



# SED

## Solar Engineering Division Newsletter

Stanley J. Kleis and David E. Claridge, Editors

Summer 1999

### State of the SED

This last year was the initial year that the incoming Chair of the Solar Energy Division (SED) had to present a "plan" for what was to be accomplished during their tenure in the position. I presented three specific objectives: 1) develop active Technical Committees; 2) update the "Long Range Plan" and "Bylaws and Operating Guide"; and 3) stimulate membership involvement in SED. I thought, and still think, these are needed for the long-term viability of the SED, especially #1 and #3. The measures of success associated with the objectives #1 and #3 above are to have the following happen:

- 3 to 5 "core" members working within each Technical Committee (TC)
- SED members coming to TC meetings at Conferences

*(continued on page 2)*

### Congratulations ASME Medal

Congratulations go to Frank Kreith, P.E., D.Sc., winner of the ASME Medal. The medal was awarded to Dr. Kreith for distinguished achievement in solar energy through research, publication and public service. It was conferred on Dr. Kreith at the Honors Assembly of the 1998 IMECE. Dr. Kreith's career has included teaching at the University of Colorado, Boulder

and other universities, research at NREL, and most recently ASME Legislative Fellow at the National Conference of State Legislatures.

### Windpower Today: On the Ropes, or a Valuable Source of Clean Renewable Energy?

Reports of the demise of wind energy are premature, to say the least. In the U.S., wind energy has gone through some difficult times in the past five years. At that time, windpower appeared to be on the verge of becoming a major player in the electric power mix in the U.S. - hundreds of megawatts of wind farms were on the drawing boards. Then deregulation struck, together with added emphasis on "least-cost" energy sources, and all but a handful of those plans were shelved or scrapped. Now the dust from deregulation is settling a bit, environmental concerns are being addressed in the true cost of energy, and windpower is again gaining momentum in the U.S. In much of the rest of the world, and in Western Europe in particular, the growth of wind energy has been nothing short of spectacular during this same time period.

*(continued on page 3)*

### Solar Boats Race

Solar Splash, the World Championship of solar/electric boating, was held in Milwaukee, Wisconsin, June 17-21, 1998. In its 5th year, students from 17 Colleges and Universities, and from two high schools gathered to compete in a variety of events including Technical Reports, Visual Displays, Qualifying, 300 meter Sprints and two hour Endurance races.



*(continued on page 3)*

- Increases in Conference attendance
- Increased JSEE submittals

To get these things to happen we have to get more readers of this Newsletter involved with the Division's conferences and committees.

So why should you, or anybody, volunteer your time and efforts in this way?

The only answer I can come up with is it interests you, and you see some benefit to you and/or others. Let me address this "interest and benefit" issue by outlining some of the activities the SED is undertaking currently and see if they appeal to you.

**Joint Conference Programming.** The Division is making a concerted effort to join with other "solar-related" organizations to hold bigger and better conferences - with a wider scope of technologies and people, foreign country involvement, and industry presence. This year's Hawaii conference was joint with Korean and Japanese solar and HVAC societies, plus the ASME Advanced Energy Systems Division presented on it's mix of technologies. The next two years' conferences will again be held jointly with the American Solar Energy Society, joint meetings which seem to mix us engineers with architects, solar industry people, government officials, and other engineers and people we wouldn't meet in ASME. Additionally, the Wind Committee holds their annual Wind Symposium jointly with the AIAA in Nevada. You can learn a lot and meet a lot of people at these conferences.

**Student Outreach Activities.** Five years ago the Division started the collegiate solar boat competition called the Solar Splash, which is held in Milwaukee on Lake Michigan the end of June each year. This event has grown to twenty boats competing, with Japanese and Puerto Rican entries giving the other teams all the competition they can stand! The event is organized for us through George Ettenheim, who will be "retiring" from the Solar Splash after this year - so we are exploring new venues and organizational "interest and benefit" issues by outlining teams for the future (Disney World??) and certainly would like your help with this. In a different vein, a new initiative this year is the SED Graduate Student Award which includes \$1000, a plaque, and free registration at the annual conference - where the winner will present a paper on their research activities. Know any students working on solar-related projects?

