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Advanced Energy Systems Division Newsletter

Editors: Srinivas Garimella and Laura Schaefer *Winter 2002*

Chair's Message

S. A. Sherif

It is a pleasure and an honor to serve as the Chair of the Advanced Energy Systems Division (AESD) for 2002-2003. I have been involved with various division activities for many years, including serving on the Systems Analysis Technical Committee and editing the Newsletter for the AESD.

I plan to continue the tradition of excellence in our programs and services to the division membership, which exceeds 1000 primary members. I will do this with the help of the members of the AESD Executive Committee (EC). I am building on a strong foundation that was laid by past members of the EC. I would like to express my sincere thanks to Professor Jerzy Fiszdon for his service as AESD Chair during 2001-2002. Dr. Fiszdon will continue to be available as a resource during 2002-2003 as a Past Chair and senior member of the EC.

The AESD has seven technical committees and liaisons to two conferences, which cover a wide range of technologies in energy systems and conversion. They provide the core technical content for the programs that the AESD sponsors.These programs are offered at two main meetings: the International Mechanical Engineering Congress and Exposition (IMECE) and the International Energy Conversion Engineering Conference (IECEC). The IECEC in its new format builds on the old IECEC (see the article on the IECEC by Dr. Somasundaram elsewhere in this publication). Also, the AESD has historically participated in several European conferences. Furthermore, the Division has recently teamed up with other ASME divisions, such as the Solar Energy Division, in conference participation. There is also cross interaction with the Heat Transfer Division through its K-6 Committee on Heat Transfer in Energy Systems. Several Division members are members of K-6 and are active in organizing joint programs.

These types of interactions are crucial if our membership is to be able to communicate with other groups in an ever-increasing cross-disciplinary environment. It is partly for this reason that the Council on Engineering (COE) of ASME is looking into allowing divisions to re-align themselves with others that share common interests. For example, the Energy Conversion Group might choose to combine with the Energy Resources Group to form an energy institute (similar to the International Gas Turbine Institute). This institute would function as an autonomous technical and financial unit, while still being part of the ASME. Such a merger should be a win-win situation for

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New Energy Track at the 2002 IMECE

For the 2002 IMECE, ASME is organizing not only discipline-specific technical sessions, but also panel discussions and invited talks in various tracks that span several different disciplines and divisions. These sessions are meant to provide a more global view of the respective topics, with the objective of how a wide variety of engineers and policy makers can contribute to the greater good through technological advances.

Fifteen sessions will be presented in the Energy Track, and will cover a wide range of topics including global climate change, unconventional approaches to power generation, the future of fossil fuel and renewable resources, energy efficiency technologies, the security of the energy infrastructure, and novel energy utilization. These sessions will provide a lively forum for the presentation and discussion of new ideas in the energy field. The Energy Track is also of particular interest for those concerned with the practical application of energy technology. All members who are interested in these topics are urged to attend the Energy Track sessions at the 2002 IMECE.

Srinivas Garimella

Chair's Message

(continued from page 1)

all concerned. The re-structuring plans are currently being discussed by the COE, while various divisions are identifying their niche in the new structure.

In addition to conference activities, the AESD participates in an annual dedicated issue of *Mechanical Engineering*. Also, the ASME Transactions Journal of Energy Resources Technology (JERT) publishes peer-reviewed articles of archival value in areas of interest to the membership. Professor Michael Moran is the AESD Special Publications Liaison and has been a great resource for many years. Researchers who believe their papers have a lasting value should submit them to JERT. There is an existing procedure by which ASME conference papers can undergo a simultaneous review process for the journal with the intent of speeding up the review process.

I would like to welcome our two new Executive Committee members, Dr. Michael von Spakovsky and Dr. Muhammad Rahman. Dr. von Spakovsky is also the ASME Representative to the Centre for the Analysis and Dissemination of Demonstrated Energy Technologies - Energy and Environmental Technologies Information Centres. Dr. Rahman is the current chair of the Direct Thermal Power Conversion and Thermal Management Technical Committee. I am looking forward to the contributions of these two capable individuals.

In closing, I would like to urge all interested individuals to get involved with the AESD. We will hold several committee meetings at the upcoming IMECE in New Orleans. These meetings are open, and all are welcome to attend. I would also like to remind you that the Division intends to make a stronger commitment to the IECEC. This is a major energy conversion event that has researchers from the space power, the terrestrial energy, and the electrical power community sharing one venue to present their latest findings. As the current IECEC Steering Committee Chair, I invite the participation of the professional societies that previously sponsored the IECEC.

