NATIONAL SOLAR ENERGY CONFERENCE

Solar Electric Generating System for Nevada

ELDORADO SOLAR ELECTRIC GENERATING SYSTEM

Portland Or, July 13, 2004

Gilbert E Cohen

Vice President of Engineering & Operations

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SOLARGENIX ENERGY

Discussion topics

- Solargenix Energy LLC (SGE), the Company
- SGE technology of choice
- Brief history of PT
- Simple schematic
- Nevada – Eldorado SEGS Project status
- Arizona – Red Rock Saguaro solar power plant
- Concluding remarks

SOLARGENIX ENERGY

Solargenix Energy, LLC

Corporate Headquarters: Raleigh, NC

Branch Offices

Sanford, North Carolina

Las Vegas, Nevada

Newport Beach, California

Manufacturing

Chicago, Illinois

Engineering and RD&D branches

California, Colorado, Europe

SOLARGENIX ENERGY

Solargenix Energy initiative for the development of An advanced Concentrating Solar Power Plant in Boulder City – Nevada

SOLARGENIX ENERGY

THE PARABOLIC TROUGH TECHNOLOGY

Solargenix Energy technology of choice for the Nevada Solar project

SOLARGENIX ENERGY

Renewable Energy
With Proven Solar Thermal Electric Technology

With the first CSP project under construction since 1991, and a large utility-scale solar plant in advanced development phase, Solargenix is the leading developer of CSP in the USA.

Evolution of the technology

September 1, 1907

PATENT-URKUNDE

No. 237294.

UF GRUND DER ANGEHEFTETEN PATENTSCHRIFT IST DURCH BESCHLUSZ DES KAISERLICHEN PATENTAMTES

an Dr. Wilhelm Maier in Aalen und Adolf Remshardt in Stuttgart

EIN PATENT ERTEILT WORDEN.

GEGENSTAND DES PATENTES IST:

GESETZ v. 7. APRIL 1891

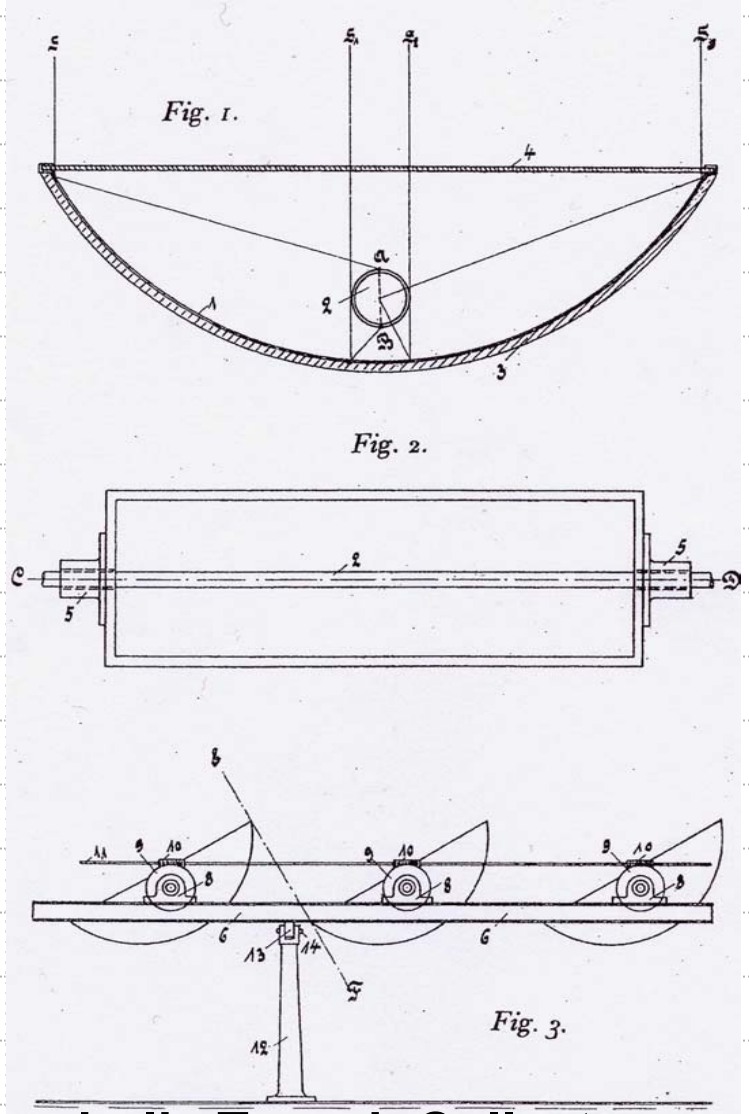
Vorrichtung zur unmittelbaren Verwendung der Sonnenwärme zur Dampferzeugung.

ANFANG DES PATENTES: *1. September 1907*

DIE RECHTE UND PFLICHTEN DES PATENTINHABERS SIND DURCH DAS PATENT-GESETZ VOM 7. APRIL 1891 (REICHS-GESETZBLATT FÜR 1891 SEITE 79) BESTIMMT.

ZU URKUND DER ERTEILUNG DES PATENTES IST DIESE AUSFERTIGUNG ERFOLGT.

KAISERLICHES PATENTAMT.



Parabolic Trough Collector

SOLARGENIX ENERGY

1912: 55 kW
by Shuman in Egypt

Kramer Junction 1988

LUZ - LS3

September 1, 1907

KAISERLICHES PATENTAMT.

AUSGEGEBEN DEN 18. FEBRUAR 1911.

PATENTSCHRIFT

— № 231294 —

KLASSE 42*i*. GRUPPE 18.

DR. WILHELM MAIER IN AALEN
UND ADOLF REMSHARDT IN STUTTGART.

Vorrichtung zur unmittelbaren Verwendung der Sonnenwärme zur Dampferzeugung.

Patentiert im Deutschen Reiche vom 1. September 1907 ab.

SOLARGENIX ENERGY

US006668820B2

(12) **United States Patent**
Cohen et al.

(10) **Patent No.: US 6,668,820 B2**
(45) **Date of Patent: Dec. 30, 2003**

(54) **MULTIPLE REFLECTOR SOLAR CONCENTRATORS AND SYSTEMS**

(76) Inventors: **Gilbert E. Cohen**, 115 White Bloom La., Morrisville, NC (US) 27560; **Roland Winston**, 5217C S. University Ave., Chicago, IL (US) 60615

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **09/939,261**

(22) Filed: **Aug. 24, 2001**

(65) **Prior Publication Data**

US 2003/0037814 A1 Feb. 27, 2003

(51) **Int. Cl.**[7] **F24J 2/18**; H01L 31/052

(52) **U.S. Cl.** **126/685**; 126/246; 126/259

5,062,899 A * 11/1991 Kruer 136/259
5,578,140 A * 11/1996 Yogev et al. 136/246
5,979,438 A * 11/1999 Nakamura 126/680

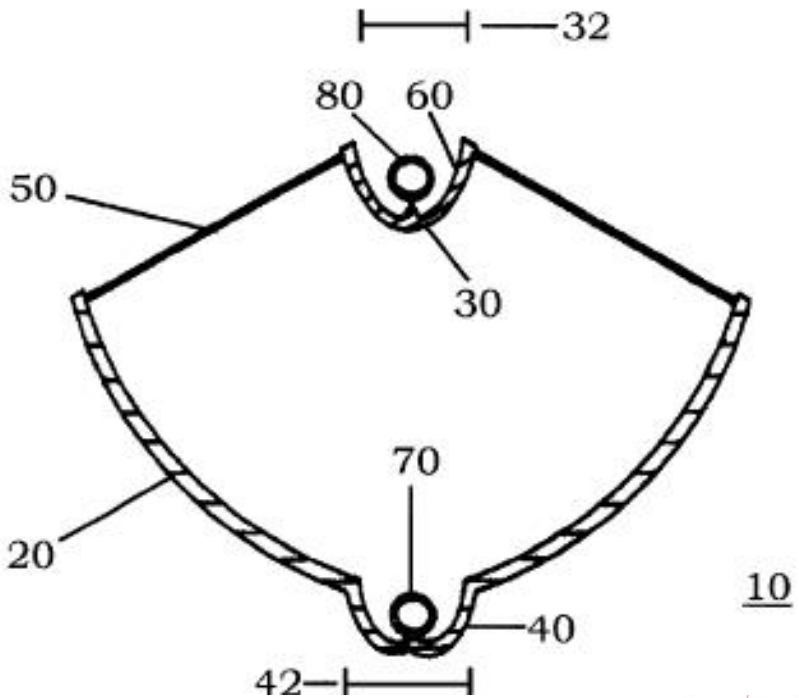
* cited by examiner

Primary Examiner—Nam Nguyen
Assistant Examiner—Brian L. Mutschler
(74) *Attorney, Agent, or Firm*—Brian D. Voyce

