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About the UTSR Meeting

The National Energy Technology Laboratory University Turbine Systems Research (NETL-UTSR) program manages a portfolio of university-based turbine research projects. The UTSR program offers a Gas Turbine Industrial Fellowship funded by sponsoring gas turbine manufacturers. This fellowship has helped to facilitate the transition of the best students from academia to the gas turbine industry, thereby helping to maintain U.S. leadership in this important area of technology.

The success of the UTSR program has been made possible by a network of universities, the collaborating gas turbine industry, and the DOE turbine program – all of which are facilitated by an annual UTSR project review meeting, which is open to the public and brings together experts from academia, industry, and government to present and discuss ongoing turbine research sponsored by the DOE Office of Fossil Energy UTSR program under existing cooperative agreements.

The UTSR program committee selects meeting venues close to leading universities directly involved in turbine research. The 2019 UTSR project review meeting, co-hosted by University of Central Florida, will be held at the Renaissance Orlando Airport Hotel in Florida, Nov. 5–7, 2019. The theme of this year’s review meeting is “Turbine Technologies in a Changing Energy Landscape.” Three speakers will provide keynote addresses:

- Mr. Paul Browning, President & CEO, Mitsubishi Hitachi Power Systems Americas — “Technology and Fuel Choice for Tomorrow’s Generation — Change in Power”
- Mr. Richard Voorberg, Executive Vice President, Service–North America, Siemens Energy — “Evolution of Energy in a Decarbonizing World”
- Mr. John Intile, General Manager, Gas Turbine Engineering, GE Power — “Impact of Changing Landscape of Power Generation on Innovations in Gas Turbines”

The meeting will feature a panel discussion on the topic “Power Generation with Integrated Large-Scale Energy Storage” by Mr. Jan Teichmann, Vice President, Fluence; Mr. Michael J. Ducker, Senior Director, New Product Solutions & Operations, Mitsubishi Hitachi Power Systems; Dr. Rachana Vidhi, Senior Project Manager, NextEra Energy Resources; Dr. Issa Batarseh, Professor, Department of Electrical and Computer Engineering, University of Central Florida; and Dr. Jay Kapat, UCF Pegasus Professor and Trustee Chair Professor, University of Central Florida. The meeting will also include an open discussion on the future of the UTSR program. In addition, Dr. Karen Thole from the Pennsylvania State University will discuss the Steady Thermal Aero Research Turbine (START) Lab at Penn State, focusing on advancing turbine research through the National Experimental Turbine (NExT). Project reviews will be organized into three parallel technology tracks: combustion and pressure gain combustion; aero/heat transfer and supercritical CO$_2$ and materials, ceramic matrix composites and additive manufacturing. The meeting will feature approximately 80 DOE-sponsored projects in the form of oral and poster presentations including a majority of NETL’s extramural projects for the Advanced Turbines Program, as well as internal NETL R&D projects.
UTSR Technology Summary

Since the inception of the DOE turbine program, the NETL-UTSR program has sought to support the underlying scientific research necessary to develop advanced turbines and turbine-based systems in support of the DOE’s turbine program’s strategic goals and program mission needs. The UTSR program has two primary goals. One is to produce results that resolve technical issues associated with DOE’s Office of Fossil Energy Advanced Turbines Program and the other is to maintain and enhance university-based turbine engineering capabilities in the United States. These two UTSR Program goals will continue to be realized through the involvement of professors and students in research and development on advanced turbine technical issues, while enhancing the education of future scientists and engineers in the U.S. This is accomplished by funding university-based research projects that address scientific R&D and technical challenges in turbine-based systems and technology. This research focuses on the fundamental and applied issues associated with advancing the performance and efficiency of turbines in fossil fuel power generation beyond current state-of-the-art. Technical areas of interest include combustion, aerodynamics, heat transfer, materials, technology development for supercritical carbon dioxide based power cycles, pressure gain combustion, and oxy-fuel turbine based systems and technology.

The projects are typically three years in duration and focus on applied laboratory/bench scale R&D. Currently 12 universities and 18 projects are involved in the NETL-UTSR program. The innovations and scientific understanding generated under this program will then be transferred to industry manufacturers for incorporation into their next generation turbine technology products with the goal of producing reliable, affordable, clean, efficient, and cost-effective energy supplies.

One of the main purposes of this UTSR project review meeting is to facilitate peer-to-peer knowledge sharing and collaboration across boundaries to create a network of expertise and facilitate the acceleration of advancements in those fields.

Organizing Committee

Patcharin (Rin) Burke
U.S. Department of Energy, National Energy Technology Laboratory
Richard Dalton
KeyLogic
Bill Day
Longview Energy Associates LLC
Richard Dennis
U.S. Department of Energy, National Energy Technology Laboratory
Jay Kapat
University of Central Florida
Karen Lockhart
SSC-Deltha
Greg O’Neil
U.S. Department of Energy, National Energy Technology Laboratory

UTSR Industry Committee

John Alday
FlexEnergy
Michael Fox
Solar Turbines, Inc.
Jonathan Li
Siemens Energy, Inc.
Scott Macadam
Gas Technology Institute (GTI)
David Ransom
Southwest Research Institute
Joe Weber
General Electric
Renaissance Orlando Airport

Hotel Layout
Laboratory Tour

We will visit three adjoining facilities on the University of Central Florida (UCF) main campus in east Orlando. All three facilities are affiliated with Center for Advanced Turbomachinery & Energy Research (CATER) at UCF.

No photography is allowed in any of the facilities.

- Siemens Energy Center (SEC): This special-purpose, 7200-sq-ft facility complements the Laboratory for Turbine Aerodynamics, Heat Transfer and Durability under CATER. SEC is managed by a Research Faculty under the joint supervision of a UCF faculty member and Siemens expert engineer. SEC is a restricted facility, with restrictions imposed by both UCF and Siemens Gas & Power. Access is limited to only those working inside the facility or who are provided special authorization. A number of Siemens experts and engineers also have 24/7 unlimited access to the facility. Everyone with access to the building is required to observe the same level of confidentiality as in a typical OEM such as Siemens, with restriction on every outside activity that must be pre-approved. Each such user is provided special training on export control regulations, corporate confidentiality, and laboratory safety. The specific experimental rigs inside SEC address single jet and multi jet impingement, trailing edge treatment, ribbed turbulators, water flow visualization, midframe aerodynamics, rotating and stationary seals, and film cooling. Among the doctoral graduates from this facility or its precursors, twelve are currently in various OEM's for turbomachinery for power generation, aviation and space propulsion: Siemens, GE, Mitsubishi, P&W, Aerojet Rocketdyne, Northrop Grumman (Orbital ATK).

- Propulsion & Energy Research Lab (PERL): The PERL is focused on investigating multi-phase turbulent reacting flows, clean combustion strategies, and alternative fuels for the next generation advanced propulsion and combustion energy technologies. The lab’s research objective is concentrated on advancing the scientific research through fundamental physics understanding of turbulent reacting flows, combustion dynamics, pressure gain combustion, supersonic compressible flows, fluid mechanics, flow control, flame-fluidics interactions, vortex dynamics, and hydrodynamic instabilities. The lab is specialized in experimental investigations, physics-based models, and development of unit problems that couples fundamental lab research to national technological problems. The PERL is equipped with state-of-the-art advanced high-speed laser diagnostics and experimental tools for studying turbulent flow mixing and reactions. Computational methods (CFD) are developed and utilized in coordination with experimental research.

