

# GLOBAL

# Gas Turbine News

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and more!

## Introducing...

With this issue, a new layout for the *Global Gas Turbine News* for the new millennium. We hope you enjoy the change.

**ASME TURBO EXPO**  
**LAND, SEA & AIR**  
**2000**

8-11 May  
Munich, Germany

## WOLFGANG DEMISCH TO ADDRESS “INDUSTRY IN TRANSITION”

## AT TURBO EXPO 2000 IN MUNICH

*König and Steffens Will be Featured Technology Speakers*

More than 4,000 engineers, managers and executives from 55 countries around the world will be in Munich May 8-11 to participate in ASME TURBO EXPO 2000, the world's most esteemed technical program for the international gas turbine industry. This important international meeting includes a four-day Technical Congress, a four-day Gas Turbine Users Symposium and a three-day Exposition. Together the technical programs will feature 614 refereed technical papers presented in 122 sessions. These will be supplemented by 32 other sessions including panels, tutorials, and discussion groups. Most of the panels and a special “User's Lite and Technical Lite” tutorial will be directed toward solving the problems of the gas turbine user as part of the Gas Turbine Users Symposium (GTUS).

Speaking before this distinguished audience of industry professionals at Monday's opening Keynote Session will be Wolfgang H. Demisch, managing director of Wasserstein Perella Securities, Inc. Mr. Demisch has over 20 years' experience as a senior securities analyst and is responsible for coverage of aerospace, defense and high technology industrial companies. Mr. Demisch has made multiple appearances on national financial television in the United States, including *Wall Street Week*.

In concert with this year's theme of “Industry in Transition,” Demisch will speak on “Turbines and Wall Street.” His working thesis is: “Economics is emerging as the critical variable in gas turbine design. ROI (return-on-investment) drivers such as capital cost and development time are overriding operational measures of merit such as SFC or thrust/weight. The implication for the designers, builders and sellers of

gas turbines in all applications is that their current processes must be radically simplified to free up the resources needed to pursue new technology. Sale of service marketing and E-commerce are among the options.”

Supplementing the insights of Wolfgang Demisch will be those of our two Featured Technology Speakers, Norbert König of Siemens AG, Power Generation Group (KWU), and Dr. Klaus Steffens of MTU Munich.

Mr. König was appointed to the Group Executive Management of Siemens AG, Power Generation Group (KWU), in October 1998. His responsibilities include Fossil Power Generation



Wolfgang H. Demisch



Norbert König



Dr. Klaus Steffens

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# Benefits of Attending ASME TURBO EXPO

For 45 years ASME's International Gas Turbine Institute has hosted an Exposition and Congress designed to be the world's premier event for those involved in the application and development of gas turbine technology. The Exposition is comprised of exhibits of land-based, aero, and marine gas turbine engine suppliers, support system component suppliers, manufacturing and engineering tool and process system suppliers and others generally associated with the gas turbine industry. The Congress is comprised of more than 500 technical paper presentations sponsored by the Institute's 17 committees. Both are complimented by a Gas Turbine User's Symposium specifically created to address topics of interest to those with a primary focus on the operation and maintenance of gas turbines. The overall experience provides you with a unique opportunity to interface with those involved in the design, development and use of gas turbines and gas turbine components, particularly with other experts in your area of interest.

For engineers who are in the early phases of their career, attending TURBO EXPO is a learning experience that cannot be duplicated by a traditional seminar. For senior practitioners the opportunity to exchange ideas on a variety of advanced topics and pursue others of interest is truly unique. Individuals interested in devoting a portion of their personal time toward professional society goals also have a variety of opportunities available.

Today's business climate is very sensitive to return-on-investment, as it should be. As I consider the cost for a U.S. participant to attend TURBO EXPO in Munich this year (assume about \$2,900 in direct expenses plus your time ... less if coming from Europe) and the corresponding benefits to the average engineer or marketing



**H. Allan Kidd**  
Chair  
IGTI Board of Directors

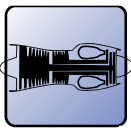
executive, I easily discover a favorable return. The minimum cost for a basic University sponsored research activity is \$10,000, for an in-company development program \$50,000, or for a weeklong seminar \$5,000. In the course of four days at TURBO EXPO you can comfortably observe at least 20 presentations and discussions on topics of direct interest to your company. In addition, you can spend the equivalent of one full day interfacing with exhibitors and colleagues discussing practical solutions to your problems or considering design improvements to your existing company products. I think it is reasonable to assume that two of the presentations will have immediate value to your company and that one practical solution to a problem can be developed from conversations with exhibitors and colleagues. Furthermore, you can obtain personal satisfaction and make long term contacts by participating in one or more technical committee meetings during the evening. A conservative estimate of the return-on-investment for the TURBO EXPO experience is 3 to 1. The benefit is further enhanced when you consider the fact that the information gathered is compressed into a cycle time of less than one week as opposed to 10 to 50 weeks for a typical research project or supply chain improvement.

Personally, I have found attending TURBO EXPO over the past 20 years to be a benefit to me both personally and professionally. I know my employer and my employer's clients have also benefited significantly. I trust that you will come to ASME TURBO EXPO 2000 in Munich and continue to work with the IGTI leadership team to implement the continuous improvements necessary to maintain TURBO EXPO as the premier gas turbine conference in the world. \*



***A conservative estimate of the return-on-investment for the TURBO EXPO experience is 3 to 1.***





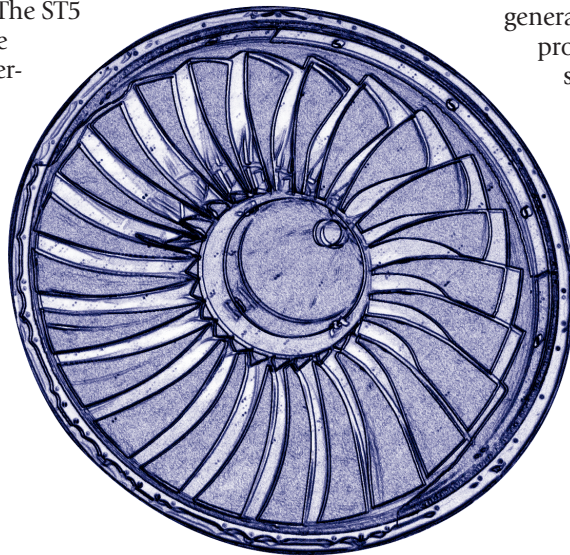
**GE POWER SYSTEMS** has completed agreements totaling nearly \$4 billion to supply power generation equipment and services to Duke Energy North America. The agreements cover the purchase of 36 Frame 7FA and up to 48 Frame 7EA gas turbines, plus 17 steam turbines and long-term services agreements for up to 23 merchant power plants across the country. All machines will be equipped with Dry Low NOx reduction systems. When completed, the power plants will produce more than 13 gigawatts of power for the wholesale U.S. market.

### **PRATT & WHITNEY CANADA**

announced the launch of a technology demonstration program for a new engine family intended for the distributed power generation market. The family, designated as ST5 will be offered in a power band ranging from about 250 kW to 600 kW. P&WC termed the engine a 'miniturbine', to distinguish it from smaller microturbines. The ST5 will be offered in simple cycle and recuperated versions for both peaking and base load applications. Pratt Canada expects simple-cycle efficiency to be better than 20 percent. A prototype is scheduled to be ready in late 2000.

### **VICKERS PLC**

agreed to a US\$933 million cash purchase offer from Rolls-Royce, with the intent to make Rolls-Royce a global leader in marine power systems.



**PANCANADIAN PETROLEUM LIMITED** announced that it has embarked on the final testing phase of a plan to generate electricity at oil field locations by burning natural gas in four, high-tech microturbines.

The natural gas-fueled microturbines from Capstone Turbine Corporation will each burn about 9,000 cubic feet of natural gas a day, generating up to 28 kilowatts of cleaner power. Each turbine provides sufficient electricity to run up to two oil well screw pumps. PanCanadian and Capstone have signed a memorandum of understanding to continue working jointly to improve the petroleum industry applications of the microturbines.

