8th International

Supercritical CO_2 Power Cycles Symposium

San Antonio, TX · February 26 - 29, 2024

ABOUT THE PROGRAM

SYNOPSIS

The 8th International Supercritical CO_2 Power Cycles Symposium is a technical meeting organized and designed by industry, academia, and government agencies to advance the development of technology for power cycles with supercritical carbon dioxide (sCO_2) as the working fluid. The theme for this year's meeting is "The Role of sCO_2 in the Global Energy Transition" with an emphasis on sCO_2 systems' emerging role in decarbonizing multiple economic sectors including power generation, energy storage, and industrial applications. The symposium provides researchers, industry partners, and end users the opportunity to meet to learn about advancements in the field, discuss priorities, and establish a critical path for technology development. The perspective gained will allow researchers to better coordinate work and allow participants greater insight into the overall status and direction of sCO_2 technology. The first symposium was held at the Massachusetts Institute of Technology (Cambridge, Massachusetts) in 2007, the second was held at Rensselaer Polytechnic Institute (Troy, New York) in 2009, and the third was held at the University of Colorado at Boulder (Boulder, Colorado) in 2011. The 2014 and 2018 symposia were held in Pittsburgh, Pennsylvania, and the 2016 and 2022 symposia were held in San Antonio, Texas. The technical papers and presentations for the 2024 symposium will be available online following the meeting, archived alongside those of the previous workshops. The goal of the symposium is to facilitate peer-to-peer knowledge sharing and collaboration across organizational and company boundaries that will create a network of expertise and accelerate advancements in the field.

TECHNOLOGY SUMMARY

Carbon dioxide is an extremely power dense and efficient working fluid for thermodynamic cycles in power generation and heat pump applications. Power cycles based on supercritical carbon dioxide (sCO_2) as the working fluid have the potential for a transformative role in the Energy Transition due to their expected higher thermal efficiencies and lower capital costs relative to state-of-the-art incumbents of steam-based power cycles, organic Rankine cycles, or even many heat pump cycles. Taken together, the unique features of sCO_2, which include having a small environmental footprint, lower or even zero water use, fuel/heat source flexibility, the potential for lower capital cost, and low global warming potential as a refrigerant – along with multiple performance benefits that result from higher efficiency (e.g., lower fuel use, reduced emissions, lower cooling requirements) – are creating broad interest in the sCO_2 power cycle. Additionally, this power cycle is synergistic with a wide spectrum of heat sources; the sCO_2 cycle can be configured to operate with heat from nuclear, fossil fuel (with inherent carbon capture), waste heat, solar thermal, and geothermal systems as well as stored thermal energy as part of an energy storage system. The high power density characteristic of the fluid tends to amplify benefits in each application, enabling reduced footprint, material costs, and faster ramp rates. Carbon dioxide is an attractive working fluid because its critical pressure and temperature are reasonable to work with, in addition to its being non-toxic, easily obtained, inexpensive, low-viscosity, and freeze-proof at ambient conditions. Heat engines that use sCO_2 as a working fluid can be smaller and less complex than heat engines that use many traditional working fluids, including superheated steam, helium, and organic fluids. A main purpose of this symposium is to help identify and resolve technical and cost issues in the development of this technology.

ORGANIZING COMMITTEE

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Eric Clementoni
Naval Nuclear Laboratory

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Southwest Research Institute