- Laboratory for Supercritical CO\textsubscript{2} Heat Transfer, Leakage and Component Evaluation: This new laboratory has been adopted from past activities under GE sponsorship where carbon dioxide supply system was utilized in PSP-based measurement of film cooling effectiveness. With recent modifications, the experimental facility will allow open-loop and closed-loop measurements of heat transfer coefficients in internal channels, leakage flows past various types of seals, and (in future) evaluation of various concepts for individual components, as applicable to sCO\textsubscript{2} power cycles.
### Agenda-At-A-Glance

**Tuesday, November 5, 2019**

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
</tr>
</thead>
<tbody>
<tr>
<td>7:30 a.m.</td>
<td>Registration/Continental Breakfast - Vienna A Foyer</td>
</tr>
<tr>
<td>8:30 a.m.</td>
<td>Michael Georgiopoulos, Dean of the College of Engineering and Computer Science, University of Central Florida - Welcome &amp; Introduction</td>
</tr>
<tr>
<td>8:55 a.m.</td>
<td>Richard Dennis, Turbine Technology Manager, NETL - Opening Remarks</td>
</tr>
<tr>
<td>9:00 a.m.</td>
<td>Richard Dennis, Turbine Technology Manager, NETL - Overview of DOE Advanced Turbines Program</td>
</tr>
<tr>
<td>9:30 a.m.</td>
<td>Paul Browning, President &amp; CEO, Mitsubishi Hitachi Power Systems Americas - Technology and Fuel Choice for Tomorrow’s Generation – Change in Power</td>
</tr>
<tr>
<td>10:15 a.m.</td>
<td>AM Break - Vienna A Foyer</td>
</tr>
<tr>
<td></td>
<td>Panel Discussion, Power Generation with Integrated Large - Scale Energy Storage</td>
</tr>
<tr>
<td></td>
<td>Issa Batarseh, Professor, Department of Electrical and Computer Engineering, University of Central Florida</td>
</tr>
<tr>
<td></td>
<td>Michael J. Ducker, Senior Director, New Product Solutions &amp; Operations, Mitsubishi Hitachi Power Systems</td>
</tr>
<tr>
<td>10:45 a.m.</td>
<td>Jay Kapat, UCF Pegasus Professor and Trustee Chair Professor, University of Central Florida</td>
</tr>
<tr>
<td></td>
<td>Jan Teichmann, Vice President, Fluence</td>
</tr>
<tr>
<td></td>
<td>Rachana Vidhi, Senior Project Manager, NextEra Energy Resources</td>
</tr>
<tr>
<td>12:00 p.m.</td>
<td>Lunch - Vienna B</td>
</tr>
<tr>
<td>1:30 p.m.</td>
<td>Richard Voorberg, Executive Vice President, Service – North America, Siemens Energy – Evolution of Energy in a Decarbonizing World</td>
</tr>
<tr>
<td>2:15 p.m.</td>
<td>Continue to Breakout Rooms</td>
</tr>
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</table>

Detailed list on pages 12 - 14
### Track A - Combustion (Day 1 & 2) & Pressure Gain Combustion (Day 2 & 3) - Vienna B

**Moderators:** Mark Freeman & Donald Ferguson

<table>
<thead>
<tr>
<th>Time</th>
<th>Organization</th>
<th>Title</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.35 pm</td>
<td>GE Power</td>
<td>Advanced Multi-Tube Mixer Combustion for 65% Efficiency</td>
<td>Michael Hughes</td>
</tr>
<tr>
<td>3.05 pm</td>
<td>Georgia Tech</td>
<td>High-Frequency Transverse Combustion Instabilities in Low-NO(_x) Gas Turbines</td>
<td>Tim Lieuwen</td>
</tr>
<tr>
<td>4.05 pm</td>
<td>Penn State University</td>
<td>Understanding Transient Combustion Phenomena in Low-NO(_x) Gas Turbines</td>
<td>Jacqueline O’Connor</td>
</tr>
<tr>
<td>4.35 pm</td>
<td>Embry Riddle</td>
<td>Improving NO(_x) Entitlement with Axial Staging</td>
<td>Scott Martin</td>
</tr>
<tr>
<td>5.05 pm</td>
<td>Siemens Energy</td>
<td>Extremely Low NO(_x) Axial Staged Combustion System</td>
<td>Andrew North</td>
</tr>
</tbody>
</table>

3:35 pm Break - Vienna A Foyer

<table>
<thead>
<tr>
<th>Time</th>
<th>Organization</th>
<th>Title</th>
<th>Presenter</th>
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<tbody>
<tr>
<td>5:45 pm-7:00 pm</td>
<td>Poster Session - Vienna A</td>
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</table>

### Track B - Aero & Heat Transfer (Day 1) & Super Critical CO\(_2\) (Day 2 & 3)-Normandy A

**Moderators:** Robin Ames & Seth Lawson

<table>
<thead>
<tr>
<th>Time</th>
<th>Organization</th>
<th>Title</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.35 pm</td>
<td>GE</td>
<td>Turbine Aero-Thermal Technologies for 65% Combined Cycle Efficiency</td>
<td>Joe Weber</td>
</tr>
<tr>
<td>3.05 pm</td>
<td>Purdue University</td>
<td>Bulk Temperature, Adiabatic-Wall Temperature, &amp; Heat-Transfer Coefficient -Revisited</td>
<td>Tom Shih</td>
</tr>
<tr>
<td>4.05 pm</td>
<td>NETL-RIC</td>
<td>Analysis of Turbine Cooling Technologies for Increasing NGCC Efficiency</td>
<td>Selcuk Can Uysal</td>
</tr>
<tr>
<td>4.35 pm</td>
<td>Ohio State University</td>
<td>Revolutionizing Turbine Cooling with Micro-Architectures Enabled by Direct Metal Laser Sintering</td>
<td>Jeffrey Bons</td>
</tr>
<tr>
<td>5.05 pm</td>
<td>Penn State University</td>
<td>LES &amp; RANS/DERM Modeling for Design Optimization of Additively &amp; Conventionally Manufactured Internal Turbine Cooling Passages</td>
<td>Robert Kunz</td>
</tr>
</tbody>
</table>

3:35 pm Break - Vienna A Foyer

5:45 - 7:00 pm - Poster Session - Vienna A

### Track C - Materials (Day 1) & CMC & AM (Day 2 & 3)- Normandy B

**Moderators:** Rin Burke & Richard Dalton

<table>
<thead>
<tr>
<th>Time</th>
<th>Organization</th>
<th>Title</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.35 pm</td>
<td>Siemens Energy, Inc</td>
<td>Design &amp; Development of Low Weight, Titanium Aluminide Airfoils for High Performance Industrial Gas Turbines Meeting 65% Combined Cycle Efficiency</td>
<td>Sam Miller</td>
</tr>
<tr>
<td>3.05 pm</td>
<td>GE</td>
<td>High Temperature, High AN2 Last Stage Blade for 65% Combined Cycle Efficiency</td>
<td>John Delvaux</td>
</tr>
<tr>
<td>4.05 pm</td>
<td>The Ohio State University</td>
<td>Development of High Performance Ni-Base Alloys for Gas Turbine Wheels Using a Coprecipitation Approach</td>
<td>Yunzhi Wang</td>
</tr>
<tr>
<td>4.35 pm</td>
<td>Georgia Tech</td>
<td>Real-Time Health Monitoring for Gas Turbine Components Using Online Learning &amp; High Dimensional Data</td>
<td>Nagi Gebraael</td>
</tr>
<tr>
<td>5.05 pm</td>
<td>University of Central Florida</td>
<td>In-Situ Optical Monitoring of Gas Turbine Blade Coatings Under Operational Extreme Environments</td>
<td>Quentin Fouliard</td>
</tr>
</tbody>
</table>