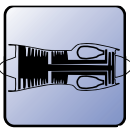
**ROLLS-ROYCE PLC** is to invest more than £1.6 million over five years to establish a Rolls-Royce University Technology Centre at the University of Southampton. The center, specializing in gas turbine noise research - particularly in relation to aircraft engines - will be based in the Institute of Sound and Vibration Research (ISVR) at the University's Highfield Campus.

The **RAYTHEON COMPANY** ordered **TELEDYNE CONTINENTAL MOTORS** in December to stop all work on its Tactical Tomahawk engine development contract. Teledyne's J402 turbojet was to be used. The J402 currently powers the Boeing Harpoon missile. Teledyne was not able to meet the required combination of fuel efficiency and maximum thrust on schedule. In parallel, Raytheon stated its intent to contract with Williams International for development of an alternative engine.

### **SERMATECH INTERNATIONAL INC.** and **SAMSUNG AEROSPACE INDUSTRIES, LTD.**

announced the formation of a joint venture that will provide surface treatment services for new and repaired flight turbine engine components. The joint venture, called Sermatech Korea, will apply aluminum-ceramic, diffusion, and thermal spray protective coatings to new-build flight turbine components. For engine components undergoing repair, the venture will apply the same protective coatings, and perform activated diffusion brazing and weld repair processes.

...continued on page 4



**AVIALL, INC.** has been awarded exclusive 10-year worldwide civil aftermarket parts distribution rights for Rolls-Royce (Allison) Model 250 turboshaft and turboprop engines. As of January 1, 2000, Aviall became responsible for all Rolls-Royce Model 250 aftermarket parts sales, marketing, order administration, warehousing, and product and publication distribution. Forecast International estimates over 30,000 Model 250 turboshaft and turboprop engines are in service worldwide.

Two **GENERAL ELECTRIC** CT7-8 turboshaft engines performed flawlessly on their 1.4-hour maiden flight. The engines were aboard Sikorsky Aircraft's new S-92 Helibus. The 2,500 shp (takeoff-rated) engines are to be FAA and European JAA-certificated before the end of 2000. The CT7-8, which is being jointly developed by GE and FiatAvio of Italy, features a new, increased-flow compressor incorporating technology developed under the U.S. Army's Joint Turbine Advanced Gas Generator (JTAGG) program. The engine also uses an advanced dual-channel full-authority digital electronic control (FADEC).

### **HAMILTON SUNDSTRAND**

expects to supply over \$1 billion worth of systems for Embraer's new ERJ-170/190 regional jets over the life of the programs. The ERJ-170/-190 will be the launch platform for Hamilton Sundstrand's new APS2300 APU. The APS 2300 APU is specifically designed to meet the requirements of the new, large regional aircraft.

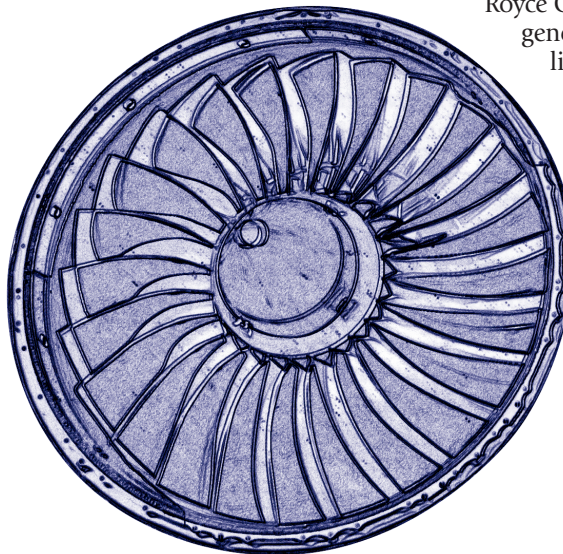
**AIR FRANCE** has launched GE's new-variant CF6-80E1A3 with an order to power eight firm and five optioned Airbus A330-200 aircraft. The engine order is valued at more than \$250 million. The CF6-80E1A3 will be rated at 72,000 pounds of thrust, and incorporates a new, more durable high-pressure turbine (HPT) made of Rene 88. In addition, the engine's compressor is enhanced with advanced 3D aerodynamics in the final eight stages for improved fuel burn and exhaust gas temperature (EGT) margins. The engine's increased thrust rating will provide the A330-200 with greater takeoff capability. \*

The **U.S. CONGRESS** has approved \$18 million in long-lead funding for the re-engining of GE TF-39-powered Lockheed C-5 airlifters. Funding in the FY2000 budget will enable Lockheed Martin to begin designing the new engine pylons for the aircraft. What has yet to be decided is how many aircraft will be re-engined. There are 126 C-5s in inventory; seventy-six are older-A model aircraft, the other 50 are newer-B model aircraft. Some or all of these could be re-engined, with new C-17 purchases making up any difference.

**ROLLS-ROYCE PLC** ("Rolls-Royce") and **BMW AG** ("BMW") reached agreement on a repositioning of their strategic relationship. Rolls-Royce takes full control of BMW Rolls-Royce GmbH, while BMW intends to increase its equity investment, through further market purchases, in Rolls-Royce to just over 10 percent. The two companies also intend to co-operate in areas such as R&D, purchasing and logistics. Sole ownership will enable Rolls-Royce to better align BMW Rolls-Royce's product strategy, marketing and R&D with the wider Rolls-

Royce Group. These measures are expected to generate cost savings of around 20 million pounds per annum by 2001.

BMW intends to become more gas turbine oriented by increasing its equity investment in Rolls-Royce.



### **ALLIEDSIGNAL INC.**

has announced that its new 131-9(A) Auxiliary Power Unit (APU) has completed its first year of service without a single unit having to be removed from an aircraft for repair.

*Gas Turbine News in Brief ...  
is compiled for  
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## Gas Turbine Industry Overview\*

by Lee S. Langston ... University of Connecticut, ASME Vice President – IGTI

**D**uring the last century, the American essayist Henry Thoreau wrote: “New ideas come into the world somewhat like falling meteors, with a flash and an explosion.” Just 60 years ago, the incarnation of such a new idea—the first jet powered aircraft—flashed across the skies above Baltic Sea shores in Germany, fulminating an explosive change in aviation, to start the Jet Age.

Hans von Ohain’s aviation gas turbine powered the first flight of the Heinkel He 178 on August 27, 1939 at the Heinkel Airfield in Marieneke. (Frank Whittle’s W1 jet engine, developed earlier, was to power the first British jet aircraft 20 months later.) Dr. von Ohain, who just passed away in 1998 at age 86, received the R. Tom Sawyer Award, IGTI’s highest honor, at the 1990 IGTI Gas Turbine Conference in Brussels. My wife and I sat with him at the awards banquet, where we asked him if he and his small team in 1939 had any idea that his (and Whittle’s) invention would spawn the vast gas turbine industry that we see today. No, he replied. What’s more, he doubted they could do the same task today—too much paper work! He also recalled that on the morning of the historic first flight, test pilot Erich Warsitz arrived in flight gear, carrying a hammer. When von Ohain asked about the hammer, Warsitz (who had just test flown Hitler’s first rocket powered aircraft) replied it was his escape tool, to be used if he needed to get out of the cockpit in a hurry.

Another historic gas turbine event occurred in 1939, lending weight to Victor Hugo’s observation that there is nothing more powerful than an idea whose time has come. Within the same year and some 500 miles to the south of von Ohain’s team, the Swiss company Brown Boveri completed development of the first modern land-based gas turbine. This gas turbine was installed at Neuchatel in the Swiss Alpine foothills to power a 4 MW electrical generator for backup power (and still does, six decades later). Thus 1999 marked the 60th anniversary of the gas turbine for both aviation and electric power generation applications.

