U.S. Department of Energy

Programs in Utility Technologies

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PHOTOVOLTAIC ENERGY CONTRACT LIST FISCAL YEAR 1990

Contents

Introduction

The federal government has conducted the National Photovoltaics Program since 1975. Its purpose is to provide focus, direction, and funding for the development of terrestrial photovoltaic technology as an energy option for the United States.

In the past, a summary was prepared each year to provide an overview of the government-funded activities within the National Photovoltaics Program. Tasks conducted in-house by participating national laboratories or under contract by industrial, academic, and other research institutes were highlighted.

This year's document is more concise than the summaries of previous years. The FY 1990 contract overview comprises a list of all subcontracts begun, ongoing, or completed during FY 1990 (October 1, 1989, through September 30, 1990). Under each managing laboratory, projects are listed alphabetically by project area and then by subcontractor name.

For additional information on the National Photovoltaics Program, the reader is encouraged to consult the *Photovoltaic Energy Program Overview, Fiscal Year 1990* (DOE/CH10093-93); *Photovoltaic Energy Program Summary, Volume II: Research Summaries, Fiscal Year 1989* (DOE/CH10093-59); and *The National Photovoltaics Program Five Year Research Plan 1987–1991, Photovoltaics: USA's Energy Opportunity* (DOE/CH10093-7). The *Five Year Research Plan 1987–1991* gives an excellent overview of the program's history, framework, technical and management plans, and goals. Copies of these documents and this contract list may be obtained by writing the Solar Energy Research Institute, Technical Inquiry Service, 1617 Cole Boulevard, Golden, Colorado 80401-3393.

Organizational Relationships

The National Photovoltaics Program is conducted by the U.S. Department of Energy (DOE) and is assigned to the Assistant Secretary for Conservation and Renewable Energy. Day-to-day research activities are managed by Sandia National Laboratories (SNLA) in Albuquerque, New Mexico, and the Solar Energy Research Institute (SERI) in Golden, Colorado.

FY 1990 Contract List

Sandia National Laboratories

Sandia National Laboratories

Contract No. Contract Period Title	Contractor (Principal Investigator) Sandia Contact	Funding $ (Source)	Selected FY 1991 Milestones (Sandia contact has more information)
Cell Research and Development Project			
55-0702A 08/01/88–12/31/91 One-Sun Crystalline Solar Cell Research	Arizona State University (D.K. Schroder) Tempe, AZ 85287 J.M. Gee	**Total Funding** $380,257 (DOE) **FY 90 Funding** $124,846 (DOE)	Submit the draft final report (September 1991).
69-2081 07/16/90–06/30/91 Polycrystalline Silicon-Film Solar Cells	AstroPower, Inc. (R.B. Hall) 30 Lovett Avenue Newark, DE 19711 P.A. Basore	**Total Funding** $800,000 (DOE) **FY 90 Funding** $200,000 (DOE)	Deliver 11 test structures and one solar cell with efficiency > 10% (April 1991). Submit internal and external final reports (May 1991).
05-7828B 04/01/89–07/15/90 Polycrystalline Silicon-Film Solar Cells	Astrosystems, Inc. (R.B. Hall) 30 Lovett Avenue Newark, DE 19711 P.A. Basore	**Total Funding** $1,777,804 (DOE) **FY 90 Funding** $700,000 (DOE)	None. Contract completed.
54-1113 07/07/89–11/30/89 22X Solar Cell Procurement	Astrosystems, Inc. (J. Culik) 30 Lovett Avenue Newark, DE 19711 P.A. Basore	**Total Funding** $1,500 (DOE) **FY 90 Funding** -0-	None. Contract completed.
55-0702B 09/01/88–12/31/91 Mechanical Deformation of One-Sun Crystalline Silicon	Cornell University (D.G. Ast) Bard Hall Ithaca, NY 14853 J.M. Gee	**Total Funding** $371,654 (DOE) **FY 90 Funding** $128,151 (DOE)	Submit the draft final report (September 1991).
42-3377 05/15/89–08/15/90 Research on High-Efficiency Silicon Cells	Georgia Institute of Technology School of Electrical Engineering (A. Rohatgi) Atlanta, GA 30332 J.M. Gee	**Total Funding** $90,000 (DOE) **FY 90 Funding** -0-	None. Contract completed.

Contract No. Contract Period Title	Contractor (Principal Investigator) Sandia Contact	Funding $ (Source)	Selected FY 1991 Milestones (Sandia contact has more information)
78-2488 08/15/90–07/30/91 Investigation of High-Efficiency Silicon Solar Cells	Georgia Institute of Technology School of Electrical Engineering (A. Rohatgi) Atlanta, GA 30332 J.M. Gee	**Total Funding** $160,000 (DOE) **FY 90 Funding** $160,000 (DOE)	Submit the final report (June 1991).
66-3692 11/13/89–02/13/90 Recombination Parameter Measurements and Numerical Modeling of High-Efficiency Solar Cells	Purdue University School of Electrical Engineering (R.J. Schwartz) West Lafayette, IN 47907 J.M. Gee	**Total Funding** $60,000 (DOE) **FY 90 Funding** $60,000 (DOE)	None. Contract completed.
66-2878 07/24/89–07/23/90 One-Sun Single Crystalline Silicon Solar Cell Research	Stanford University (R.M. Swanson) Stanford, CA 94305 J.D. McBrayer	**Total Funding** $100,000 (DOE) **FY 90 Funding** -0-	None. Contract completed.
75-6318 02/03/89–06/30/90 High-Efficiency Concentrator Silicon Solar Cells	Stanford University (R.M. Swanson) Stanford, CA 94305 P.A. Basore	**Total Funding** $458,000 (DOE) **FY 90 Funding** $142,100 (DOE)	None. Contract completed.
75-7782 01/01/89–03/31/90 AlGaAs/GaAs Superlattice Alloys as Solar Cell Window Layers	University of Michigan Department of Electrical Engineering and Computer Science (T. Drummond) Ann Arbor, MI 48109 J.M. Gee	**Total Funding** $36,583 (DOE) **FY 90 Funding** -0-	None. Contract completed.

