

GLOBAL Gas Turbine News

CIRCULATION 15,000 • ATLANTA, GEORGIA USA • ASME INTERNATIONAL GAS TURBINE INSTITUTE

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...and much more



U.S. Air Force, U.S. Navy and British Ministry of Defence Share Program Development

Conference Co-Chairs, Ted Fecke with the U.S. Air Force (USAF), and Ray Bull with the British Ministry of Defence (MOD) are putting together a sharply focused, specialty conference for the aero engine community. The conference is co-sponsored by the U.S. Air Force, the U.S. Navy, and IGTI in cooperation with the British Ministry of Defence and the Institution of Mechanical Engineers (IMEchE).

IGTI is presenting the second of its specialty conference offerings in launching the Aero Engine Life Management Conference.

The two-day conference, set for London, March 2-3, 2004, at the Thistle Royal Horseguards Hotel, will explore life management issues for military and commercial aero engines. Co-Chairs Fecke and Bull have secured experts from airlines, engine manufacturers, academia and both the U.S. and British militaries to address conference topics, including:

- Affordability and Costing
- Reliability-Centered maintenance
- Engine Health Monitoring
- Life Usage Issues for Civil Engines
- Life Usage for Military Engines
- Emerging Technologies Advances in Diagnostics
- Component Aging Durability

Executives, engineers and others affiliated with the following types of organizations may benefit greatly by attending this highly specialized and focused conference:

- Military organizations
- International, national and regional airlines
- Air framers
- Engine manufacturers (OEMs)
- Engine maintenance and repair organizations
- Suppliers
- Legislative and regulatory organizations
- Researchers and technologists

Luncheons on both days of the conference will feature dynamic speakers. A hosted networking reception at the end of the first day will be at the historic facilities of IMechE at One Birdcage Walk. The last session of the conference will be a wrap-up panel session of key speakers.



TED FECKE



RAY BULL

...continued on page 12

ASME TURBO EXPO 2004 Set for Vienna, Austria

TURBO EXPO is the leading event for technology, knowledge exchange and networking among gas turbine professionals worldwide.

Via an industry exposition, application oriented panels and discussions, keynote presentations, technical paper sessions, and technical committee meetings, the 4-day conference covers the span of gas turbine expertise, offering an unparalleled opportunity for all those affiliated with gas turbine engines to gather and share the latest in technology and issues.

The exposition at TURBO EXPO features manufacturers of gas turbines, equipment suppliers, computer software developers, and service companies.

In the application-oriented panels and discussion sessions, gas turbine operators, manufacturers, and third-party service providers focus on applying cost effective technology to the operation, maintenance and upgrade of their gas turbine fleets.

The keynote session, under the leadership of Executive Conference Chair, Sigmar Wittig (see accompanying article), offers perspectives from prestigious members of the gas turbine community on the conference theme, "New Benchmarks for Operating Efficiency."

The technical paper sessions at TURBO EXPO provide a forum for some of the world's leading authorities on gas turbine design, analysis and development to present their research and insights. The variety of machines studied range from the largest gas turbine power generators to marine and aircraft engines to the smallest microturbines.

The source of the expertise and program organization for TURBO EXPO, the members of IGTI's 17 Technical Committees, Gas Turbine Users Symposium Advisory Group, and Distributed Generation Task Force meet annually during the conference to deliberate on the pressing issues of their respective industry segments and to plan for future activities.

Now in its 49th year, ASME TURBO EXPO is sponsored by the International Gas Turbine Institute of the American Society of Mechanical Engineers (ASME International). In 2003, ASME TURBO EXPO was held in Atlanta with nearly 3,000 participants from 60 countries, 150+ exhibitors, 193 conference sessions, and 587 technical papers published on CD ROM.

For general information or to inquire about exhibiting, contact the ASME International Gas Turbine Institute, (404) 847-0072, email igti@asme.org or visit the web site, www.asme.org/igti.*

Pre-Conference Workshops in Vienna

On Sunday, June 13, three pre-conference, one-day workshops will be presented by IGTI for the gas turbine community. Offering CEUs, planned topics include:

- Basic Gas Turbine Engine Technology
- Combustion Dynamics
- GT Metallurgy & Repair Technology

For more information, email thomasj@asme.org or telephone 1-404-847-0072, ext. 1649.