Anniversaries provide the occasion to look back, and to better understand what is going on now. What is going on now in the gas turbine industry is continued and healthy growth. It has taken just these 60 years—a short interval in the history of technology—to make the gas turbine an overnight success.



### Market Results for 1999

Forecast International provides IGTI with information on the value of worldwide gas turbine production. The value of production estimates are more reliable indicators than factory sales estimates. Based on their estimates the value of production of gas turbines in 1999 will total \$34B worldwide, up 21% from \$28B in 1998 (which in turn, was up 12% from the 1997 total). To put these figures in some perspective, the total sales of electricity in the U.S. is currently about \$200B - \$220B per year.

The greater portion of the 1999 gas turbine market is associated with aviation. It is estimated that jet engine value of production totaled \$20B (up 11% from \$18B in 1998), which is 59% of the 1999 total (down from 64% in 1998). Of the aviation market, \$17.2B (up 15% from \$15B in 1998) was for the worldwide civil aviation market, with the remaining \$2.8B (7% less than 1998) for manned military aircraft around the world.

In general, the civil aviation gas turbine market was good for 1999 with more of the public flying and the start of a recovery for some of the

“  
...one can predict a dominance of land-based gas turbine sales may occur within the next decade.”  
”

depressed economies in Asia. Consolidation of repair and overhaul companies continued as the major engine manufacturers took over more of these businesses. This goes along with the new “power by the hour” maintenance agreements that the airlines are negotiating with engine companies.

The military market remained flat from 1998, reflecting current or projected military budget cuts worldwide. Several new fighter programs are on the verge of production, and the European nations are reassessing their air force inventories after the NATO bombing in Kosovo and Serbia, so that the military market may improve in the near future.

As in 1998, the non-aviation segment of the gas turbine market has experienced the fastest rate of growth. The value of production for this segment in 1999 is estimated to be \$14B (up 40% from \$10B in 1998). This represents 41% of the total gas turbine market (up from 36% in 1998). When one considers the rate of growth of the civil aviation market (15% from 1998) and that of non-aviation (40% from 1998), one can

\* Excerpted from IGTI’s 2000 Technology Report and Product Directory—Land, Sea & Air, pages 7-9.



predict a dominance of land-based gas turbine sales may occur within the next decade.

Of the non-aviation part of the market, 93% or \$13B (up 53% from \$8.5B in 1998) represents the value of production of electric power gas turbines. The remaining \$1B (down about 33% from \$1.5B in 1998) is accounted for by mechanical drive gas turbines (e.g. gas pipeline compressor drives) and for marine propulsion gas turbines.

It is obvious from these estimates that the market for electric power gas turbines boomed in 1999. There are at least two reasons for this:

- 1) Electric power gas turbine units fueled by natural gas now have the highest operating efficiencies (40% for simple cycle and up to 60% for combined cycle operations), are clean (less pollutants than other major combustion energy converters) and cost effective (low capital and operating costs).
- 2) The electric utilities in North America, which are now starting to be deregulated, are placing record orders to replace old equipment and to increase electrical power reserve margins, which have gotten to be dangerously low, especially in the U.S. Midwest.

This has filled the order books and production lines of the major gas turbine manufacturers for at least the next two years.

### Some Problems in 1999

The new electric power gas turbines being produced today are the cleanest of large combustion driven energy converters the world has ever seen. A gas turbine power plant burning natural gas will emit much less oxides of nitrogen (NOx) and as much as 43% less carbon dioxide as a coal burning steam plant of the same power output.

In the effort to meet new environmental regulations and to lower NOx emissions to even lower levels, the gas turbine industry has run into a combustion instability problem called "humming." It is so named for the low frequency sound emission that is its signature. The poet John Keats wrote: "Hear ye the hum of mighty workings -?" The mighty workings of a gas turbine in a sustained humming mode can lead to severe engine vibrations (e.g. a rumble), causing unit damage or shutdown. David Gillespie, who is a manager of several gas turbine merchant plants in the U.S. northeast explained to me that when humming sets in on one of his low NOx, high firing temperature, high mass flow rate machines, it means cutting back on power and operating at lowered plant outputs—and lowered plant revenues.

Humming is not completely understood yet, and a member of IGTI's Combustion and Fuels Committee has summarized the phenomenon as follows:

"As lean-premixed gas turbines drive the combustor toward the lean stability limit to minimize NOx, an acoustic instability can arise causing the engine to go into "humming." This instability can be initiated by slightly reducing the overall stoichiometry or by reducing the local stoichiometry in a flame stabilization site, such as reducing a pilot gas flow rate or by simply running the engine on a cold day. Advantages gained by a few ppm in NOx by operating the engine closer to this lean stability limit or at different ambient conditions, can be more than offset by triggering potentially damaging engine humming. Unlike the beauty of a humming bird, humming in a gas turbine results in high cycle fatigue failure which may not be limited to the combustor section of the engine alone. Similar to the humming bird, it can manifest itself in the blink of an eye with only a subtle change in operating conditions. The challenge to the gas turbine community is knowing where the boundary is and avoiding it."

The humming problem will eventually be solved, either by more cost-benefit analysis which could result in more enlightened emission regulations, or by improved technology through research and development—for which the gas turbine industry is renowned.

There is another problem, not strictly technical, that has gotten more acute during 1999. It has to do with the recent and growing experience of users and buyers of the larger (greater than 50 MW) and newer, more advanced electric power gas turbines as they are being introduced into the marketplace.

### Thank You...to the following committee members for their contribution to this year's overview.

COMMITTEE	REPRESENTATIVE
Combustion & Fuels	Jim Peters Tim Snyder Hukam Mongia
Controls, Diagnostics & Instrumentation	Rob Luppold
Cycle Innovations	Inaki Ulizar
Environmental & Regulatory Affairs	Manfred Klein
Industrial & Cogeneration	Rakesh Bhargava Howard Holland
Vehicular & Small Turbomachines	Mary Gerstner





During 1999, IGTI not only staged a highly successful Technical Congress and Gas Turbine Users Symposium, but also put on seminars in Atlanta, Houston and Buenos Aires on topics of interest to electric power gas turbine users, buyers, insurers and financiers. Complaints of seminar participants concerning new machines ranged from problems that the industry solved decades ago (rotor vibrations, through-bolt assembly procedures) to others that might have been solved through more OEM component testing before going to market (some of the humming problems, combustor parts that fail during operation and enter the gas path to cause downstream turbine damage). Much to their dismay, they concluded that extended commissioning periods, performance shortfalls, and outages for component repair or replacement have become all too common with the newest of large gas turbines.

### The Case for Certification

Harkening back to Hans von Ohain's story of his test pilot, Erich Warwitz—who was history's first "real" gas turbine user—one could argue that today's electric power gas turbine users also need a hammer for their own protection. That protection could come from the establishment of a third party certifier of performance standards for new electric power gas turbines. Such a certification process would help to eliminate some of the new machine problems discussed above, and a set of standards would level the playing field for all of the OEMs.

It is well known that such a certification process has long been established for civil aircraft gas turbines around the world. In the U.S. the third party certifier is the Federal Aviation Administration (FAA). I don't think anyone would argue that such regulation has slowed the pace of technical advancement of jet engine technology, or limited competition among jet engine manufacturers.

The FAA regulations are in place and have the force of the law behind them because they directly concern public safety. However, the gas turbine is now becoming the major means of electric power generation around the world. Society has now become so dependent on electric power – not only for basic needs but also for the electrons needed to run all our computer systems – that the possibility of a major electrical shut down (say in the U.S. northern Midwest in winter) does seriously involve public safety.

During 1999, discussions about performance standards, a certification program and a third party certifier have been going on between electric power gas turbine users, IGTI volunteers and ASME Codes and Standards volunteers to determine the merits of such an undertaking.

