SOCRATCES

Solar Calcium looping integRAtion for Thermo-Chemical Energy Storage

SOCRATCES WEBINAR 10 June 2021

SOLAR CALCIUM-LOOPING INTEGRATION FOR THERMO-CHEMICAL ENERGY STORAGE

SOCRATCES

High Temperature Solar-Thermal technology and Calcination Integration. Prototype Construction and Integration

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SOLAR CALCIUM-LOOPING INTEGRATION FOR THERMO-CHEMICAL ENERGY STORAGE

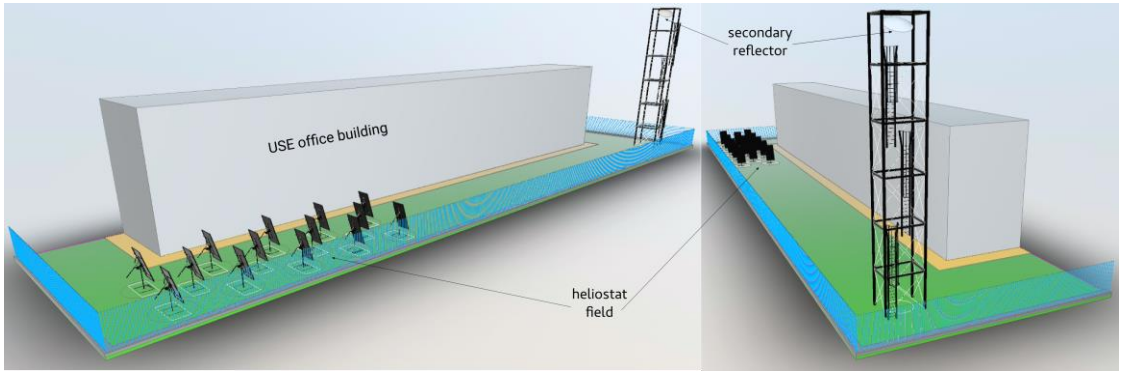
AGENDA

- Solar Field design (heliostats and secondary reflector)
- Solar calciner cavity design
- Systems integration
- Construction/EPC including calciner/solar tower
- SF control and control integration
- Operation and testing (following weeks!!)

SOLAR FIELD (SF) DESIGN

Solar Field design constraints:

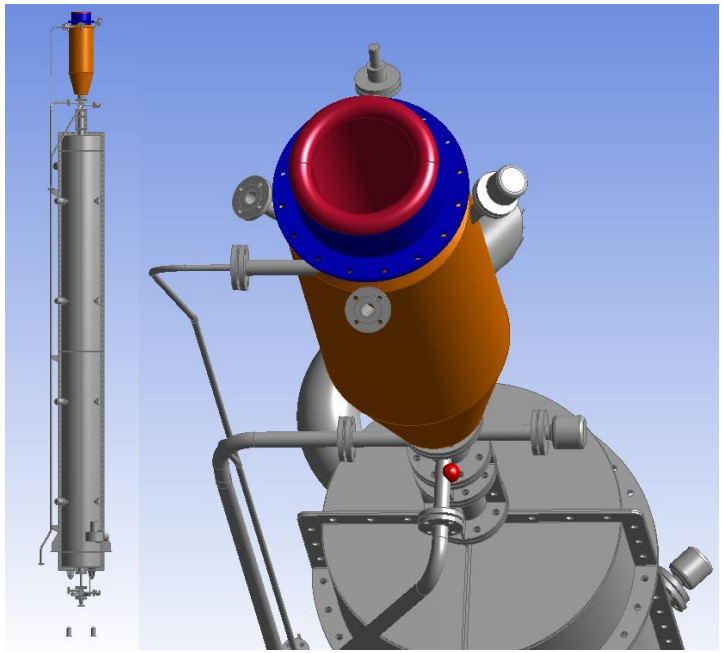
- Entrained Flow → vertical beam → secondary reflector (SR)
- Available space
- Available €



Montecarlo Raytracing → conceptual and basic design:

- Number and shape of heliostats (selection)
- Elevation and position of tower, SF and SR

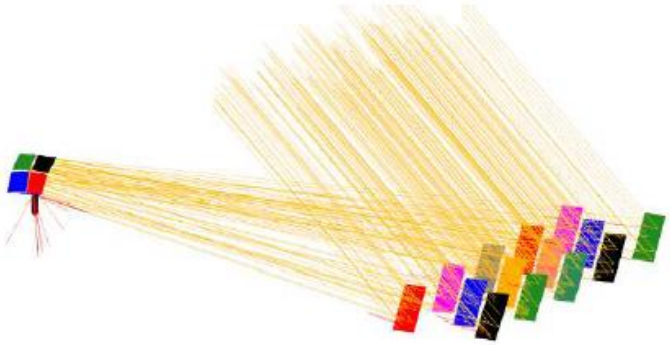
SOLAR FIELD DESIGN: Design point June 21st at mid-day

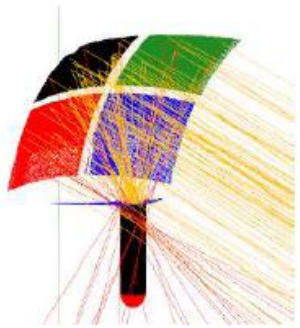


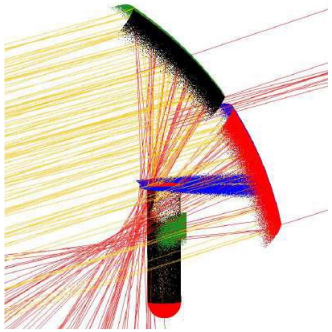
Indirect calcination cavity

Goals:

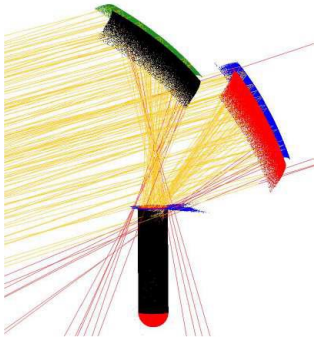
- ~20 kW_{opt} on squared centimeters
- T>950ºC
- Even radiation distribution on cavity



