DOE Solar Energy Technologies Program Peer Review

Technical Track: CSP Operations and Planning

Project Name: National Solar Thermal Test Facility: Sandia's Facility Plan

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Denver, Colorado

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The NSTTF

The National Solar Thermal Test Facility (NSTTF) at Sandia National Laboratories in Albuquerque, NM

- 117 acres on KAFB built in 1976 at an initial cost of about $120m
- Prototype and systems testing for CSP (trough, tower, and dish/engine systems)
- Designated User Facility (NASA, Consortium of astronomers, Air Force Research Laboratories

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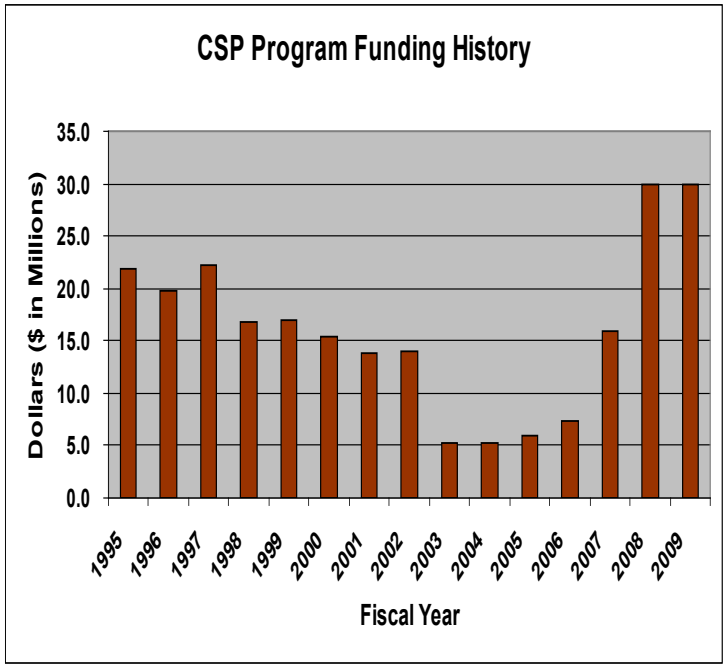
The NSTTF

The National Solar Thermal Test Facility (NSTTF) at Sandia National Laboratories in Albuquerque, NM

- an 8 acre heliostat field and power tower (5 MW_{th})
- a molten-salt test loop,
- a rotating platform for solar thermal and optical testing of trough concentrators,
- a 16 kWT solar furnace for materials, small component, thermo-chemistry and hydrogen generation experiments,
- a dish engine test facility,
- an engine test facility, and
- associated laboratories, specialized test equipment, shop facilities, vehicles, administrative and office buildings.

Program Status



- Increasing funding and projections
- DOE asked the Labs (SNL and NREL) to develop Facilities Plans

Inputs to the Plan

- **CSP ind. road map mtg,**
- **discussions with industry & FOA partners,**
- **Lab views of R&D, and**
- **NSTTF staff.**

Facilities Criteria

Criteria for Modifications and New Facilities

- support multiple CSP companies/technologies
- improve performance (test, evaluation, operation of prototype components and systems, and advanced R&D)
- all with the goals of reducing the LCOE in support of CSP deployment commercialization

The NSTTF Facilities Plan is prioritized
near-term needs (0 to 2 years),
mid-term needs (2 to 5 years), and
long-term needs (5 to 10 years).

NSTTF Activities

Current Activities

- Stirling Energy Systems (6 dishes upgraded to 10)
- Infinia 3 kW dish installation
- SkyFuel trough test

Planned Activities

- Continued testing of SES dishes
- Hamilton Sundstrand – molten-salt panel test
- HS & Friatec – pump and valve test
- HS – heliostat test
- Trough test for LMC
- eSolar support for receiver test

The NSTTF Plan

Near-Term Activities (0 to 2 years)

