GLOBAL GAS TURBINE NEWS

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Advances in technology, regulatory changes, and market forces require that future power and propulsion systems undergo a major transformation. Emphasis on clean energy has led to increased use of renewables for power generation. Operation flexibility is critical for energy utilities that incorporate wind turbines or solar panels along with traditional gas turbines for efficient peak and level-load power management. This has driven innovative ideas for power plant integration, new cycles, and energy storage concepts that are in many ways reliant on turbomachinery. For aviation, marine, and other applications, there is a push to reduce the carbon footprint by moving to bio-fuels. Recently, the aviation industry is considering turbo-electric and hybrid-electric propulsion concepts in future aircraft for reduced emissions. These new propulsion systems require changes to the traditional turbomachinery architecture for seamless integration with the electrical components. The conference will bring together experts from power and propulsion areas to highlight the emerging trends and challenges associated with bringing clean energy technologies to fruition and new applications that will shape the turbomachines of the future.

It is the unique experience of the ASME Turbomachinery community combined with the conference theme Turbomachines for Clean Power and Propulsion Systems and the focus tracks Turbomachines for Clean Power and Propulsion; Maintenance, Repair, and Overhaul (MRO) for Turbomachinery, that will make the 2019 ASME Turbo Expo a must-attend event. Use this opportunity to network with the best and brightest experts from around the world in Phoenix, Arizona, USA, to open new chapters in turbomachinery. Kicking off the Conference on Monday is the Keynote panel focusing on Turbomachines for Clean Power and Propulsion Systems. On Tuesday and Wednesday, Plenary sessions will explore the keynote theme further by dedicated discussion on the aviation and power industry.

The Keynote is held in conjunction with the annual ASME IGTI Honors & Awards program honoring individuals who have made significant contributions to the advancement of the turbomachinery technology.

**KEYNOTE MODERATORS**

- **Atul Kohli**, Pratt & Whitney
- **Ruben Del Rosario**, NASA

**CLEAN ENERGY PLENARIES**

**Plenary: Aviation Focus**  
Tuesday, June 18, 2019 | 9:40 – 11:10 a.m.  
Phoenix Convention Center

**Plenary: Power Focus**  
Wednesday, June 19, 2019 | 9:40 – 11:10 a.m.  
Phoenix Convention Center

**KEYNOTE PANELISTS**

- **Janet L. Kavandi**  
  Center Director  
  NASA Glenn Research Center

- **Andrew “John” Lammas**  
  Vice President & CTO  
  Gas Power Systems  
  GE

- **Thomas Alley**  
  Vice President of Generation  
  Electric Power Research Institute (EPRI)
Over 2500 attendees expected. Join your colleagues for valuable networking and hear from industry leaders. Register online at www.turboexpo.org.

Over 1000 papers expected for presentation.

Over 100 high-quality leading companies in the exhibition held June 18-20.

June 17-21, 2019 | Phoenix, Arizona
www.turboexpo.org
Keynote Theme: Turbomachines for Clean Power and Propulsion Systems
As the Turbine Turns...

#37 MARCH 2019

Lee S. Langston
Professor Emeritus
University of Connecticut
Mechanical Engineering Department

Hydrogen-Fueled Gas Turbines

“The Role of Gas Turbines in Global Energy Conversion” is the title of a talk I have given to audiences in universities, companies and energy meetings. During recent talks, in the question-and-answer period, I have been asked, can gas turbines run on hydrogen as a fuel, instead of the usual jet fuel, fuel oil or natural gas?

Why hydrogen? As author Peter Hoffman points out in The Forever Fuel: The Story of Hydrogen [1], hydrogen, a normally invisible, tasteless colorless gas, is the most abundant element in the universe. As a fuel it is very energetic and non-polluting, reacting with oxygen to yield H2O.

