

Overview of Symposium Goals and Objectives

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Rensselaer Polytechnic Institute

Supercritical CO₂ Power Cycle Symposium
Troy, NY
April 29-29, 2009



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Presentation Outline

- Symposium Organization
- Technical Scope
- Look into the Future



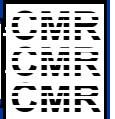
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Symposium Organization

- Co-organizing Institutions
- Program: see *Symposium Brochure* and/or *Symposium Website* for details
- Keynote presentations
- Technical presentations
- After-dinner presentation
- Panel discussion
- Conference proceedings



Technical Scope: Supercritical CO₂

- Systems and Applications
- Components and Equipment
- Major Issues in SCO₂ Science & Technology

Co-organizing Institutions

- Knolls Atomic Power Laboratory (initiator and sponsor)
 - Bettis Atomic Power Laboratory
 - Rensselaer Polytechnic Institute
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- Current symposium follows a similar conference held at the Massachusetts Institute of Technology in 2007

Organizing/Scientific Committee

- Co-Chair:* Ken Kimball (KAPL)
- Local members:* Steve Antal (KAPL/RPI)
Tara Gallaway (RPI)
Ryan McNab (KAPL)
Brian Morris (KAPL)
- Other members:* Pavel Hejzlar (TerraPower, LLC),
Damon Howard (Bettis),
Anton Moiseyev (ANL)
Steve Wright (SNL)
- Local Arrangements:* RPI Outreach Office
Kim Scalzo - Director

Systems and Applications

- Nuclear systems
- Solar systems (storage)
- Conventional systems (small size power generation)
- Sequestration and oil recovery

Components and Equipment

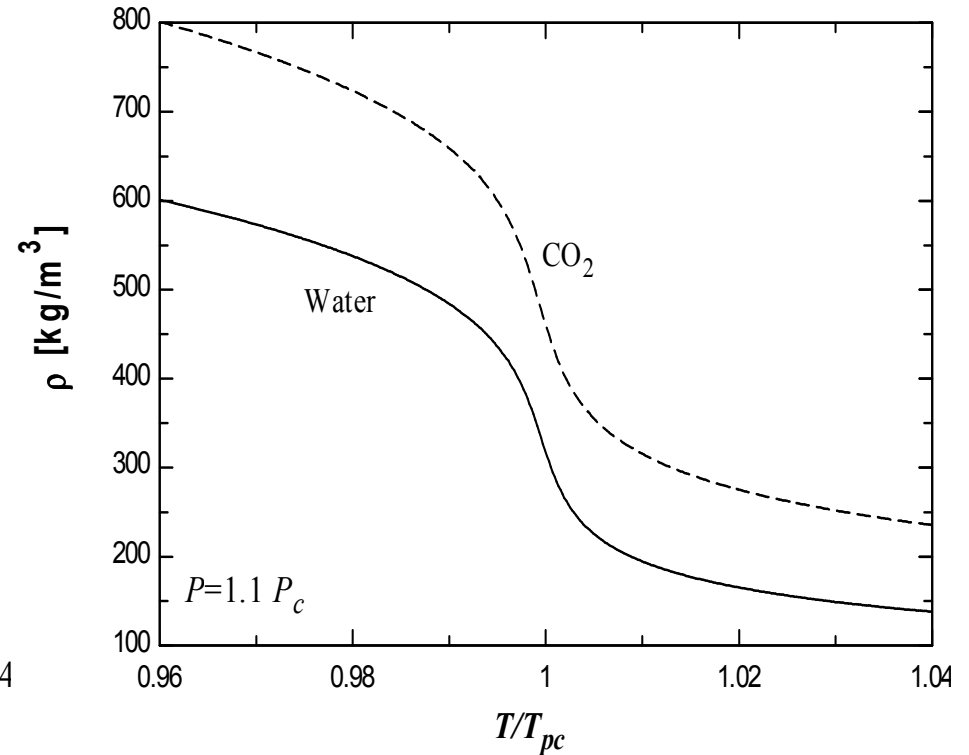
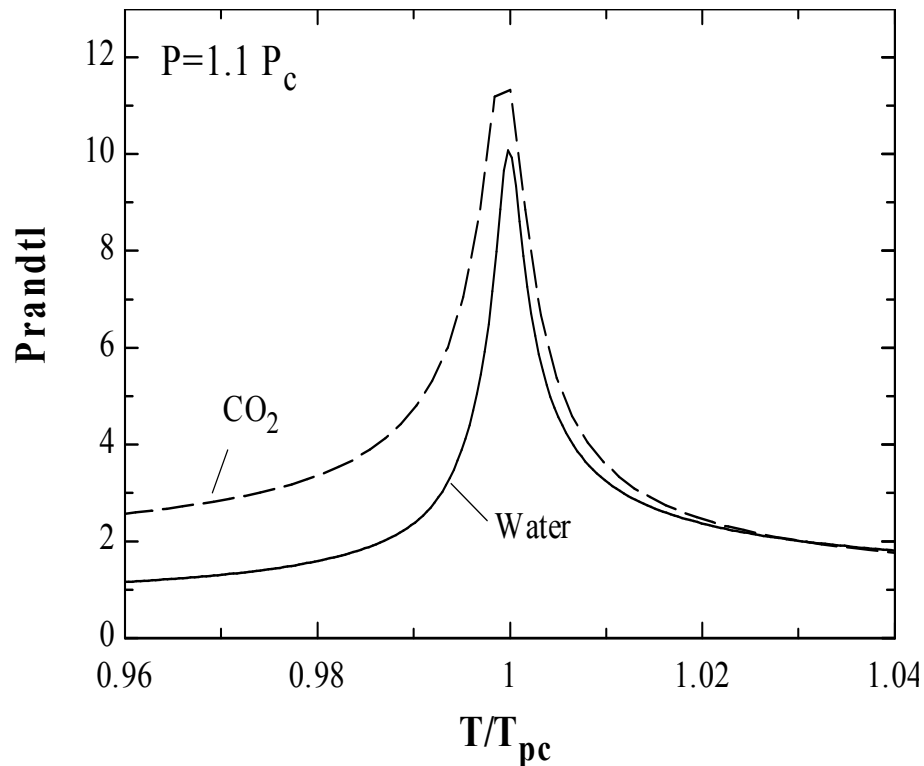
- Rotating machinery :
 - turbines
 - compressors
 - electric generators (SCO₂ cooling)
 - bearings, seals
- Heat exchangers