(57) **ABSTRACT**

The present invention relates to multiple reflector light or

SGE NEW CONCEPT



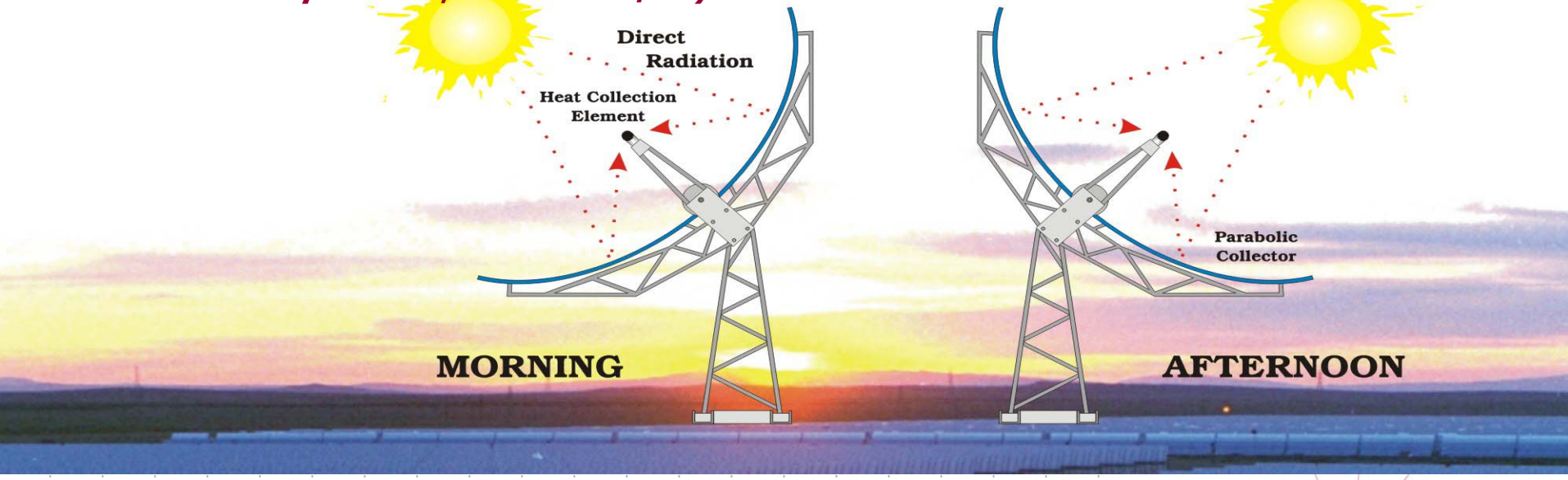
SOLARGENIX ENERGY
Formerly Duke Solar Energy

SIMPLE SCHEMATIC OF PARABOLIC TROUGH OPERATION (North-South Axis)

- The SEGS utilize Parabolic Trough Collectors which is a Concentrating Solar Power (CSP) Technology

- CSP Technologies utilize Direct Normal Radiation (DNR) which is measured in terms of Watts per Square Meter (good sunlight yields ~1,000+ Watts/m^2)

Concentration Ratio		
Solargenix	71:1	(71 Suns)



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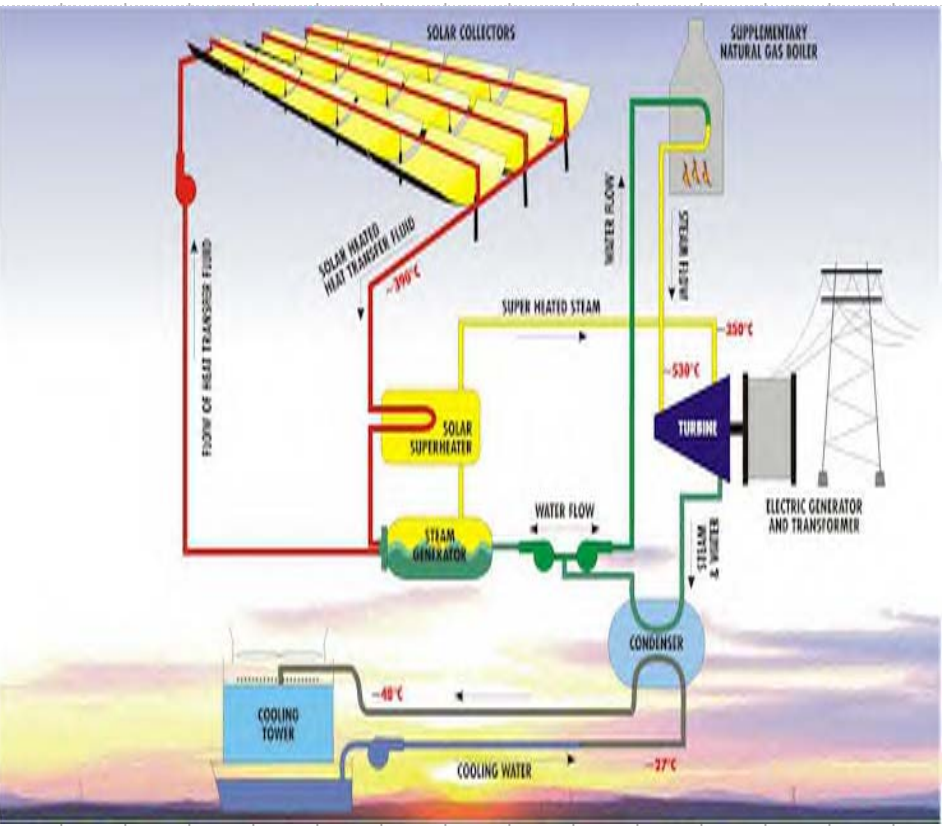
Simple schematic of a typical SEGS power plant



SOLAR FIELD

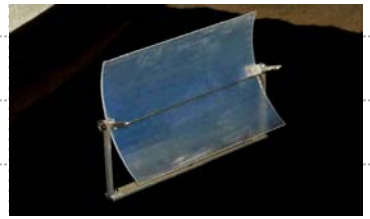
65 MW solar field – 25 Minutes Storage –

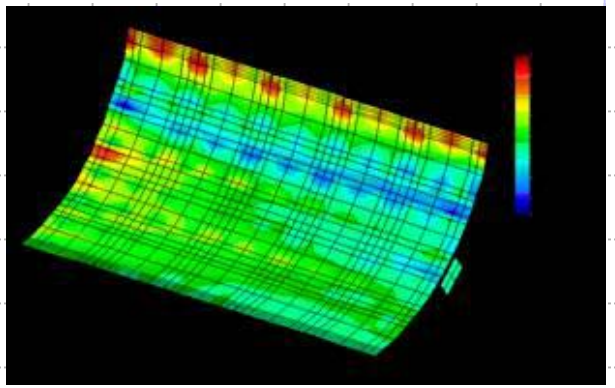
Solar Collector Assemblies:	**640**
Aperture Area (m²/Sq.ft):	**5.0 / 59**
Length (m/ft):	**100/328**
Concentration Ratio:	**71**
Optical Efficiency:	**0.77**
# of Mirror Segments:	**157440**
# of receiver tubes	**15360**
Field Aperture (m²):	**300,320**
Site area (Km²/acres):	**1.40/350**
Field Inlet Temp.(°C/°F):	**350/662**
Field Outlet Temp. (°C/F°):	**395/743**

The solar thermal industry and especially the Concentrating Solar Power industry are being developed worldwide in a rapid pace, this should attract more large manufacturers to consider the production of solar field components at attractive costs.

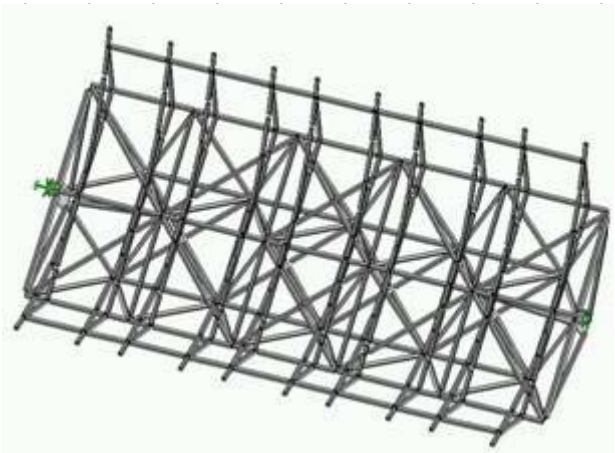
SOLARGENIX ENERGY

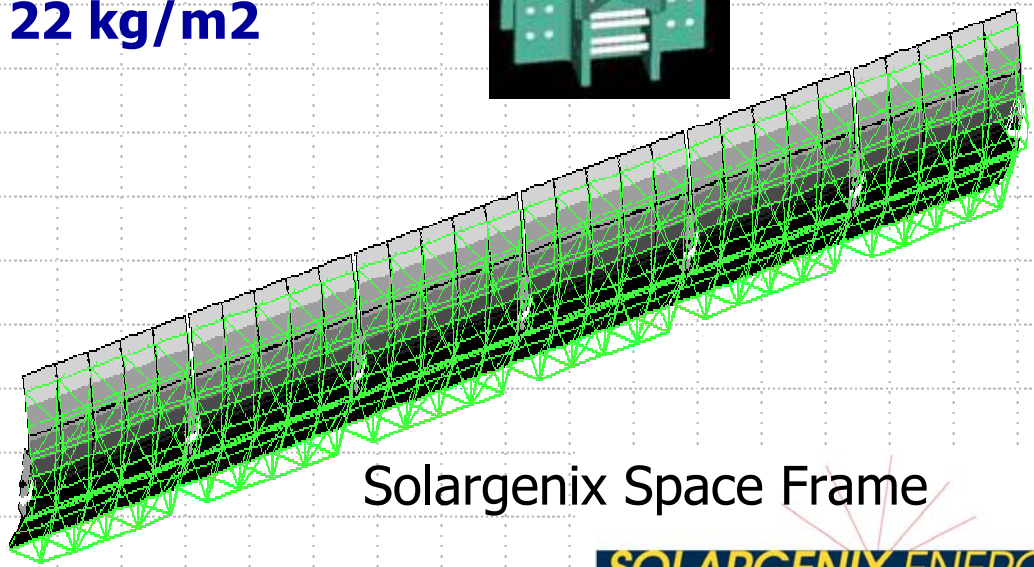
Solargenix Advanced Parabolic Trough





- Increased Rigidity via Interlinking
- No Site Cutting or Welding
- No Jig Necessary for Assembly
- Components Easier to Handle and Ship
- Weight Incl. Mirrors ~ 22 kg/m2
- Length : 100 meters





