

UNIVERSITY OF
CENTRAL FLORIDA

2019

University Turbine Systems Research

Project Review Meeting

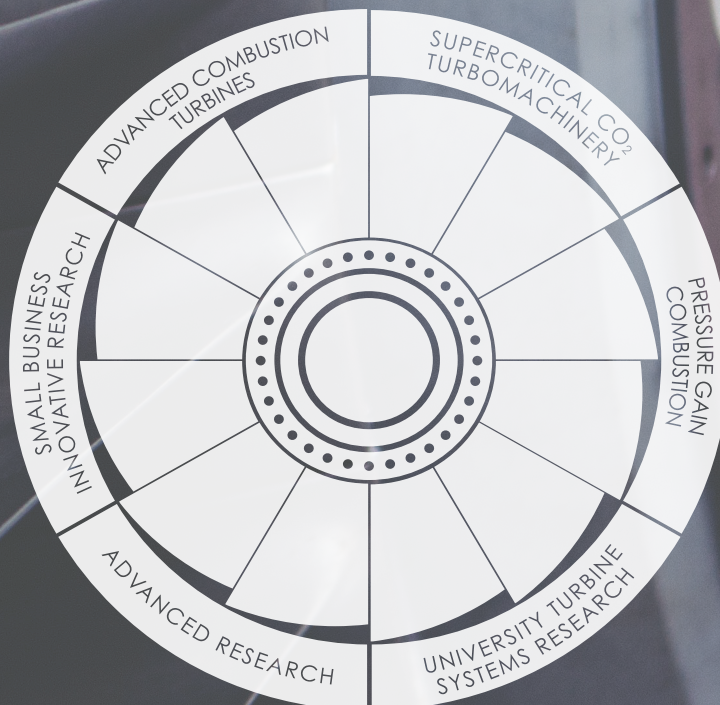


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About the UTSR Meeting

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. Juan Lopez, Director of Business Development, Power Generation Services, Siemens Energy; Dr. Doug Hofer, Senior Principal Engineer, GE Research; 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 CO₂; 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

