



## Concentrated Solar Air Conditioning for Buildings

***“GLOBAL COLLABORATION IN SUSTAINABLE ENVIRONMENTAL  
AND ALTERNATIVE ENERGY STRATEGIES”***



### **International Workshop on Environment and Alternative Energy**

The European Space Research and Technology Centre (ESTEC), Noordwijk, The Netherlands

November 17, 2011

**Presenter:** Mr. Al Sorkin, Senior Principal Engineer, ITB Inc.



## Believe It Or Not!

- ***Solar heating for staying cool in buildings!?***
- ***NASA is doing a project with the Navy at an Air Force Base!?***
- ***A Hawaiian company is installing a Chinese chiller in Arizona!?***



## Believe It! It's true!

- ***NASA organized a collaborative technology demonstration project with the DOD ESTCP Program to get performance data on concentrated solar collectors supplying the energy for absorption chillers to air condition building***
- ***Project team developed proposal; went through ESTCP project selection and funding process***
- ***Demonstration site was selected from list of potential sites based on feasibility of facility and eagerness of base energy managers***



## Partners in the Project

– **ESTCP**



– **Naval Facilities Engineering Service Center**



– **NASA TEERM**



– **ITB**



**ITB**.inc

– **Sopogy**



– **TESS**



– **Enovity**



– **Davis-Monthan AFB**

**Davis-Monthan  
Air Force Base**





## Roles of Partners in the Project

- ***ESTCP – Major funding source***
- ***Naval Facilities Engineering Service Center – Principal Investigator***
- ***NASA TEERM/ITB Inc.– Co-principal investigator***
- ***Other NASA Centers (JSC, DFRC) – Peer review***
- ***Sopogy – Technology provider***
- ***TESS – Modeling & Simulation***
- ***Enovity – Measurement & Verification***
- ***Davis-Monthan AFB – Demonstration Site***





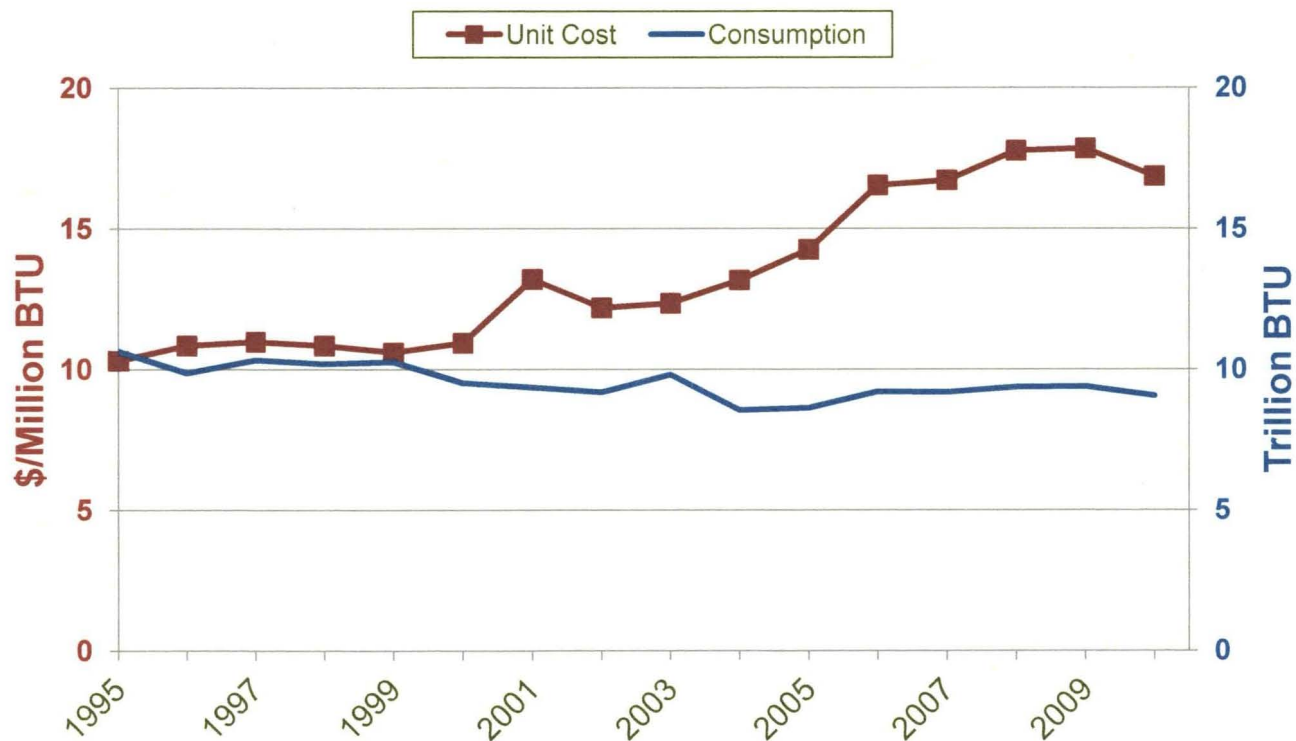
## Federal facilities energy use reduction mandates