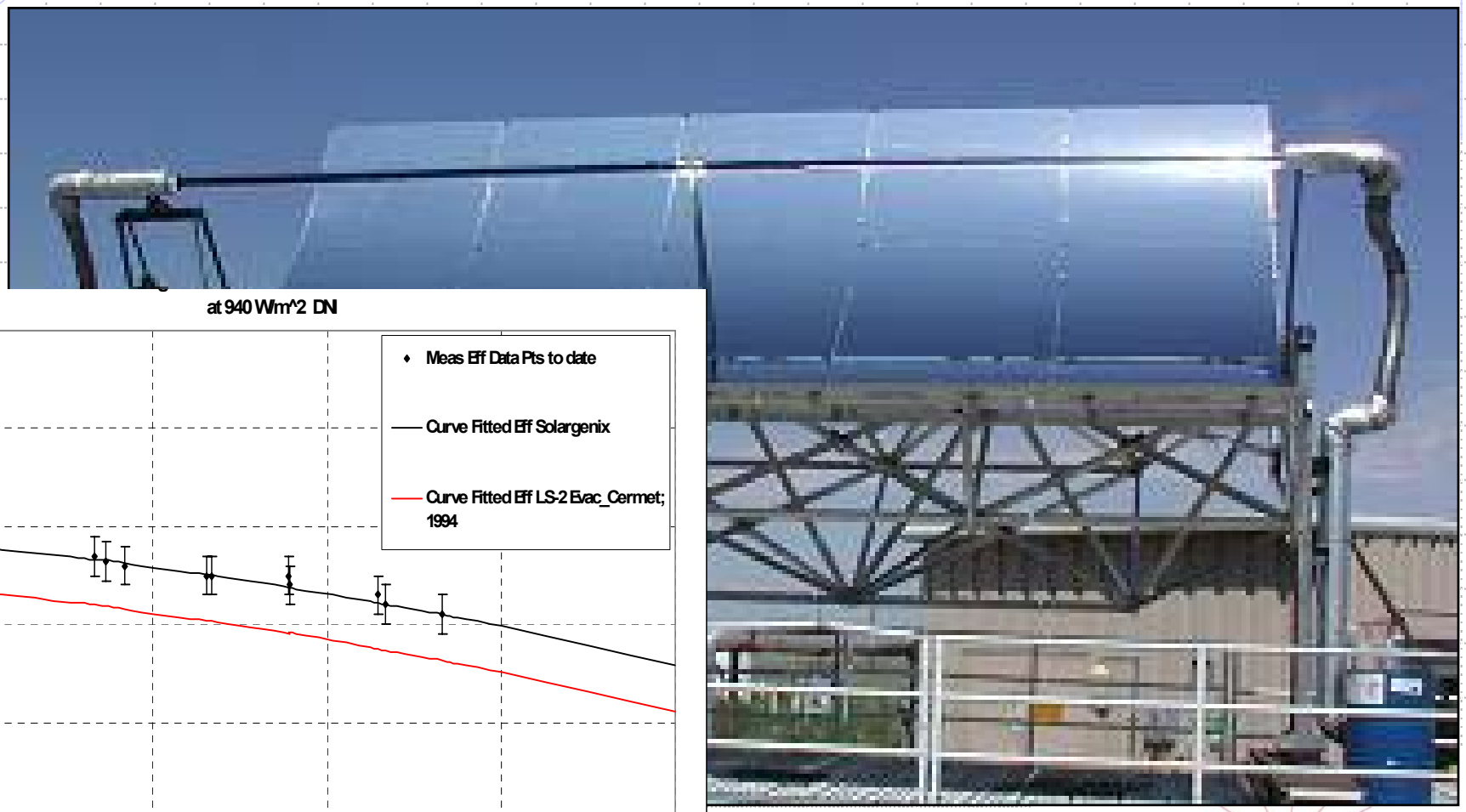
Solargenix Space Frame

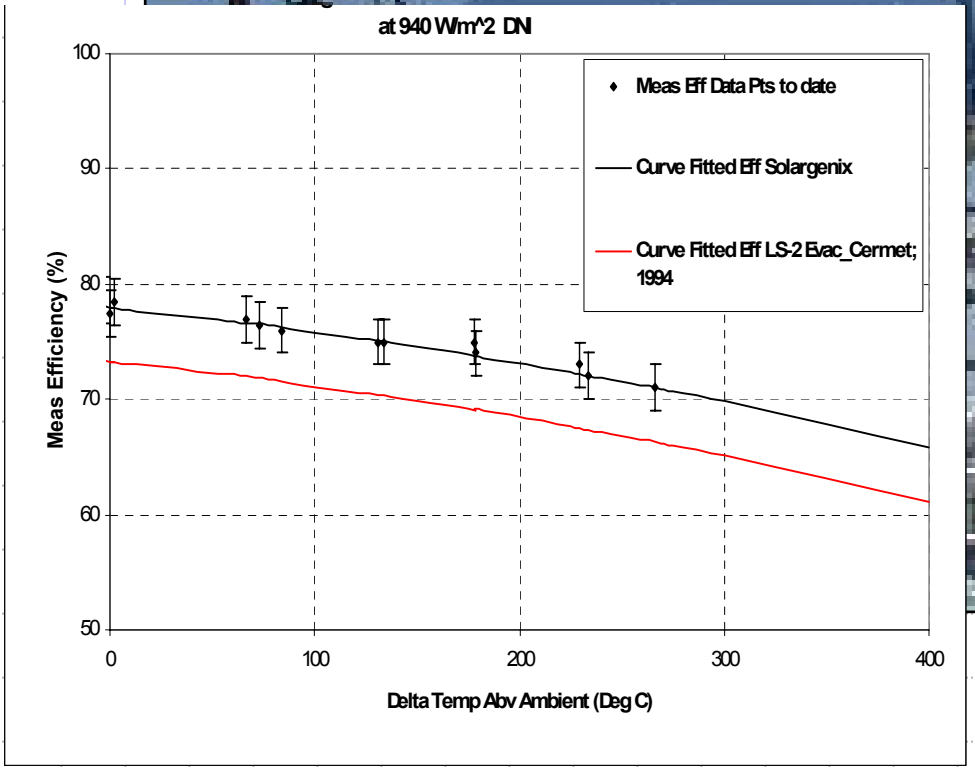
SOLARGENIX ENERGY

Preliminary Test Results: Solargenix Prototype Collector

Tested in Albuquerque - NM

Sandia National Laboratories





SOLARGENIX ENERGY

POWER BLOCK

Turbine Generator Gross Output	**55 MWe**
Net Output to Utility	**50 MWe**
Solar Steam Conditions	
Inlet Pressure	**102 bars/1480 psi**
Reheat Pressure	**17.5 bars/254 psi**
Inlet Temperature	**371 Deg.C / 700 Deg.F**
OPTION (NOT CONSIDERED IN BOULDER CITY)	
Gas Mode Steam Conditions	
Inlet Pressure	**102 bars/ 1480 psi**
Reheat Pressure	**17.5 bars / 254 psi**
Inlet Temperature	**510 Deg.C / 950 Deg.F**

The market for conventional power plants today is very competitive,leading to many sources for components at attractive costs

SOLARGENIX ENERGY

SCHOTT

Supplier of the Heat Collection Element (HCE)

