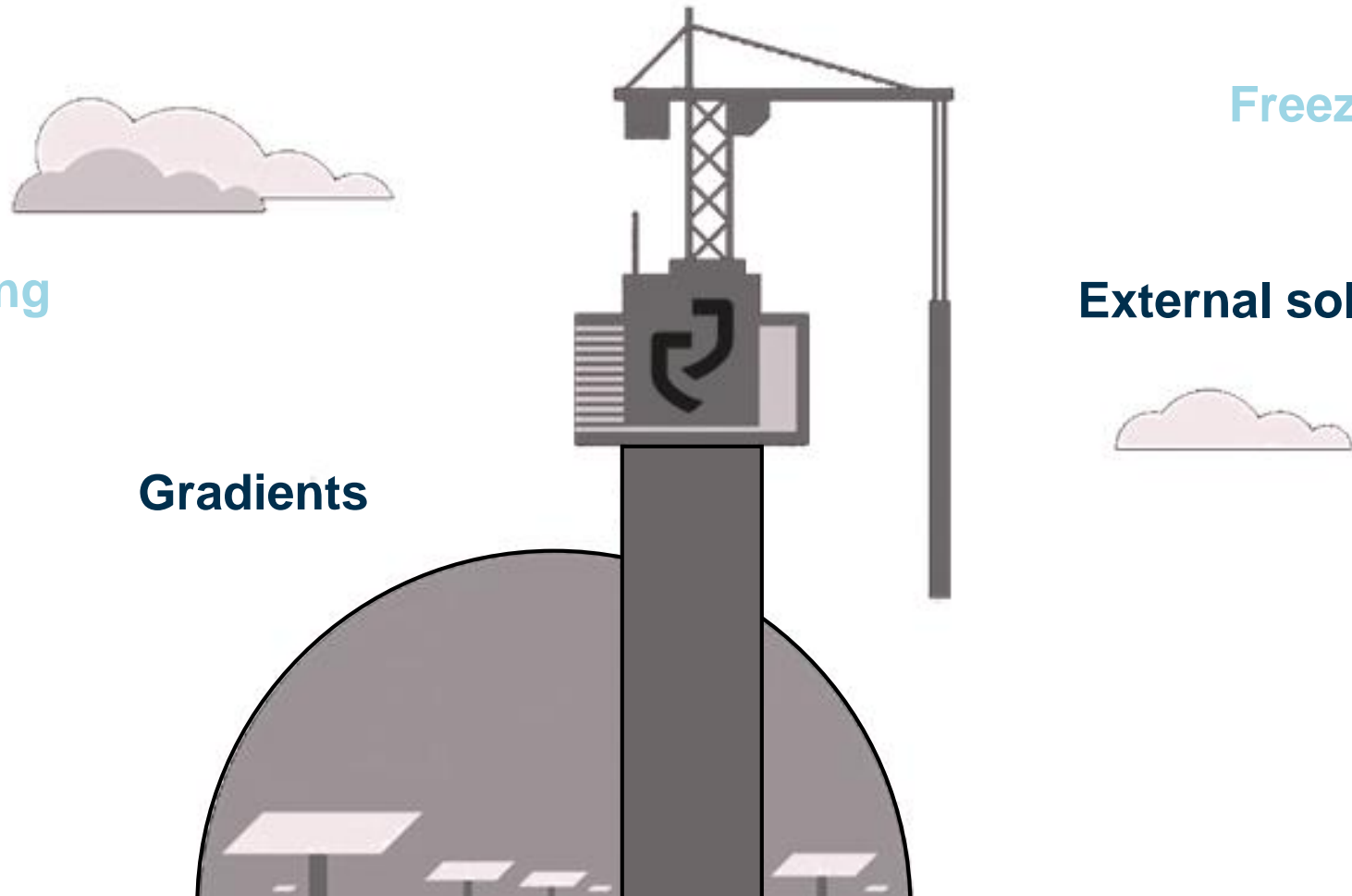
Freezing

Thermal cycling

External sollicitations

Gradients

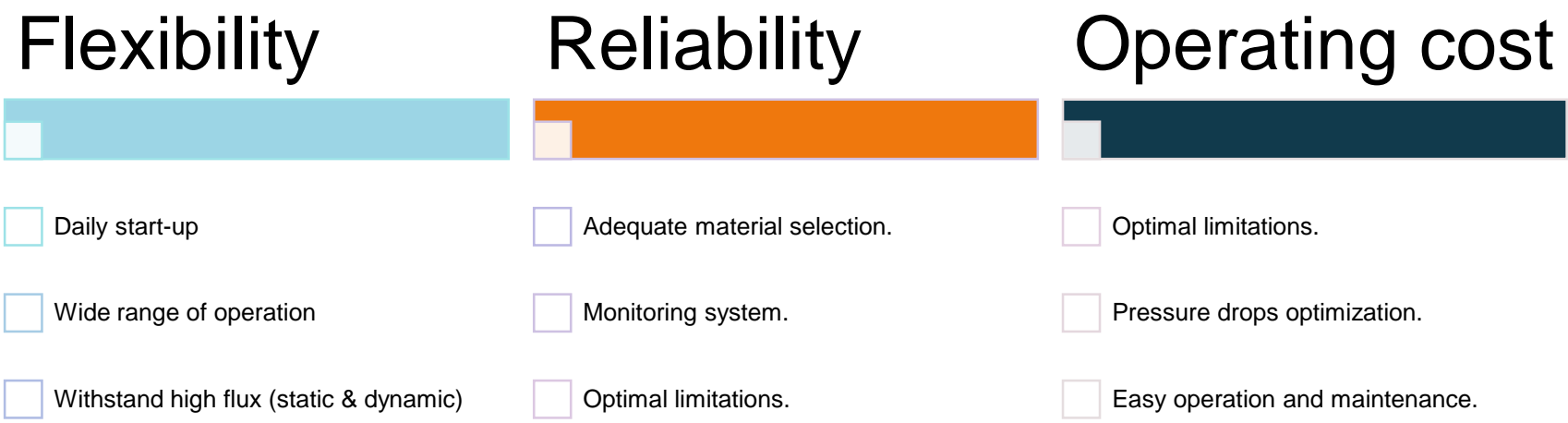
Creep



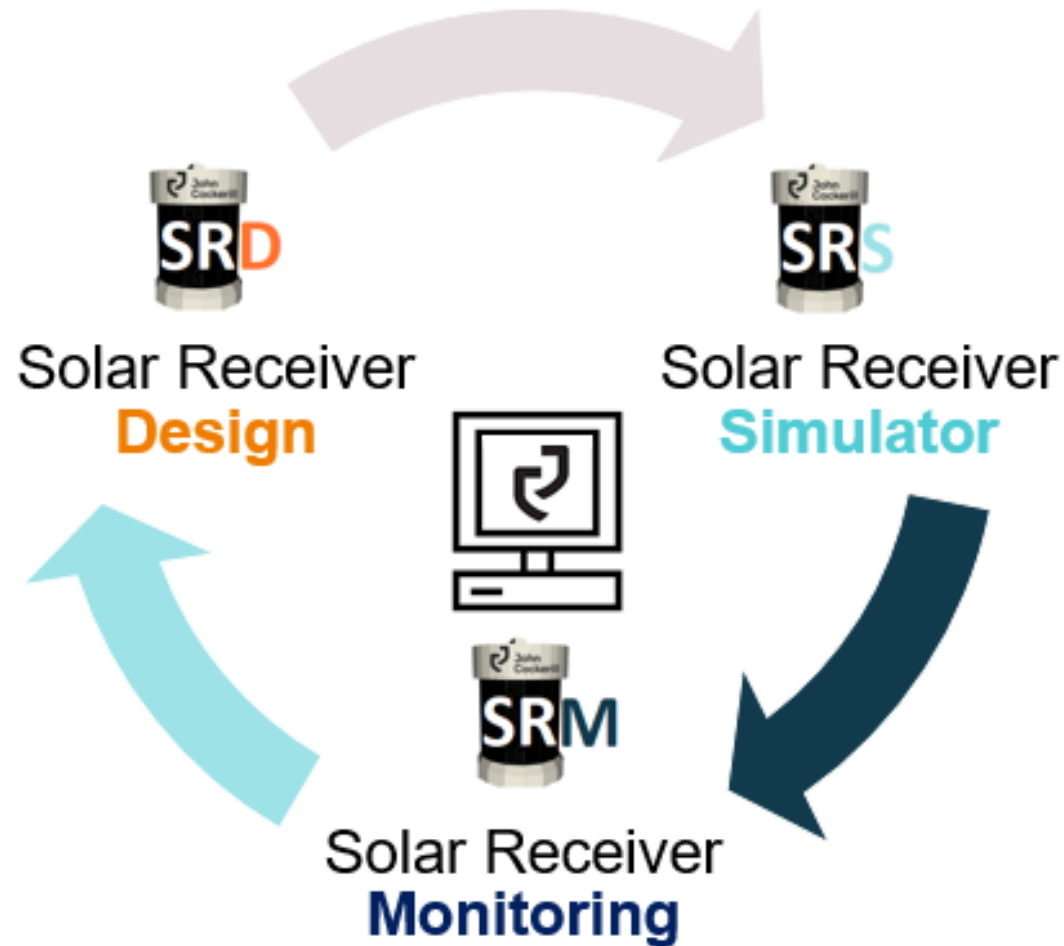
Solar Receiver Design Criteria



Independent Solar Receiver Provider