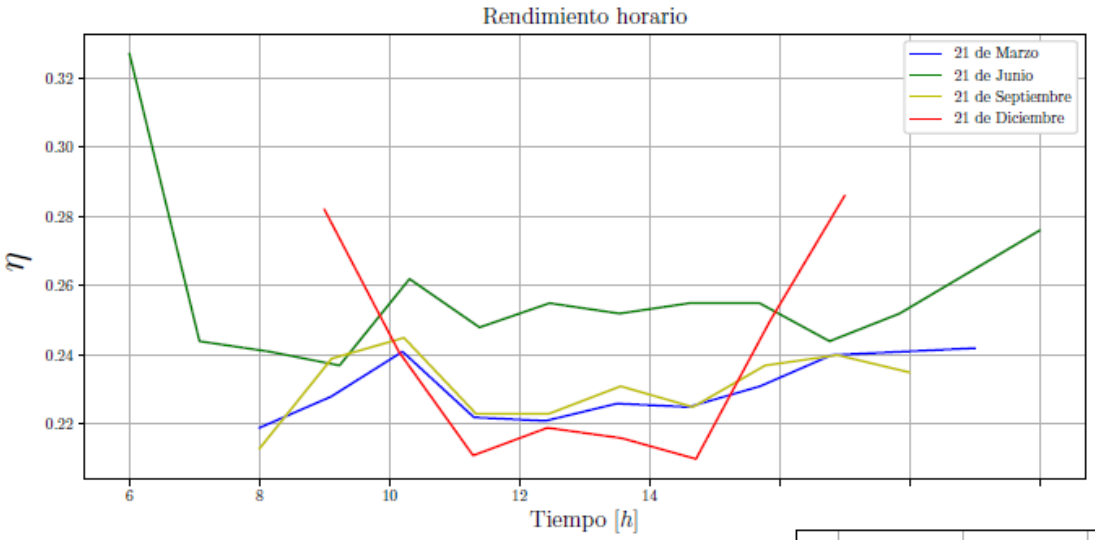




Iterative process

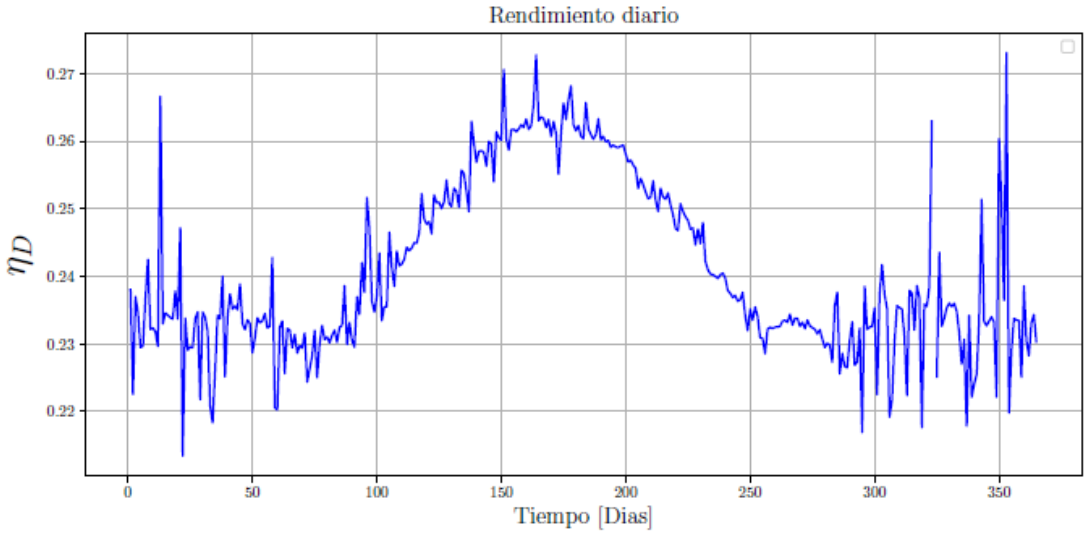


SOLAR FIELD DESIGN: off-design performance

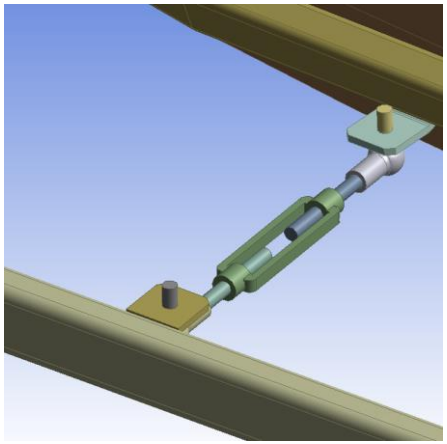


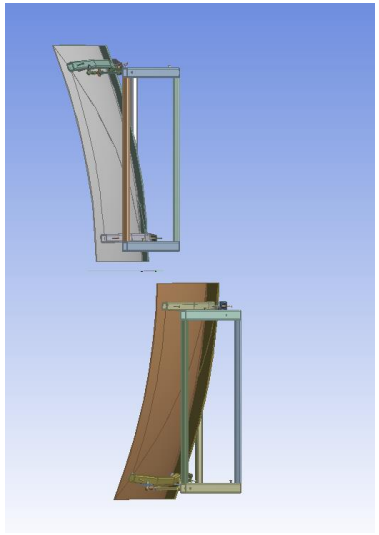
Performance during a day

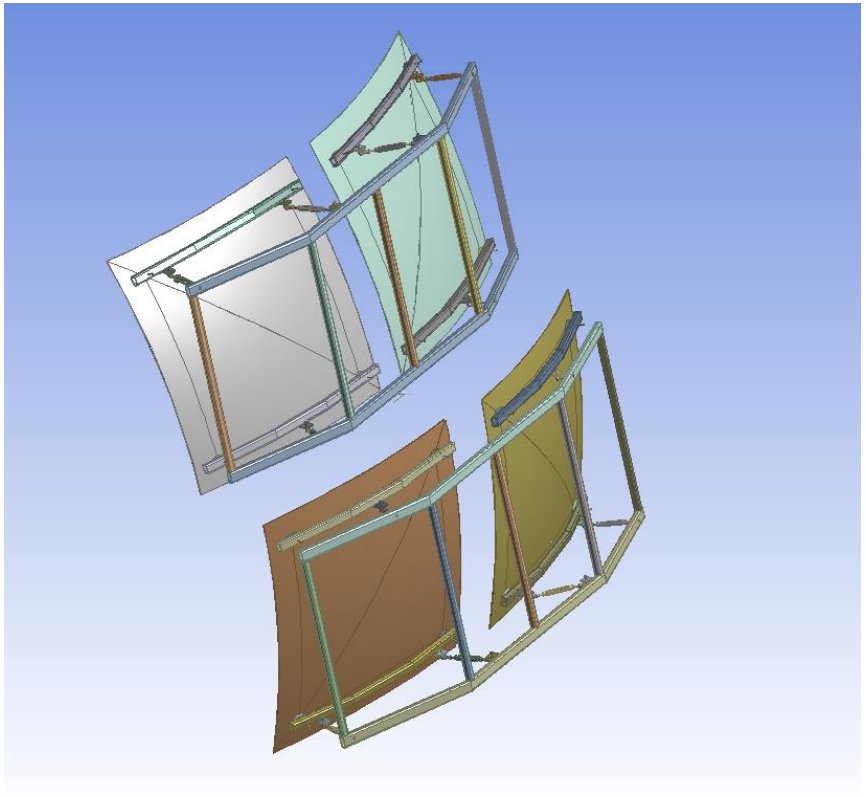
Performance during the year