More than 200 prototypes installed at Kramer Junction in the last two years

No degradation or breakage reported

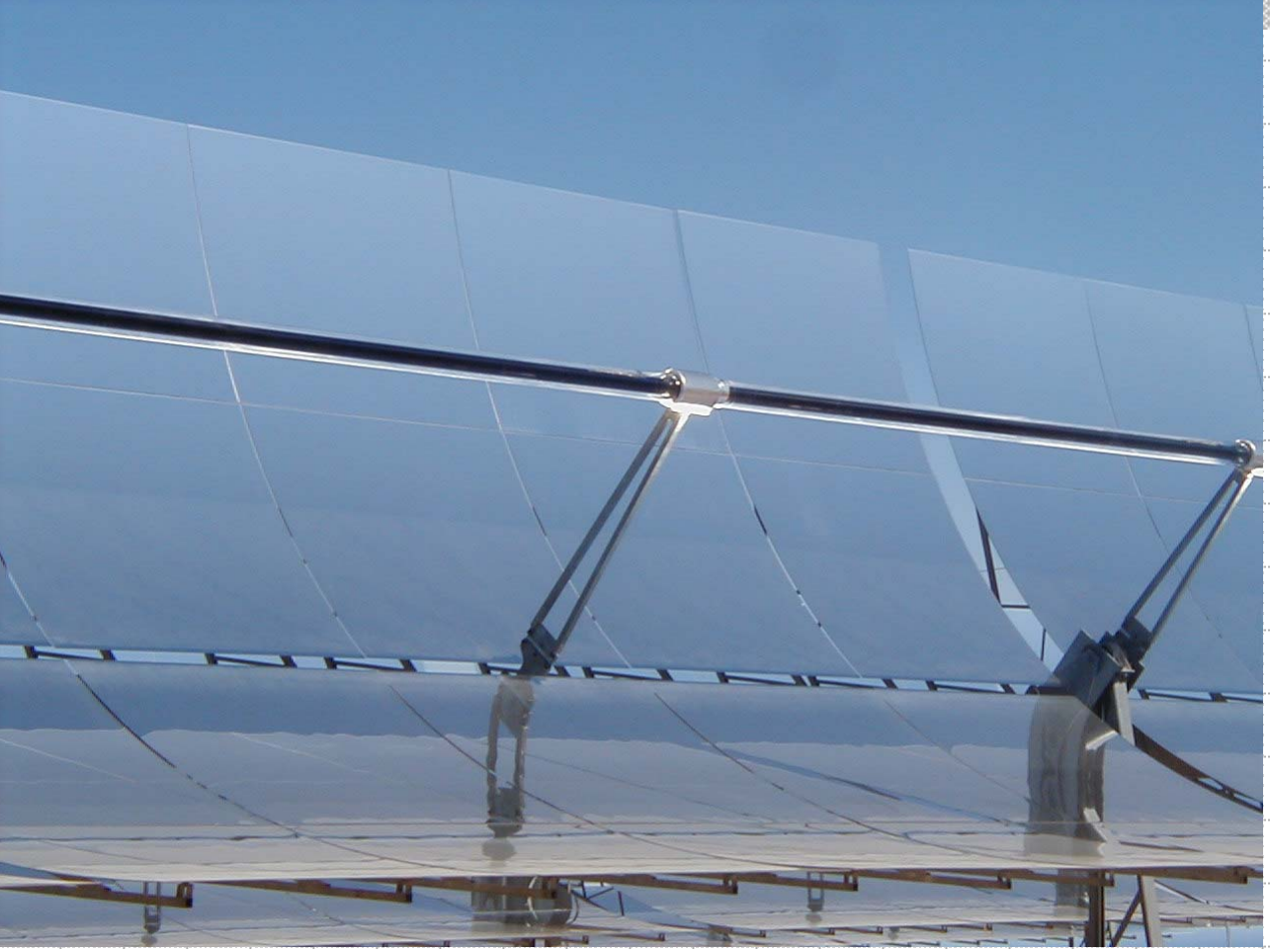
SOLARGENIX ENERGY

SCHOTT

Corporate Structure

	Strategic Business Units (SBU)				
	O	H	E	P	S
SBU	Advanced Optical Materials and Components	Home Tech	Electronics	Pharmaceutical Systems	Solar
Business Segments (BS)	→ Optics for Devices → Ophthalmics → Special Flat Glass → Microlithography → Lighting Components → Digital Projection → Advanced Coated Components	→ White Goods → Food Display	→ Electronic Packaging → Fiber Optics → Cathode Ray Tube (CRT) → Flat Panel Display (FPD)	→ Pharmaceutical Packaging → Tubing → Labware → Health	→ Photovoltaics → Solarthermal → Gas Burner Systems

SOLARGENIX ENERGY



REFLECTOR PANELS

- Proven Durability
- Excellent Reflectivity
- Easy to install

SOLARGENIX ENERGY

Flabeg GmbH & Co. KG is a company specialized on production of glass products like automotive and decorative mirrors, glass for solar applications and architectural products. The company with world-wide activities is located in Fürth, Germany. It is well known for the production and delivery of more than 2.000.000 m^2 of mirror surface for all nine existing SEGS-plants built in California.

Supplier of Mirrors for the Solar Field

PROJECT STATUS

Long term Power Purchase Agreement signed with Nevada Power and Sierra Pacific

Long term lease agreement signed with the City of Boulder City, at the Eldorado Valley - Nevada

Long term Water service contract signed with the City of Boulder City

Development agreement signed with the City of Boulder City

SOLARGENIX ENERGY

PROJECT STATUS (Continued)

Interconnection study – Phase 1 completed

Project design in final stages

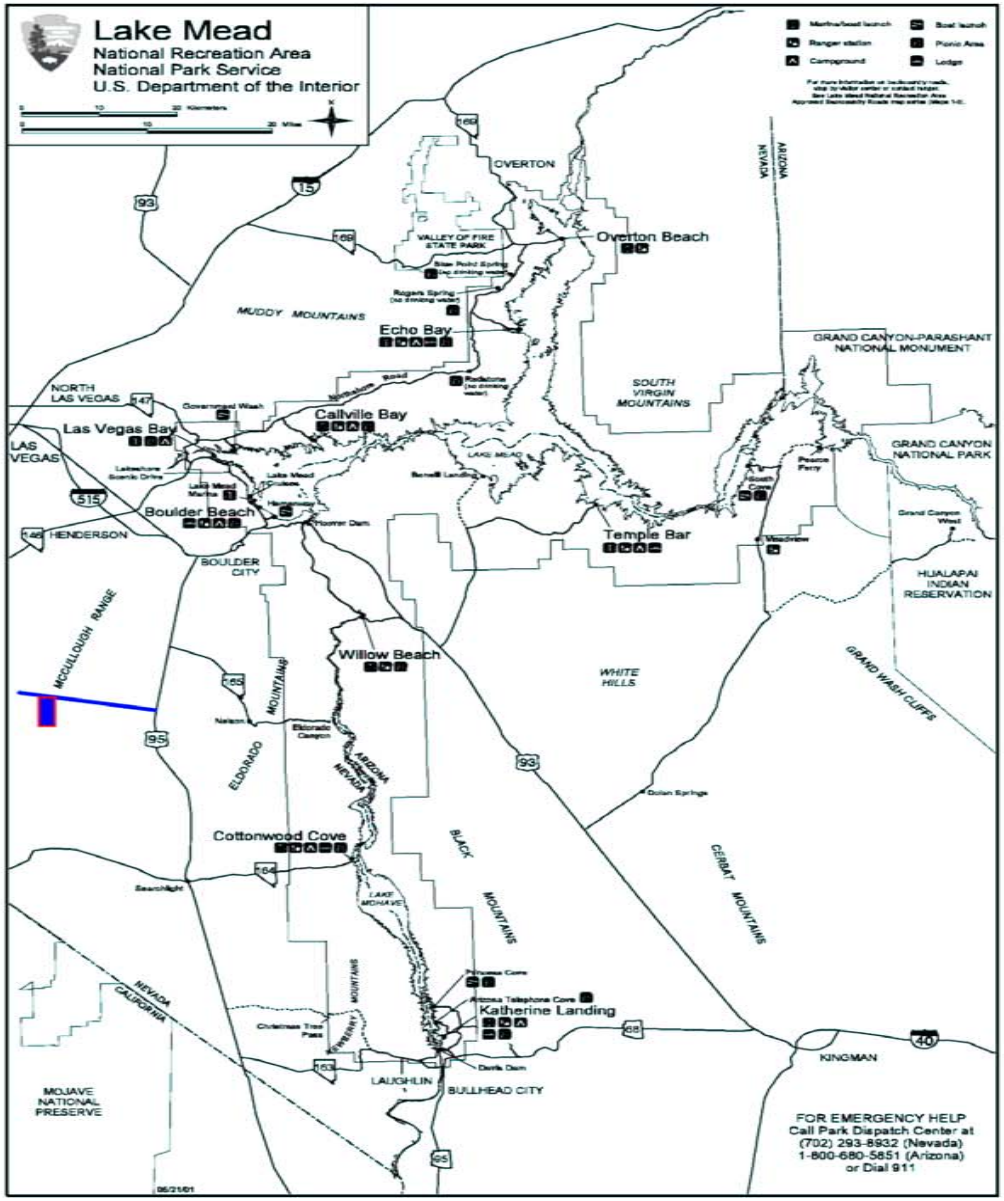
Financial team selected and in due diligence phase