Topic	Requirement
Energy Intensity	Reduce Btu/gsf 3% annually from FY 2003 baseline for FY 2006-2015 (30%)
Water Intensity	Reduce gal/gsf 2% annually from FY 2007 baseline for FY 2008-2020 (26%)
Renewable Energy	Increase percentage of total electricity from renewable sources 3% FY 2007-2009 5% FY 2010-2012 7.5% FY 2013+



## Risk to Mission

- **Rising energy unit costs eroding mission funding**
  - **Trend: Buying less yet spending more**
    - **Since FY 1995, use down 15% and unit costs up 64%**





## Significance of air conditioning

- ***DOD studies have concluded that air conditioning accounts for 30-60% of total energy expenditures***
  - ***Gas-Fueled Cooling Technologies at DOD Fixed Facilities***
    - <http://oai.dtic.mil/oai/oai?verb=getRecord&metadataPrefix=html&identifier=ADA309231>
  
- ***Why use solar thermal energy? To offset energy provided from the grid***
  - ***Concentrating Solar Power Outlook***
    - <http://www.greenpeace.org/international/en/publications/reports/concentrating-solar-power-2009/>
  - ***Particularly in the southwest***
    - <http://www.nrel.gov/csp/maps.html>





# Environmental Security Technology Certification Program



Meeting DoD's Environmental Challenges

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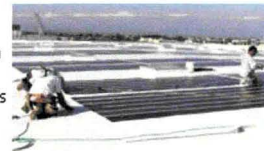
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## Energy and Water

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SERDP and ESTCP's Energy and Water program area supports the demonstration of innovative technologies to reduce the Department of Defense's (DoD) installation energy consumption and carbon footprint, improve energy security, and facilitate water conservation.

DoD manages more than 300,000 buildings on some 500 installations throughout the United States. As the nation's largest single energy consumer, DoD spends close to \$4 billion every year on facility energy consumption. Fixed installations and the non-tactical vehicles used on them contribute nearly 40 percent of the military's greenhouse gas emissions.

DoD has made energy policy a high priority. Its goal is to improve energy conservation and efficiency, reduce water and energy demand, and increase the use of renewable energy. Advances will provide military installations with increased flexibility, lower costs, and reduced greenhouse gas emissions.

SERDP and ESTCP invest in innovative technologies and methods to help achieve these goals. Through the Energy and Water program area, DoD's installations serve as a test bed for cutting-edge technologies developed by researchers from industry, universities, and federal agencies. By reducing real and perceived risks, these demonstrations accelerate the broader deployment of innovative energy technologies across DoD.

Areas of investment include:

- ◆ technologies that support sustainable building design and operations, including innovative energy-efficient lighting, heating, and air conditioning systems
- ◆ renewable energy, such as solar and wind power, and other distributed-energy generation sources
- ◆ systems that enable better management of energy resources, such as improved energy storage and control techniques
- ◆ methods and technologies to reduce water demand

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[Symposium & Workshop](#)  
November 29 – December 1, 2011  
Washington, D.C.

*Symposium Registration is now open!*

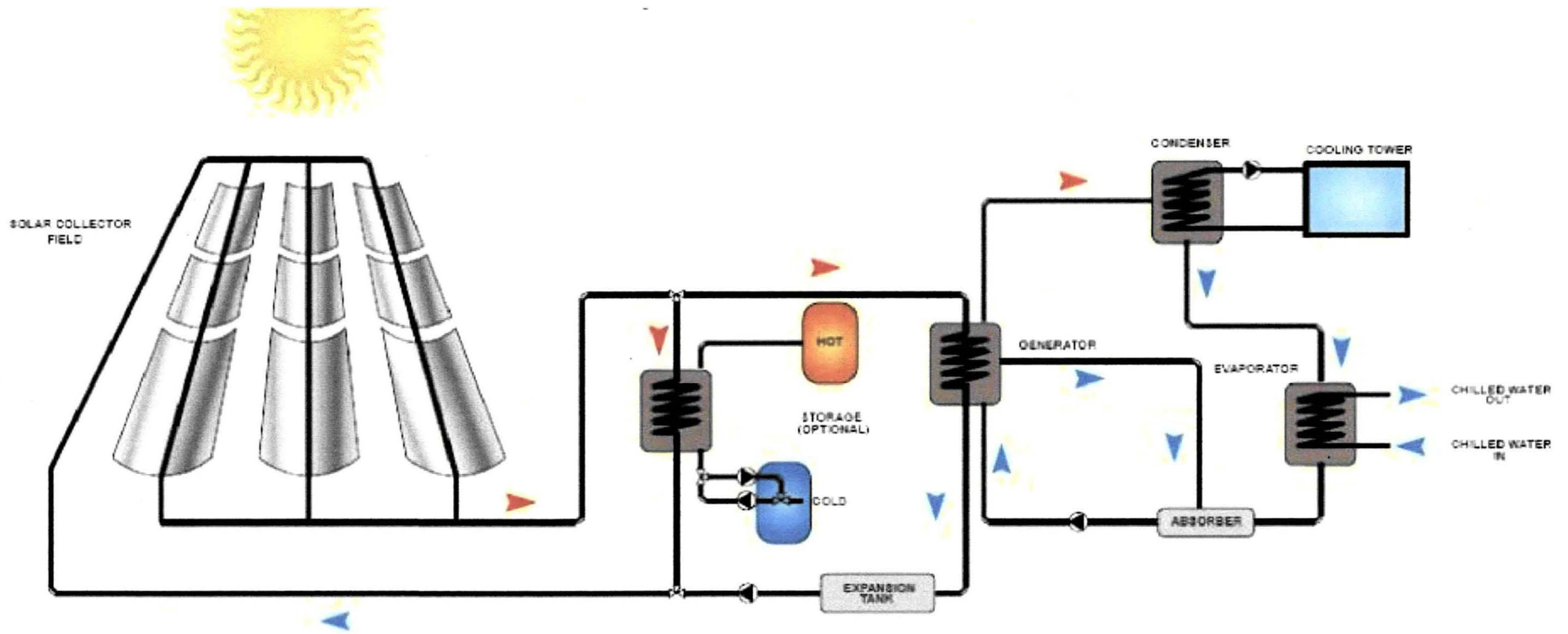
[DoD Facilities Energy Directorate](#)