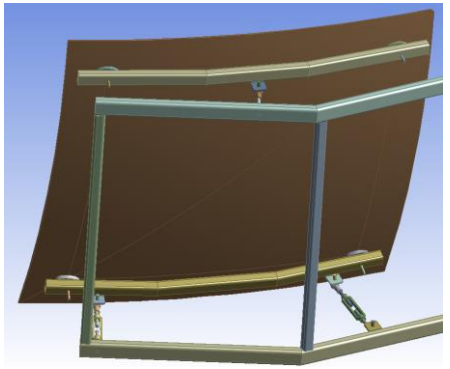


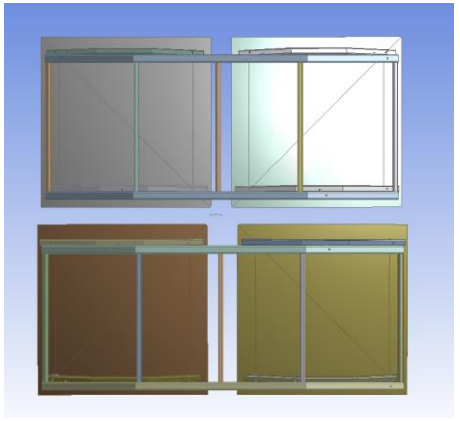
SOLAR FIELD DESIGN: SECONDARY REFLECTOR





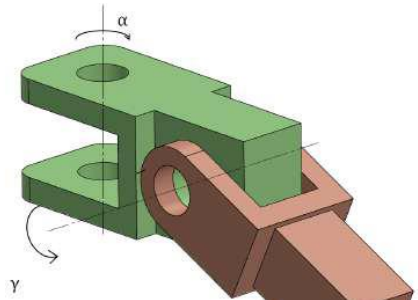


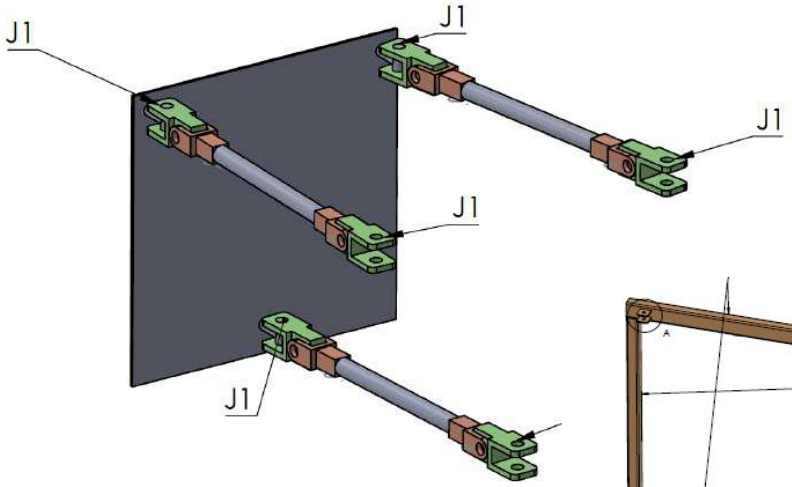


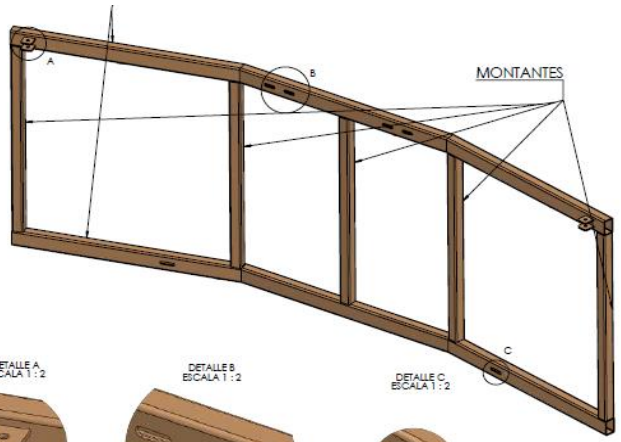


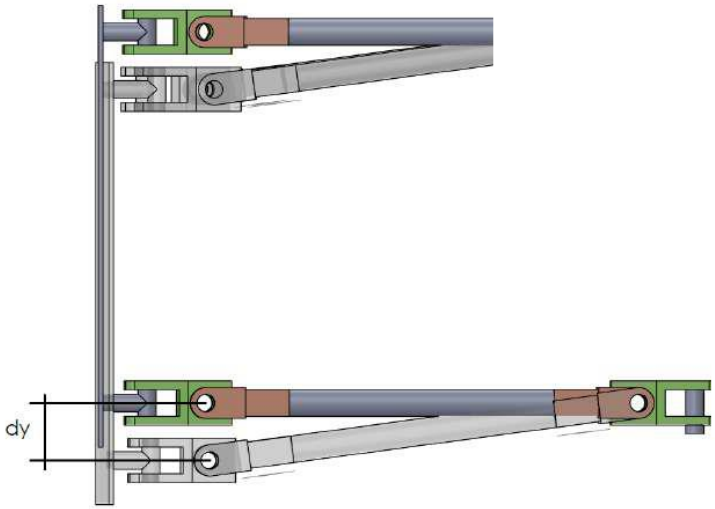
- Articulated substructure
- Fine-tuning during operation