EPC selection in progress – Decision must be made soon

Permitting process in progress

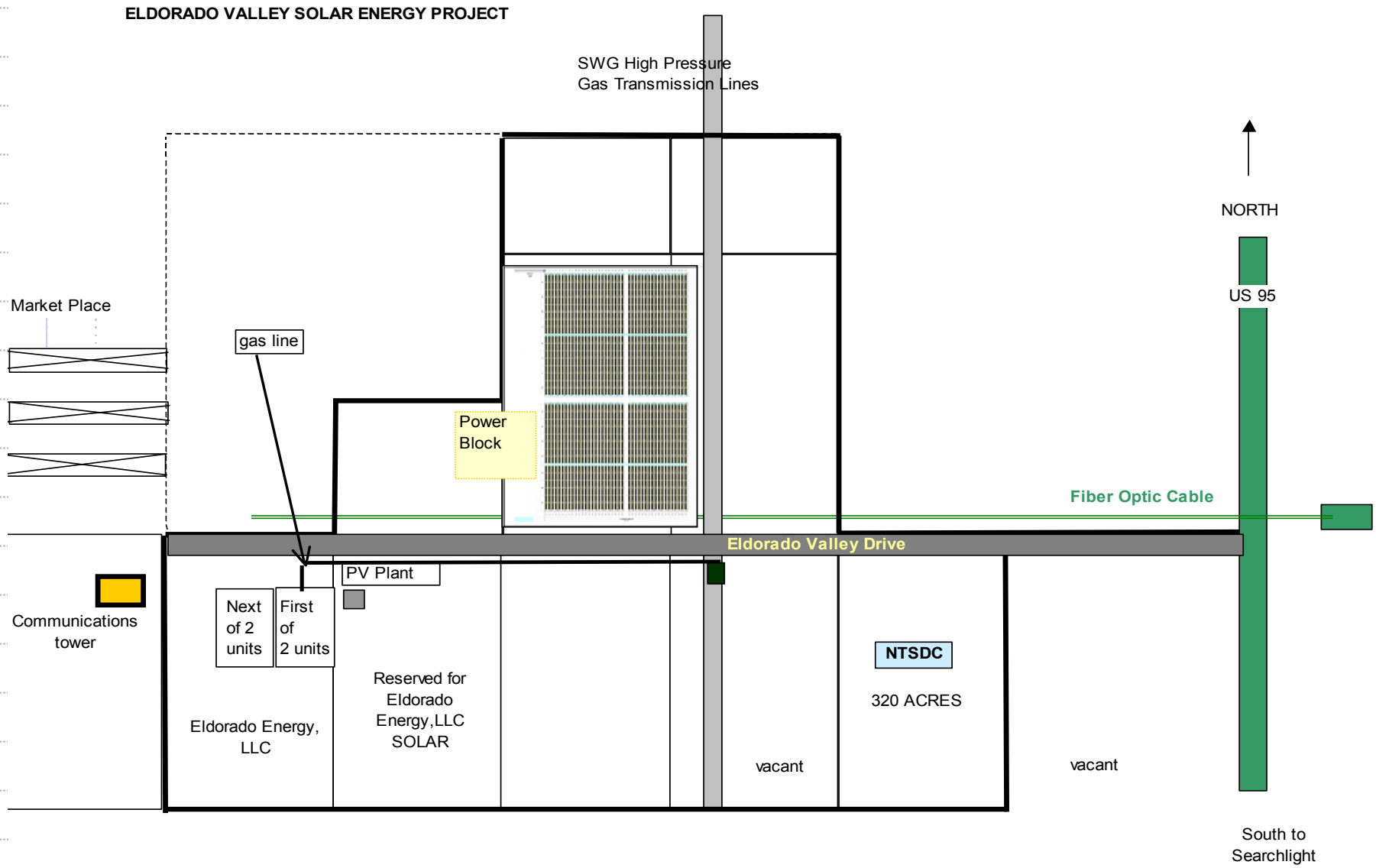
SOLARGENIX ENERGY

PROJECT LOCATION



SOLARGENIX ENERGY

PROJECT LOCATION



GOVERNOR
KENNY C. GUINN
STATE OF NEVADA

FOR IMMEDIATE RELEASE: July 9, 2004

Contact Greg Bortolin or John Trent
775-684-5670

GOV. GUINN ANNOUNCES FINANCING TO ENSURE COMPLETION OF RENEWABLE ENERGY PROJECTS

CARSON CITY – Gov. Kenny Guinn announced today that representatives from the Governor's Office, renewable developers, the state's two investor-owned utilities, the State Consumer Advocate and the staff of the Public Utilities Commission (PUC) agreed on regulatory and legislative proposals that meet Nevada's strict renewable energy portfolio standard.

"We are accomplishing two things today," Gov. Guinn said. "We are proposing changes that will give investors in Nevada renewable projects additional reasonable guarantees that they will receive a fair return on their investments. We are also giving our utilities a chance to use more renewable energy, sooner."

The proposals are outlined in three documents filed today with the PUC. They are: a petition asking that a rulemaking docket be opened, draft changes to the PUC's regulations and draft changes to Nevada's Revised Statutes. Gov. Guinn has agreed to file the draft statutory changes with the Legislative Commission or the Legislature at the time the PUC files its adopted regulation. The filings are expected to occur in early September. Proposed regulatory changes give the PUC the authority to create a "Temporary Renewable Energy Development" (TRED) trust that receives renewable energy payments from the utilities' rate payers, and makes scheduled payments to renewable developers for energy delivered to utilities. New PUC authority also allows separation of such revenues from other payments made to utilities so that they are not "commingled" with general revenues. These steps are necessary because investors who should provide the capital for renewable projects are concerned that impaired credit status of the two utilities might interfere with the repayment schedules. Statutory changes, if approved by the Legislature, provide protections for the TRED trust similar to those granted to selected utility contracts and certain state revenue bonds, and would prevent a future PUC from countermanding a PUC Resource Plan order that determined a project was in the public interest and prudent.

"This effort involved the joint commitment of some individuals and organizations that usually have no need to work together," said Richard Burdette, Gov. Guinn's energy advisor. "Nevada's renewable energy development was interrupted by financial events of 2002, but will be put back on track by this initiative."

MEDIA CONTACT: RICHARD BURDETTE, (775) 684-5677.

Office of the Governor
101 North Carson Street
Carson City, NV 89701
Fax: 775-684-7198

Grant Sawyer State Office Building
555 East Washington, Suite 5100
Las Vegas, NV 89101
Fax: 702-486-2505

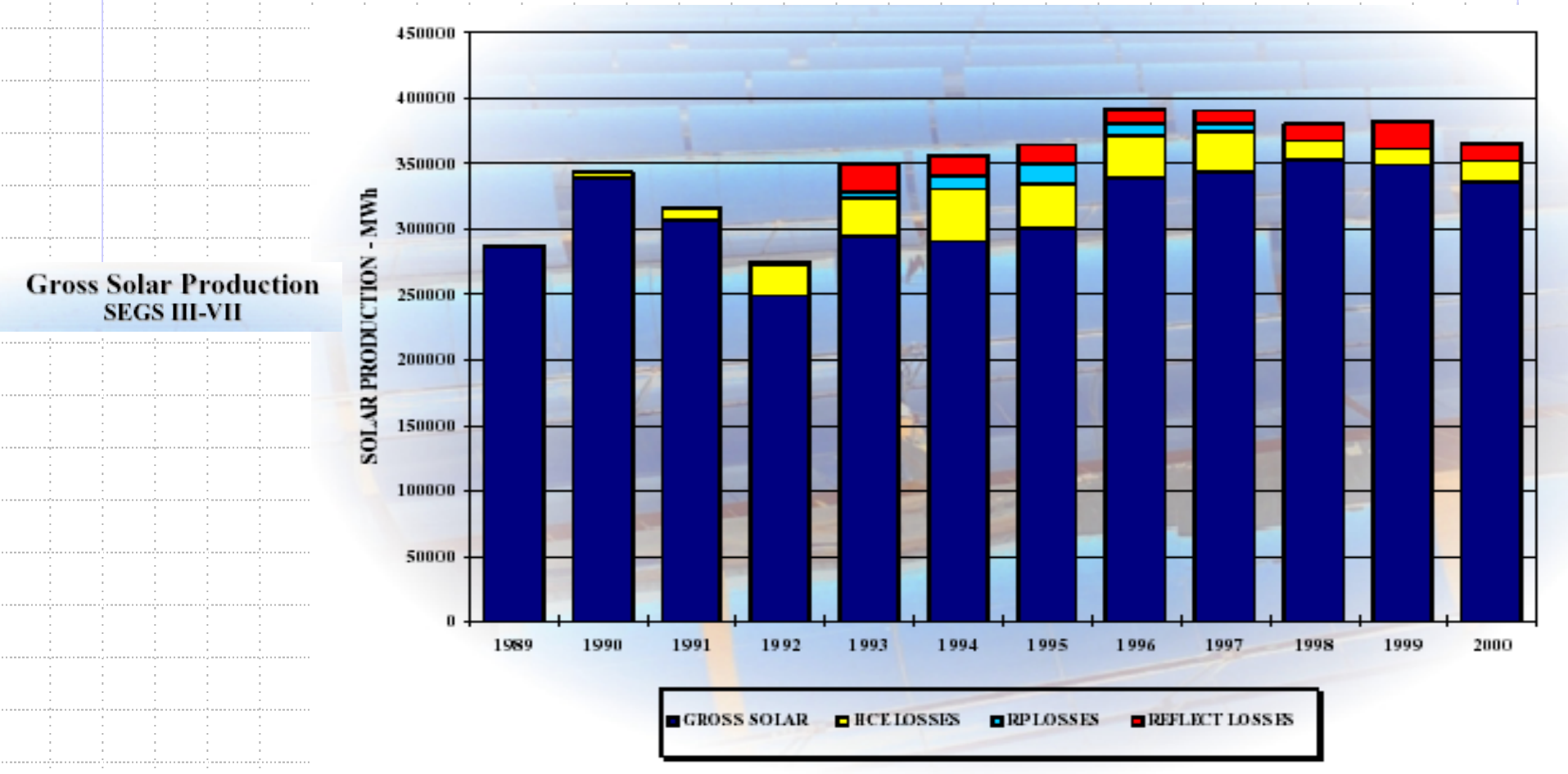
SOLARGENIX ENERGY

Why this project is feasible?

