Final Technical Report

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Executive Summary:

Southwest Technology Development Institute (SWTDI), an independent, university-based research institute, has been the operator of the Southwest Region Photovoltaic Experiment Station (SWRES) for almost 30 years. The overarching mission of SWTDI is *to position PV systems and solar technologies to become cost-effective, major sources of energy for the United States*. Embedded in SWTDI's general mission has been the more-focused mission of the SWRES: to provide value added technical support to the DOE Solar Energy Technologies Program (SETP) to effectively and efficiently meet the R&D needs and targets specified in the SETP Multi-Year Technical Plan.

The DOE/SETP goals of growing U.S. PV manufacturing into giga-watt capacities and seeing tera-watt-hours of solar energy production in the U.S. require an infrastructure that is under development. The staff of the SWRES has supported DOE/SETP through a coherent, integrated program to address infrastructural needs inhibiting wide-scale PV

deployment in three major technical categories: specialized engineering services, workforce development, and deployment facilitation.
The SWRES contract underwent three major revisions during its five year period-of-performance, but all tasks and deliverables fell within the following task areas:

- Task 1: PV Systems Assistance Center
    1. Develop a Comprehensive multi-year plan
    2. Provide technical workforce development materials and workshops for PV stakeholder groups including university, professional installers, inspectors, state energy offices, Federal agencies
    3. Serve on the NABCEP exam committee
    4. Provide on-demand technical PV system design reviews for U.S. PV stakeholders
    5. Provide PV system field testing and instrumentation, technical outreach (including extensive support for the DOE Market Transformation program)

- Task 2: Design-for-Manufacture PV Systems
    1. Develop and install 18 kW parking carport (cost share) and PV-thermal carport (Albuquerque) deriving and publishing lessons learned

- Task 3: PV Codes and Standards
    1. Serve as the national lead for development and preparation of all proposals (related to PV) to the National Electrical Code
    2. Participate in the Standards Technical Panels for modules (UL1703) and inverters (UL1741)

- Task 4: Assess Inverter Long Term Reliability
    1. Install and monitor identical inverters at SWRES and SERES
    2. Operate and monitor all inverters for 5 years, characterizing all failures and performance trends

- Task 5: Test and Evaluation Support for Solar America Initiative
    1. Provide test and evaluation services to the National Laboratories for stage gate and progress measurements of SAI TPP winners

DOE-funded SWRES activities in these five areas resulted in major successes for PV stakeholders, assistance overcoming major technical challenges, and a reduction in the size and number of challenges to hundreds of deployments throughout the U.S. through direct technical support to designers, installers, and inspectors of PV systems. During the five-year reporting period, some of the prominent activities accomplished under this contract include the following:

1. SWTDI served Secretary of the PV industry forum, responsible for organization, drafting, assembling, vetting, circulating, and final preparation of submissions to

the NFPA for changes to the National Electrical Code during its three year revision cycles in 2008, 2011, and 2014.

2. SWTDI served as technical Tiger Team lead agency for Solar America Cities (SAC) Tucson, AZ and Santa Rosa, CA. Both cities increased PV use multiple times over pre-SAC periods and the Tiger Team activities directly reduced barriers related to installer training, evolution of structural codes, focused technical and economic analyses for major PV users, and technical support for preparation of CREBS bond applications and use.
3. SWTDI represented the U.S. to the IEA PVPS Task 2 (International PV Reliability Database) providing PV performance data and technical assistance and review of several publications.
4. SWTDI provided technical design reviews for hundreds of large and small PV systems throughout the U.S. including direct support to all of the major manufacturers and integrators in the country including: SunPower, Akeena Solar,
5. SWTDI provided all PV technical support for Solar America Showcase projects Forrest City Hawaii and U.S. Army Papago Park Arizona.
6. SWTDI operated the Inverter Long Term Test Facility (ILTF) at SWRES installing, instrumenting, and collecting data for a unique five-year set of fielded system side-by-side performance for inverters from SMA, Xantrex, Fronius, Solectria, and PV Powered.
7. SWTDI provided technical review for the CEC $35M PIER Commonwealth Energy System Renewables program as well as PV system technical review of all Solar Decathlon entries in 2007, 2009, 2011.
8. SWTDI engineers have been key members of the UL Standards Technical Panels for inverters (UL1741) and modules (UL1703) as well as participant on the NABCEP exam committee since its founding.

This project has been of considerable value to the public and all U.S. PV stakeholders. Direct value was provided with dozens of PV system field tests, site surveys, feasibility studies, and economic analyses performed for cities, Federal agencies, private industry, and the participants in the DOE Market Transformation program. An equal value was provided indirectly through the support for the development, implementation, and training of codes and standards, best practices, and publications of field experiences and lessons learned.

Progress versus Plans:

The original 2006 SWRES SOPO summarized the goals and objectives of this multi-year project: “The major objective of this proposal is to see that all education, training,

outreach, and technical support required to accelerate the rate of the nation's PV deployment efforts are present and effectively implemented to support growth of PV into a major source of electricity generation in the U.S." These goals are qualitative and difficult to report on in a quantitative manner, but some accomplishments stand out.

Through its technical leadership, this was demonstrated in two Solar America Cities (Tucson and Santa Rosa) in which rate of PV deployments rose significantly through delivery of targeted economic analyses and support for preparation of CREBS applications (both cities received large amounts of CREBS funding). Further, in both cities, the quality of installations was improved through training in PV and Solar Thermal design and installation. In support of Solar America Showcase Forrest City Hawaii, SWTDI engineers provided performance and economic analyses showing how favorable the use of PV would be in Hawaii resulting in the wide deployment of PV by the recipient (including a recent 1 MW PPA).

No activity of technical support provides greater value to all U.S. PV stakeholders than SWTDI's central role in preparing submissions to the National Electrical Code. In the reporting period, this has included updating the code in essential areas including ungrounded inverters, arc fault detection requirements, and grounding and bonding. In association with this activity has been training on the proper use and interpretation of the NEC Article 690 (PV) provided to professional PV installers and electrical inspectors around the country. SWTDI has provided training workshops attended by roughly 1,250 professionals every year of the five-year reporting period.

Through the implementation of the Inverter Long Term Test Facility (ILTF), SWTDI in association with FSEC and SNL have identified inverter performance weaknesses and documented performance trends for five major residential-scale inverter types.

SWTDI provided services to PV stakeholders through participation in the merit reviews for SAI TPP process and through stage gate testing and reporting for TPP winners. SWTDI also provided all code-compliance and PV array safety services for the last three Solar Decathlons.

Publications:

A list of the publications and major presentations resulting from this five-year program includes the following:

A. L. Rosenthal

- Delivered the final report, *SMUD Performance Index Program and Results,* to SMUD and Sandia, *March 2006*.
- Delivered the final report, *SRP Performance Index Program User's Manual*, to SRP and Sandia, *May 2006*.

- V.G. Gude, N. Nirmalakhandan, C. Asbill, A. Rosenthal, *Prototype Evaluation of Low Temperature*, Solar-Powered Desalination System, submitted to American Solar Energy Society, March 2007.
- Technical Report, *FC 5Warehouse*, was delivered to Solar America Showcase recipient Forest Cities Military Communities to document the economics and performance of prospective PV arrays on five large warehouses in Honolulu, HI, September 2007.
- Reports presented in the current period
  - "FC Radford V1", delivered to SAS Forest City Military Communities, technical review of three PV system proposals. (February 2008)
  - "FC Halsey V1", delivered to SAS Forest City Military Communities, Performance calculations for six proposed PV system. (March 2008)

C. Asbill

- Technical Report, *PV Solar Ready*, was delivered to Solar America Showcase recipient Forest Cities Military Communities to present recommendations for new home construction that will easily support addition of PV arrays in the future, October, 2007.

J. C. Wiles

- Presented *Recent Changes in the National Electrical Code* at the DOE Annual Program Review, *November 2005*.
- Presented *Southwest Region Experiment Station Annual Report and Summary*, at the DOE Peer Review Meeting, October 2005
- Delivered two IEEE papers at the IEEE World Conference on Photovoltaic Energy Conversion: "Changes in the National Electrical Code for 2005"and "Designing and Installing Safe, Durable, and Cost-Effective PV Systems
- Presented *Recent Changes in the National Electrical Code* at the DOE Annual Program Review, *November 2005*
- Presented *Southwest Region Experiment Station Annual Report and Summary*, at the DOE Peer Review Meeting, October 2005
- J. Wiles and W. Bower, *Photovoltaic Power Systems and the 2008 National Electrical Code*, submitted to American Solar Energy Society, March 2007.
- Magazine Articles in both *Home Power* and *IAEI* (Written within the1st Quarter):
  - "Making the Utility Connection, in Home Power, #112 March 2006
  - "Working with Inspectors" in Home Power, #111 February 2006/March 2006
  - "Back to the Grid" IAEI News January – February 2006

- “Plan check" IAEI News March – April 2006
- "Making the Utility Connection, in Home Power, #112 March 2006
- "Working with Inspectors" in Home Power, #111 February 2006/March 2006
- "Back to the Grid" IAEI News January – February 2006
- “Plan check" IAEI News March – April 2006
- "Beauty is in the Eye of the Inspector" in *Home Power* #116 December 2006/January 2007
- "Considerations for PV Site Surveys" in *Home Power* #115 October/November 2006
- "Inspectors Demand More Answers" IAEI News January – February 2007
- “The Development of Codes, Standards, and PV Equipment—How are they related?" IAEI News March – April 2007
- "Codes and Standards Development" in *Home Power* #118 January 2007
- "Disco Madness" in *Home Power* #119 March 2007
- "Inspectors Demand More Answers" IAEI News January – February 2007
- “The Development of Codes, Standards, and PV Equipment—How are they related?" IAEI News March – April 2007
- "PV Equipment, Innovations and Standards" in *Home Power* #118 June 2007
- "Code Changes Through the Years" in *Home Power* #120 June 2007
- "Perspectives on PV" IAEI News July - August 2007
- "PV Module Wiring 101" in *Home Power* #121 July 2007
- " Code Changes Through the Years " in *Home Power* #123 September 2007
- "The Nature of the PV Module" IAEI News September-October 2007
- "PV Module Wiring 101" in *Home Power* #121 December 2007/January 2008
- " Ground-Fault Protection is Expanding " (draft to be published in *Home Power*February-March 2008)
- "Why Inspect PV systems" IAEI News November/December 2007
- "Ground Fault Protection is Expanding" in *Home Power* #123 February/March 2008
- "Avoiding Common Code Mistakes" in *Home Power* #124 April/May 2008
- "Ground Fault Protection for PV systems" IAEI News January/February 2008.
- "To Fuse or Not to Fuse" in *Home Power* #125 April/May 2008

- "Code Changes, Grid Connections" in *Home Power* #126 June 2008
- "Grid Interconnections, Then and Now" IAEI News July/August 2008.
- "To Fuse or Not to Fuse" in *Home Power* #125 June/July 2008
- "Code Changes, Grid Connections" in *Home Power* #126 AugustSeptember 2008
- "Grid Interconnections, Then and Now" IAEI News July/August 2008.
- “Are We Grounded Yet?”, IAEI News, September/October 2008
- "New Grounding Methods" in *Home Power* #127 Oct/Nov 2008
- "Combiner to DC Disconnects" in *Home Power* #129 Jan/Feb
- “Perspectives on PV” and “Still on the Roof”, articles published in *IAEI News*.
- Three articles published in *Solar Pro* magazine in the reporting period.
- "Array to Inverter and Things in Between" in *Home Power* #131 Mar/Apr
- "The Inverter" in *Home Power* #132 May/June
- “Approaching the Inverter”, article published in *IAEI News*.
- “Load Side Point of Interconnection – Bus or Conductor Rating”, article published in *Solar Pro* magazine.
- "Inverter Grounding" in *Home Power* #133 Jul/Aug
- "Connecting Inverters to the Grid – Part I" in *Home Power* #134 Sep/Oct
- “The Inverter”, article published in *IAEI News July-August 2009*.
- “Connecting the Inverter”, article published in *IAEI News September-October 2009*.
- "Making the AC Utility Connection", article published in the *IAEI News* Nov-Dec 2009.
- "Supply-Side Utility Connections", article published in the *IAEI News* Jan-Feb 2010.
- "Inverter Supply Side Connections" in *Home Power* #135 Nov/Dec 2009.
- "Microinverters" in *Home Power* #136 Jan/Feb 2010.
- "Common Questions About PV Systems" in *Home Power* #138 Aug/Sep 2010
- "Ungrounded PV Systems" in *Home Power* #139 Oct/Nov 2010
- “Odds and Ends”, article published in *IAEI News July-August 2010*.
- “Ungrounded Electrical Systems”, article published in *IAEI News September-October 2010*.

Summary of Project Activites:

A program such as the SWRES, with its many diverse activities, covers very many tasks and deliverables in a five year reporting period. The most effective way to present a comprehensive final summary, is to utilize the quarterly progress reports submitted for each period of the five-years. These follow.

