Duke Solar Near-Term Projects

Thermal Storage Needs

Wide Range in Project Sizes

- *50 MWe (Nevada)*
- *1 MWe (Arizona)*
- *100 kWe (in development)*

Nevada Power and Sierra Pacific: 50 MWe

No Storage

1 MWe ORC Plant in Arizona
300 C, ORC System

Nexant Report: Table 10
Thermal Storage System Characteristics for the 1,000 kWe Plants

Type and Fluid	Inventory density, kg/m^3	Inventory specific heat, kJ/kg-°C	Unit tank volume, m^3-°C/kWht	Unit storage cost [1], $/kWht	Relative storage cost
Two Tank					
Caloria	688	2.70	1.94	33	1.00
Binary salt	1,910	1.49	1.26	43	1.30
Thermocline [2]					
Caloria/quartzite [3]	2,172	1.23	1.35	19	0.58
Binary salt/quartzite [4]	2,465	1.18	1.24	34	1.03

Short-term storage (< 3 hrs) may be important

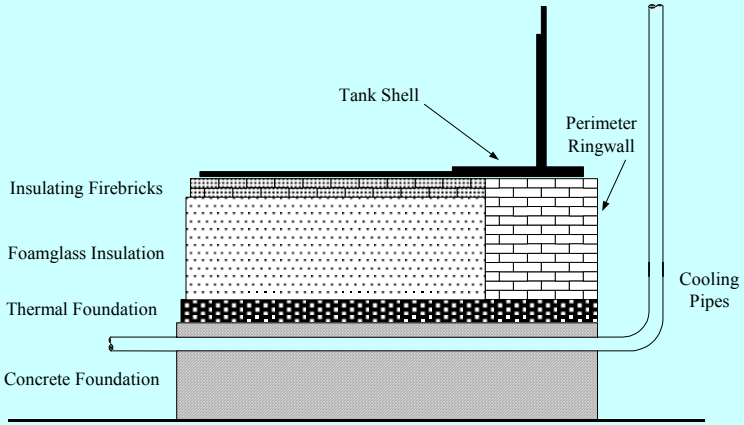
Installation and startup during ’04

Need performance evaluation, detailed design and component spec’s

Issues: cost minimization, 2-tank only near-term option

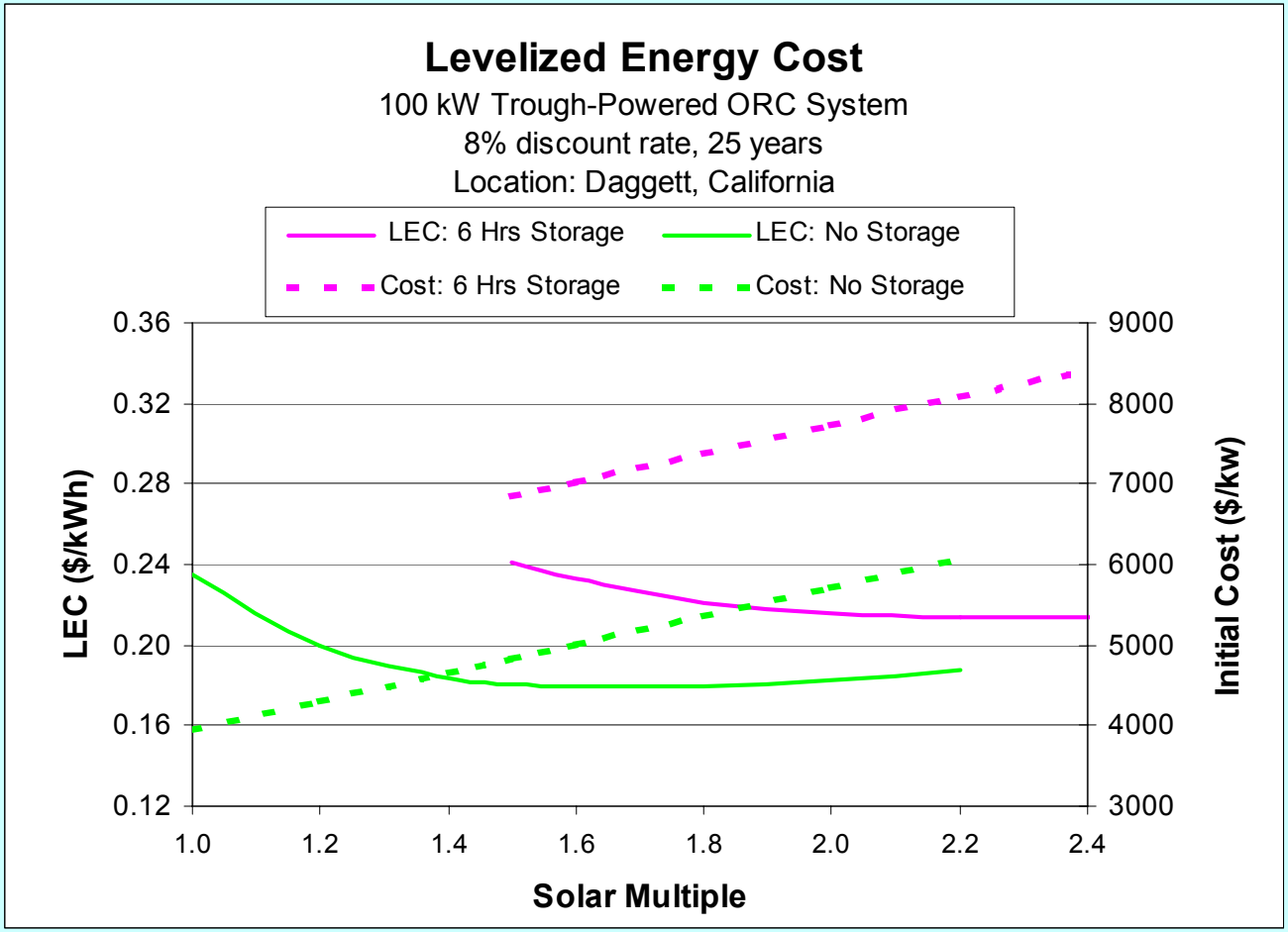
100 kWe and 1 MWe: 2-Tank Cost Estimates (Nexant)