**Leadership Training Opportunities.** ASME overall is viewed by many as a "training ground" for leadership, and the SED certainly has many places you can get experience in and practice leadership. Your level of involvement is entirely up to you, and we volunteers definitely "run" the organization - we decide when, where, and how much on all those topics described above. The Division needs TC members to help formulate conference topic areas, reviewers for papers, session chairs for conferences, administration committee members to help run the Division itself, and finally, members that would like to serve on the Executive Committee to help direct future SED activities. I can promise you one thing - you will grow as a leader if you can get other ASME volunteers to help you!

In conclusion, I hope you have read something above that interests and can benefit you. As I stated, getting your involvement is the only way we can keep the Division's activities going - and keep making these activities more interesting and relevant. It's easy to get involved - contact me, or any of the others listed in this Newsletter, or just show up at a conference and talk to us. So, I hope to hear from you or see you in the near future.

*Jefferey Morehouse  
Solar Energy Division Chair*

## ENERGY Appoints new Editor

Professor Noam Lior has been appointed as the new Editor-in-Chief of ENERGY - The International Journal (Elsevier Science Publishers - Pergamon Press). He is a member of the ASME AES Systems Analysis Committee, the Heat Transfer Division K6 committee on Heat Transfer In Energy Systems, and of the Solar Energy Division Committee on Fundamentals. He can be reached at:

Department of Mechanical Engineering  
and Applied Mechanics  
University of Pennsylvania  
297 TB  
Philadelphia, PA 19104-6315  
lior@seas.upenn.edu

The journal description and guidelines to authors can be found at <http://www.elsevier.nl/locate/energy>

## 1999 "Best Paper" Awards Presented

The SED "Best Paper" Awards for the 1999 International Solar Energy Conference held in Maui, Hawaii, were selected by the technical committees from papers presented in sessions sponsored by the Solar Energy Division. The "Best Paper" Awards, which includes a certificate and a year subscription to the ASME Journal of Solar Energy Engineering, were:

### Heating and Cooling

"Applicability Of Uniform Heat Flux Nusselt Number Correlations To Thermosyphon Heat Exchangers For Solar Water Heaters" by Scott Dahl and Jane H. Davidson.

### Solar Space Applications

"Thermal-Mechanical Stability Of Single Crystal Oxide Refractive Concentrators For High-Temperature Solar Thermal Propulsion" by Dongming Zhu, Nathan S. Jacobson, and Robert A. Miller.

### Solar Thermal Power

"Heat Pipe Solar Receiver Development Activities At Sandia National Laboratories" by Douglas R. Adkins, Charles E. Andraka, J. B. Moreno, K. S. Rawlinson, S. K. Showalter, and T. A. Moss.

### Photovoltaics

"Plasma Texturing, Etching And Passivation Of Multicrystalline Silicon Solar Cells" by Douglas S. Ruby, Pin Yang, Saleem Zaida, Madhu Roy, and S. Narayanan.

### Solar Chemistry

"Economic Evaluation And Comparison Of The Industrial Photosynthesis Of E-Caprolactam Via Solar Or Lamp Operated Photooxygenation Of Cylohexane " by Christian Sattler, Franz-Josef Muller, Klaus-Jurgen Riffelmann, Jurgen Ortner, and Karl-Heinz Funken.

## George Ettenheim Honored

George Ettenheim was honored by the SED for his contributions in organizing and running the ASME/SED sponsored Solar Splash events. George and his wife were flown to the 1999 meeting in Maui, Hawaii, where he received the award.

In accepting the award, George was grateful for the opportunity to touch the lives of so many young people during the competitions.