ASME TURBO EXPO 2004

Leadership Team

Executive Conference Chair
SIGMAR WITTIG

*Chairman of the Executive Board
German Aerospace Center (DLR)
Cologne, Germany*

Chair of Conferences
HAROLD SIMMONS
*Southwest Research Institute
San Antonio, TX USA*

Technical Program Chair
REZA ABHARI
*Swiss Federal Institute
of Technology
Zurich, Switzerland*

Gas Turbine Users
Symposium Chair
TERRY MORGAN
*Terry Morgan & Associates LLC
Laramie, WY USA*

Review Chair
ANTHONY STRAZISAR
*NASA Glenn Research Center
Cleveland, OH USA*

Local Liaison Committee Chair
HERBERT JERICHA
*Technical University Graz
Graz, Austria*

CONFERENCE WEB TOOL...

*Submit papers, preview all accepted
technical paper abstracts online and
follow the content development of
ASME TURBO EXPO 2004 at
<http://www.asmeconferences.org/TE04/>.*

Sigmar Wittig Named Executive Conference Chair, ASME TURBO EXPO 2004



The ASME International Gas Turbine Institute is pleased to announce that Professor Dr. Sigmar Wittig, Chairman of the Executive Board, German Aerospace Center (DLR),

Cologne, Germany, will serve as Executive Conference Chair of ASME TURBO EXPO 2004.

In recommending the conference to his colleagues, Wittig said, "Everybody active in the gas turbine field should be motivated to attend this extraordinarily important event."

He explained, "Gas turbines and their power concentration are continuously growing. Manufacturers are pressed to provide their customers with the latest turbomachinery technology. The tools necessary to meet the requirements related to this fast development will be discussed and presented at ASME TURBO EXPO in Vienna. Participants from around the world will get the opportunity to upgrade their gas turbine knowledge by attending well organized sessions, visiting an exposition which showcases newest developments and high quality gas turbine equipment and discussing problems of mutual interest with colleagues from different countries."

Wittig considers Vienna an excellent choice as a venue for the conference. "Vienna is the vibrant capital of Austria. Its settlement dates back to about 100 A.D. when the Romans built their first camps in the area. Remains of early settlements survive to this day, and are open to public. The city has numerous attractions: architecture, art, theater, and music as well as the beautiful countryside. Located in the center of Europe, it can be a starting point for further trips through the Alps and to other parts of Europe," he said.

In March 2002, Wittig became the Chairman of the Executive Board of the German Aerospace Center (DLR), the German partner of NASA, with approximately 5,000 employees at eight major locations throughout Germany. He is the head of the German delegation to the European Space Agency (ESA) as well as a consultant and a member of advisory boards for a large number of corporations.

He was director of the Institute for Thermal Turbomachinery, Technical University of Karlsruhe, Germany. He held the offices of president/rector of Technical University of Karlsruhe, vice president of the Deutsche Forschungsgemeinschaft (German Science Foundation), and Chairman of the Council of Presidents of the major universities of the German state of Baden-Wuerttemberg. Wittig has published more than 250 papers in the areas of gas turbine combustions, heat transfer, instrumentation and component development. Earlier this year, he received the 2003 R. Tom Sawyer Award from ASME.

As Executive Conference Chair for 2004, Wittig provides direction for the activities supporting the keynote theme, "New Benchmarks for Operating Efficiency." He also lends strategic support and offers recommendations for other portions of the conference. *

ASME **TURBO EXPO**
Power for Land, Sea & Air

VIENNA



AUSTRIA

Vienna, Austria is one of the world's top conference destinations. Vienna waits for you with arts and delights. The old imperial residence city, now a modern art center, remains a city for connoisseurs—whether you want to enjoy immortal waltzes, the exciting tension between imperial and modern architecture, a relaxed shopping trip or simply the sweet life between coffeehouses and Heurigen, trendy bars and sausage vendors, discos and ASME TURBO EXPO 2004!

***If Gas Turbines are important in your professional life,
you can't afford to miss ASME TURBO EXPO 2004!***



VIEW FROM THE CHAIR

Dilip Ballal, Chair, IGTI Board of Directors



Dilip Ballal
Chair

IGTI Board of Directors

Boldly Moving Forward

"IGTI's success an example for others," read the headline on the front page of *ASME News* in November 2002. IGTI owes its long-term success to business strategies marked by flexibility, forward thinking, and openness to change. Let me describe to you how IGTI is boldly moving forward with a three-pronged strategy for improvement.

Multi-Conference Strategy

Building upon the success and unmatched reputation of the annual ASME Turbo Expo, IGTI is developing a new kind of event: the specialty conference with a narrower focus, in a smaller venue. This kind of conference allows us to explore new emerging technologies and hot topics to meet the needs of our sponsors. With a multi-conference strategy, IGTI is positioned to boldly move forward with novel offerings to capture new markets. This venture is already bringing us fiscal success.