Status Q1 2006:

Task 1: Benchmarking

A. U.S. Grid Connected PV Systems

- Represented *the Southwest Region Experiment Station* at the DOE SETP Mid-year Program Review, *February 2006*.
- Four SWRES staff participated in the inaugural design and development meeting for the PVSAC at FSEC, Cocoa, FL, *March 2006*.
- Participated in video conference with Mike Stern, former president of UPG at Sandia headquarters, *February 2006*.

B. International. Grid Connected PV Systems

- Task completed, *September 2005*.

C. Support for IEA PVPS Task 2

- Peer review Web page data entry forms for *IEA Photovoltaic Power Systems Program Task 2, PV Systems Performance*, by Thomas Nordmann, *January 2006*.
- Benchmark dataset provided for PVPS database, *January 2006*.

Task 2: PV Systems Analysis and Engineering

A. U.S. PV Industry

- Presented final report for SMUD residential PV performance index programs, submitted to SMUD and Sandia, *March 2006*
- Attended DOE 'PV Accelerated Ageing Conference, Baltimore, MD, *February 2006*.
- Participated in California Energy Commission PIER Commonwealth Energy Renewables Resources Program final review, *February 2006*.

B. Design Reviews of U.S. PV Systems

- 6 Major system design reviews, *January - March 2006*.

C. Thin-Film Module Reliability

- 3 kW CIS system installation completed, software development completed, system on-line, *Febraury 2006*.

D. International Strategic Plan Development

- Final industry survey results completed, *October 2005*.

Task 3: Codes and Standards

A. Development of Codes and Standards

- Attendance at UL 1741 Standards Technical Panel meeting, *October 2005*.
- Attended NABCEP Exam Committee meeting , *October 2005*.

B. Training

- Presented 3 PV/NEC day-long workshops for electrical inspectors, *October-December 2005*.

Task 4: Component Testing

A. PV Module Testing

- MLTE decommissioned and modules extracted for return to Sandia, *December 2005*.

B. Inverter Long Term Test Facility

- Solectria residential inverter brought on-line as ILTF unit 5, *February 2006*

C. LED Lighting

- Task completed, *December 2005*.

D. NiMH Batteries

- Task deleted, *July 2005*.

Status Q2 2006:

Task 1: Benchmarking

A. U.S. Grid Connected PV Systems

- Represented *the Southwest Region Experiment Station* at the DOE SETP Mid-year Program Review, *February 2006*.
- Four SWRES staff participated in the inaugural design and development meeting for the PVSAC at FSEC, Cocoa, FL, *March 2006*.
- Participated in video conference with Mike Stern, former president of UPG at Sandia headquarters, *February 2006*.

B. International. Grid Connected PV Systems

- Task completed, *September 2005*.

C. Support for IEA PVPS Task 2

- Peer review Web page data entry forms for *IEA Photovoltaic Power Systems Program Task 2, PV Systems Performance*, by Thomas Nordmann, *January 2006*.
- Benchmark dataset provided for PVPS database, *January 2006*.

Task 2: PV Systems Analysis and Engineering

A. U.S. PV Industry

- Compiled a list of PV system simulation programs and the strengths and weaknesses of each for Conergy, Santa Fe, NM, *April 2006*
- Presented a working model of software for Performance Index determination and presentation to Utility Engineers from Salt River Project, *April 2006*
- Provided PV power system background and design guidance to General Dynamics for inclusion in proposed National Spaceport to be located in Upham, NM, *April 2006*.

- Consulted with Solar Roofing Systems, Philadelphia, PA, regarding PV components in CIS prototype, flexible laminate roofing design issues, *May 2006*.

B. Design Reviews of U.S. PV Systems

- Reviewed the following PV systems for *NEC* compliance.
- 32 kW System, Scottsdale Senior Center, Scottsdale, AZ
- 1 MW System, Sonoma Mountain Village, City of Rohnert Park, CA
- 12.5 kW system with batteries, Town of Woodside, CA

C. Thin-Film Module Reliability

- 3 kW CIS system installation completed, software development completed, system on-line, data collection for module and inverter performance proceeding with real-time, Web-based review, *May 2006*.

D. International Strategic Plan Development

- Project completed, *October 2005*.

Task 3: Codes and Standards

A. Development of Codes and Standards

- Circulated comments on 2005 NEC proposals for Article 690 to PV industry Forum and coordinated responses for submission to NFPA.
- Provided Underwriters Laboratories (UL) with inputs on UL Standard 1741 (inverters) and UL 1703 (PV modules)

B. Training

- Conducted the following Codes and Standards Workshops for inspectors, PV Pros, electricians, electrical contractors and others.
- San Juan College, Farmington, NM 20 people
- Salt River Project, Phoenix AZ 20 people
- Hawaii Electric Light Company, Kona Hawaii 105 people

Task 4: Component Testing

A. PV Module Testing

- Consulted with Southern California Edison to develop a test plan for module degradation performance determination on Rogers Peak, CA, following customer's inquiries of systems issues, *June 2006*.

B. Inverter Long Term Test Facility

- Solectria residential inverter (ILTF unit 5) performance validation, DAS calibration verification, *April-May 2006*

C. LED Lighting

- Task completed, *December 2005*.

D. NiMH Batteries

- Task deleted, *July 2005*.

Status Q3 2006:

Task 1: PV Systems Assistance Center

A. Impanel a Board of Advisors

- Eighteen prospective Board members identified, *July 2006*.
- Engineers from *the Southwest Region Experiment Station* and the *Southeast Region Experiment Station* contact all prospective Board members, field questions, compile responses for DOE, *July - August 2006*.
- Nine industry, utility, research professionals identified for service on the PVSAC Board of Advisors, *August 2006*.

Robert Broderick	Electrical Engineer	Distribution Planning & Customer Generation Programs
Jerry Cargile	Senior Product Manager	Tennessee Valley Authority
Mark Dougherty	Manager of Distributed Generation and Renewable Programs	Long Island Power Authority
Julia Judd	Executive Director	Solar Electric Power Association
Stephen Kalland	Executive Director	North Carolina Solar Center
David Kulik	President	Sunwize Technologies
Arthur Rudin	Director of Engineering	SHARP Solar Systems Division
Rhone Resch	President	Solar Energy Industries Association
Jane Weissman	Executive Director	Interstate Renewable Energy Council

- Planning, agenda, and arrangements made to hold first Board meeting in San Jose, CA, in October 2006 in association with Solar Power 2006 – SEPA Conference (Agenda appended at the end of this progress report), *September 2006*.

B. Public Policy and Procurement Support

- Review of PV plans for the Town of Woodside, CA resulted in the town formulating a standardized PV plans permitting requirement

C. Workforce Development

- Design support and concept development for innovative, solar thermal/PV hybrid for vacuum distillation of potable water, graduate-level project to be ongoing for 12 months, *August-September 2006*.

D. Web-based Technical Support and Design Reviews

- Project design begun, *September 2006*.

E. Field Test, Instrumentation, Data Monitoring

- Reviewed DOE Test and Evaluation Draft Plan for T&E team led by NREL and Sandia to critically asses how DAS data from different sources may be integrated into a national database of performance parameters, *August 2006*.
- Field test and calibration of DAS and kiosk installed for Public Service Company of New Mexico at Algodones Solar system, *August 2006*.
- Developed concepts to standardize PV DAS's for support of DOE benchmark tasks in 2007 and support TPP DAS requirements, *September 2006*.

- Developed industry survey form for T&E team to assess industry needs, existing data, access requirements, and overall level of support required, submitted to T&E team, *September 2006*.
- Participated in system testing protocol review for SAI and general long-term testing requirements, included review questions of how system efficiency determination affects interpretation of results, *September 2006*.
- Participated in FOA Technical Committee under contract with DOE to determine accuracy of technical and economic data submissions within SAI TPP proposals, *September 2006*.

Task 2: Create New *Design-for-Manufacturing* Integrated PV Systems

A. U.S. PV Industry

- Designed 17 kW modular, prototype, PV parking structure (project is cost shared with New Mexico Energy Minerals and Natural Resources Department), *July – September 2006*
- Revised PV systems designs for modular, factory panelization of PV subcomponents enabling drop-in installation of sub-arrays, coordinated designs with architect and structural engineers to ensure compatibility, *July - September 2006*.
- Revised designs for PV parking structure to meet budget and streamline on-site installation requirements, *September 2006*.

Task 3: Update Codes and Standards

A. Development of Codes and Standards

- Circulated Public Comments on the 2005 NEC proposals for Article 690 to PV industry Forum and coordinated responses for submission to NFPA.
- Provided Underwriters Laboratories (UL) with inputs on UL Standard 1741 (inverters) and UL 1703 (PV modules) based on field tests and inspections and feedback from PV installers and inspectors.
- NABCEO Exam Committee meeting for test development
- The following systems were reviewed and/or inspected to supply feedback to the codes and standards development process
    - 30 kW System, Phoenix Pecos Park, Phoenix, AZ
    - 5 kW System, County of Hawaii, HI
    - 7 kW System, U-I with batteries, Town of Woodside, CA
    - 5 kW System, Hebron, CT

B. Training

- Conducted the following Codes and Standards Workshops for inspectors, PV Pros, electricians, electrical contractors and others.
    - ASES Solar 2006, Denver, CO — 74 people
    - IAEI NW Section Annual Meeting, Spokane, WA — 190 people
    - WA State Inspectors, Pacific Beach, WA — 55 people
    - IBEW, San Jose, CA — 190 people
    - NMSEIA Solar Fiesta, Albuquerque, NM — 34 people

- SEI, Carbondale, CO 50 people
- UNISOURCE Energy, Lake Havasu City, AZ 25 people
- TREIA, Austin, TX 130 people
- Task 4: Independent Assessment of Long-term Inverter Reliability

A. Inverter Long Term Test Facility

- Six ILTF monitoring systems on-line and collecting data, real-time displays of performance on the web, developed new automated QA tool for identifying underperforming systems, *July-September 2006*.

Status Q4 2006:

Task 1: PV Systems Assistance Center

A. Impanel a Board of Advisors

- First Board meeting in San Jose, CA, in October 2006 in association with Solar Power 2006 – SEPA Conference , *October 2006*.
- PVSAC Board meeting notes adapted into revised PVSAC Implementation Plan (PVSAC-IP) 2nd Draft. PVSAC-IP draft circulated for review to RES's, Sandia, *December 2006* (returns due by end of *February 2007*)

B. Public Policy and Procurement Support

- Several tasks performed in support of DOE policy and implementation of SAI. (note: the majority of the following are funded separately, however, the decisions to support these tasks reflect the PVSAC commitment to targeting support activities where they are most needed and have the maximum impact)
- SWTDI/PVSAC completed support for SAI FOA Technical Committee, including review of 11 SAI proposals for technical accuracy, completeness, and results, *October 2006*.
- SWTDI support for Sandia-led task to define standard system test methodology, instrumentation, metrics and parameters, and reference systems, *October 2006*.
- SWTDI participated in the SAI TPP merit review process for large systems proposals, *November 2006*.
- Translated NM State Solar Tax Rebate form into Spanish for non-English speaking state residents to participate in the state Solar Program. Began process of contacting the states with the 8 largest PV rebate programs to learn which states require Spanish translation of state solar program documents for non-English speaking residents, *December 2006*.
- PVSAC participated with SMUD in position paper for Zero Energy Homes study to be performed through support of California Energy Commission (PVSAC taking the PV component of ZEH design and analysis), *December 2006*.

F. Workforce Development

- SWTDI/PVSAC participation in signing of MOU between NMSU and Sandia National Laboratories. PVSAC inserts request for Sandia visiting (adjunct) faculty program in renewables and BOS for NMSU master's program, *December 2006*.

G. Web-based Technical Support and Design Reviews

- Review of FSEC/SERES first layout of PVSAC home page designs, *December 2006*.

H. Field Test, Instrumentation, Data Monitoring

- Completed DOE Test and Evaluation Draft Plan for T&E team led by NREL and Sandia to prepare T&E requirements for support of upcoming SAI TPP awards, *December 2006*.
- Begin steps to obtain accreditation for PVSAC PV System Field Test from the American Association of Laboratory Accreditors (A2LA). This activity includes formal definition of tests, instrumentation, and processes required to certify performance of PV systems in the field. Successful completion of this process is scheduled for Q3 2007, when SWTDI/PVSAC will become the first laboratory in the U.S. accredited to certify PV system performance (a credential that will make PVSAC both self-supporting and of major value to SAI support), *October – December 2006*.

Task 2: Create New *Design-for-Manufacturing* Integrated PV Systems

A. U.S. PV Industry

- Modified 17 kW modular, prototype, PV parking structure (project is cost shared with New Mexico Energy Minerals and Natural Resources Department) to reduce cost and assembly time, *December 2006*
- Begin draft report of PV system Design-for-Manufacture activities with emphasis on design for streamlined field assembly, *December 2006*.