## Solar Boats Race

(continued from page 1)

Points are accumulated and the Overall Winner and World Champion is the team from the University of South Carolina. The competition was extremely close. Out of a possible 1000 points, South Carolina had 786.5, runner up Columbia had 775.0, Southern Maine was in third with 764.9, the Coast Guard Academy in fourth with 754.3 and the University of Arkansas-Little Rock in fifth with 752.0. The 34.5 points which separated the top 5 finishers is by far the closest finish and is a real testament to the quality of the competitors.

Dr. Jeffery Morehouse, Chair of the Solar Energy Division of ASME presented design awards to the following:

- Marquette University -  
Overall Design Achievement
- Ottawa Hills High School -  
Best Team-Built Hull
- Columbia University -  
Best Electrical System
- Marquette University -  
Best Solar System Design
- University of New Orleans -  
Outstanding Drive Train

The U.S. Coast Guard took first place in Technical Report and Visual Display and had they not missed one mark on their initial run on the qualifying course, would have been the Overall Winner.

Qualifying is a combination of times on a short Sprint course and on a Maneuverability course. The winner was the University of Southern Maine with an outstanding 13 second lead over the University of Arkansas at Little Rock. South Carolina's win in the Endurance Event secured their championship. Columbia did very well in all events achieving their best finish in the four years they have competed.

The Sprint was won by the University of New Orleans, with the University of Michigan only .62 seconds behind and closing fast at the end of the 300 meter run. The Arkansas Sprint boat entry was less than 3 seconds behind Michigan.

Other awards were presented to New Orleans as the most improved team, amassing more than 340 points better than in 1997. The State University of New York team from Stony Brook was the Best Rookie Team.

In addition to the Solar Energy Division, sponsorship from EATON, EDS, the State of Wisconsin, Marquette University, Miller Brewing and IEEE made the Event possible. For more information and photos, visit the web site [www.sunrayce.com/solar\\_splash](http://www.sunrayce.com/solar_splash).

## Honors Presented

### ASME Fellow

Jane Davidson was elected to Fellow grade by ASME for her outstanding technical contributions and service to the Society.

### ASME Dedicated Service Award

Bob Reid was awarded the ASME Dedicated Service Award at the 1999 meeting in Maui, Hawaii. During his many years of service, Bob has served as a chair of the division and editor of JSEE.

## Solar Sessions at IMECE

SED sponsored two panels at the 1998 International Mechanical Engineering Congress and Exposition in Anaheim CA in November. Attendance at both panels was high, with about 40 people attending the second. The first panel addressed "Photovoltaics for Disaster Relief" and was chaired by NREL's Andy Walker. Natural disasters can happen at any time destroying homes and businesses. After the disaster, relief efforts are hampered by damage of infrastructure and loss of the power grid. Solar electric energy can meet many of the energy needs of emergency management organizations, relief workers, and the general public. John Thornton, Byron Stafford, and Dave Howard of NREL, and Steve Oravetz of the U.S. Forest Service discussed how photovoltaics can be used to meet the challenges of a post-disaster effort and showed numerous applications of PV. They also pointed out that cost/benefit analyses are often hard to determine in a post-disaster situation, since the benefits of having equipment available in the right place at the right time are not always measured by normal economic parameters.

The second panel addressed "Can Renewables Compete in a Deregulated Economy?". Frank Kreith of the National Conference of State Legislatures chaired the panel. Steve Kelly of the Renewable Energy Marketing Board, Gary Nakarato from NREL, and Jim Chavez from Sandia National Labs presented their views. The electric industry in the United States is changing from the regulated monopoly structure of the past 50 years to a more competitive system. This change carries with it great opportunities, but there are also risks and potential pitfalls. There have been particular concerns in the renewable energy industry, because there is fear that when utilities concentrate merely on short-term profits for their

stockholders, incentives for renewable energy and conservation measures may diminish. On the other hand, state governments are anxious to preserve a robust and diversified utility industry and have included in their energy deregulation legislation measures such as portfolio standards, renewable set-asides and low interest loan programs for renewables and energy conservation measures.