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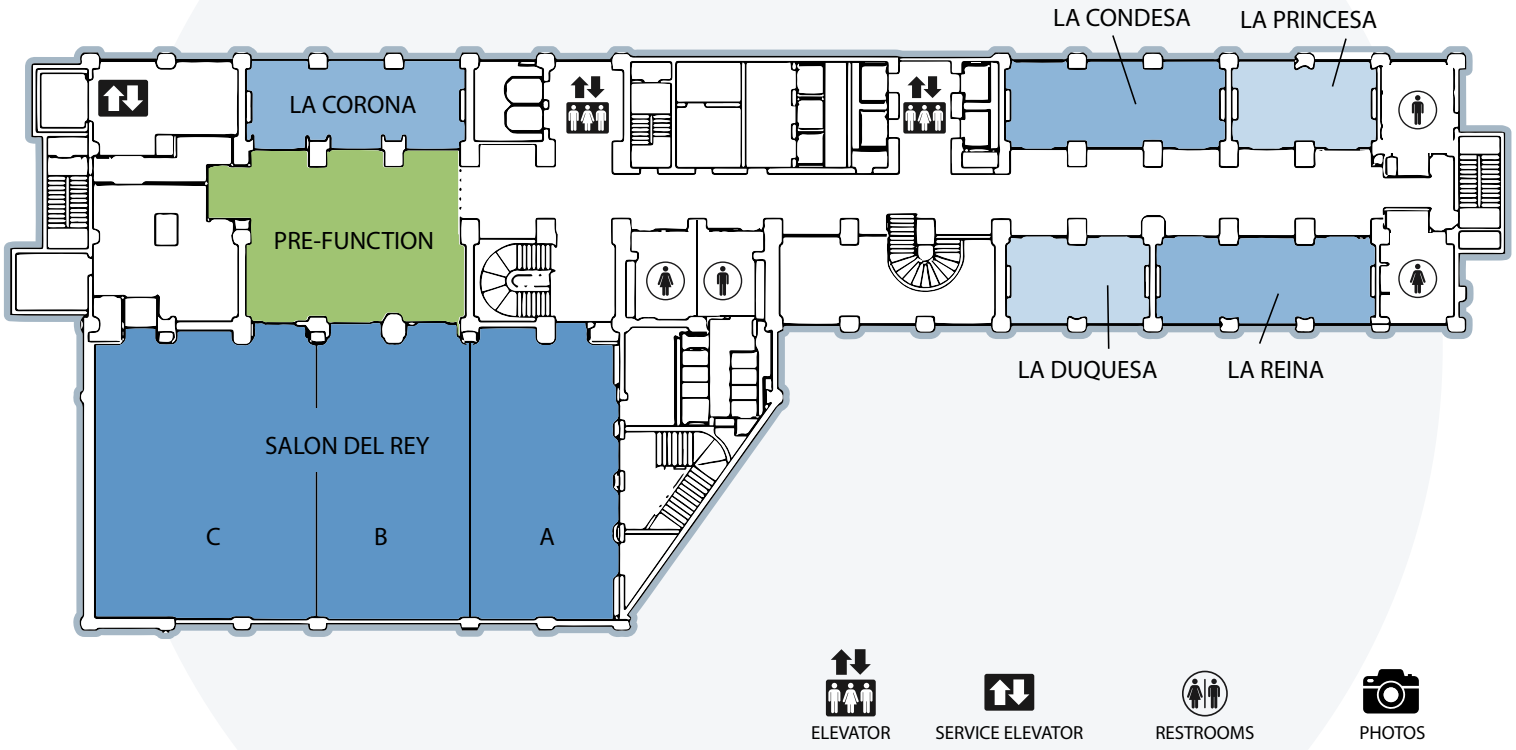
Avi Shultz

HOTEL MAP

Hilton Palacio del Rio
200 South Alamo Street
San Antonio, Texas

Hilton
HOTELS & RESORTS

MEZZANINE LEVEL



AGENDA-AT-GLANCE

8th International Supercritical CO_2 Power Cycles Symposium
AGENDA AT-A-GLANCE--February 26–29,2024