John Cockerill Software Suite





Solar Receiver **Design**

Stage

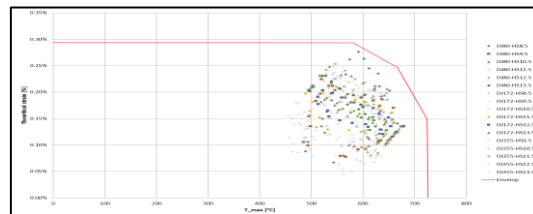
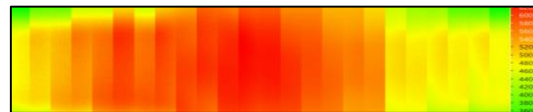
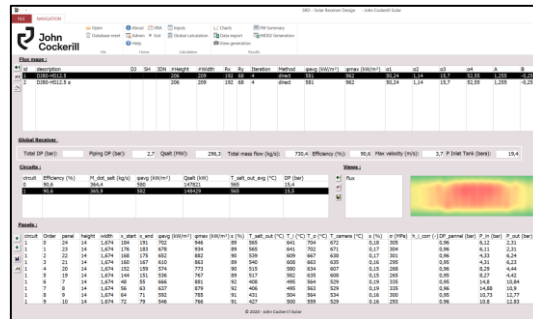
Proposal

Type

Steady state (static)

Main goals

To define **receiver dimensions** and to check internal **design criteria**