Again, I thank you for giving me this opportunity to lead the Division.

S.A. Sherif

AES Division Participation in IECEC

The 37th IECEC was held in Washington, D.C., July 28 - July 31, 2002, with about 42 technical sessions, where authors from the U.S. and abroad presented about 200 papers. Starting next year, the new International (instead of Intersociety) Energy Conversion Engineering Conference (IECEC) will be administered by AIAA, and hosted in succession by AIAA, ASME and IEEE. Concerns about dropping attendance at this conference in the past five years or so were allayed by the Steering Committee pledging to take a more proactive role in conducting a tighter conference with peer-reviewed papers presented in "energy conversion" topics both in aerospace as well as terrestrial applications. It was felt that there was still a need for such a crosscutting conference to cover all the energy conversion topics across the whole domain. On behalf of AESD, Dr. S.A. Sherif (current chair of the Steering Committee) has pledged full and unqualified support to contributing to the Conference Program through its various subcommittees, and also to try and convince other divisions and groups (who have coverage for energy-conversion related topics) within the COE of ASME to actively participate in future conferences. So, it is up to all of us to make sure his pledge comes true.

In 2003, the First International Energy Conversion Engineering Conference will be held in Portsmouth, Virginia, August 17-21, 2003. While not an AIAA conference, abstract submissions will be accepted through AIAA's web site at: *http://www.aiaa.org* through January 31, 2003. The web site is open for abstract submittal starting September 1, 2002. Hard copy submissions can also be submitted to Dr. Ashwani K. Gupta, IECEC Technical Program Chair, Combustion Laboratory, University of Maryland, Department of Mechanical Engineering, College Park, MD 20742, (301) 405-5276, (301) 314-9477 (Fax), *akgupta@eng.umd.edu*.

Sriram Somasundaram

Publication Opportunities for AESD Authors

Several opportunities are available for AESD authors to publish their technical articles. These include symposia, the monthly *Mechanical Engineering*, and archival journals. AESD authors are encouraged to give a tangible expression of their ASME affiliation by considering these publication outlets.

Opportunities for publishing technical papers are provided by the symposium volumes of the IMECE AESD technical sessions. Normally one or more such volumes are prepared annually, comprised of the dozens of papers presented at the IMECE. Such papers may be eligible for consideration for the prestigious E.F. Obert Award.

Symposium volumes are available for purchase at IMECE or may be ordered directly from ASME technical publications. Abstracts are generally due in January for papers to be presented at the following IMECE. Authors wanting to participate in the 2003 IMECE should check the calls for papers in the monthly meetings calendar in *Mechanical Engineering* or visit *http://www.asme.org/events/*.

Nearly every summer for several years, AESD also has participated in symposia held outside the United States at various memorable sites. The 2002 event, ECOS 2002 (Efficiency, Costs, Optimization, Simulation and Environmental Aspects of Energy Systems) was held in July in Berlin, Germany. ECOS 2003 will be held in Copenhagen, Denmark from June 20 through July 2, 2003. Papers for such conferences are reviewed according to ASME standards, and the symposium volumes are published by ASME or commercial publishing houses. For information concerning upcoming conferences, authors should check the meetings calendar in *Mechanical Engineering* or visit *http://www.asme.org/events/*.

Additional outlets for technical articles by AESD authors are provided by the archival ASME journals: *Journal of Energy Resources Technology*, *Journal of Engineering for Gas Turbines and Power*, and *Journal of Turbomachinery*. Owing to peer review requirements and some queuing of accepted papers before publication, a year or more can elapse between submission and publication. Still, archival journals are the appropriate forum for articles of enduring value. Prospective authors should see current issues of the journals for submission instructions.

Periodically, AESD has a special section in *Mechanical Engineering*. Special sections are comprised of articles submitted by various AESD technical committees on a rotating basis. Members interested in participating in this activity should contact the AESD chair and/or their technical committee chairs.

AESD authors also can participate in the annual IECEC conferences held during the summer. IECEC 2002 was hosted by IEEE in July in Washington, DC. The 2003-2005 events will be hosted by AIAA.

For answers concerning your questions about AESD publishing opportunities contact M.J. Moran (contact information is provided at the end of the newsletter).