Day/Time				
Monday,February 26, 2024				
Mon. 12:00 pm	Early Registration (Pre-Function)			
Mon. 12:00–6:00 pm	Pre-Conference Tutorial Sessions (Salon Del Rey A)			
Mon. 12:00–1:00 pm	sCO_2 Power Cycles Fundamentals Tutorial (Southwest Research Institute)			
Mon. 1:00–2:00 pm	sCO_2 Cycles Tutorial (Echogen Power Systems / Southwest Research Institute)			
Mon. 2:00–3:00 pm	sCO_2 Oxy-Combustion Tutorial (University of Central Florida / Southwest Research Institute)			
Mon. 3:00–4:00 pm	sCO_2 Turbomachinery Tutorial (Southwest Research Institute)			
Mon. 4:00–5:00 pm	sCO_2 Materials Tutorial (Carleton University / Electric Power Research Institute / GTI Energy)			
Mon. 5:00–6:00 pm	sCO_2 Heat Exchanger Tutorial (Southwest Research Institute / Heatric (Parker Hannifin) / Thar Energy)			
Mon. 6:30 pm	Industry Sponsored Reception – Speaker #1: Karl Wygant, Elliott Ebara Energy (Salon Del Rey C)			
Mon. 7:00 pm	Welcome–Tim Allison, Southwest Research Institute/Eric Clementoni, Naval Nuclear Laboratory			
Tuesday, February 27, 2024				
Tues. 7:00 am	Continental Breakfast/Registration/Poster Session (Pre-Function/La Corona)			Posters Displayed
Tues. 8:00 am	Welcome to the Symposium–Tim Allison, Southwest Research Institute (Salon Del Rey)			
Tues. 8:10 am	Welcome to San Antonio–State Senator José Menéndez (Salon Del Rey)			
Tues. 8:25 am	Key note Speaker #2: Matt Bauer, DOE (Salon Del Rey)			
Tues. 8:45 am	Panel Session I: Industry – Turbomachinery Manufacturers (Salon Del Rey)			
Tues. 10:15 am	Break/Poster Session (Pre-Function/La Corona)			
Tues. 10:45 am	Key note Speaker #3: Jeremy Fetvedt, 8 Rivers Capital, LLC (Salon Del Rey)			
Tues. 11:05 am	Panel Session II: Applications & End Users (Salon Del Rey)			
Tues. 12:15 pm	Lunch/Fast Pitch Session (Salon Del Rey)			
Tues. 1:15 pm	**Paper Track 1 Modeling & Control 2: 10, 59, 71**	**Paper Track 2 Heat Exchangers 2: 12, 73, 114**	**Paper Track 3 Systems 3: 38, 32, 47**	
Tues. 2:45 pm	**Paper Track 1 Testing 1: 8, 48, 104**	**Paper Track 2 Turbines 6: 102, 105**	**Paper Track 3 Materials 2: 63, 89, 113**	
Tues. 4:15 pm	Break/Poster Session (Pre-Function/La Corona)			
Tues. 4:45 pm	Panel Session III: International Panel Session (Salon Del Rey)			
Tues. 6:00 pm	Industry Sponsored Cocktail Hour (Pre-Function)			
Tues. 7:00 pm	Dinner – Keynote Speakers: Chris Clements, Tokamak Energy Ltd. / Jack Acres, UKAE			
Wednesday, February 28, 2024				
Wed. 7:00 am	Continental Breakfast/Registration/Poster Session(Pre-Function/La Corona)			Posters Displayed
Wed. 8:00 am	Welcome to the Symposium–Eric Clementoni, Naval Nuclear Laboratory (Salon Del Rey)			
Wed. 8:10 am	Keynote Speaker #5: Chris Fraughton, MAN Energy Solutions USA (Salon Del Rey) Keynote Speaker #6: Don Stevenson, GTI Energy (Salon Del Rey) Keynote Speaker #7: Young Jae Choi, Hyundai Engineering Co. LTD (Salon Del Rey)			
Wed. 9:10 am	Panel Session IV: High-level DOE Panel Session (Salon Del Rey)			
Wed. 10:30 am	Break/Poster Session (Pre-Function/La Corona)			
Wed. 11:00 am	**Paper Track 1 Modeling& Control 1: 5, 25**	**Paper Track 2 Compressors 1: 37, 70**	**Paper Track 3 Testing 3: 103,100**	
Wed. 12:00 pm	Lunch–Awards Ceremony (Salon Del Rey)			
Wed. 1:30 pm	**Paper Track 1 Heat Transfer & Properties: 13, 51, 67, 27**	**Paper Track 2 Systems 2: 52, 78, 85, 108**	**Paper Track 3a Materials 1: 2,57 Paper Track 3b Bearings & Seals 1: 45, 112**	
Wed. 3:30 pm	Break/Poster Session (Pre-Function/La Corona)			
Wed. 4:00 pm	Panel Session V: University R&D (Salon Del Rey)			
Wed. 5:30 pm	Adjourn Day 3			
Thursday, February 29, 2024				
Thurs. 7:00 am	Continental Breakfast/Poster Session (Pre-Function/La Corona)			Posters Displayed
Thurs. 8:00 am	**Paper Track 1 Systems 1: 1, 14, 22**	**Paper Track 2 Compressors 2: 20, 44**	**Paper Track 3 Bearings & Seals 2: 33, 50, 107**	
Thurs. 9:30 am	**Paper Track 1 Systems 4: 61, 26, 64**	**Paper Track 2 Testing 2: 74, 94, 98**	**Paper Track 3 Heat Exchangers 1: 4,18, 31**	
Thurs. 11:00 am	Break/Poster Session(Pre-Function/La Corona)			
Thurs. 11:15 am	Panel Session VI: Industrial/National Labs Panel Session (Salon Del Rey)			
Thurs. 12:45 pm	Symposium Closing–Eric Clementoni, Naval Nuclear Laboratory (Salon Del Rey)			
Thurs. 1:30 pm–4:00 pm	Southwest Research Institute Facility Tour (Transportation provided from Hotel to SwRI. RSVP Required)			

