

# Instrumentation and controls solutions for Concentrated Solar Power Plants

Performance, reliability, dispatchability and references



# Siemens Energy

## The leading pureplay energy company



### Our offering

Products, Solutions, Services

### Across the value chain

Generation, Transmission, Storage

### Broad technology portfolio

From Conventional to Renewables



# Siemens Energy' solar I&C a reflection of the world's foremost integration expertise

We provide optimal I&C design for CSP & Hybrid-PV plants to **achieve the full dispatchability** of solar energy power plants

With **start-up and shut-down 365 days a year**, high demands are placed on your plant even on the sunniest of days.

Count on our I&C's integration expertise in **steam turbine controls, balance-of-plant, and solar fields** to optimize your plant's performance and maintain its long-term reliability.

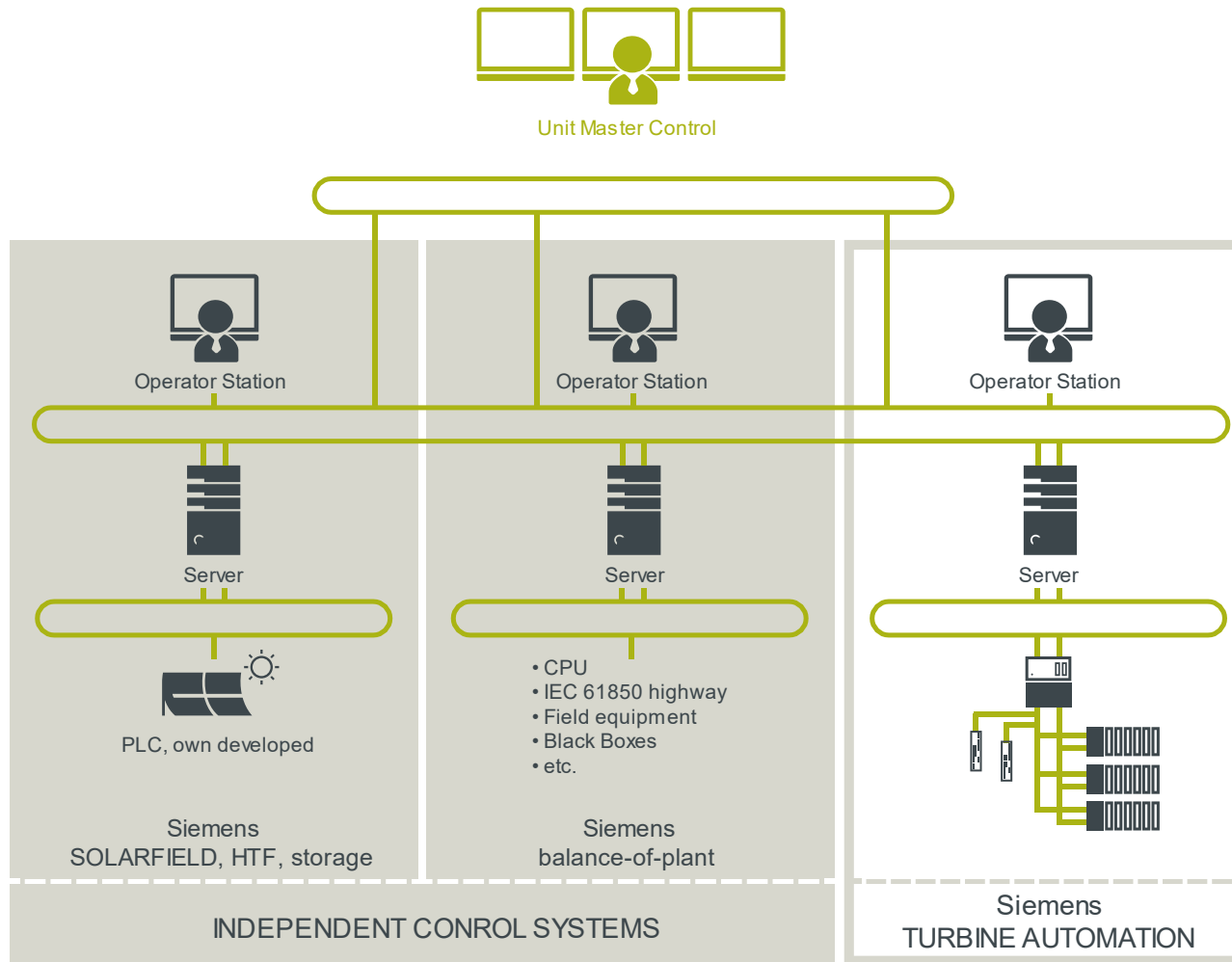
As a world leader in I&C for solar power plants, Siemens Energy will be there to ensure **your plant reflects the true power of solar.**



## Achievements

- **Increase energy production/day** up to **20%**
- More reliable and smooth operation especially for big components
- **Reduction of maintenance costs** more up to **10%**
- Ensure faster & reproducible start-up with higher automation degree
- **Reduce work load** for operators up to **30%**
- Able to meet dispatchability requirements

# For us, performance means the optimum for your invest



## Better performance

- ✓ Less operator interactions
- ✓ Temperature set point coordination module

## Minimized process losses

- ✓ Main steam pressure set point coordination
- ✓ Patented Thermal Stress reduction module