For engines, hydrogen is the best of everything [2]. It has low weight and the highest specific heat value of any fuel—about three times greater than jet fuel. However, it is an energy carrier that must be manufactured (like electricity), for instance by electrolysis of water or by steam reforming of natural gas. Recently these properties are being considered to have hydrogen be used as an energy storage fuel for use in gas turbine electrical power generation. More on this later!

SOME HISTORY

Can hydrogen be used to power a gas turbine? A straight forward way to answer this is to retell some early history of the gas turbine in its role as an aircraft jet engine.

The first jet engine powered flight took place on Sunday, August 27, 1939 at the Heinkel aircraft factory airfield along the Baltic coastline, near Rostock, Germany. It was achieved in the Heinkel He 178 single engine aircraft, powered by inventor Dr. Hans von Ohain’s He S 3B jet engine, fueled by gasoline.

The He S 3B, with a thrust of 989 pounds (lbt), had been developed from a
Dick Mulready’s account [2] of the hydrogen-fueled 304 engine is a fascinating story. The early testing and subsequent production of five 304 engines took place in East Hartford, Connecticut, from 1956 to about 1959. Extensive testing was then carried out at the company’s new Florida Research and Development Center, located inland west of West Palm Beach in 7000 acres of swamp land. The area of the 304 test stand had the colorful name of the Loxahatchee slough. A 304 engine test run was dubbed the “Swamp Monster”, characterized by a low frequency howl that would increase in pitch with throttle advance until it became inaudible at full thrust [2]. Test results showed the turbine inlet temperature profile was flat, giving a profile superior to existing hydrocarbon fueled engines.

The Suntan 304 engine was a success, but the proposed CL-400 aircraft was a bust. As Jack Connors [4] relates, the airplane would be a flying thermos bottle to cryogenically contain the liquid hydrogen fuel, giving it little flying range. Instead, Lockheed and P&WA set off on a different path to develop what became the Blackbird SR-71, with its JP-7 jet fueled J58 turbojet/ramjet engine. Aircraft range could be achieved by packing the hydrocarbon fuel in every available volume in wings and fuselage—not achievable with liquid hydrogen.

ENERGY STORAGE WITH HYDROGEN

So, why is there a current interest in hydrogen-fueled gas turbines? It has to do with the increased use of renewable energy, i.e. the electric power produced by wind turbines and solar devices. When the wind blows and the sun shines, electricity is produced, but what happens when customer demand falls short of its supply? The surplus renewable energy could be stored for future use, but how?

Turner [5], among others, has advocated that surplus renewable energy from solar and wind could be used for electrolysis of water to produce hydrogen (and of course, oxygen). Just to get an estimate on how much water, he points out that 100 billion gallons of water/year could supply hydrogen to power the U.S. light-duty fleet of some 250 million vehicles, if all were fuel cell equipped. By comparison the U.S. uses about 300 billion gallons of water/year for gasoline production alone, three times that conjectured for hydrogen generation.

Hydrogen so produced could be stored in underground caverns (natural or man-made salt caverns) to be used as fuel in many existing gas turbine power plants (or directly in the rarer fuel-cell power plants).

Currently, there is considerable research going on (especially in Europe and Japan) to inject the hydrogen...
produced from electrolysis directly into existing natural gas networks (pipelines, storage tanks, etc.) that already feed gas turbine power plants. This would use the surplus renewable energy to directly reduce carbon dioxide power plant production.

Questions about combustion problems arising from the addition of hydrogen to the natural gas that might increase production of nitrous oxides need to be addressed. Current results indicate that up to 5-8% of hydrogen in gas turbine natural gas fuel will not be a problem for NOx production. In Japan, Mitsubishi [6] has successfully fired a 30% hydrogen natural gas fuel mix in a gas turbine.

The ideal economic model for energy storage is “buy low, sell high”. Cheap stored hydrogen fuel for use in gas turbine power plants should fit that economic model!

**REFERENCES**

techniques have been mainly used to optimize the shape of one single blade row at a time, leaving a large potential for improvement unused.