Task 3: Update Codes and Standards

A. Development of Codes and Standards

- Attendance at UL 1741 Standards Technical Panel meeting, *October 2006*.
- Attended NABCEP Exam Committee meeting , *October 2006*.

B. Training

- Presented PV/NEC day long workshop for 15 California IBEW members and local electrical inspectors, *October 2006*.
- Presented PV/NEC day long workshop for 200 Colorado IBEW members and local electrical inspectors, *October 2006*.
- Presented PV/NEC day long workshop for 65 NM state, city, and county electrical inspectors (Albuquerque), *November 2006*.
- Presented PV/NEC day long workshop for 30 NM state, city, and county electrical inspectors (Las Cruces), *November 2006*.
- Presented PV/NEC design workshop for 63 electrical engineers and designers at corporate headquarters of U.S. largest PV system installer, Powerlight, *December 2006*.

Task 4: Independent Assessment of Long-term Inverter Reliability

A. Inverter Long Term Test Facility

- Six ILTF monitoring systems on-line and collecting data, real-time displays of performance on the web, repairs made to failed input channel on Xantrex inverter system (minimal lost data), *December 2006*.

Status Q1 2007:

Task 1: PV Systems Assistance Center

A. Board of Advisors

- The PVSAC Board meeting notes were adapted into a revised PVSAC Implementation Plan (PVSAC-IP) during the last quarter. This has been circulated for review. The final draft is in progress awaiting return comments from some reviewers.

B. Policy, Standards, and Procurement Support

- SWTDI staff participated in a 'tiger team' evaluation of the National Zoo in Washington, D.C. as they renovate the zoo facilities and grounds. SWTDI led the team that provided evaluation of the PV array planned for the site and proposed an additional array for consideration. The 'tiger team' members included staff from SWTDI, Sandia, and NREL/FEMP.
- SWTDI/PVSAC developed the test requirements (labor, hardware, travel) for T&E support of the SAI TPP award winners. This plan and budget will become part of the revised SWRES SOPO due for delivery to Golden Field Office in April.
- SWTDI/PVSAC supported the Sandia-led task to define standard system test protocols and reporting requirements. Plans are being made for a group meeting of the Test and Evaluation team (NREL, Sandia, SWRES, SERES) to come together for a round-robin test and validation of all equipment and protocols at either Sandia or in the field at the site of a recently installed PV array in San Luis Obispo, CA.
- PVSAC participated with SMUD concluded in March with the final revision and validation of the SMUD Performance Index software. Special validation was required for the one-axis tracking algorithms used to validate performance of the utility's larger arrays.
- SWTDI staff regularly provide support to private industry on a proprietary basis with assistance for short duration, high value technical issues. In the current reporting period, services of this kind include: development of new electrical configuration for ac coupled, battery backed up PV systems; meeting with the CEO and CTO of a start up company developing a new ac PV module; and code-compliance review of a new inverter topology for an inverter company proposing a new design for the U.S. market.

I. Workforce Development

- SWTDI staff participated in the 2007 Solar Decathlon kickoff meeting in Washington, D.C. SWTDI reviewed electrical drawings and specifications submitted by all 20 participating University teams for safety, compliance with the National Electrical Code, and general quality of design.
- SWTDI staff assisted with instrumentation and data analysis for an advanced solar still with integrated PV research project. The results have been accepted by the American Solar Energy Society for oral presentation at this year's meeting.

J. Web-based Technical Support and Design Reviews

- This activity is on hold waiting further definition from the SWRES and SERES managers while the two programs revise their SOPO submissions to DOE.

K. Field Test, Instrumentation, Data Monitoring

- SWTDI staff performed acceptance testing of the new 30 kW PV system at the City of Phoenix Pecos Park municipal building. The system was checked for code

compliance and rated for performance. This test was the first performance evaluation of Chinese modules (Suntech Power Holdings) by the SWRES and represents a qualified performance baseline for these modules as they undergo exposure.

- SWTDI staff tested and provided a field rating for the new, 1 MW PV system at the Sonoma Mountain Village in Rohnert Park, CA. In addition to rating the system, SWTDI engineers used this test to develop and revise the test protocols for arrays and inverters that will be put forward for consensus adoption by the T&E group in May.
- Activities continue on the task to obtain accreditation for PVSAC PV System Field Test from the American Association of Laboratory Accreditors (A2LA). In the current reporting period these activities have included obtaining requisite training for all staff for

Task 2: Create New *Design-for-Manufacturing* Integrated PV Systems

A. U.S. PV Industry

- Construction was begun of the 17 kW modular, prototype, PV parking structure on the NMSU campus. The design of this system includes several advanced features selected for reducing cost and streamlining installation time. Construction of the system will be completed next quarter. A white paper of the new design features and their evaluation of their efficacy will be delivered.

Task 3: Update Codes and Standards

A. Development of Codes and Standards

- SWTDI hosted the IEEE SCC-21 Battery Standards Group meeting in Las Cruces for 2 days.
- SWTDI staff participated in the NABCEP Exam Committee meeting in Orlando, FL. The committee developed and approved the latest edition of the NABCEP exam for PV installer certification.

B. Training

- Presented PV/NEC day long workshop for 63 California electrical inspectors, PV installers, and electricians in San Jose, CA. *February 2007*.
- Presented PV/NEC day long workshop for 71 Arizona electrical inspectors, PV installers, and electricians in Tucson, AZ. *February 2007*.
- Presented PV/NEC day long workshop for 100 Colorado electrical inspectors, PV installers, and electricians in Denver CO. *February 2007*.
- Presented PV/NEC day long workshop for 475 California electrical inspectors and IBEW members in Los Angeles, CA. *March 2007*.
- Presented PV/NEC webcast for 50 NABCEP certified PV system installers nationwide. *March 2007*.
- Presented PV/NEC day long workshop for 55 PV professionals in association with Solar Energy International in Denver, CO. *March 2007*.

Task 4: Independent Assessment of Long-term Inverter Reliability

A. Inverter Long Term Test Facility

- Six ILTF monitoring systems continue operation on-line and collecting data, real-time displays of performance on the web.

Status Q2 2007:

Task 1: PV Systems Assistance Center

A. Board of Advisors

- No activity was recorded by the Board during the reporting period.

B. Policy, Standards, and Procurement Support

- SWTDI/PVSAC continutes support for the Sandia-led task to define standard system test protocols and reporting requirements.
- SWTDI staff regularly provide support to private industry on a proprietary basis with assistance for short duration, high value technical issues. In the current reporting period, services of this kind include: consultation with a New York company using new PV grounding techniques including UL in the discussions and review; support for wiring and grounding of UniSolar roofing shingles by a California PV installation company, meeting with personnel from an inverter startup company and signing of an NDA, collaboration with Tom Bowes of the Detroit Electrical Industry Training Center for PV training of electricians, consultation with Solar Design Associates on proper grounding of a large commercial PV array it is designing, assistance with the installers and inspectors in NJ to resolve several concerns about systems that have failed inspection.
- In April, SWTDI staff led a SEPA on-line conference covering PV and utility interconnection with 100 utility participants from around the country. The on-line conference supported questions and answers to specific issues.

L. Workforce Development

- SWTDI staff are participating in ongoing design reviews for several participating universities in the 2007 Solar Decathlon. SWTDI reviews cover the latest, revised electrical drawings and specifications submitted by participating University teams for safety, compliance with the National Electrical Code, and general quality of design.

M. Technical Support and Design Reviews

- SWRES staff reviewed designs for dozens of PV systems during the reporting period by working directly with designers and installers who needed these services.

N. Field Test, Instrumentation, Data Monitoring

- SWTDI staff supported several activities associated with Test and Evaluation tasks as a part of an ongoing participation in the T&E team needed to support the development of test protocols and requirements and to perform testing. This activity supports the SAI program directly but also brings these test protocols and lessons learned to U.S. PV stakeholders through SWRES outreach and training.
- SWTDI/PVSAC reviewed the latest test requirements (labor, hardware, travel) for T&E support of several of the SAI TPP award winners. As TPP SOPO's are prepared, the T&E requirements are circulated to the T&E participants (e.g. SWRES) for assessment of practicality and completeness.
- SWTDI staff prepared to participate on its second 'tiger team' of PV field evaluation and technical support. The team will be led by Sandia National Laboratories with NREL providing solar thermal technical support and SWRES providing project planning and PV technical support. The activity provides support to Forrest City Military Communities evaluation and use of solar DHW and PV. Forest City has currently installed S DHW systems on half of the 6500 homes it is

building or refurbishing for the U.S. Navy. It's plans call for additional thermal use and the evaluation and inclusion of PV on the remaining homes.

- SWTDI staff tested and provided a complete field rating for the new, 18 kW PV parking structure installed on the campus of NMSU. This array is now fully characterized from module panels to completed array and will serve as a source of performance, O&M, and replacement data for the next 3 years through benchmarking and baselining activities.
- Activities are delayed on the task to obtain accreditation for PVSAC PV System Field Test from the American Association of Laboratory Accreditors (A2LA). All preparation for this accreditation is completed, but the necessary time to undertake this lengthy process is not yet available (other activities have precedence).

Task 2: Create New *Design-for-Manufacturing* Integrated PV Systems

A. U.S. PV Industry

- Construction was completed on the 18 kW modular, prototype, PV parking structure on the NMSU campus. The design of this system includes several advanced features selected for reducing cost and streamlining installation time. Photographs and other documentation were kept and the array and components all were fully characterized before and after installation. A white paper of the new design feature, system evaluation results, and performance is being developed.

Task 3: Update Codes and Standards

A. Development of Codes and Standards

- The NFPA Technical Correlating Committee is currently reviewing the *2008 NEC* language including final votes on the Code Making Panel Actions (SWTDI is panel secretary).
- SWTDI provided support for UL investigating module grounding problems and concerns. SWTDI is also supporting UL in the next revision of UL 1741 for inverters.
- SWTDI staff participated in the NABCEP Exam Committee meeting in Albuquerque, NM. The committee developed and approved the latest edition of the NABCEP exam for PV installer certification.

B. Training

- Presented PV/NEC day long class on PV system design fundamentals for 23 students, engineers, and electricians at San Juan College in Farmington, NM. *April 2007*.
- Presented PV/NEC day long workshop for 83 Colorado electrical inspectors, professional engineers, and utility engineers in Denver, CO. *May 2007*.
- Presented two PV/NEC day long workshops for a combined total of 150 California electrical inspectors in San Diego, CA. *June 2007*.
- Presented PV/NEC day long workshop for 100 California electrical inspectors and IBEW members in San Francisco, CA. *March 2007*.

Task 4: Independent Assessment of Long-term Inverter Reliability

A. Inverter Long Term Test Facility

- Six ILTF monitoring systems continue operation on-line and collecting data, real-time displays of performance on the web (www.nmsu.edu/~tdi/iltf).

- Data from ILTF unit 6 is being compiled into a performance report summarizing trends in the PV subsystem. The PV array for ILTF 6 is composed of CIS (copper indium diselenide, thin film) that are now showing signs of degradation after only one year of exposure. The recorded data in association with the degraded modules are going to be used as a thin film reliability assessment set.

Status Q3 2007:

Task 1: PV Systems Assistance Center

A. Board of Advisors

- Activity complete, no activity recorded in the current reporting period.

B. Policy, Standards, and Procurement Support

- SWTDI/PVSAC continues support for the Sandia-led task to define standard system test protocols and reporting requirements (see first bullet, item E).
- SWTDI staff regularly provide support to private industry on a proprietary basis with assistance for short duration, high value technical issues. In the current reporting period, services of this kind include: consultation with three major inverter manufacturers on issues of inverter code-compliance, and design discussions with two PV module manufacturers over issues of connectors, wire size, insulation, and grounding.
- SWTDI participated in a panel discussion at the recent SEPA conference covering PV and utility interconnection and inverters with other experts from industry and the national laboratories.

O. Workforce Development

- SWTDI staff are participating in ongoing design reviews for all participating universities in the 2007 Solar Decathlon. SWTDI reviews cover the latest, revised electrical drawings and specifications submitted by participating University teams for safety, compliance with the National Electrical Code, and general quality of design. SWTDI will be the DC/PV electrical inspector for the Decathlon, working directly with the teams to assess code compliance and safety throughout the competition.
- SWTDI is participating in the developing Train-the-Trainer program with FSEC and Brooks, Engineering. SWTDI attended the organizational meeting in Orlando to begin formalizing the curriculum and processes for this task. Several conference calls among the task leads were conducted during the reporting period. Train-the-Trainer will target teachers of PV installers, inspectors, and designers to accelerate the rate of trained PV professionals available in the workforce.

P. Technical Support and Design Reviews

- SWTDI staff reviewed designs for over 20 PV systems during the reporting period by working directly with designers and installers who needed these services.

Q. Field Test, Instrumentation, Data Monitoring

- SWTDI staff have scheduled a two-day test procedure review with scientists from Sandia, NREL, and SERES. This review will be to standardize all system characterization test equipment, procedures, measurement uncertainties, and reporting formats.