In February 2003 in Arlington, Virginia, we ran a very successful 2-day specialty conference, co-sponsored by the U.S. Department of Energy, on the topic of "Gas Turbines for a National Energy Infrastructure." In March of 2004, London will be the setting for our next specialty conference, "Aero Engine Life Management," co-sponsored by U.S. Air Force and U.S. Navy. Finally, we are planning a fall 2004 conference in the United States for gas turbine users and operators.

Revenue Generation Strategy

All of us have heard about the sagging financial performance of our exhibition, the degradation of portfolio investment returns, and the need for improved service. Above and beyond enhancing our traditional offerings (technical congress, GTUS, and exhibition), your board is aggressively pursuing the following key revenue generation strategies.

- **Education:** Significant business opportunities exist to develop marketable educational products and services. The board will empower an advisory group (led by a board member) comprising members of various technical committees and IGTI staff to develop strategy, define markets, and produce educational products (workshops, home study products, GTUS offerings, tutorials, distance or web-based learning tools etc.) for sale.
- **Bundled Services:** IGTI wants to win over the corporate world. To that end, various schemes are under discussion: corporate annual bundled-services subscriptions, reduced rates for bulk corporate purchase of educational products, corporate employee support to attend IGTI conferences, and promotion of ASME-IGTI on company websites. The success of this endeavor depends on enlisting corporate and government leaders who will emphasize the values and benefits of ASME-IGTI membership within corporations.
- **Board of Advisors:** With a view to enhancing its appeal to federal sponsoring agencies (DOE, Air Force, Navy, FAA, et al.) and corporations, IGTI has established a Board of Advisors. Its mission is to help generate revenue for IGTI and assist in marketing IGTI. Currently, the board is recruiting members.

“
**IGTI's success ... an
example for others**
”

Operational Improvements Strategy

IGTI's operations have grown over the years and IGTI has implemented several improvements to respond to this growth and to accommodate future volume. (Just one small improvement is the fresh, new look for the *Global Gas Turbine News*!)

- **Conference Development Web Tool:** This system worked well for handling the 2003 ASME Turbo Expo papers. IGTI has listened to your comments and more improvements are coming, such as better abstract handling, paper re-reviews, push-button specification of session type, etc.
- **Paper Submission Deadlines:** Computer processing has yielded a significant extension of the paper submission deadline. Therefore, a firm draft manuscript deadline (28 weeks before the conference) has been put into effect for all future meetings.

I believe that the strategies we have put into place are already yielding improvements and benefits for IGTI in a rapidly changing world. *

ASME TURBO EXPO & IJPGC 2003: Thank You for Making It a Success!

Gas Turbines were HOT in Atlanta this past June, when the worldwide gas turbine community converged on IGTI's hometown for ASME TURBO EXPO 2003. 3,000 people gathered at the Georgia World Congress Center, June 16-19, where TURBO EXPO was joined by ASME's International Joint Power Generation Conference (IJPGC), offering a comprehensive collection of power and propulsion content. 216 exhibit booths, 193 TURBO EXPO sessions and 34 IJPGC sessions provided attendees with a breadth of knowledge unmatched in any other venue. The two disk CD ROM proceedings published 587 technical papers from TURBO EXPO and 130 from IJPGC.

The 2003 edition of the annual Technical Congress, Users Symposium, and Exposition attracted people from 60 countries, representing corporations, academic institutions, independent research laboratories, and government agencies. *



Mark Little, Vice President of GE Power Systems Energy Products and Executive Conference Chair for TURBO EXPO & IJPGC 2003, delivered one of three presentations that made up the Keynote Session. Paul Bowers, President of Southern Company Generation and Energy Marketing, and Udo Rieder, Vice President of Engineering and Planning for Delta Air Lines, also made keynote presentations.



Alan Epstein, director of the MIT Gas Turbine Laboratory and recipient of the 2003 IGTI Scholar Award, presented a talk in support of his award-winning paper, "Millimeter-Scale, MEMS Gas Turbine Engines."



The Technical Congress showcased the very latest technological developments in such areas as emissions regulation, heat transfer, diagnostics and monitoring, microturbines, reliability, alternative fuels, and axial flow turbine aerodynamics.

The Gas Turbine Users Symposium addressed the concerns of those who purchase, own, and operate gas turbines, with sessions covering environmental issues, practical operations challenges, long-term service agreements and overhaul and repair strategies.



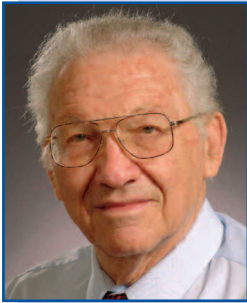
Visitors to the Exposition enjoyed a comprehensive array of the newest products and services from 150+ exhibitors.