M.J. Moran

Rahman and von Spakovsky Named to Executive Committee

M. M. Rahman

Dr. Muhammad Mustafizur Rahman is one of the new Executive Committee members for the AESD. He is an Associate Professor in the Department of Mechanical Engineering at the University of South Florida. His principal research work has been in the fields of modeling and simulation of thermo-fluid systems, heat transfer, and energy conversion. He received a B.S. from Bangladesh University of Engineering and Technology, an M.S. from the University of Manitoba, and a Ph.D. from the University of California, Berkeley. After holding a research faculty position at Wright State University and a senior research position at Mainstream Engineering Corporation, he joined the University of South Florida in 1993. He has served as an Associate Technical Editor for the *ASME Journal of Solar Energy Engineering* since 1998 and chaired the AESD Direct Thermal Power Conversion and Thermal Management Technical Committee since 2000. He has authored or co-authored 87 archival papers and co-edited 3 conference proceedings. He received the USF Outstanding Teaching Award in 1997, a Best Paper Award at the Conference on Renewable and Advanced Energy Systems in 1999, and the SAE Teeter Educational Award in 1999.

M. R. von Spakovsky

Dr. Michael von Spakovsky is the other new Executive Committee member. He is a representative from ASME to the Centre for the Analysis and Dissemination of Demonstrated Energy Technologies - Energy and Environmental Technologies Information Centres U.S. National Team. He has over 13 yrs of teaching and research experience and over 17 yrs of industry experience. He received a B.S. in Aerospace Engineering from Auburn University and M.S and Ph.D. degrees in Mechanical Engineering from the Georgia Institute of Technology. He has held prior positions at NASA, the power utility industry, and the Swiss Federal Institute of Technology. Since 1997, he has been a Professor of Mechanical Engineering and Director of the Energy Management Institute at Virginia Tech and has taught courses in thermodynamics, fuel cell systems, and energy system design. His research interests include computational methods for modeling and optimizing complex energy systems, methodological approaches for the integrated synthesis, design, operation and diagnosis of such systems, theoretical non-equilibrium and equilibrium thermodynamics, and fuel cell applications.

AES Division Awards and Keynote Lecture

The AES Division recognizes the contributions of its members and researchers and educators in Advanced Energy Systems at the annual AESD Luncheon at the IMECE. The contributions of these individuals are truly outstanding and are one of the main reasons for the continued advancement of energy related technology. The Awards Luncheon also offers the opportunity for attendees to hear from a leading expert on issues at the forefront of such research and technology.

At the 2001 IMECE, Rita Bajura, Director of the National Energy Technology Laboratory, gave a stimulating talk on "The Energy Policy of the United States." Ms. Bajura spoke about how to intelligently use America's energy resources, and the need to develop technologies that can better utilize existing resources such as coal. Ms. Bajura also discussed the necessity for developing new power generation and distribution methods that will increase energy security.

The following awards were given at the 2001 IMECE:

The Edward F. Obert Award recognizes an outstanding paper on thermodynamics authored during the preceding two calendar years. In 2002, Anna Stoppato, Cristian Carraretto, and Alberto Mirandola were selected for their papers on "A Diagnosis Procedure for Energy Conversion Plants."

The 2001 *Heat Pump Technical Committee Best Paper Award* was given to A. Laveau, J. S. Kapat, L. C. Chow, E. Enikov, and K. B. Sundaram for their paper entitled "Design, Analysis, and Fabrication of a Meso-Scale Centrifugal Compressor."

The Systems Analysis Technical Committee gave two awards in 2001. The *Best Paper Award* was presented to D. A. Betts, V. P. Roan, and J. H. Fletcher for "Discussion and Analysis of Flue Gas Utilization in a Phosphoric Acid Fuel Cell Engine During Idle Operation." The *Best Student Paper Award* was given to J. R. Munoz and Michael von Spakovsky for their paper "The Use of Decomposition for the Large Scale Synthesis/Design Optimization of Highly Coupled, Highly Dynamic Energy Systems."

Additionally, the following members of the AESD were elected Fellows of ASME:

Dr. Robert C. Brown
Dr. Landis D. Kannberg
Dr. Ziung Nei, P.E.

Congratulations and a hearty thanks to all these awardees!