Sandia National Laboratories

Contract No. Contract Period Title	Contractor (Principal Investigator) Sandia Contact	Funding $ (Source)	Selected FY 1991 Milestones (Sandia contact has more information)
40-6845 12/01/88–08/01/90 Concentrator Silicon Cell Research	University of New South Wales (M.A. Green) Kensington, NSW 2033 Australia D.L. King	**Total Funding** $149,600 (DOE) **FY 90 Funding** $74,600 (DOE)	None. Contract completed.
66-5863 03/01/90–10/31/91 One-Sun Silicon Solar Cell Research	University of New South Wales (M.A. Green) Kensington, NSW 2033 Australia P.A. Basore	**Total Funding** $319,300 (DOE) **FY 90 Funding** $150,000 (DOE)	Submit the final report (September 1991).
75-0282 09/27/88–04/30/90 One-Sun Silicon Solar Cell Research	University of New South Wales (M.A. Green) Kensington, NSW 2033 Australia D.L. King	**Total Funding** $299,000 (DOE) **FY 90 Funding** $59,000 (DOE)	None. Contract completed.
69-5269 06/01/90–05/31/91 Full-Width Dendritic Web Crystal Seeding	Westinghouse Electric Corporation Advanced Energy Systems Division (C.M. Rose) P.O. Box 10864 Pittsburgh, PA 15236 P.A. Basore	**Total Funding** $300,800 (DOE) **FY 90 Funding** $150,000 (DOE)	Submit the final report (May 1991).
Crystalline Cell Research			
N/A 10/01/89–10/01/90 Concentrator Cell Research	Sandia National Laboratories (P.A. Basore) Albuquerque, NM 87185 D.E. Hasti	**FY 90 Funding** $552,000 (DOE)	Enhance collaborative research efforts with concentrator industry through silicon process research capabilities in Sandia's Photovoltaic Device Fabrication Laboratory (PDFL). Conduct in-house silicon process research in the PDFL (ongoing). Continue silicon concentrator cell research efforts (ongoing).

Contract No. Contract Period Title	Contractor (Principal Investigator) Sandia Contact	Funding $ (Source)	Selected FY 1991 Milestones (Sandia contact has more information)
N/A 10/01/89–10/01/90 One-Sun Silicon Research	Sandia National Laboratories (P.A. Basore) Albuquerque, NM 87185 D.E. Hasti	**FY 90 Funding** $444,000 (DOE)	Continue silicon-on-ceramic technology development effort through collaborative contract with AstroPower; goal is 10% large area cell (ongoing). Enhance collaborative research efforts with one-sun industry through silicon process research capabilities in Sandia's Photovoltaic Device Fabrication Laboratory (PDFL). Develop in-house capability associated with the PDFL for laser scribing, patterning, and processing of one-sun silicon cells (ongoing). Continue silicon cell research efforts (ongoing).
Module Evaluation and Development Project			
05-4239A 07/89–06/90 PV Concentrator Module Development	Alpha Solarco, Inc. (E. Schmidt) 11534 Gondola Drive Cincinnati, OH 45241 A.B. Maish	**Total Funding** $85,000 (DOE) $90,000 (Alpha Solarco) **FY 90 Funding** -0-	None. Contract completed.
40-8941D 10/90–10/94 PV Concentrator Module Development	Alpha Solarco, Inc. (E. Schmidt) 11534 Gondola Drive Cincinnati, OH 45241 A.B. Maish	**Total Funding** $1,237,668 (DOE) $1,142,463 (Alpha Solarco) **FY 90 Funding** $200,000 (DOE) $96,700 (Alpha Solarco)	Deliver prototype cell assemblies (June 1991). Draft quality assurance plan (July 1991).
23-0789 08/05/87–03/31/91 Injection Molded Lens Parquet	American Optical Corporation (C. Grendol) 14 Mechanic Street Southbridge, MA 01550 C.B. Stillwell	**Total Funding** $331,308 (DOE) **FY 90 Funding** $21,655 (DOE)	Deliver injection mold single lens (March 1991). Deliver lens parquet (June 1991). Prepare the final report (September 1991).
54-2191B 10/90–10/93 PV Concentrator Cell Development	Applied Solar Energy Corporation (S. Khemthong) 15251 East Don Julian Road City of Industry, CA 91746 D.S. Ruby	**Total Funding** $1,026,665 (DOE) $342,222 (Applied Solar Energy Corporation) **FY 90 Funding** $170,000 (DOE) $56,000 (Applied Solar Energy Corporation)	Establish University of New South Wales' passivated emitter solar cell process using production equipment (October 1990). Analyze cost, performance, and yield trade-offs (September 1991).

Sandia National Laboratories

Contract No. Contract Period Title	Contractor (Principal Investigator) Sandia Contact	Funding $ (Source)	Selected FY 1991 Milestones (Sandia contact has more information)
56-7211 08/11/86–02/28/91 PV Concentrator Module Development	Black & Veatch (K. Kerschen) P.O. Box 8405 Kansas City, MO 64114 C.B. Stillwell	**Total Funding** $425,021 (DOE) $63,000 (Black & Veatch) **FY 90 Funding** -0-	Complete module evaluation (February 1991). Prepare the final test report (March 1991).
32-9298 01/01/86–01/01/91 Environmental Exposure of Acrylic Lens Material	DSET Laboratories, Inc. (N. Walp) Box 1850 Black Canyon Stage 1 Phoenix, AZ 85027 T.D. Hund	**Total Funding** $20,000 (DOE) **FY 90 Funding** $603 (DOE)	Provide services on outdoor exposure on acrylic lens material as needed by Sandia (ongoing).
75-3058 07/01/89–06/30/94 Support Services	EG&G Special Projects (K.D. McAllister) 2450 Alamo SE Albuquerque, NM 87119 D.L. King	**Total Funding** $2,500,000 (DOE) **FY 90 Funding** $400,000 (DOE)	Provide technical support for Sandia photovoltaic projects (ongoing).
40-8941A 10/09/90–08/31/92 PV Concentrator Module Development	ENTECH, Inc. (M.J. O'Neill) 1015 Royal Lane DFW Airport, TX 75261 T.D. Hund	**Total Funding** $890,608 (DOE) $70,324 (ENTECH) **FY 90 Funding** $150,000 (DOE) $7,895 (ENTECH)	Provide quality assurance/quality control plan (January 1991).
27-0597 08/07/90–08/31/91 Reliability Research on Photovoltaic Concentrator Modules	Jet Propulsion Laboratory California Institute of Technology (R.S. Sugimura) 4800 Oak Grove Drive Pasadena, CA 91109 M.L. Whipple	**Total Funding** $60,000 (DOE) **FY 90 Funding** $40,000 (DOE)	Establish a procedure for a wet-insulation resistance test for concentrator modules (December 1990). Establish a procedure for a nonintrusive hot-spot test for concentrator modules (March 1991).
42-4458 04/11/89–11/30/90 Reliability Research on Photovoltaic Concentrator Modules	Jet Propulsion Laboratory California Institute of Technology (R.S. Sugimura) 4800 Oak Grove Drive Pasadena, CA 91109 E.H. Richards	**Total Funding** $40,000 (DOE) **FY 90 Funding** -0-	Determine applicability of electrophoretic coatings for electrical isolation of concentrator modules (April 1991).

