

Solar Systems CS500 Mark V Dish Generating System

Scalable, high efficiency, utility-grade solar power

The Solar Systems Concentrating Photovoltaic (CPV) technology delivers versatile, high efficiency solar power, scalable by the megawatt to the capacity you need.

The CS500 Mk V Dish delivers energy efficiency unrivalled in solar generation by combining the world's most efficient photovoltaic technology originally developed for powering satellites with precision mirrors to concentrate the sun 500 times.

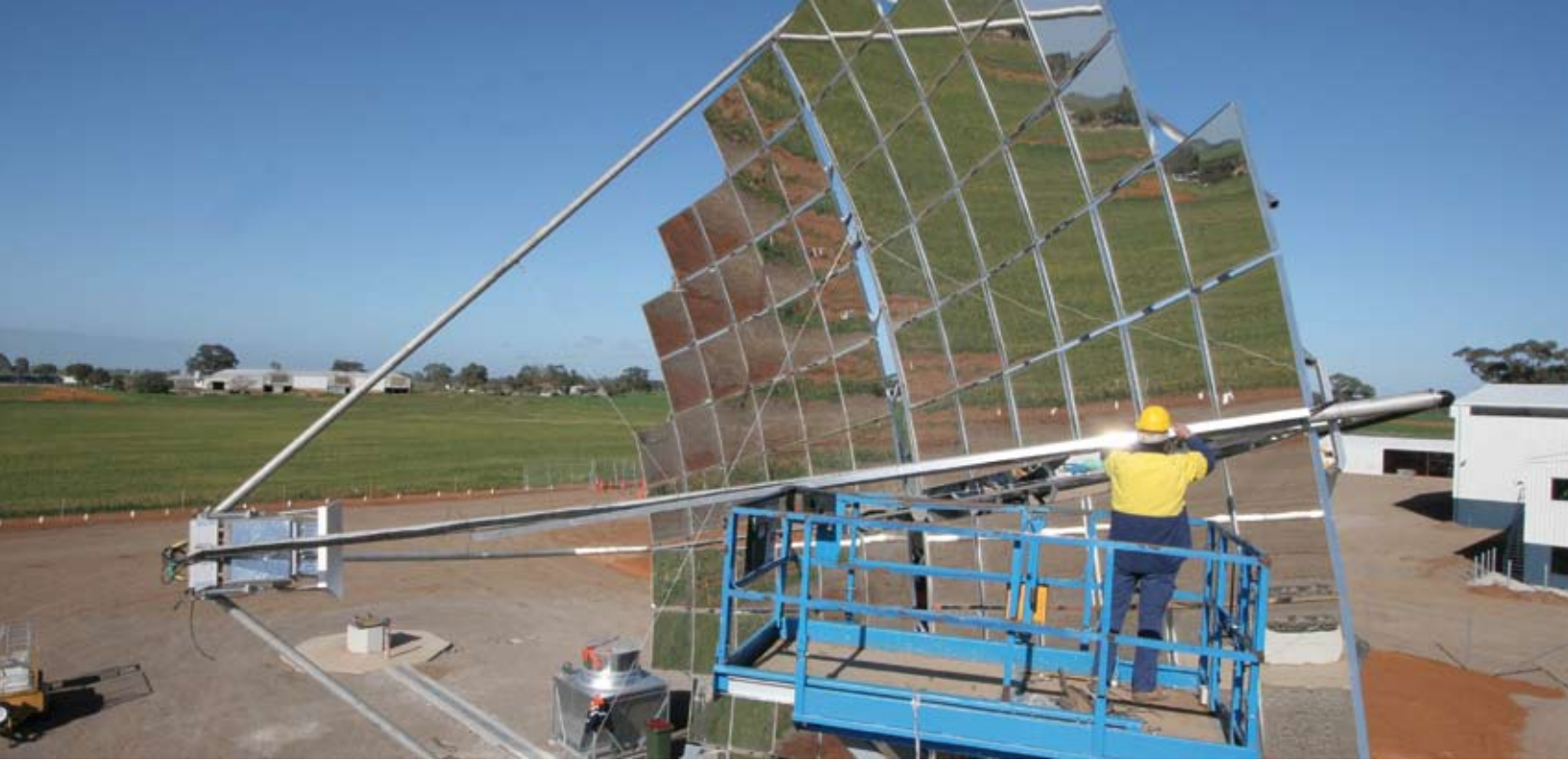
With over 100 dish-years of experience across five operational power stations Solar Systems has the proven technology and the experience to deliver utility-scale solar power generation today.

Since each CS500 Mk V Dish can operate autonomously,

Solar Systems CPV technology is totally scalable to your utility-grade generation needs.

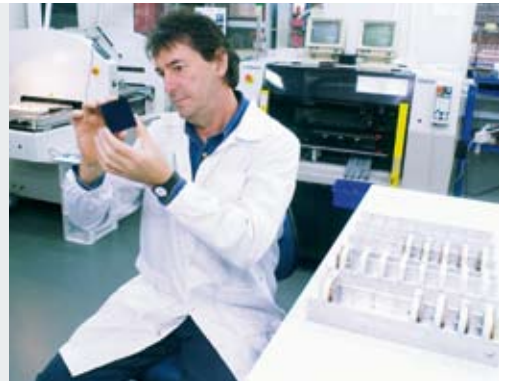
Solar power is no longer an 'all or nothing' affair for large-scale operations. Construction and deployment can be phased with the first dish in a project exporting power as soon as it is commissioned and grid connection is available.

Generation capacity can be distributed as needed, or facilities expanded to meet renewable obligations when required. The project flexibility you need from a technology that delivers.