PRIORITY	FACILITY TITLE	TECHNOLOGIES SUPPORTED	BRIEF DESCRIPTION OF THE ACTIVITY	IMPACTS/BENEFITS TO THE PROGRAM	ESTIMATED COST ($1000)	TIME FRAME (YR/QTR)	PRIORITY (H,M,L)
1	PH 1 Molten Salt Test Facility Upgrade	Tower, Trough, CLFR, Storage	*Upgrade of MS faciity for instrmt, valves, corrosion, and trough applications	Suppts commercialization of MS technology for troughs and towers and R&D.	3,300	Present to FY10/Q4	H
2	NSTTF Site Facilities Upgrade	Tower, Trough, CLFR, Dish, Storage	Upgrade NSTTF site: communications, Instrumentation, remodel/expand office space, replace field equip	Infrastrucut improvements support all CSP industry companies that will use the facility	2,125	FY09/Q4 TO FY10/Q4	H
3	Trough Alternate Working Fluids Test Facility	Trough, CLFR, working fluids, Storage	Add trough test loop for testing alternate working fluid; Upgrade Rotating Platform for larger concent	Alternate fluids for trough collectors supports trough industry for higher T and storage and R&D.	3,800	FY10/Q1 TO FY11/Q1	H
4	Optical Methods Test Laboratory	Tower, Trough, CLFR, Dish	Optical Methods Lab for developing measmts and methods for test, align	Concentrator, dish, trough, heliostat developers and facet manufacturers and R&D.	500	FY10/Q1 TO FY10/Q4	M
5	Mobile CSP Test Laboratory	Tower, Trough, CLFR, Dish, Storage	Develop a mobile, van-based test laboratory	Perform testing at industry, and utility sites	300	FY10/Q4 TO FY11/Q3	M
6	Long Range Heliostat Site	Tower	Develop a site 1 mile from tower for installing heliostats for test	Users of large heliostats for higher power level power tower applications and R&D.	200	FY10/Q2 TO FY11/Q2	M

The NSTTF Plan

Mid-Term Activities (2 to 5 years)

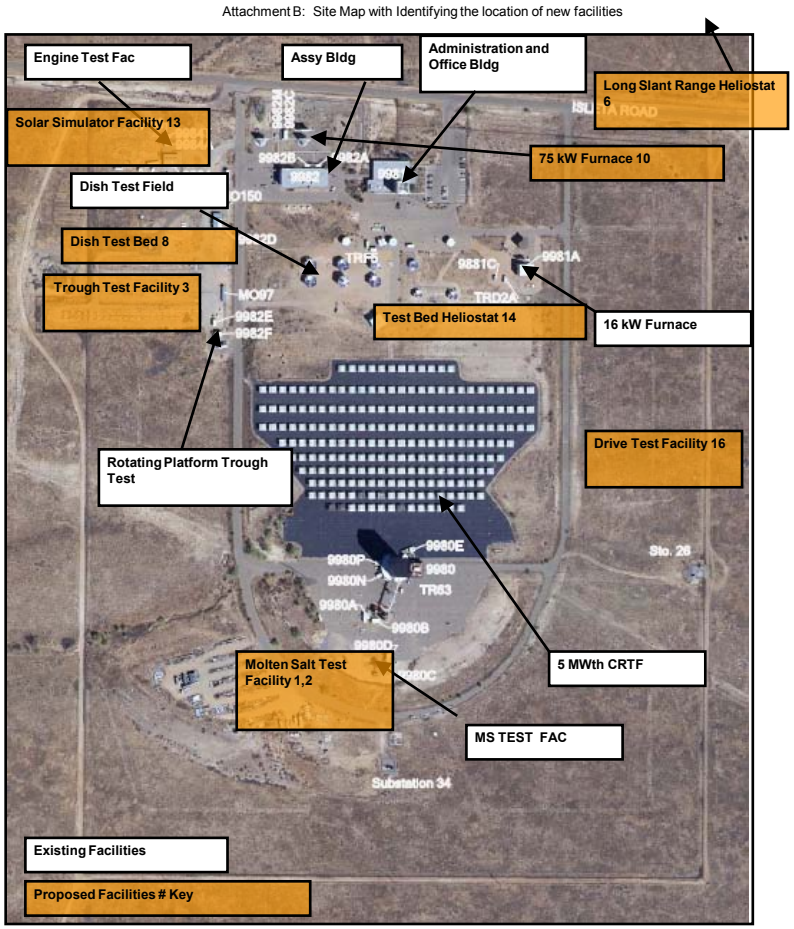
PRIORITY	FACILITY TITLE	TECHNOLOGIES SUPPORTED	BRIEF DESCRIPTION OF THE ACTIVITY	IMPACTS/BENEFITS TO THE PROGRAM	ESTIMATED COST ($1000)	TIME FRAME (YR/QTR)	PRIORITY (H,M,L)
7	PH 2 Molten Salt Test Facility	Tower, Trough, CLFR, Storage	Expand to include test of other equipment as identified by industry	Suppts commercialization of MS technology for troughs and towers.	3,000	FY12/Q1 TO FY13/Q4	H
8	Dish Test Bed Concentrator	Dish	Develop a new dish test bed for receiver and engine testing	Receiver and engine developers and R&D	1,000	FY11/Q3 TO FY12/Q3	H
9	Small Tower Receiver Panel Test Facility	Tower	Develop a test facility in one Bay of the CRTF for testing advanced CR panel materials	Power tower receiver manufacturers and materials developers and R&D.	750	FY12/Q1 TO FY12/Q4	M
10	75 KWth Solar Furnace	Tower, Trough, Dish, CLFR	Convert one of the TBCs to a fixed, higher flux solar furnace for materials, instr, and small component testing	All CSP technologies and materials developers for high temperature applicatons and R&D.	550	FY12/Q4 TO FY13/Q4	H
11	Re-Lamp NSTTF Heliostats	Tower, Storage	Replace 35-year-old glass facets on CRTF field	Power tower industry	4,000	FY12/Q1 TO FY14/Q1	M
12	Solar Simulator	Dish, Tower	Faciity for simulating solar input to dish and tower receiver panels	Supports long-term, cyclical, materials and component testing and R&D.	1,000	FY13/Q2 TO FY14/Q2	M
13	Test Bed Heliostat	Tower	Basic TBH for testing heliostat facet concepts	Power tower and glass facet manufacturers for heliostat applicatons and R&D.	400	FY13/Q1 TO FY13/Q4	L