Fuel Cell Systems and Their Promise for the 21st Century

Michael R. von Spakovsky

Within the context of mounting pressures on existing resources and the environment, fuel cell systems can and probably will play a major role. From a first and second law standpoint, their potential for effectively contributing to solutions is great. This is true for fuel cells as standalone systems and as systems working in concert with more conventional energy conversion processes.

To put this potential into perspective, it is useful to consider the performance of competing technologies (see Figure 1). For example, the average yearly efficiencies for systems based on renewable energies range from a high of 70-90% for hydroelectric power to a low of 10-11% for photovoltaic. However, hydropower can play only a limited role in the expansion of world generating capacity, particularly in the developed countries due to the lack of new exploitable water resources and the environmental implications of building such systems. In addition, photovoltaic, thermal solar, and wind are location dependent and intermittent in nature, requiring storage or coupling with conventional systems. Costs per kWh are thus high, and even though significant progress in their development has been made over the last three decades, their role as major energy producers will continue to be limited in the near to mid-term.

For systems based on non-renewable energy resources, tremendous progress has been made since the turn of the 19th century, when many system efficiencies were less than 1%. In fact, a number of significant improvements have occurred in the last two to three decades, both with respect to the possible types of systems possible and the attainable efficiencies and costs. Of the existing types, internal combustion engines, steam turbine cycles, and gas turbines have seen the greatest advances. Costs per kWh have come down, as have emissions, due to improvements, for example, in combustion chamber designs (e.g., low NOx burners, steam or water injection, etc.) and cycle enhancements such as sequential combustion, improved blade cooling, regeneration, exhaust gas recycling, improved materials, etc. However, the drawback to some of these systems has been the elevated costs of emission clean up.

Combined gas and steam turbine cycles and integrated gasification combined cycles continue to push efficiencies ever higher. Additionally, emissions have been greatly reduced due to the use of cleaner fuels and improved technologies. However, technological limits on efficiency are fast being approached due to their reliance on combustion technology, and will probably plateau between 63% and 65% over the next decade.

For nuclear plants, efficiencies have remained stagnant at about 32-34% over the last three decades. This is primarily due to safety considerations and to a dependence on reactor designs (BWR and PWR) little evolved from those developed in the 1950s. Newer and better designs exist but are not being built due to political and social impediments resulting from real and perceived nuclear core and radioactive waste safety issues.

So, the question arises: How do fuel cell systems (see Figures 2 and 3) stack up against the competitors? The simple answer is: quite well! One of the reasons is that during the last three decades, there has been a significant upsurge in fuel cell research and development. By no means a new energy conversion process, interest in fuel cells ceased in the late 19th century and did not re-emerge until the work of Francis Bacon and his co-workers in 1932, gaining impetus during the 1960s from the American space program. What is remarkable is the comparatively high efficiencies and relatively low emissions that these devices already exhibit in an early stage of development both for transportation and portable and stationary power production. Advantages of these types of systems are their high energy conversion efficiencies at design and *off-design* (the latter provides a significant advantage for fuel cells over other more conventional systems); performance that is roughly independent of system size and load factor; lower emissions (but not zero emissions); no moving parts in the stacks resulting in lower maintenance costs; high power density; modularity; and low and relatively low operating temperatures and pressures, respectively.

There are five basic types of fuel cells, which have seen or are seeing significant development: the AFC, PEMFC, DMFC, PAFC, MCFC, and SOFC. Of these, one of the most promising is the proton exchange membrane fuel cell (PEMFC). The PEMFC is often considered as a potential replacement