### Featured Initiatives

[Installation Energy](#)

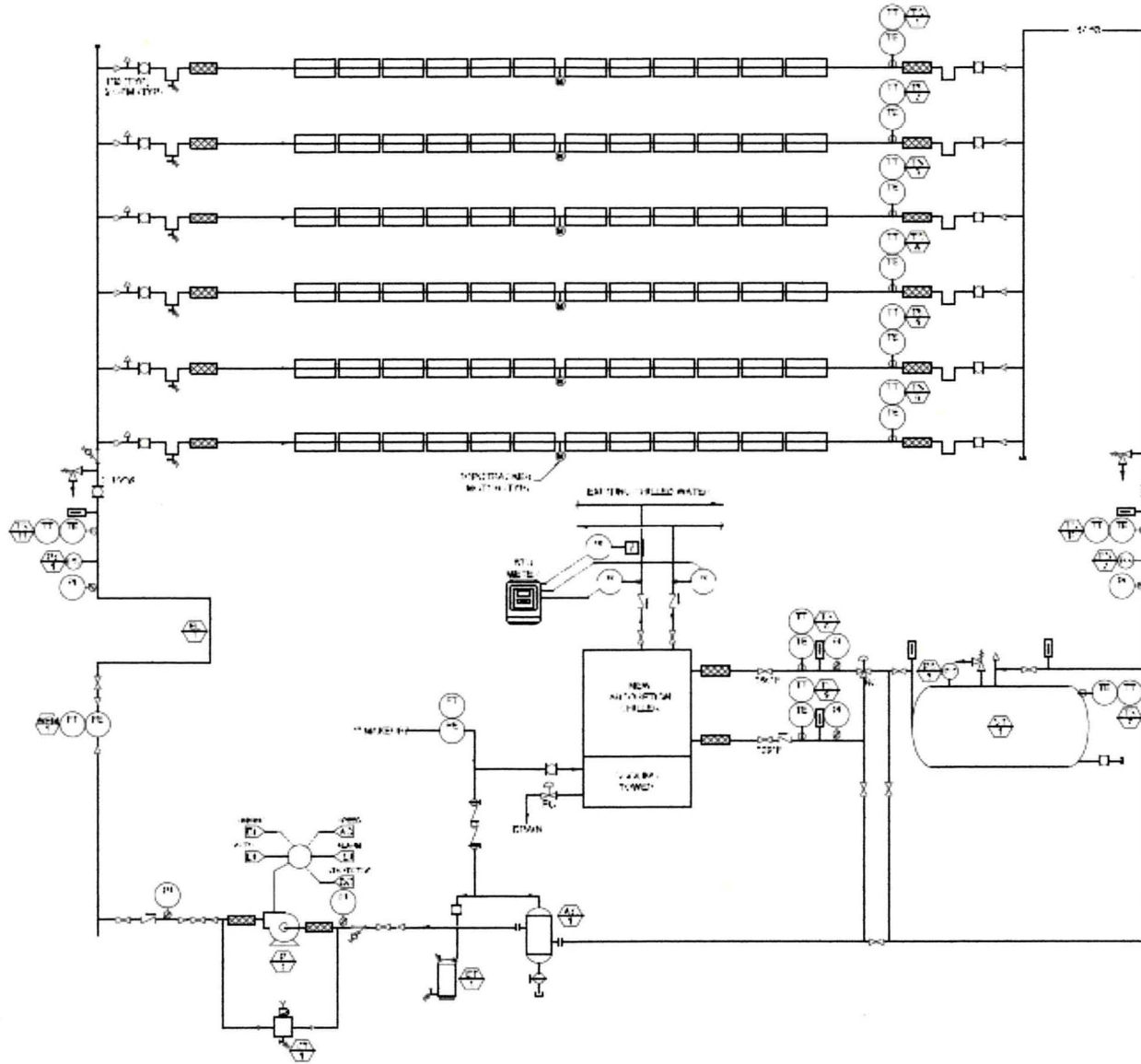


# Overall conceptual schematic of technology





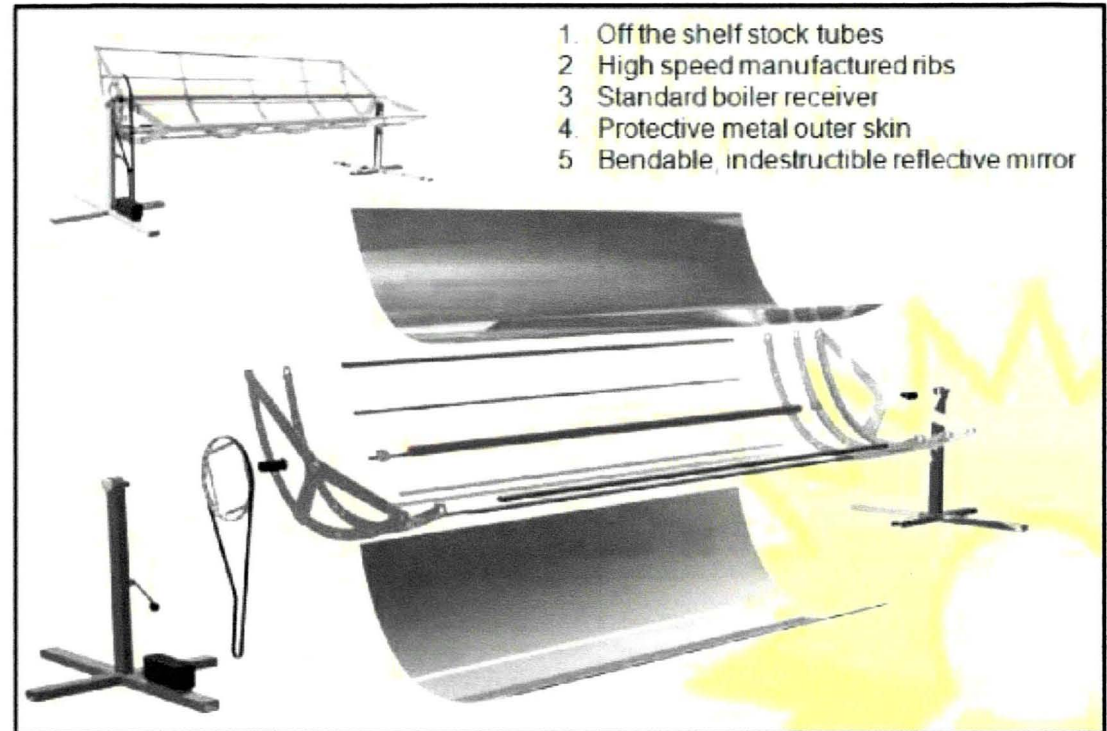
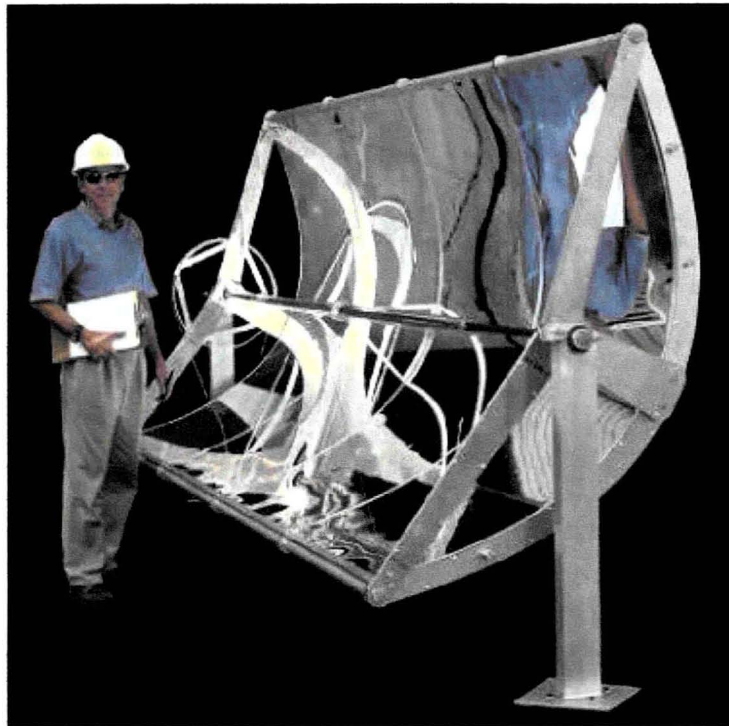
# Mechanical Diagram







## Solar Collectors



– ***Sopogy SopoNova MicroCSP Data Sheet***

– [http://sopogy.com/pdf/contentmgmt/Data\\_Sheet\\_SopoNova\\_Web.pdf](http://sopogy.com/pdf/contentmgmt/Data_Sheet_SopoNova_Web.pdf)