3:35 pm Break - Vienna A Foyer

5:45 - 7:00 pm Poster Session - Vienna A
D A Y  2

Agenda-At-A-Glance

Wednesday, November 6, 2019

7:30 a.m.    Registration/Continental Breakfast - Vienna A Foyer

8:30 a.m.    John Intile, General Manager, Gas Turbine Engineering, GE Power - Impact of Changing Landscape of Power Generation on Innovations in Gas Turbines

9:15 a.m.    Rich Dennis, Turbine Technology Manager, NETL - Open Discussion on the Future of The UTSR Program

10:00 a.m.   AM break - Vienna A Foyer

10:30 a.m.   Karen Thole, Distinguished Professor & Department Head, Department of Mechanical Engineering - Pennsylvania State University - Advancing Turbine Research through the National Experimental Turbine (NExT)

11:30 a.m.   Lunch - Vienna B

Detailed list on pages 15 - 18
## Track A - Combustion (Day 1 & 2) & Pressure Gain Combustion (Day 2 & 3) - Vienna B

**Moderators:** Mark Freeman & Donald Ferguson

<table>
<thead>
<tr>
<th>Time</th>
<th>Organization</th>
<th>Title</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:30 pm</td>
<td>Georgia Tech</td>
<td>High Temperature, Low NO(_x) Combustor Concept Development</td>
<td>Tim Lieuwen</td>
</tr>
<tr>
<td>1:00 pm</td>
<td>GTI</td>
<td>Advanced Modular Sub-Atmospheric Hybrid Heat Engine</td>
<td>Yaroslav Chudnovsky</td>
</tr>
<tr>
<td>1:30 pm</td>
<td>Bechtel</td>
<td>Turbocompound Reheat Gas Turbine Combined Cycle</td>
<td>S.C. (John) Gülen</td>
</tr>
<tr>
<td>2:00 pm</td>
<td>Combustion Research &amp; Flow Technology, Inc.</td>
<td>Modeling sCO(_2) Compressors at Off-Design Conditions with Fluid Impurities</td>
<td>Ashvin Hosangadi</td>
</tr>
<tr>
<td>2:30 pm</td>
<td>Break - Vienna A Foyer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3:00 pm</td>
<td>Gas Technology Institute</td>
<td>H(_2)-Power - A Modular Heat Engine for the Direct Conversion of Natural Gas to Hydrogen &amp; Power Using Hydrogen Turbines</td>
<td>Jeffrey Mays</td>
</tr>
<tr>
<td>3:30 pm</td>
<td>NETL-RIC</td>
<td>Overview of Rotating Detonation Combustion Study at NETL</td>
<td>Don Ferguson</td>
</tr>
<tr>
<td>4:00 pm</td>
<td>University of Michigan</td>
<td>A Joint Experimental/Computational Study of Non-Idealities in Practical Rotating Detonation Engines</td>
<td>Mirko Gamba</td>
</tr>
<tr>
<td>4:30 pm</td>
<td>University of Michigan</td>
<td>Fuel Injection Dynamics &amp; Composition Effects on Rotating Detonation Engine Performance</td>
<td>Mirko Gamba</td>
</tr>
</tbody>
</table>

5:30 pm - 7:15 pm - Lab tour: University of Central Florida

## Track B - Aero & Heat Transfer (Day 1) & Super Critical CO\(_2\) (Day 2 & 3) - Normandy A

**Moderators:** Robin Ames & Seth Lawson

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<tr>
<th>Time</th>
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<tbody>
<tr>
<td>12:30 pm</td>
<td>GE</td>
<td>Novel Modular Heat Engines with sCO(_2) Bottoming Cycle Utilizing Advanced Oil-Free Turbomachinery</td>
<td>Bugra Ertas</td>
</tr>
<tr>
<td>1:00 pm</td>
<td>NETL-RIC</td>
<td>Materials Research for Supercritical CO(_2) Power Cycles</td>
<td>Omer Dogan</td>
</tr>
<tr>
<td>1:30 pm</td>
<td>GE</td>
<td>Low-Leakage Seals for Utility-Scale sCO(_2) Turbines</td>
<td>Rahul Bidkar</td>
</tr>
<tr>
<td>2:00 pm</td>
<td>SwRI</td>
<td>Advanced Gas Turbine &amp; sCO(_2) Combined Cycle Power System</td>
<td>Kevin Hoopes</td>
</tr>
<tr>
<td>2:30 pm</td>
<td>Break - Vienna A Foyer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3:00 pm</td>
<td>CATER/UCF</td>
<td>Combustion Kinetics Model Development &amp; Fluid Property Experimental Investigation for Improved Design of Supercritical CO(_2) Power Cycle Components</td>
<td>Subith Vasu</td>
</tr>
<tr>
<td>3:30 pm</td>
<td>Echogen</td>
<td>Integrated Optimization &amp; Control of a Hybrid Gas Turbine/sCO(_2) Power System</td>
<td>Tim Held</td>
</tr>
<tr>
<td>4:00 pm</td>
<td>Thar Energy, LLC</td>
<td>Development of Modular, Low-Cost, High-Temperature Recuperators for the sCO(_2) Power Cycle - Prototype Performance Update</td>
<td>Marc Portnoff</td>
</tr>
<tr>
<td>4:30 pm</td>
<td>Echogen Power Systems</td>
<td>Supercritical Carbon Dioxide Primary Power Large - Scale Pilot Plant</td>
<td>Tim Held</td>
</tr>
</tbody>
</table>