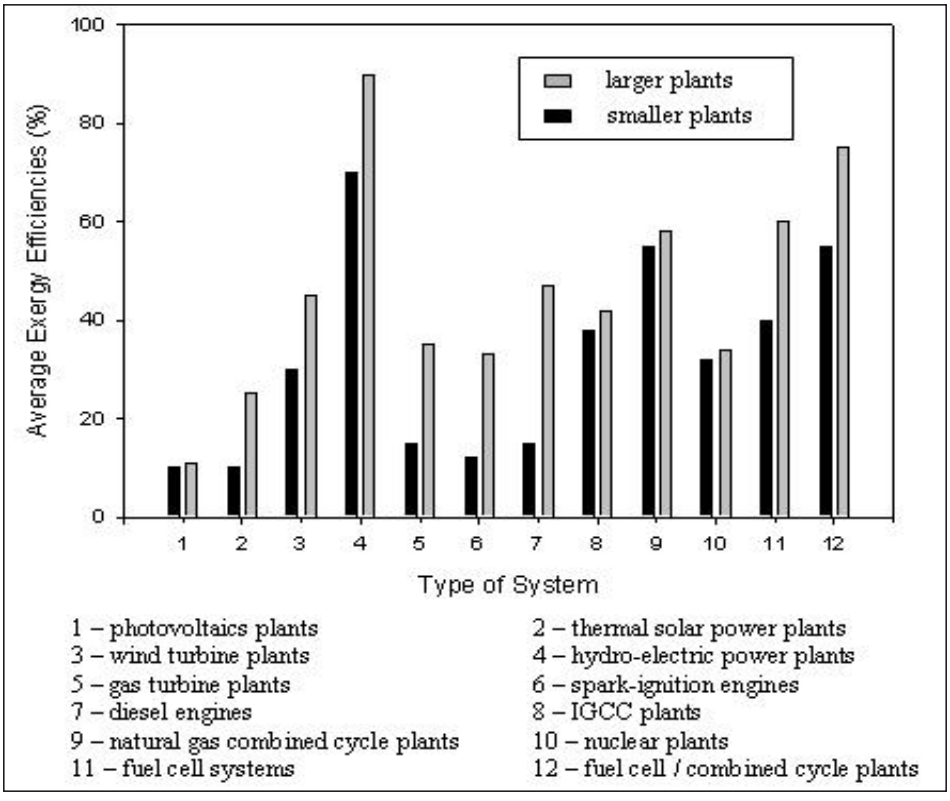

Figure 1. Average Full-Load Exergy Efficiencies of the Principal Types of Energy Conversion Systems (Note that the "larger/smaller" designation in the legend does not apply to fuel cells, but rather to the type of fuel cell system used.)

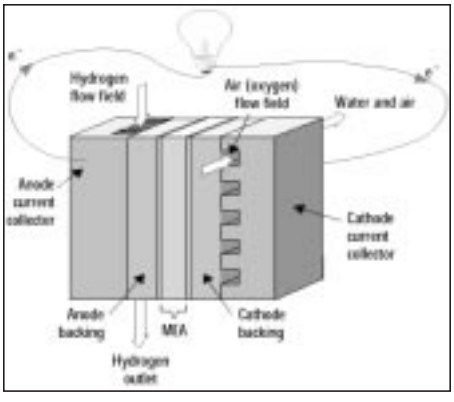

Figure 2. Single Cell Fuel Cell

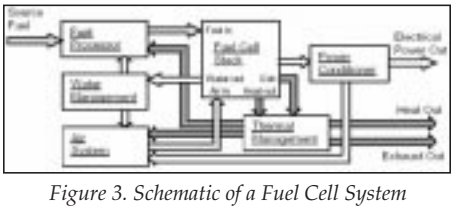

Figure 3. Schematic of a Fuel Cell System

for the internal combustion (IC) engine in transportation applications. The efficiency of a PEMFC stack operating on hydrogen and pressurized air at typical operating current conditions would be approximately 50%. The PEMFC also provides a very high power density. Automotive fuel cell systems based on PEMFC technology have demonstrated a power density as high as 1.35 kW/l, which is comparable to that of the IC engine. This power is produced while the cell operates at a relatively low temperature of 60-80°C. The low operating temperature permits the fuel cell to warm up quickly. The combination of high efficiency, high power density, and rapid start-up makes the PEMFC attractive as a replacement for conventional automobile engines.

Unfortunately, the low operating temperature leads to very slow chemical kinetics. Precious metal catalysts, typically platinum, must be used in the electrodes to facilitate reactions. As recently as 10 years ago, the cost of the catalyst alone was as high as $184/kWe, making the PEMFC too expensive for most applications. In recent years, dramatic advances in the design of the electrodes and the application of the catalyst have led to catalyst costs approaching a design goal of $3.50/kWe. However, further advances in technology and manufacturing are needed to reduce the cost of other cell components, particularly the collector plates, which are typically machined from graphite. Assuming application of the mass manufacturing techniques that would be associated with a large-scale deployment of PEMFC technology, such as in automobiles (see Figure 4), the US Department of Energy has established a goal of $35/kW for the fuel cell stack. Even at ten times this price, PEMFC technology would be attractive in a wide range of stationary and portable power applications (see Figure 5).