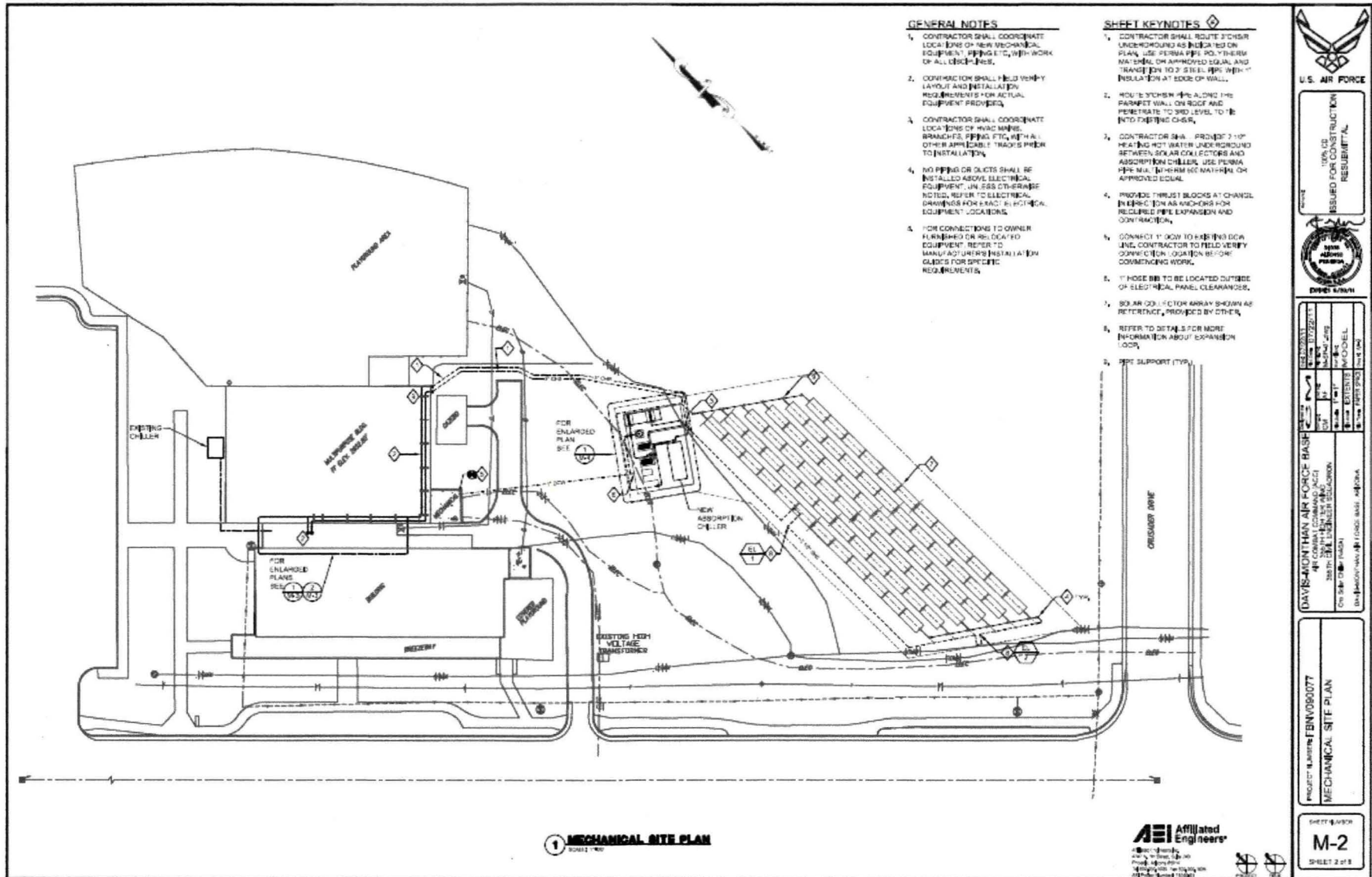
## Photo of Youth Center







# Mechanical Site Plan



- GENERAL NOTES**
- CONTRACTOR SHALL COORDINATE LOCATION OF NEW MECHANICAL EQUIPMENT PIPING ETC. WITH WORK OF ALL OTHER TRADES.
  - CONTRACTOR SHALL FIELD VERIFY LAYOUT AND INSTALLATION REQUIREMENTS FOR ACTUAL EQUIPMENT PROVIDED.
  - CONTRACTOR SHALL COORDINATE LOCATIONS OF HVAC MAINS, BRANCHES, PIPING ETC. WITH ALL OTHER APPLICABLE TRADES PRIOR TO INSTALLATION.
  - NO PIPING OR DUCTS SHALL BE INSTALLED ABOVE ELECTRICAL EQUIPMENT UNLESS OTHERWISE NOTED. REFER TO ELECTRICAL DRAWINGS FOR EXACT ELECTRICAL EQUIPMENT LOCATIONS.
  - FOR CONNECTIONS TO OWNER FURNISHED OR RELOCATED EQUIPMENT. REFER TO MANUFACTURERS INSTALLATION GUIDES FOR SPECIFIC REQUIREMENTS.