### Technology View of 1999

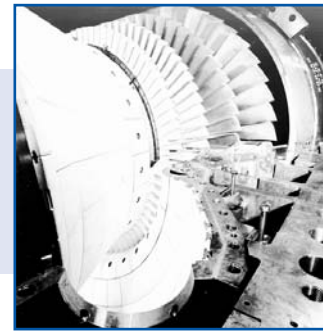
The success of the gas turbine in its 60 years has been fueled by the continued application of basic and applied technology to solve problems and increase performance. That which follows is a synthesis of reports from IGTI Technical Committee chairs and other volunteer leaders, highlighting some technical issues and progress for 1999.

### Cogeneration

Industrial and Cogeneration Committee Chair Rakesh Bhargava reports the following:

Deregulation of electrical utilities worldwide has changed the power generation market, particularly development of the power plants operating in cogeneration modes. The available data on new cogeneration plants, developed or under development in the last 18 months, suggest that the power rating of gas turbines used in cogeneration applications varies from 0.5 MW

to 170 MW. A large number of cogeneration plants use gas turbines with ratings 10 MW and smaller. The development of cost competitive microturbines (\$300 to \$500 per kW) and Solid Oxide Fuel Cells (SOFC) has shown some promising results for a small size power generation system. A considerable amount of research and development work is in progress to use the combined technologies of microturbines and SOFC's and it is shown that this combination can achieve overall electrical efficiency of 60% and higher. The prototype testing of this combination (GT + SOFC) was expected to start by 1999 and end with commercial availability, by some estimates, foreseen by 2005. Furthermore, preliminary studies have indicated that using a combination of microturbines and SOFC in cogeneration applications will achieve high electric efficiency and a decreased level of pollution.



### Microturbines

The Vehicular and Small Turbomachinery Committee Chair Mary Gerstner reports the following:

Microturbines made marketplace advances in 1999 with several companies initiating commercial production and sales. Capstone announced a milestone of 6000 hours of continuous operation of a unit at a customer site. Other companies have announced production starting in 2000. The early products introduced have been in the 25-100 kW range, but recent announcements from several producers have indicated that cogeneration units (initially hot water heating) are now being offered with some of the products.

Although the primary focus in the small gas turbine area has centered on distributed power markets, efforts in the vehicular arena continue. Recent sales of microturbines for commercial hybrid electric buses have been announced by at least two producers. The ability to operate with fuels from the existing infrastructure while producing extremely low emissions continues to be of great interest to the vehicular community in a world of ever more stringent emission regulations.



### Measurements and Control

Controls & Diagnostics Committee Chair Robert Luppold reports as follows:

The Propulsion Instrumentation Working Group (PIWG), an alliance of U.S. engine manufacturers who are working to standardize the industry specification for emerging instrumentation technology, held one of its meetings in parallel with the Indianapolis TURBO EXPO, using this major event as a "shop window" on the turbomachinery community. The high concentration of instrumentation manufacturers and suppliers at the Indianapolis exhibition and the presence of so many key instrumentation specialists resulted in an excellent interchange between instrumentation users, suppliers and developers.

The last twelve months has seen a rapid increase in the interest in optical probes and microsensors, i.e., the so-called Micro-Electro-Mechanical Systems (MEMS). As the MEMS manufacturing technology is developed, it is finding application in turbomachinery instrumentation, usually in combination with microelectronics. The technology reduces sensor size and cost by typically two orders of magnitude. The immunity to electromagnetic interferences makes optical sensors the preferred choice in some of the most demanding applications.

In the industrial sector of the market, low NOx combustion continues to be the major push. The control systems for these low NOx combustor systems are rapidly becoming more complex, with an emerging need for closed loop control on NOx and CO levels. The demand for NOx and CO sensors has increased sharply over the past 12 months.

The development of blade tip clearance probes that will form part of the closed loop control system has been actively pursued over the last year, with very significant progress, prompted by the emphasis on increased efficiency in large gas turbines.



**Those who set emission regulations should recognize that ... the construction and utilization of clean efficient gas turbine power plants will be the most effective way to reduce GHG and regional air pollution during the coming century.**



### Combustion

Combustion and Fuels Committee Chair Jim Peters reports as follows:

Significant advances have been made during 1999 in Computational Combustion Dynamics (CCD), combustion research and combustion technology. The National Combustion Code, a joint university, government and industry initiative, is coming close to validation and production under the guidance of the NASA Glenn Research Center. Significant advances have been made in many other combustion codes that, along with "best combustion models," will make possible "over-night million node calculations." This brings us a step closer to achieving an ultimate goal of making analytically predicted results for gas turbine combustor emissions and performance as reliable as engine data.

### Environmental Issues

During 1999 more gas turbine power plants were installed, replacing old units and reducing air pollution and greenhouse gases (GHG) for the same power output.

Environmental & Regulatory Affairs Committee Chair Manfred Klein pointed out in his report and in an 1999 article in IGTI's Global Gas Turbine News ("Is Lower PPM Better?" p.6-7, 1999, No.2) that regulations requiring simply a lower ppm of NOx emission level (which have given rise to the humming problem described above) are not necessarily better for the environment. Those who set emission regulations should recognize that, after the encouragement of energy conservation and the use of renewable resources, the construction and utilization of clean efficient gas turbine power plants will be the most effective way to reduce GHG and regional air pollution during the coming century. Improved efficiency is the key, not the single-minded goal of ultra low NOx. \*



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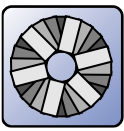
To stay "in-the-know" and up-to-date in the dynamic worldwide gas turbine market, contact Forecast International directly and begin receiving the benefits of having your own Weekly E-Mail News and Analysis Services. \*

## 1999 IGTI SCHOLARSHIP RECIPIENTS

**IGTI** is pleased to announce the recipients of its \$1,000 student scholarships for 1999. Schools with ASME student sections are eligible to apply for consideration. Scholarships are awarded to the school and the award recipient is then selected by the members of the ASME student section. \$20,000 in scholarships were awarded for 1999. This brings the total amount awarded by IGTI since initiating the Scholarship Program in 1986 to \$883,500. Please join us in congratulating the following IGTI Scholarship recipients and their schools:

Alfred State College*	James Sisson & Marc D. Harper
Arizona State University*	Christopher P. Urwiller & Adam G. White
Baylor University	Brett Matthew Taylor
Concordia University	Christopher Pin Harry
GIK Institute of Engineering Sciences & Technology	Adeel Khalid
Mississippi State University	TBA
Northeastern University	Timothy Goddard
Ohio University	Joseph Beyer
Penn State University	Lori Baker
Purdue University	Kwee Yan Teh
Syracuse University	Ellen M. Ellis
Texas A&M University	Robert L. Poling
University of Arizona*	Christopher Trangsrud & Clede O'Neal
University of California, Irvine	Vu Phi
University of Connecticut	Andris Bilmanis
University of Dayton	Lauren Perry
University of Florida, Gainesville	Gilbert Canton
University of Minnesota	Rupal H. Shroff
Virginia Polytechnic	TBA
West Virginia University	Christopher T. Yocum

\* Split Scholarship (\$500 each)



# Run Up to the Millennium: State of the Power Generation Gas Turbine Industry\*

by Jon Lane ... Datamonitor

## Merger-Mania

The most important development in the global gas turbine market during 1999 was the merger of the power generating activities of ABB and Alstom. The new company, ABB Alstom Power, encompassed all of Alstom Energy, except the heavy duty gas turbine business, which operated under license from General Electric (GE) of the USA. This was disposed of to GE. Likewise ABB kept its nuclear power business.

The effect of this merger will be felt globally. GE gained access to an installed base and to sales & marketing operations in Europe, whilst the world's largest power group will be strongly targeting the U.S. market—which is expected to have high order volumes for the next few years. The merger was brought about due to two major forces:

- Both ABB and Alstom lost out to their major competitors, GE and Siemens Westinghouse, on the large number of power plant orders in the U.S. during 1998; and
- Increasing customer pressures are forcing companies to become larger in order to compete.