Gradient-based optimization techniques, on the other hand, seem to provide a solution. These techniques rely on gradient information, i.e. on how the performance changes when infinitesimal changes to the design variables are made. Especially when the adjoint technique \([4]\) is used to compute the gradient, the computational advantage is apparent: the cost of this computation is equivalent to that of one additional CFD computation, regardless the number of design variables. This allows for very rich design spaces at a very small computational cost \([5]\).

Figure 1 shows the result of such additional adjoint computation for a turbine blade shape optimization: next to the Mach number distribution, obtained by the CFD computation, arrows on the profile wall indicate in which direction the profile needs to change to increase the total pressure losses. A reduction of the pressure loss is thus obtained by moving the blade wall opposed to the arrows indicated in the figure. Even when not introduced in an automated design optimization framework, the added information is crucial to designers, as it visually shows where to apply design changes. This technique is for instance used by car manufacturers to modify the exterior shape of the car for reduced drag coefficients.

Adjoint techniques for CFD have been around for over 3 decades, and although they are now commonly used for exterior aerodynamics, they are yet not commonly applied to turbomachinery, even though the potential is very widely recognized. The optimism of the early days has been replaced by the realism that turbomachinery is a more complex field, where large separation zones occur, where the shape parametrization is more complex, and where the interactions between different disciplines (aerodynamics, thermal, structural) are more pronounced. Many different researchers have however advanced the state-of-the-art in the past decades, such that today we are at the verge of introducing these techniques on an industrial level in the multi-disciplinary design of multistage machines with over 10,000 degrees of freedom. Over the years, issues of stability have been addressed to make the adjoint more stable for mildly unsteady processes such as separations \([6]\). Additionally, the multi-disciplinary character has been addressed where structural, vibrational and heat transfer sensitivities can now also be computed by the efficient adjoint method \([7]\). A significant effort has also been put on including CAD parametrizations in the computation of these sensitivities, as turbomachinery components are best parametrized using CAD-based models. Still, there are a number of issues to be addressed, but the progress has been steady and there is a large optimism now that these methods will be deployed in the industrial design process in the next decade. This is also clear from the introduction of adjoint methods in commercial CFD codes, which pick up the methodology as well.

Against common belief, optimizations of large scale problems, such as full multistage compressors or turbines, are within reach of current computational power. Now with the development of suitable methods reaching enough maturity, we will soon see the appearance of these techniques on the work floor. And it will not go unnoticed, as they will highly impact the development cycle of future gas turbine engines, enabling significant performance gains with much faster design processes.

**REFERENCES**

GTSLT Update

THE ROLE OF GAS TURBINES IN THE NEW ASME STRATEGY

The establishment of the ASME Gas Turbine Segment (GTS) in 2016 recognizes the importance of the field in the engineering arena. Gas turbines incorporate some of the most cutting edge technologies available in the world today. They also continue to dominate in areas such as aircraft propulsion, power generation and mechanical drive applications.

For 2018 ASME has released a new Strategy encapsulating Mission and Vision through Objectives and Goals to an Integrated Operating Plan, and which can be read in its entirety at:


The ASME Strategy also identifies Five Core Technologies & Eight Enabling Applications and Cross-Cutting Technologies which are shown in Figure 1. Most of these technologies are employed in gas turbines, in many cases representing the forefront of advancements in each of the areas. The GTS Leadership Team thought it worthwhile to reflect on how these ASME Strategic Technologies are incorporated in turbomachinery.

Many of these technologies were on display in the conference papers, tutorials, exposition and the panel sessions at last year’s ASME Turbo Expo in Lillestrøm, Norway. This article explores how the conference reflects the ASME Strategic Technologies and demonstrates turbomachinery’s leading role in advancing engineering technology.