- SHEET KEYNOTES**
- CONTRACTOR SHALL ROUTE JOHNSON UNDERGROUND AS INDICATED ON PLAN. USE PERMA PIPE POLYURETHANE MATERIAL ON APPROVED EQUAL AND TRANSITION TO 2" STEEL PIPE WITH INSULATION AT EDGE OF WALL.
  - ROUTE JOHNSON PIPE ALONG THE PARAPET WALL ON ROOF AND PENETRATE TO 3RD LEVEL TO BE INTO EXISTING CHSR.
  - CONTRACTOR SHALL PROVIDE 2" O.P. HEATING HOT WATER UNDERGROUND BETWEEN SOLAR COLLECTORS AND ABSORPTION CHILLER. USE PERMA PIPE MULTIPHASE MATERIAL ON APPROVED EQUAL.
  - PROVIDE THIRST BLOCKS AT CHANGE IN DIRECTION AS ANCHORS FOR REQUIRED PIPE EXPANSION AND CONTRACTION.
  - CONNECT TO EXISTING DCA LINE. CONTRACTOR TO FIELD VERIFY CONNECTION LOCATION BEFORE COMMENCING WORK.
  - PIPE SHALL BE LOCATED OUTSIDE OF ELECTRICAL PANEL CLEARANCES.
  - SOLAR COLLECTOR ARRAY SHOWN AS REFERENCE, PROVIDED BY OTHERS.
  - REFER TO DETAILS FOR MORE INFORMATION ABOUT EXPANSION LOOP.
  - PIPE SUPPORT (TYP)