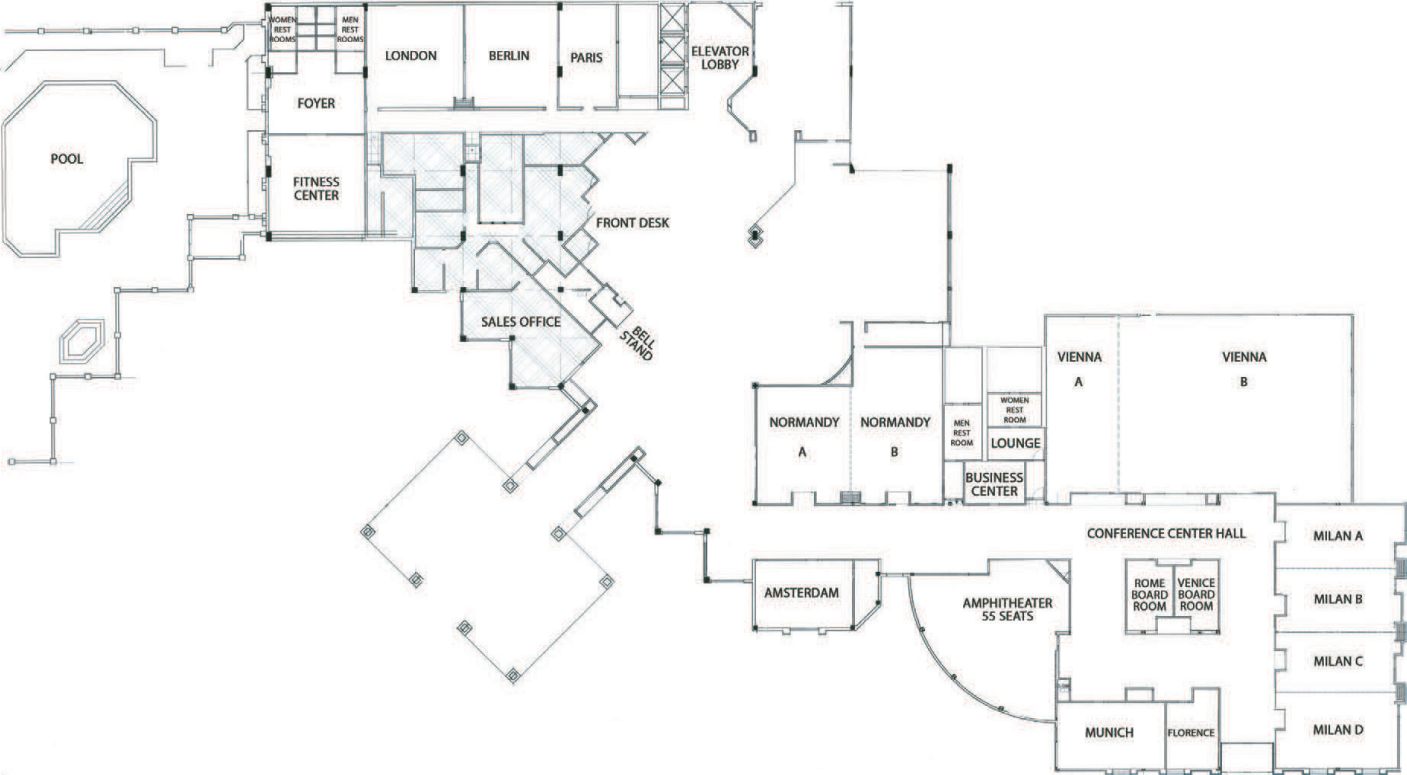
Patcharin (Rin) Burke	U.S. Department of Energy, National Energy Technology Laboratory
Richard Dalton	KeyLogic
Bill Day	Longview Energy Associates LLC
Richard Dennis	U.S. Department of Energy, National Energy Technology Laboratory
Jay Kapat	University of Central Florida
Karen Lockhart	SSC-Deltha
Greg 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 CO₂ 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 sCO₂ power cycles.

DAY I

Agenda-At-A-Glance

Tuesday, November 5, 2019

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

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

	Organization	Title	Presenter
2.35 pm	GE Power	Advanced Multi-Tube Mixer Combustion for 65% Efficiency	Michael Hughes
3.05 pm	Georgia Tech	High-Frequency Transverse Combustion Instabilities in Low-NO _x Gas Turbines	Tim Lieuwen
3:35 pm Break - Vienna A Foyer			
4.05 pm	Penn State University	Understanding Transient Combustion Phenomena in Low-NO _x Gas Turbines	Jacqueline O'Connor
4.35 pm	Embry Riddle	Improving NO _x Entitlement with Axial Staging	Scott Martin
5:05 pm	Siemens Energy	Extremely Low NO _x Axial Staged Combustion System	Andrew North

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

Track B - Aero & Heat Transfer (Day 1) & Super Critical CO₂ (Day 2 & 3)-Normandy A

Moderators: Robin Ames & Seth Lawson

	Organization	Title	Presenter
2.35 pm	GE	Turbine Aero-Thermal Technologies for 65% Combined Cycle Efficiency	Joe Weber
3.05 pm	Purdue University	Bulk Temperature, Adiabatic-Wall Temperature, & Heat-Transfer Coefficient -Revisited	Tom Shih
3:35 pm - Break - Vienna A Foyer			
4.05 pm	NETL-RIC	Analysis of Turbine Cooling Technologies for Increasing NGCC Efficiency	Selcuk Can Uysal
4.35 pm	Ohio State University	Revolutionizing Turbine Cooling with Micro-Architectures Enabled by Direct Metal Laser Sintering	Jeffrey Bons
5:05 pm	Penn State University	LES & RANS/DERM Modeling for Design Optimization of Additively & Conventionally Manufactured Internal Turbine Cooling Passages	Robert Kunz