5:30 pm - 7:15 pm - Lab tour: University of Central Florida

## Track C - Materials (Day 1) & CMC & AM (Day 2 & 3) - Normandy B

**Moderators:** Rin Burke & Richard Dalton

<table>
<thead>
<tr>
<th>Time</th>
<th>Organization</th>
<th>Title</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>12:30 pm</td>
<td>GE Power</td>
<td>High Temperature Ceramic Matrix Composite (CMC) Nozzles for 65% Efficiency</td>
<td>John Delvaux</td>
</tr>
<tr>
<td>1:00 pm</td>
<td>Siemens Energy, Inc</td>
<td>Additive Manufactured Metallic-3D Ox-Ox CMC Integrated Structures for 65% Combined Cycle Efficiency</td>
<td>Ramesh Subramanian</td>
</tr>
<tr>
<td>1:30 pm</td>
<td>UTRC</td>
<td>Hybrid Ceramic-CMC Vane with EBC for Future Coal Derived Syngas Fired Highly Efficient Gas Turbine</td>
<td>John Holowczak</td>
</tr>
<tr>
<td>2:00 pm</td>
<td>Arizona State University</td>
<td>A Multiphysics Multiscale Simulation Platform for Damage, Environmental Degradation, &amp; Life Prediction of Ceramic Matrix Composites (CMCs) in Extreme Environments</td>
<td>Aditi Chattopadhyay</td>
</tr>
<tr>
<td>2:30 pm</td>
<td>Break - Vienna A Foyer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3:00 pm</td>
<td>Clemson University</td>
<td>Integrated TBC/EBC For SiC Fiber Reinforced SiC Matrix Composites for Next Generation Gas Turbines</td>
<td>Fei Peng</td>
</tr>
<tr>
<td>3:30 pm</td>
<td>Penn State</td>
<td>Development of Additive Manufacturing for Ceramic Matrix Composite Vanes</td>
<td>Steve Lynch</td>
</tr>
<tr>
<td>4:00 pm</td>
<td>ORNL</td>
<td>Next Generation Environmental Barrier Coating</td>
<td>Bruce Pint</td>
</tr>
<tr>
<td>4:30 pm</td>
<td>GE</td>
<td>High Temperature Additive Architectures for 65% Efficiency</td>
<td>Joe Weber</td>
</tr>
</tbody>
</table>

5:30 pm - 7:15 pm - Lab tour: University of Central Florida
DAY 3

Agenda-At-A-Glance

Thursday, November 7, 2019

7:30 a.m.  Registration/Continental Breakfast - Vienna A Foyer

Detailed list on pages 19 - 20
# Track A - Combustion (Day 1) & Pressure Gain Combustion (Day 2 & 3) - Vienna B

**Moderators:** Mark Freeman & Donald Ferguson

<table>
<thead>
<tr>
<th>Time</th>
<th>Organization</th>
<th>Title</th>
<th>Presenter</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30 am</td>
<td>Aerojet Rocketdyne</td>
<td>Rotating Detonation Combustion for Gas Turbines - Modeling &amp; System Synthesis to Exceed 65% Efficiency Goal</td>
<td>Scott Claffin</td>
</tr>
<tr>
<td>9:00 am</td>
<td>University of Central Florida</td>
<td>Advanced Cost-Effective Coal-Fired Rotating Detonation Combustor for High Efficiency Power Generation</td>
<td>Kareem Ahmed</td>
</tr>
<tr>
<td>9:30 am</td>
<td>Oregon State University</td>
<td>Pulse Detonation Engine for Advanced Oxy-Combustion of Coal-Based Fuel for Direct Power Extraction Applications</td>
<td>David Blunck</td>
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</table>

**Moderators:** Mark Freeman & Donald Ferguson

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<tr>
<td>10:00 am</td>
<td></td>
<td>Break - Vienna A Foyer</td>
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</tr>
<tr>
<td>10:30 am</td>
<td>University of Michigan</td>
<td>Pressure Gain, Stability, &amp; Operability of Methane/Syngas Based RDEs Under Steady &amp; Transient Conditions</td>
<td>Mirko Gamba</td>
</tr>
<tr>
<td>11:00 am</td>
<td>West Virginia University</td>
<td>Techno-Economic Optimization of Advanced Energy Plants with Integrated Thermal, Mechanical &amp; Electro-Chemical Storage</td>
<td>Debangsu Bhattacharya</td>
</tr>
</tbody>
</table>

12:00 pm - Change Room

**Presenter**

12:05 pm | Open Discussion, Workshop Summary, Closing Comments & Wrap-up - Richard Dennis, Advanced Turbines Technology Manager, NETL - Vienna B

12:30 pm - Adjourn

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# Track B - Aero & Heat Transfer (Day 1) & Super Critical CO\(_2\) (Day 2 & 3)-Normandy A

**Moderators:** Robin Ames & Seth Lawso

<table>
<thead>
<tr>
<th>Time</th>
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<th>Presenter</th>
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<tbody>
<tr>
<td>8:30 am</td>
<td>GTI</td>
<td>Supercritical Carbon Dioxide Pilot Plant Facility</td>
<td>Brian Lariviere</td>
</tr>
<tr>
<td>9:00 am</td>
<td>Altex Technologies Corporation</td>
<td>Corrosion &amp; Erosion Resistant Surface Features for High Pressure Supercritical Carbon Dioxide Heat Exchangers</td>
<td>John Kelly</td>
</tr>
<tr>
<td>9:30 am</td>
<td>SwRI</td>
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<td>Jeff Moore</td>
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10:00 am - Break - Vienna A Foyer

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<td>Jacob Delimont</td>
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<td>Georgia Tech</td>
<td>Advanced Model Development for LES of Oxy-Combustion &amp; Supercritical Carbon Dioxide Power Cycles</td>
<td>Joseph C. Oefelein</td>
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12:00 pm - Change Room

**Presenter**

12:05 pm | Open Discussion, Workshop Summary, Closing Comments & Wrap-up - Richard Dennis, Advanced Turbines Technology Manager, NETL - Vienna B

12:30 pm - Adjourn

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# Track C - Materials (Day 1) & CMC & AM (Day 2 & 3)- Normandy B

**Moderators:** Rin Burke & Richard Dalton

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<td>Minking Chyu &amp; Bruce Kang</td>
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<td>9:00 am</td>
<td>University of Texas at Austin &amp; Penn State University</td>
<td>Integrated Turbine Component Cooling Designs Facilitated by Additive Manufacturing &amp; Optimization</td>
<td>David Bogard &amp; Karen Thole</td>
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<td>9:30 am</td>
<td>Penn State University</td>
<td>Development and Evaluation of a Novel Fuel Injector Design Method Using Hybrid Additive Manufacturing</td>
<td>Jacqueline O’Connor &amp; Guha Manogharan</td>
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<td>University of Pittsburgh</td>
<td>An Effective Quality Assurance Method for Additively Manufactured Gas Turbine Metallic Components via Machine Learning from in-Situ Monitoring, Part-scale Modeling, &amp; Ex-Situ Characterization Data</td>
<td>Xiayun Zhao</td>
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<td>11:00 am</td>
<td>Siemens Corporation</td>
<td>Ensemble Manufacturing Techniques for Steam Turbine Components Across Length Scales</td>
<td>Anand Kulkarni</td>
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<tr>
<td>11:30 am</td>
<td>GE</td>
<td>Improve Performance and Cost for Steam Turbine Maintenance, Repair, and Overhaul Using Additive Manufacturing</td>
<td>Changjie Sun</td>
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12:00 pm - Change Room

**Presenter**

12:05 pm | Open Discussion, Workshop Summary, Closing Comments & Wrap-up - Richard Dennis, Advanced Turbines Technology Manager, NETL - Vienna B

12:30 pm - Adjourn
7:30 a.m. | Registration/Continental Breakfast — Vienna A Foyer

**General Session | Vienna B**

**8:30 a.m. | Welcome & Introduction**
* Michael Georgiopoulos, Dean, College of Engineering and Computer Science, University of Central Florida

**8:55 a.m. | Opening Remarks**
* Richard Dennis, Advanced Turbines Technology Manager
  * U.S. Department of Energy, National Energy Technology Laboratory

**9:00 a.m. | Overview of DOE Advanced Turbines Program**
* Richard Dennis, Advanced Turbines Technology Manager
  * U.S. Department of Energy, National Energy Technology Laboratory