**1 MECHANICAL SITE PLAN**  
Scale: 1/8" = 1'-0"



**U.S. AIR FORCE**

WORK ISSUED FOR CONSTRUCTION  
RESUBMITTAL

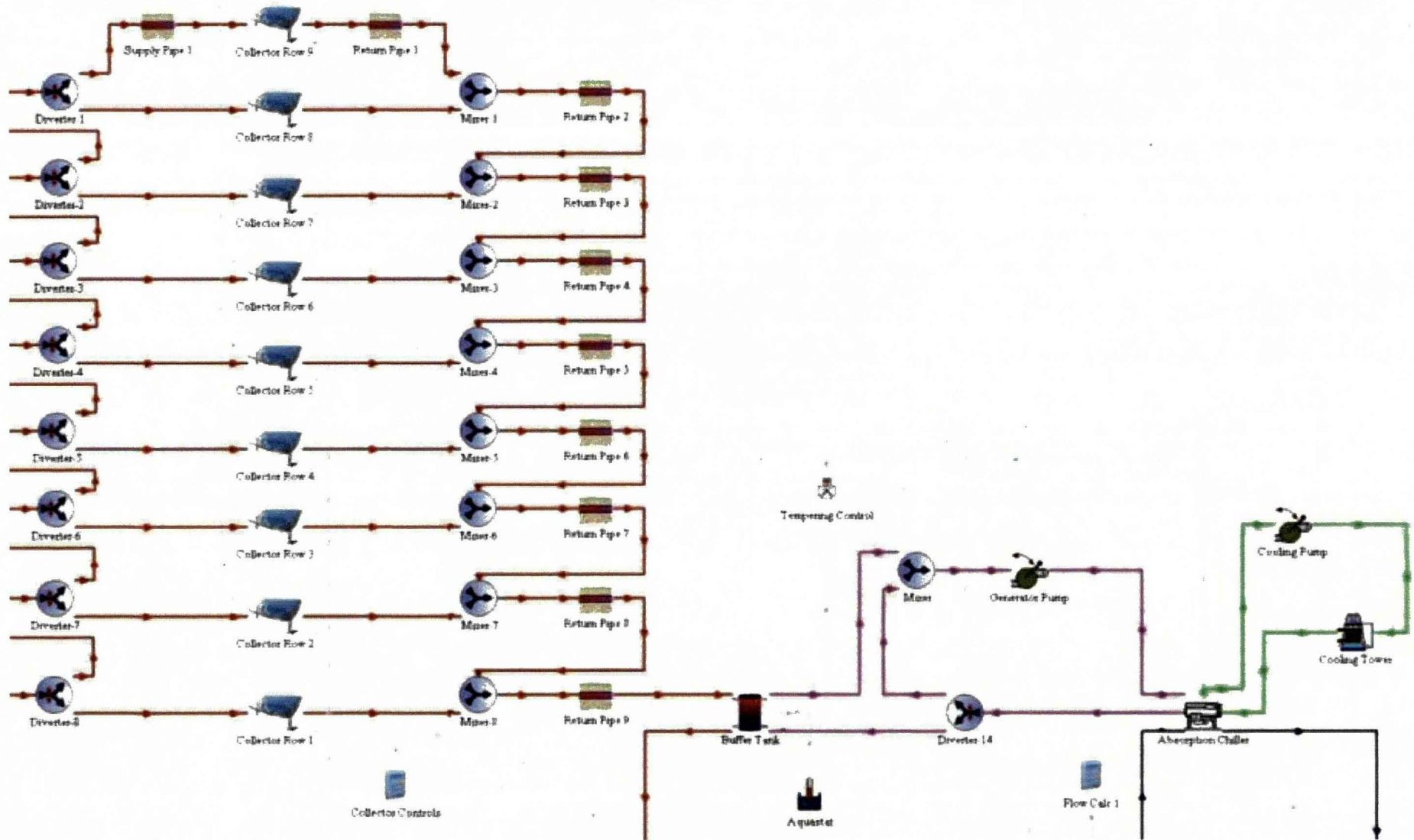
DATE: 10/15/07

PROJECT: DAVIDSON HAN AIR FORCE BASE  
MECHANICAL SITE PLAN

SHEET: M-2  
SHEET 2 OF 8

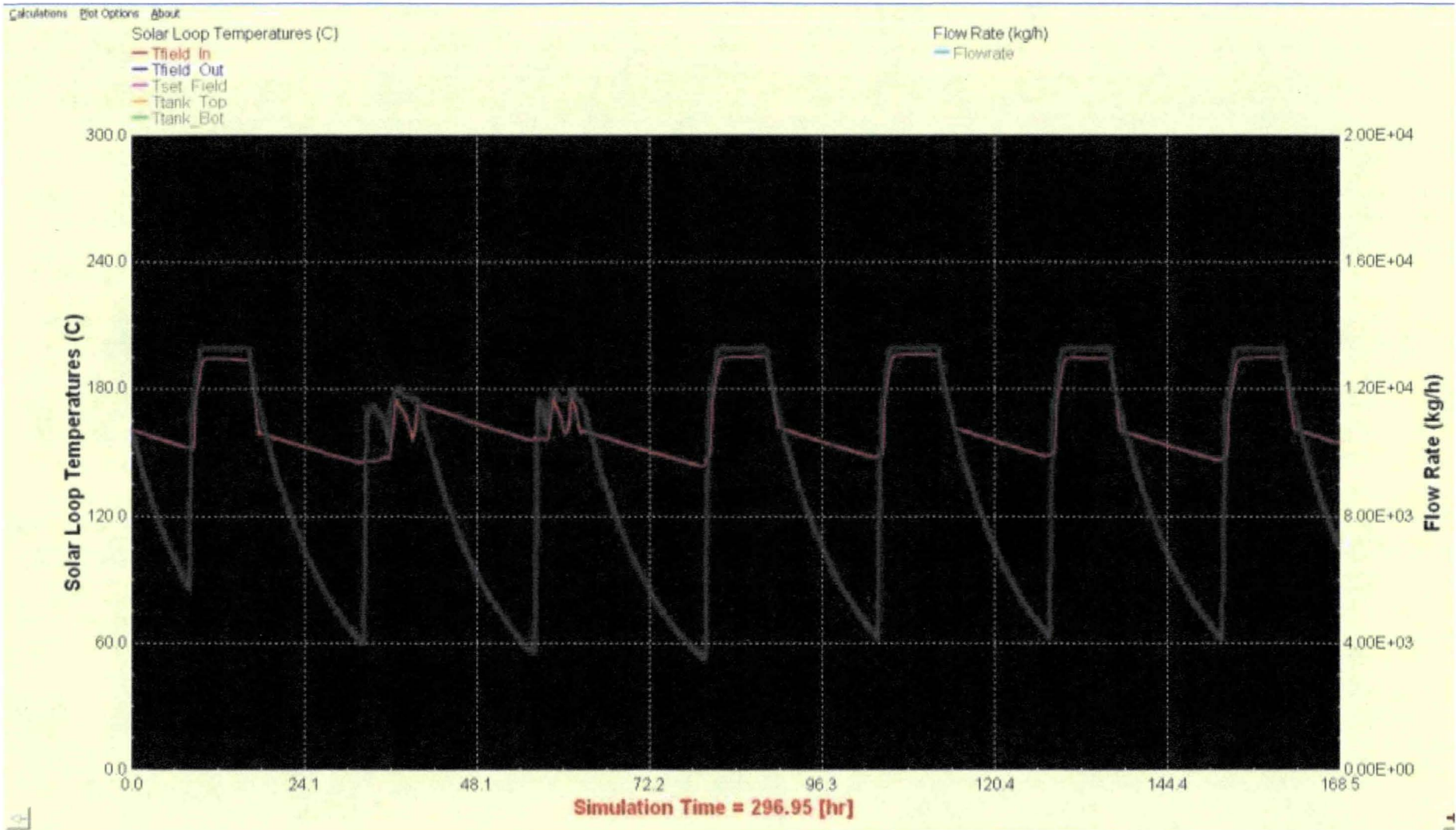


# TESS modeling in TRNSYS





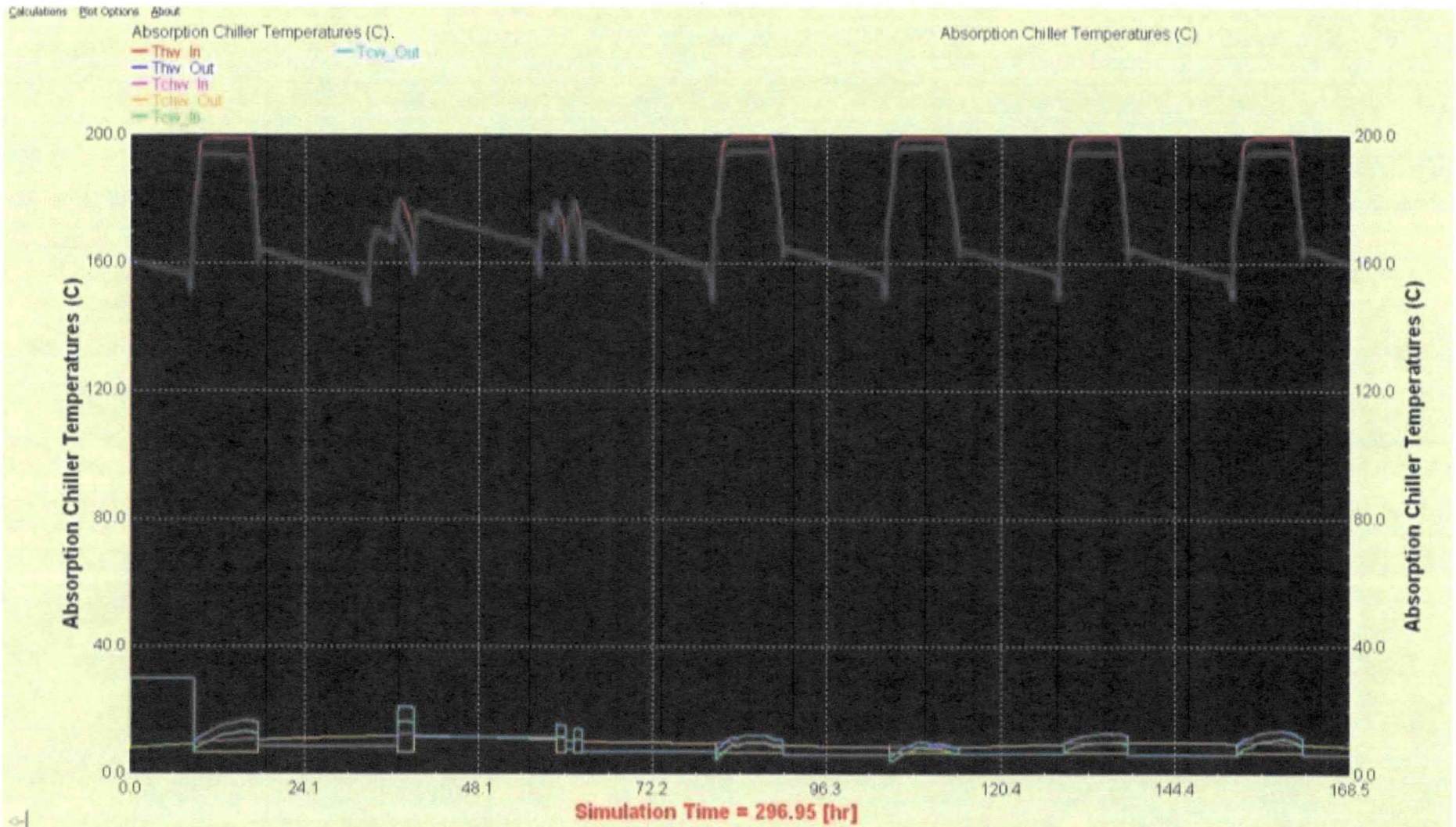
# TESS modeling in TRNSYS







# TESS modeling in TRNSYS





## Concentrated Solar Air Conditioning for Buildings

### Description:

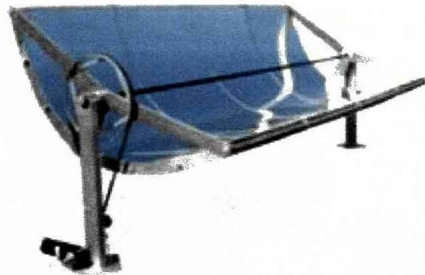
- Electricity from utility grids is not always reliable or affordable, presenting problems for building air conditioning in hot climates.
- New solar thermal energy systems offer advantages of proven technology, small footprint, easy installation, and affordability.
