



Modeling Multi Effect Distillation powered by CSP in TRNSYS

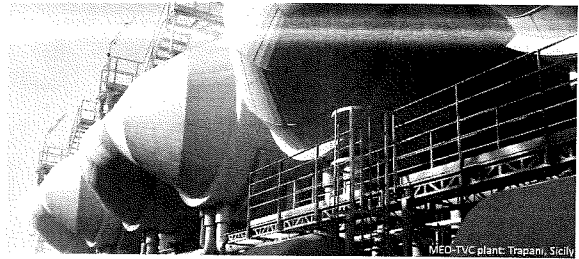
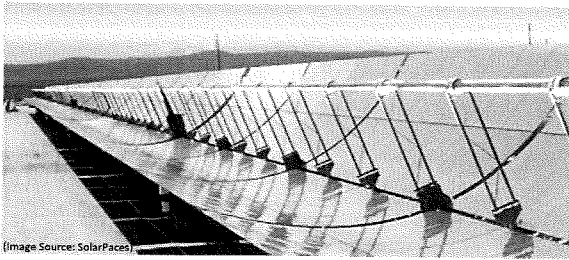
Case Study using System Advisor Model (SAM): San Diego, CA

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New tool for simulation of cogeneration of Electricity and Water with CSP and Forward Feed - Multi Effect Desalination plants (FF - MED), using SAM.

MED model and controlling strategy presented in this work. Results: CSP+MED can be feasible and has potential to be economically interesting.

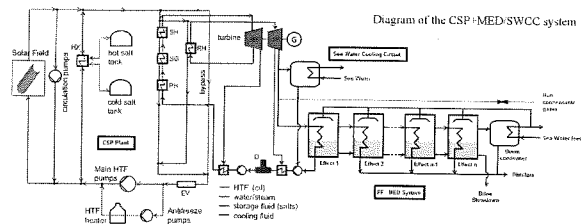
THE MODEL USED

FF-MED Mathematical model main assumptions:

- Const. thermodynamic losses / effect (losses subtracted to heat input of 1st effect)
- Constant heat transfer area and energy losses to surroundings
- Saturated Feed seawater (except 1st effect)
- Equal thermal loads for effects

MED/SWCC Dimensioning:

- MED plant capacity sized according to CSP installed power
- MED operates at nominal conditions for % of the steam output from Rankine cycle (user defined)
- Remaining steam condensed by Seawater Cooling Circuit (absorbs most fluctuations when operating)



- Predefined: operating temp., max. allowed salinity and U values
- Operating temp. assumed constant by varying mass flows internally >> reacting to transient effects of CSP
- Parasitic consumptions: water pumping, extraction of NCG (not accounted motive steam used for NCG extraction in CSP electrical output)

MED/SWCC Controlling strategy:

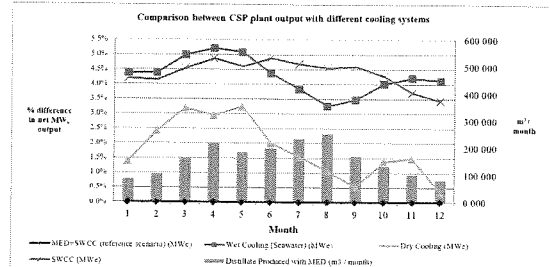
- Minimum startup time (user defined)
- Assumed to preserve temperature and vacuum during standby
- MED Operating modes: Online, Startup or Standby (no offline, no shutting down, no cold startups)
- MED only starts up after CSP turbine becomes online
- Cutoff and overdesign loads assumed for MED (user defined)
- When MED starting up or in standby, and turbine online: all exhaust from CSP is condensed by SWCC.



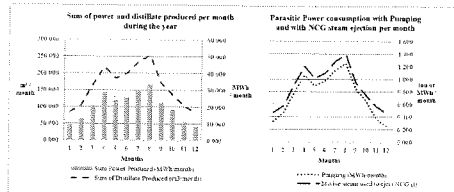
CASE STUDY: San Diego, CA

- Installed CSP Power: 111 MW_e
- Saturated Steam powering MED: 70°C;
- MED capacity: 16 400 m³/day
- Feedwater MED Condenser: 35°C
- MED designed to reject 40% heat load from CSP exhaust (Once-Trough cycle designed to reject 100%)
- Seawater: 18.5 °C; 33 000 ppm
- Brine: max. 55 000 ppm

Results:

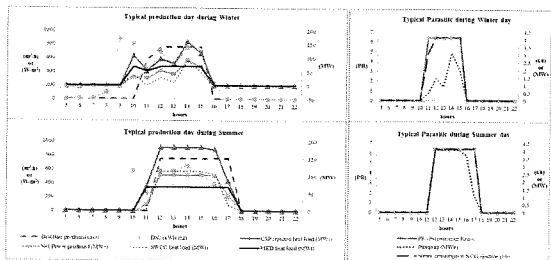


Comparative power output: CSP plant with different cooling systems (and distillate production when MED is used)



CSP + MED capacity factors:
 . 37% MED
 . 25% CSP

Cumulative production and parasitic of the CSP+MED/SWCC for a one year operation



Typical operation days: CSP + MED/SWCC during winter (1st of January) and summer time (1st of July)

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