Reliability of Solar Field

Because : Past experience shows:

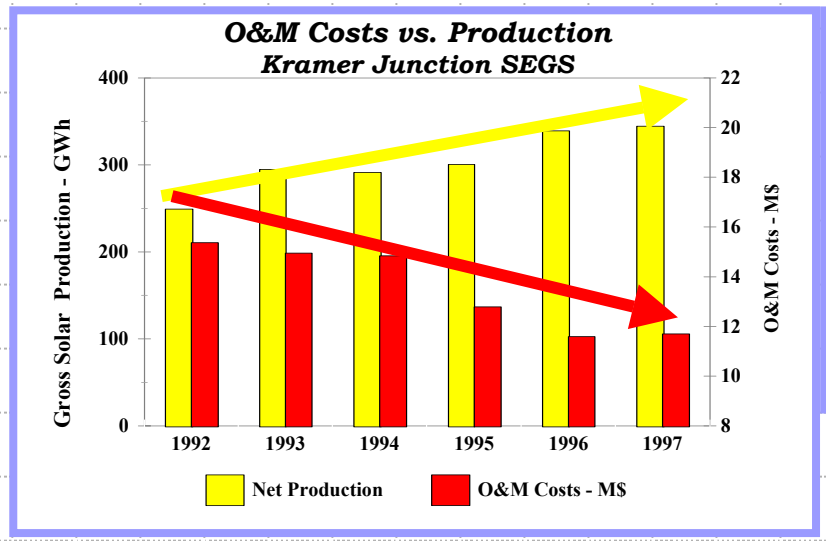
- Evidence of longevity
- Satisfactory performance of existing plants



Operation and Maintenance

O&M will be done under long term contract by qualified Solargenix operators with substantial experience in that field.

- O&M contract may provide variable payment rates depending on plant output.
- One Operating Company for several projects.



Efficient tooling and procedures have been developed for O&M

SOLARGENIX ENERGY

Reliable prediction of solar radiation levels

- Although Solar radiation varies from year to year, the US has an excellent track record of solar radiation measurement.
  - Sophisticated and unique output performance models have been developed, proved and validated during the past 10 years.
  - Financial sensitivity analysis assume lower insolation levels.

SOLARGENIX ENERGY

SOLAR ELECTRIC GENERATING SYSTEMS
SOME NEAR OPPORTUNITIES

- Solargenix 1 MW project in Arizona.
- 1000 MW Initiative for CSP in the Southwest of the USA.
- Western Governors Associations commitment to the deployment of 30,000 MW of renewable energies by 2015.
- 5000 Mw Global Market Initiative (GMI) adopted at the World energy summit last month in Bonn (Germany).
- Solargenix strategic alliances in Australia, Mexico and Spain etc…
- Renewable Solar Portfolios.

SOLARGENIX ENERGY

ARIZONA

SOLARGENIX ENERGY

MODULAR DISTRIBUTED SOLAR TROUGH POWER PLANT

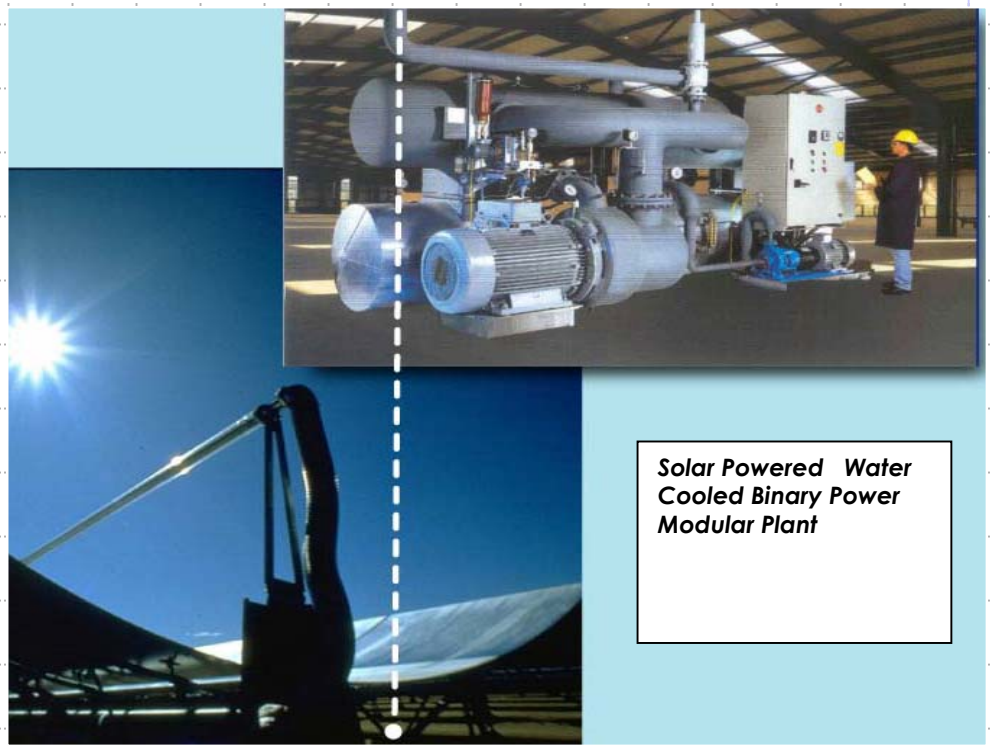
Robert Cable
Solargenix

Scott Canada
APS
The power to make it happen.

Gilbert Cohen
Solargenix
SOLARGENIX ENERGY

APS 1 MWe Project Introduction

- Project Team
- Plant Performance
- Plant Layout
- Operation
- Maintenance
- Schedule



SOLARGENIX ENERGY

Project Team

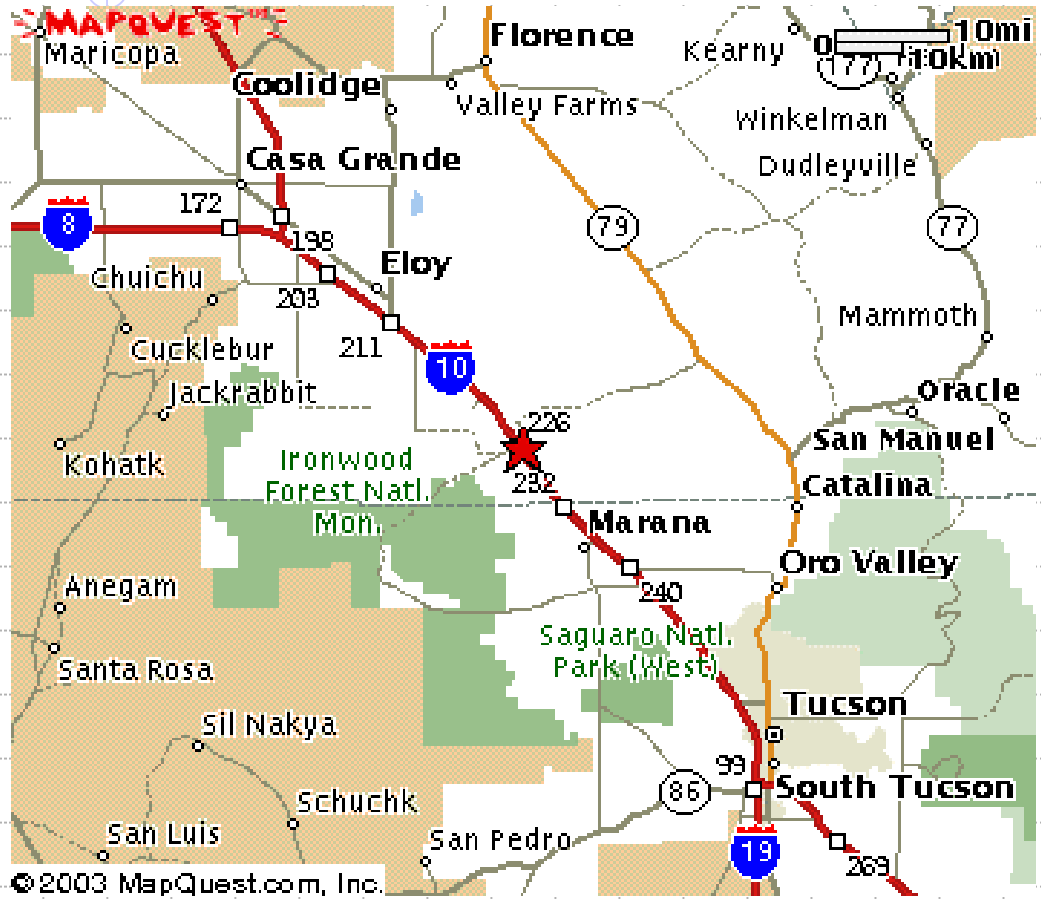
- Strong Project Team for Integration of two proven technologies.
  - ORMAT - OEC system.
  - Solargenix - Solar system and Solar Field.
  - APS – General Site Conditions, Oversight, and Utilities.