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

	Organization	Title	Presenter
2.35 pm	Siemens Energy, Inc	Design & Development of Low Weight, Titanium Aluminide Airfoils for High Performance Industrial Gas Turbines Meeting 65% Combined Cycle Efficiency	Sam Miller
3.05 pm	GE	High Temperature, High AN2 Last Stage Blade for 65% Combined Cycle Efficiency	John Delvaux
3:35 pm Break - Vienna A Foyer			
4.05 pm	The Ohio State University	Development of High Performance Ni-Base Alloys for Gas Turbine Wheels Using a Coprecipitation Approach	Yunzhi Wang
4.35 pm	Georgia Tech	Real-Time Health Monitoring for Gas Turbine Components Using Online Learning & High Dimensional Data	Nagi Gebraeel
5:05 pm	University of Central Florida	In-Situ Optical Monitoring of Gas Turbine Blade Coatings Under Operational Extreme Environments	Quentin Fouliard

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

DAY 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

	Organization	Title	Presenter
12:30 pm	Georgia Tech	High Temperature, Low NO _x Combustor Concept Development	Tim Lieuwen
1:00 pm	GTI	Advanced Modular Sub-Atmospheric Hybrid Heat Engine	Yaroslav Chudnovsky
1:30 pm	Bechtel	Turbocompound Reheat Gas Turbine Combined Cycle	S.C. (John) Gülen
2:00 pm	Combustion Research & Flow Technology, Inc.	Modeling sCO ₂ Compressors at Off-Design Conditions with Fluid Impurities	Ashvin Hosangadi

2:30 pm - Break -Vienna A Foyer

3:00 pm	Gas Technology Institute	H2-Power - A Modular Heat Engine for the Direct Conversion of Natural Gas to Hydrogen & Power Using Hydrogen Turbines	Jeffrey Mays
3:30 pm	NETL-RIC	Overview of Rotating Detonation Combustion Study at NETL	Don Ferguson
4:00 pm	University of Michigan	A Joint Experimental/Computational Study of Non-Idealities in Practical Rotating Detonation Engines	Mirko Gamba
4:30 pm	University of Michigan	Fuel Injection Dynamics & Composition Effects on Rotating Detonation Engine Performance	Mirko Gamba

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

Track B - Aero & Heat Transfer (Day 1) & Super Critical CO₂ (Day 2 & 3)-Normandy A

Moderators: Robin Ames & Seth Lawson

	Organization	Title	Presenter
12:30 pm	GE	Novel Modular Heat Engines with sCO ₂ Bottoming Cycle Utilizing Advanced Oil-Free Turbomachinery	Bugra Ertas
1:00 pm	NETL-RIC	Materials Research for Supercritical CO ₂ Power Cycles	Omer Dogan
1:30 pm	GE	Low-Leakage Seals for Utility-Scale sCO ₂ Turbines	Rahul Bidkar
2:00 pm	SwRI	Advanced Gas Turbine & sCO ₂ Combined Cycle Power System	Kevin Hoopes

2:30 pm Break -Vienna A Foyer

3:00 pm	CATER/UCF	Combustion Kinetics Model Development & Fluid Property Experimental Investigation for Improved Design of Supercritical CO ₂ Power Cycle Components	Subith Vasu
3:30 pm	Echogen	Integrated Optimization & Control of a Hybrid Gas Turbine/sCO ₂ Power System	Tim Held
4:00 pm	Thar Energy, LLC	Development of Modular, Low-Cost, High-Temperature Recuperators for the sCO ₂ Power Cycle - Prototype Performance Update	Marc Portnoff
4:30 pm	Echogen Power Systems	Supercritical Carbon Dioxide Primary Power Large - Scale Pilot Plant	Tim Held