- SWTDI staff have placed on the web all data being obtained from the new, 18 kW PV parking structure installed on the campus of NMSU. The web page can be found at: http://www.nmsu.edu/~tdi/parking/.
- SWTDI led the first DOE Tiger Team effort (Smithsonian National Zoo) in the Spring 2007 and now leads or participates in three DOE Tiger Team efforts:
    - Solar America Showcase: Forest City Military Communities. This Tiger Team is led by Sandia. In support of this tiger team, SWTDI has written and delivered two major reports and supported the development of the project plan for the entire team. The reports, *FC 5Warehouse_v2.pdf* and *PV Solar Ready.pdf*, are appended to this progress report.
    - Solar America Cities Tucson: SWTDI is the Tiger Team lead for Tucson. During the reporting period, SWTDI staff met twice with city of Tucson engineers and managers, developed a draft of the technical support program (for review), and have identified the remaining tiger team requirements for this 2-year program.
    - Solar America Cities Austin: SWTDI is participating in this Tiger Team led by Sandia. SWTDI staff supported the 2-hour presentation to Austin Energy in the discussion of technical assistance. Currently, technical assistance proposed includes assessment of rooftop area suitable for PV, solar/wind hybrid potential, and RE transmission requirements for Austin and elsewhere in Texas.

Task 2: Create New *Design-for-Manufacturing* Integrated PV Systems

A. U.S. PV Industry

- SWTDI has begun working closely with a major U.S. manufacturer of nonresidential, architectural, industrial, and institutional metal buildings. SWTDI is developing optimized design specifications for including PV on the manufacturer's existing building designs and preparing a document with recommendations for making future commercial buildings Solar Ready to accommodate PV installations at any time after construction is completed.

Task 3: Update Codes and Standards

A. Development of Codes and Standards

- SWTDI continued to provide input for UL investigating module grounding problems and concerns. Currently, a new class of grounding fasteners are being widely circulated that do not have UL listing. All parties are seeking to resolve this contentious issue in a safe and amicable way.

B. Training

- Presented PV/NEC workshop for 49 attendees at the American Solar Energy Society annual meeting in Cleveland, *July 2007*.
- SWTDI staff were on a panel during the forum, presentation, and discussion of Inverter Design and its impact on codes and standards at the SEPA conference in Long Beach, CA., *September 2007*.
- SWTDI staff participated NABCEP training in Long Beach during the SEPA conference, *September 2007*

- Presented PV/NEC day long workshop for a combined total of 73 electrical inspectors at the IAEI chapter meeting in Grand Junction, CO. *August 2007*.
- Presented PV/NEC day long workshop for 82 University RE students, electrical inspectors and IBEW members in Boone, NC. *September 2007*.

Task 4: Independent Assessment of Long-term Inverter Reliability

A. Inverter Long Term Test Facility

- Six ILTF monitoring systems continue operation on-line and collecting data, real-time displays of performance on the web (www.nmsu.edu/~tdi/iltf).
- Two inverters (SMA, Fronius) were removed from service and sent to Sandia National Laboratories for the second round of full characterization. Both inverters passed all tests though operational anomalies were observed in the performance of the Fronius unit. This will be monitored closely.

Status Q4 2007:

Task 1: PV Systems Assistance Center

A. Board of Advisors

- Activity complete, no activity recorded in the current reporting period.

B. Policy, Standards, and Procurement Support

- SWTDI/PVSAC continues support for the Sandia-led task to define standard system test protocols and reporting requirements. This includes standards for field test, reliability statistics gathering, and .
- SWTDI staff regularly provide support to private industry on a proprietary basis with assistance for short duration, high value technical issues. In the current reporting period, services of this kind include: consultation with two major inverter manufacturers on issues of inverter code-compliance, and design discussions with one U.S. PV module manufacturers over issues of connectors, wire size, insulation, and grounding.
- SWTDI participated in a on-line webinars discussing PV and utility interconnection with other experts from industry and the national laboratories.

R. Workforce Development

- SWTDI staff are participating in ongoing design reviews for all participating universities in the 2007 Solar Decathlon. SWTDI reviews cover the latest, revised electrical drawings and specifications submitted by participating University teams for safety, compliance with the National Electrical Code, and general quality of design. SWTDI will be the DC/PV electrical inspector for the Decathlon, working directly with the teams to assess code compliance and safety throughout the competition.

S. Technical Support and Design Reviews

- SWTDI staff reviewed designs for over 18 PV systems during the reporting period by working directly with designers and installers who needed these services.

T. Field Test, Instrumentation, Data Monitoring

- SWTDI staff have scheduled a two-day test procedure review with scientists from Sandia, NREL, and SERES for Feb 5 and 6. This review will be to standardize all

system characterization test equipment, procedures, measurement uncertainties, and reporting formats. SWTDI is developing the test plan and objectives.

- SWTDI staff have placed on the web all data being obtained from the new, 18 kW PV parking structure installed on the campus of NMSU. The web page can be found at: http://www.nmsu.edu/~tdi/parking/.
- SWTDI led the first DOE Tiger Team effort (Smithsonian National Zoo) in the Spring 2007 and now leads or participates in three DOE Tiger Team efforts:
    - Solar America Showcase: Forest City Military Communities. This Tiger Team is led by Sandia. SWTDI has reviewed two documents by other tiger team members and supplied bid review comments to the client on purchase of a 30 kW PV system in Oahu.
    - Solar America Cities Tucson: SWTDI is the Tiger Team lead for Tucson. During the reporting period, SWTDI staff met with the new city of Tucson point of contact, defined the first activities and established the timetable to begin. First on-site activities begin in the second week of February, 2008.
    - Solar America Cities Austin: SWTDI is participating in this Tiger Team led by Sandia. SWTDI engineers are preparing the assessment of rooftop area estimations for solar development. SWTDI is also leading the portion of the technical effort to design a solar/wind transmission corridor in collaboration with ERCOT.
    - Solar America Showcase: San Jose, CA. This Tiger Team is led by NREL/Sandia. SWTDI staff have done modeling and data gathering tasks in support of the TT leads. SWTDI has also compiled the list of TT participants, their expertise, and availabilities for the DOE MT group.

Task 2: Create New *Design-for-Manufacturing* Integrated PV Systems

A. U.S. PV Industry

- SWTDI has developed a wireless, low-cost pyranometer for integration into the systems monitoring already available in most commercial inverters. In the next quarter, this device will be documented and presented to the public for use as an integral part of reliability assessment of standard systems by untrained users.

Task 3: Update Codes and Standards

A. Development of Codes and Standards

- SWTDI continued to provide input for UL investigating module grounding problems and concerns. Currently, a new class of grounding fasteners are being widely circulated that do not have UL listing. All parties are seeking to resolve this contentious issue in a safe and amicable way.
- SWTDI has begun offering proposed changes for review to be included in the next revision of the NEC, the 2011 issue.

B. Training

- Presented PV/NEC day long workshop for a combined total of 73 electrical inspectors in Vancouver, BC and Seattle, WA. *October 2007*.
- Presented PV/NEC day long workshop for a combined total of 75 electrical inspectors, PV professionals and electricians in Burlington, VT. *October 2007*.

- Presented PV/NEC day long workshop for a combined total of 20 electrical inspectors in Albany, NY. *November 2007*.
- Presented PV/NEC day long workshop for a combined total of 35 SRP utility engineers in Phoenix, AZ. *November 2007*.
- Presented PV/NEC day long workshop for 62 electrical inspectors and PV system designers in Los Angeles, CA. *November 2007*.
- Presented PV/NEC day long workshop for 65 electrical inspectors and PV system designers in Palm Springs, CA. *November 2007*.

Task 4: Independent Assessment of Long-term Inverter Reliability

A. Inverter Long Term Test Facility

- Six ILTF monitoring systems continue operation on-line and collecting data, real-time displays of performance on the web (www.nmsu.edu/~tdi/iltf).
- Two inverters (SMA, Fronius) were removed from service in Q3 and sent to Sandia National Laboratories for the second round of full characterization. Both inverters were reinstalled and returned to service during this reporting period.

Status Q1 2008:

Task 1: PV Systems Assistance Center

A. Board of Advisors

- Activity complete, no activity recorded in the current reporting period.

B. Policy, Standards, and Procurement Support

- SWTDI/PVSAC continues support for the Sandia-led task to define standard system test protocols and reporting requirements. This includes standards for field test, reliability statistics gathering. SWTDI staff are currently scheduled to test concentrator PV in Las Vegas in a joint test with Sandia in April to validate new field protocols.
- SWTDI staff regularly provide support to private industry on a proprietary basis with assistance for short duration, high value technical issues. In the current reporting period, services of this kind include:
  consultation electrical inspectors on UL requirements for grounding, main disconnects, panels and conductors, load breaker rating equations, overcurrent ratings for panels and conductors, bonding, module grounding (San Diego, Bakersfield, Hawaii, Hayward, San Jose , New York, Chula Vista consultation with major installers on improperly drilled PV module grounding connections, consultation with users on the need for codes applicable to battery acids in residential environments and with safety engineers from Salt River Project on UL 1741 and utility linemen safety concerns.,
- SWTDI participated in an on-line webinars discussing PV and utility interconnection with other experts from industry and the national laboratories.

U. Workforce Development

- SWTDI staff participated in the development and execution of a PV design challenge for the International Design Contest. Teams from two major Universities participated in this competition, University of Rhode Island and Duke University. The competition was won by University of Rhode Island.

V. Technical Support and Design Reviews

- SWTDI staff reviewed designs for over several PV systems during the reporting period by working directly with designers and installers who needed these services. These include: Three PV systems for the City of Palo Alto (with major code violations), one utility scale system for designers in Massachusetts that uncovered deficiencies in a UL listed inverter, one major system designer and installer in California who had grounding and bonding design concerns brought up during inspection.

W. Field Test, Instrumentation, Data Monitoring

- The latest data for the SWTDI 18 kW PV parking structure installed on the campus of NMSU are updated. The web page can be found at http://www.nmsu.edu/~tdi/parking/.
- SWTDI led the first DOE Tiger Team effort (Smithsonian National Zoo) in the Spring 2007 and now leads or participates in three DOE Tiger Team efforts:
    - Solar America Showcase: Forest City Military Communities. Sandia leads this Tiger Team. SWTDI reviewed revised bids for this Showcase recipient. The winning bid was selected and 109 kW ($891k) system is being constructed (scheduled for completion in May) in Oahu.
    - Solar America Cities Tucson: SWTDI is the Tiger Team lead for Tucson. During the reporting period, SWTDI delivered three major deliverables to Tucson: a) a contract was written with CH2Mhill for the development of an RFP to purchase a 1-5 MW PV system, b) team member, Jason Coughlin (NREL) presented a financing primer document outlining the financing options open to Tucson, and c) SWTDI engineers tested six city-owned PV systems and reported on their code compliance, performance, and workmanship.
    - Solar America Cities Austin: SWTDI is participating in this Tiger Team led by Sandia. SWTDI engineers continue to develop the technical design a solar/wind transmission corridor in collaboration with ERCOT for conducting energy from large wind and solar farms in West Texas to the Austin area.
    - Solar America Showcase: San Jose, CA. This Tiger Team is led by NREL/Sandia. SWTDI staff has done modeling and data gathering tasks in support of the TT leads. SWTDI participated in the ranking of 8 city-owned municipal buildings for suitability for PV installation in the coming year.

Task 2: Create New *Design-for-Manufacturing* Integrated PV Systems

A. U.S. PV Industry

- There was no progress in deployment testing of the SWTDI-developed wireless, low-cost pyranometer for integration into the systems monitoring already available in most commercial inverters. .

Task 3: Update Codes and Standards

A. Development of Codes and Standards

- SWTDI participates in two UL Standards Technical Panels. In the reporting period, SWTDI reviewed the latest revisions for UL 1741 (inverters) and the draft to UL 1703 (modules) being proposed by Brian Wiley of Wiley Electronics with new input for grounding of PV module frames. The use of dissimilar metals in bonding applications for field installed connections will be evaluated in the listing process in future UL tests.
- SWTDI circulated the first 17 draft proposals for the 2011 *NEC*, to the member of the PV Industry Forum in February. The second 22 proposals to the 2011 *NEC* were circulated in March. Feedback is coming in and being collated. Additional proposals and updates will be sent once per month until final proposal deadline in November.

B. Training

- For the first time in ten years, no training workshops were performed due to injury to John Wiles and to the overall workload of the rest of the SWRES staff.

Task 4: Independent Assessment of Long-term Inverter Reliability

A. Inverter Long Term Test Facility

- Six ILTF monitoring systems continue operation on-line and collecting data, real-time displays of performance on the web (www.nmsu.edu/~tdi/iltf).
- All inverters are in service and recording data during this reporting period.

Status Q2 2008:

Task 1: PV Systems Assistance Center

A. Board of Advisors

- Activity complete, no activity recorded in the current reporting period.