The U.S. gas turbine market boomed during 1998, and order volumes have remained strong during 1999. Following years of under-investment in power plants by leading U.S. generating companies, the U.S. market suddenly caught fire during the second half of 1998. Uncertainty over the deregulation of the U.S. electricity market, led to uncertainty over return-on-investment for power plant developers. Investment had been so low in the USA that reserve margins remained thin, and in some areas power shortages were felt. This spurred the market for gas-fired power plants, which are quick and cheap to build, and offer improved environmental performance over coal- or oil-fired plants.

GE and Siemens were quick to capitalise on this demand growth and booked the majority of orders in the market, leaving ABB and Alstom out in the cold. Siemens's acquisition of Westinghouse earlier in the year meant that both ABB and Alstom lost ground on their major European competitor in the global market. The merger of ABB and Alstom was the only way to catch up quickly with both GE and Siemens Westinghouse.

On the basis of power plant orders received by the leading companies during 1998, it is evident the effect that the U.S. market growth has produced. With GE and Westinghouse taking almost all U.S. orders during 1998, and the U.S. market making up 40% of total global demand, ABB and Alstom slipped rapidly down the ranking.

The pressures on all power plant suppliers are also a major factor behind the companies' decision to merge their operations. As electricity market deregulation sweeps the globe, power plant suppliers are increasingly expected to take on higher levels of project risk. This includes most power plant completion risks, and they often have to take an equity participation in power projects to secure the equipment order. The bigger the company, the more these risks are spread over a number of projects - driving consolidation. In the future it is expected that these pressures will become even greater, and that equipment supply companies and contracting companies may need to fund power projects in their entirety.

Pre-payments to equipment suppliers for power projects are also becoming less common, which means that they are having to fund the construction of many projects through their own cash flow, and will not get paid until completion. In order to take on the required number of projects to spread the risk, this means that companies must become larger.

ABB Alstom Power has become the world's largest power generation equipment and turnkey power plant supplier following the merger. This will be a significant advantage when bidding for turnkey power projects, as the new company will be able to grow its margins on the basis of taking on more projects. Predicted savings of \$450m over the next 3-4 years will also stimulate both companies' profitability.

## Latest Generation Turbines Arrive

The first commercial installation of the Department of Energy's (DOE) heavy-duty gas turbine program was announced in September 1999. The GE H-class turbine is to be installed in combined-cycle operation at the Scribna plant owned by leading U.S. IPP, Sithe Energies. The GE turbine is far enough through the program to allow Sithe to announce plans to install two units. Siemens Westinghouse, GE's major competitor in the U.S., is ready to release its own version of the product shortly.

Both GE and Siemens Westinghouse turbines will be able to break the 60% efficiency barrier in combined cycle operation, and a resultant 3-6% reduction in CO<sub>2</sub> emissions should be possible due to the higher efficiency. Improvements in turbine designs, cooling systems and materials achieved through the program have allowed turbine temperatures to be pushed to more than 2,600 degrees Fahrenheit, well above the capabilities of any previous system.

Although the technology has clear benefits, the competitive U.S. electricity generating market may take some time before installing the technology on a widespread basis. Both GE and Siemens have had some problems in the U.S. with advanced turbines cracking. Plant

\* Excerpted from IGTI's 2000 Technology Report and Product Directory—Land, Sea & Air, pages 10-11.



“  
**Plant availability is the primary concern for generators in the U.S. market, and it will take thousands of hours of operation before the [new H-class] technology becomes field proven.**  
”

availability is the primary concern for generators in the U.S. market, and it will take thousands of hours of operation before the [new H-class] technology becomes field proven.

### Microturbine Market Heats Up

The microturbine market received considerable attention during 1999. The development of distributed generation provides a good platform for the growth of this market, particularly, but not only, in deregulated markets. The key difference between mature on-site power plant markets and distributed generation markets is that the latter is driven by deregulation rather than regulation.

Electricity market deregulation is designed to give customers the choice of whom they purchase their electricity from, or to allow them to generate it themselves. As electricity suppliers compete to provide their customers with the lowest cost supply one of their major weapons is the use of on-site supply.

Almost all U.S. electric utilities have set up energy service companies (ESCOs) in order to take advantage of the benefits of deregulation in full. The concept of the ESCO is founded upon performance-based contracting, which means that the reimbursement that the ESCO receives for the project is based upon the savings that are realised. Some projects are paid for by energy savings, or the fitting of electricity efficient drives and motors. In others revenues are earned via the cost savings that can be achieved through autogeneration and energy demand management.

Furthermore, to increase electricity market competition, spot markets have been developed in countries such as the U.S. and the UK which mean electricity prices fluctuate dramatically according to supply and demand constraints. There is a clear competitive advantage for companies that can start up smaller plants to take advantage of high prices and switch them off when prices are low.

The use of small power plants in the distribution network, known as embedded generation, is becoming an increasingly feasible option in many countries. Embedded generation allows distributors to relieve congested distribution networks, increase the flexibility of the network, remove transmission loss and costs, and improve power quality for their customers.

All these drivers for distributed generation, and the innovative vehicles of delivery, stem from deregulation of the electricity market, and are helped by the deregulation of the gas

market. This means that once a market has been deregulated, small power plant equipment suppliers should be able to forecast the market potential with far more comfort than in a market where one regulatory decision can make or break it. The key market drive has moved from regulation to competition in the move into a distributed generation market.

The commercial release of the microturbine increases the possibilities for distributed generation down to smaller energy consumers than ever before. Microturbines will compete directly with reciprocating engines for such business, but offer considerable advantages which will drive the total market forward:

- lower power outputs;
- reduced emissions;
- increased reliability;
- significantly reduced maintenance costs.

There has been a massive interest in microturbines across the world, and especially in the USA, and with companies such as GE, Kohler and EdF becoming involved in the industry, it must be treated with credibility. The sales and marketing strategy used by microturbine suppliers will prove to be the key to the success of the technology. The microturbine-ESCO fit is very strong and the major technology developers will have to cede some control of the market to these third parties in order to grow the industry as they would like.

Like gas engines, microturbines have a low heat output, so a large heat requirement is not needed to make them economical. Microturbines also have some key advantages over gas engines: lower emissions and reduced maintenance.

Although microturbines are less fuel efficient than gas engines in low-load applications (standby and peak shaving), fuel efficiency, and therefore fuel costs, are less important to the overall plant costs than are maintenance costs.

The microturbine also performs well in higher loads, and some estimates have put maintenance at just a few hours for a plant in continuous operation. In such plants these cost savings are balanced by higher fuel costs brought about by a lower electrical efficiency. Thus there is a balance: gas engines will be most suitable for some applications, microturbines for others. Each project is individual, and it is the job of the contractor to offer the best solution to the owner.



### Deregulation Moves Ahead

The deregulation of the world's electricity markets continued to gather speed during 1999. One of the bright spots was Germany, where price falls of up to 50% were obtained by some large industrial customers connected directly to generators. Unlike other EU countries, Germany has deregulated its electricity market all at once, rather than in stages starting with the largest users. The country has not installed a market regulator, and both strategies have had the effect of putting the market under intense pressure. Merger activity between generators is expected to be rife for the next few years.

However, unlike in the U.S. and UK, German deregulation has not yet provided a boost to the gas turbine market. This is due to the differences between the structure of the power generation market in the three countries, which mean that the key market drivers act in different ways. In the U.S. the massive gas turbine market is being driven by the requirement to meet demand. In some parts of the U.S., capacity has simply not been large enough to meet the daily demand growth at peak times, and generators are now reacting to this and the high prices that can be obtained at peak times. Deregulated markets encourage larger amounts of over-capacity than monopoly markets as a larger number of companies are chasing peak-load revenues. Once the U.S. has a sufficient level of over-capacity to operate an effective competitive generation market then gas turbine order volumes will subside.

This trend is already in evidence as the market moves from simple cycle gas turbines to combined cycle gas turbine power plants.