The known costs of installing renewable generation provide a hedge against unknown future fluctuations of fossil prices, and are competitive in cases of price spiking seen in some deregulated markets. However, reliability data are largely unknown. Better models and better understanding of costs and interdependencies are needed.

### Windpower Today

(continued from page 1)

Windpower is the fastest growing energy source in the world, with the addition of more than 1,560 MW (25%) in 1997 and 2,100 MW (35%) in 1998 to reach a total of about 9,600 MW world wide. That total is double the total installed wind capacity of just three years ago, and is sufficient to generate approximately 21 billion kilowatt-hours of electricity, or enough power for 3.5 million suburban homes. 84% of the new installations occurred in Europe. Only 11 MW of capacity were added in the U.S. in 1997, for example, but the total U.S. wind capacity grew by more than 230 MW in 1998 (to a total of about 1,900 MW), with major new wind plants being built in states outside of California, the nation's leading wind energy producer. The states of Minnesota, Oregon, Wyoming and Iowa account for most of the new growth, but wind farms were also installed in Nebraska, Colorado, Texas, and Wisconsin. For 1999, the American Wind Energy Association (AWEA) is projecting 600 MW of new U.S. wind energy capacity, and between 120 and 250 MW of "repowering" development at several California wind farms. Although the world market will continue to broaden, as more countries around the world become active, the vast majority of the growth over the next decade will probably occur in Europe.

Germany, Spain and Denmark lead the growth in wind-energy capacity: Germany topped the charts in 1998 with the addition of 800 MW, boosting the country's total capacity to over 2,800 MW. The country's wind turbines are now producing the same amount of electricity as two of its largest coal-fired power plants. Spain also emerged as a world leader in wind energy by adding approximately 395 MW in 1998 for an increase in

installed wind capacity of 86% during the year. Spain's total wind capacity now stands at over 850 MW.

Denmark continues as a leading producer of wind energy with the addition of approximately 235 MW in 1998, bringing its total capacity to more than 1,350 MW. The country's wind plants now provide over 8% of its electricity demand, and its wind turbine manufacturers are among its leading exporters.

The wind energy industry has become one of the world's most rapidly expanding industries, with equipment sales reaching roughly \$2 billion in 1998. According to Worldwatch Institute, a Washington, D.C.-based policy organization, the wind-energy industry is creating thousands of jobs at a time when employment in manufacturing is falling in the U.S. and many other nations. In 1995 wind power created some 9,000 jobs in Denmark, including jobs with Danish turbine component suppliers. The impact on global employment from the manufacturing process is some 12,000 jobs, and the installation of Danish turbines worldwide created another 4,000 jobs. Danish wind turbine manufacturers supply approximately half of the nameplate generating capacity in the world market. One may therefore estimate world-wide employment in the wind power industry to be in the range of 30,000 to 35,000 jobs in 1995. Since the installed capacity is now double what it was in 1995, current employment estimates would be 60,000 to 70,000 jobs.

Public support for wind energy and other non-polluting renewable energy sources has grown steadily, as more people learn about the impact that generation of electricity from fossil fuels such as coal can have on our environment. A series of recent polls in the U.S. have shown that 80% of people polled about future sources of energy are in favor of wind energy. Building wind turbines is not especially energy intensive, either. In 3 to 4 months a modern wind turbine on an average site will generate as much energy as was used to manufacture it. In addition, wind farms can be decommissioned and sites fully restored very easily, with a net gain in energy.

Overall, wind power is a far larger potential energy source than most people realize. In the U.S., the states of North Dakota, South Dakota, and Texas have sufficient wind resources to provide electricity for the entire nation. One 1998 Danish study states that 10% of the world's electricity needs can be met with wind energy in the next two decades. In the U.S., just 0.04% of North Dakota's wind land could produce 10% of that state's 1993 electricity requirements, while approximately 1.3% of the wind land in Texas could generate 10% of that

state's electricity needs. Worldwatch predicts that in the long run, wind power could easily exceed hydropower—which now supplies 23% of the world's electricity—as an energy source.