DETAILED PROGRAM

Monday, February 26, 2024

Early Registration
12:00 PM – 6:00 PM in Pre-Function

Pre-Conference Tutorial Sessions
12:00 PM – 6:00 PM in Salon Del Rey A

1. 12:00 – 1:00: sCO_2 Power Cycles Fundamentals Tutorial
   Jason Wilkes, Southwest Research Institute
2. 1:00 – 2:00: sCO_2 Cycles Tutorial
   Tim Held, Echogen Power Systems
   Doug Hofer, Southwest Research Institute
3. 2:00 – 3:00: sCO_2 Oxy-Combustion Tutorial
   Steve White, Southwest Research Institute
   Subith Vasu, University of Central Florida
4. 3:00 – 4:00: sCO_2 Turbomachinery Tutorial
   Jeff Moore, Southwest Research Institute
5. 4:00 – 5:00: sCO_2 Materials for Supercritical CO_2 Applications Tutorial
   Prof. Henry Saari, Carleton University
   Steven Kung, Electric Power Research Institute
   Ganesan Subbaraman, GTI Energy
6. 5:00 – 6:00: Heat Exchangers for Supercritical CO_2 Power Cycle Applications Tutorial
   Michael Marshall, Southwest Research Institute
   Renaud Le Pierres, Heatric (Parker Hannifin)
   Marc Portnoff, Thar Energy, LLC

Industry Sponsored Reception
6:30 PM – 8:30 PM in Salon Del Rey C

Introductions – Tim Allison, Southwest Research Institute and Eric Clementoni, Naval Nuclear Laboratory

Welcome to the Industry Sponsored Reception – Jon Wade, Southwest Research Institute

Keynote Presentation
Comparative Analysis of Centrifugal Compressor Types for sCO_2 applications – Karl Wygant, Elliott Ebara Energy

DETAILED PROGRAM

Tuesday, February 27, 2024

Continental Breakfast / Registration / Poster Session
7:00 AM – 8:00 AM in Pre-Function / La Corona

Welcome to the Symposium
8:00 AM – 8:10 AM in Salon Del Rey
Tim Allison, Southwest Research Institute

Welcome to San Antonio
8:10 AM – 8:25 AM in Salon Del Rey
José Menéndez, Texas State Senator

Keynote Presentation
8:25 AM – 8:45 AM in Salon Del Rey
The Development of the sCO_2 Power Cycle for Concentrating Solar Power - Matt Bauer, DOE-EERE

Panel Session I: Industry – Turbomachinery Manufacturers
8:45 AM – 10:15 AM in Salon Del Rey
Moderators: Kevin Kisor, MAN Energy Solutions and Tim Allison, Southwest Research Institute

- Colin Duncan, Hanwha Power Systems
- Jason Mortzheim, GE Vernova Advanced Research
- Lorenzo Toni, Baker Hughes
- Kevin Kisor, MAN Energy Solutions
- Jeff Moore, Southwest Research Institute
- Rob Pelton, Elliott Ebara Energy

Break and Poster Session
10:15 AM – 10:45 AM in Pre-Function / La Corona

Keynote Presentation
10:45 AM – 11:05 AM in Salon Del Rey
Beyond sCO_2 Power - Jeremy Fetvedt, 8 Rivers Capital, LLC

Panel Session II: Applications & End Users
11:05 AM – 12:15 PM in Salon Del Rey
Moderators: Mauricio Ramirez, MAN Energy Solutions; Tim Held, Echogen Power Systems; and Jeremy Fetvedt, 8 Rivers Capital, LLC

- Sergio Grado, CenTrio
- Eric Watson, Energy Dome
- Mike Stoia, Boeing
- Matt Carlson, Heliogen
- Wes Stein, CSIRO