MANUFACTURING

Pushing the limits of existing manufacturing capabilities and leveraging new methods such as Additive Manufacturing (AM) allows for further advances in turbomachinery. Through coordination with the International Gas Turbine Institute’s Manufacturing, Materials and Metallurgy Technical Committee a dedicated AM Focus Track was incorporated into the TE program. This included a tutorial by Tim Simpson of Pennsylvania State University (“AM with Metals”), a plenary session (“Impact of AM on Future Gas Turbine Engines and Parts”), panels (“AM for Gas Turbines and Parts”) and papers. Related to conventional machining, the impact of machining tolerances on small compressor aerodynamics was the subject of a paper from Dyson (GT2018-77280).

PRESSURE TECHNOLOGY

Although not a primary focus at Turbo Expo, Pressure Technology is a core area to all gas turbine applications and arguably used in most work presented at the conference. Pressure vessel, containment, and piping are utilized by the community on a daily basis. There are several sessions within the Structures and Dynamics committee which directly involve elements and considerations of pressure technology including Fatigue Life Modelling, Material and Structural Integrity as well as Frictional Joints. A couple of examples of papers from the 2018 Turbo Expo range from topics addressing thermal stresses in pressure containing structures to modelling bolt stresses (GT2018-76519, GT2018-75101 & GT2018-75303). Additionally, there are newer applications, such as supercritical CO2, which are reevaluating the limits of our knowledge in this area.

CLEAN ENERGY

Roughly 40% of the world’s electricity is generated in Rankine cycle coal-fired power plants. According to the Energy Information Administration, in 2014, U.S. coal-fired plants accounted for 76% of the carbon dioxide emissions for the U.S. electric power sector. If a significant portion of these coal-fired Rankine cycle plants were replaced by the latest natural gas-fired Combined Cycle Gas Turbine (CCGT) power plants, anthropogenic carbon dioxide released into the earth’s atmosphere would be greatly reduced. Two contributing factors bring this about:

1. Coal combustion produces more carbon dioxide than that of natural gas, by a factor of 2.

2. The thermal efficiency of modern CCGT Power plants is double that of most existing coal-fired power plants.

Thus, a CCGT power plant can result in about a 75% reduction of carbon dioxide production when it replaces...
a coal-fired plant. Some of the latest developments for these game-changing. Clean Energy plants were given by GE Power (GT2018-76911) and Mitsubishi Hitachi Power Systems (GT2018-77273). Important market forces which influence the deployment and use of these combined cycle gas turbines were dealt with by Salvatore Della Villa (GT2018-75030). Lastly, the production of totally clean energy was covered in 17 papers, presented by the Wind Energy Committee.

Moving forward GT will continue to be important technology in the clean energy future. For instance, CCGT power plants are easily adapted to CO2 capture and storage scenarios with a moderate increase in the cost of electricity. As GT and CO2 capture technology advances, these costs will come down. GT are also amenable to the combustion of pure hydrogen as a fuel allowing this technology to integrate well with renewables that generate and store hydrogen during periods of excess power generation. Turbine technology will also play a key role in many energy storage concepts. In summary GT and turbine technology will have an important role in a clean energy future.

**ROBOTICS**

Regarding Robotics, some examples were provided in the plenary keynote session on the first day (“Maintenance, Repair and Overhaul (MRO) in the Light of Digitalization”). In his address, the Chief Technology Officer of Siemens Power & Gas Zuozhi Zhao identified autonomous robotics and automation as key areas of innovation. This includes robots for the automated inspection and repair of gas turbine parts without requiring any prior disassembly. The role of robotics in improved process control for an advanced Laser Metal Deposition manufacturing process was the subject of a paper from Siemens (GT2018-75066). Robots are also used in experimental rigs to improve the reliability of measurements as captured in a paper from GE Global Research (GT2018-76168). Another example is the automated inspection and measurement of manufacturing tolerances in gas turbine parts as presented in a paper from Chalmers University of Technology and GKN (GT2018-76340).

**ENABLING APPLICATIONS & CROSS-CUTTING TECHNOLOGIES**

For the first Cross-Cutting Technology on Internet of Things (IoT), applications were also discussed in the plenary keynote panel. In addition, IoT was addressed in a technical track (“Data Analytics and Reasoning for Smart MRO”) and in a tutorial session on wind energy (“Flow Control and Smart Turbines”).