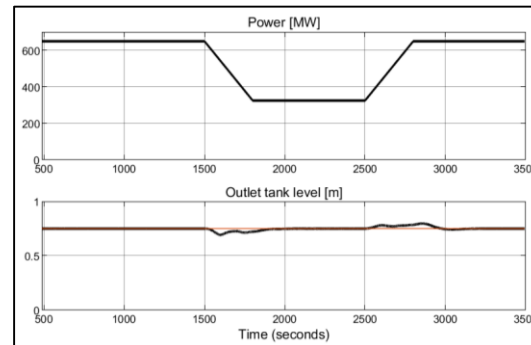


Solar Receiver **Simulator**

Project

Transient (dynamic)

To check the solar receiver response to **external dynamic solicitations**

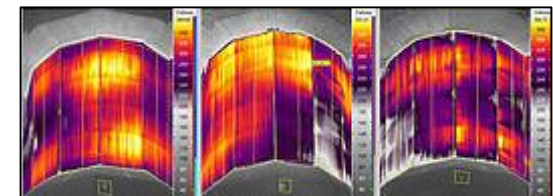
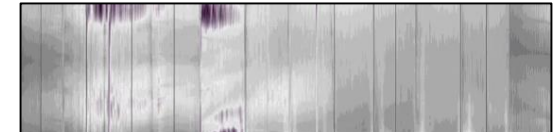