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

	Organization	Title	Presenter
12:30 pm	GE Power	High Temperature Ceramic Matrix Composite (CMC) Nozzles for 65% Efficiency	John Delvaux
1:00 pm	Siemens Energy, Inc	Additive Manufactured Metallic-3D Ox-Ox CMC Integrated Structures for 65% Combined Cycle Efficiency	Ramesh Subramanian
1:30 pm	UTRC	Hybrid Ceramic-CMC Vane with EBC for Future Coal Derived Syngas Fired Highly Efficient Gas Turbine	John Holowczak
2:00 pm	Arizona State University	A Multiphysics Multiscale Simulation Platform for Damage, Environmental Degradation, & Life Prediction of Ceramic Matrix Composites (CMCs) in Extreme Environments	Aditi Chattopadhyay

2:30 pm Break -Vienna A Foyer

3:00 pm	Clemson University	Integrated TBC/EBC For SiC Fiber Reinforced SiC Matrix Composites for Next Generation Gas Turbines	Fei Peng
3:30 pm	Penn State	Development of Additive Manufacturing for Ceramic Matrix Composite Vanes	Steve Lynch
4:00 pm	ORNL	Next Generation Environmental Barrier Coating	Bruce Pint
4:30 pm	GE	High Temperature Additive Architectures for 65% Efficiency	Joe Weber

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

	Organization	Title	Presenter
8:30 am	Aerojet Rocketdyne	Rotating Detonation Combustion for Gas Turbines - Modeling & System Synthesis to Exceed 65% Efficiency Goal	Scott Clafin
9:00 am	University of Central Florida	Advanced Cost-Effective Coal-Fired Rotating Detonation Combustor for High Efficiency Power Generation	Kareem Ahmed
9:30 am	Oregon State University	Pulse Detonation Engine for Advanced Oxy-Combustion of Coal-Based Fuel for Direct Power Extraction Applications	David Blunck
10:00 am - Break -Vienna A Foyer			
10:30 am	University of Michigan	Pressure Gain, Stability, & Operability of Methane/Syngas Based RDEs Under Steady & Transient Conditions	Mirko Gamba
11:00 am	West Virginia University	Techno-Economic Optimization of Advanced Energy Plants with Integrated Thermal, Mechanical & Electro-Chemical Storage	Debangsu Bhattacharyya
12:00 pm - Change Room			
12:05 pm	Open Discussion, Workshop Summary, Closing Comments & Wrap-up - Richard Dennis, Advanced Turbines Technology Manager, NETL - Vienna B		
12:30 pm - Adjourn			

Track B - Aero & Heat Transfer (Day 1) & Super Critical CO₂ (Day 2 & 3)-Normandy A

Moderators: Robin Ames & Seth Lawson

	Organization	Title	Presenter
8:30 am	GTI	Supercritical Carbon Dioxide Pilot Plant Facility	Brian Lariviere
9:00 am	Altex Technologies Corporation	Corrosion & Erosion Resistant Surface Features for High Pressure Supercritical Carbon Dioxide Heat Exchangers	John Kelly
9:30 am	SwRI	Development of Oxy-Fuel Combustion Turbines with CO ₂ Dilution for sCO ₂ Based Power Cycles	Jeff Moore
10:00 am - Break -Vienna A Foyer			
10:30 am	Cascade Technologies	LES of Direct-Fired Oxy-Combustion in sCO ₂ Power Systems	Lee Shunn
11:00 am	SwRI	1MW Direct-Fired Oxy-Fuel sCO ₂ Combustor Demonstration	Jacob Delimont
11:30 am	Georgia Tech	Advanced Model Development for LES of Oxy-Combustion & Supercritical Carbon Dioxide Power Cycles	Joseph C. Oefelein
12:00 pm - Change Room			
12:05 pm	Open Discussion, Workshop Summary, Closing Comments & Wrap-up - Richard Dennis, Advanced Turbines Technology Manager, NETL - Vienna B		
12:30 pm - Adjourn			