The theme of **Big Data Analytics** received significant attention at the Turbo Expo conference including the plenary keynote session, a panel session on the estimation of gas turbine life cycles using data analytics (Panel 5-14) and a tutorial by GE (5-15/16) dedicated to the concept of the “Digital Twin”. Several technical sessions were also focused on Big Data applied to gas turbine health monitoring, fault detection and MRO (sessions 8-2 “Gas Turbine Analysis & Optimization”, 5-3 “Performance Monitoring and Fault Diagnostics of Gas Turbines”, 5-4 “Data Analytics and reasoning for Smart MRO”, 24-6 Component Degradation & Failure Analysis”, 1-14 “Engine Maintenance and On-wing Monitoring of Deterioration” & 27-6 “MRO/Digital”).

**Artificial Intelligence (AI)** was the core of several technical sessions. In particular, machine learning and its application to gas turbine design, modelling performance prediction and MRO have been one of the most trending topics at the conference. One tutorial on wind energy (E-5) discussed the application of machine learning to power curve methods. More than eight technical papers were focused on machine learning based methods applied to compressor optimization and performance (GT2018-77098 & GT2018-75372), material design (GT2018-75207) and gas turbine and component flow modelling (GT2018-76927, GT2018-75447 & GT2018-75444).

**Sustainability** is a topic of particular relevance, since most applications of advanced-technology turbomachinery (e.g. gas turbines for flight propulsion and power generation) are long-lived assets and are in active operation for most of their life span. Thus, fuel cost is by far the largest contributor to their direct operating costs. Due to this fact, commercially efficient operation and sustainability are both driven by reductions in fuel consumption, whatever that fuel may be (including bio-fuels in the future). Increasing the efficiency of gas turbines, thus reducing their environmental impact, is the key motivation for many publications presented at Turbo Expo. Cranfield University looked into the application of bio-fuels (GT2018-75751); a key enabler to reducing carbon emissions in propulsion engines. Many papers dealing with turbomachinery aerodynamic design quoted efficiency improvements as their primary motivation such as DLR on compressor tandem airfoil design (GT2018-75132) or Lyulka Design Bureau investigating the efficiency impact of different turbine tip shroud geometries (GT2018-75418). Unconventional concepts are also being investigated, like plasma actuators for reducing tip flows (GT2018-76680).

**Materials** are at the core of modern turbomachinery capabilities, and have been a key element of improvements in gas turbine performance for decades. Advances in materials contribute to improvements in heat transfer, manufacturability (traditional and additive), maintenance, and the overall life cycle of gas turbine engines, all of which are present in the Turbo Expo content. The Manufacturing, Materials, and Metallurgy committee incorporates dedicated technical sessions to the areas of superalloys, coatings, and ceramics. In particular, applications and development of AM are a major contributor to the materials content at Turbo Expo including tutorials, technical sessions, and panel sessions. AM paper examples include the characterization of new Nickel alloys described by Ansaldo (GT2018-76614), and the characterization of pressure losses and cooling effectiveness in AM porous materials for film cooling presented by Fantozzi et al.
Outside of the Manufacturing, Materials and Metallurgy committee there are technical sessions dedicated to materials development for applications with supercritical CO2 power cycles and heat transfer and papers utilizing AM for compressor vanes, cooling passages, and combustor swirlers.

**Design Engineering** is a key focus area since turbomachinery parts must be designed and manufactured to extremely tight tolerances (e.g. airfoil surfaces, rotor tip clearances) and are operating in the harshest conditions. This makes it important for the gas turbine engineering community to be at the forefront of the development of integrated design systems. A common goal is to link every aspect from preliminary design to manufacturing quality control to a "digital twin". Taking full advantage of the substantial amounts of data this will generate researchers will need the help artificial intelligence and the smart use of big data analytics; again, showing the closely related nature of these cross-cutting technologies. A performance-based quality assessment was presented by Rolls-Royce (GT2018-75157) utilizing white-light scanning and feeding back as-manufactured geometries into the design and analysis tool-chain. As a further example, the mechanical preliminary design and assembly-ability was being investigated by the University of Stuttgart (GT2018-75615).