Solar Receiver **Monitoring**

Operation

Live

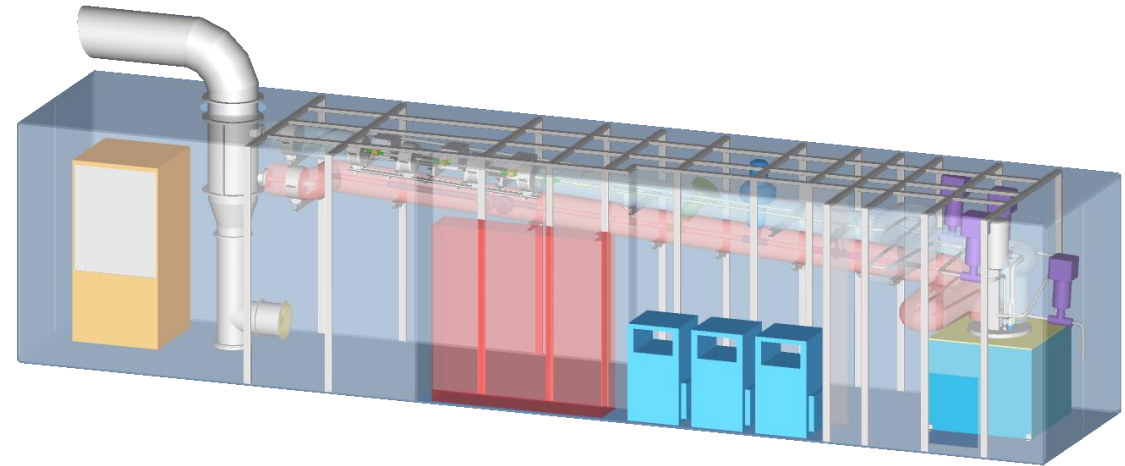
To ensure solar receiver **integrity** and analyse **data**



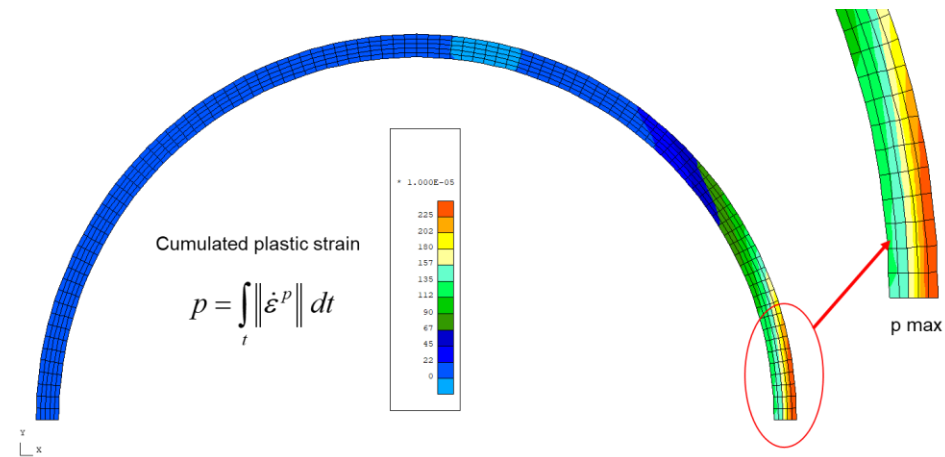
Focus on lifetime

■ Corrosion test loop

- ✓ Corrosion tests
- ✓ Heat exchange coefficient tests
- ✓ Erosion tests
- ✓ Sensitivity studies
- ✓ Material behavior
- ✓ Fluid behavior