Solar Systems CS500 Mk V Dish technology provides:

- Modularity – Ability to rollout in small incremental units adds site flexibility, reduces deployment risk and improves customer cash flow.
- Unique cooling system virtually eliminating cell degradation.
- Reliability – A core feature of the CS500 Mk V Dish design.
- Upgradable – Components upgradable to accommodate more efficient modules.



CS500 Mk V Dish Features

Scalable, Large Scale Installation

A typical configuration groups 24 CS500 Mk V Dishes around a shared step-up transformer. These groups are the basic building-block to assemble a large scale facility to the capacity required. Deployment programs can easily be phased and structured to the project needs making Solar Systems CPV technology flexible and completely scalable from Megawatts to hundreds of Megawatts.

SCADA Control System

While each CS500 Mk V Dish can operate independently managing its own tracking, systems and generation, the Supervisory Control And Data Acquisition (SCADA) system provides the facility-wide control and management necessary to operate and maintain the site. The SCADA system allows power output to be ramped up and down, systems to be monitored and diagnostics and maintenance performed by facility, group or individual dish.

Class-leading Efficiency

Solar System CPV technology is built on the ultra-high efficiency of **III-V triple junction photovoltaic cells**. Layering three different junctions on top of each other captures a wide spectral range

and delivers the highest efficiency rates, especially at high concentration levels.

Multi-junction technology is steadily improving and delivering higher efficiency cells. Working closely with our suppliers we can quickly bring the latest developments from the research labs into our production cycle giving a continual improvement in dish output.

Control and Electrical System

- Drive and control systems for Azimuth and Elevation utilise dynamic feedback sun-tracking
- The 'fail-safe' protection shield deploys to protect the receiver in case of fault
- A central controller manages all dish functions either under direction from the SCADA system or local operator control
- Inverter and electrical controls deliver reliable, high efficiency AC power
- Closed loop liquid-to-ambient heat exchanger cooling system maintains cell temperature for maximum output and low lifetime degradation.

CS500 Mk V Dish

RECEIVER AND SHIELD

The receiver at the focal point of the dish focuses the high intensity solar energy into the photovoltaic cells to convert the sunlight into electricity. Solar Systems proprietary cooling and control systems keep the cells 'on sun', safe and cool for maximum efficiency and reliability.

The DC power from the receiver is converted to grid quality AC voltage by the high efficiency inverter.

Should any problems develop, the fail-safe deflector shield can rapidly provide protection for the receiver.

DISH

The 49 foot diameter parabolic dish with its 112 focused mirrors tracks the sun from dawn to dusk to concentrate the sun 500 times onto the PV Receiver.



COOLING SYSTEM

An efficient closed-loop cooling system expels the excess heat from the receiver. The cooling system consists of the liquid to ambient heat exchanger and pump skid, which contains the pump system, filter and pressure tank.

General Technical Specifications

General	
Concept	Dish Concentrated Photovoltaic Solar Power Generator
Nominal rated DC power *	Subject to continuous efficiency improvement 36.5kW _{DC SOC} (2009) to 40.0kW _{DC SOC} (2011) (Standard Operating Conditions of 25°C/77°F cell temperature and 1000W/m ²)
Nominal rated AC power *	Subject to continuous efficiency improvement 31.6kW _{AC NOC} (2009) to 34.8 kW _{AC NOC} (2011) (Normal Operating Condition of 28°C/82°F ambient and 1000W/m ²)
Optical concentration	500 suns nominal
Design life	20 years
Degradation	Cells less than 0.1% annually
Receiver	
Receiver	III-V Multi-Junction PV cells in a dense array configuration receiver
Nominal PV cell efficiency	2009-36.5%, 2010- 38.0%, 2011- 40.0%
Electrical System	
Nominal mains voltage / range	3Ø 400 V _{AC} / 360-440 V _{AC}
Power factor (PF)	>0.97 at rated output
Nominal mains frequency / range	50Hz ± 1Hz or 60 Hz ± 1Hz (±2Hz transient)
Total harmonic distortion (THD)	<3%
Inverter	
Inverter type	3 phase Sputnik Engineering Solarmax 35S or equivalent
Topology	Transformer-less, 2-stage, PWM (IGBT) including Maximum Power Point Tracking control (MPPT)
Inverter maximum efficiency	97%

All specifications are subject to change without notice.

Cooling System	
Cooling system type	Solar Systems closed liquid cooling loop with fan forced liquid to ambient heat exchanger
Cooling system rating	65 kW at rated conditions
Mirror System	
Mirror type	Solar Systems curved glass mirrors on foam and metal mirror trays
Tracking Control	
Tracking type	Solar Systems Sun Tracking Control System, high accuracy dual axis position control
Receiver Protection	
Concept	Solar System fail-safe receiver shield
Drive System	
Concept	2 axis
Dish Structure	
Number of mirrors	112
Dish height	17.6 meters / 57.7ft
Dish diameter	14.9 meters / 48.8ft
Material grade of dish structure	Galvanised / painted structural steel
Weight of dish including mast	7.5 tonnes / 16,500lb
Maximum design wind speed	41m/s / 91miles/h
Site Requirements	
Land area requirements	Approximately 6.5 acres per MW _{AC} at typical spacing including provision for access
Typical Spacing	131ft East - West x 65ft North – South
Remote Monitoring	
Dish control system	Solar Systems Supervisory Control and Data Acquisition (SCADA) system

* Rated dish output power is continually improving with evolving cell efficiency. Projects are typically specified for a nominated power output and the final system configuration is determined by site specifics and the actual cell efficiency delivered.

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