The UK has also had large order volumes for gas turbine power plants throughout the 1990s. Unlike the U.S., however, these plants are replacing older coal-fired power plants. This is not happening in the U.S., as coal remains low cost, and in baseload operation generating costs for coal plants are lower than for gas plants. There has been a small amount of displacement in the U.S. as generators move toward the enhanced flexibility of gas-fired plants. In Germany displacement has not yet taken hold. German generators are suspicious of gas-fired plants in baseload operation as Germany does not have sufficient domestic gas reserves to guarantee security of supply. The leading generators also own their own coal mines providing them with more control over price and quality. Over the coming years this will have to change, and as the complex web of cross ownership between the major utilities, regional utilities and municipal Stadwerke unravels, some displacement of coal-fired plant is inevitable as electricity prices fall below the level of generating costs for a medium load coal plant. \*

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### Call For Papers

ASME TURBO EXPO 2001

Land, Sea & Air

June 4-7, 2001

Ernest Morial Convention Center  
New Orleans, Louisiana USA

The technical committees of the ASME International Gas Turbine Institute (IGTI) are seeking papers on topics related to applications, design, operation, and manufacture of all gas turbines and related equipment for the 46th ASME Gas Turbine and Aeroengine Technical Congress, Exposition and Users Symposium.

To offer a paper for publication, submit a 200 to 300 word **abstract by July 7** to IGTI via email: [igtiprogram@asme.org](mailto:igtiprogram@asme.org); via fax: (404) 847-0151; or via mail: IGTI, 5775-B Glenridge Dr., Suite 370, Atlanta, GA 30328-5380 USA. Provide all pertinent contact information, including address, phone, fax and email.

Final acceptance for papers is determined by a review of **draft manuscripts**, which are **due October 6**, and must be accompanied with a completed and signed ASME copyright release (1903) form to allow publication. If warranted by review, papers may also be recommended for publication in an ASME Transaction.

To obtain the assignment of copyright (1903) form and guidelines for preparing an ASME paper, visit ASME's website: [www.asme.org/pubs/authors/](http://www.asme.org/pubs/authors/) or contact ASME Technical Publishing, New York, NY, +1 (212) 591-7000.

All paper submittals are interpreted as an intention to attend the conference (registration fee required) and to present the final paper.

Technology Transfer Considerations: All presenters assume all responsibility for obtaining all needed company approvals or government clearances prior to submitting a draft for review, final manuscript for publication, or participation in panel discussion. If approvals or clearances are involved, this should be noted in the original submittal of a paper and draft manuscript. \*



# Roy P. Allen Receives ASME Performance Test Codes Medal



Roy P. Allen

**R**oy P. Allen, P.E., consultant, West Union, SC was awarded the ASME Performance Test Codes Medal ... "for outstanding contributions to gas turbine technology and dedicated service on the Board on Performance Test Codes, including chair of PTC Committee No. 22." Established in 1981, the Performance Test Codes Medal is awarded to an individual or individuals who have made outstanding contributions to the development and promotion of ASME Performance Test Codes, including the Supplements on Instruments and Apparatus. Roy received his medal at the recent ASME International Mechanical Engineering Congress and Exposition in Nashville, TN.

An expert in the application and performance of gas turbines, Roy currently provides personal consulting services related to gas turbine technology development.

Roy's vast experience includes serving in the U.S. Army Corps of Engineers from 1956 to 1958, followed by three years with Thompson Ramo Woolridge, Inc., now TRW (Cleveland, OH).

In 1962 Roy began what became a 30-year career at the General Electric Company (Schenectady, NY and Greenville, SC). Prior to his retirement from GE, he held the position of manager of technology programs, with responsibility for development planning and budgeting, program management of new gas turbine models and management of research activities funded by outside agencies.

From 1992 to 1994, Mr. Allen served as the director of the advanced gas turbine systems research program at the South Carolina Energy Research and Development

Center in Clemson. There, he was the first administrator of the DOE-funded gas turbine research program for American universities.

Roy has been a member of the Board on Performance Test Codes (PTC) since 1994. He has devoted 30 years of continuous service to PTC Committee No. 22 on gas turbines, holding the position of distinguished chair since 1987. In addition to his PTC activities, Roy also served as chair of the Codes and Standards Committee B133, which is responsible for gas turbine procurement standards; and is presently chair of TC192, the gas turbine technical committee of the International Standards Organization.

During his career he has authored ASME and SAE papers, GE state-of-the-art technology papers, trade journal articles and the gas turbine section of the Electrical Engineers Handbook.

A member of ASME since 1963, Roy Allen is also a member of the Cornell Society of Engineers.

Roy earned his bachelor's and master's degrees in mechanical engineering from Cornell University (Ithaca, NY) in 1956 and 1963, respectively. He is a registered professional engineer in New York. \*

# Aspi R. Wadia Wins Melville Medal



Aspi R. Wadia

**D**r. Aspi Rustom Wadia, a resident of Loveland, Ohio, and engineering program leader at GE Aircraft Engines (Cincinnati, OH), was honored recently by ASME as recipient of the Society's Melville Medal.

The medal, first awarded in 1927, is the highest honor for the best original technical paper published in the *ASME Transactions* in the past two years. Wadia was recognized for a paper he co-authored entitled, "Inner Workings of Aerodynamic Sweep," which was presented at ASME TURBO EXPO and examines the aerodynamic effects of axial rotor blade sweep on the design of turbofans.

Over a 20-year career in the gas turbine industry, Wadia has made significant contributions benefiting compressive turbomachinery aerodynamic design. Through the utilization of evolving 3-D computational fluid dynamic codes, Wadia has achieved a number of firsts that represent evolu-

tionary payoffs in fan and compressor aerodynamic design. His identification of 3-D relief has proven to be critical to compressor blading design in the endwall region. His pioneering research work with forward sweep has culminated in test results for performance and stability improvements that were called "revolutionary" by government technical reviewers.

Wadia is presently the engineering program leader for the F110-GE-129 enhanced fighter engine (EFE) at GE Aircraft Engines (GEAE). He has played a leadership role in the aerodynamic design of the F110-GE-129 EFE blisk fan, the LM2500+ and CF6-80C2 high pressure compressors and the LM6000PC/PD low pressure compressor. GEAE has acknowledged his efforts with Managerial Awards in 1988 and 1990 and the Six Sigma Award in 1998.

Wadia holds three patents and has published over 30 technical papers in archival journals. An ASME Fellow, he has been a member of the IGTI Turbomachinery Committee since 1983 and the IGTI Aircraft Engine Committee since 1996. He has been session organizer, session chair or vice chair at TURBO EXPOs in 1989, 1991, 1992, 1997, 1998 and 1999.

After receiving his master's degree in aerospace engineering at Cornell University (Ithaca, NY) in 1977, Wadia went on to earn his doctorate at the University of Texas at Arlington in 1979.

The co-authors of the award-winning paper, also with GE Aircraft Engines, are Peter N. Szucs, principal engineer-fan and compressor aero technology, and David W. Crall, P.E., manager-Tech56 compressor group. \*



## Exposition

**T**URBO EXPO 2000 features a world-class Exposition of more than 250 suppliers of the latest gas turbine products and services.

The three-day Exposition (8-10 May) will allow you to network with industry professionals and find answers to your practical design and operational questions.

The exposition will showcase a full range of gas turbine applications including ...

- ❖ Land-based Industrial Engines
- ❖ Commercial Power Plant Applications
- ❖ Utilities and IPPs
- ❖ Microturbines and Distributed Generation
- ❖ Marine Propulsion and Power Systems
- ❖ Oil and Gas Platforms
- ❖ Pipeline Applications
- ❖ Commercial and Military Aircraft Engines
- ❖ and much more.

Entry to the Exposition and Keynote Session is free of charge to all industry related personnel. Complimentary passes are available from IGTI and in the registration area on-site in Munich. \*

## The Technical Congress

It has been said, "every significant advancement in gas turbine technology in the last 30 years was first presented at ASME TURBO EXPO." This year's Technical Congress promises to live up to that maxim once again.