Major Issues in SCO_2 Science & Technology

Physics of Fluids

- Fluid properties
- Thermodynamics
- Fluid mechanics
- Heat transfer

Properties of Supercritical Fluids



Gallaway et. al, "Multi-dimensional Model of Fluid Flow and Heat Transfer in Generation-IV Supercritical Water Reactors", Nuclear Engineering and Design 238 (2008)



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**Best Paper Award, 2nd Prize, Reactor Thermal-Hydraulics
2009 ANS Student Conference, Gainesville, FL
April 1-4, 2009**

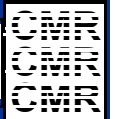


“Multidimensional Analysis of Heated Channel Dynamics at Supercritical Pressures”, Tara Gallaway

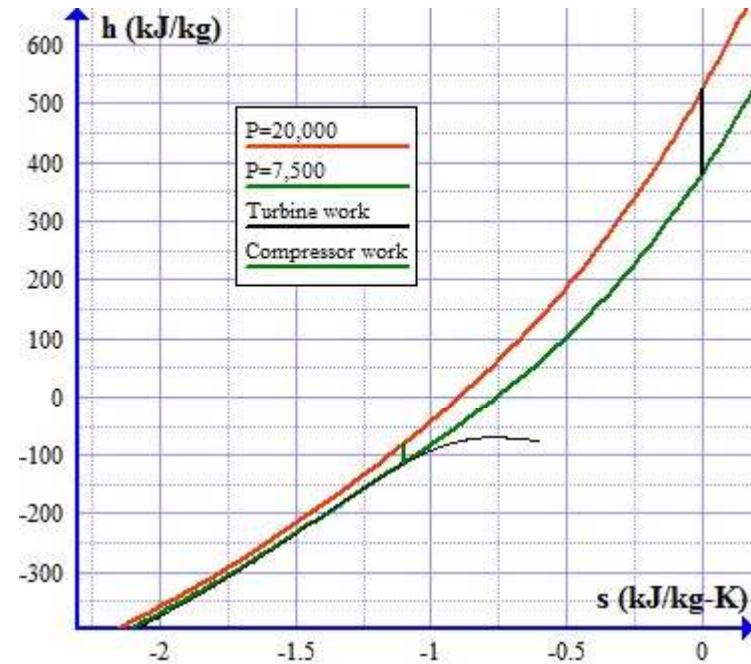
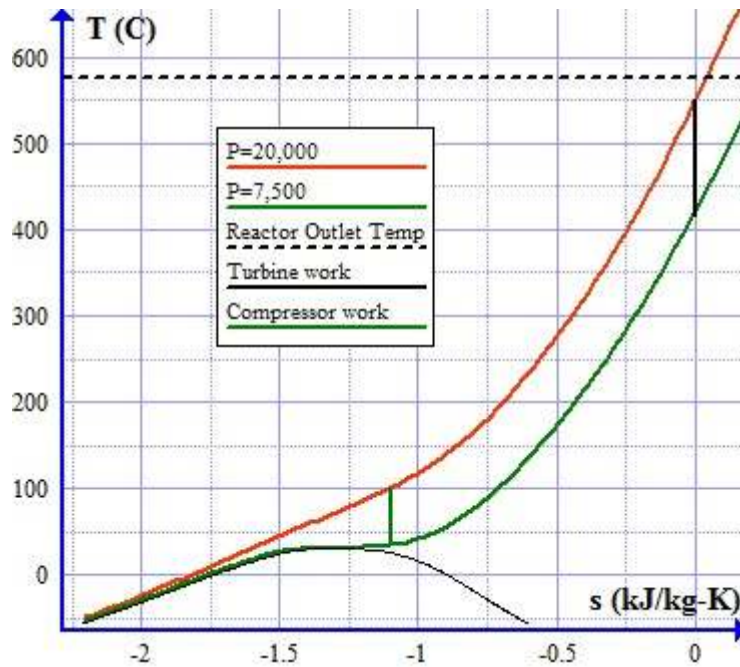


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Supercritical CO₂ Thermodynamic Cycle : Optimization of Brayton Cycle Design



Senior Design Project in Nuclear Engineering:
“Conceptual Design of Sodium Fast Reactor”,
K. Black, J. Hagaman, B. Herman, A. Pavlou, Class of 2009

Best Paper Award, Reactor Physics

2009 ANS Student Conference, Gainesville, FL

April 1-4, 2009



“Conceptual Design of Sodium Fast Reactor”, B. Herman, A. Pavlou

Fluid Mechanics and Heat Transfer of Supercritical Fluids

- Fluid mechanics:
 - effect of variable properties (density, viscosity)
 - pressure drop
 - effect of compressibility
 - choked flow
- Heat transfer
 - effect of variable properties (conductivity, specific heat, density)

Major Issues in SCO_2 Science & Technology

Chemistry of Materials

- Chemical reactions
- Effect of nuclear radiation
- Corrosion
- Welding
- Diffusion-bonding

Major Issues in SCO_2 Science & Technology

Methods of Analysis

- Experimental techniques
- Phenomenological models
- Similarity analysis
- First-principle models of local phenomena
- Transients (depressurization)
- Computational tools:
 - system codes (TACE, RELAP),
 - commercial CFD codes (FLUENT, CFX)
 - advanced ensemble-averaging-based solvers (NPHASE-CMFD)
 - LES, DNS, etc.

Major Issues in SCO_2 Science & Technology

Engineering Issues

- Scaling
- Component testing
- Integrated system testing
- Data acquisition
- Control systems
- Performance of rotating machinery (bearings, seals)
- Design optimization

Look into the Future: Means to Enhance Advancements and Accelerate Progress

- Formulate criteria to identify priorities
- Enhance communications between industrial engineers, academic researchers, national laboratories
- Enhance international collaboration
- Identify, and capitalize on, synergistic effects between various applications
- Learn from past experience