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

Moderators: Rin Burke & Richard Dalton

	Organization	Title	Presenter
8:30 am	University of Pittsburgh & West Virginia University	Integrated Transpiration & Lattice Cooling Systems Developed by Additive Manufacturing with Oxide-Dispersion Strengthened Alloys	Minking Chyu & Bruce Kang
9:00 am	University of Texas at Austin & Penn State University	Integrated Turbine Component Cooling Designs Facilitated by Additive Manufacturing & Optimization	David Bogard & Karen Thole
9:30 am	Penn State University	Development and Evaluation of a Novel Fuel Injector Design Method Using Hybrid Additive Manufacturing	Jacqueline O'Connor & Guha Manogharan
10:00 am - Break -Vienna A Foyer			
10:30 am	University of Pittsburgh	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
11:00 am	Siemens Corporation	Ensemble Manufacturing Techniques for Steam Turbine Components Across Length Scales	Anand Kulkarni
11:30 am	GE	Improve Performance and Cost for Steam Turbine Maintenance, Repair, and Overhaul Using Additive Manufacturing	Changjie Sun
12:00 pm - Change Room			
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
Juan Lopez, Siemens Energy
Doug Hofer, GE Research
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-NO_x Gas Turbines

Tim Lieuwen, Georgia Institute of Technology

3:35 p.m. | Break – Vienna A Foyer

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

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

5:05 p.m. | Extremely Low NO_x 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

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 NO_x 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

WEDNESDAY, NOVEMBER 6, 2019

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 Clafin, 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

THURSDAY, NOVEMBER 7, 2019

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

KEYNOTE SPEAKERS

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).

KEYNOTE SPEAKERS

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

PANELISTS BIOS

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.

PANELISTS BIOS

Doug Hofer

Doug Hofer is currently Senior Principal Engineer in the Thermosciences organization at GE Research. His research interests are in the areas of advanced cycles, turbomachinery aero-thermal fluid dynamics, advanced expander and compressor technologies, highly unsteady flows, two-phase flows, transonic and supersonic flows. He has deep experience in the power generation industry both in turbomachinery design and cycle analysis and innovation.

Before joining GE, Doug graduated with a B.S. and M.S. degree from Department of Mechanical Engineering, University of Florida in 1987. He completed his Ph.D. in Mechanical Engineering from Purdue University in 1995. His research concentrated on developing shock capturing CFD code based on the method of characteristics. Upon completion of his Ph.D. coursework in 1990, Doug joined Westinghouse as a steam turbine thermal design engineer where he worked until he joined GE in 1997. Dr. Hofer holds 32 US patents and has authored over 25 technical publications on turbomachinery and thermodynamic cycles.

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.

Juan Lopez

As Director of Business Development for the Power Generation Services, Juan Lopez is responsible for the development and validation of new business fields and models for power generation customers. Examples of such efforts include the SynerGen Technologies solution to enhance existing generation facilities with the integration and optimization of large scale energy storage as well as the O&M4.0 effort leveraging Siemens digital portfolio thru innovative Operations & Maintenance solutions.

Juan has over 18 years of experience with Siemens in various roles of increasing responsibility in engineering, product development, strategy, sales and marketing. He received his B.S. in Mechanical Engineering and M.S. in Engineering Management from the University of Central Florida, and his MBA from Rollins College.

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).

POSTER PRESENTATIONS

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_x Gas Turbines

Jeong-Won Kim, Georgia Institute of Technology (Presenter Tim Lieuwen)

High Temperature, Low NO_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 CO₂ Combustion

Raghu veera m Kancharla, University of Central Florida

Thermodynamic Property Measurements for SCO₂ 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

sCO₂ 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

POSTER PRESENTATIONS

Autoignition Delay Time Measurements in $s\text{CO}_2$ 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 $s\text{CO}_2$ 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

Akshay Khadse, University of Central Florida

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