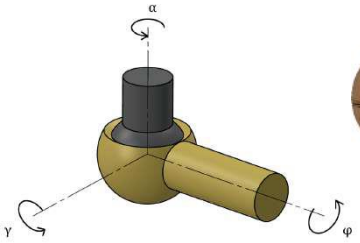
SOLAR FIELD DESIGN: SECONDARY REFLECTOR MECHANISM



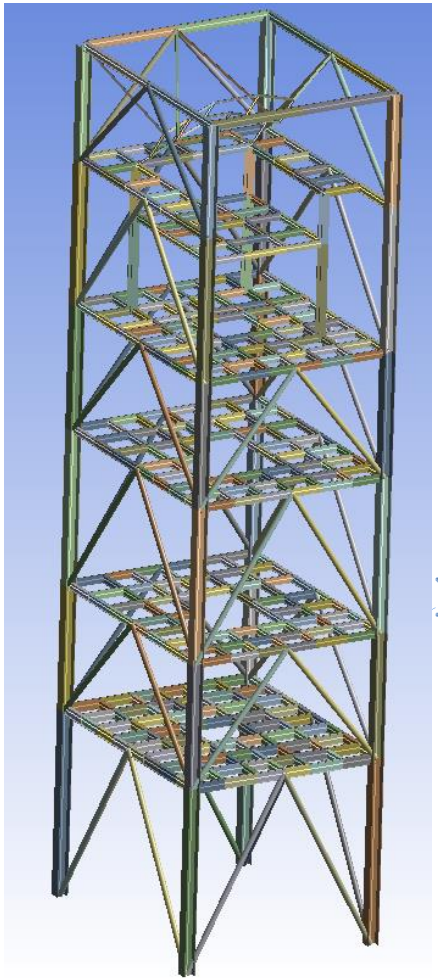


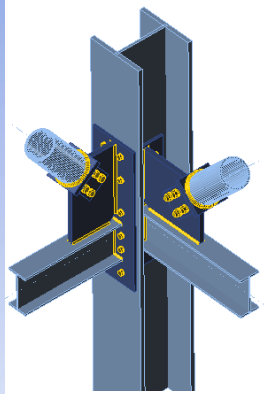


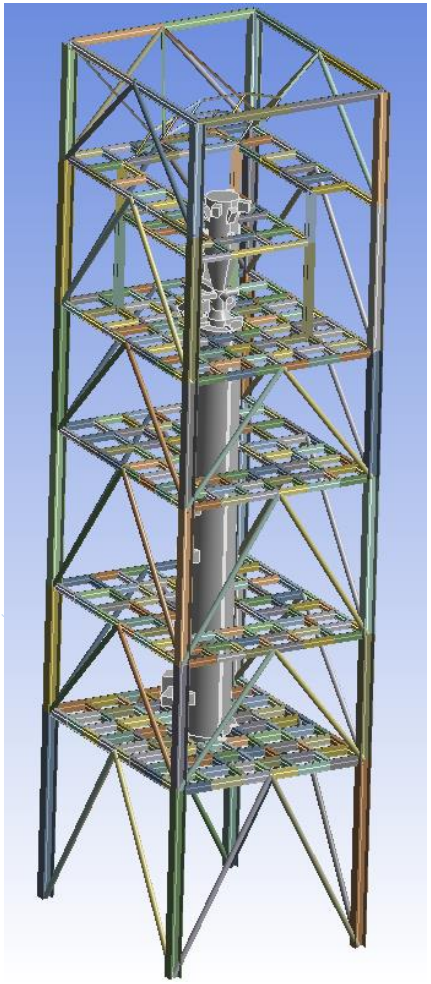




SOLAR FIELD DESIGN: TOWER



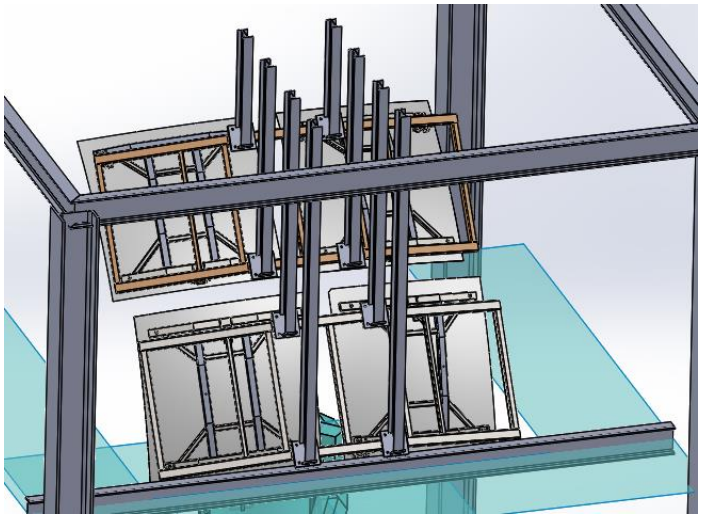


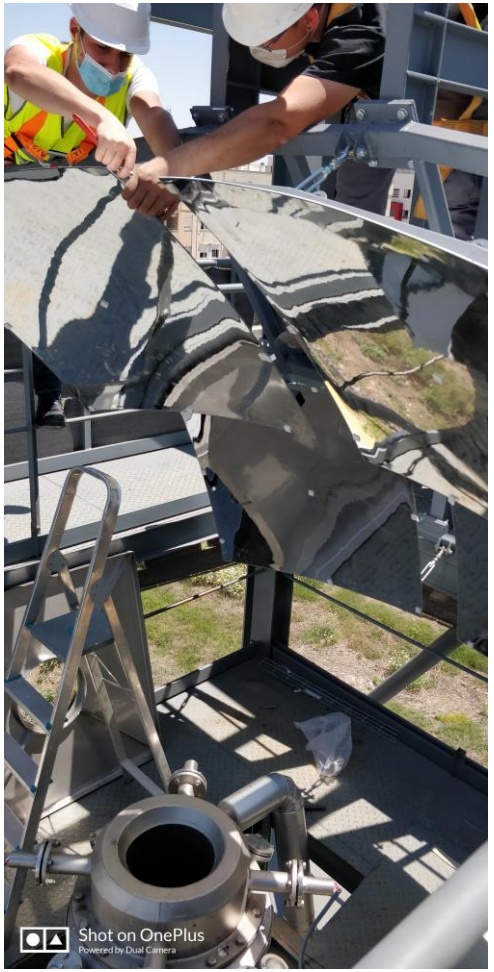


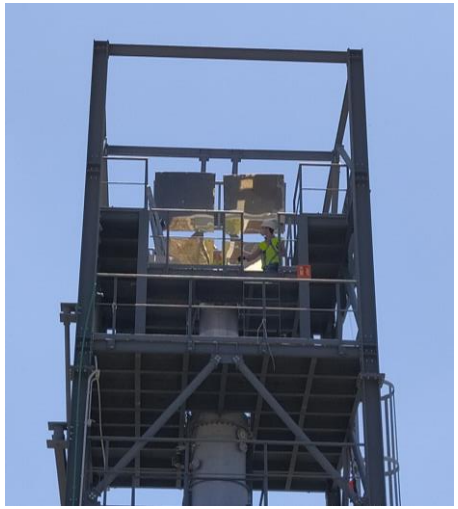
Functionality

- Secondary Reflector