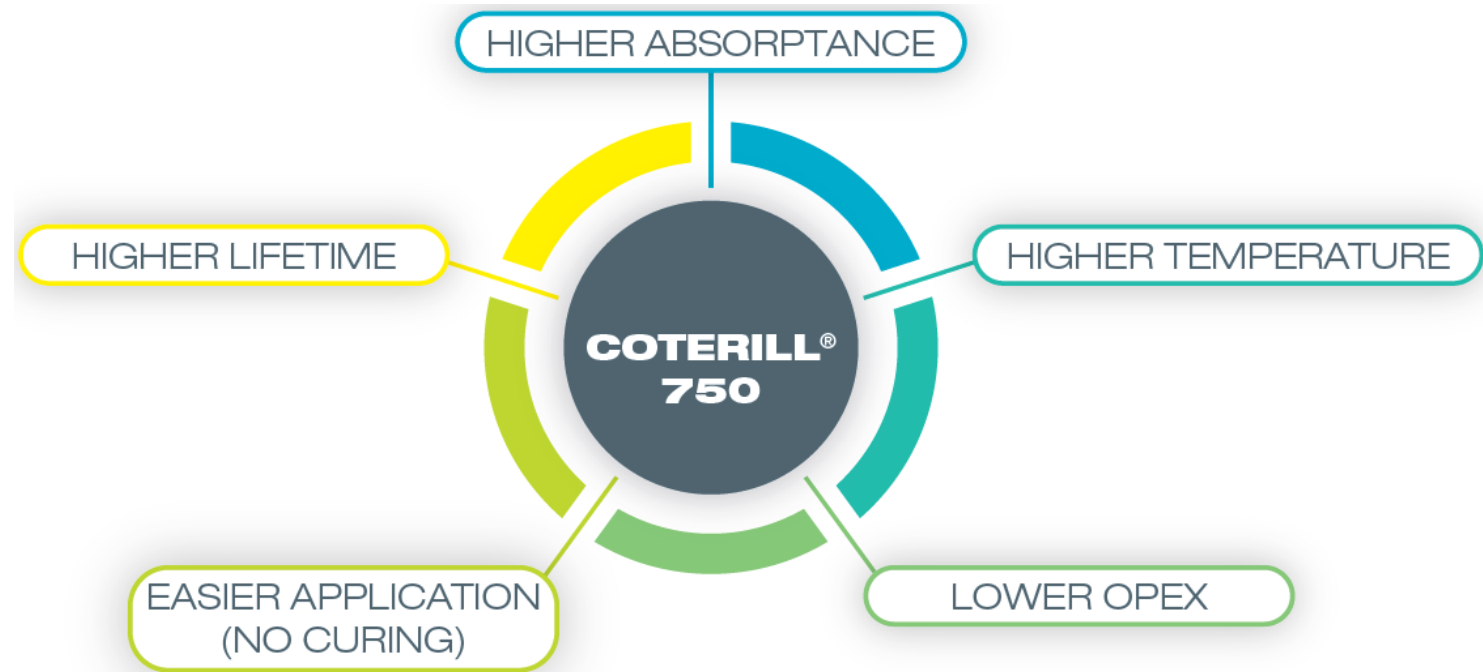


■ Constitutive model for materials



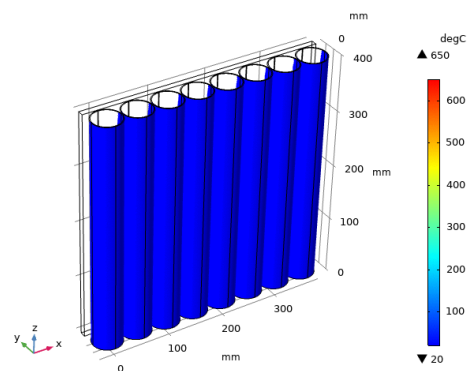
Focus on Performances

- John Cockerill coating

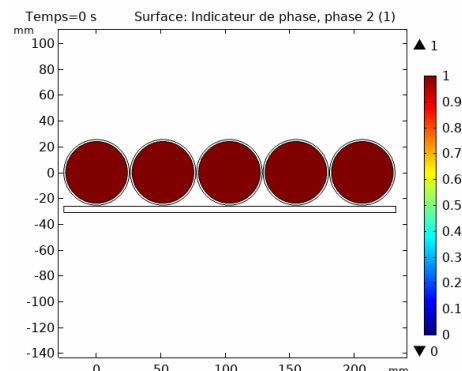


Focus on Performances

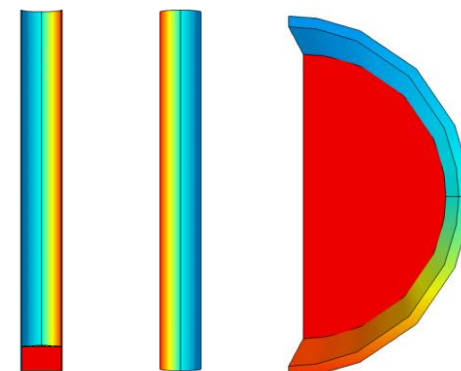
- Simulations :