Like the PEMFC, the direct methanol fuel cell (DMFC) typically uses a polymer membrane as the electrolyte. In the DMFC, however, the fuel is methanol, which is dissolved in liquid water and supplied to the anode. Since it is a liquid, methanol is easy to transport, and since it is used directly in the stack, there is no need for a fuel processor. However, because the reaction rate for methanol on currently available catalysts is slow, DMFCs have relatively low efficiencies and power densities. Furthermore, since methanol is soluble in the polymer membrane, it can cross over to the cathode where it reacts without producing electrical power, thus further reducing efficiency. However, DMFCs can be competitive with batteries in terms of storage density. Currently, the most promising applications for DMFCs appear to be as replacements for batteries in small portable power applications where the simplicity of the system and the portability of the liquid methanol fuel outweigh the relatively low efficiency.

Figure 4. PEMFC Powered Fuel Cell Vehicle

Figure 5. Portable Fuel Cell Application

The phosphoric acid fuel cell (PAFC) was the first fuel cell to be commercially available (see Figure 6). PAFCs operate with efficiencies that are comparable to PEMFCs but with lower power densities. The operating temperature of the PAFC is approximately 200°C. This temperature is high enough to facilitate the recovery of heat produced within the stack for water and space heating in building applications. However, the operating temperature is not high enough to overcome the need for precious metal catalysts. Furthermore, despite years of intensive development, the costs of these systems have not fallen sufficiently. PAFC fuel cell systems, each of which includes a natural gas fuel processor, are commercially available at an installed cost of approximately $5000 to $5600/kWe.

Nonetheless, PAFC systems have been practically demonstrated through a number of projects. One of the largest demonstration projects is the U.S. Department of Defense Fuel Cell Demonstration Program that has placed 30 PAFCs in a variety of applications, including boiler plants, hospitals, dormitories, and office buildings. Current information on this program is available at *http://www.dodfuelcell.com*. While these programs have demonstrated the technical feasibility of applying PAFC systems, the widespread economic feasibility of these systems will depend on reducing costs by at least a factor of two.

Molten carbonate fuel cells (MCFCs) are typically designed for mid-size to large stationary (or shipboard) power applications. The MCFC operates at a very high temperature of approximately 650°C. At this temperature, precious metal catalysts are not required for the fuel cell reaction, and the heat available from the stack can be used to produce steam and hot water in building cogeneration applications. Furthermore, at this temperature, fuel gases other than hydrogen can be used by reforming the fuel within the cell stack in a process called *internal reforming*. This greatly simplifies the *balance of plant* equipment required to operate the fuel cell. Heavier hydrocarbons may still require external fuel processing.

Development efforts for MCFCs are focused on reducing costs and increasing the life of cell components in the harsh, high temperature environment within the stack. Systems based on MCFC technology are expected to be available within 5 years at costs ranging from $2000 to $3000/kWe. The target markets for MCFCs include small, distributed generation systems for utilities as well as building cogeneration systems at sizes of 0.1 to 2.0 MWe.

The solid oxide fuel cell (SOFC) operates at the highest fuel cell system temperature (800-1000°C). These high temperatures simplify system configuration by permitting internal reforming and also facilitate the development of cogeneration systems and hybrid power systems that use fuel cells as topping cycles for gas turbines or steam cycles. Development efforts for SOFCs are focused on reducing manufacturing cost, improving system integration, and lowering the operating temperature to the range of 550-750°C. The lower operating temperature would still provide the advantages of internal reforming without the material problems associated with very high temperature operation. Systems based on SOFCs are being considered for a variety of purposes, ranging from small applications such as residential power systems and vehicle auxiliary power units, where the simplified fuel processing requirements associated with SOFCs are attractive, to large utility-scale applications, which benefit from the high efficiencies obtained by combining SOFC systems with gas turbines or steam cycles.

In conclusion, many believe that fuel cell systems promise to provide benefits in a variety of applications. Systems based on PEMFC and DMFC technology promise to make power more portable and convenient, while those based on PEMFC technology promise to provide a more efficient, cleaner technology for the automotive industry. All four technologies, PEMFC, PAFC, MCFC, and SOFC, are likely to be applied in building cogeneration applications. With combined cycle and cogeneration thermodynamic (exergy) efficiencies potentially above 70 and even 80%, these applications promise to reduce energy use and environmental impact. Many research and development organizations, manufacturers, and regulatory agencies are working to ensure that fuel cell systems fulfill their promise in each of these areas.