	Case 1, 100 kWe	Case 2, 1,000 kWe	Case 3, 100 kWe	Case 4, 1,000 kWe
Fluids				
Collector field	Caloria	Caloria	VP-1	VP-1
Thermal storage	Caloria	Caloria	Binary salt	Binary salt
Temperature, C				
Hot tank	304	304	368	368
Cold tank	221	221	236	236
Storage tanks				
Hot	$26,000	$107,000	$14,000	$57,000
Cold	$25,000	$101,000	$14,000	$55,000
Thermal insulation				
Hot	$17,000	$64,000	$10,000	$38,000
Cold	$14,000	$52,000	$8,000	$29,000
Foundations				
Hot	$35,000	$135,000	$23,000	$98,000
Cold	$29,000	$108,000	$20,000	$80,000
Inventory	$36,000	$303,000	$28,000	$234,000
Subtotal - Storage tanks	$182,000	$870,000	$117,000	$591,000
Balance of system equipment				
Oil-to-salt heat exchanger	N/A	N/A	$66,000	$411,000
Nitrate salt pumps	N/A	N/A	$20,000	$20,000
Total thermal storage system	$182,000	$870,000	$203,000	$1,022,000
Storage capacity, kWht	2,860	26,600	2,570	23,960
Unit cost, $/kWht	$64	$33	$79	$43



100 kWe Trough-Powered ORC

Preliminary Feasibility Results



High-value for small systems

Green Power

Remote Sites

Issues

Costs

Risk

Thermocline

Timing:

'04 - '05