B. Policy, Standards, and Procurement Support

- SWTDI/PVSAC worked with Sandia-to finalize standard system test protocols and reporting requirements for stage gate testing the Amonix CPV systems in Las Vegas.
- SWTDI staff regularly provides support to private industry on a proprietary basis with assistance for short duration, high value technical issues. In the current reporting period, services of this kind include:
  consultation with electrical inspectors: questions about Enphase micro inverter (San Diego, CA), consultation about TYCO grounding clips and UL 1703 (Bakersfield, CA), disconnect switch/main meter busbar details (Los Gatos, CA), disconnects for multiple inverter systems (HI), ground clips for listed equipment (NY), 18 electrical inspectors sent questions for an Inspection Checklist (various states)
  consultation with major installers: PV demonstration trailer, metal clad cable, on improperly drilled PV module grounding connections, 23 email inquiries were received from installers covering a wide range of topics (all were answered)
- SWRES hosted visits from engineers and scientists with the following companies requesting assistance on PV system design and code compliance: Enphase Energy, Schott Solar, SolarEdge Technologies, Positive Energy

X. Workforce Development

- SWTDI staff participated in the review of the PV design challenge for the International Design Contest. SWTDI is developing curriculum for a renewable energy minor at NMSU College of Engineering to meet the growing demand for trained engineers in green collar industries.

Y. Technical Support and Design Reviews

- SWTDI staff reviewed designs for over several PV systems during the reporting period by working directly with designers and installers who needed these services. These include several PV systems for Salt River Project (AZ).

Z. Field Test, Instrumentation, Data Monitoring

- The latest data for the SWTDI 18 kW PV parking structure installed on the campus of NMSU are updated. The web page can be found at http://www.nmsu.edu/~tdi/parking/.
- SWTDI/PVSAC worked with Sandia-to perform stage gate testing the Amonix CPV systems in Las Vegas, NV. These tests entailed IV curve acquisition throughout an entire day with calibrated instruments according to procedures developed by consensus earlier.
- SWTDI led the first DOE Tiger Team effort (Smithsonian National Zoo) in the Spring 2007 and now leads or participates in three DOE Tiger Team efforts:
    - Solar America Showcase: Forest City Military Communities. In the current reporting period, SWRES engineers performed modeling and economic analyses in support of Forest City's first major PV procurement and installation. DOE SETP manager attended ribbon cutting. Post ribbon cutting, SWTDI evaluated performance of the 107 kW system and compared actual with projected energy production.
    - Solar America Cities Tucson: SWTDI is the Tiger Team lead for Tucson. During the reporting period, SWTDI delivered three major deliverables to Tucson: a) participation in procurement merit review of 1-5MW PV PPA for CAVSARP site in north Tucson b) team member, Jason Coughlin (NREL) presented a financing primer document outlining the financing options open to Tucson, and c) SWTDI engineers tested four more city-owned PV systems and reported on their code compliance, performance, and workmanship.
    - Solar America Cities Santa Rosa: SWTDI is the Tiger Team lead for Santa Rosa. In the reporting period, SWTDI engineer met with the Solar Sonoma County group, solicited input for the Technical Assistance Statement of Work, drafted the SOW, and supplied it to Solar Sonoma County for review. In the next two weeks, the SOW will undergo final revision for submission to DOE Golden for approval.
    - Solar America Cities Austin: SWTDI is participating in this Tiger Team led by Sandia. SWTDI engineers continue to develop the technical design a solar/wind transmission corridor in collaboration with ERCOT for conducting energy from large wind and solar farms in West Texas to the Austin area. Work has begun on PVSAM modeling of potential PV CPV sites in west Texas.

- Solar America Showcase: San Jose, CA. This Tiger Team is led by NREL/Sandia. SWTDI staff has completed modeling and data gathering tasks in support of the TT leads. .

Task 2: Create New *Design-for-Manufacturing* Integrated PV Systems

A. U.S. PV Industry

- There was no progress in deployment testing of the SWTDI-developed wireless, low-cost pyranometer for integration into the systems monitoring already available in most commercial inverters. .

Task 3: Update Codes and Standards

A. Development of Codes and Standards

- SWTDI participates in two UL Standards Technical Panels. In the reporting period, SWTDI reviewed the second edition for UL 1741 (inverters) and the third edition to UL 1703 (modules) concerning grounding will be evaluated by the STP at the next meeting.
- SWTDI circulated third and fourth drafts of 36 proposals for the 2011 NEC to the members of the PV Industry Forum and feedback is being received. Final proposals must be submitted NFPA by early November. These drafts may be reviewed on the Solar ABCs web site
- A PV Industry Forum, meeting was held in Denver on 5-6 June. Twenty-five people were in attendance and extensive progress was achieved on reviewing Draft 4 proposals to the 2011 NEC.

B. Training

- SWTDI engineers participated in the June 10-13 NABCEP Exam Committee meeting in Orlando, FL.

Task 4: Independent Assessment of Long-term Inverter Reliability

A. Inverter Long Term Test Facility

- Six ILTF monitoring systems continue operation on-line and collecting data, real-time displays of performance on the web (www.nmsu.edu/~tdi/iltf).
- All inverters are in service and recording data during this reporting period.

Status Q3 2008:

Task 1: PV Systems Assistance Center

A. Board of Advisors

- Activity complete, no activity recorded in the current reporting period.

B. Policy, Standards, and Procurement Support

- SWTDI/PVSAC hosted six staff members from Sandia National Laboratories to discuss: solar modeling activities (PVSAM, PVWatts), joint field test exercises, reliability tests, benchmark data validation, accelerated life testing, instrumentation requirements.

- SWTDI staff regularly provides support to private industry on a proprietary basis with assistance for short duration, high value technical issues. In the current reporting period, services of this kind include:
  consultation with electrical inspectors: questions were answered for electrical inspectors from 7 jurisdictions on major concerns regarding: disconnect requirements (Article 690.14), multiple PV arrays on a single structure, type MC vs type AC cables, large commercial system reviews, dc metal conduits, and major challenges faced by inspectors seeking to perform the calculations required by Article 690.7 (temperature derating).
  consultation with major installers: 96 email inquiries were received from installers covering a wide range of technical topics (all were answered), in addition, major support was provided to electrical contractors working in Florida designing a 92 KW PV system in the Florida Keys.
- SWRES hosted a visit from engineers and scientists from Carrier Corp. who are developing a PV subsystem for a roof mounted heat pump. Carrier will supply a prototype unit to the SWRES next quarter for installation, operation, and evaluation of this proof-of-concept design.

AA. Workforce Development

- SWTDI staff is developing curriculum for a renewable energy minor at NMSU College of Engineering to meet the growing demand for trained engineers in green collar industries. Committees met on this subject twice in the reporting period

BB. Technical Support and Design Reviews

- SWTDI staff reviewed designs for over several PV systems during the reporting period by working directly with designers and installers who needed these services. These include several PV systems for Salt River Project (AZ).

CC. Field Test, Instrumentation, Data Monitoring

- The latest data for the SWTDI 18 kW PV parking structure installed on the campus of NMSU are updated. The web page can be found at http://www.nmsu.edu/~tdi/parking/.
- SWTDI tested two large off-grid PV systems used for telecommunications sites in California. These sites were Rogers Peak and Ord Mountain. Both sites are owned by Southern California Edison and testing was to assess the current state of degradation of both systems and recommend upgrade and replacement strategy for each.
- SWTDI led the first DOE Tiger Team effort (Smithsonian National Zoo) in the Spring 2007 and now leads or participates in three DOE Tiger Team efforts:
  - Solar America Showcase: Forest City Military Communities. In the current reporting period, SWRES engineers performed performance assessment of Forest City's first major PV system on Oahu. SWTDI also performed modeling and analysis for installation of PV on several roofs in Kauai – contract for installation of this MW size development program was awarded in October..
  - Solar America Cities Tucson: SWTDI is the Tiger Team lead for Tucson. During the reporting period, SWTDI concluded participation in procurement merit review of 1-5MW PV PPA for CAVSARP site in north Tucson (contract awarded). SWTDI performed technical analyses of all bids to deliver 8 large PV systems with CREBS funding to Tucson during the reporting period,

SWTDI provide PV/NEC workshop for 74 attendees in Tucson in July.

- Solar America Cities Santa Rosa: SWTDI is the Tiger Team lead for Santa Rosa. In the reporting period, SWTDI engineer met with the Solar Sonoma County group, participated in a steering committee planning meeting, revised the TA SOW and submitted to GFO for approval, met with faculty and students from Sonoma State University to develop a task involving SSU in solar thermal assessment and analysis, reviewed several web-based mapping products and participated in the selection process.
- Solar America Cities Austin: SWTDI is participating in this Tiger Team led by Sandia. SWTDI engineers continue to develop the technical design a solar/wind transmission corridor in collaboration with ERCOT for conducting energy from large wind and solar farms in West Texas to the Austin area. Work continues on PVSAM modeling of potential PV CPV sites in west Texas and convolving CSP energy and potential wind energy from west Texas fields to City of Austin.
- Solar America City: San Jose, CA. This Tiger Team is led by NREL/Sandia. SWTDI staff numerous support activities for TT lead during the reporting period. .

Task 2: New Integrated PV Systems – Design and Test

A. U.S. PV Industry

- SWTDI has refurbished its two-axis tracker for eventual return to service for support of SAI testing of CSP and CPV modules for U.S. industry. The refurbishment included complete rework of the motors and gearing subassemblies and replacement of the two-axis controller with one developed by SWTDI in-house.

Task 3: Update Codes and Standards

A. Development of Codes and Standards

- SWTDI participates in two UL Standards Technical Panels. In the reporting period, SWTDI participated in the UL 1703/IEC 61730 meeting in Tempe, AZ in September.
- SWTDI circulated drafts five and six of 36 proposals for the 2011 NEC to the members of the PV Industry Forum and feedback is being received. Final proposals must be submitted NFPA by early November. These drafts may be reviewed on the Solar ABCs web site. SWTDI participated in the NEC?PV review meeting in Albuquerque in September.

B. Training

- SWTDI engineers continue participation in theNABCEP Exam Committee meeting review and development.
- SWTDI conducted an internet-based training and webinar for electricians, inspectors and installers on September 9, 2008. Over 60 professionals participated.

- SWTDI engineers trained over 1,140 designers, inspectors and installers in NEC workshops during the three month reporting period

Task 4: Independent Assessment of Long-term Inverter Reliability

A. Inverter Long Term Test Facility

- Six ILTF monitoring systems continue operation on-line and collecting data, real-time displays of performance on the web (www.nmsu.edu/~tdi/iltf).
- All inverters are in service and recording data during this reporting period.

Status Q4 2008:

Task 1: PV Systems Assistance Center

A. Board of Advisors

- Activity complete, no activity recorded in the current reporting period.

B. Policy, Standards, and Procurement Support

- SWTDI staff regularly provides support to private industry on a proprietary basis with assistance for short duration, high value technical issues. In the current reporting period, services of this kind include:
  consultation with electrical inspectors: questions were answered for more than 25 electrical inspectors from jurisdictions around the country on major concerns. In particular, there are recurring questions about the mathematical calculation of PV open circuit voltage (Article 6907) in the 2008 code.
  consultation with major installers: 85 email inquiries and over 60 telephone calls were received from installers covering a wide range of technical topics (all were answered).
- SWRES installed a new PV-assisted heat pump at its main offices. The heat pump is developed bye Carrier Corp. SWRES will be responsible for operation and evaluation of this proof-of-concept design.

DD. Workforce Development

- SWTDI staff met with University of Arizona faculty and administration to support their developments of campus sustainability, materials science, and photovoltaics test and evaluation. The meeting was in conjunction with AZRise.
- SWTDI engineers worked directly with students from Sonoma State University in association with the Solar America Cities program (Santa Rosa, CA). A program of study that integrated Sonoma State students with vendor and municipal activities within Sonoma County has been outlined and reviewed and is proceeding.

EE. Technical Support and Design Reviews

- SWTDI staff reviewed designs for over several PV systems during the reporting period by working directly with designers and installers who needed these services. These include several PV systems for Solar America Cities participants.

FF. Field Test, Instrumentation, Data Monitoring

- The latest data for the SWTDI 18 kW PV parking structure installed on the campus of NMSU are updated. The web page can be found at http://www.nmsu.edu/~tdi/parking/.