Figure 6. ONSI's Commercial PAFC PC25 200kWe Cogeneration Power Plant System

COMMITTEE REPORTS

Direct Thermal Power Conversion and Thermal Management

The committee promotes research and development in all areas of direct conversion of heat to electric power without any moving parts or thermal management of energy. Direct thermal energy conversion devices include thermionics, thermoelectrics, AMTEC (an alkali metal thermal-to-electric converter), and TPV (thermophotovoltaics). All areas of thermal management, including aircraft and spacecraft, ground vehicles, electric components and power systems, and industrial energy systems are covered. The committee participates in the IECEC, IMECE, and other conferences related to advanced energy systems. During this year, the committee organized two sessions at the Intersociety Energy Conversion Engineering Conference held in Washington, D.C., in July-August, 2002, and two sessions for the IMECE to be held in New Orleans, Louisiana, in November 2002.

Muhammad Rahman

Heat Pumps

The main objective of the Heat Pump Technical Committee is to help advance the state of the art of heat pumps, which play an essential role in the lives of human beings. The ongoing depletion of energy resources is driving science and technology towards innovation in the art of energy production, storage and transmission. Refrigerators, air conditioners and other heat pumping devices being marketed today are expected to perform at high efficiencies. Therefore, this is a time with great challenges and promise for engineers and researchers who want to focus on the art, science and technology of heat pumps.

The committee organizes technical sessions at the annual IMECE to bring together researchers working on the fundamental understanding and development of heat pumps. During the 2001 IMECE in New York, the committee's seven technical sessions and one panel session were well-attended. At the 2002 IMECE, one panel session and five technical sessions, including an invited paper session on *Heat Pump Systems and Components*, have been organized.

To encourage research and participation at these symposia, the committee presents a *Best Paper Award* to the authors of the paper adjudged as the best amongst those presented at the previous year's congress. For 2001, the paper by Y. Jiang and S. Garimella entitled "Compact Air-Coupled and Hydronically Coupled Microchannel Heat Pumps" has been selected. The award, which also carries a $500 prize, will be presented to the authors at the 2002 IMECE. Beginning at this year's IMECE, the committee will also select a recipient for the *Best Student Paper Award*.

The committee meets once a year at the IMECE. The 2001 committee meeting was well attended with members expressing interest in organizing technical sessions. At the 2002 meeting, Dr. B.G. Shiva Prasad of Dresser-Rand will transfer the Chairmanship to Dr. Abdi Zaltash of Oak Ridge National Laboratory, who is currently the Vice-Chair. Also, an election will be held for the position of secretary.

B. G. Shiva Prasad

Energy Systems Miniaturization

This committee organized a successful and well-attended session at the 2001 IMECE in New York on miniature devices that may play a role in future portable power systems. Members interested in topics such as miniaturization of energy conversion systems and components, micro-scale phenomena, micro-fabrication and other related issues are encouraged to participate in the activities of this committee.

Richard B. Peterson

Superconductivity

The Superconductivity Technical Committee provides a forum for presenting the most recent progress in the field of applied superconductivity. The committee continues its efforts in sponsoring paper sessions, including those co-sponsored in conjunction with other ASME committees. New members are sought to bring in new ideas and to help coordinate future activities. Information on this committee can be obtained by contacting committee chairman, Dr. Ming Chyu, whose contact information is in the back of this newsletter, committee vice chairman, Dr. John R. Hull, Argonne National Laboratory, (708) 252-8580, or committee secretary, Dr. P. E. Phelan, Arizona State University, (480) 965-1625.

Ming-C. Chyu

System Analysis

Nine technical sessions and two panel discussions comprise the *Symposium on Thermodynamics and the Design, Analysis, and Improvement of Energy Systems*, organized for the 2002 IMECE by the Systems Analysis Technical Committee. Sixty-four papers were submitted, of which forty-seven were accepted for publication in the proceedings. The authors for these papers came from fifteen different countries (Mexico, United States, France, China, Italy, Greece, Brazil, Canada, Colombia, Spain, Germany, Malaysia, Korea, Iran and Argentina), indicating the worldwide interest in our symposium. Nine technical sessions were organized, with papers covering a wide range of theoretical and applied aspects, as well as two panel sessions. The two panels are on topics of strong current interest: "Low-Zero-Emission Power Plants," and "Status of Fuel Cells Technology Development," and have the participation of panelists from government, industry and academia, with the intention of having an open discussion on the key issues to be resolved in the near term.