- Calciner Reactors

SOLAR FIELD DESIGN: assembly



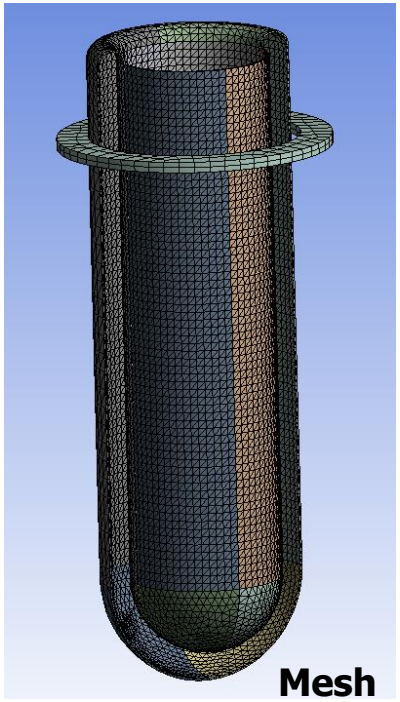


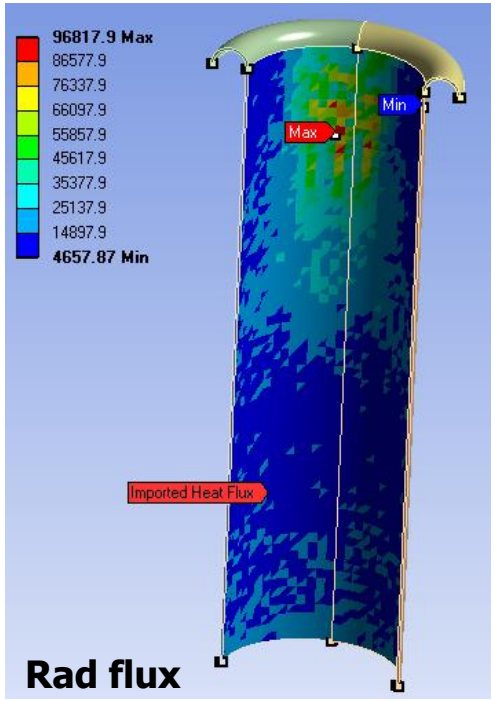


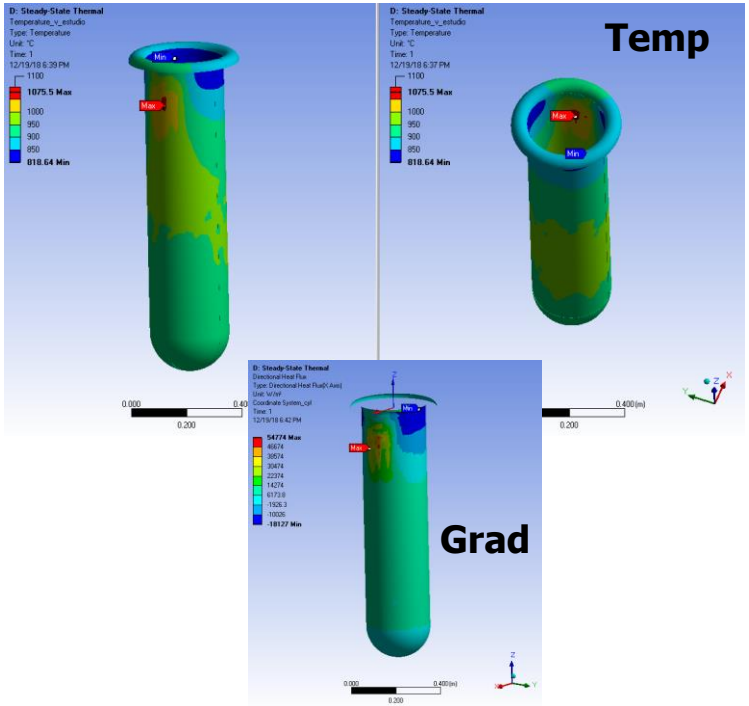
SOLAR CALCINER CAVITY DESIGN

Optical-thermal-mechanical system:

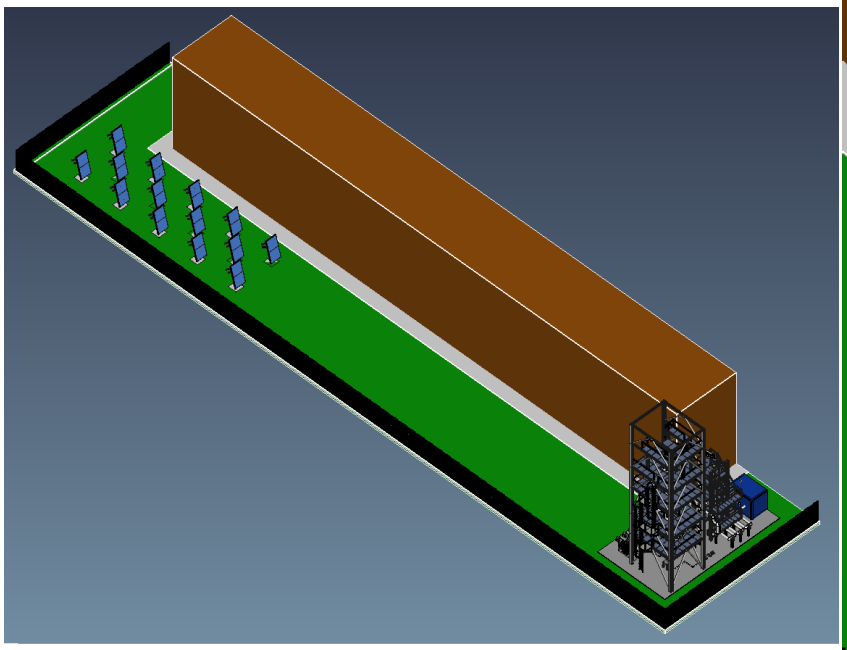
- Coupled Field Finite Element Model
- Transfer maximum energy to the calcination reaction
- Select allowable materials for +1000ºC