–CONTINUED–

DETAILED PROGRAM

Lunch/Fast Pitch
12:15 PM – 1:15 PM in Salon Del Rey

Paper Track 1 – Modeling & Control 2
1:15 PM – 2:45 PM in Salon A
Session Chair – Eric Clementoni

TRACK 1

1. *Paper # 10* – ARC-100 Plant Simulator
   Anton Moisseytsev, Argonne National Laboratory
2. *Paper # 59* – Evaluation on the rapidity of sCO_2 cycle power up and down events using the STEP dynamic simulation model
   Michael McDowell, GTI Energy
3. *Paper # 71* – Simple Cycle Test Validation of the STEP Dynamic Simulation Model
   Darryl Hino, GTI Energy

Paper Track 2 – Heat Exchangers 2
1:15 PM – 2:45 PM in Salon B
Session Chair – Seth Lawson

TRACK 2

4. *Paper # 12* – Powerful Heat Transfer Solutions™ for Supercritical CO_2 Recuperators
   Richard Huntington, Powerful Heat Transfer Solutions
5. *Paper # 73* – Experimental Demonstration of a Coal Fired Primary Heat Exchanger in a sCO_2-based Power Cycle
   Kyle Sedlacko, Echogen Power Systems
6. *Paper # 114* – Technical feasibility analysis and thermo-mechanical modelling of a high-temperature solar receiver and a shell and tube heat exchanger for next-generation CSP plants
   David Sanchez, University of Seville

Paper Track 3 – Systems 3
1:15 PM – 2:45 PM in Salon C
Session Chair – Tim Allison and Kevin Kisor

TRACK 3

1. *Paper # 38* – Modeling and Economic Analysis of sCO_2 Power Systems Hybridized with a Gas Turbine
   Joshua Schmitt, Southwest Research Institute
2. *Paper # 32* – Performance and Economic Evaluation of sCO_2 Bottoming Cycles for Natural Gas Combined Cycle Plants with Carbon Capture
   Eric Liese, Department of Energy, KeyLogic/NETL
3. *Paper # 47* – Annual Performance Profiles of CO_2-Plume Geothermal (CPG) Systems: Impact of the Ambient Conditions
   Christopher Schifflechner, Technical University of Munich

–CONTINUED–

DETAILED PROGRAM

Paper Track 1 – Testing 1
2:45 PM – 4:15 PM in Salon A
Session Chair – Bill Follet

TRACK 1

1. *Paper # 8* – Design of a sCO_2-based Pumped Thermal Energy Storage (PTES) test rig integrated with industrial waste heat recovery
   Simone Maccarini, Università di Genova
2. *Paper # 48* – sCO_2 Power Cycle Prototype using Thermal Energy Storage
   David Stapp, Peregrine Turbine Technologies, LLC
3. *Paper # 104* – Design of a High-Temperature Test Facility for an Additive Manufactured Supercritical Carbon Dioxide Turbine
   Anthony Grotjan, UW-Madison Solar Energy Laboratory

Paper Track 2 – Turbines
2:45 PM – 4:15 PM in Salon B
Session Chairs – Jason Mortzheim

TRACK 2

1. *Paper # 6* – S-CO_2 radial turbine testing data and performance map for thermodynamic conditions with strong real gas effect
   Seungkyu Lee, KAIST
2. *Paper # 102* – Blade and Rim Seal Design of a First Stage High Pressure Turbine for a 300 MWe Supercritical CO_2 Power Cycle
   Logan Tuite, Purdue Experimental Turbine Aerothermal Laboratory
3. *Paper # 105* – STEP 10 MWe SCO_2 Turbine Design, Assembly and Commissioning
   Jeff Moore, Southwest Research Institute

Paper Track 3 – Materials 2
2:45 PM – 4:15 PM in Salon C
Session Chair – Jeff Phillips

TRACK 3

1. *Paper # 63* – High-Temperature Creep and Creep-Fatigue Performance of Stainless Steel 316 Diffusion Bonds
   John Shingledecker, EPRI
2. *Paper # 89* – High-Temperature Oxidation Behavior of Wrought and Additive Manufactured Ni-based Alloys in Direct-Fired Supercritical CO_2 Power Cycle Environments
   Casey Carney, Department of Energy – NETL
3. *Paper # 113* – Coated and Uncoated Steel Compatibility in Supercritical CO_2 at 450°-650°C
   Bruce Pint, ORNL