**9:30 a.m. | Technology and Fuel Choice for Tomorrow’s Generation – Change in Power**
* Paul Browning, President & CEO, Mitsubishi Hitachi Power Systems Americas

**10:15 a.m. | Break – Vienna A Foyer**

**10:45 a.m. | Panel Discussion, Power Generation with Integrated Large - Scale Energy Storage**
* Issa Batarseh, University of Central Florida
* Michael J. Ducker, Mitsubishi Hitachi Power Systems
* Jay Kapat, University of Central Florida
* Jan Teichmann, Fluence
* Rachana Vidhi, NextEra Energy Resources

**12:00 p.m. | Group Lunch — Vienna B**

**1:30 p.m. | Evolution of Energy in a Decarbonizing World**
* Richard Voorberg, Executive Vice President, Service – North America, Siemens Energy

**Track A | Vienna B**

Combustion (Day 1 & 2)
Pressure Gain Combustion (Day 2 & 3)
* Moderators: Mark Freeman & Donald Ferguson
  * U.S. Department of Energy, National Energy Technology Laboratory

**2:35 p.m. | Advanced Multi-Tube Mixer Combustion for 65% Efficiency**
* Michael Hughes, GE Power

**3:05 p.m. | High-Frequency Transverse Combustion Instabilities in Low-NOX Gas Turbines**
* Tim Lieuwen, Georgia Institute of Technology

**3:35 p.m. | Break – Vienna A Foyer**
TUESDAY, NOVEMBER 5, 2019

4:05 p.m. | Understanding Transient Combustion Phenomena in Low-NOₓ Gas Turbines
Jacqueline O'Connor, Pennsylvania State University

4:35 p.m. | Improving NOₓ Entitlement with Axial Staging
Scott Martin, Embry Riddle Aeronautical University

5:05 p.m. | Extremely Low NOₓ Axial Staged Combustion System
Andrew North, Siemens Energy, Inc.

5:45–7:30 p.m. | Poster Session – Vienna A

Track B | Normandy A

Aero & Heat Transfer (Day 1)
Supercritical CO₂ (Day 2 & 3)
Moderators: Robin Ames & Seth Lawson
U.S. Department of Energy, National Energy Technology Laboratory

2:35 p.m. | Turbine Aero-Thermal Technologies for 65% Combined Cycle Efficiency
Joseph Weber, General Electric

3:05 p.m. | Bulk Temperature, Adiabatic-Wall Temperature, & Heat-Transfer Coefficient — Revisited
Tom I-P Shih, Purdue University

3:35 p.m. | Break - Vienna A Foyer

4:05 p.m. | Analysis of Turbine Cooling Technologies for Increasing NGCC Efficiency
Selcuk Can Uysal, U.S. Department of Energy, National Energy Technology Laboratory

4:35 p.m. | Revolutionizing Turbine Cooling with Micro-Architectures Enabled by Direct Metal Laser Sintering
Jeffrey Bons, The Ohio State University

5:05 p.m. | LES & RANS/DERM Modeling for Design Optimization of Additively & Conventionally Manufactured Internal Turbine Cooling Passages
Robert Kunz, Pennsylvania State University

5:45 – 7:30 p.m. | Poster Session – Vienna A

Track C | Normandy B

Materials (Day 1)
Ceramic Matrix Composites & Additive Manufacturing (Day 2 & 3)
Moderators: Rin Burke & Richard Dalton
U.S. Department of Energy, National Energy Technology Laboratory
2:35 p.m. | Design & Development of Low Weight, Titanium Aluminide Airfoils for High Performance Industrial Gas Turbines Meeting 65% Combined Cycle Efficiency
Sam Miller, Siemens Energy, Inc.

3:05 p.m. | High Temperature, High AN2 Last Stage Blade for 65% Combined Cycle Efficiency
John Delvaux, GE Power

3:35 p.m. | Break - Vienna A Foyer

4:05 p.m. | Development of High-Performance Ni-Based Alloys for Gas Turbine Wheels Using a Coprecipitation Approach
Yunzhi Wang, The Ohio State University

4:35 p.m. | Real Time Health Monitoring for Gas Turbine Components Using Online Learning & High Dimensional Data
Nagi Gebraeel, Georgia Institute of Technology

5:05 p.m. | In-Situ Optical Monitoring of Gas Turbine Blade Coatings Under Operational Extreme Environments
Quentin Fouliard, University of Central Florida

5:45 – 7:30 p.m. | Poster Session – Vienna A
**WEDNESDAY, NOVEMBER 6, 2019**

7:30 a.m. | Registration/Continental Breakfast – Vienna A Foyer

**General Session | Vienna B**

8:30 a.m. | Impact of Changing Landscape of Power Generation on Innovations in Gas Turbines - John Intile, General Manager, Gas Turbine Engineering, GE Power

9:15 a.m. | Open Discussion on the Future of the UTSR Program
Richard Dennis, Turbine Technology Manager, U.S. Department of Energy, National Energy Technology Laboratory

10:00 a.m. | Break – Vienna A Foyer

10:30 a.m. | Advancing Turbine Research through the National Experimental Turbine (NExT)
Karen Thole, Distinguished Professor & Department Head, Department of Mechanical Engineering, Pennsylvania State University

11:30 a.m. | Group Lunch – Vienna B

**Track A | Vienna B**

Combustion (Day 1 & 2)
Pressure Gain Combustion (Day 2 & 3)
Moderators: Mark Freeman & Donald Ferguson
U.S. Department of Energy, National Energy Technology Laboratory

12:30 p.m. | High Temperature Low NOx Combustor Concept Development
Tim Lieuwen, Georgia Institute of Technology

1:00 p.m. | Advanced Modular Sub-Atmospheric Hybrid Heat Engine
Yaroslav Chudnovsky, Gas Technology Institute

1:30 p.m. | Turbocompound Reheat Gas Turbine Combined Cycle
John Gülen, Bechtel

2:00 p.m. | Modeling sCO2 Compressors at Off-Design Conditions with Fluid Impurities
Ashvin Hosangadi, Combustion Research & Flow Technology Inc. (CRAFT Tech)

2:30 p.m. | Break
3:00 p.m. | H2-Power – A Modular Heat Engine for the Direct Conversion of Natural Gas to Hydrogen & Power Using Hydrogen Turbines
Jeffrey Mays, Gas Technology Institute

3:30 p.m. | Overview of Rotating Detonation Combustion Study at NETL
Don Ferguson, U.S. Department of Energy, National Energy Technology Laboratory

4:00 p.m. | A Joint Experimental/Computational Study of Non-Idealities in Practical Rotating Detonation Engines
Mirko Gamba, University of Michigan

4:30 p.m. | Fuel Injection Dynamics & Composition Effects on Rotating Detonation Engine Performance
Mirko Gamba, University of Michigan

5:30 – 7:15 p.m | Lab Tour – University of Central Florida

Track B | Normandy A

Aero & Heat Transfer (Day 1)
Supercritical CO₂ (Day 2 & 3)
Moderators: Robin Ames & Seth Lawson
U.S. Department of Energy, National Energy Technology Laboratory

12:30 p.m. | Novel Modular Heat Engines with sCO₂ Bottoming Cycle Utilizing Advanced Oil-Free Turbomachinery
Bugra Ertas, GE Research