Preheating

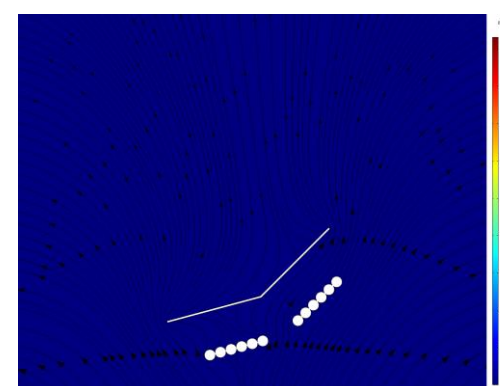
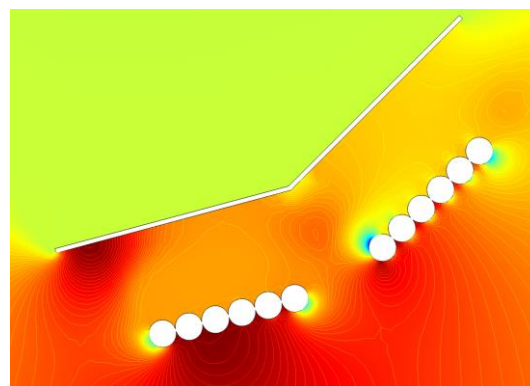
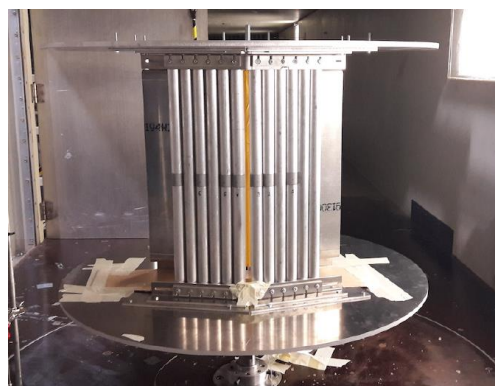


freezing



filling

- Wind tunnel study



Conclusions

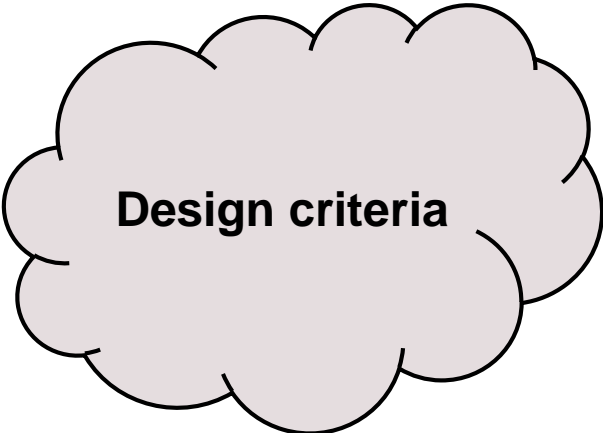
200 YEARS OF FUTURE



Solar Receiver
Design



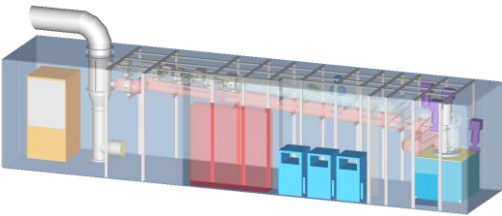
Solar Receiver
Simulator



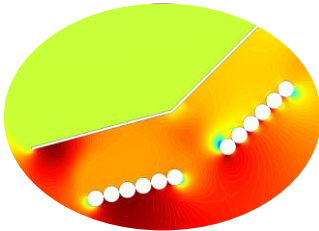
Solar Receiver
Monitoring



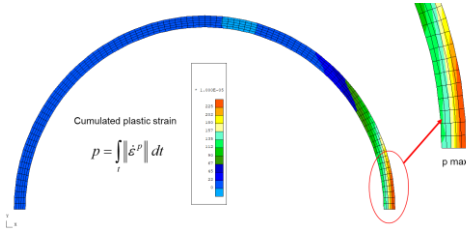
Lessons learnt



Test bench



Wind tunnel



Simulations



Constitutive model



Thank you

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