Contract No. Contract Period Title	Contractor (Principal Investigator) Sandia Contact	Funding $ (Source)	Selected FY 1991 Milestones (Sandia contact has more information)
63-6078 06/14/88–12/31/89 Technical Consulting Services for Qualification Testing and Reliability Modeling	Jet Propulsion Laboratory California Institute of Technology (R.S. Sugimura) 4800 Oak Grove Drive Pasadena, CA 91109 E.H. Richards	**Total Funding** $40,000 (DOE) **FY 90 Funding** -0-	None. Contract completed.
63-5668 05/02/88–08/31/91 Thick Caliper Lens Parquet	3M Company Federal Systems Department (A. Zderad) Building 224-25-25 St. Paul, MN 55144 C.B. Stillwell	**Total Funding** $103,149 (DOE) **FY 90 Funding** -0-	Deliver the final report (August 1991).
05-4239E 08/11/89–10/31/90 PV Concentrator Module Development	Science Applications International Corporation (K. Beninga) 10260 Campus Point Drive San Diego, CA 92121 C. B. Stillwell	**Total Funding** $147,944 (DOE) $63,000 (SAIC) **FY 90 Funding** -0-	Complete the final report (April 1991).
40-8941B 10/90–10/93 PV Concentrator Module Development	Solar Kinetics, Inc. (S. Saifee) 10635 King William Drive Dallas, TX 75220 M.L. Whipple	**Total Funding** $1,746,044 (DOE) $315,580 (Solar Kinetics, Inc.) **FY 90 Funding** $200,000 (DOE) $15,000 (Solar Kinetics, Inc.)	Demonstrate two cell assembly designs that pass qualification tests (January 1991 and July 1991). Demonstrate a module design that passes qualification tests (August 1991).
40-8941C 09/26/90–12/31/91 PV Concentrator Module Development	Solar Engineering Applications Corporation (N. Kaminar) 2010 Fortune Drive, #102 San Jose, CA 95131 C.B. Stillwell	**Total Funding** $387,374 (DOE) $96,844 (Solar Engineering Applications Corporation) **FY 90 Funding** $170,000 (DOE) $42,500 (Solar Engineering Applications Corporation)	Deliver receiver sections and modules for evaluation (April 1991 and July 1991).

Sandia National Laboratories

Contract No. Contract Period Title	Contractor (Principal Investigator) Sandia Contact	Funding $ (Source)	Selected FY 1991 Milestones (Sandia contact has more information)
05-4239C 07/08/89–03/01/91 PV Concentrator Module Development	Solar Engineering Applications Corporation (N. Kaminar) 2010 Fortune Drive, #102 San Jose, CA 95131 C.B. Stillwell	**Total Funding** $162,000 (DOE) **FY 90 Funding** -0-	Work on module development including extruded lens and receiver sections (December 1990).
05-4239D 08/08/89–04/30/91 PV Concentrator Module Development	Solar Kinetics, Inc. (S. Saifee) P.O. Box 540636 Dallas, TX 75354 C.B. Stillwell	**Total Funding** $199,727 (DOE) **FY 90 Funding** -0-	Work on cell-to-heat spreader solder bond (January 1991). Prepare final report (April 1991).
54-2191A 09/26/90–08/31/92 PV Concentrator Cell Development	Spectrolab, Inc. (G. Crotty) 12500 Gladstone Avenue Sylmar, CA 91342 D.S. Ruby	**Total Funding** $258,364 (DOE) $86,122 (Spectrolab, Inc.) **FY 90 Funding** $60,000 (DOE) $20,000 (Spectrolab, Inc.)	Deliver 200 concentrator cells using simplified process (June 1991). Review cell design (July 1991). Deliver 500 concentrator cells incorporating design changes (September 1991).
27-9394 02/91–01/92 Quality Assurance/ Quality Control Plan Support	Texas Southern University Office of Sponsored Programs (V. Murty) 3100 Cleburn Houston, TX 77004 A.B. Maish	**Total Funding** $27,224 (DOE) **FY 90 Funding** $27,224 (DOE)	Meet with companies participating in the Concentrator Initiative program to assess their quality assurance/quality control programs (ongoing). Provide support to these companies' quality assurance/ quality control program development efforts (ongoing).
54-6448 02/90–03/91 Generic Quality Assurance/Quality Control Plan	Texas Southern University Office of Sponsored Programs (V. Murty) 3100 Cleburn Houston, TX 77004 A.B. Maish	**Total Funding** $24,550 (DOE) **FY 90 Funding** $24,550 (DOE)	Produce a generic quality assurance/ quality control plan that can be adapted to meet the needs of any organization involved in the design and/or production of photovoltaic concentrating modules, arrays, or systems (March 1991).

Contract No. Contract Period Title	Contractor (Principal Investigator) Sandia Contact	Funding $ (Source)	Selected FY 1991 Milestones (Sandia contact has more information)
05-4239F 09/18/89–04/30/91 Optimization of the Wattsun Short Focal Length Concentration PV Module	Wattsun Corporation (J. Doherty) P.O. Box 751 Albuquerque, NM 87103 T. Hund	**Total Funding** $84,064 (DOE) $155,336 (Wattsun) **FY 90 Funding** $84,064 (DOE) $155,336 (Wattsun)	Prepare the final report (April 1991).
Photovoltaic Technology			
N/A 10/01/89–10/01/90 Concentrator Collector Research	Sandia National Laboratories (D.L. King) Albuquerque, NM D.E. Hasti	**FY 90 Funding** $933,000 (DOE)	Implement, coordinate, and technically collaborate with contractors associated with the Sandia/DOE Photovoltaic Concentrator Initiative (ongoing). Support the U.S. photovoltaic industry by providing detailed and accurate device measurement through the Sandia Photovoltaic Device Measurement Laboratory (ongoing). Support the concentrator photovoltaic industry by providing extensive component and module design assistance, analysis, and qualification testing services through Sandia's Photovoltaic Technology Evaluation Laboratory (ongoing).
System Evaluation and Development Project			
69-3963 10/21/90–06/30/91 Experimental Lighting System Installation	B&D Electric (G. Grabiel) 9720 Bell SE Albuquerque, NM 87123 J. Stevens	**Total Funding** $23,000 (DOE) **FY 90 Funding** $20,000 (DOE)	Install lighting systems (June 1991).
66-8647 03/01/90–09/01/91 Utility-Owned Photovoltaic Water Pumping System	K. C. Electric Association (J. Zabukover) P.O. Box 8 Hugo, CO 80821 J. Stevens	**Total Funding** $10,000 (DOE) **FY 90 Funding** $7,000 (DOE)	Prepare the final report (September 1991).