- SWTDI led the first DOE Tiger Team effort (Smithsonian National Zoo) in the Spring 2007 and now leads or participates in three DOE Tiger Team efforts:
    - Solar America Showcase: Forest City Military Communities. In the current reporting period, SWRES reviewed some of the specifications for the proposals received by Forest City to install 1-2 MW of PV at the Pacific Missile Test Range on the island of Kauai.
    - Solar America Cities Tucson: SWTDI is the Tiger Team lead for Tucson. During the reporting period, SWTDI performed field testing and analysis of two large city-owned PV systems: Pennington Street Garage and Hayden Udall Water Treatment Plant. Site surveys were conducted on three large, municipal roofs. Interviews were conducted with city employees in support of development of an integrated program for specification, procurement, installation and operation of PV systems by the city (Tiger team deliverable).
    - Solar America Cities Santa Rosa: SWTDI is the Tiger Team lead for Santa Rosa. In the reporting period, SWTDI engineer met with the Solar Sonoma County group, participated in a steering committee planning meeting. The solar mapping subcontractor was selected, presentations were made to city groups and the tiger team participated in scheduling future activities. TT lead also wrote and submitted an abstract to document the performance of a new PV system in Sebastopol, CA installed by SSC using CREBS funding. The paper was accepted by ASES for oral presentation.
    - Solar America Cities Austin: SWTDI is participating in this Tiger Team led by Sandia. SWTDI engineers continue to develop the technical design a solar/wind transmission corridor in collaboration with.
    - Solar America City: San Jose, CA. This Tiger Team is led by NREL/Sandia. SWTDI staff numerous support activities for TT lead during the reporting period. .

Task 2: New Integrated PV Systems – Design and Test

A. U.S. PV Industry

- SWTDI has refurbished its two-axis tracker for eventual return to service for support of SAI testing of CSP and CPV modules for U.S. industry. The is completed and concentrating PV modules are being sought for use with the tracker.

Task 3: Update Codes and Standards

A. Development of Codes and Standards

- SWTDI circulated 54 final proposals for the 2011 NEC to the members of the PV Industry Forum. Final proposals were submitted to NFPA in early November. These drafts may be reviewed on the Solar ABCs web site.

B. Training

- SWTDI engineers continue participation in theNABCEP Exam Committee meeting review and development.

- SWTDI engineers trained over 600 designers, inspectors and installers in NEC workshops during the three month reporting period

Task 4: Independent Assessment of Long-term Inverter Reliability

A. Inverter Long Term Test Facility

- Six ILTF monitoring systems continue operation on-line and collecting data, real-time displays of performance on the web (www.nmsu.edu/~tdi/iltf).
- All inverters are in service and recording data during this reporting period.

Status Q1 2009:

Task 1: PV Systems Assistance Center

A. Board of Advisors

- Activity complete, no activity recorded in the current reporting period.

B. Policy, Standards, and Procurement Support

- SWTDI staff regularly provides support to private industry on a proprietary basis with assistance for short duration, high value technical issues. In the current reporting period, services of this kind include:
  consultation with electrical inspectors: questions were answered for more than 110 emails and 22 phone calls from electrical inspectors from jurisdictions around the country on major concerns. In particular, there are recurring questions brought up during design reviews between installers and inspectors. SWRES provided dispute resolution in all cases through understanding of the code and intent of the code.
  consultation with major installers: 55 email inquiries and over 20 telephone calls were received from installers covering a wide range of technical topics (micro inverters were the topic with the most difficlties).
- SWRES installed a new PV-assisted heat pump at its main offices last quarter. The heat pump is developed bye Carrier Corp is operating with ongoing data collection for the electrical load and PV contribution.

GG. Workforce Development

- SWTDI staff participated in the Train the trainer conference call with DOE and other participants on 5 March 2009.
- Twenty initial designs for 2009 Solar Decathlon were reviewed in January with feedback provided in writing to all participants on 10 Jan.

HH. Technical Support and Design Reviews

- SWTDI staff reviewed designs for over several PV systems and components during the reporting period by working directly with designers and installers who needed these services. These include several PV systems for Solar America Cities participants, Sempra Energy, SCE, DuPont Solar Solutions, Solmetric, Emerson, and Solaria.
- SWTDI staff provided telephone support to Aaron Song of DOE/HQ in the development and structure of the planned PV Community Project to be launched end of this FY or early next.

- SWTDI presented its program at the bi-annual DOE Peer Review in Denver in March. The presentation was well-received with SWRES receiving high grades in all review categories.

II. Field Test, Instrumentation, Data Monitoring

- The latest data for the SWTDI 18 kW PV parking structure installed on the campus of NMSU are updated. The web page can be found at http://www.nmsu.edu/~tdi/parking/.
- SWTDI led the first DOE Tiger Team effort (Smithsonian National Zoo) in the Spring 2007 and now leads or participates in three DOE Tiger Team efforts:
    - Solar America Cities Tucson: SWTDI is the Tiger Team lead for Tucson. During the reporting period, SWTDI performed field testing and analysis city-owned PV systems. SWTDI prepared and scheduled a workshop on Solar thermal systems given by Chuck Marken (AAA Solar). This two-day workshop was presented to 65 installers, plumbers, and city employees in February and was extremely well received. SWTDI prepared and submitted to DOE an RFP for services from CH2MHill. These services are for support in developing structural analyses and policies for City of Tucosn.
    - Solar America Cities Santa Rosa: SWTDI is the Tiger Team lead for Santa Rosa. In the reporting period, SWTDI engineer met with the Solar Sonoma County group, participated in a steering committee planning meeting. SWTDI identified four major PV systems for completed testing and two large municipal buildings for site assessment for future PV systems. Tests and assessments to be conducted the first month of next quarter.
    - Solar America Cities Austin: SWTDI is participating in this Tiger Team led by Sandia. SWTDI engineers worked with Clean Energy Associates in Austin to validate data and methods for work previously submitted.
    - Solar America City: San Jose, CA. This Tiger Team is led by NREL/Sandia. SWTDI staff numerous clerical/support activities for TT lead during the reporting period. .

Task 2: New Integrated PV Systems – Design and Test

A. U.S. PV Industry

- SWTDI has refurbished its two-axis tracker for eventual return to service for support of SAI testing of CSP and CPV modules for U.S. industry. SWTDI is currently preparing CPV testing with two manufacturers for use of this tracker.

Task 3: Update Codes and Standards

A. Development of Codes and Standards

- SWTDI has begun collecting submissions for the 2013 NEC.

B. Training

- SWTDI engineers continue participation in theNABCEP Exam Committee meeting review and development.

- SWTDI engineers trained over 650 designers, inspectors and installers in NEC workshops during the three month reporting period

Task 4: Independent Assessment of Long-term Inverter Reliability

A. Inverter Long Term Test Facility

- Six ILTF monitoring systems continue operation on-line and collecting data, real-time displays of performance on the web (www.nmsu.edu/~tdi/iltf).

Status Q2 2009:

Task 1: PV Systems Assistance Center

A. Board of Advisors

- Activity complete, no activity recorded in the current reporting period.

B. Policy, Standards, and Procurement Support

- SWTDI staff regularly provides support to private industry on a proprietary basis with assistance for short duration, high value technical issues. In the current reporting period, services of this kind include:
  consultation with electrical inspectors: questions were answered for more than 40 electrical inspectors, nationwide. SWRES provided dispute resolution in several cases through understanding of the code and intent of the code.
  consultation with major installers: approximately 150 inquiries were answered regarding specific interpretations of the National Electrical Code during design or installation of PV systems around the country.
  proprietary engineering assistance and support: In the reporting period, SWTDI provided engineering support to Schott Solar (module grounding issues), Enphase Energy (inspector education for new product), and training for UL module test engineers in two UL test locations.
- SWRES continued to Beta test and take data on the new PV-assisted heat pump at its main offices. The heat pump is developed bye Lennox Corp is operating with ongoing data collection for the electrical load and PV contribution. Data and analysis reports are being submitted to Lennox as they pursue including PV in their high-end heat pump product line.

JJ. Workforce Development

- Second review of all system designs for 2009 Solar Decathlon were completed. Several systems were red-flagged as not yet acceptably safe for installation in the National Mall in Washington. SWTDI is working with each teem to get these design deficiencies corrected on a timely basis.

KK. Technical Support and Design Reviews

- SWTDI staff reviewed designs for over several PV systems and components during the reporting period by working directly with designers and installers who needed these services. These include several PV systems for Solar America Cities participants.
- SWTDI staff provided technical support to Dan Ton (DOE) regarding PV Community Project's monitoring needs and requirements. Information regarding barriers to monitoring of PV and system performance were the major focus of this support.

LL. Field Test, Instrumentation, Data Monitoring

- The latest data for the SWTDI 18 kW PV parking structure installed on the campus of NMSU are updated. The web page can be found at http://www.nmsu.edu/~tdi/parking/.
- SWTDI engineers performed PV system testing for Salt River Project in Phoenix, AZ on the large Agua Fria PV power system. SRP requested this test following questions about system performance and the need to replace the system's original inverter.
- SWTDI led the first DOE Tiger Team effort (Smithsonian National Zoo) in the Spring 2007 and now leads or participates in three DOE Tiger Team efforts:
    - Solar America Cities Tucson: SWTDI is the Tiger Team lead for Tucson. During the reporting period, SWTDI completed and submitted to DOE an RFP for services from CH2MHill. These services are for support in developing structural analyses and policies for City of Tucson with two major goals: support for the 8 systems now being designed with CREBS funding and to use these analyses to establish city structural regulations that are more in keeping with those in other cities (less restrictive).
    - Solar America Cities Santa Rosa: SWTDI is the Tiger Team lead for Santa Rosa. In the reporting period, staff of SWTDI travelled to Santa Rosa to perform a variety of services in support of the TT MOA:
        - TT tested three existing PV systems while working with the system installer in each case. Systems were inspected for code compliance and findings were discussed with each installer. Systems were also tested for performance and any failures or deficiencies were brought to the attention of the installer.
        - TT performed site surveys for the City of Petaluma on municipally owned buildings and lots. In each case, area measurements were taken, SolMetric SunEye readings were obtained to determine solar exposure and specifications of the existing electrical panel(s) were recorded. A feasibility report for use of PV at each site will be written and submitted.
        - TT performed site survey at the Sonoma Valley Hospital, Sonoma, CA. SunEye readings were taken of the parking lots, the hospital's complex roof, and a large 4 acre lot near the hospital. Feasibility studies for PV, PV parking structures, and large solar hot water systems will be developed and submitted to the hospital staff.
    - Solar America Cities Pittsburgh: SWTDI staff have agreed to participate in a regional conference being held in Pittsburgh next quarter. SWTDI has begun preparing presentation materials on the topic of "PV in cold, cloudy climates".

Task 2: New Integrated PV Systems – Design and Test

A. U.S. PV Industry

- SWTDI has refurbished its two-axis tracker for eventual return to service for support of SAI testing of CSP and CPV modules for U.S. industry. SWTDI is currently preparing CPV testing with two manufacturers for use of this tracker.
- SWTDI installed a 2 kW system built by Solaria (Berkeley, CA) to test this new, low concentration, PV technology. Plans call for operation and data collection to continue for 2 years.

Task 3: Update Codes and Standards

A. Development of Codes and Standards

- SWTDI is continuing to collect and collate submissions for the 2013 NEC.

B. Training

- SWTDI engineers continue participation in theNABCEP Exam Committee meeting review and development with two day test development support in June.
- SWTDI engineers trained over 690 designers, inspectors and installers in NEC workshops during the three month reporting period (see travel summary table)

Task 4: Independent Assessment of Long-term Inverter Reliability

A. Inverter Long Term Test Facility

- Six ILTF monitoring systems continue operation on-line and collecting data, real-time displays of performance on the web (www.nmsu.edu/~tdi/iltf).
- All inverters are in service and recording data during this reporting period.

Status Q3 2009:

Task 1: PV Systems Assistance Center

A. Board of Advisors

- Activity complete, no activity recorded in the current reporting period.

B. Policy, Standards, and Procurement Support

- SWTDI staff regularly provides support to private industry on a proprietary basis with assistance for short duration, high value technical issues. In the current reporting period, services of this kind include:
  consultation with electrical inspectors: questions were answered for more than 80 electrical inspectors, nationwide. SWRES provided dispute resolution in several cases through understanding of the code and intent of the code.
  consultation with major installers: approximately 170 inquiries were answered regarding specific interpretations of the National Electrical Code during design or installation of PV systems around the country In addition, system design reviews were conducted on 12 PV system installation schematic packages.
  proprietary engineering assistance and support: In the reporting period, SWTDI provided engineering support to EMCORE to discuss code compliance concerns related to their newly developed concentrating PV collector; conference calls were concudted with TenkSolar working with the AHJ in Minneapolis, MN, to address

more than 12 NEC-related issues with their new beta demonstration project; Extensive review of manuals for SolarEdge with special emphasis on grounding and code compliance for the U.S. market; and extensive review of manuals for National Semiconductor Solar Magic product, including a 2-hour conference call; SWTDI staff met with representatives of Kaneka with regard to implementing a test program for their new hybrid amorphous silicon PV modules; SWTDI met with representatives from Solaria to discuss expansion of current tests to include two 5 kW test arrays on one-axis trackers.

