



U.S. Department of Energy
Energy Efficiency and Renewable Energy

Parabolic Trough Workshop

Cooling for Parabolic Trough Power Plants

Overview

Incline Village, Nevada

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Water Requirements for Power Generation

(in Gallons per MWh of Plant Output)

Plant Type	Steam Condensing	Auxillary Cooling and Hotel Load	Total
Stand-alone steam plant	720 ⁽¹⁾	30 ⁽²⁾	750
Simple-cycle gas turbine	0	150 ⁽³⁾	150
Combined-cycle plant (2/3 CT + 1/3 steam)	240 (1/3 x 720)	110 (2/3 x 150 + 1/3 x 30)	350
Combined-cycle plant with dry cooling	0	110	110
Stand-alone steam plant with dry cooling	0	30	30
Parabolic Trough with wet cooling	920 ⁽⁴⁾	80 ⁽⁵⁾	1000
Parabolic Trough with dry cooling	0	80	80

(1) evaporation + blowdown = 12 gpm/MW

(2) estimated at ~5% of evaporation + blowdown

(3) mid-range of 75-200 gal/MWh for turbine cooling, emissions control and hotel load.

(4) based on historical data from SEGS (higher than conventional because of lower net steam cycle efficiency of SEGS, in part due to HTF pumping and night time parasitics).

(5) Includes make-up water requirements for steam cycle (60 gal/MWh) and solar field mirror wash (20 gal/MWh) data from KJCOC.



NREL Wet/Dry Cooling Analysis

	100 MWe Trough				
At Kramer Junction Radiation 8.05 kWh/m ² /day	Wet Cooling	Dry Cooling			
In Service	2006	2006			
Solar Field Area (m ²)	684,717	684,717			
Cooling System					
T _{air,d} (°F)	na	87	75	65	54
ITD (T _{cond} – T _{air,d}) (°F)	na	22	34	44	55
Capital Cost (\$/kWe)	40 ^a	288	193	152	123
Fan Design Point Parasitics (MWe)	1.9 ^b	5.6	2.8	1.9	1.6
Annual Cooling Parasitics (MWh)	5,297	11,847	7,022	5,205	4,405
Dry Cooling Penalty (MWh)	na	1,912	3,502	5,529	10,878
Total Plant Parasitics (% of gross)	12.4%	14.5%	13.1%	12.6%	12.5%
Annual Net Capacity Factor	29.3%	28.4%	28.8	28.7%	28.3
Plant Capital Cost (\$/kWe)	3080	3328	3233	3192	3164
Operating Costs (k\$/yr) ^c	5292	5201	5201	5201	5201
Insurance	0.5%	0.5%	0.5%	0.5%	0.5%
Levelized Cost of Energy (\$/kWh) ^d	0.119	0.131	0.126	0.125	0.126
	100%	110%	106%	105%	106%
Relative Factors					
Capital Cost	100%	108%	105%	104%	103%
Operating Costs	100%	98%	98%	98%	98%
Annual Performance	100%	97%	98%	98%	97%
Water Use (gal/MWh)	1000	80	80	80	80



[1] California Energy Commission, 2002, “Comparison of Alternative Cooling Technologies for California Power Plants Economics, Environmental and Other Tradoffs,” CEC 500-02-079F, Feb 2002.

http://www.energy.ca.gov/pier/final_project_reports/500-02-079f.html

[2] KJC Operating Company, 2002, “SEGS Acquaintance & Data Package,” Boron, CA.