Sandia National Laboratories

Contract No. Contract Period Title	Contractor (Principal Investigator) Sandia Contact	Funding $ (Source)	Selected FY 1991 Milestones (Sandia contact has more information)
40-5372 04/10/89–10/31/91 Prototype Development of Small Farm PV Power Systems	University of Alabama, Huntsville Alabama Solar Energy Center (L. Adcock) Huntsville, AL 35899 J. Stevens	**Total Funding** $9,627 (DOE) **FY 90 Funding** $6,032 (DOE)	Prepare the final report (September 1991).
Systems Research/Systems Development			
N/A 10/89–10/90 Design Assistance Center	Sandia National Laboratories (R.C. Pate) Albuquerque, NM 87185 R.C. Pate	**FY 90 Funding** $716,000 (DOE)	Conduct SOLTECH '91 conference in San Francisco, CA (March 1991). Publish and distribute *Photovoltaics for Utilities* (February 1991).
N/A 10/89–10/90 Systems Evaluation	Sandia National Laboratories (M.G. Thomas) Albuquerque, NM 87185 M.G. Thomas	**FY 90 Funding** $404,000 (DOE)	Develop stand-alone power processing manual (August 1991). Field high-value utility applications (September 1991).

FY 1990 Contract List

Solar Energy Research Institute

Contract No. Contract Period Title	Contractor (Principal Investigator) SERI Contact	Funding $ (Source)	Selected FY 1991 Milestones (SERI contact has more information)
		Amorphous Silicon	
06003-3 07/01/87–01/31/91 Research on Stable High-Efficiency, Large-Area, Amorphous Silicon-Based Submodules	ARCO Solar, Inc. (K. Mitchell) 4650 Adhor Lane Camarillo, CA 93010 W. Luft	**Total Funding** $2,622,813 (DOE) $2,993 489 (ARCO Solar) **FY 90 Funding** -0-	None.
6003-1 03/16/87–12/15/90 Research on Stable, High-Efficiency, Large-Area, Amorphous Silicon-Based Submodules	Chronar Corporation (A.E. Delahoy) P.O. Box 177 Princeton, NJ 08542 W. Luft	**Total Funding** $4,193,018 (DOE) $4,449,726 (Chronar) **FY 90 Funding** -0-	Demonstrate an amorphous silicon p-i-n/p-i-n tandem-junction submodule having an area ≥ 900 cm^2 and having an aperture area efficiency ≥ 9% and demonstrate a degradation of an initial efficiency of ≥ 8% (October 1990).
19033-3 08/01/90–09/30/93 Research on Stable, High-Efficiency Amorphous Silicon Multijunction Modules	Glasstech Solar, Inc. (P. Bhat) 6800 Joyce Street Golden, CO 80403 W. Luft	**Total Funding** $575,000 (DOE) $575,000 (Glasstech Solar) **FY 90 Funding** $575,000 (DOE) $575,000 (Glasstech Solar)	Produce 1-cm^2 amorphous silicon cell with ≥ 7.8% stable efficiency and ≥ 900 cm^2 module with stable efficiency ≥ 6.5% after 600 h at one-sun illumination (August 1991).
18131-1 07/01/88–02/28/91 Structural and Electronic Studies of a-SiGe:H Alloys	Harvard University (W. Paul) Cambridge, MA 02138 B. Stafford	**Total Funding** $374,500 (DOE) **FY 90 Funding** $145,000 (DOE)	Complete the final technical report (February 1991).
19121-1 10/01/89—06/30/91 Optimization of Transparent and Reflecting Films for Amorphous Silicon Solar Cells	Harvard University Department of Chemistry (G. Gordon) 12 Oxford Street Cambridge, MA 02138 W. Luft	**Total Funding** $200,098 (DOE) **FY 90 Funding** $70,098 (DOE)	Complete the final technical report (July 1991).

Contract No. Contract Period Title	Contractor (Principal Investigator) SERI Contact	Funding $ (Source)	Selected FY 1991 Milestones (SERI contact has more information)
11002-1 03/15/91–05/15/94 Amorphous Silicon Deposition Research with *In Situ* Diagnostics	Jet Propulsion Laboratory (Y.H. Shing) California Institute of Technology Pasadena, CA 91109 W. Luft	**Total Funding** $325,000 (DOE) **FY 90 Funding** $325,000 (DOE)	Fabricate p-i-n solar cells using electron-cyclotron-resonance-deposited a-Si:H showing a 50% improvement in stability compared with cells with films deposited by radio frequency glow discharge (September 1991).
4078-1 02/15/80–01/31/91 Diagnostics of Glow Discharge Used to Produce Amorphous Silicon Films	National Institute for Standards and Technology (A.C. Gallagher) Quantum Physics Division Boulder, CO 80303 W. Luft	**Total Funding** $651,676 (DOE) **FY 90 Funding** $20,000 (DOE)	Complete the final technical report (March 1991).
19033-1 05/01/90–06/30/93 Research on Stable, High-Efficiency, Amorphous Silicon Multijunction Modules	Solarex Corporation Thin Film Division (A. Catalano) 826 Newtown-Yardley Road Newtown, PA 18940 W. Luft	**Total Funding** $999,786 (DOE) $999,786 (Solarex) **FY 90 Funding** $999,786 (DOE) $999,786 (Solarex)	Demonstrate multijunction amorphous silicon module with stabilized efficiency of ≥ 8.8% (May 1991).
18092-1 05/01/88–03/31/91 Research on Efficient, Stable, Low-Cost, Amorphous Silicon-Based Thin Film Solar Cells	University of Delaware Institute of Energy Conversion (B. Baron) Newark, DE 19716 B. Stafford	**Total Funding** $1,099,982 (DOE) **FY 90 Funding** $379,981 (DOE)	Complete the final technical report (March 1991).
7183-1 10/01/87–03/15/91 Studies on Relative Effects of Charged and Neutral Defects in Hydrogenated Amorphous Silicon	University of North Carolina (M. Silver) Chapel Hill, NC 27514 B. Stafford	**Total Funding** $116,909 (DOE) **FY 90 Funding** $10,000 (DOE)	Complete the final technical report (March 1991).