–CONTINUED–

DETAILED PROGRAM

Break and Poster Sessions
4:15 PM – 4:45 PM in Pre-Function / La Corona

Panel Session II: International Panel Session
4:45 PM – 6:00 PM in Salon Del Rey
Moderators: David Sanchez, University of Seville and Renaud Le Pierres, Heatric (Parker Hannifin)

- Guillermo Paniagua, Purdue University
- Lorenzo Cosi, Baker Hughes
- Rafael Gúedez, KTH
- Jeong Ik Lee, KAIST
- Tim Allison, Southwest Research Institute

Industry-Sponsored Cocktail Hour
6:00 PM – 7:00 PM in Pre-Function / La Corona

Industry-Sponsored Dinner
7:00 PM – 9:00 PM in Salon Del Rey

Keynote Speakers
Supercritical CO_2 Power Cycle in Fusion Energy
Chris Clements, Tokamak Energy Ltd.
Jack Acres, UKAE

DETAILED PROGRAM

Wednesday, February 28, 2024

Continental Breakfast / Registration / Poster Session

7:00 AM – 8:00 AM in Pre-Function / La Corona

Welcome
8:00 AM – 8:10 AM in Salon Del Rey
Eric Clementoni, Naval Nuclear Laboratory

Keynote Presentations
8:10 AM – 9:10 AM in Salon Del Rey
Chris Fraughton, MAN Energy Solutions USA
STEP Update - Don Stevenson, GTI Energy
Feasibility Study on sCO_2 Power Cycle Coupling with Small Modular Reactor - Young Jae Choi, Hyundai Engineering Co. LTD

Panel Session IV: High-level DOE Panel Session
9:10 AM – 10:30 AM in Salon Del Rey

Moderators: Jason Mortzheim, GE Vernova Advanced Research and Doug Hofer, Southwest Research Institute

- Rajgopal Vijaykumar, SETO
- Chris Vandervort, ARPA-E
- Robert Schrecengost, Headquarters
- Aleksandr Kozlov, IEDO
- John Crane, FECM

Break and Poster Session
10:30 AM – 11:00 AM in Pre-Function / La Corona

Paper Track 1 – Modeling & Control 1
11:00 AM – 12:00 PM in Salon A
Session Chair – Tim Held

TRACK 1

1. *Paper # 5* – Evaluation of S-CO_2 Compressor Inlet Temperature Controllers
   Gihyeon Kim, KAIST
2. *Paper # 25* – Multi-Model Predictive Control for Enhanced Load Following of a sCO_2 Recompression Brayton Cycle
   Jacob Albright, Department of Energy – NETL

Paper Track 2 – Compressors 1
11:00 AM – 12:00 PM in Salon B
Session Chairs – Rob Pelton

TRACK 2

1. *Paper # 37* – Experimental and Numerical Performance Evaluation of a Modified sCO_2 Compressor Blade Profile to Reduce Leading Edge Condensation
   Erik Fernandez, University of Central Florida

–CONTINUED–

DETAILED PROGRAM

2. *Paper # 70* – Design and Optimization of a 3-Stage Axial Supercritical CO_2 compressor
   Mark Turner, University of Cincinnati

Paper Track 3 – Testing 3
11:00 AM – 12:00 PM in Salon C
Session Chairs – Ladislav Vesely

TRACK 3

1. *Paper # 103* – Design and Construction of a 1 MWth sCO_2 Thermal Loop Heated by Particle-Based Concentrating Solar Power
   Hendrik Frederik Laubscher, Sandia National Laboratories
2. *Paper # 100* – Investigation of high-pressure CO_2-diluted methane/oxygen jet flame stabilization and laser-induced plasma kernel formation
   Francesco Di Sabatino, Southwest Research Institute

Lunch
12:00 PM – 1:30 PM in Salon Del Rey
Awards Ceremony – Lifetime Service Award, Best Poster, and Best Paper

Paper Track 1 – Heat Transfer & Properties
1:30 PM – 3:30 PM in Salon A
Session Chair – Rene Pecnik