## Improved efficiency

- ✓ HTF distribution coordination

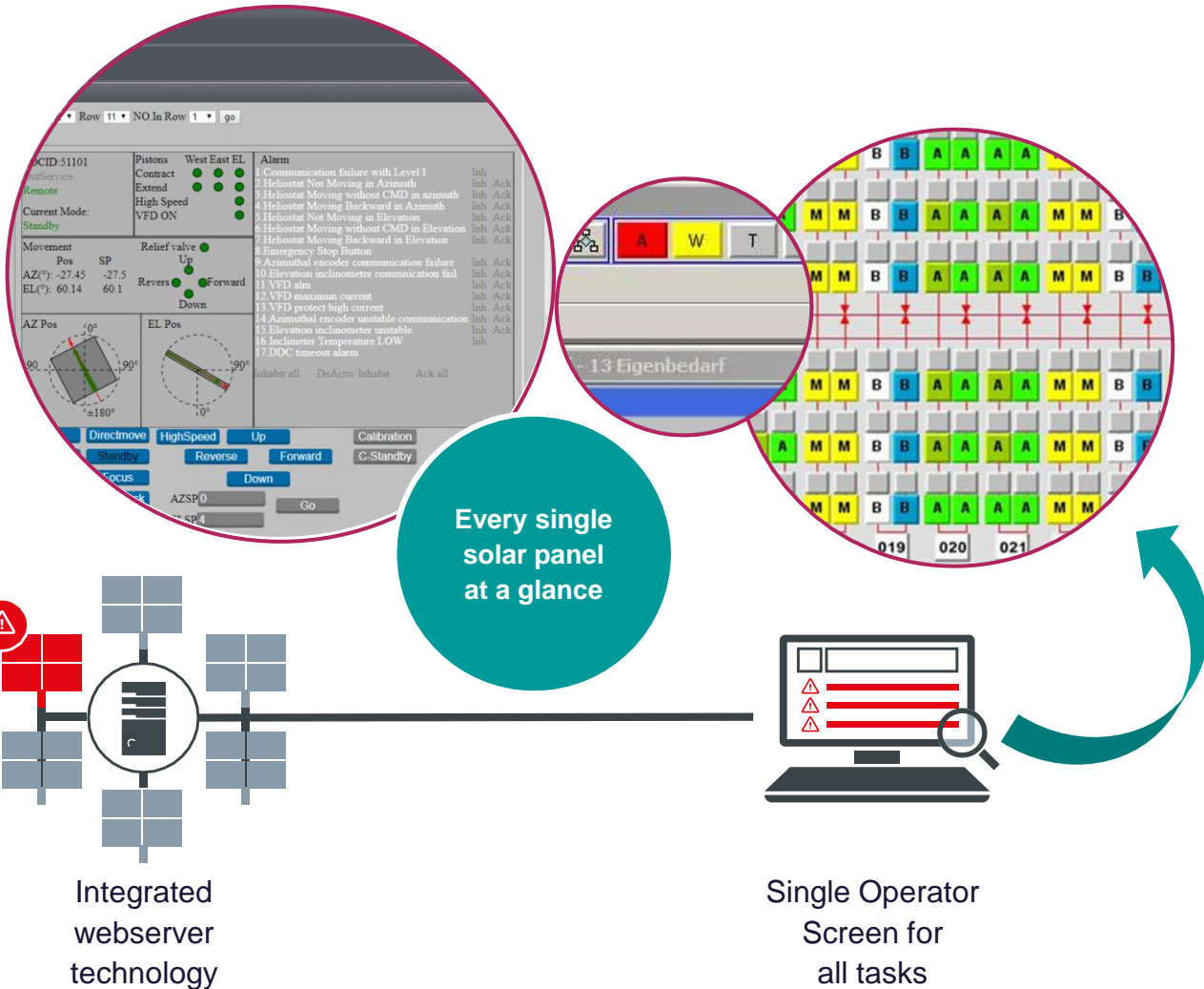


Performance

Optimize closed loop control between solar field and turbine

Intelligent set point guidance to avoid stress for the components and unpredictable trips