Solar Energy Research Institute

Contract No. Contract Period Title	Contractor (Principal Investigator) SERI Contact	Funding $ (Source)	Selected FY 1991 Milestones (SERI contact has more information)
18061-1 04/01/88–03/31/91 Investigations of the Origins of Metastable Light-Induced Changes in Hydrogenated Amorphous Silicon	University of Oregon (J.D. Cohen) Eugene, OR 97403 B. Stafford	**Total Funding** $193,913 (DOE) **FY 90 Funding** $75,000 (DOE)	Complete the final technical report (March 1991).
6055-1 01/15/87–03/31/91 The Structure of Amorphous Silicon Alloy Films	Washington University Department of Physics (R.E. Norberg, P.A. Fedders) St. Louis, MO 63130 W. Luft	**Total Funding** $224,874 (DOE) **FY 90 Funding** $60,000 (DOE)	Complete the final technical report (June 1991).
6056-1 11/01/86–01/31/91 Research on the Electronic and Structural Properties of Amorphous Silicon Alloys	Xerox Corporation (R. Street) Palo Alto Research Center 3333 Coyote Hill Road Palo Alto, CA 94304 B. Stafford	**Total Funding** $1,855,803 (DOE) **FY 90 Funding** $137,986 (DOE)	Complete the final technical report (January 1991).
Crystalline Silicon Materials Research			
18097-1 07/01/88–09/30/91 Basic Studies of Point Defects and their Influence on Solar Cell Related Properties of Crystalline Silicon	Duke University Office of Sponsored Programs (U.M. Goesele) 705 Broad Street Box 40005 Durham, NC 27706 B.L. Sopori	**Total Funding** $288,618 (DOE) **FY 90 Funding** $45,000 (DOE)	Complete theoretical modeling of point defect diffusion in silicon (January 1991). Complete experimental measurements of self interstitial diffusivity in silicon (July 1991).
19145-1 10/23/89–10/23/91 Impurity Characterization/Cell Fabrication Support for Silicon Materials Program	Georgia Institute of Technology School of Electrical Engineering (A. Rohatgi) Atlanta, GA 30332 B.L. Sopori	**Total Funding** $105,000 (DOE) **FY 90 Funding** $40,000 (DOE)	Compare efficiencies of solar cells fabricated by the optical processing technique with those fabricated by conventional procedures, using single and polycrystalline substrates (July 1991).

Contract No. Contract Period Title	Contractor (Principal Investigator) SERI Contact	Funding $ (Source)	Selected FY 1991 Milestones (SERI contact has more information)
18097-2 06/01/88–07/31/91 The Effectiveness and Stability of Impurity/ Defect Interactions and their Impact or Minority Carrier Lifetime	North Carolina State University Office of Contracts and Grants (G.A. Rozgonyi) Box 7214 Raleigh, NC 27695-7214 B.L. Sopori	**Total Funding** $420,000 (DOE) **FY 90 Funding** $70,000 (DOE)	Determine the influence of dislocations, with and without impurity decorations, on the minority carrier lifetime in silicon (April 1991). Evaluate such effects after hydrogen passivation (July 1991).
18907-3 07/01/88–10/31/91 Passivation and Gettering in Solar Cell Silicon	The Research Foundation of SUNY (J.W. Corbett) P.O. Box 9 Albany, NY 12201 B.L. Sopori	**Total Funding** $363,301 (DOE) **FY 90 Funding** $57,500 (DOE)	Complete theoretical modeling of hydrogen diffusion in silicon (March 1991). Complete study of impurity in-diffusion (Fe) into silicon using radioactive isotopes (July 1991).
19144-1 12/01/89–11/30/91 Electrical Characterization Support for Crystalline Silicon Program	University of Southern California Sponsored Projects Accounting (S. Forrest) P.O. Box 52095 Los Angeles, CA 90074-2095 B.L. Sopori	**Total Funding** $45,316 (DOE) **FY 90 Funding** $25,618 (DOE)	Complete spatial mapping of material parameters and electrical characteristics of SERI-supplied substrates using organic-semiconductor/semiconductor contacts (June 1991).
High Efficiency Concepts			
19142-9 06/01/90–07/31/93 Arsine and Hydride Radical Generation for MOCVD Growth	Colorado State University (G. Collins) Department of Electrical Engineering Fort Collins, CO 80523 J. Benner	**Total Funding** $234,537 (DOE) **FY 90 Funding** $67,537 (DOE)	Complete assessment of porous structures and begin evaporation experiments; achieve hydrogenation of evaporated arsenic (June 1991).
19142-4 07/01/90–08/31/93 High-Efficiency Thin-Film Solar Cells	Kopin Corporation (R. Gale) 695 Miles Standish Boulevard Taunton, MA 02780 J. Benner	**Total Funding** $896,586 (DOE) **FY 90 Funding** $298,547 (DOE)	Achieve surface recombination velocity < 1000 cm/s in GaInP/GaAs double heterostructures; demonstrate lateral overgrowth of GaAs using diethyl gallium chloride (August 1991).

Solar Energy Research Institute

Contract No. Contract Period Title	Contractor (Principal Investigator) SERI Contact	Funding $ (Source)	Selected FY 1991 Milestones (SERI contact has more information)
19142-1 08/01/90–09/30/93 New III-V Solar Cell Design Approaches	Purdue University School of Electrical Engineering (M. Mellock, M. Lundstrom) West Lafayette, IN 47907 J. Benner	**Total Funding** $597,496 (DOE) **FY 90 Funding** $198,800 (DOE)	Demonstrate substrate removal by selective etching (for producing thin-film cells); complete numerical simulation program for solar cells and diagnostic structures that includes photon recycling effects (April 1991).
19142-10 07/01/90–02/28/93 Cl-MO and MOCVD Crystal Growth Research	Rensselaer Polytechnic Institute (S. Ghandhi) 6022 Engineering Center Troy, NY 12181 J. Benner	**Total Funding** $251,765 (DOE) **FY 90 Funding** $50,720 (DOE)	Complete computer simulation and experimental measurement of inlet and reactor wall temperatures for the stagnation point reactor (February 1991).
19142-3 06/22/90–08/21/93 Quaternary Materials for Ultra-High Efficiency	Research Triangle Institute (M. Timmons) P.O. Box 12194 Research Triangle Park, NC 27709 J. Benner	**Total Funding** $297,678 (DOE) **FY 90 Funding** $99,300 (DOE)	Demonstrate GaInAsP-on-Ge cell with one-sun efficiency of 15% (March 1991). Demonstrate front metalization with $p_c < 10^{-5}$ Ω-cm^2 (June 1991).
19142-7 08/15/90–10/14/93 Evaluation of New Growth Techniques and Operating Regimes for Ultra-High-Efficiency Solar Cells	Spire Corporation (S. Vernon) Patriots Park Bedford, MA 01730 J. Benner	**Total Funding** $560,298 (DOE) **FY 90 Funding** $180,613 (DOE)	Define atomic layer epitaxy process parameters (November 1990). Complete design of superlattice Bragg reflector (February 1991). Demonstrate GaAs-on-Si one-sun efficiency of 19% (July 1991).
19142-6 06/01/90–07/31/93 Atomic Layer Epitaxy for Low-Temperature Growth of Photovoltaic Materials	University of Southern California (D. Dapkus) 502 Seaver Science Center Los Angeles, CA 90089-0483 J. Benner	**Total Funding** $473,522 (DOE) **FY 90 Funding** $99,684 (DOE)	Develop a reactor model to account for the reactant transport to the surface and the pumping configuration to support the vacuum requirements of the reactor; test model by predictions versus experimental results obtained under Task 2 (June 1991).