In the February, 1999 issue of "Windpower Monthly" magazine, British analyst David Milborrow writes that wind turbine costs have fallen by 15% with each doubling of worldwide capacity, and that capacity is doubling every three years: "[T]he downward trend in wind turbine costs is no less than stunning. According to learning-curve theory, a reduction in cost of 8-10% for each doubling of manufacturing volume would have been reasonable."

Wind technology is getting a boost from better turbine productivity, Milborrow says, with new machines generating some 2,000 kWh of electricity per kW of capacity installed as of 1996, compared with 1,300 kWh/kW in 1983. With turbine costs about one-third what they were in the early 1980s and productivity up by 50%, he said, the cost of wind-generated electricity has fallen by a factor of 4.5 [making it 20-25% of its cost in the early years of the industry].

Wind's progress into the electric generation market has been slowed only because the cost of electricity from other sources has also dropped during the same time period. "The installed costs of combined-cycle gas turbines have fallen by about a third in the past eight years, and the price of coal delivered to American utilities fell by 40% in the 10 years to 1996."

Milborrow also examines the cost of wind compared with other energy sources in four countries (the U.S., Germany, the U.K., and France) and finds it generally competitive across the board. For the U.S., he places the cost of wind-generated electricity at 4.49-5.48 cents/kWh, with coal-fired power ranging from 3.69-5.28 cents/kWh and electricity from gas plants ranging from 3.69-5.68 cents/kWh.

If a common set of assumptions is made for all generating technologies, Milborrow says, as with a procedure used by the International Energy Agency (IEA), "The comparison is encouraging. At wind speeds over 6.5 m/s [14.6 mph], wind energy falls within the price range of all the thermal technologies. Mid-range costs for the thermal technologies are around 5.8 cents/kWh, which corresponds to the price of wind energy at wind speeds of 7.5 m/s [16.8 mph]."

"A Few Dollars Per Family: The Cost of Large-Scale Wind Power Development" is a new study from the Renewable Energy Policy Project (REPP), a Washington, D.C.-based think tank, authored by Dr. Jamie Chapman of OEM Development Corp. and Steven Wiese of

Planergy, Inc. The authors conclude that the United States could easily add 10,000 MW of new wind turbines over the next ten years. In addition to obtaining the additional clean energy (and decreasing pollution), the country would reap the following benefits:

\$7 billion in economic activity associated with manufacturing, construction, and supply of parts and components. Most, but not all, of this activity would benefit the domestic economy.

\$863 million in annual revenue from the sale of 21.6 billion kilowatt-hours (kWh) of electricity, once all the turbines are installed.

\$17 million per year in land-use easement payments to the owners of the land on which the windfarms are situated, once all the turbines are installed.

\$89 million per year from maintenance and operations, once all the turbines are installed."

Overall, the report said, it is evident that the U.S. has more than enough windy land to "dramatically" increase wind generation without creating conflicts with other land uses (about 99% of the land area within a typical wind farm site is available for agricultural or other use). The cost per household of doing so is modest (about \$9 per year for a family of four).

The growing penetration of world wide markets, the increasing reliability of wind turbines, and the decreasing price of wind energy contribute to a bright future for the technology. The prospects for the industry are good if the political will to address the environmental aspects of energy production continues to grow, as it has for the past five years in Europe. The EU member states are in an excellent position to reap the economic benefits of this future. The U.S. wind energy industry, on the other hand, is in rather poor shape today, with only one major manufacturer of large wind turbines. Although we have many wind farms operating in the U.S., the vast majority of the money to purchase new machines to repower those wind farms and to power new ones will go to foreign companies, most likely European.

The sustainability of wind as a resource is beyond doubt. The wind may die down for hours but it has been blowing for millennia and will continue to do so in the future—providing clean power for generations. Will we be smart enough to harness it? If so, who will reap the economic rewards for building the machines to do that job?