- SWRES continued to Beta test and take data on the new PV-assisted heat pump at its main offices. The heat pump is developed bye Lennox Corp is operating with ongoing data collection for the electrical load and PV contribution. Meetings were held with Lenox during the reporting period to discuss listing requirements for the Enphase inverter portions of the HVAC system. Meetings were also conducted at the Lenox factory. Data and analysis reports are being submitted to Lennox as they pursue including PV in their high-end heat pump product line.

MM. Workforce Development

- Final pre-competition review of all system designs for 2009 Solar Decathlon were completed. All red-flagged systems (except Spain) were brought into code compliant designs prior to installation on the National Mall in Washington. SWTDI is working with the Spanish team to bring their complex PV system into compliance before shipping to the U.S.

NN. Technical Support and Design Reviews

- SWTDI staff reviewed designs for over several PV systems and components during the reporting period by working directly with several PV systems for Solar America Cities participants.

OO. Field Test, Instrumentation, Data Monitoring

- The latest data for the SWTDI 18 kW PV parking structure installed on the campus of NMSU are updated. The web page can be found at http://www.nmsu.edu/~tdi/parking/.
- SWTDI engineers met with Sandia scientists to refine the designs for the upcoming System Long Term Evaluation DAS's which SWTDI will construct to SNL/NREL specifications in the fourth quarter of 2009.
- SWTDI led the first DOE Tiger Team effort (Smithsonian National Zoo) in the Spring 2007 and now leads or participates in three DOE Tiger Team efforts:
    - Solar America Cities Tucson: SWTDI is the Tiger Team lead for Tucson. During the reporting period, CH2MHill provided services for support in developing structural analyses and policies for City of Tucson. SWTDI reviewed the technical reports submitted by CH2MHill and made comments to the SAC lead. Comments were submitted to CH for additional work to bring this task to completion.
    - Solar America Cities Santa Rosa: SWTDI is the Tiger Team lead for Santa Rosa. In the reporting period, staff of SWTDI travelled to Santa Rosa to perform a variety of services in support of the TT MOA:
        - TT tested four existing PV systems while working with the system installer in each case. Systems were inspected for code compliance and findings were discussed with each installer. Systems were also tested for performance and any

failures or deficiencies were brought to the attention of the installer.

- TT submitted site survey reports for the City of Petaluma on municipally owned buildings and lots. Reports included, area measurements were taken, SolMetric SunEye readings and specifications of the existing electrical panel(s)
- TT submitted three major reports developed for the Sonoma Valley Hospital covering: energy and economics of using large PV array installed on the hospital roof; energy and economics of installing a large solar hot-water system on the hospital roof; energy and economics of installed a multi-MW array on a parking canopy in a large, undeveloped lot near the hospital.

- Solar America Cities Pittsburgh: SWTDI prepared a presentation to deliver at the NorthEast Regional Solar conference in Pittsburgh on the topic "PV in cold, cloudy climates".
- Solar America Showcase Forest City LLC: SWTDI provided technical support for the zero energy home development at Kaneohe Marine Base in Oahu with design guidance for the roof-top PV arrays (size, location, energy modeling).
- Within the reporting period, SWTDI staff participated in the design review for the Solar America Cities Special Projects round of funding. This merit review took place of 3 days and evaluated more than 30 proposals for award of the $10M in additional funding to existing SAC's for new projects.

Task 2: New Integrated PV Systems – Design and Test

A. U.S. PV Industry

- The SWTDI refurbished two-axis tracker has developed operational problems and is undergoing repair. It is being prepared for testing of CSP and CPV modules for U.S. industry. SWTDI is currently preparing for CPV testing with two manufacturers for use of this tracker.
- SWTDI operated a 2 kW system built by Solaria (Berkeley, CA) testing this new, low concentration, PV technology. The first quarterly report of results was prepared and presented to Solaria.

Task 3: Update Codes and Standards

A. Development of Codes and Standards

- SWTDI drafted and coordinated six comments for the Report on Proposals for the 2011 NEC. This work was ins support of the U.S. PV Industry Forum in attempt to illuminate positions on code proposals rejected by the NFPA code making panels.

B. Training

- SWTDI engineers continue participation in theNABCEP Exam Committee. In the reporting period, SWTDI staff submitted 8 questions for the next NABCEP exam and participated in the exam review conference call.
- SWTDI engineers trained over 400 designers, inspectors and installers in NEC workshops during the three month reporting period (see travel summary table)

Task 4: Independent Assessment of Long-term Inverter Reliability

A. Inverter Long Term Test Facility

- Six ILTF monitoring systems continue operation on-line and collecting data, real-time displays of performance on the web (www.nmsu.edu/~tdi/iltf).
- All inverters are in service and recording data during this reporting period.

Status Q4 2009:

Task 1: PV Systems Assistance Center

A. Board of Advisors

- Activity complete, no activity recorded in the current reporting period.

B. Policy, Standards, and Procurement Support

- SWTDI staff regularly provides support to private industry on a proprietary basis with assistance for short duration, high value technical issues. In the current reporting period, services of this kind include:
  consultation with electrical inspectors: questions were answered for more than 80 electrical inspectors, nationwide. SWRES provided dispute resolution in several cases through understanding of the code and intent of the code.
  consultation with major installers: approximately 50 inquiries were answered regarding specific interpretations of the National Electrical Code during design or installation of PV systems around the country In addition, system design reviews were conducted on 8 PV system installation schematic packages.
  proprietary engineering assistance and support: In the reporting period, SWTDI provided engineering support to SRP and Underwriter's Laboratories in the assessment of whether ground fault protected circuit breakers can be properly used in backfed PV applications (they can not); reviewed Navajo PV system designs for the company Dependable Solar; .
- SWRES continued to Beta test and take data on the new PV-assisted heat pump at its main offices. The heat pump is developed bye Lennox Corp is operating with ongoing data collection for the electrical load and PV contribution. Meetings were held with Lenox during the reporting period to discuss listing requirements for the Enphase inverter portions of the HVAC system. Results of testing have been used to bring this product to market where it is currently offered for sale.

PP. Workforce Development

- SWTDI inspected all competition systems in the 2009 Solar Decathlon. SWTDI worked with all teams to correct red-flagged code or safety violations and bring them into code compliant designs prior to operation on the National Mall in Washington. SWTDI engineers also assisted Byron Stafford in the implementation of a 230V/50Hz grid for the participating international teams.
- SWTDI engineers supported the judging of the 2009 Solar Decathlon on an emergency basis when grid failures during competition led to outages for the two international teams. SWTDI provided system modeling and energy analysis to keep the competition on an even footing and allow the Decathlon to complete according to schedule.

QQ. Technical Support and Design Reviews

- SWTDI staff reviewed designs for over 200 PV systems and components during the reporting period by working directly with several PV systems for Solar America Cities participants.

RR. Field Test, Instrumentation, Data Monitoring

- The latest data for the SWTDI 18 kW PV parking structure installed on the campus of NMSU are updated. The web page can be found at http://www.nmsu.edu/~tdi/parking/.
- SWTDI engineers participated in a series of teleconferences and document reviews of standard DAS design methodology for supporting Recovery Act and earmark funded PV systems deployed in 2010 (activity led by Sarah Kurtz, NREL).
- SWTDI engineers met with Sandia scientists to define a transition of the SWRES engineering tasks from DOE. These tasks, under the Test and Evaluation category, will include work in reliability assessment, accelerated life testing, technical outreach to GSA, design and operation of the SLTE DASs and systems, and field data collection systems for operation at the DeSoto PV plant in Florida.
- SWTDI led the first DOE Tiger Team effort (Smithsonian National Zoo) in the Spring 2007 and now leads or participates in three DOE Tiger Team efforts:
    - Solar America Cities Tucson: SWTDI is the Tiger Team lead for Tucson. During the reporting period, SWTDI reviewed and made suggested revisions to CH2MHill for support in developing structural analyses and policies for City of Tucson. SWTDI reviewed the technical reports submitted by CH2MHill and made comments to the SAC lead. Comments were adopted by CH and revised documents were received. SWTDI also participated with Critigen on the collection and discussion of metrics for Tucson SAC program.
    - Solar America Cities Santa Rosa: SWTDI is the Tiger Team lead for Santa Rosa. In the reporting period, staff of SWTDI travelled to Santa Rosa to perform a variety of services in support of the TT MOA:
        - TT consulted with SR city employees on their professional service agreement with Fat Spaniel (data monitoring).
        - TT also participated in a SR code and inspector workshop for PV and solar thermal. TT led the discussion of results of field inspections of 12 different PV systems in Sonoma County and the deficiencies that were commonly observed.
    - Solar America Cities Pittsburgh: SWTDI engineer delivered a presentation at the NorthEast Regional Solar conference in Pittsburgh on the topic “PV in cold, cloudy climates”.
    - Solar America Showcase Forest City LLC: SWTDI provided technical support for the zero energy home development at Kaneohe Marine Base in Oahu with design guidance for the roof-top PV arrays (size, location, energy modeling). SWTDI sponsored an electrical engineering professor from NMSU to attend meetings in Oahu on the development of a high penetrations PV smartgrid for the Pearl Harbor Peninsula housing area.

- Within the reporting period, SWTDI staff participated in the design review and specification development for PV system deployment by GSA at the Emmett Bean Center in Indianapolis, IN.

Task 2: New Integrated PV Systems – Design and Test

A. U.S. PV Industry

- SWTDI operated a 2 kW system built by Solaria (Berkeley, CA) testing this new, low concentration, PV technology. The first quarterly report of results was prepared and presented to Solaria.

Task 3: Update Codes and Standards

A. Development of Codes and Standards

- SWTDI prepared comments on panel actions for prior to their submission to NFPA on October 19.
- SWTDI engineers worked with Ward Bower and Bill Brooks to prepare for their participation in the December NFPA code making panel meeting in December.

B. Training

- SWTDI engineers trained over 300 designers, inspectors and installers in NEC workshops during the three month reporting period (see travel summary table)

Task 4: Independent Assessment of Long-term Inverter Reliability

A. Inverter Long Term Test Facility

- Six ILTF monitoring systems continue operation on-line and collecting data, real-time displays of performance on the web (www.nmsu.edu/~tdi/iltf).
- All inverters are in service and recording data during this reporting period.

Status Q1 2010:

Task 1: PV Systems Assistance Center

A. Board of Advisors

- Activity complete, no activity recorded in the current reporting period.

B. Policy, Standards, and Procurement Support

- SWTDI staff regularly provides support to private industry on a proprietary basis with assistance for short duration, high value technical issues. In the current reporting period, services of this kind include:
  consultation with electrical inspectors: questions were answered for more than 45 electrical inspectors, nationwide. SWRES provided dispute resolution in several cases through understanding of the code and intent of the code.
  consultation with major installers: approximately 100 inquiries were answered regarding specific interpretations of the National Electrical Code during design or installation of PV systems around the country In addition, system design reviews were conducted on 8 PV system installation schematic packages.
  proprietary engineering assistance and support: In the reporting period, SWTDI provided engineering support to industry on a request basis. The list of service

recipients includes Solar Edge, who requested review of their manuals, and Solaria, with review of their PV modules and tracker development.

- SWRES continued to Beta test and take data on the new PV-assisted heat pump at its main offices. The heat pump is developed bye Lennox Corp is operating with ongoing data collection for the electrical load and PV contribution. Meetings were held with Lenox during the reporting period to discuss listing requirements for the Enphase inverter portions of the HVAC system. Results of testing have been used to bring this product to market where it is currently offered for sale.

SS. Workforce Development

- SWTDI inspected all competition systems in the 2009 Solar Decathlon. SWTDI developed a specialized checklist for the Solar Decathlon PV systems for use in the next competition.
- SWTDI gave a special presentation to the International Association of Arson Investigators of New Mexico (22 attendees) on the subject of PV and Fire.

TT. Technical Support and Design Reviews

- SWTDI staff reviewed designs for over 250 PV systems and components during the reporting period by working directly with several PV systems for Solar America Cities participants.

UU. Field Test, Instrumentation, Data Monitoring

- The latest data for the SWTDI 18 kW PV parking structure installed on the campus of NMSU are updated. The web page can be found at http://www.nmsu.edu/~tdi/parking/.
- SWTDI continue to work with Sandia scientists to define a transition of the SWRES engineering tasks from DOE. These tasks, under the Test and Evaluation category, will include work in reliability assessment, accelerated life testing, technical outreach to GSA, design and operation of the SLTE DASs and systems, and field data collection systems for operation at the DeSoto PV plant in Florida.
- SWTDI led the first DOE Tiger Team effort (Smithsonian National Zoo) in the Spring 2007 and now leads or participates in three DOE Tiger Team efforts:
    - Solar America Cities Tucson: SWTDI prepared and delivered the final two deliverables for City of Tucson SAC technical assistance. The first was written by Gaby Cisneros and documents a complete procedure for specification, solicitation, procurement, operations of PV systems by the various departments of the City. The second, written by Andrew Rosenthal, documents a hardware and software solution to integrating real-time PV data into the existing City of Tucson Building Energy Management and Control System.
    - Solar America Cities Santa Rosa: SWTDI is the Tiger Team lead for Santa Rosa. In the reporting period, staff of SWTDI travelled to Santa Rosa to perform a variety of services in support of the TT MOA:
        - TT continues to consult with SR city employees on their professional service agreement with Fat Spaniel (data monitoring).
        - TT traveled to Santa Rosa and Sonoma County to perform ten site assessments on businesses, wineries, private residences, etc. The resulting site assessment reports are

being submitted sequentially to Solar Sonoma County for distribution.