Contract No. Contract Period Title	Contractor (Principal Investigator) SERI Contact	Funding $ (Source)	Selected FY 1991 Milestones (SERI contact has more information)
Module and System Performance and Engineering Project			
19103-1 10/01/89–09/30/90 Management and Administration of the IEC/PV/TC-82 Secretariat and U.S. Industrial Participation in International Standards Development	Solar Energy Industries Assocation (R. Klein) 777 North Capitol Street, N.E. Washington, D.C. 20002-4226 L. Mrig	**Total Funding** $39,412 (DOE) **FY 90 Funding** $39,412 (DOE)	Manage and administrate the International Electrotechnical Commission/Photovoltaics/Technical Committee-82 Secretariat and U.S. Industrial Participation (ongoing).
New Ideas for Photovoltaic Conversion			
6074-1 06/87–05/90 Novel Concepts for High-Efficiency Energy Conversion: The Avalanche Heterostructure and Superlattice Solar Cell	Georgia Institute of Technology (C. Summers) Physical Sciences Division Atlanta, GA 30332 R.L. Mitchell, T. Basso	**Total Funding** $103,418 (DOE) **FY 90 Funding** -0-	None. Contract completed.
6074-2 06/87–02/90 Low-Cost Technique for Producing CdZnTe Devices for Cascade Cell Application	International Solar Electric Technology (B.M. Basol) 8635 Aviation Boulevard Inglewood, CA 90301 R.L. Mitchell, T. Basso	**Total Funding** $199,071 (DOE) **FY 90 Funding** -0-	None. Contract completed.
6074-3 06/87–10/90 Hydrogen Radical Enhanced Growth of Solar Cells	Rensselaer Polytechnic Institute ECSE Department (S.K. Ghandhi) Troy, NY 12180-3590 R.L. Mitchell, T. Basso	**Total Funding** $200,080 (DOE) **FY 90 Funding** -0-	Complete the final technical report (October 1990).

Contract No. Contract Period Title	Contractor (Principal Investigator) SERI Contact	Funding $ (Source)	Selected FY 1991 Milestones (SERI contact has more information)
18110-2 01/01/90–02/28/91 An Inverted AlGaAs/ GaAs Patterned Tunnel Junction Cascade Concentrator Solar Cell	Research Triangle Institute (M. Timmons) Research Triangle Park, NC 27709 T.S. Basso	**Total Funding** $100,000 (DOE) **FY 90 Funding** $100,000 (DOE)	Provide samples of AlGaAs cells (target: 15% efficiency at one-sun, AM1.5) (April 1991). Provide samples of GaAs bottom cell under AlGaAs layers (target: 11% efficiency at one-sun, AM1.5) (July 1991).
18110-1 01/01/90–02/28/91 Novel Ways of Depositing ZnTe Films by a Solution Growth Technique	University of Delaware (R. Birkmire) Institute of Energy Conversion Newark, DE 19716 T.S. Basso	**Total Funding** $100,000 (DOE) **FY 90 Funding** $100,000 (DOE)	Complete the annual technical progress report (January 1991). Deliver indium tin oxide/CdS/CdTe/ZnTe solar cell (July 1991). Deliver Mo/$CuInSe_2$/ZnSe solar cell (July 1991).
18110-3 01/01/90–04/30/91 High-Efficiency Epitaxial Optical Reflector (EOR) Solar Cells	University of Southern California (P.D. Dapkus) University Park Los Angeles, CA 90089-1147 T.S. Basso	**Total Funding** $92,758 (DOE) **FY 90 Funding** $92,758 (DOE)	Provide samples of AlGaAs EOR solar cells (April 1991).
Photovoltaic Measurements and Performance			
N/A 10/89–09/90 Advanced Module Performance Testing and Reliability Research	Solar Energy Research Institute (R. DeBlasio) 1617 Cole Boulevard Golden, CO 80401 L.L. Kazmerski	**FY 90 Funding** $1,080,920 (DOE)	Organize and lead a research forum on module energy rating issues and test methods (meeting and status report) (February 1991). Participate as the SERI/DOE Technical Review Committee (TRC) member for the Photovoltaics for Utility-Scale Applications Project and the Niagara Mohawk Project (participate in TRC meetings and provide recommendations) (September 1991).
N/A 10/89–09/90 Cell Modeling and Fabrication	Solar Energy Research Institute (T. Coutts) 1617 Cole Boulevard Golden, CO 80401 L.L. Kazmerski	**FY 90 Funding** $836,840 (DOE)	Enhance the development of III-V tandem solar cells (April 1991). Advance activities in the area of contacts to $CuInSe_2$ and publish findings (August 1991).

Contract No. Contract Period Title	Contractor (Principal Investigator) SERI Contact	Funding $ (Source)	Selected FY 1991 Milestones (SERI contact has more information)
N/A 10/89–09/90 Electro-Optical and Cell Performance Characterization	Solar Energy Research Institute (R.K. Ahrenkiel) 1617 Cole Boulevard Golden, CO 80401 L.L. Kazmerski	**FY 90 Funding** $864,300 (DOE)	Apply new radio frequency absorption apparatus for measuring the lifetime in low E_g materials such as InGaAs and silicon (June 1991). Develop theoretical models for the analysis of lifetime measurements on poly-CdTe solar cells (August 1991).
N/A 10/89–09/90 Materials Characterization	Solar Energy Research Institute (M. Al-Jassim) 1617 Cole Boulevard Golden, CO 80401 L.L. Kazmerski	**FY 90 Funding** $621,150 (DOE)	Use high-resolution transmission electron microscopy to investigate the structure of polycrystalline CdTe, CdS/CdTe, $CuInSe_2$, and $CuGaSe_2$ thin films (June 1991). Study the atomic ordering structure of GaInP grown on GaAs substrates (July 1991).
N/A 10/89–09/90 Photovoltaic Surface and Interface Analysis	Solar Energy Research Institute (A. Nelson) 1617 Cole Boulevard Golden, CO 80401 L.L. Kazmerski	**FY 90 Funding** $588,820 (DOE)	Develop state-of-the-art migration-enhanced epitaxy (MEE) growth facility and complete software development for fully automated MEE growth (March 1991). Enhance and coordinate activities in II-VI material/device/module development with subcontractors by providing advanced measurement and characterization support (July 1991).
Polycrystalline Thin Films			
7133-1 01/01/90–02/28/91 Investigation of Stable Contacts to $CuInSe_2$ Thin Films	California Institute of Technology Applied Physics & Engineering (M. Nicolet) Pasadena, CA 91125 R.L. Mitchell	**Total Funding** $44,970 (SERI) **FY 90 Funding** $44,970 (SERI)	Complete the final report (January 1991).
10046 04/01/90–05/31/93 Role of Polycrystallinity in CdTe and $CuInSe_2$	Colorado State University Department of Physics (R. Sites) Fort Collins, CO 80523 H.S. Ullal	**Total Funding** $240,000 (DOE) **FY 90 Funding** $80,000 (DOE)	Complete the annual technical report (May 1991).