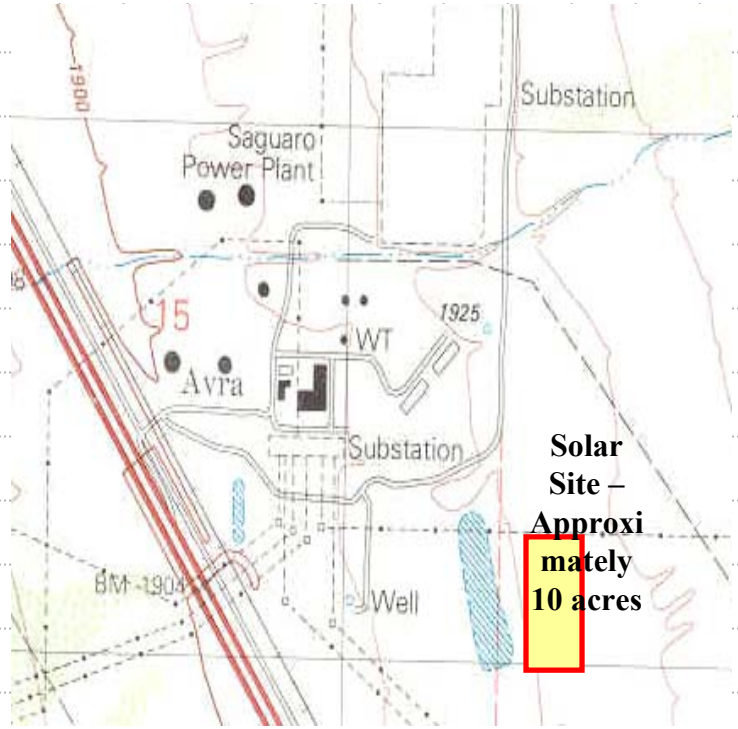
APS
The power to make it happen.

ORMAT®

SOLARGENIX ENERGY

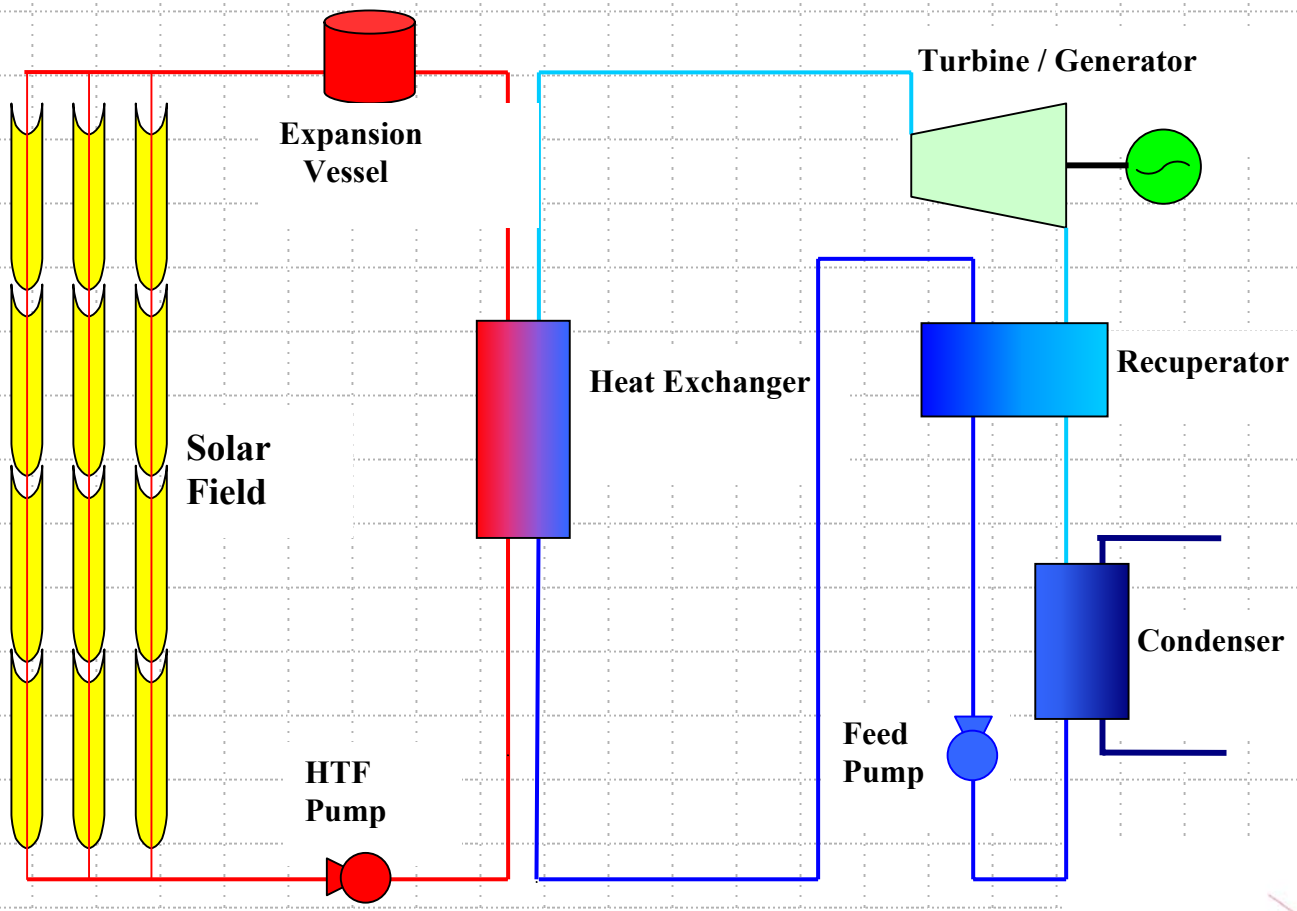
Project Location





Saguaro Power plant is approximately one hour south and east of Phoenix, AZ on I-10.

Schematic of 1MW Solar Trough Power Plant



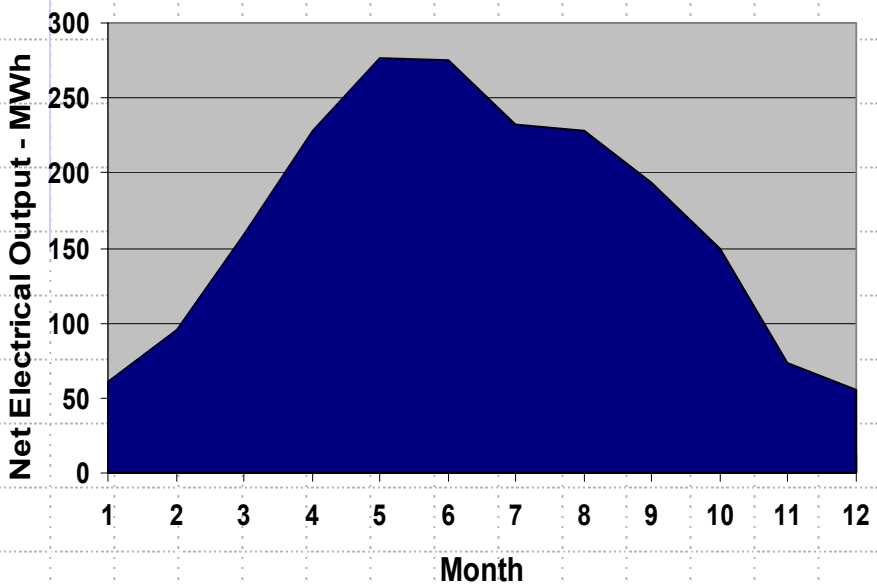
SOLARGENIX ENERGY

Performance Assumptions

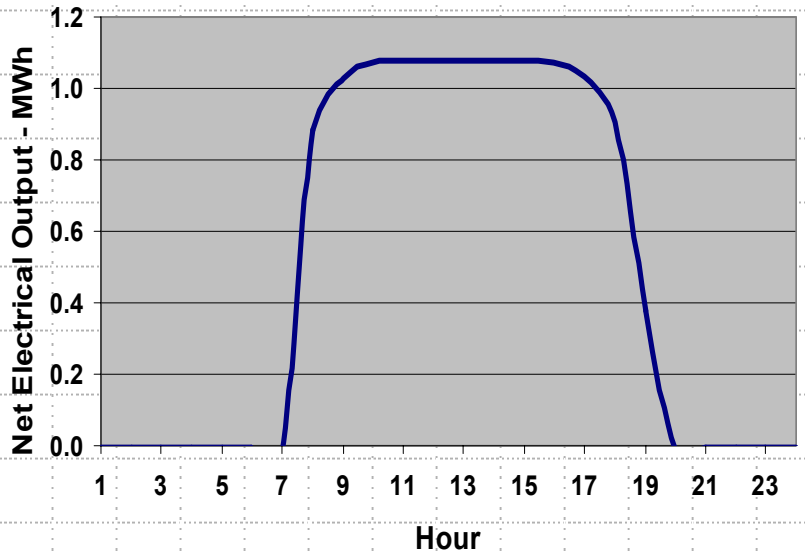
- 2000 MWhr Generated Annually
- $0.0291/kWh Annual O&M Expenses
- 95% plant availability (>1 SCA's o/s)
- 10,346 square meters of aperture (~22 SCA's)
- 86.5% spectral reflectivity (92.5 cleanliness)
- Evacuated receivers (HCE's)