- Need is to increase energy efficiency, and percentage renewable consumption. (Summer AC loads account for 30-60% of total energy expenditures at DoD facilities.)
- Project objective is demonstrate that solar collectors can be integrated with absorption chillers to provide a renewable energy based source of air conditioning.

### Stakeholders:

- Work Partners: Navy [Principal Investigator], Sopogy [Turnkey], TESS/Enovity [subcontractors]; Davis-Monthan AFB (demo site in AZ)
- Other: NASA (JSC & DFRC), HQ EMD

### Project Approach:

- Collect baseline operational data
- Install MicroCSP™ and absorption chiller
- Collect at least 12 months of operational data
- Determine offset electrical grid energy quantities and savings
- Prove cost-effective alternative to fossil fuel based energy



MicroCSP™ Solar Collector "SopoNova 4.0™"  
(Illustration courtesy of Sopogy)

### Alternatives:

- Parabolic solar collectors coupled with absorption chiller

**Progress:** Demonstration Plan approved in May; collecting baseline data; Construction underway

**Period of Performance:** May 2010 to February 2013

### Contact:

- Project Manager: Rusty McLaughlin, ITB, 321-867-3351, [russell.l.mclaughlin@nasa.gov](mailto:russell.l.mclaughlin@nasa.gov)
- TEERM Program Manager: Chuck Griffin, NASA, 321-867-6225, [chuck.griffin@nasa.gov](mailto:chuck.griffin@nasa.gov)





# Project Schedule

	FY10			FY11			FY12			FY13		
<b>Project Kickoff</b>												
<b>Project Planning</b>												
<b>Requirements Definition</b>												
<b>Materials Preparation</b>												
<b>Testing</b>												
<b>Analysis and Reporting</b>												
<b>Follow-Up / Closeout</b>												

– *Questions?*