Contract No. Contract Period Title	Contractor (Principal Investigator) SERI Contact	Funding $ (Source)	Selected FY 1991 Milestones (SERI contact has more information)
6031-01 06/01/87–03/31/93 High Efficiency Cd and Zn Telluride Thin Film Cells	Georgia Institute of Technology School of Electrical Engineering (A. Rohatgi) Atlanta, GA 30332 R.L. Mitchell	**Total Funding** $607,698 (SERI) **FY 90 Funding** $148,055 (SERI)	Deliver two samples of CdTe and CdZnTe cells (December 1990). Deliver two samples of high-efficiency CdTe cells of more than 11% efficiency (April 1991). Deliver two samples of CdZnTe cells of at least 5% efficiency (April 1991).
6031-6 03/01/87–08/31/90 High-Efficiency $CuInSe_2$ and $CuInSe_2$-Alloy Cells	International Solar Electric Technology (V.K. Kapur) 8635 Aviation Boulevard Inglewood, CA 90301 R.L. Mitchell	**Total Funding** $944,043 (SERI) **FY 90 Funding** -0-	Complete the final report (January 1991).
19019-2 07/09/90–09/08/93 Process Development for High-Efficiency, Low-Cost, $Cu(In,Ga)Se_2$ Module Fabrication	International Solar Electric Technology (V.K. Kapur) 8635 Aviation Boulevard Inglewood, CA 90301 R.L. Mitchell	**Total Funding** $623,480 (SERI) $267,206 (ISET) **FY 90 Funding** $623,480 (SERI) $267,206 (ISET)	Deliver two samples of $Cu(In,Ga)Se_2$-based solar cells with an area of at least 4 cm^2 and efficiencies of at least 9% (April 1991). Deliver two samples of $Cu(In,Ga)Se_2$-based solar cells with an area of at least 4 cm^2 and efficiencies of at least 11% (July 1991).
19019-1 06/16/90–08/31/93 Module Process Optimization and Device Efficiency Improvement for Stable, Low-Cost, Large-Area CdTe-Based Photovoltaic Module Production	Photon Energy (S. Albright) 9650 A Railroad Drive El Paso, TX 79924 R.L. Mitchell	**Total Funding** $621,953 (SERI) $283,817 (Photon Energy) **FY 90 Funding** $621,953 (SERI) $283,817 (Photon Energy)	Achieve SERI verification of 13.5% efficiency on a small area CdTe cell (December 1990). Achieve 26 mA/cm^2 on a small area CdTe cell (December 1990). Achieve SERI verification of 10% aperture area efficiency on a 1-ft^2 CdTe module (June 1991).
10013-1 01/01/90–12/31/91 Development of a Computer Model for Polycrystalline Thin-Film $CuInSe_2$ and CdTe Solar Cells	Purdue University School of Electrical Engineering (R.J. Schwartz, J.L. Gray) West Lafayette, IN 46907 H.S. Ullal	**Total Funding** $101,864 (DOE) **FY 90 Funding** $50,000 (DOE)	Complete the annual technical report (March 1991). Deliver "user-friendly" numerical models for $CuInSe_2$ solar cells to be used on personal computers (June 1991).

Contract No. Contract Period Title	Contractor (Principal Investigator) SERI Contact	Funding $ (Source)	Selected FY 1991 Milestones (SERI contact has more information)
19019-4 11/08/90–12/31/93 Research on Polycrystalline Thin-Film Submodules Based on $CuInSe_2$ Material	Solarex Corporation Thin Film Division (R.R. Arya) 826 Newtown-Yardley Road Newtown, PA 18940 H.S. Ullal	**Total Funding** $1,905,000 (DOE) $835,715 (Solarex) **FY 90 Funding** $600,000 (DOE) $257,143 (Solarex)	Complete the annual technical report (December 1990).
10012-1 03/01/90–04/30/91 Novel Thin-Film $CuInSe_2$ Fabrication	University of Colorado (A. Hermann) Department of Physics Boulder, CO 80309 R.L. Mitchell	**Total Funding** $35,362 (SERI) **FY 90 Funding** $35,362 (SERI)	Deliver four samples of high quality copper indium diselenide (CIS)/glass formed by either laser synthesis, rapid thermal anneal, or laser ablation (December 1990). Deliver four samples of high quality glass/Mo/CIS/CdS formed by either laser synthesis, rapid thermal anneal, or laser ablation (March 1991).
10023-1 01/16/90–03/15/93 Polycrystalline Thin-Film Materials and Devices	University of Delaware Institute of Energy Conversion (R.W. Birkmire, J.E. Phillips) Newark, DE 19716 H.S. Ullal	**Total Funding** $1,880,947 (DOE) **FY 90 Funding** $601,440 (DOE)	Complete the annual technical report (March 1991).
10017-1 03/01/90–05/31/91 Alternative Fabrication Techniques for High-Efficiency $CuInSe_2$ and $CuInSe_2$ Alloy Films and Cells	University of Illinois Science Laboratory (A. Rockett) Urbana, IL 61801-3082 R.L. Mitchell	**Total Funding** $59,538 (SERI) **FY 90 Funding** $59,538 (SERI)	Deliver one sample of an active hybrid-deposited $CuInSe_2$ cell with a CIS layer deposited below 200°C (December 1990). Deliver two samples of hybrid-deposited $CuInSe^2$ films (March 1991).
18091-1 07/01/88–02/28/91 Thin-Film CdTe, ZnTe, and HgZnTe Solar Cells	University of South Florida Department of Electrical Engineering (T.L. Chu, S.S. Chu) Tampa, FL 33620-5350 H.S. Ullal	**Total Funding** $624,689 (DOE) **FY 90 Funding** $124,746 (DOE)	Complete the annual technical report (May 1991). Deliver SERI-verified CdTe solar cell of 13% efficiency (May 1991).