Photos ©2003 Arthur Usherson

New

Over the next several issues, the *Global Gas Turbine News* will feature IGTI Technical Committee Chairs who are serving the first year of their term. Here, we introduce the first two.

Technical Committee Chairs



A World War II veteran, Alex was a faculty member at the University of Cincinnati and at Florida State University, before joining the faculty of the University of Florida, where he has been a professor for the last 40 years. He is director of the Interdisciplinary Center for Aeronomy and (Other) Atmospheric Sciences (ICAAS). His primary current interest is the co-utilization of domestic fuels (CDF), focusing on the benefits of blending traditional domestic fuels like coal and natural gas with renewable fuels such as biomass. As Alex puts it, "The farmers and the miners should be friends."

Alex enjoys listening to chamber music, and spends much of his leisure time resuscitating or converting defunct machines. He is a member of the Oughtred Society, an international group of slide rule collectors. *

COMMITTEE: Coal, Biomass & Alternative Fuels

Alex E. S. Green - "Al, Ally"
Graduate Research Professor Emeritus,
Department of Mechanical and
Aerospace Engineering
University of Florida
Gainesville, Florida USA
Attended: City College of New York,
California Institute of
Technology and
University of Cincinnati

COMMITTEE: Oil & Gas Applications

Rainer Kurz - "Rainer"
Manager, Systems Analysis
and Field Testing
Solar Turbines Incorporated
San Diego, California USA
Attended: University of the Federal
Armed Forces, Hamburg,
Germany

Rainer has been with Solar Turbines since 1993. His department is responsible for equipment selection in the business development phase including the prediction of gas compressor and gas turbine performance, conducting application studies, and for field performance tests on gas turbine driven compressor and generator packages. He has authored numerous publications in the fields of turbomachinery and fluid dynamics, and has given a number of gas turbine related tutorials.

Rainer stays busy outside of his professional life, pursuing interests in camping, jogging, skiing, photography—and, of course, his two daughters (ages six and eight). *



CALENDAR OF EVENTS

SEPTEMBER 7-11, 2003

Tenth International Symposium on Unsteady Aerodynamics, Aeroacoustics and Aeroelasticity of Turbomachines (10th ISUAAAT)

Duke University
Durham, NC USA

Researchers from around the world exchange the latest

information on unsteady flows, fluid-structure interactions and aeroacoustics in turbomachines, propellers and helicopters.

<http://isuaaat.mems.duke.edu/>

OCTOBER 3-4, 2003

IGTI Board of Directors Meeting

Dayton, OH USA

OCTOBER 24, 2003

Impact of the Jet Engine on Aviation

Inaugural Symposium of the von Ohain Fuels and Combustion Center

University of Dayton
Dayton, OH USA

Distinguished speakers from GE Aircraft Engines, Rolls-Royce, Boeing, and the U.S. Air Force offer historical insights.

<http://www.udri.udayton.edu/vofcc/>

NOVEMBER 2-7, 2003

International Gas Turbine Congress 2003 Tokyo

Tower Hall Funabori
Tokyo, Japan

One of the largest technical meetings in Asia on gas turbine technology.

<http://wwwsoc.nii.ac.jp/gtsj/igt/c/IGTC'03Tokyo.html>

New Members of IGTI Board of Directors



A long-time member of the IGTI Structures & Dynamics committee, Kenneth recently completed a term as chair of that committee, and is also a member of the Turbomachinery committee. He also served as the Technical Program Chair for ASME TURBO EXPO 2003. A member of the faculty at Duke University since 1990, his research has focused primarily on computational unsteady aerodynamics, structural dynamics, aeroelasticity and aeroacoustics of turbomachinery and aerospace vehicles. He has also worked on the fluid dynamics of flapping flight.

Kenneth's avocation, closely related to his vocation, is flying general aviation aircraft. He is an instrument-rated commercial pilot with single and multiengine land aircraft ratings. He is happiest when flying his Cessna Skyhawk in the skies over North Carolina.. *

INCOMING MEMBER

Kenneth C. Hall - "Kenneth"
Professor and Chair
Department of Mechanical Engineering
and Materials Science
Duke University
Durham, North Carolina USA
Attended: Massachusetts Institute
of Technology
Term: 2003-2009

TREASURER

H. Allan Kidd - "Allan"
Director - Development, Technology
and Product Configuration
Dresser-Rand Co.
Olean, New York USA
Attended: Northeastern University
and Penn State

Allan returns to the IGTI board of directors this year, having served previously from 1995 to 2000 in the regular board member rotation. Recently appointed the lead position for Dresser Rand's worldwide development and technology groups, he has, in the past six years, pioneered various business process automation techniques. Allan has 20 years experience designing and managing the packaging of various gas turbines for mechanical drive applications, and holds several gas turbine related patents applying low emissions technology. He has received the Dresser Industries



Corporate Silver medal technology award for participation in control systems designs.