# For us, reliability means customer satisfaction



## High availability

- ✓ No maintenance of user-defined configurations

## Early failure prevention, shorter shutdowns and product evolution

- ✓ Remote Diagnostic

## Faster plant response

- ✓ Integrated webserver

## Minimized number of interfaces for maximum reliability

- ✓ Holistic software architecture



Reliability

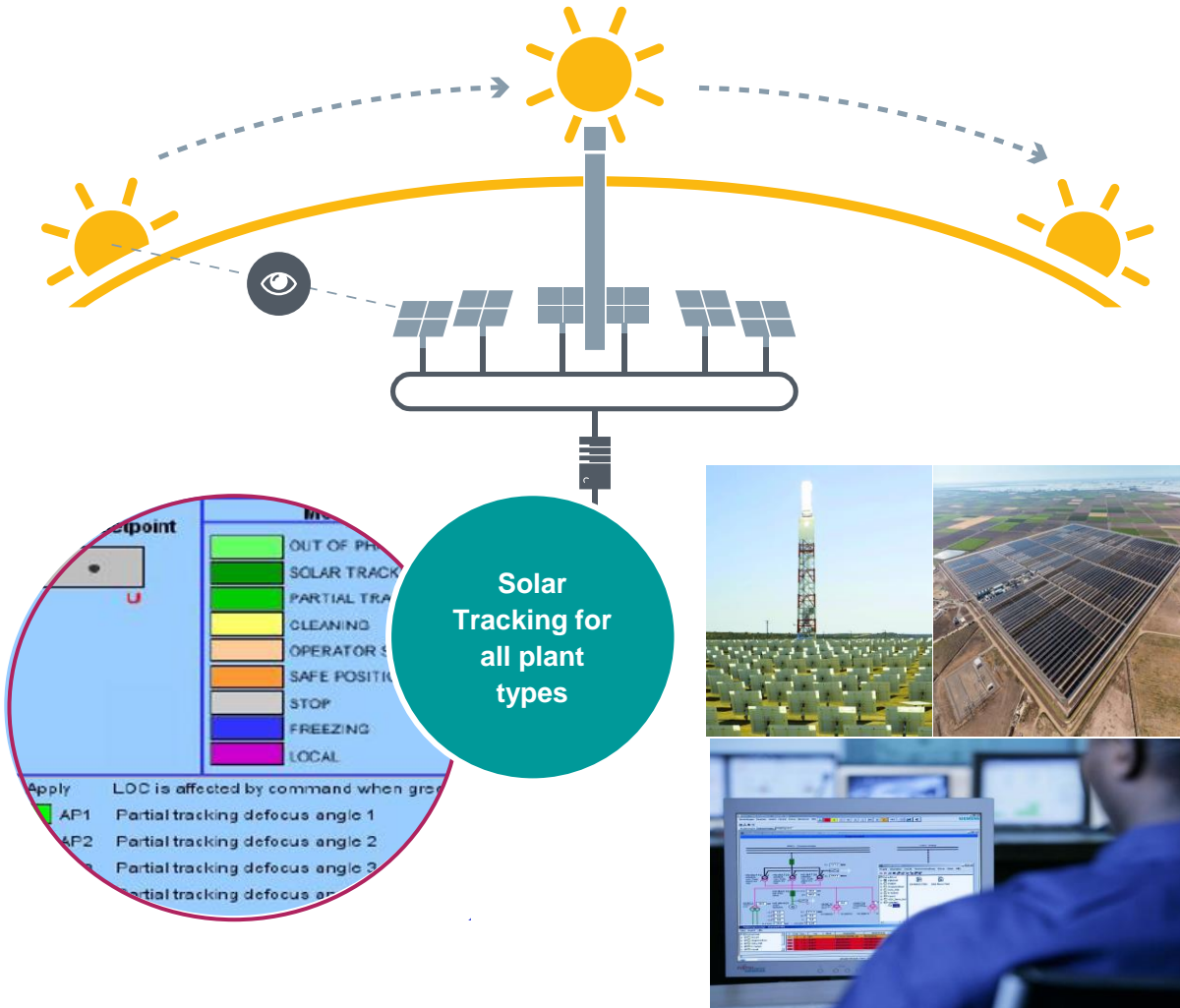
One integrated automation software for all automation tasks

Integrated web server for engineering, control and diagnostics purposes

One alarming system for the entire plant



# For us, dispatchability means SMART control designed to meet your requirements



## Shorter start-up time

- ✓ Patented solar field closed loop control concept

## Flexible and optimized operation

- ✓ Fast load changes
- ✓ Utilizing every sun beam

## Avoid electrical limitations

- ✓ Intelligent loads shedding system

## Minimized operator interactions

- ✓ Runback Scenarios



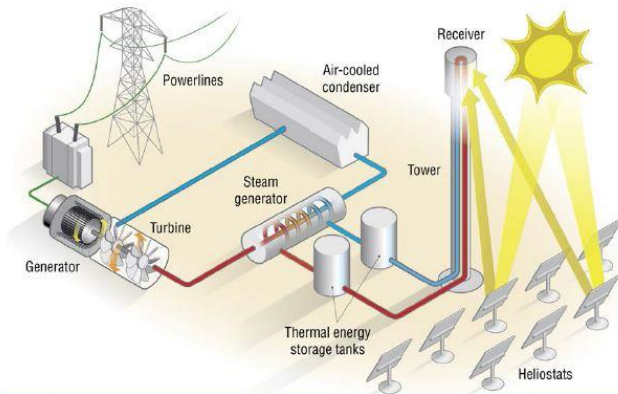
## Dispatchability

Fast, reliable and reproducible fully automatic „Golden button“ unit startup

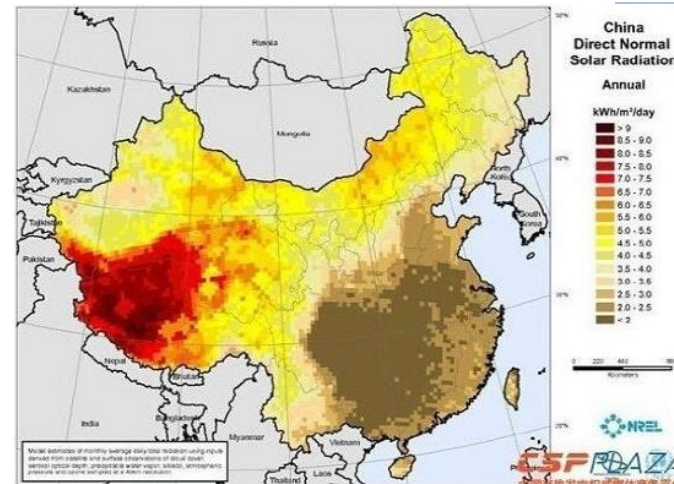
Flexible and optimized plant operation with minimized operator interactions