- Solar America Showcase Forest City LLC: SWTDI provided technical support for the procurement specification of a stand-alone weather station for monitoring direct and diffuse irradiance on the Big Island of Hawaii. This monitoring is necessary prior to the specification of a concentrating solar power system with storage for the location.
- Within the reporting period, SWTDI staff participated in several rounds of design review and specification development for PV system deployment by GSA at the Emmett Bean Center in Indianapolis, IN.
- SWTDI has done approximately ten other design reviews for government agencies including the GSA and the National Park Service for the system upgrade at Natural Bridges National Park in Utah.

Task 2: New Integrated PV Systems – Design and Test

A. U.S. PV Industry

- SWTDI operated a 2 kW system built by Solaria (Berkeley, CA) testing this new, low concentration, PV technology. The first quarterly report of results was prepared and presented to Solaria.

Task 3: Update Codes and Standards

A. Development of Codes and Standards

- SWTDI engineers worked with Ward Bower and Bill Brooks to prepare for their GFCI specifications for PV design and review with UL.

B. Training

- SWTDI engineers trained over 300 designers, inspectors and installers in NEC workshops during the three month reporting period (see travel summary table)

Task 4: Independent Assessment of Long-term Inverter Reliability

A. Inverter Long Term Test Facility

- Six ILTF monitoring systems continue operation on-line and collecting data, real-time displays of performance on the web (www.nmsu.edu/~tdi/iltf).
- All inverters are in service and recording data during this reporting period.

Status Q2 2010:

Task 1: PV Systems Assistance Center

A. Board of Advisors

- Activity complete, no activity recorded in the current reporting period.

B. Policy, Standards, and Procurement Support

- SWTDI staff regularly provides support to private industry on a proprietary basis with assistance for short duration, high value technical issues. In the current reporting period, services of this kind include:
  consultation with electrical inspectors: questions were answered for more than 100 emails from electrical inspectors, nationwide. .
  consultation with major installers: approximately 180 inquiries were answered regarding specific interpretations of the National Electrical Code during design or installation of PV systems around the country In addition, system design reviews were conducted on 10 PV system installation schematic packages.
  proprietary engineering assistance and support: In the reporting period, SWTDI provided engineering support to industry on a request basis. The list of service recipients includes SMA Americas with concerns regarding the Sunny Central, Sunny Island and transformerless inverters.
- SWRES continued to Beta test and take data on the new PV-assisted heat pump at its main offices. The heat pump is developed bye Lennox Corp is operating with ongoing data collection for the electrical load and PV contribution. Reports were sent to Lenox during the reporting period.

VV. Workforce Development

- SWTDI engineers attended the kickoff meeting of the 2011 Solar Decathlon in Washington, DC. Meetings and orientation were conducted with all teams present.

WW. Technical Support and Design Reviews

- SWTDI staff reviewed designs for over 250 PV systems and components during the reporting period by working directly with several PV systems for Solar America Cities participants.
- SWTDI provided technical support to John O'Connell, Environmental Health Department, City of Albuquerque with issues brought by the city utility engineer. The City engineer would not allow the Environmental Health Dept. install a 400 kW PV system in Albuquerque unless backfeeding was prevented. SWTDI discussed the use of reverse power relays for this purpose and the project went forward.
- SWTDI provided technical support and bid reviews to the National Park Service Natural Bridges National Monument for the modification and repair of their on-site PV system. This entailed review of drawings, simulation of PV/battery performance, and discussions with vendors over specific technical aspects of the various proposals.

XX. Field Test, Instrumentation, Data Monitoring

- The latest data for the SWTDI 18 kW PV parking structure installed on the campus of NMSU are updated. The web page can be found at http://www.nmsu.edu/~tdi/parking/.
- SWTDI finalized an SOW for Test and Evaluation activities to support Sandia National Laboratories and a contract was awrded. These tasks, under the Test and Evaluation category, now include work in reliability assessment, accelerated life testing, technical outreach to GSA, design and operation of the SLTE DASs and systems, and field data collection systems for operation at a new, 17 MW PV plant under construction in Alamosa, CO.
- SWTDI led the first DOE Tiger Team effort (Smithsonian National Zoo) in the Spring 2007 and now leads or participates in three DOE Tiger Team efforts:

- Solar America Cities Tucson: SWTDI prepared the closeout documentation for the original SAC award to Tucson and submitted this to the Golden Field Office and NREL. SWTDI also supported Tucson with task definition and budget determination for the Technical Assistance needed to support the new Tucson Special Project Award (now funded).
- Solar America Cities Santa Rosa: SWTDI is the Tiger Team lead for Santa Rosa. In the reporting period, staff of SWTDI reviewed 6 proposals for installation of 1 MW PV systems at the Manzana Processing Plant in Sebastopol, CA. This technical support was requested by Solar Sonoma County. SWTDI also provided Santa Rosa with the task definition and budgets for Technical Assistance in support of Santa Rosa's Special Project award (now funded). Lastly, SWTDI specified a monitoring system from Fat Spaniel to be installed in Sonoma County as one of the deliverables in the original SAC TA SOW for Santa Rosa.
- Solar America Showcase Forest City LLC: SWTDI provided final technical support for the bid reviews of a stand-alone weather station for monitoring direct and diffuse irradiance on the Big Island of Hawaii. This monitoring is necessary prior to the specification of a concentrating solar power system with storage for the location.
- Solar America City San Antonio: SWTDI reviewed the technical report prepared by Sandia on operational difficulties of a large PV system at the Pearl Brewery in San Antonio. The review included recommendations for further data collection and will be followed in the next quarter with a visit to the site by SWTDI engineers to take on-site measurements of voltage and current transients.
- Solar America City San Diego: SWTDI supported San Diego with task definition and budget determination for the Technical Assistance needed to support the new San Diego Special Project Award (now funded). In the coming quarter, SWTDI and NREL will begin technical support for San Diego's Special Project activities.
- Within the reporting period, SWTDI staff participated in further rounds of design review and specification development for PV system deployment by GSA at the Emmett Bean Center in Indianapolis, IN.

Task 2: New Integrated PV Systems – Design and Test

A. U.S. PV Industry

- SWTDI installed two 5 kW PV systems under contract to Solaria (Berkeley, CA) testing this new, low concentration, PV technology. Both systems are installed on one-axis trackers from Array Technologies, Albuquerque, NM.

Task 3: Update Codes and Standards

A. Development of Codes and Standards

- SWTDI engineers worked with Ward Bower and Bill Brooks to prepare for their GFCI specifications for PV design and review with UL.

B. Training

- SWTDI engineers trained over 272 designers, inspectors and installers in NEC workshops during the three month reporting period (see travel summary table)

Task 4: Independent Assessment of Long-term Inverter Reliability

A. Inverter Long Term Test Facility

- Six ILTF monitoring systems continue operation on-line and collecting data, real-time displays of performance on the web (www.nmsu.edu/~tdi/iltf).
- All inverters are in service and recording data during this reporting period.

Status Q3 2010:

Task 1: PV Systems Assistance Center

A. Board of Advisors

- Activity complete, no activity recorded in the current reporting period.

B. Policy, Standards, and Procurement Support

- SWTDI staff regularly provides support to private industry on a proprietary basis with assistance for short duration, high value technical issues. In the current reporting period, services of this kind include:
  consultation with electrical inspectors: questions were answered for more than 80 emails from electrical inspectors, nationwide. .
  consultation with major installers: approximately 300 inquiries were answered regarding specific interpretations of the National Electrical Code during design or installation of PV systems around the country In addition, system design reviews were conducted on over 12 PV system installation schematic packages.
  proprietary engineering assistance and support: In the reporting period, SWTDI provided engineering support to industry on a request basis. The list of service recipients includes SolarEdge, with whom, SWTDI have begun developing a White Paper on proper installation practices.
- During reporting period, SWTDI also responded to approximately 25 emails and 15 telephone inquiries for technical support from PV equipment manufacturers (not requiring confidentiality).

YY. Workforce Development

- SWTDI engineers continued review of 2011 Solar Decathlon rules and requirements. At NREL's request, negotiations have begun with Colorado Code Consultants, subcontractor to NREL, for Decathlon support from John Wiles to continue until end of Decathlon.
- SWTDI engineers participated in the NABCEP Exam Committee meeting in July 2010.

ZZ. Technical Support and Design Reviews

- SWTDI staff reviewed designs for dozens of PV systems and components during the reporting period including two for National Park Service: new PV system design for the Maze (Utah) and new PV power system for waste water treatment facility at Grand Teton Park (Wyoming).
- SWTDI provided technical support to Sierra County, NM with hearings and review of materials for implementing renewable energy plants.

- SWTDI provided technical support to DOE/Carlsbad WIPP Energy Park development. This entailed review of drawings, simulation of PV/battery performance, and determination of a suitable portfolio of solar technologies to power WIPP.

AAA. Field Test, Instrumentation, Data Monitoring

- The latest data for the SWTDI 18 kW PV parking structure installed on the campus of NMSU are updated. The web page can be found at http://www.nmsu.edu/~tdi/parking/.
- In preparation for transition of SWTDI Test and Evaluation activities support to Sandia National Laboratories contract work in reliability assessment, accelerated life testing, technical outreach to GSA, design and operation of the SLTE DASs and systems, and field data collection systems for operation at a new, 17 MW PV plant under construction in Alamosa, CO were all supported. Individual activities included sending performance data to Sandia, meetings at Alamos, CO for wireless data monitoring project, continued support for GSA Emmett Bean Center DAS and communication specifications, and meeting with University of Vermont staff in preparation of deployment of Sandia SLTE PV arrays in Burlington.
- SWTDI led the first DOE Tiger Team effort (Smithsonian National Zoo) in the Spring 2007 and now leads or participates in three DOE Tiger Team efforts:
    - Solar America Cities Tucson: SWTDI prepared the closeout documentation for the original SAC award to Tucson and submitted this to the Golden Field Office and NREL. SWTDI was designated to lead technical support the new Tucson Special Project Award. In the reporting period, SWTDI drafted and revised several times a request for proposal to CH2MHill for support of the Tucson Special Project. SWTDI has also begun working to deliver a one-day training workshop on commissioning PV and industrial solar thermal systems.
    - Solar America Cities Santa Rosa: SWTDI is the Tiger Team lead for Santa Rosa. In the reporting period, staff of SWTDI reviewed 3 proposals for installation of two PV systems at Sea Ranch community (Sonoma County, CA). This technical support was requested by Solar Sonoma County. SWTDI also provided Santa Rosa with the task definition and budgets for Technical Assistance in support of Santa Rosa's Special Project award and accepted the technical lead for executing the Special Project in Santa Rosa.
    - Solar America Showcase Forest City LLC: SWTDI provided additional technical support with data from the weather station for monitoring direct and diffuse irradiance on the Big Island of Hawaii. This monitoring is necessary prior to the specification of a concentrating solar power system with storage for the location.
    - Solar America City San Diego: SWTDI supported San Diego with task definition and budget determination for the Technical Assistance needed to support the new San Diego Special Project Award (now funded). SWTDI and NREL have begun review of technical designs and specifications for San Diego's Special Project activities (assisted with simulations from Peter Lillienthal).
    - Within the reporting period, SWTDI staff participated in further rounds of review and specification development for PV system

deployment by GSA at the Emmett Bean Center in Indianapolis, IN. Particular emphasis was on issues related to metering and communication of metering data.

Task 2: New Integrated PV Systems – Design and Test

A. U.S. PV Industry

- The two SWTDI-installed 5 kW PV systems built for Solaria (Berkeley, CA) are operating and data are being collected. Both systems are installed on one-axis trackers from Array Technologies, Albuquerque, NM. These trackers required special technical support to operate properly.

Task 3: Update Codes and Standards

A. Development of Codes and Standards

- SWTDI engineers began reviewing all submissions and documentation for the upcoming UL 1703 Standards Technical Panel Meeting. This meeting represents the first time in over 5 years the UL 1703 STP will have met and there are large number of topics, issues, and concerns.

B. Training

- SWTDI engineers trained over 200 designers, inspectors and installers in NEC workshops during the three month reporting period (see travel summary table)

Task 4: Independent Assessment of Long-term Inverter Reliability

A. Inverter Long Term Test Facility

- The ILTF monitoring systems continue operation on-line and collecting data, real-time displays of performance on the web (www.nmsu.edu/~tdi/iltf).
- All inverters are in service and recording data during this reporting period. A final report of performance trends and operational experience is due Nov. 30, 2010.