Allan is an avid camper and naturalist, and is active in his local church, leading missionary efforts. *

NOVEMBER 15-21, 2003

ASME International Mechanical Engineering Congress (IMECE 2003) and RD&D Expo

Marriott Wardman Park Hotel
and Omni Shoreham Park Hotel
Washington, D.C.

Among 550 sessions in 35 technical fields, IGTI's Heat Transfer Committee is sponsoring three technical paper sessions on gas turbine heat transfer.

<http://www.asmeconferences.org/Congress03/index.cfm>

MARCH 1, 2004

Cranfield University Aero Engine Workshop

IMechE Headquarters
London, England

A one-day workshop focusing on prognostics, diagnostics, and simulation.

<http://www.cranfield.ac.uk/>

MARCH 2-3, 2004

Aero Engine Life Management Conference

Thistle Royal Horseguards Hotel
London, England

A new specialty conference focusing on topics of reliability, affordability, durability, monitoring, maintenance, and diagnostics, as they relate specifically to aero engines.

Co-sponsored by the U.S. Air Force, U.S. Navy, and ASME IGTI, in cooperation with the U.K. Ministry of Defence and

the Institution of Mechanical Engineering.

http://www.asme.org/igti/events/aero_conf_04.html

JUNE 14-17, 2004

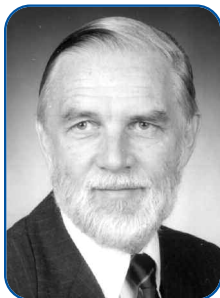
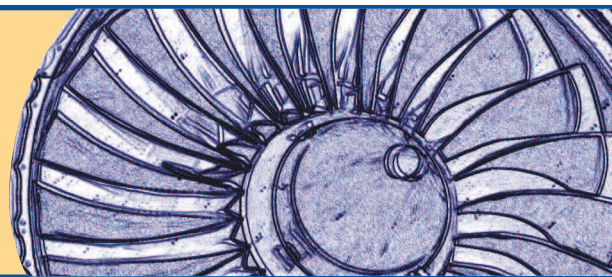
ASME TURBO EXPO 2004

Austria Center Vienna
Vienna, Austria

IGTI's flagship event, comprising a major gas turbine conference and exhibition.

<http://www.asme.org/igti/events/te2004/index.html>

Journal of Engineering FOR Gas Turbines and Power



Lee Langston

Important News ... from Lee Langston, Editor

As I write this, the great electrical power blackout of August 15, 2003 has just occurred in the U.S. Northeast and Midwest, and in neighboring Canada. Our modern society has become so dependent on electrical power, that a power failure immediately focuses everyone's attention. The public's attitude concerning electrical power

can be likened to the awareness of one's own health: *When you have it, you don't think about it, but when you don't have it, that's all you can think about.*

Reasons for this latest major blackout will be discovered. It is a safe bet that long-term prevention of future blackouts will come not from the politicians and lawmakers, but from solid research and development on the production and control of electrical power, as reported and archived in technical journals such as our *Journal of Engineering for Gas Turbines and Power*.

The state of the journal is sound and it should continue to thrive. Current technical challenges in the electrical power industry (e.g., preventing blackouts) should lead to more research—and more journal papers. While aviation gas turbine technology research has accounted for many of the IGTI Journal papers published up until now, that may change as the key role of gas turbines in the electrical power market continues to grow. One can expect to see more non-aviation gas turbine research papers in the future, as gas turbines and combined cycle systems become a more important (and possibly dominant) part of the electrical power grids.

In the past, the journal's paper backlog has been significant, with nearly two years elapsing between papers' presentation at TURBO EXPO and their publication in the journal. Working with Judith Sierant, ASME Production Coordinator, and the ASME Publications Committee, we have obtained 300 cumulative additional journal pages for the past four issues. The January 2003 issue had a record 400 pages, making it the largest issue ever published of any of ASME's eighteen journals. This has helped to reduce our current backlog, allowing publication of journal papers one year after conference presentation. We are working to further reduce this time-to-publication.

As many IGTI authors and session organizers know, all papers for TURBO EXPO 2003 went through the review process using ASME's new web-based tool for conference paper processing. A total of 587 Atlanta papers were processed and presented, with 150 of these recommended for journal publication. Of these, 85 will be published in the *Journal of Engineering for Gas Turbines and Power*, and 65 will be published in our companion ASME publication, *Journal of Turbomachinery*.