# Reference project tower CSP with storage in China

- Tower CSP
- molten salt as HTF, with 12h storage
- Capacity 50MW
- 4,400 Heliostats, 12mx12m each, hydraulic drive
- Siemens scope: steam turbine and I&C system

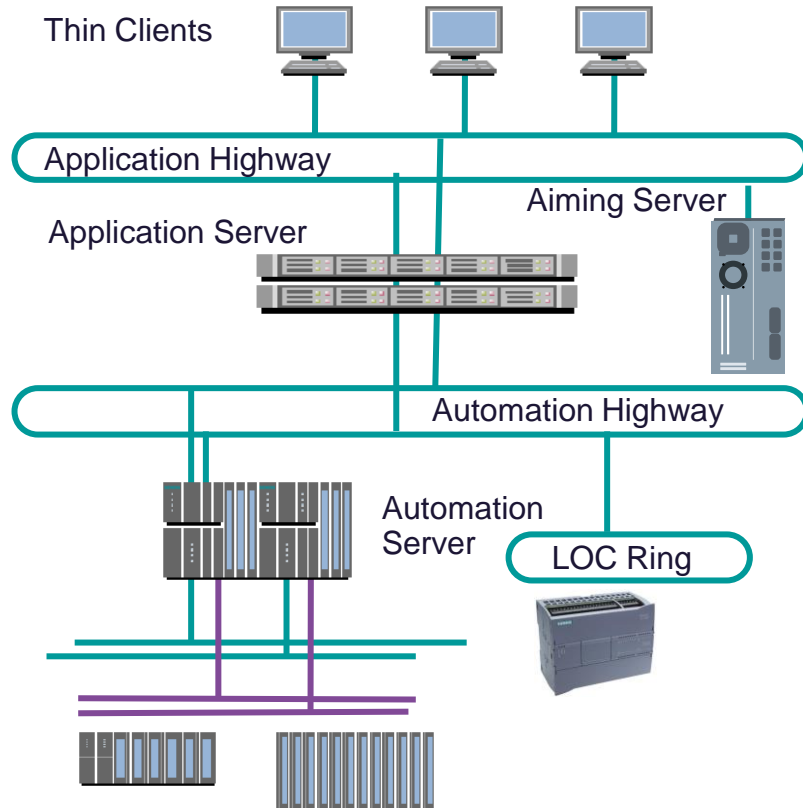


In a CSP system with thermal energy storage, the heat transfer medium, such as molten salt, retains heat so well that it enables the plant to generate electricity for hours when the sun is not shining.





# Reference project tower CSP with molten salt storage in China

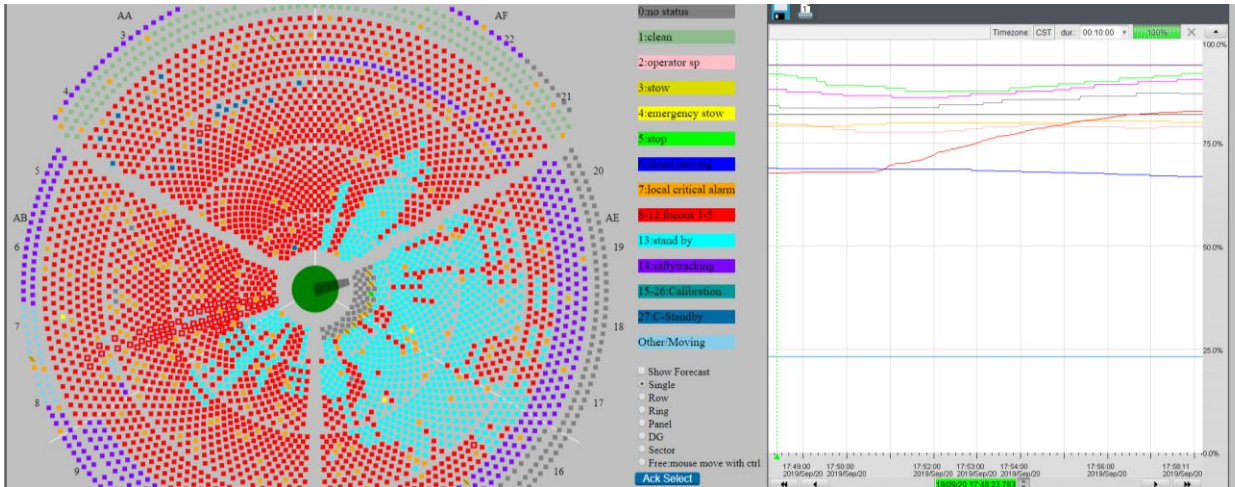


This block contains three related images from the project:

- Top Image:** A circular heliostat field status map. The field is divided into sectors (AA, AB, AE, AF) and rows (3-8). A legend on the right lists 17 status categories, such as '1: clean', '2: operator up', '3: slow', '4: emergency slow', '5: stop', '6: heliostat moving', '7: local critical alarm', '13: stand by', '14: safety tracking', '15: 26: calibration', '16: Standby', and '17: C-Standby'. A graph on the right shows percentage values over time.
- Middle Image:** A detailed PLC control schematic for the heliostat system. It shows the 'Application Highway' and 'Automation Highway' connecting various PLC units, including 'Redundant Application Server' and 'Heliostat AC Expander'. It also depicts 'LOC Ring' connections for each heliostat.
- Bottom Image:** A Siemens HMI control interface for a heliostat. It displays real-time data for 'Sector AE', 'Row 11', and 'NO In Row 1'. The interface includes a status table for 'LOCID:51101' with columns for 'Contract', 'Extend', 'High Speed', 'VFD ON', 'Relief valve', 'Revers', and 'Devan'. It also features a 'Movement' section with 'AZ Pos' and 'EL Pos' readouts, and a control panel with buttons for 'Clean', 'Directmove', 'HighSpeed', 'Up', 'Stop', 'Standby', 'Reverse', 'Forward', 'Slow', 'Focus', 'EmSlow', 'SafetyTrack', 'AZSP 0', 'Go', 'OP Setpoint', 'Vorticality', and 'ELSP 4'.



# Integration of each heliostat including optimized parameters



## One I&C System

- Solar field + Steam turbine + BoP
- Integrated webserver technology
- Integrated sun-position algorithm
- Heliostat calibration and optimization integrated
- Complete system time synchronized
- Mass code downloads to each Heliostat reduce efforts

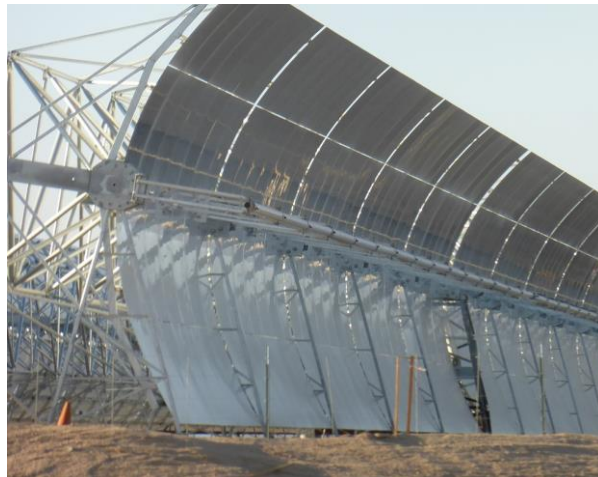
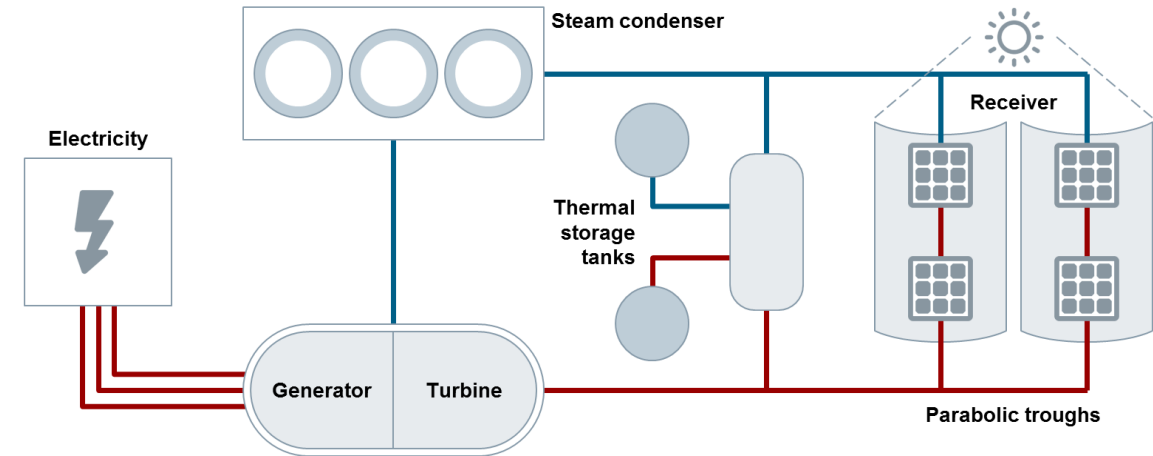
The screenshot shows the SIEMENS control interface. At the top, it displays 'Sector AE' and 'Row 11'. Below this, there are sections for 'LOCID:51101', 'Pistons', 'West East EL', 'Alarm', 'Movement', 'AZ Pos', and 'EL Pos'. The 'Alarm' section lists 17 different alarm types with their corresponding status (Inh, Ack). The 'Movement' section shows 'Pos SP' and 'AZ(°): -27.45 -27.5'. The 'AZ Pos' and 'EL Pos' sections show graphical representations of the heliostat's position and elevation. At the bottom, there are several control buttons: 'Clean', 'Directmove', 'HighSpeed', 'Up', 'Calibration', 'Stop', 'Standby', 'Reverse', 'Forward', 'C-Standby', 'Slow', 'Focus', 'Down', 'EmSlow', 'SafetyTrack', 'AZSP0', 'Go', 'OP Setpoint', 'Vertically', and 'ELSP4'.

The screenshot shows a data table with columns for 'Date', 'Time', 'Device', 'MAC Address', 'IP Address', 'Event', and 'Result'. The table contains multiple rows of data, likely representing the status of individual heliostats or system components. The 'Result' column shows various status codes and messages.