As a Technical Congress registrant you will choose from more than 130 paper and panel sessions offering state-of-the-art knowledge and vision concerning all aspects of gas turbine technology. The 614 papers presented in these sessions are not marketing presentations, but peer reviewed papers of the very highest quality.

You also get to choose from another 20+ panel sessions that are part of the Gas Turbine Users Symposium (GTUS), and interact with leading industry professionals of every type. This represents more knowledge and experience about gas turbine technology than you would have access to anywhere in the world. What an opportunity to learn and to obtain solutions to your most challenging problems!

Visit our web site at [www.asme.org/igti/te2000](http://www.asme.org/igti/te2000) for a complete list of the sessions and their scheduled times. Registration and housing forms are also available on the web site or by calling IGTI at +1 (404) 847-0072. \*

“  
*...every significant advancement in gas turbine technology in the last 30 years was first presented at ASME TURBO EXPO.*  
”





## Award Winners

The following award winners will be honored at the Awards Banquet on Sunday, May 7 at the Park Hilton Hotel in Munich. Tickets are available for purchase by contacting Laura Kemp at the IGTI office in Atlanta. E-mail: [kempl@asme.org](mailto:kempl@asme.org)

### 2000 R. Tom Sawyer Award

Martin C. Hemsworth

### 1998 ASME Gas Turbine Award

Josef Panosky and Robert E. Kielb

### 1998 John P. Davis Award

Jean-Pierre Stalder

### 2000 Aircraft Engine Technology Award

Peter C. Tramm

## REGISTER NOW!

Session Schedules, Registration Forms and Housing Forms are all on the web.

GO TO OUR WEB SITE at  
[www.asme.org/igti/te2000](http://www.asme.org/igti/te2000) to register

OR

E-MAIL our office at:  
[igtiregistration@asme.org](mailto:igtiregistration@asme.org)

OR

CALL +1 (404) 847-0072

## GAS TURBINE USERS SYMPOSIUM

### Hot User Issues Featured in GTUS

The Gas Turbine Users Symposium (GTUS) at TE 2000 in Munich will feature several issues of new and evolving importance to the user community. Expert panels of users and other contributors will discuss 22 key topics. Among these will be:

- ... Diesel Engines vs. Gas Turbines up to 300 MW (a CIMAC sponsored session.)
- ... Remote Monitoring and Diagnostics
- ... Combined Cycle Plants – Several Options
- ... Long-term Service Agreement Contracts – Trends and Experience
- ... Microturbine Operational Experiences
- ... User's Lite and Technical Lite (see below)
- ... Risk Management and Issues
- ... Practical Aspects of Filtration and Compressor Fouling and Washing
- ... Legacy Unit Upgrade and Uprates
- ... Airfoil Repair Strategies for Reduced Life Cycle Costs
- ... Cogeneration in Pipeline Compressor Stations
- ... Retrofitting with New Materials
- ... and much more.

Register today by visiting our web site at:  
[www.asme.org/igti/te2000](http://www.asme.org/igti/te2000)

### New "Lite" Session Introduced into GTUS

A new two-part "Lite" session will be introduced into the Gas Turbine Users Symposium in Munich this year. The two parts are "Users Lite" and "Technical Lite." This innovative tutorial and interactive session will promote dialogue and better understanding between two main TURBO EXPO constituencies: users of gas turbines and technologists who do the research and design.

In part one, "Users Lite," Ron Natole of Natole Turbine Enterprises, Inc. will describe to technologists the power generation business from an after-market perspective. Ron will describe the language of the business, distinguishing technical features of various frame machines, hot issues and problems facing users of the machines, and insights on how technologists can help users address these problems.

In part two, "Technical Lite," Dave Wisler of GE Aircraft Engines will host presentations on several technical issues requested by users. Understandable explanations will be given for compressor stall, film cooling, flutter/forced response, and thermal coatings.

The interactive tutorials will be followed by discussion. \*

**ASME CODES & STANDARDS  
 OPEN FORUM:**

**Standardization  
 and Conformity  
 Assessment Needs  
 for Gas Turbines**

**G**as turbines are in the number one position in new electric power purchases, largely due to their high performance. The utility market demands reliability. The potential conflict between reliability and performance for these advanced turbines is the foundation of ASME's involvement in the issue.

ASME Codes and Standards will hold an open forum at the ASME TURBO EXPO in Munich, reviewing current ASME and ISO gas turbine standards, and eliciting experiences with the advanced turbines in service today.

**Tuesday, 9 May  
 9:00h – 12:00h\***

**Chair: Don Frikken**

**Chair of ASME Council on Codes and Standards**

**\*Revised schedule from earlier publication.**

**Schedule Highlights**

**SUNDAY (7 MAY)**

**Awards Dinner**  
**Park Hilton Hotel** 19:30h - 22:00h  
 Open to those with special invitation or paid ticket. (Tickets available from IGTI for \$75.00 each)

**MONDAY (8 MAY)**

**Keynote Address**  
**MOC** 10:00h - 12:00h  
 Open to all registrants. (See page 1)

**Exhibit Hall Open**  
**MOC** 12:00h - 18:00h  
**Grand Opening** 12:00h - 14:00h  
 Open to all registrants. (Complimentary passes available at the MOC.)

**Welcome Reception**  
**Residence Museum** 19:00h - 20:30h  
 Admission by special ticket only. (Available while they last on 8 May from "Badge Pickup" at the MOC.)

**Technical Congress and GTUS Sessions**  
**MOC** 14:00h - 17:00h  
 Paid registration required.

*Pamphlets and CD available. All 614 Technical Papers for TE2000 will be available in pamphlet form for \$5.00 each (+ tax). AND on CD for \$100 (+ tax) for all. This special CD price is available only on-site at TE2000. The post-conference CD price is \$476.00 for ASME members and \$595.00 for non-members. Plan to be in Munich to take advantage of this significant price difference.*

**TUESDAY (9 MAY)**

**IGTI Appreciation Luncheon**  
**MOC** 12:00h - 13:30h  
 By invitation only.

**Exhibit Hall Open**  
**MOC** 10:00h - 18:00h  
 Open to all registrants. (Complimentary passes available at the MOC.)

**Technical Congress and GTUS Sessions**  
**MOC** 9:00h - 12:00h & 14:00h - 17:00h  
 Paid registration required.

**Codes and Standards Open Forum on Standardization and Conformity Assessment Needs for Gas Turbines**  
**MOC** 9:00h - 12:00h  
 Open to all registrants.

**WEDNESDAY (10 MAY)**

**Exhibit Hall Open**  
**MOC** 10:00h - 18:00h  
 Open to all registrants. (Complimentary passes available at MOC.)

**Technical Congress and GTUS Sessions**  
**MOC** 9:00h - 12:00h & 14:00h - 17:00h  
 Paid registration required.

**Facility Tours**  
 See updated details on the web site at: [www.asme.org/igti/te2000/](http://www.asme.org/igti/te2000/)

**THURSDAY (11 MAY)**

**Technical Congress and GTUS Sessions**  
**MOC** 9:00h - 12:00h & 13:30h - 16:30h  
 Paid registration required.

**Facility Tours**  
 See updated details on the web site at: [www.asme.org/igti/te2000/](http://www.asme.org/igti/te2000/)

**IGTI** is pleased to announce that **Otto Wiesheu, The Minister of Economic Affairs, Transport and Technology, for the State of Bavaria, and Hep Monatzeder, the Mayor of the City of Munich, will be participating in the opening keynote session and offering introductory comments and words of welcome.**

**"Industry in Transition"**

*...continued from front page*

(Technology, Engineering and Manufacturing Divisions), Nuclear Power Generation, Hydro Power Plants, and Fuel Cells. Mr. König took over the management of KWU's Instrumentation and Control Division in 1992. He then coordinated plans for the integration of the fossil power generation businesses of Siemens and Westinghouse.

Mr. König will speak to the development of markets and players in today's power industry, the driving forces behind evolving technologies, and the outlook for the future.