ASME Technical Publishing has also developed a similar electronic web tool to process papers submitted directly to the journals. I have scheduled the *Journal* to start using the new web tool on November 1, 2003. We will encourage authors to make use of the new web tool, but will continue to accept papers for review by the traditional method, until most authors and reviewers have become accustomed to the web tool. *

Lee S. Langston, Editor
ASME Journal of Engineering for Gas Turbines and Power
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191 Auditorium Road – U-3139, Storrs, CT 06269-3139
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E-mail: langston@enr.uconn.edu

Thanks for Spreading the Word!

The new Registrant Referral Reward program, launched in conjunction with ASME TURBO EXPO 2003, enjoyed a successful debut. Nineteen repeat TURBO EXPO attendees took advantage of the program, referring a total of 23 new registrants and reaping the rewards—a \$50 American Express gift check for each qualifying referred attendee. We count on our long-time returning attendees to help spread the word to colleagues throughout the worldwide gas turbine community, and we are pleased to recognize those who do!

Thank you to the following ASME TURBO EXPO advocates that were listed by first-time registrants as the colleague who recommended the conference to them:

Jeffrey Armstrong
Patricia Cargill
Bill Carscallen
Jenping Chen (2 referrals)
Russell Chetwynd (2 referrals)

Dave Dewis
Stephen Hall (2 referrals)
Markland Jones (2 referrals)
Jay Kapat
Harry F. Martin

Neil McDougald
Nirm V. Nirmalanah
Prakash Patnaik
Jeffrey Phillips
Geo Richards

Dennis Schumerth
L. Scott Stephens
Gyorgy Szasz
Allan Volponi



Cycles for Low Carbon Dioxide Production

by Riti Singh, John Horlock, and Tony Haslam

ABSTRACT

Environmental concern about greenhouse gas emissions has created a desire to move toward a sustainable energy future by using fuels in an increasingly clean and environmentally friendly manner for power generation. The UK government recently stated the goal that 20% of the nation's energy should be produced by renewable means by the year 2020. Even if this aspiration were to be achieved, it implies that up to 80% of energy in the UK would still be produced from thermal power. Combined cycle gas turbine plants are currently the most efficient means of producing thermal power and are likely to be so until 2020 and well beyond. Ways of mitigating greenhouse gas emissions, in particular CO₂, will therefore become increasingly important in these cycles. The Conference on Cycles for Low Carbon Dioxide Production, held at Cranfield University in March 2003 focused on CO₂ mitigation technologies, and on ways to move forward that might lead to the formation of governmental policy and its eventual implementation.

This report provides an overview of the status of the technology and other factors required to achieve low carbon dioxide cycles. It also summarizes opinions expressed and questions raised by delegates at the March conference.

Get the complete report online at <http://www.asme.org/igti>. Follow the link under the "Features" heading on the IGTI home page. *

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The UK government recently stated the goal that 20% of the nation's energy should be produced by renewable means by the year 2020.
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Millimeter-Scale, MEMS Gas Turbine Engines

Alan H. Epstein, Gas Turbine Laboratory, Massachusetts Institute of Technology, Cambridge, Mass. USA

MICRO ELECTRO MECHANICAL SYSTEMS

ABSTRACT

The confluence of market demand for greatly improved compact power sources for portable electronics with the rapidly expanding capability of micromachining technology has made feasible the development of gas turbines in the millimeter-size range. With airfoil spans measured in 100's of microns rather than meters, these "microengines" have about 1 millionth the air flow of large gas turbines and thus should produce about 1 millionth the power, 10-100 W. Based on semiconductor industry-derived processing of materials such as silicon and silicon carbide to submicron accuracy, such devices are known as micro-electro-mechanical systems (MEMS). Current millimeter-scale designs use centrifugal turbomachinery with pressure ratios in the range of 2:1 to 4:1 and turbine inlet temperatures of 1200-1600 K. The projected performance of these engines are on a par with gas

turbines of the 1940's. The thermodynamics of MEMS gas turbines are the same as those for large engines but the mechanics differ due to scaling considerations and manufacturing constraints. The principal challenge is to arrive at a design which meets the thermodynamic and component functional requirements while staying within the realm of realizable micromachining technology. This paper reviews the state-of-the-art of millimeter-size gas turbine engines, including system design and integration, manufacturing, materials, component design, accessories, applications, and economics. It discusses the underlying technical issues, reviews current design approaches, and discusses future development and applications.

Read the full text of Alan Epstein's 2003 IGTI Scholar Award paper on the IGTI web site at <http://www.asme.org/igti/> *

"With airfoil spans measured in 100's of microns rather than meters, these 'microengines' have about 1 millionth the air flow of large gas turbines and thus should produce about 1 millionth the power..."