1:00 p.m. | Materials Research for Supercritical CO₂ Power Cycles
Omer Dogan, U.S. Department of Energy, National Energy Technology Laboratory

1:30 p.m. | Low-Leakage Seals for Utility Scale sCO₂ Turbines
Rahul Bidkar, GE

2:00 p.m. | Advanced Gas Turbine & sCO₂ Combined Cycle Power System
Kevin Hoopes, Southwest Research Institute

2:30 p.m. | Break

3:00 p.m. | Combustion Kinetics Model Development & Fluid Property Experimental Investigation for Improved Design of Supercritical CO₂ Power Cycle Components
Subith Vasu, CATER/University of Central Florida
3:30 p.m. | Integrated Optimization & Control of a Hybrid Gas Turbine/sCO₂ Power System
Timothy Held, Echogen Power Systems

4:00 p.m. | Development of Modular, Low-Cost, High Temperature Recuperators for the sCO₂ Power Cycle – Prototype Performance Update
Marc Portnoff, Thar Energy, LLC

4:30 p.m. | Supercritical Carbon Dioxide Primary Power Large-Scale Pilot Plant
Timothy Held, Echogen Power Systems

5:30 – 7:15 p.m. | Lab Tour – University of Central Florida

Track C | Normandy B

Materials (Day 1)
Ceramic Matrix Composites & Additive Manufacturing (Day 2 & 3)
Moderators: Rin Burke & Richard Dalton
U.S. Department of Energy, National Energy Technology Laboratory

12:30 p.m. | High Temperature Ceramic Matrix Composite (CMC) Nozzles for 65% Efficiency
John Delvaux, GE Power

1:00 p.m. | Additive Manufactured Metallic-3D Ox-Ox CMC Integrated Structure for 65% Combined Cycle Efficiency
Ramesh Subramanian, Siemens Energy Inc.

1:30 p.m. | Hybrid Ceramic-CMC Vane with EBC for Future Coal Derived Syngas Fired Highly Efficient Gas Turbine
John Holowczak, United Technologies Research Center

2:00 p.m. | A Multiphysics Multiscale Simulation Platform for Damage, Environmental Degradation, & Life Prediction of Ceramic Matrix Composites (CMCs) in Extreme Environments
Aditi Chattopadhyay, Arizona State University

2:30 p.m. | Break

3:00 p.m. | Integrated TBC/EBC for SiC Fiber Reinforced SiC Matrix Composites for Next Generation Gas Turbines
Fei Peng, Clemson University

3:30 p.m. | Development of Additive Manufacturing for Ceramic Matrix Composite Vanes
Steve Lynch, Pennsylvania State University
4:00 p.m. | Next Generation Environmental Barrier Coatings
Bruce Pint, Oak Ridge National Laboratory

4:30 p.m. | High Temperature Additive Architectures for 65% Efficiency
Joseph Weber, General Electric

5:30 – 7:15 p.m. | Lab Tour – University of Central Florida
7:30 a.m. | Registration/Continental Breakfast – Vienna A Foyer

**Track A | Vienna B**

**Pressure Gain Combustion**  
Moderators – Mark Freeman & Donald Ferguson  
U.S. Department of Energy, National Energy Technology Laboratory

8:30 a.m. | Rotating Detonation Combustion for Gas Turbines – Modeling & Systems Synthesis to Exceed 65% Efficiency Goal  
Scott Claflin, Aerojet Rocketdyne

9:00 a.m. | Advanced Cost-Effective Coal-Fired Rotating Detonation Combustor for High Efficiency Power Generation  
Kareem Ahmed, University of Central Florida

9:30 a.m. | Pulse Detonation Engine for Advanced Oxy-Combustion of Coal Based Fuel for Direct Power Extraction Applications  
David Blunck, Oregon State University

10:00 a.m. | Break – Vienna A Foyer

10:30 a.m. | Pressure Gain, Stability & Operability of Methane/Syngas Based RDEs Under Steady & Transient Conditions  
Mirko Gamba, University of Michigan

11:00 a.m. | Techno-Economic Optimization of Advanced Energy Plants with Integrated Thermal, Mechanical & Electro-Chemical Storage  
Debangsu Bhattacharyya, West Virginia University

12:05 p.m. | General Session - Vienna B

**Track B | Normandy A**

**Supercritical CO₂**  
Moderators: Robin Ames & Seth Lawson  
U.S. Department of Energy, National Energy Technology Laboratory

8:30 a.m. | Supercritical Carbon Dioxide Pilot Plant Facility  
Brian Lariviere, Gas Technology Institute (GTI)
THURSDAY, NOVEMBER 7, 2019

9:00 a.m. | Corrosion & Erosion Resistant Surface Features for High Pressure Supercritical Carbon Dioxide Heat Exchangers
John Kelly, Altex Technologies Corporation

9:30 a.m. | Development of Oxy-Fuel Combustion Turbines with CO₂ Dilution for sCO₂ Based Power Cycles
Jeff Moore, Southwest Research Institute

10:00 a.m. Break

10:30 a.m. | LES of Direct-Fired Oxy-Combustion in sCO₂ Power Systems
Lee Shunn, Cascade Technologies

11:00 a.m. | 1MW Direct-Fired Oxy-Fuel sCO₂ Combustor Demonstration
Jacob Delimont, Southwest Research Institute

11:30 a.m. | Advanced Model Development for LES of Oxy-Combustion & Supercritical Carbon Dioxide Power Cycle
Joseph C. Oefelein, Georgia Institute of Technology

12:05 p.m. | General Session - Vienna B

Track C | Normandy B

Additive Manufacturing
Moderators: Rin Burke & Richard Dalton
U.S. Department of Energy, National Energy Technology Laboratory

8:30 a.m. | Integrated Transpiration & Lattice Cooling Systems Developed by Additive Manufacturing with Oxide Dispersion Strengthened Alloys
Minking Chyu, University of Pittsburgh & Bruce Kang, West Virginia University

9:00 a.m. | Integrated Turbine Component Cooling Designs Facilitated by Additive Manufacturing & Optimization
David Bogard, University of Texas at Austin & Karen Thole, Pennsylvania State University

9:30 a.m. | Development & Evaluation of a Novel Fuel Injector Design Method Using Hybrid Additive Manufacturing
Jacqueline O’Connor & Guha Manogharan, Pennsylvania State University

10:00 a.m. | Break
10:30 a.m. | An Effective Quality Assurance Method for Additively Manufactured Gas Turbine Metallic Components via Machine Learning from in-Situ Monitoring, Part-Scale Modeling & Ex-Situ Characterization Data
Xiayun Zhao, University of Pittsburgh

11:00 a.m. | Ensemble Manufacturing Techniques for Steam Turbine Components Across Length Scales
Anand Kulkarni, Siemens Corporation

11:30 a.m. | Improved Performance & Cost for Steam Turbine Maintenance Repair, & Overhaul Using Additive Manufacturing
Changjie Sun, General Electric Research

12:05 p.m. | General Session – Vienna B
Open Discussion, Workshop Summary, Closing Comments & Wrap-Up
Richard Dennis, Advanced Turbines Technology Manager
U.S. Department of Energy, National Energy Technology Laboratory

12:30 p.m. | Adjourn
Paul F. Browning

Paul F. Browning was appointed President and Chief Executive Officer of Mitsubishi Hitachi Power Systems Americas, Inc. on April 1, 2016. He leads two global businesses that are headquartered in the United States, and three regional businesses for North and South America. MHPS Americas is headquartered in Orlando, FL. With over 2,000 employees, MHPS Americas operates four manufacturing and repair centers and provides a wide variety of products and services for the electric power generation industry including natural gas, steam, and geothermal turbines, air quality control systems, solar power, energy storage and artificial intelligence to serve customers throughout the Americas. Mr. Browning has led the company’s expansion into Central and South America, positioning MHPS Americas as a top competitor in the LATAM energy market. He has also expanded the business into renewable power project development, energy storage and artificial intelligence products and services.