The NSTTF Plan

Long-Term Activities (> 5 years)

PRIORITY	FACILITY TITLE	TECHNOLOGIES SUPPORTED	BRIEF DESCRIPTION OF THE ACTIVITY	IMPACTS/BENEFITS TO THE PROGRAM	ESTIMATED COST ($1000)	TIME FRAME (YR/QTR)	PRIORITY (H,M,L)
14	NSTTF Remodel for Collocation of CSP and PV	Tower, Trough, Dish, CLFR, PV	Collocation of PV Test Facilities at the NSTTF. Building remodel and new constructions	Supports increased efficiency and reduced cost for program operation	15,000	FY15/Q1 TO FY17/Q4	M
15	Concentrator Drive Test Facility	Tower, Trough, Dish	Develop a dynamic, mechanlical test loading facility for testing concentrator drives	Dish and heliostat drive manufacturers and R&D.	2,000	FY15/Q1 TO FY16/Q4	L
16	CSP Manufacturing Facility	Tower, Trough, Dish, CLFR	Develop a manufacturing assistance center in support of rapid prototyping and best practices	All CSP technologies	1,500	FY15/Q1 TO FY16/Q4	L

The NSTTF Plan



The National Solar Thermal Test Facility located at Sandia National Laboratories in Albuquerque, NM.

The photograph of the facility at the left shows the proposed new facilities (in orange) and the existing facilities (in white).

The details of the NSTTF Facilities Plan are contained in the document provided with this presentation. In the remainder of this discussion, I will focus on the near-term activities.

The NSTTF Plan

Phase 1 MS Test Facility Upgrade

- Two-phase upgrade
- Tanks, heaters, pumps, controls for testing valves instrumentation, etc.
- Upgrade field chemistry lab with balances, oven etc.
- Receiver panel on-sun test

Impacts/Benefits/Users

- Thermal Storage is CSP differentiator
- Troughs and Power Towers
- Hamilton Sundstrand, SolarReserve, Abengoa, Solar Millennium, Lockheed Martin, eSolar, Friatec-Rheinhuete, SQM, Sener, Sandia and NREL

The NSTTF Plan

NSTTF Site Facilities Upgrades

- Communications, tel. And broadband
- Replace aging test and controls equipment – sensors, meters
- T-Building and remodel of permanent office space
- Aging vehicles and field equipment

Impacts/Benefits/Users

- Basic infrastructure support at the NSTTF
- Supports all users.