Who's Who in IGTI

ANNUAL UPDATE DUE

If you have not recently visited the online directory of Who's Who, please do so and verify that your contact information, IGTI affiliations, and review expertise are up-to-date. The Who's Who web site: <http://my.memberclicks.com/igti/>

Now is also the time for IGTI Committee Chairs to visit the online Who's Who and update your committee's membership listing.

PDF OF WHO'S WHO AVAILABLE

Any member of an IGTI Technical Committee may print out a hard copy directory from the Who's Who web site. The web site offers a two column PDF format similar to the "old" printed directories.

Directory Printing Guidelines:

1. After login, on the Directory Search page, select View All (or enter selection criteria for a subset, ex: Ceramics committee).
2. After the Directory Search Results page appears, from the Directory drop down menu, select Print Center.
3. On the Print Center page, click the link for the Old Print Center.
4. Under "Select the print format to use:", select Print Business Card Small.
5. Under "Select the layout to use:", select Card/Letter (2 column...)
6. Click Preview. A new window will open with the PDF. Note: The new window may be minimized so you may have to click on it to open it. Also, Internet Explorer users may need to click Refresh for best results.
7. Print.

If you have questions about using the online Who's Who in IGTI directory, please email hawkenk@asme.org.*



What is the outlook for industrial and aero gas turbines for the coming decade? Find Out HERE!

The World Gas Turbine Industry: Production Trends and Key Factors, 2003-2012
 By Forecast International / DMS
 48-Page Report • \$450

In cooperation with Forecast International/DMS, the IGTI Board of Directors is pleased to announce the availability of a new 10-year gas turbine industry forecast. The report has been prepared by the Forecast International Power Group for IGTI. The data used to prepare the report is effective as of June 2003, and is drawn directly from the company's Gas Turbine Forecast service, as well as from associated databases and other sources.

Order your report directly from:
 Forecast International/DMS – Sales
 22 Commerce Road, Newtown, CT 06470 USA
 Phone: (203) 270-0633 Worldwide
 Phone: (800) 451-4975 in U.S. & Canada
 Fax: (203) 426-0223
 E-mail: sales@forecast1.com

Disclaimer: ASME and IGTI are not involved in the development of the above report, and are not responsible for the content. Contact Forecast International/DMS for a separate warranty statement.



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The International Gas Turbine Institute of The American Society of Mechanical Engineers is dedicated to supporting the international exchange and development of information to improve the design, application, manufacture, operation and maintenance, and environmental impact of all types of gas turbines and related equipment.



IGTI Self-Paced and Customized Educational Solutions Training Your Way

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See how much you and your employees can accomplish when you work at your own pace!

IGTI Home Study Courses are moderately priced, well-written treatments of essential gas turbine-related topics, prepared by undisputed experts in their field. Topics include: *Basic Gas Turbine Engine Technology*, *Gas Turbine Applications and Economics* and *The Design of Gas Turbine Engines: Thermodynamics and Aerodynamics*. Professors from MIT and Virginia Tech played active roles in the course preparation, and senior advisors from major gas turbine manufacturers edited and guided the course development process. Take advantage of this expert training on your own schedule.

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Save your organization training dollars!

Is your company attempting to manage and maintain a complicated training curriculum for your engineers? Let IGTI do it for you! We have courses already developed, which have proven, over 20 years, to be the tops in the gas turbine industry. For large numbers of trainees in an organization, we can arrange to deliver the training on site at your facility. For smaller numbers, the training can be staged in regional locations—perhaps even at a local college or university. Courses may be customized to fit your needs.

**Ask us about our course topics . . .
Nobody knows gas-turbine-related education like IGTI!**

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IGTI is the gas turbine industry's technology and knowledge clearinghouse! Should we be playing that role for your company?