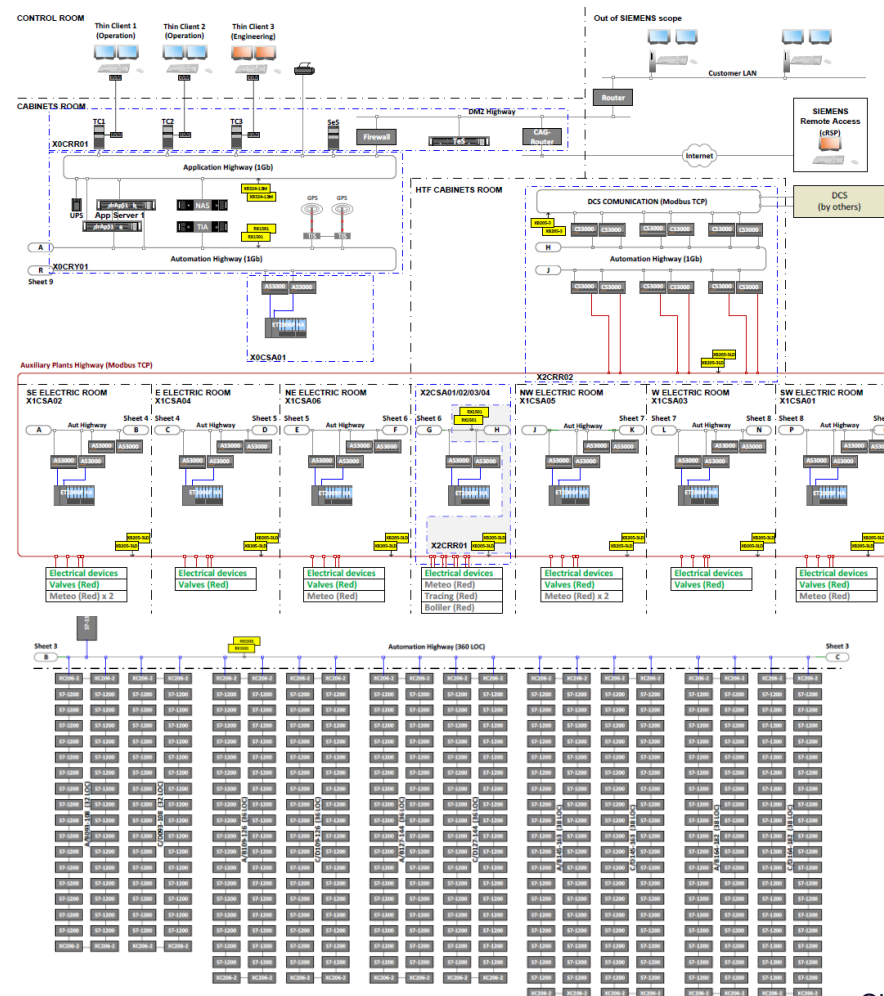
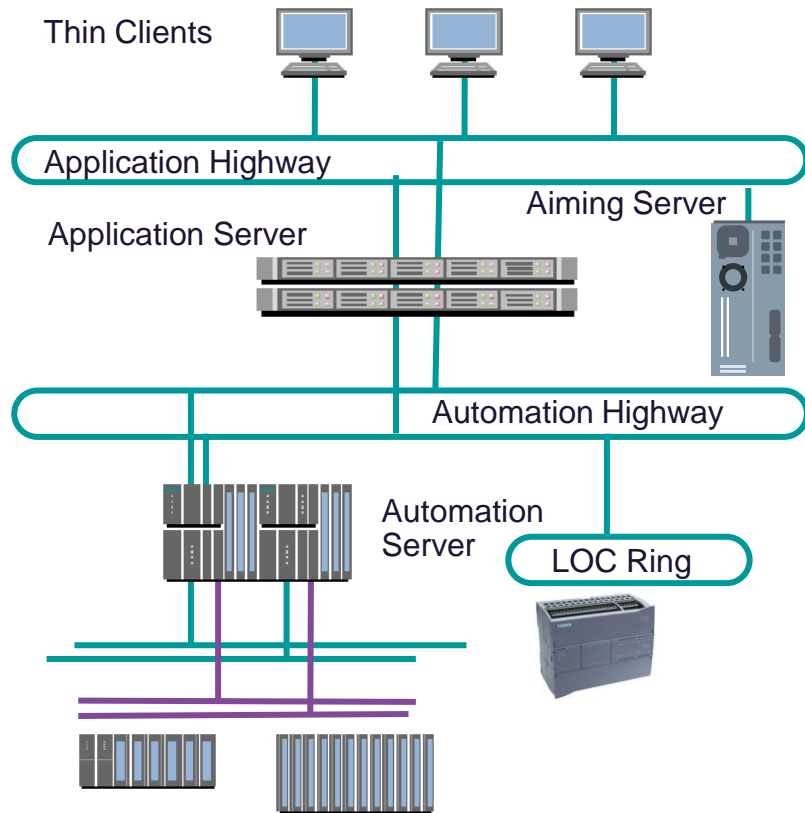
The screenshot shows a data table with columns for 'Plant', 'Name', 'Partion', 'Length', 'Area', 'Material', 'In Part', 'LiftHeight', 'Reflexion', 'Area', 'Present', 'Temperature', 'Area Length', 'Date 1', 'Area Ratio', 'As Inhabited', 'In Habitation', and 'Consumption'. The table contains multiple rows of data, likely representing the physical characteristics and operational parameters of the heliostats.