Much of the information contained in this article comes from the Wind Energy Weekly, published by the American Wind Energy Association (AWEA), 122 C Street, 4th Floor, Washington, DC 20001. Phone: (202) 383-2500. Fax: (202) 383-2500

## Solar Energy Division 1998-1999

### **Executive Committee**

#### *Chair*

Jeff H. Morehouse  
University of South Carolina  
Mechanical Engineering Department  
Columbia, SC 29208  
803-777-3017  
803-777-0106 (F)  
more@enr.engr.sc.edu

#### *Vice Chair*

Roy E. Hogan  
Sandia National Laboratories  
P.O. Box 5800, MS 0835  
Albuquerque, NM, 87185-0835  
505-845-9585  
505-844-8251 (F)  
rehogan@sandia.gov

#### *Secretary/Treasurer*

James E. Pacheco  
Sandia National Laboratories  
P.O. Box 5800, MS 0703  
Albuquerque, NM 87185-0703  
505-844-9175  
505-844-7786 (F)  
jepache@sandia.gov

#### *Member*

Stanley Kleis  
University of Houston  
Mechanical Engineering Department  
4800 Calhoun  
Houston, TX 77204-4792  
713-743-4536  
713-743-4503 (F)  
kleis@uh.edu

#### *Past Chair*

David E. Claridge  
Texas A&M University  
Mechanical Engineering Department  
College Station, TX 77843-3123  
409-845-1280  
409-862-2726 (F)  
claridge@esl.tamu.edu

### **Administrative Committees**

#### *Energy Resource Board Representative*

Jane H. Davidson  
Jeff H. Morehouse

#### *Annual Report*

James E. Pacheco  
Jeff H. Morehouse

#### *International Congress Program Representative*

James E. Pacheco

#### *Division Operations*

Richard B. Bannerot

#### *Education*

David Klett

#### *Government Relations*

Jeff H. Morehouse  
Robert L. Reid

#### *Honors & Awards*

David Klett

#### *IECEC Representative*

W. Dan Turner

#### *Editor*

*ASME Journal of Solar Energy Engineering*  
Robert L. Reid

#### *Membership Development*

Stanley Kleis

#### *Publicity/Newsletter*

David Claridge  
Stanley Kleis

#### *ASME Headquarters*

ASME, MS-22W3  
Three Park Ave.  
New York, NY 10016  
212-591-7008

### **Technical Committees**

#### *Conservation and Solar Buildings*

Moncef Krarti  
Department of Civil, Environmental,  
and Architectural Engineering  
Campus Box 428  
University of Colorado at Boulder  
Boulder, CO 80309-0428  
303-492-3389  
303-492-7317 (F)  
krarti@colorado.edu

#### *Fundamentals and Theory*

Mary Jane Hale  
National Renewable Energy Laboratory  
1617 Cole Boulevard  
Golden, CO 80401-3305  
303-384-7453  
303-384-7495 (F)  
mary\_hale@nrel.gov

#### *Heating and Cooling Applications and Analysis*

Mark Thornbloom  
Florida Solar Energy Center  
1679 Clearlake Road  
Cocoa, FL 32922  
407-638-1444  
407-638-1010 (F)  
thornbloom@fsec.ucf.edu

#### *Photovoltaics*

Ralph Nigro  
Applied Energy Group, Inc.  
46 Winding Hill Drive  
Hockessin, DE 19707  
302-239-8325  
302-239-8325 (F)  
ralph.nigro@dol.net

#### *Solar Chemistry*

Dan Blake  
NREL, Mail Stop 1613  
1617 Cole Blvd.  
Golden, CO 80401  
303-275-3702  
303-275-2905 (F)  
blaked@tcplink.nrel.gov

#### *Solar Ponds and OTEC*

Huanmin Lu  
Dept. of Mechanical & Industrial Engineering  
The University of Texas at El Paso  
El Paso, TX  
915) 747-5282  
lhuanmin@mail.utep.edu

#### *Solar Space Applications*

J. Boise Pearson  
Marshall Space Flight Center  
P.O. Box 707, M/S k-68  
Huntsville, AL 35812  
TEL: 205 961-0078  
FAX: 205 544-5876  
Boise.Pearson@msfc.nasa.gov