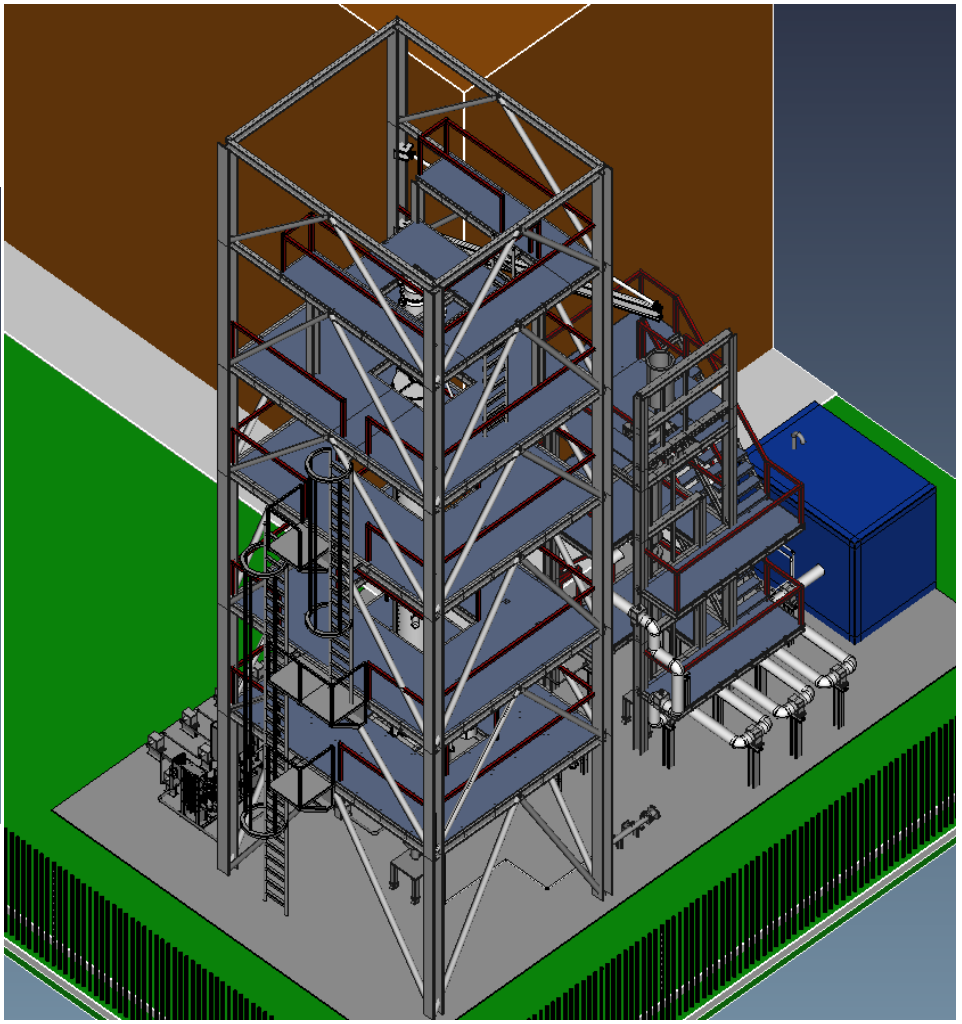




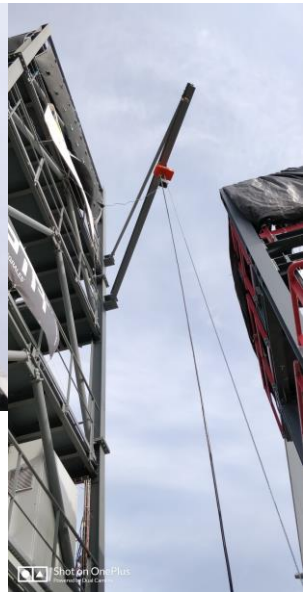


SYSTEM INTEGRATION & EPC: FULL PLANT 3D BIM

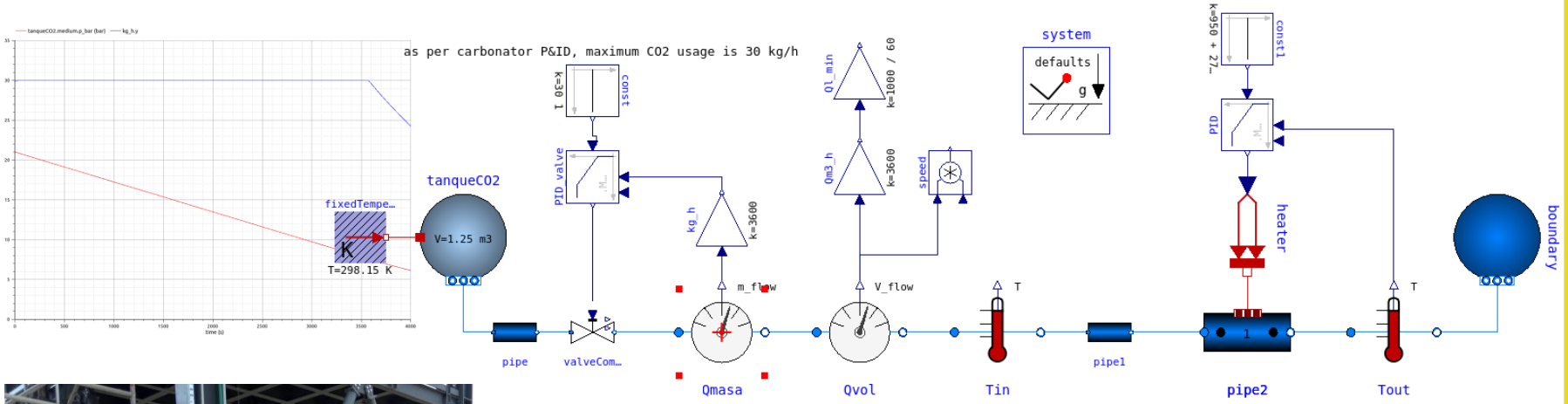