- **Turbo Expo Exhibitions and Conferences:** Every year, for nearly 50 years, IGTI has produced the Turbo Expo Exhibition and Conference. We urge you to attend, exhibit, or even co-locate your company's important meetings with Turbo Expo to access the best and brightest in the gas turbine industry!
- **Specialty Conferences (and Exhibits):** Beginning in 2003, IGTI now offers specialty conferences to focus on specific topics and market segments of the gas turbine industry. In 2003, IGTI and DOE successfully presented the "Gas Turbines for a National Energy Infrastructure" conference. The "Aero Engine Life Management Conference" is set for London, England, March 2-3, in collaboration with the U.S. Air Force and U.S. Navy.
Let IGTI help you design, organize and produce your own meeting, conference or exhibition, from the concept to the conference center!
- **Gas Turbine Users Symposium (GTUS):** In 2004, watch for the new Gas Turbine Users Symposium to be held in Orlando. If you are planning a user group meeting in conjunction with this exciting new forum for gas turbine end-users and operators, we can offer you a special rate.
- **Specialty Conference Proceedings:** A new offering that captures the presentations in panels and other sessions that are not based on published technical papers. All recorded presentations from the 2003 Gas Turbines for a National Energy Infrastructure conference are available on one CD for only \$150. The CD allows you to see the slides and hear the synchronized audio for any or all of the sessions that may interest you. It is almost as good as being there!
- **Conference Workshops:** IGTI offers workshops on a variety of gas turbine industry topics, which add greater technical depth and learning opportunities for those who attend Turbo Expo or specialty conferences. Topics include: *Combustion Dynamics*, *GT Metallurgy & Repair Technology*, *Industrial GT Operating & Performance*, *Preliminary Design of Aircraft Engines*, *Steam Turbine Fundamentals*, *Basic Gas Turbine Engine Technology*, *Gas Turbine Applications and Economics* and *The Design of Gas Turbine Engines: Thermodynamics and Aerodynamics*. Take advantage of one of our top-flight workshops while attending an IGTI conference.
Don't miss this opportunity to double-up on your training value!
- **IGTI Original and Cooperative Publications:** IGTI has exceptional industry publications to keep you abreast of ground-breaking technology, current events and future trends. They include: *Index of IGTI Technical Papers (1956-2003)*; *ASME/IGTI Technical Papers (1956-2000)*; *Turbo Expo Present and Past Conference Proceedings (Turbo Expo 2003, Turbo Expo 2002, Turbo Expo 2001, Turbo Expo 2000)*; *Gas Turbine Industry Overview (2003 Edition)*; *SourceGT* (online industry resource currently being upgraded); *Gas Turbine Industry Reference Guide* (hard copy and online versions under development); *Discounted Subscriptions (Journal of Turbomachinery and Journal of Engineering for Gas Turbines and Power)*; *The History of Aircraft Gas Turbine Engine Development in the United States*; and *Global Gas Turbine News*.
Get in the know and stay in the know with IGTI publications!

For more details and pricing information on any IGTI products (ask about discounts), please visit our website (<http://www.asme.org/igti/>) or contact the IGTI Marketing and Products department (404-419-1646). *



ASME AERO ENGINE   
LIFE MANAGEMENT CONFERENCE

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Registrants also have the opportunity to enroll in two special events that book-end the conference. Cranfield University is offering a one-day, pre-conference aero engine workshop on March 1, 2004, covering diagnostics, prognostics, and simulation. On Thursday, March 4, following the conference, there will be a facility tour of the GE engine repair facility in Wales.

Ted Fecke is currently the Chief Engineer of the Turbine Engine Division within the Propulsion Directorate of the U.S. Air Force Research Laboratory at Wright-Patterson Air Force Base, Ohio. In this capacity he is responsible for providing oversight and guidance to all the turbine engine technical efforts of 250 employees. Ted has been with the Air Force since 1977 and he is a member of the American Institute of Aeronautics and Astronautics and the American Society of Mechanical Engineers. Ted is the recipient of the Society of Automotive Engineers' Probabilistic Design Leadership award for 2000 and holds a U.S. Air Force Distinguished Civilian Service Award.

Ray Bull is a senior propulsion engineer within the UK Ministry of Defence. Following a successful career in the Royal Air Force as an Aircraft Engineering Officer, which included command of all engineering and logistical support at a front line operational base, Ray Bull took early retirement from the Armed Forces and joined the UK MOD's Defence

Research and Development Agency (DERA). As a technical manager, Ray was responsible for directing research and assessment activities for a range of future air weapons platforms. When DERA was largely privatized, Ray stayed within government at the Defence Science and Technology Laboratory. Among his current interests are future propulsion system capability requirements and technology development, and driving down the costs of support of air weapon systems.

Assisting Fecke and Bull in organizing the conference are Charlie Gorton with the U.S. Navy, Dilip Ballal, Chair of the IGTI Board of Directors, Riti Singh, Past Chair of IMechE's Aerospace Division, and Richard Hill, a member of IGTI's Board of Advisors.

Registration for the Aero Engine Life Management Conference is scheduled to open in mid-October. Send a message to igti@asme.org indicating your interest in being notified when registration opens, or to receive further details about the event. Contact Kevin Gaffney at igtiexpo@asme.org or 404-847-0072, ext. 1647 for information about signing on as an activity sponsor. Conference updates may be found on IGTI's web site: <http://www.asme.org/igti/>. *

If your organization is interested in presenting a conference on a gas-turbine-related topic, IGTI can help you with it. Don't hesitate to give us a call.