#### *Solar Thermal Power*

Gilbert Cohen  
KJC Operation Company  
41100 Highway 395  
Boron, CA 93516  
760-762-5562 x 229  
760-762-5546 (F)  
GilbertCohen@compuserve.com

#### *Testing and Measurement*

Carl Bingham  
National Renewable Energy Laboratory  
1617 Cole Blvd.  
Golden, CO 80401  
TEL: 303-384-6390  
FAX: 303-384-7540  
binghamc@nrel.gov

#### *Wind Energy*

Dale Berg  
Sandia National Laboratories  
P.O. Box 5800, MS 0708  
Albuquerque, NM 87185-0708  
505-844-1030  
505-845-9500 (F)  
deberg@sandia.gov

# CALL FOR PAPERS

## *Solar 2000*

*“Solar Powers Life—Share the Energy”*

An International Conference  
Sponsored by ASME/ASES/AIA  
June 17-22, 2000  
Madison, Wisconsin

The American Society of Mechanical Engineers' Solar Energy Division, the American Solar Energy Society, and the American Institute of Architects Committee on Environment will host the 2000 joint international conference. The Solar 2000 conference will occur in conjunction with the 11th Annual Midwest Renewable Energy Fair, which attracts over 10,000 grassroots renewable energy users annually. The conference will include technical papers presented in stand-up presentations, keynote lectures, panel discussions, open forum sessions as well as social events. Papers submitted to ASME will be peer reviewed following standard ASME procedures.

Papers are solicited in all areas of renewable and advanced energy systems research and development. These would include: solar ponds, ocean energy, heat pumps, cogeneration, photovoltaics, geothermal systems, Stirling engines, superconductivity, synfuels, energy storage, building energy conservation, hydrogen technologies, bioconversion, fuel cells, efficiency standards, chillers, component simulation, economic analyses, testing, measurements, fundamentals and theory. Accepted papers will be published in the ASME conference proceedings. In their letter of transmittal, authors can request that their papers also be reviewed for publication in the ASME Journal of Solar Energy Engineering. Papers submitted for joint Journal review should be of permanent interest and of archival value and not exceed six Journal pages (6000 words).

Abstracts in English of 500 words or less should be submitted by mail or e-mail to one of the program chairs listed below. With the abstract, submit the paper title, three keywords, the author's names, affiliations, and full addresses and the name, address, phone and fax numbers, and e-mail address of the author to whom correspondence should be directed.

ASME Solar Energy Division General  
James E. Pacheco  
Sandia National Laboratories  
PO Box 5800, MS 0703  
Albuquerque, NM 87185-0703  
(505) 844-9175  
FAX: (505) 844-7786  
jepache@sandia.gov

ASME Solar Energy Division Technical Program Chair  
Mark Thornbloom  
Florida Solar Energy Center  
1679 Clearlake Road  
Cocoa, FL 32922  
407-638-1444  
407-638-1010 (F)  
thornbloom@fsec.ucf.edu

### DEADLINES

Abstracts to Technical Committee Chair:	September 1, 1999
Abstract acceptance:	September 15, 1999
Five copies of paper to session chair:	November 1, 1999
Authors notified of final acceptance:	November 1, 1999
Final manuscript mats to session chair:	February 1, 2000

## Upcoming Events

The Solar Energy Division of ASME will be sponsoring sessions at the following conferences:  
1999 IMECE, Nashville, Nov. 14–19, 1999. General/Technical program chairs: Jim Pacheco/Ralph Nigro  
2000 ISEC, Madison, (see above), General/Technical program chairs: Jim Pacheco/Mark Thornbloom  
2000 IMECE, Orlando, General program chair: Stan Kleis  
2001 ISEC, Washington, D.C., General/Technical program chairs: Stan Kleis/Carl Bingham  
2001 IECEC, General/Technical program chairs: Dan Turner/Siram Somasundaram