SYSTEM INTEGRATION & EPC: TOWER ASSEMBLY



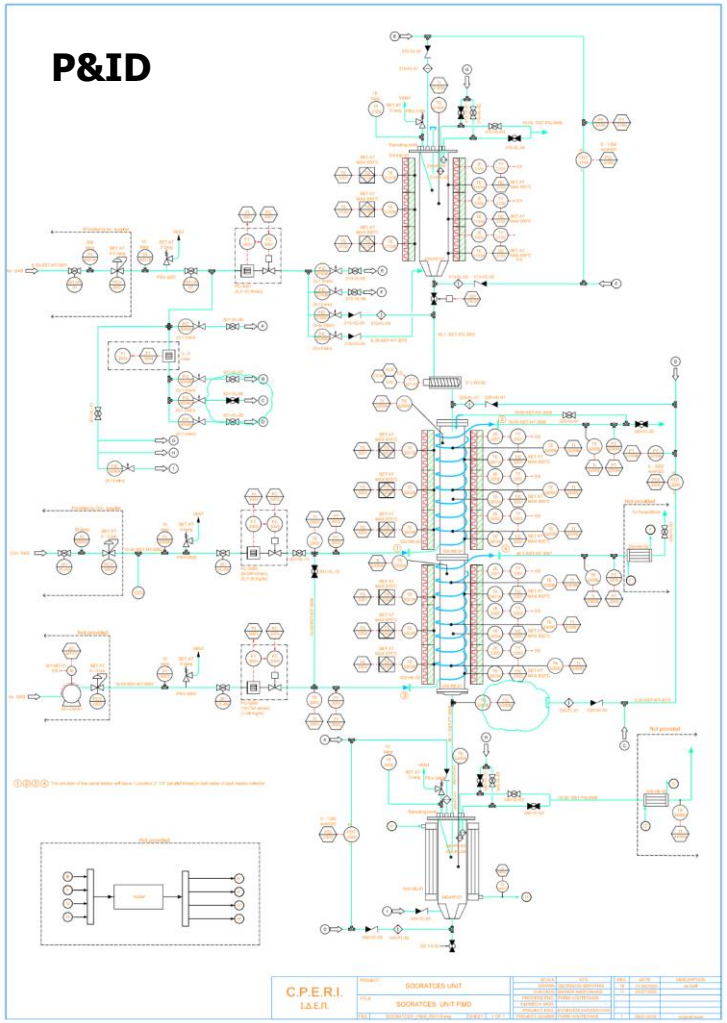
SYSTEM INTEGRATION & EPC: CO2 STORAGE SYSTEM



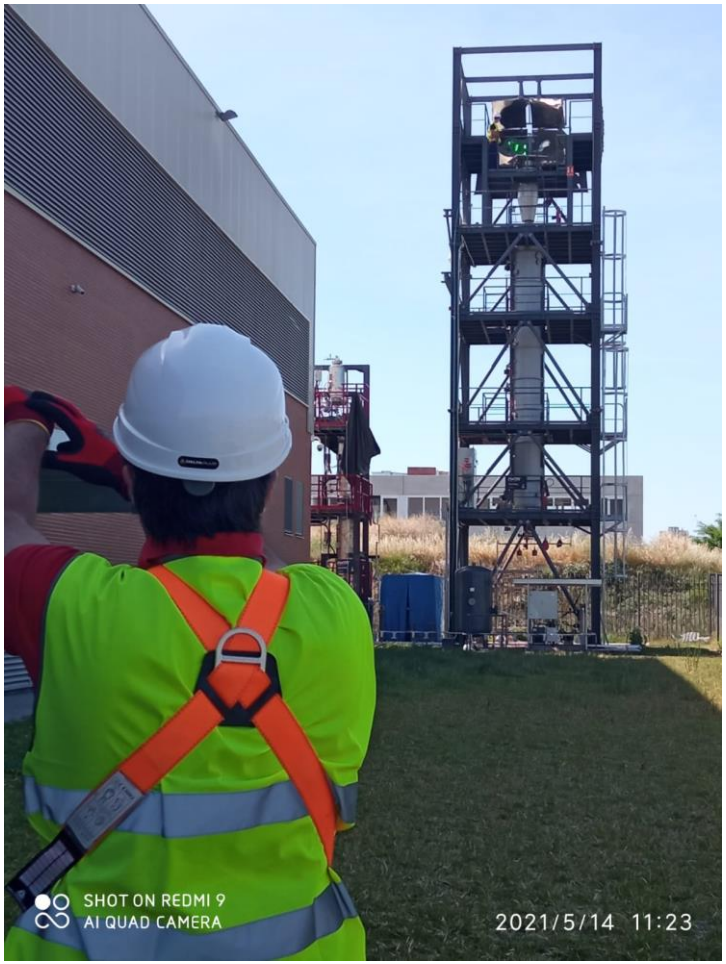
Design:

- OpenModelica model for sizing
- Simulation under several conditions

SYSTEM INTEGRATION & EPC: INSTRUMENTS



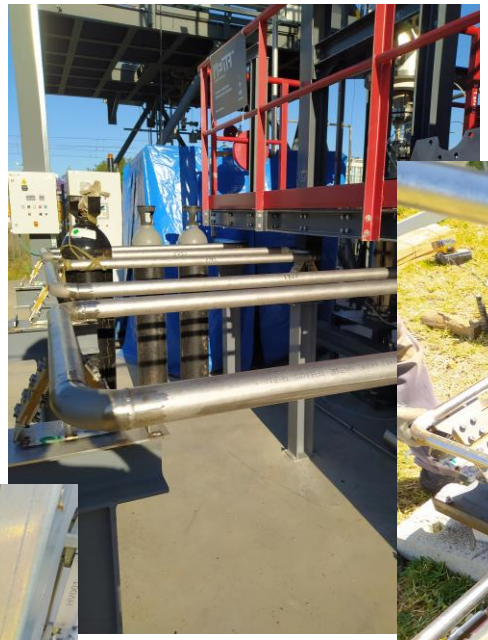
SYSTEM INTEGRATION & EPC



SYSTEM INTEGRATION & EPC: pneumatic conveyor granular material handling

Swappable vessel

SYSTEM INTEGRATION & EPC: HIGH TEMP PIPING

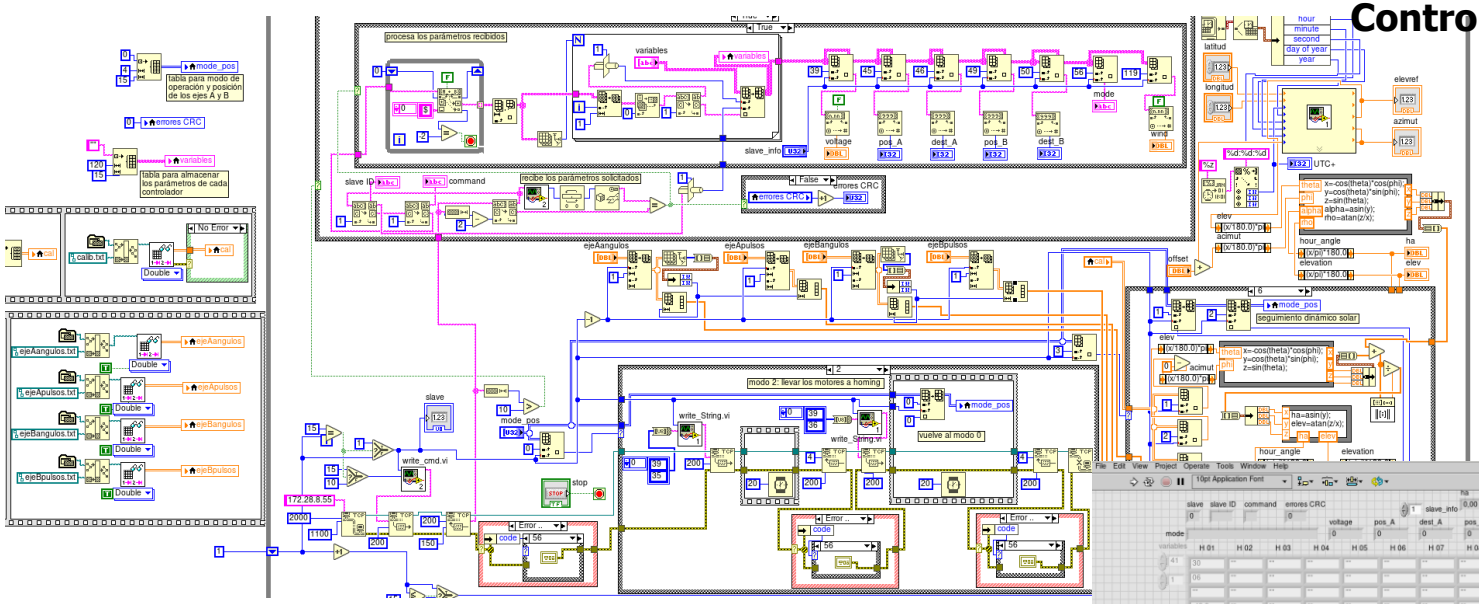


Design:

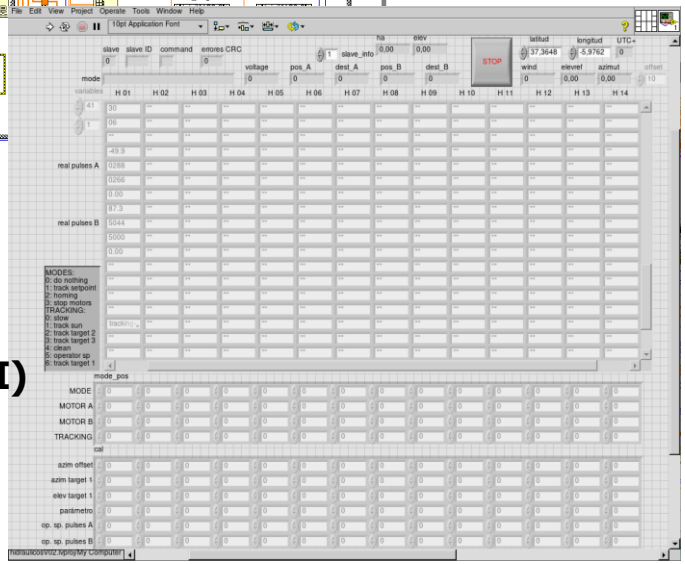
- Special supports allowing large expansions
- Bents and bellows for 950ºC

SOLAR FIELD CONTROL

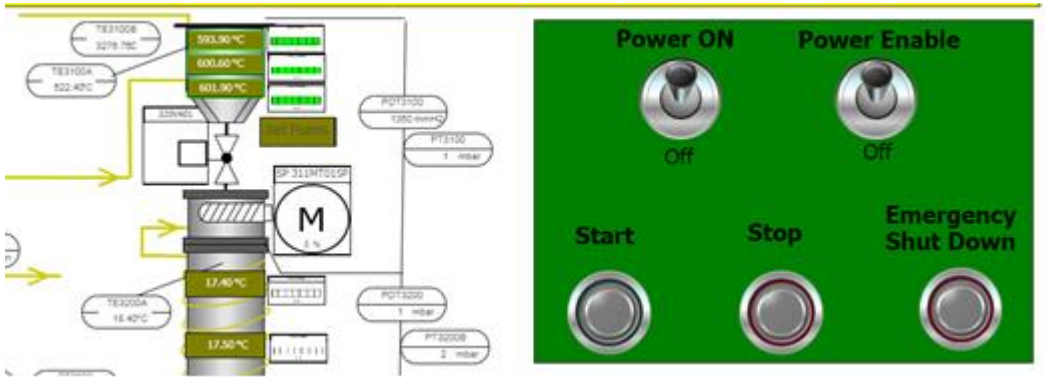
Control software flow



User Interface (GUI)



CARBONATOR CONTROL INTEGRATION



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Thanks for your attention

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