Solar Energy Research Institute

Contract No. Contract Period Title	Contractor (Principal Investigator) SERI Contact	Funding $ (Source)	Selected FY 1991 Milestones (SERI contact has more information)
19019-3 07/23/90–09/22/93 Thin-Film Cadmium Telluride Photovoltaic Cells and Submodules Fabrication	University of Toledo (A. Compaan) Department of Physics Toledo, OH 43606 H.S. Ullal	**Total Funding** $685,407 (DOE) $325,553 (UT) **FY 90 Funding** $285,407 (DOE) $122,317 (UT)	Complete the annual technical report (October 1990). Deliver CdTe solar cell, fabricated by laser-driven physical vapor deposition, of 9% efficiency (August 1991).
Solar Radiation Research			
N/A 10/89–09/90 Solar Radiation Research	Solar Energy Research Institute (C.J. Riordan) 1617 Cole Blvd. Golden, CO 80401 R.L. Hulstrom	**FY 90 Funding** $502,770 (DOE)	Publish the annual technical progress report on solar radiation influence on PV device performance (December 1990).
Solid State Research			
N/A 10/89–09/90 Advanced High-Efficiency Solar Cells	Solar Energy Research Institute (J.M. Olson) 1617 Cole Boulevard Golden, CO 80401 S. Deb	**FY 90 Funding** $865,380 (DOE)	Evaluate and analyze a broad scan of GaAs/Ge growth initiation conditions (July 1991). Investigate the effect of potential fluctuations in $Ga_{0.52}In_{0.48}P$ using temperature-dependent Hall analysis and photoconductivity. (September 1991).
N/A 10/89–09/90 Amorphous Silicon	Solar Energy Research Institute (R. Crandall) 1617 Cole Boulevard Golden, CO 80401 S. Deb	**FY 90 Funding** $1,376,000 (DOE)	Using "hot-wire deposition," fabricate low-band-gap a-SiGe alloys with transport properties superior to those deposited by glow discharge (May 1991). Deposit microcrystalline silicon films using a remote hydrogen plasma and incorporate these films in a p-i-n device (June 1991).
N/A 10/89–09/90 Crystal Growth Research	Solar Energy Research Institute (T. Ciszek) 1617 Cole Boulevard Golden, CO 80401 S. Deb	**FY 90 Funding** $427,490 (DOE)	Provide researchers with samples starting with stoichiometric crystals, then nonstoichiometric crystals, followed by Ga or Ag alloys (ongoing). Advance innovative thick silicon growth methods (report) (ongoing). Determine whether handling requirements of 30–50 μm Si preclude transfer from temporary to permanent substrates (November 1990).

Contract No. Contract Period Title	Contractor (Principal Investigator) SERI Contact	Funding $ (Source)	Selected FY 1991 Milestones (SERI contact has more information)
N/A 10/89–09/90 Solid State Research Management	Solar Energy Research Institute (S. Deb) 1617 Cole Boulevard Golden, CO 80401 S. Deb	**FY 90 Funding** $324,830 (DOE)	Complete the annual report for the SERI Solid State Photovoltaic Research Program (July 1991). Coordinate research activities with university and industrial laboratories (July 1991). Identify promising new research opportunities (ongoing).
N/A 10/89–09/90 Solid State Theory	Solar Energy Research Institute (A. Zunger) 1617 Cole Boulevard Golden, CO 80401 S. Deb	**FY 90 Funding** $579,780 (DOE)	Calculate stability and charge transfer in $AlInX_2$ and $GaInX_2$ (X = P or As) (April 1991). Calculate GaAs surface energies of reconstruction (June 1991). Calculate phonon spectra and lattice instabilities in GaInP (June 1991).
N/A 10/89–09/90 Thin-Film Compound Semiconductors	Solar Energy Research Institute (R. Noufi) 1617 Cole Boulevard Golden, CO 80401 S. Deb	**FY 90 Funding** $847,110 (DOE)	Conclude study on substrate/back-contact/active layer adhesion effects (June 1991). Identify improved device structures either through optimization of $CuInSe_2$ technologies and/or through the introduction of multinary alloys into the device (August 1991).
University Participation			
18141-1 07/01/89–08/31/92 New Approaches for High Efficiency Solar Cells	North Carolina State University Electrical Engineering Department (S. Bedair, N. El-Masry) Raleigh, NC 27695 J. Benner	**Total Funding** $477,243 (DOE) **FY 90 Funding** $80,000 (DOE)	Investigate the electrical properties of patterned n^+-p^+ tunnel junctions (April 1991). Build a new growth chamber for atomic layer epitaxy/flow-modulated epitaxy that will allow a growth rate higher than 1 μm/h for large area substrates (July 1991).
18141-2 07/01/89–08/31/92 Fundamental Studies of Defect Generation in Amorphous Silicon Alloys Grown by Remote Plasma-Enhanced Chemical-Vapor Deposition	North Carolina State University Department of Physics (G. Lucovsky) Box 8202 Raleigh, NC 27695-8202 J. Benner	**Total Funding** $383,446 (DOE) **FY 90 Funding** $63,700 (DOE)	Deposit a- and μc-Si,C:H and a-Si,Ge:H alloy films; fabricate metal oxide semiconductor/metal insulator semiconductor structures; study accumulation-bias-induced defects (August 1991).

Contract No. Contract Period Title	Contractor (Principal Investigator) SERI Contact	Funding $ (Source)	Selected FY 1991 Milestones (SERI contact has more information)
18141-4 07/01/89–08/31/92 Ion and Photon-Assisted Growth and Doping of II-VI Compounds	Stanford University Material Science and Engineering (R. Bube) Stanford, CA 94305 J. Benner	**Total Funding** $523,038 (DOE) **FY 90 Funding** $85,000 (DOE)	Compare dopants for photon-assisted doping with CdTe, using neutral and ionized dopants such as Sb, P, As, N (ions only), Cs, Na, and Bi, with respect to maximum doping, dopant activity, and lifetime; evaluate most of the dopants (August 1991).
18141-3 07/01/89–08/31/92 Electronic Processes in Thin-Film PV Materials	University of Utah Physics Department (C. Taylor) Salt Lake City, UT 84112 J. Benner	**Total Funding** $449,015 (DOE) **FY 90 Funding** $86,000 (DOE)	Complete optical determination of states in the gap in alloys and multilayers (August 1991).

Index of Current Contractors

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