# Reference project parabolic through CSP with storage in Dubai

- Parabolic through CSP
- molten salt storage
- Capacity 3 x 200MW
- 2120 collectors per unit
- Siemens scope: steam turbine and I&C system incl. (Solar Collector Assembly)

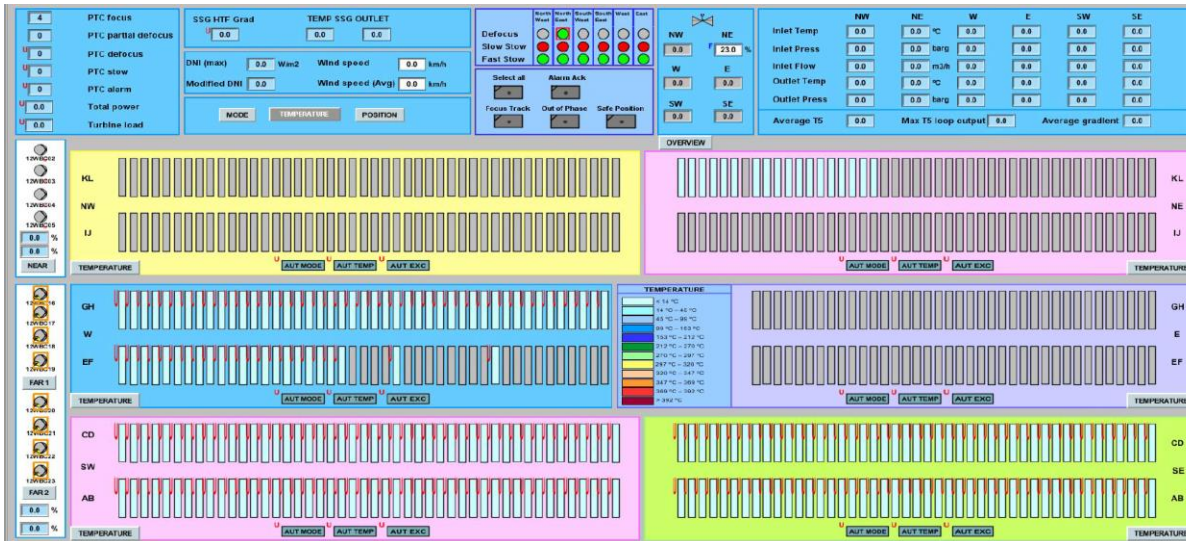


# Reference project parabolic through CSP with storage in Dubai



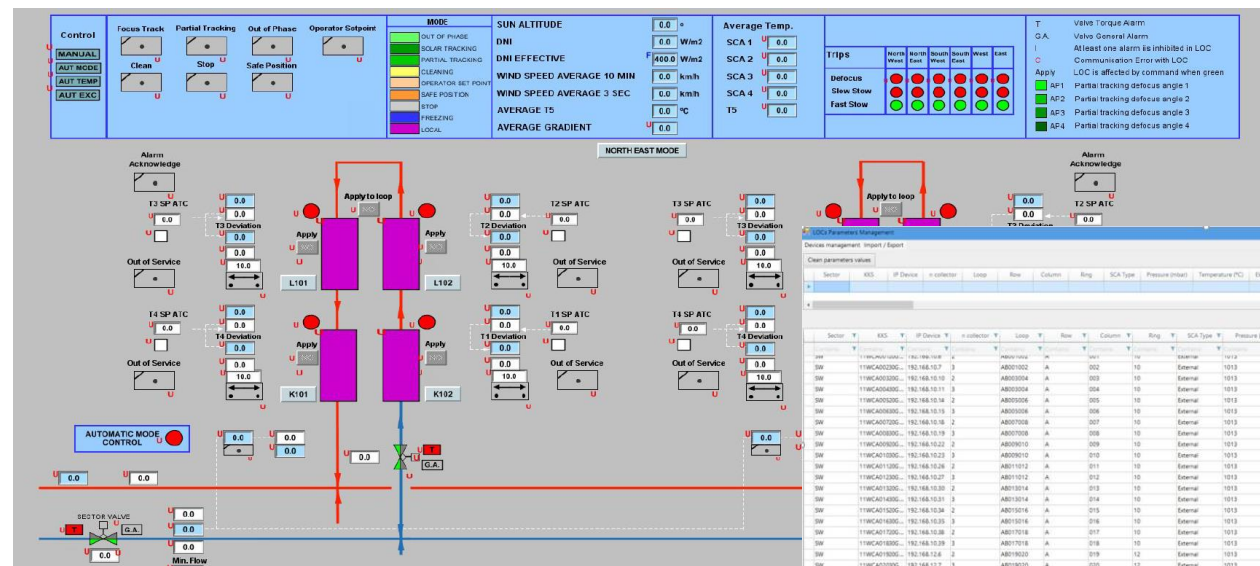
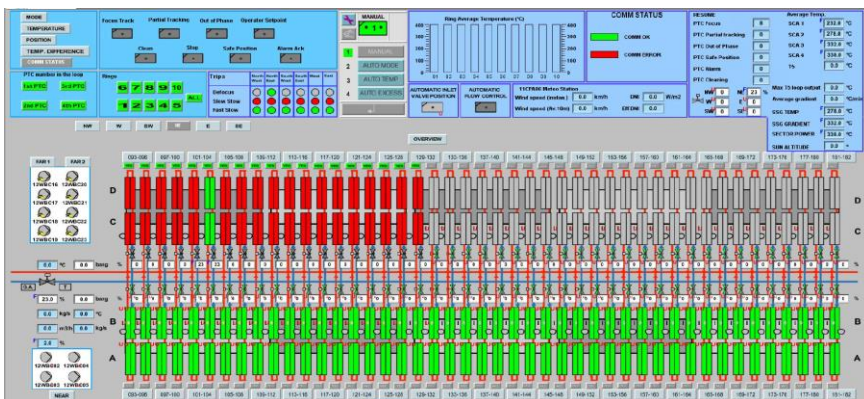