Mr. Browning has extensive global leadership experience in distributed and central power generation, as well as in North American midstream and downstream oil and gas operations. He has worked in the United States, Canada, Mexico, and Germany and has commercial experience around the world. He has also served on the Board of Directors of eSolar and Fuel Cell Energy.

Prior to joining MHPS Americas, Mr. Browning was President and Chief Executive Officer of Irving Oil Company Limited. Irving Oil owns and operates Canada's largest oil refinery and crude oil import terminal, and is a joint venture partner in Canada's only LNG import terminal. The company markets its products in eastern Canada and the northeastern United States.

Before joining Irving Oil, Mr. Browning was President and Chief Executive Officer of the Thermal Products Division of GE Power & Water in Schenectady, New York. At General Electric, he and his team developed new products for the power generation industry and sold and executed utility scale power generation projects throughout the world. Earlier in his career, Mr. Browning worked for Caterpillar Corporation in a variety of leadership positions, including Managing Director of Caterpillar Motoren in Kiel, Germany, Vice President of Turbomachinery Products for Solar Turbines in San Diego, CA and General Manager of a manufacturing facility in Tijuana, Mexico. He began his career at GE Corporate Research and Development in Niskayuna, New York.

Mr. Browning holds a B.S. degree in Metallurgical Engineering & Materials Science from Carnegie Mellon University, as well as an M.S. degree in Materials Engineering from Rensselaer Polytechnic Institute.

Richard Dennis

Mr. Richard Dennis is currently the Technology Manager for Advanced Turbines and Supercritical Carbon Dioxide Power Cycle Programs at the U.S. Department of Energy’s National Energy Technology Laboratory (NETL). These programs support US university, industry and U.S. national laboratory research, development and demonstration projects. Rich has a BS and MS in Mechanical Engineering from West Virginia University and has worked at NETL since 1983 in various research and project management capacities. In 2002 Richard was selected as a Technology Manager. Additionally, Richard is the 2018-19 leader of the American Society of Mechanical Engineers (ASME) Gas Turbine Segment (GTS).
Michael Georgiopoulos

Michael Georgiopoulos received his Diploma in EE (National Technical University of Athens; 1981), and MS, Ph.D. in EE (University of Connecticut; 1983, 1986). He is currently a Professor in ECE at the University of Central Florida (UCF). He also serves as the dean of the College of Engineering and Computer Science (2013-present). His research expertise lies in machine learning with special emphasis on neural network algorithms and related applications. He has been involved in more than 50 grants and contracts and his funding share exceeds $9.0M. He has published and presented more than 270 papers in journals and conferences. He is one of the founders of the EXCEL program at UCF. EXCEL has increased retention and graduation of more than 2,600 students by more than 50%. He has served as the Graduate Coordinator of Electrical and Computer Engineering Department (1999-2009), Interim Assistant Vice President of Research (2011-2012), and Interim dean of the College of Engineering and Computer Science (2012-2013). He served as an Associate Editor of the Neural Networks journal and the IEEE Transactions on Neural Networks. He received the UCF Pegasus Award in 2010 the most prestigious award awarded to full professors at UCF that recognizes their outstanding contributions in teaching, research and service. He was inducted to the UConn Academy of Engineering in 2014.

John Intile

John Intile is the General Manager, Gas Turbine Engineering at GE Power. In this role, John is responsible for leading the engineering team designing and supporting GE Power’s gas turbines. He and his team are focused on executing new product development for both the new units and services businesses, supporting our manufacturing and product management teams, and resolving technical challenges for our fleet of gas turbines.

Most recently, John served as the Leader of Combustion Engineering. John has been with GE for 19 years, serving in engineering leadership roles in combustion, systems engineering, conceptual design and the Global Research Center. He is a graduate of the State University of New York – Stony Brook, with bachelor’s and master’s degrees in Mechanical Engineering.

Karen Thole

Karen A. Thole serves as the head of the Department of Mechanical Engineering at Pennsylvania State University and also holds the title of Distinguished Professor. At Penn State, Dr. Thole founded and directs the Steady Thermal Aero Research Turbine (START) Lab. Her area of expertise is turbine cooling and using additive manufacturing to develop innovative cooling technologies. She has published over 220 archival papers and advised 75 dissertations and theses. She and her students have been recognized numerous times by ASME with best paper and best presentation awards.

Dr. Thole has provided service leadership to numerous organizations including being a member of ASME’s Board of Governors. She has also served as the Chair of the Board of Directors for the ASME’s International Gas Turbine Institute in which she led a number of initiatives to promote communities of women engineers and students. In her roles as an educator, researcher, and mentor, Dr. Thole has received numerous awards. The most notable awards include, being recognized by the United States White House as a Champion of Change for STEM. She has been recognized by Penn State’s Rosemary Schraer Mentoring Award and Howard B. Palmer Faculty Mentoring Award. She was recognized in 2014 by the Society of Women Engineers’ Distinguished Engineering Educator Award and in 2016 by ASME’s Edwin F. Church Medal ASME’s George Westinghouse Medal. In 2017, she received ABET’s Claire L. Felbinger Award for her work in diversifying engineering. In 2019, she received AIAA’s Air Breathing Propulsion Award for her contributions to promoting diversity and for her technical work in gas turbine cooling.

Dr. Thole holds two degrees in Mechanical Engineering from the University of Illinois at Urbana-Champaign and a PhD from the University of Texas at Austin.
**KEYNOTE SPEAKERS**

**Richard Voorberg**

Richard Voorberg is Executive Vice President for Siemens Energy Inc based in Orlando FL. As the Head for Service in North America, his responsibilities include managing all aspects of Large Power Service including Gas Turbines, Steam Turbines, Generators and Nuclear.

Richard has over 26 years of experience with Siemens in the power generation industry. Initially, he was a Field Service Engineer, working in numerous foreign countries, performing service tasks and assisting construction of combined cycle power plants.

Richard has also had extensive experience in the manufacturing, commissioning management, project management and marketing aspects of the power generation business. Richard was also responsible for the design, project management and building of a brand new factory at the Charlotte, North Carolina, site for gas turbine manufacturing. Throughout his career Richard has had the privilege to live and work in several different locations including Canada, Indonesia, Argentina, Korea and Germany.

The North American service group consists of over 2000 people who managed all aspects of Service from Sales, Marketing, Project Management, Field Engineering, Shop Repair and Business Administration.

Richard holds a Bachelor of Applied Science degree in Mechanical Engineering from the University of Waterloo, Canada and his MBA from ESMT in Berlin Germany.