TRACK 1

1. *Paper # 13* – Visualizing the Turbulent Heat Transfer of Horizontal sCO_2 Flows
   Marko Draskic, TU Delft
2. *Paper # 51* – Correlational Model for Heat Transfer Coefficient of Solid Particle-to-CO_2 Moving Bed Heat Exchangers with Finned-Tubes
   Luke Magyar, Echogen Power Systems
3. *Paper # 67* – Heat Transfer Experiments of Ribbed, Serpentine Cooling Passages with Supercritical CO_2
   Michael Marshall, Southwest Research Institute
4. *Paper # 27* – Study on the initial position of Taylor vortex for Taylor-Couette-Poiseuille flow formed by supercritical carbon dioxide
   Fengxiong Lu, University of Chinese Academy of Sciences

Paper Track 2 – Systems 2
1:30 PM – 3:30 PM in Salon B
Session Chairs – Jeong Ik Lee

TRACK 2

1. *Paper # 52* – Simultaneous Design Optimization of binary CO_2-mixture-based transcritical power cycles for Concentrated Solar Power Applications
   Balkan Mutlu, Teesside University NZIIC
2. *Paper # 78* – Analysis and optimization of the recompression cycle with high-temperature recuperator bypass for concentrating solar power applications
   Taylor Brown, Department of Energy – NREL

–CONTINUED–

DETAILED PROGRAM

3. *Paper # 85* – Preliminary Results of the EU SolarSCO_2OL Demonstration Project: Enabling the Integration of Supercritical CO_2 Power Blocks into Hybrid CSP-PV Plants
   Salvatore Guccione, KTH Royal Institute of Technology

4. *Paper # 108* – Integrated Thermal Energy Storage and Brayton Cycle Equipment Demonstration (Integrated Testbed) Project Design Basis
   Masih Jorat, Heliogen Holdings LLC

Paper Track 3a – Materials 1
1:30 PM – 2:30 PM in Salon C
Session Chair – Jeff Phillips

TRACK 3

1. *Paper # 2* – Experience in Manufacturing Pipe and Fittings from INCONEL® alloy 740H® for Demonstration Facilities for sCO_2 Service
   John deBarbadillo, Special Metals

2. *Paper # 57* – Testing of Materials and Coatings at up to 1150 °C and 300 bar for use in Oxy-Combustion Turbine
   Florent Bocher, Southwest Research Institute

Paper Track 3b – Bearings & Seals 1
2:30 PM – 3:30 PM in Salon C
Session Chair – Jon Wade

1. *Paper # 45* – Bearingless Motor/Generator Opportunities in sCO_2 Power Cycles
   Eric Severson, University of Minnesota

2. *Paper # 112* – Experimental Demonstration of a Novel Supercritical CO_2 Seal Concept on a 2" Static Test Rig
   Sevki Cesmeci, Georgia Southern University

Break and Poster Session
3:30 PM – 4:00 PM in Pre-Function / La Corona

Panel Session V: University R&D Panel Session
4:00 PM – 5:30 PM in Salon Del Rey
Moderator: Jeff Phillips, Hanover College

- John DeBarbadillo, Special Metals
- Douglas Hofer, Southwest Research Institute
- Jeong Ik Lee, KAIST
- Subith Vasu, University of Central Florida
- David Sanchez, University of Seville

DETAILED PROGRAM

Thursday, February 29, 2024

Continental Breakfast / Posters
7:00 AM – 8:00 AM in Pre-Function / La Corona

Paper Track 1 – Systems 1
8:00 AM – 9:30 AM in Salon A
Session Chair – Ty Neises

TRACK 1

1. *Paper # 1* – Long-term Performance Analysis of Supercritical Cycles in Complex Industrial Environments under Semi-Transient Conditions
   Vincent Thielens, University of Mons
2. *Paper # 14* – sCO_2 Waste Heat Recovery System Evaluation for Steelmaking Process
   Ladislav Vesely, University of Central Florida
3. *Paper # 22* – sCO_2 Waste Heat Recovery System for Turbofan Engine – System Optimization and Component Design
   Claire-Phonie Bury, University of Central Florida

Paper Track 2 – Compressors 2
8:00 AM – 9:30 AM in Salon B
Session Chairs – Klaus Brun

TRACK 2

1. *Paper # 20* – A Method to Develop Centrifugal Compressor Performance Maps for Off-Design and Dynamic Simulation Studies of sCO_2 Cycles
   Colin du Sart, University of Cape Town
2. *Paper # 44* - Experimental Demonstration of an Advanced CO_2 Axial Compressor for CO_2-based Power Cycles and Energy Storage Systems
   Jeongseek Kang, University of Notre Dame
3. *No paper presentation*