Dr. Ing. Klaus Steffens will be the new President and CEO of MTU Munich, where he has been Executive Vice President Engineering and Production since 1996. Dr. Steffens has received numerous engineering awards and has presented papers at VDI, CIMAC, DGLR, and ISOABE conferences. He has made national and international presentations on the future of the aerospace business.

At TE 2000 Dr. Steffens will speak to the critical factors involved in aircraft engine development and how changing markets are resulting in additional challenges. \*



## LETTER TO THE EDITOR...

The following letter was received in response to Manfred Klein's "Critical Issues" article in the last issue of the Global Gas Turbine News entitled, "Is Lower PPM Better?" Klein's response follows. (Ed.)

Sirs:

I was surprised and somewhat disturbed to read Manfred Klein's discussion of possible changes to the gas turbine standard to emphasize overall efficiency rather than emission concentration. I have concluded he apparently believes emission concentration and efficiency is a contradiction in terms. The very fact that we now have very low levels of gas turbine emissions and high efficiencies decries this belief. The fact is, public health requirements drive gas turbine technology for low emissions and economics drive the technology for high efficiency, and this has worked out quite well.

The 1970's Clean Air Act created the Environmental Protection Agency to create standards "to protect the health and welfare of the public." Standards for air quality necessarily became pollutant concentration, an easily measurable technology. It follows that stationary sources of pollutant emissions should also be easily measurable and be in concert with air standards, simply for ready estimation and calculation of air quality impact. Anyone who has done emission dispersion analyses of stationary sources knows the complexity of the variables can only be satisfied with measurable concentration units of the plume source.

I was a member (as a representative of the small gas turbine industry, up to 10,000 horsepower) of the original EPA industry and academia advisory committee that helped develop the present Gas Turbine Standard. The subject of efficiency versus emission levels was thoroughly and frequently discussed. At that time industrial turbines were producing 200 to 300 ppm of NOx and aircraft jet engines were starting to be used as drivers for stationary source generators, with NOx levels approaching 1500 ppm. Many industry commentators felt that low emissions could not be had without deterioration of efficiency. (As we know now, this turned out not to be true. Many gas turbine manufacturers today offer simple cycle dry combustor machines with guaranteed NOx levels in the 25ppm range and

efficiencies near 40%). However, in order to satisfy industry, the standard did provide a formula to give some relief for high efficiency machines.

Today's machines are cleaner because of standards and are efficient to satisfy the marketplace. Because total emissions are still a primary concern for the environment, many state standards provide a total emissions cap for major sources in areas that are "not attainable" in meeting federal standards.

As engineers we may complain about "too strict" government standards. In the case of the gas turbine, we seem to have been able to meet the public health standards and satisfy the demands of the marketplace, which is really our job.

Ralph Kress P.E.  
ASME Fellow

### AUTHOR'S RESPONSE ...

Mr. Kress is quite right in his history of success of the industry achieving the ~25 ppm level, an 80-90% reduction with the aid of government regulation. I agree with him on those points. My article, however, questions the need to adopt a more stringent "near-zero" concentration NOx level for GTs, which I do believe will compromise their effectiveness and reliability in reducing all of society's various types of air pollution, greenhouse gases and toxic emissions. Modern gas turbine and fuel cell technologies are needed with the highest CHP efficiency to replace high polluting energy sources.

The near-zero approach (for NOx only) being considered for GTs in some regions is very onerous, and in my view is only justifiable if all other industrial sources in an area are offered some similar treatment. This type of rule does not deal with pollution prevention of other important emissions, and may represent a barrier to sustainable energy development. Energy output based rules can also assist in policy development.

Thanks,

Manfred Klein, Chair  
IGTI Environmental and Regulatory  
Affairs Committee ✪



**Modern gas turbine and fuel cell technologies are needed with the highest CHP efficiency to replace high polluting energy sources.**



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While they last, past issues of the *Global Gas Turbine News* are available for \$7.50 for the first issue and \$5.00 for each additional issue if ordered at the same time. Price is postage paid in the U.S.; add \$3.00 per order for shipping and handling outside the U.S.

Below are listed key articles by topic area that appeared in issues of the GGTN back to 1993. Because of overlapping areas of subject matter, some articles are listed more than once. Locate the articles in which you have an interest. Write the ISSUE of the newsletter AND THE ARTICLE NAME on the order form (being careful to avoid duplication of articles ordered). Fax your order with credit card information to IGTI or mail it with a check for prepayment. NOTE: Prices are based on issues, not on articles. Full issues will be sent if available. If full issues are not available, we will photocopy the articles of interest and forward them for the same price per issue. \*

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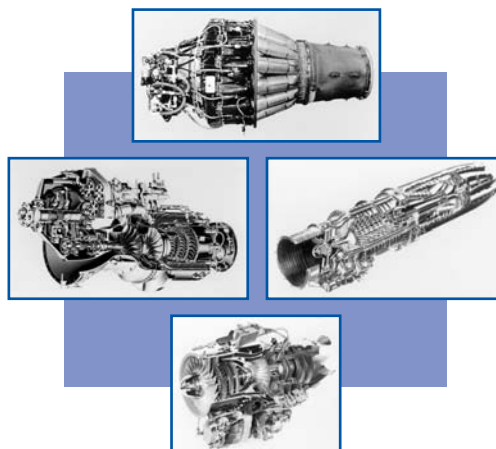
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# Gas Turbines Power Top Engineering Achievements of 20th Century

*Ballal to Present Seminar in Gottingen, Germany Prior to TURBO EXPO 2000*

To commemorate the arrival of the new millennium, the engineering community in the United States selected the top 20 engineering achievements of the 20th Century. The National Academy of Engineering (NAE), during Engineers Week late last month, announced the results of this poll. The overriding criterion used by NAE to rank the achievements was the degree to which each achievement contributed to the quality of life during the past 100 years.

Electrification and Airplanes took first and third place respectively on this list. Today, both these inventions are powered by gas turbines. It is estimated that the world market share of gas turbine engines over this decade, valued at around \$350 billion, will be about equally divided between electric power generation and aircraft engines.

The aircraft gas turbine was invented about 60 years ago by Dr. Hans von Ohain in Germany and by Sir Frank Whittle in England. The first gas turbine powered von Ohain-designed He.S.3b jet engine flew in a Heinkel He 178 aircraft on 27 August 1939 in Rostock, Germany. A "Symposium 60 Jahre Turbostrahlflug," held in Rostock on 27 August 1999, celebrated this event. A plaque commemorating the first successful flight of a gas turbine-powered aircraft was erected at the site of the (old) Heinkel factory where Hans von Ohain designed his jet engine.



**Dilip Ballal**

In the United States, the 60th anniversary celebration was held in Dayton, Ohio. A "Walk of Fame" stone slab engraved with the name of Hans von Ohain was laid at the Dayton International Airport in July 1999. The University of Dayton installed Dilip Ballal (IGTI Review Chair for ASME TURBO EXPO 2000) as a Hans von Ohain Distinguished Professor on 7 October 1999 and presented him with a University of Dayton Hans von Ohain medal. Also, the University of Dayton and General Electric Company established two Hans von Ohain/GE doctoral student fellowships in gas turbine technology.

On 5 May 2000, Dilip Ballal will present a research seminar, co-sponsored by the German Aerospace Center (DLR) and the Max Planck Institute, in the Physics Department of the University of Gottingen, Germany. This seminar is dedicated to the memory of Hans von Ohain, who conceived the idea of building a gas turbine in the 1930s, while still a student in the Physics Department at the University of Gottingen. In August 2000, a second lecture entitled, "Sixty Years of Progress in Gas Turbine Technology: The Legacy of von Ohain and Whittle," will be presented at Cranfield University in England to honor both, Hans von Ohain and Sir Frank Whittle, the co-inventors of the aircraft gas turbine.

The 60th anniversary celebration of the invention of aircraft gas turbines will conclude in Dayton, Ohio on 27 August 2000. \*



## INTERNATIONAL GAS TURBINE INSTITUTE

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