# Reference project parabolic through CSP with storage in Dubai



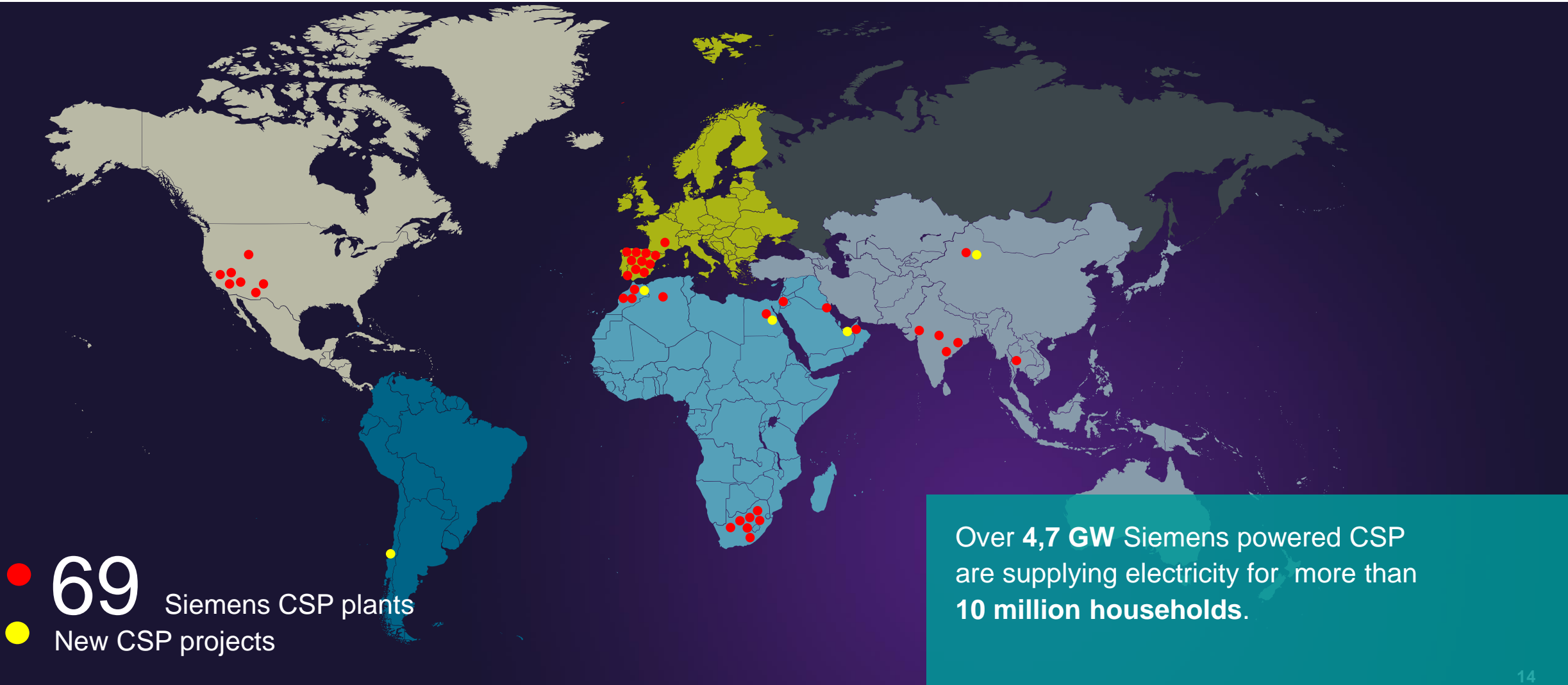
## One I&C System

- Solar field + Steam turbine + BoP
- Integrated sun-position algorithm
- EPCs calibration and optimization integrated
- Mass code downloads to each CPU



Sector	HKS	IP Device	In collector	Loop	Row	Column	Ring	SCA Type	Pressure (mbar)	Temperature (°C)	Elevation (m)	Delta T	Alarm Status (P)	Pressure start pump (bar)	Pressure stop pump (bar)
SW	118MCA0200G	192.168.10.2	AB001002	A	002	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001003	A	003	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001004	A	004	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001005	A	005	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001006	A	006	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001007	A	007	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001008	A	008	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001009	A	009	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001010	A	010	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001011	A	011	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001012	A	012	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001013	A	013	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001014	A	014	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001015	A	015	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001016	A	016	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001017	A	017	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001018	A	018	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001019	A	019	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001020	A	020	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001021	A	021	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001022	A	022	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001023	A	023	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001024	A	024	10	External	1910	20	100	67	1		130	
SW	118MCA0200G	192.168.10.2	AB001025	A	025	10	External	1910	20	100	67	1		130	

# References



● 69 Siemens CSP plants  
● New CSP projects

Over 4,7 GW Siemens powered CSP are supplying electricity for more than 10 million households.

# Contact



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