The NSTTF Plan

Trough Alternate Working Fluids Test Facility

- Field testing of high-temperature trough working fluids (MS, other)
- Testing and evaluation of BOP equipment in operation.
- Upgrade AZTRAK for larger trough collector

Impacts/Benefits/Users

- Low-melting T MS result in higher efficiency lower cost for troughs
- Larger troughs have lower cost per unit energy delivery
- Acciona, Abengoa, Sener, Solar Millennium, SkyFuel, Solel, Lockheed Martin, SQM, Sener, Sandia and NREL.

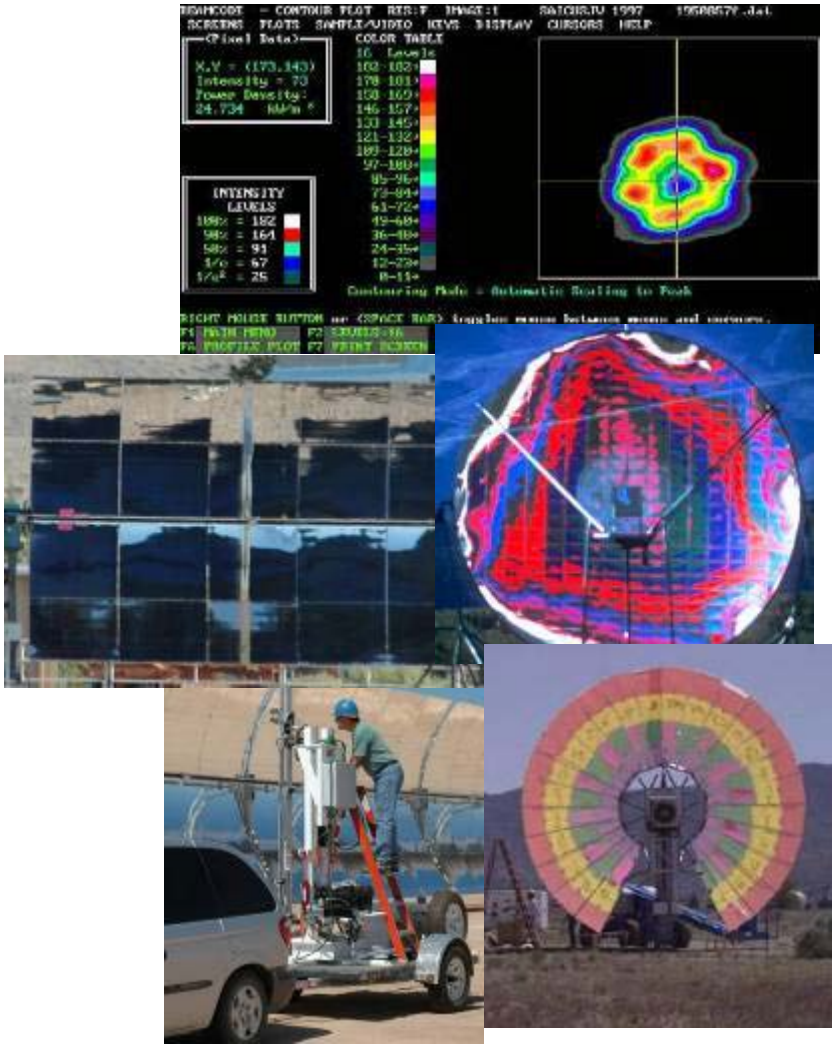
The NSTTF Plan

Optical Methods Test Laboratory

- Alignment, optical evaluation, QC during production
- SNL has three systems currently under development
- Application of field-level methodologies

Impacts/Benefits/Users

- Builds on SNL strength in an area where industry doesn't have expertise
- Supports all CSP technologies



The NSTTF Plan

Mobile CSP Test Laboratory

- Suggested by several companies at Tamaya Road Map Meeting
- Some companies are developing their own test sites in lieu of NSTTF
- Requires more complete evaluation

Impacts/Benefits/Users

- Provide industry support at their test sites
- May be an intermediate issue due to current available funding
- Would support eSolar, AUSRA, and Brightsource

The NSTTF Plan

Long-Range Heliostat Test Site

- Large heliostat fields suggest long-slant range heliostats
- HS has an immediate need to test a LSR heliostat
- NSTTF Site accommodates ½ mile but need to test up to 1 mile

Impacts/Benefits/Users

- Developers of heliostats for large power towers
- Applies only to tower technology
- Abengoa, Brightsource Energy, SolarReserve, eSolar, Sener, Sandia and NREL