SOLARGENIX ENERGY

Monthly Solar Output
1 MW ORC



Peak Day Solar Output Profile
1 MW ORC



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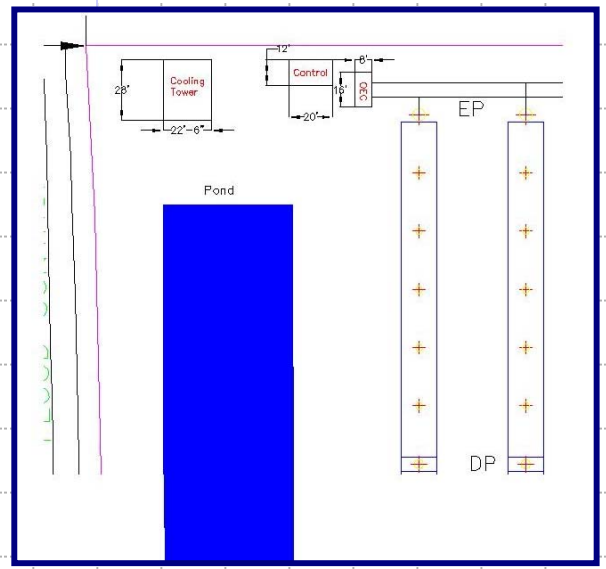
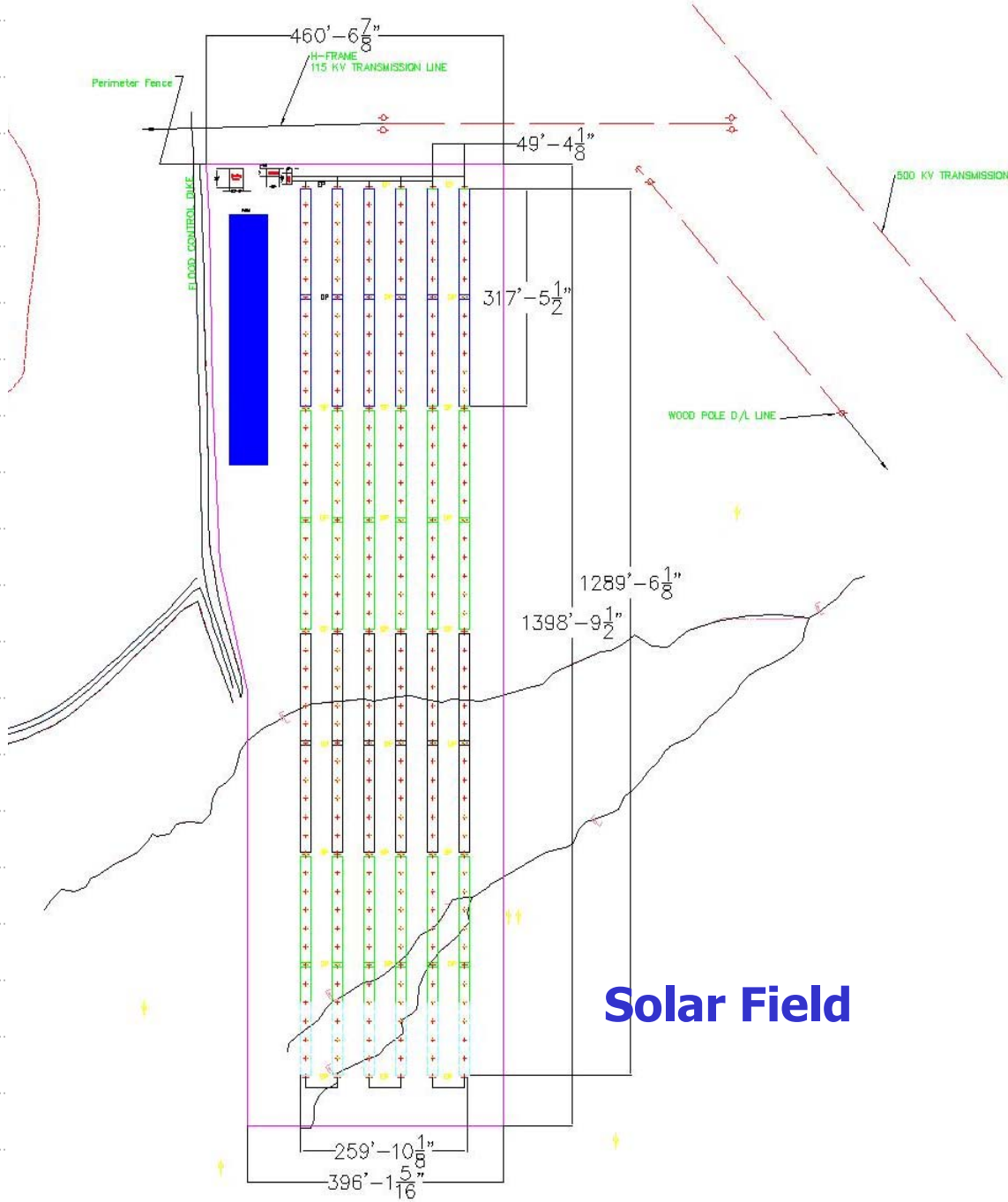
Preliminary Site Layout

Power Block





Solar Field

Power Plant Operation

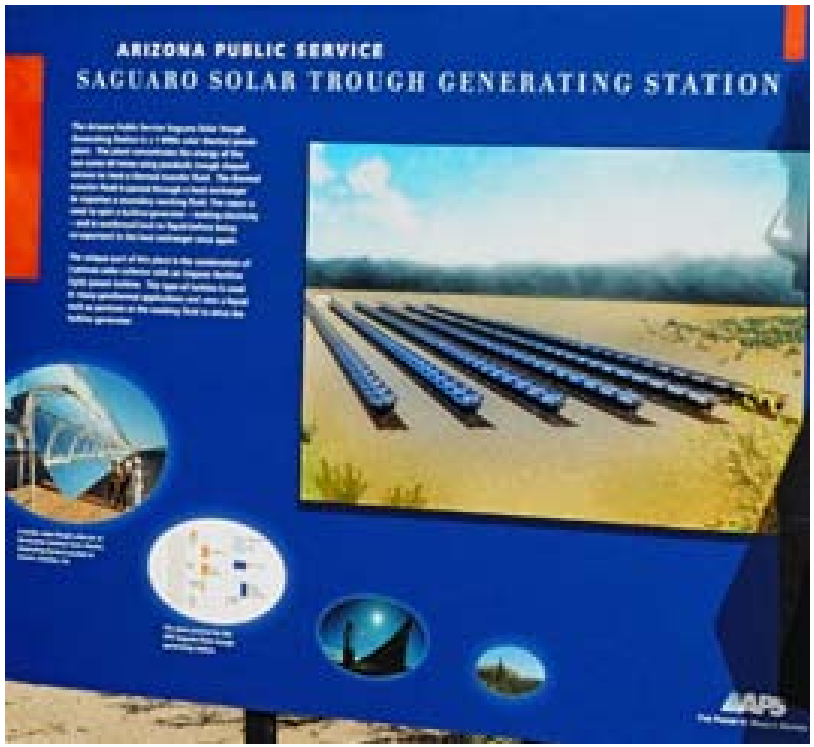
- Unattended startup and operation
  - Optimal parameters developed during 6 month startup period
  - Constant HTF flow
  - Design SF temperatures: Cold 250F; Hot 580F
  - Safety Parameters – high wind, low flow, over temp
- Remote monitoring and control
  - Integrate Field Control System & OEC control systems
  - Daily/Customized reports

SOLARGENIX ENERGY

Solar Field Maintenance

- Reflectors – 0.3% breakage/year.
  - Replace each month.
- HCE's – 1.5% failure rate.
  - Replace in winter. Coincide with outages when possible.
  - One loop o/s at a time.
- Reflectivity maintenance.
  - 1 entire field per/week in summer.
  - No washing in winter.
- Other Solar System maintenance.
  - Valve packing.
  - HTF pump vibration analysis.
  - Electronic maintenance.

SOLARGENIX ENERGY



Groundbreaking of first CSP plant in the US since 1991- Red Rocks Arizona – March 24, 2004

Saguaro 1MW solar project – Red Rock Arizona

JUNE 2004

SOLARGENIX ENERGY

In addition to generating electricity for APS' customers, the solar trough plant will help APS meet the goals of the Arizona Corporation Commission's Environmental Portfolio Standard, which requires APS to generate 1.1 percent of its energy through renewable sources – 60 percent through solar – by 2007.

The Saguaro Power Plant located in Red Rock, Arizona will be the location, of a first of its kind, solar thermal electric power plant. By combining two proven existing technologies together a unique system has been designed. Solargenix will provide and design the solar technology similar in design to that deployed at the combined, 354 MWe SEGS plants in California.

Start-up: January 2005

SOLARGENIX ENERGY

Wrap Up

- Strong/Proven Team.
  - Solargenix Energy /ORMAT/APS are strong leaders in their respective fields.
- Performance goals/targets very realistic and achievable.
- Project could be used later incorporating Alternate Fuels or Solar Storage.
- ***ANOTHER EXCELLENT SOLAR ELECTRIC PROJECT! Thank you.***

SOLARGENIX ENERGY

Changing the way we look at Solar Energy

SOLARGENIX ENERGY
Formerly Duke Solar Energy