DOCUMENT SPEC 2013102

Ultra Lite™ Solar Concentrator Thermal Store™ Energy Storage

Executive Summary

Concentrating Solar Power (CSP) plants traditionally consisted of three components; 1) the solar field, 2) the storage and 3) the turbine block. CSP without storage has a typical capacity factor of only 20%, similar to existing Solar Photo Voltaic (PV) systems. The advantage of CSP over that of PV is the ability to more economically add storage. In a CSP system, energy is stored as thermal heat, which is far less expensive than storing electricity in battery or flywheel storage as is required for PV based systems. In traditional CSP systems, storage systems typically extend plant operation by about 2 to 6 hours instead of overnight. The reason larger solar field and the associated cost to provide daylight power plus additional energy collection to charge the energy storage system.

The solar field makes up the majority of the cost of a plant. Adding to the solar field in order to facilitate storage adds even more cost.

Ultra Lite™

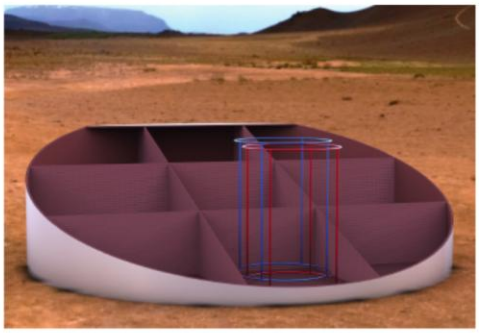
The Ultra Lite solar collector dramatically lowers the cost of solar thermal collection making solar base-load power plants economically competitive with the existing polluting

energy sources of oil, gas and coal. The Ultra Lite solar concentrator dramatically reduces the materials of construction, yet still provides high strength against wind loads, achieved with a proprietary structure strengthening technology that provides 400% over-stress to failure compared to the normal 100% margins built into existing systems.

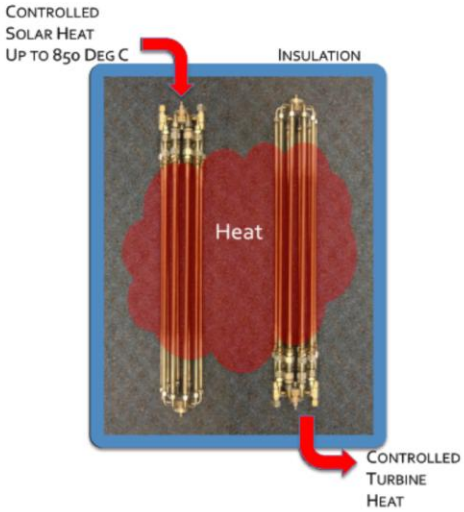
The Ultra Lite solar collector cannot be manufactured using traditional methods. New automated assembly and production processes have been built that lower the overall cost.The result an incremental improvement over existing solar trough technology with the benefit of a significant cost savings.

Thermal Store™

Thermal Store is a long term in-ground thermal storage system. The in-ground units are insulated, divided into controllable compartments. The Solar thermal heat cycle is isolated from the turbine steam cycle. operating



Each thermal storage compartment can independently store or release heat. A solar heat core radiates energy from top to bottom into the thermal media. A second heat absorption core that collects heat from bottom to top the for the steam production. This provides efficient thermal heat management, minimizing losses to less than 5% a day,therfeore maximizing the thermal charge available to turbine steam.



Using a refined sand, solid phase heat storage media results in half the volume and half the cost versus current hot and cold salt based storage. Also, without any environmental effect or risk.

These combined technologies make CSP base-load solar-fueled power plants low cost, safe and simple to deploy. The solar field can expand to facilitate extended thermal storage times without excessive capital cost. Increasing the solar field actually decreases the levelized cost of electricity (LCOE) as the turbine component is being used day and night.

Specifications

Ultra Lite™ Concentrator

Concentrator Frame	Metric
Length	8 meters
Width	4 meters
Depth	1 meter
Weight (inclusive of supports and motion articulation system)	180 Kg
A-Frame Dimensions	
Height	3 meters
Width	2 meters
Operating Temperatures	
Nominal	550 C
Maximum	700 C
Wind Environmental	
Nominal Operating	105 kph
Turn Down Survival	240 kph
Energy Output	
Thermal	20 kW
Electric	5 kW

Output is rated at solar noon. Electric power output will be dependent on the turbine efficiency and parasitic loses in the system. The above table assumes a total thermal to electrical efficiency of 25%.

Thermal Store™ Energy Storage

Thermal Store	Metric
Heat Capacity	1.1 KJ / Kg C
Density	1780 Kg/m3
Nominal Operating Temp	560 C
Max Operating Temp	850 C
Typical Delta Temp	280 C
Heat Carrier Options	
Mineral Oil (DOW Therm)	(-40) – 390 C
Molten Salt	260 – 580 C
SHEC Therm S	(-40) – 900 C

Temperature limited to Stainless Steel. Higher temperatures are achievable with more expensive alloys