With the goal of encouraging the participation of young researchers, the Systems Analysis Technical Committee has instituted the *Best Paper Student Award* for papers in which the first author and presenter is a full-time student. Two other awards are given by our Systems Analysis Technical Committee: one to the best paper presented at the symposium, and also the prestigious *ASME Edward F. Obert Award* for the best paper in Thermodynamics.

Abel Hernández-Guerrero and Kau-Fui Wong

Hydrogen Technologies

This technical committee promotes communication between all people that work on hydrogen technologies, including hydrogen production, storage, utilization, system analysis and safety.

Hydrogen can be produced exclusively from H_2O using electricity and/or heat from solar, wind, fission, or fusion sources. H2 can therefore uniquely serve as a versatile and universal energy carrier for all carbonless power sources, the crucial element of a global energy system free of air pollution, CO_2, and other greenhouse gases. If generated using renewable energy, H_2 is an inexhaustible fuel, since it relies on cyclic use and reuse of the cleanest, most abundant, natural, and elementary substances: H_2O, O_2, and H_2.

The Hydrogen Technologies committee urges people from industry, academia and government to share their experience with the international community. We are planning to have a hydrogen session at the IMECE 2003 in Washington, D.C. Those wishing to participate by contributing papers or helping to organize the session can contact Joel Martinez-Frias (contact information at the end of the newsletter). The committee appreciates all suggestions of activities that can be performed to improve the role of this forum.

Joel Martinez-Frias

Fuel Cells

The fuel cell committee activity has been limited recently to the PTC-50 fuel cell performance test code work. We welcome input and participation from others on fundamental and applied issues pertaining to the development of fuel cells.

Tony Leo

Stirling Engines

There has been relatively little large-scale development in the Stirling engine community recently. While it is expected that the return of energy issues to the public consciousness will reinvigorate interest in these efficient and clean energy converters, in the mean time, companies and researchers interested in this technology have focused on specialty applications such as small free-piston power units for deep space missions, stand-alone compact gas-fired generators, and others.

Hybrid Stirling-acoustic engines using gas inertia to achieve the desired gas motion and pressure waves are being developed for potential application in self-powering home furnaces. Also, miniature Stirling cryocoolers have been in production for the military for some time. Members interested in expanding the activities of this committee are encouraged to contact John Corey (contact information at the back of this newsletter.)

John Corey

ADVANCED ENERGY SYSTEMS DIVISION 2002-2003

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The AES Division has planned a very stimulating technical program at this year's IMECE in New Orleans, LA. A total of 20 sessions including panel sessions on current topics will be held. The papers scheduled in these sessions include numerous contributions from outside the U.S. and from industry, demonstrating the wide-ranging and global appeal of the technical topics being addressed by the AES Division. A list of session titles is provided below. Division members are also organizing several sessions for the Energy Track, more details of which are provided elsewhere in this newsletter. Please be sure to participate in these informative sessions and add your valuable input wherever possible, especially during the discussion period at the end of each paper or panel presentation. We hope to see you there.

Direct Thermal Energy Conversion/Thermal Management Technologies And Systems
Direct Thermal Energy Conversion/Thermal Management Technologies and Systems (2 Sessions)

Heat Pump and Refrigeration Systems Design, Analysis, and Applications
Heat and Mass Transfer in Heat Pump/Refrigeration Cycles
Fluid Mechanics and Heat Transfer in Positive Displacement Compressors
Invited Paper Session on Heat Pump Systems and Components
Heat Actuated Sorption and Desiccant Heat Pumps
Emerging and New Technologies for Heat Pump and Refrigeration Cycles and CHP
CFD for Positive Displacement Compressors *(Panel Session)*

Thermodynamics and the Design, Analysis, and Improvement Of Energy Systems
Energy Systems and Design (2 Sessions)
Fundamentals of Thermodynamics
Fuel Cell and Hydrogen Technologies (2 Sessions)
Applied Thermodynamics
Thermodynamics of Energy Systems and the Environment
Thermodynamics of Power and Process Plants (2 Sessions)
Fuel Cells
Low- to Zero-Emission Power Plants *(Panel Session)*
The Status of Fuel Cell Technology Development *(Panel Session)*

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