![ASME Strategic Technologies on display at 2018 ASME Turbo Expo.](image)

**SUMMARY**

The breadth of engineering disciplines on display at Turbo Expo demonstrates how turbomachinery continues to be a forerunner in applying many of the future ASME Strategic Technologies. The examples shown in Figure 2 provide just a snapshot of how turbomachinery represents the cutting edge of mechanical engineering. The importance of turbomachinery to the ASME as a carrier for these technologies is reflected in the existence of the dedicated Gas Turbine Segment (GTS) which is part of ASME’s Technical Events and Content (TEC) Sector.

The GTS Leadership Team would like to thank ASME for the continued support of the turbomachinery community, and thank everyone in the community for their valuable contribution to the success of the recent ASME Turbo Expo in Lillestrøm, Norway. We look forward to seeing more examples of these cutting edge technologies at the next Turbo Expo in Phoenix, Arizona, June 17-21, 2019.

**ASME 2019 TURBO EXPO PRE-CONFERENCE WORKSHOPS**

Pre-conference workshops will be held at the Phoenix Convention Center on Sunday, June 16, from 8:00 a.m. to 5:00 p.m. Consider attending one of the Workshops and take advantage of the low registration fee. Subject to cancellation if the minimum number of registrations is not achieved. Must register by April 22, 2019.

For detailed information about the workshops visit: [https://event.asme.org/Turbo-Expo/Program/Workshops](https://event.asme.org/Turbo-Expo/Program/Workshops)

**ASME 2019 GAS TURBINE INDIA CONFERENCE AND EXHIBITION**

DECEMBER 5 – 6, 2019
CHENNAI, INDIA

Submit Abstract by April 18, 2019
[https://event.asme.org/GT-India](https://event.asme.org/GT-India)

The 2-day event attracts the industry’s leading professionals and key decision makers, whose innovation and expertise are shaping the future of turbomachinery. Authors and presenters are invited to participate in this event to exchange ideas on research, development and best practices on Gas Turbines and allied areas. The conference is an excellent opportunity to initiate and expand international co-operation.
WHY EXHIBIT?
To gain access to professionals in the power generation and turbomachinery fields from industry, R&D, academia and government over three days while showcasing your products and services and building your customer base.

The 3-day exposition will be held June 18-20 in Phoenix, Arizona with some value added activities to promote traffic! Daily lunches in the exhibit hall are included in the registration package for exhibit booth staff. There are daily afternoon coffee breaks and open bar receptions in the Hall.

This is your chance to attract new clients, visit with current ones, learn more about the changing needs of the international turbomachinery industry - and ultimately, increase your sales.

ASME Turbo Expo brings together from around the world the top players in the turbomachinery industry and academia - attracting a key audience of over 2500 delegates from aerospace, power generation and other prime mover-related industries interested in sharing the latest in turbine technology, research, development, and application.

EXHIBITION INFORMATION
Secure your booth now for prime space availability and see how this event can generate bottom-line results for your marketing dollars. Visit the online floor plan at www.turboexpo.org and reserve your booth today. Click on the desired booth space and select RESERVE BOOTH. You will then be prompted to complete an application. Contact igtiexpo@asme.org if you have any questions or issues with space selection.