He and his wife, Esther, have four children and reside in Winter Springs, FL

**ISSA BATARSEH**

Dr. Batarseh received Ph.D., and M.S. in Electrical Engineering and the B.S. in Computer Engineering and Science from the University of Illinois at Chicago. His research focuses on the development of advanced systems for solar energy conversion to improve cost, power density, efficiency and performance. He is an inventor on 36 patents and author of more than 300 articles and 2 books, with approximately 7,000 citations to his published work. Dr. Batarseh has significant commercialization experience as a founder of two start-up companies involved solar energy conversion: Advanced Power Electronics Corp. (APECOR) and Petra Systems. He is also a fellow member in National Academy of Inventors (NAI), AAAS, IEEE, and IEE. Dr. Batarseh supervised 34 Ph.D. Dissertations, 43 MS Theses, and 15 Undergraduate Honor Theses.

**Michael J. Ducker**

Michael is responsible for the development, launch, incubation, and handover of new businesses within MHPS’s NEXT division. Example businesses include Oriden, a recently launched renewable energy solutions company, an energy storage division, investments in novel energy technology companies, and new digitalization efforts across existing product lines. Before joining MHPS, Michael worked for the US Department of Energy where he developed market models to evaluate advanced energy technologies being pursued by the DOE.

Michael earned his BS in Mechanical Engineering from the Pennsylvania State University and his MS in Mechanical Engineering from the George Washington University.
Jay Kapat

Jay Kapat is a faculty member in the Department of Mechanical & Aerospace Engineering, and is the founding Director of the Center for Advanced Turbomachinery and Energy Research (CATER) at the University of Central Florida. His research covers advanced cooling and aerodynamics in gas turbines, supercritical carbon dioxide and organic Rankine cycles for power generation, performance and impact of alternative fuels on aviation turbine engines, and digital twin architecture for engines, power plants and airframes. He received B.Tech. from IIT Kharagpur, MS from Arizona State and Sc.D. from MIT – all in Mechanical Engineering. Since joining UCF in 1997 as an Assistant Professor, he has brought over $17.5M as his share from external sources for conducting research at UCF. Jay has graduated 21 Ph.D. students, 53 Masters and 16 Honors-in-Major thesis students, and most of these students are currently in Siemens, Mitsubishi, Siemens Gamesa, GE, Ansaldo, FTT, Aerojet Rocketdyne, and Pratt & Whitney. He has published over 200 peer-reviewed papers in journals and conference proceedings, and has 12 patents issued to him.

Jan Teichmann

As Vice President for Global Markets, Jan Teichmann oversees Fluence’s global sales and product marketing efforts. Prior to joining Fluence, Jan led development of Siemens’ global energy storage business, as well as serving in senior marketing and sales capacities for Eaton’s solar inverter business and Siemens in southeast Asia. Jan has worked in the fields of product development, project management, sales and marketing for over 20 years and has a deep understanding of existing power grids and the challenges they face.

While employed by major distribution systems suppliers in Europe and several Asian countries, he built broad knowledge in power distribution products and systems and solutions, for conventional and power electronics-based technologies. Jan holds a degree in electrical engineering from University of Applied Sciences Kaiserslautern.

Rachana Vidhi

Rachana is currently working on integration and development of large-scale energy storage projects coupled with renewable generation. During her career with NextEra Energy, she led the engineering design and integration of some of the first solar + storage projects as well as developed innovative technologies for hybrid resource deployment and long-term operations. She holds a Doctorate Degree in Chemical Engineering from the University of South Florida and a bachelor’s degree in Energy Engineering from Indian Institute of Technology (IIT).
A Multiphysics Multiscale Simulation Platform for Damage, Environmental Degradation, & Life Prediction of Ceramic Matrix Composites (CMCs) in Extreme Environments  
Christopher Sorini, Arizona State University

High Frequency Transverse Combustion Instabilities in Low NO\textsubscript{X} Gas Turbines  
Jeong-Won Kim, Georgia Institute of Technology (Presenter Tim Lieuwen)

High Temperature, Low NO\textsubscript{X} Combustor Concept Development  
Vedanth Nair, Georgia Institute of Technology (Presenter Tim Lieuwen)

Data Driven Fault Detection of Premixer Centrebody Degradation in a Swirl Combustor  
Raghul Manosh Kumar, Georgia Institute of Technology (Presenter Tim Lieuwen)

Flow & Chemical Timescale Analysis in Supercritical CO\textsubscript{2} Combustion  
Raghu veera m Kancherla, University of Central Florida

Thermodynamic Property Measurements for SCO\textsubscript{2} Mixtures Relevant to Allam Cycle  
Suhyeon Park, University of Central Florida

Laser-Based Diagnostics for Characterizing Species & Temperature Within RDEs  
Kyle Thurmond, University of Central Florida

Real-Time Health Monitoring for Gas Turbine Components Using Online Learning & High Dimensional Data  
Nagi Gebraeel, Georgia Institute of Technology (Presenter Benjamin Peters)

A Multidisciplinary Study of Additively Manufactured Transpiration Cooling Structures  
Zheng Min, University of Pittsburgh

Overview of Rotating Detonation Combustion Study at NETL  
Don Ferguson, U.S. Department of Energy, National Energy Technology Laboratory

Enhanced Cooling Through Additively Manufactured Lattice Geometries  
Sarwesh Parbat, University of Pittsburgh

Experimental Investigation of Low-K, Durable Thermal/Environmental Barrier Coatings for SiC/SiC Ceramic Matrix Composites  
Anindya Ghoshal, CCDC Army Research Laboratory

sCO\textsubscript{2} Heat Transfer Analysis Using Commercial CFD Codes  
Neil Sullivan, ERAU

Reacting Jet of an Axial-Staged Combustor at High Pressure  
Bernhard Stiehl, University of Central Florida
Autoignition Delay Time Measurements in sCO$_2$ Mixtures for Oxy-Combustion
Samuel Barak, University of Central Florida

Configuration for Luminescence-Based Temperature Sensing Thermal Barrier Coatings
Quentin Fouliard, University of Central Florida

Mechanical Properties of Coatings by Electron-Beam Physical Vapor Deposition & Plasma-Spray Physical Vapor Deposition Compared Using Synchrotron X-Ray Diffraction
Matthew Northam, University of Central Florida

High Temperature Characterization & Defect Detection Through Pulsed Eddy Current Thermography
Jonathan Hernandez, University of Central Florida

Optimizing the Post-Processing of Additively Manufactured Parts
Kyle Jude Michael Ventura, University of Florida

Thermoacoustic Modeling of Gas Turbine Injector Geometry and Performance
Austin Matthews, Georgia Institute of Technology

Anomaly & Failure Prediction in Gas Turbine Using Statistical Analysis
Shinjan Ghosh, University of Central Florida

Thermodynamic Optimization & Transient Analysis of sCO$_2$ Power Cycle
Nandhini Raju, CATER, University of Central Florida

Thermal Degradation of Biofuels in Contact with Hot Metal Surfaces
Katerina Chagoya, University of Central Florida

Adiabatic Film Cooling Effectiveness of an Additively Manufactured Leading Edge Using an Engineered Porous Lattice to Simulate Transpiration Cooling Fabricated Using SLM
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