DETAILED PROGRAM

Paper Track 3 – Bearings & Seals 2
8:00 AM – 9:30 AM in Salon C
Session Chair – Jeff Moore

TRACK 3

1. *Paper # 33* – Development of a Dry Gas Seal for high-temperature supercritical carbon dioxide (sCO_2) turbines
   Jakson Andretta, EagleBurgmann Germany
2. *Paper # 50* – Preliminary Sizing of Active Magnetic Bearings for sCO_2 Waste-Heat Recovery Application
   Robert Lipham, Southwest Research Institute
3. *Paper # 107* – Design of a Permanent Magnet Biased Homopolar Magnetic Bearing for SCO_2 Turbine Applications
   Robert Lipham, Southwest Research Institute

Paper Track 1 – Systems 4
9:30 AM – 11:00 AM in Salon A
Session Chair – Jason Wilkes

TRACK 1

1. *Paper # 61* – High temperature CO_2 heat pumps for industrial process heat applications
   Timothy Held, Echogen Power Systems
2. *Paper # 26* – Thermodynamic Evaluation of a Refrigeration Bottoming Cycle on the Efficiency of a Condensing Supercritical Carbon Dioxide Power Cycle
   Phalgun Malupillai, TerraPower
3. *Paper # 64* – Technoeconomic Analysis of Low Temperature Reservoir Technologies for sCO_2 based Pumped Thermal Energy Storage
   Vamshi Avadhanula, Echogen Power Systems

Paper Track 2 – Testing 2
9:30 AM – 11:00 AM in Salon B
Session Chairs – Eric Clementoni

TRACK 2

1. *Paper # 74* – The STEP 10 MWe sCO_2 Pilot Installation and Commissioning Status Update
   William Follett, GTI Energy
2. *Paper # 94* – Commissioning and Simple Cycle Testing of the STEP Main Compressor
   Michael Kutin, GTI Energy
3. *Paper # 98* – Controls and Data Acquisition Systems Architecture for the DOE STEP 10 MWe Pilot Scale sCO_2 Power Plant
   Craig Nolen, Southwest Research Institute

–CONTINUED–

DETAILED PROGRAM

Paper Track 3 – Heat Exchangers 1
9:30 AM – 11:00 AM in Salon C
Session Chair – Renaud Le Pierres

TRACK 3

1. *Paper # 4* – Increasing Main Cooler Thermal Performance for sCO_2 Power Cycles
   Matthew Searle, NETL Support Contractor
2. *Paper # 18* – Experimental Characterization of Additively Manufactured Heat Exchangers For Supercritical Carbon Di-Oxide Cycles
   Erfan Rasouli, University of California Davis
3. *Paper # 31* – The Experimental and Numerical Investigation of Internal Heat Transfer for Supercritical Carbon Dioxide Cooling in a Staggered Pin Fin Array and Single-Jet Impingement
   Emmanuel Gabriel-Ohanu, University of Central Florida

Break and Poster Session
11:00 AM – 11:15 AM in Pre-Function / La Corona

Panel Session VI: Industrial National Labs
11:15 AM – 12:45 PM in Pre-Function / La Corona
Moderators: Seth Lawson, US DOE – NETL and Renaud Le Pierres, Heatric (Parker Hannifin)

- Aramis Cook, CiTech
- Logan Rapp, Sandia National Labs
- Renaud Le Pierres, Heatric (Parker Hannifin)
- Andrew Fry, BYU

Symposium Closing
12:45 PM – 1:00 PM in Salon Del Rey
Tim Allison, Southwest Research Institute
Eric Clementoni, Naval Nuclear Laboratory

Facility Tour @ Southwest Research Institute
1:30 PM – 4:00 PM

- STEP 10 MWe Pilot Plant Facility
- Pumped Thermal Energy Storage Test Facility
- APOLLO 1 MWe Test Loop and Integrally-Geared Compander
- APOLLO 3 MWe Centrifugal Compressor
- sCO_2 Component Test Loops including shaft seals, oxy-combustion, turbine blade heat transfer

NOTES

NOTES

Thank you to our 2024 Sponsors!!

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SOUTHWEST RESEARCH INSTITUTE
CONVERGE CFD SOFTWARE
GTI ENERGY
SPECIAL METALS
A PCC Company
Hanwha Power Systems