BOOTH SPACE PRICING:
Exhibit space rates in Phoenix, Arizona:

- Booth Space: $32.00 USD per square foot (For island or corner booths, add $2.00 USD per sq. ft)

All exhibitors receive:
- Exhibit space with 8’ black draped booth backdrop, 3’ side dividers and booth sign
- 1 technical conference badge per 100sf of exhibit space
  - Tuesday, Wednesday and Thursday exhibit hall lunch
  - Monday evening Welcome Reception, Keynote and Opening Luncheon
- Complimentary lead retrieval unit
- Free exhibit booth passes to share with customers and prospects
- Significantly discounted Technical Conference registration for company employees
- 15-word company listing in the printed Conference Program
- Discounted advertising opportunities
- Product category and company description in the online exhibitor directory with press releases, logo, brochure

Stay ahead of the competition and meet your customers face to face.

SPONSORSHIP INFORMATION
Take control of your company’s exposure before, during and after the event. Featuring a variety of sponsorship opportunities designed to maximize your company’s visibility, the ASME Turbo Expo sponsorship program provides even more ways to stand out from the crowd and make the most of your budget. Additional opportunities and descriptions can be found at https://www.asme.org/events/turbo-expo/sponsor-exhibit.

- PLATINUM CLUB: $20,000
- GOLD CLUB: $15,000
- SILVER CLUB: $10,000
- BRONZE CLUB: $5,000
Awards & Honors

ASME R. TOM SAWYER AWARD

Your nomination package should be received at the ASME Office no later than August 15, 2019 to be considered.

The nomination must be complete and accompanied by three to five Letters of Recommendation from individuals who are well acquainted with the nominees’ qualifications. Candidate nominations remain in effect for three years and are automatically carried over. The completed reference form from a minimum of 3 people will need to be sent in with the nomination package. It is up to the “Nominator” to submit all required information.

Email completed nomination package to: igtiawards@asme.org.

ASME IGTI AIRCRAFT ENGINE TECHNOLOGY AWARD

Nominating and supporting letters for the Aircraft Engine Technology Award should be sent by October 15, 2019 to: igtiawards@asme.org.

Nominating letters should contain all information on the nominee’s relevant qualifications. The Award Committee will not solicit or consider materials other than those described below. The selection committee will hold nominations active for a period of three years.

A minimum of two supporting letters from individuals, other than the nominator, must accompany the nominating letter. Supporting letters should reflect peer recognition of the nominee’s breadth of experience with various aspects of industrial gas turbine technology.

ASME IGTI STUDENT SCHOLARSHIP PROGRAM

Student application deadline is March 1, 2019 for the 2019-2020 Academic School Year. Scholarship winners will be notified between June 15 and July 15, 2019.

For complete information on the scholarship program and application process, visit: https://www.asme.org/career-education/scholarships-and-grants/scholarship/asme-scholarships-how-to-apply

ASME IGTI INDUSTRIAL GAS TURBINE TECHNOLOGY AWARD

Nominating and supporting letters for the Industrial Gas Turbine Technology Award should be sent by October 15, 2019 to: igtiawards@asme.org.

Nomination requirements are identical to the ASME IGTI Aircraft Engine Technology Award.

ASME IGTI DILIP R. BALLAL EARLY CAREER AWARD

Nomination packets are due to ASME on or before August 1, 2019. Send complete nomination to: igtiawards@asme.org.

The nomination package should include the following:

A. A paragraph (less than 50 words) from the nominator highlighting nominee’s contributions
B. Nomination letter
C. Two supporting letters
D. Current resume of the nominee

PROFESSIONAL DEVELOPMENT TUTORIAL

ABOUT TRANSITION COACHING FOR MID AND LATE CAREER ENGINEERS

FRIDAY, JUNE 21, 10:15 A.M. – 12:45 P.M.
DURING ASME TURBO EXPO 2019 IN PHOENIX

This tutorial will explore the challenges of transitions and take the class participants through a series of exercises to:

- Assess current professional and personal situation
- Develop goals for the next phase of life
- Create an Action Plan for achieving those goals
- Evaluate existing and new identity
- Explore existing habits and how they will support or hinder the next phase of your life

Who May Attend? This tutorial, funded by IGTI, is open to all who register and pay to attend the ASME 2019 Turbo Expo Conference.