44TH TURBOMACHINERY & 31ST PUMP SYMPOSIA
HOUSTON, TEXAS | SEPTEMBER 14 – 17 2015
GEORGE R. BROWN CONVENTION CENTER

COMPRESSOR 201

JIM SOROKES – DRESSER-RAND COMPANY
JIM HARDEN – ELLIOTT GROUP
JEFF MOORE – SOUTHWEST RESEARCH INSTITUTE
GARY COLBY – DRESSER-RAND COMPANY
R.C. WHITE – SOLAR TURBINES

TEES TURBOMACHINERY LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION
TEXAS A&M UNIVERSITY

James M. “Jim” Sorokes is a Principal Engineer at Dresser-Rand with over 37 years of experience in the turbomachinery industry. Jim joined Dresser-Clark (now Dresser-Rand) after graduating from St. Bonaventure University in 1976. He spent 28 years in the Aerodynamics Group, became the Supervisor of Aerodynamics in 1984 and was promoted to Manager of Aero/Thermo Design Engineering in 2001. While in the Aerodynamics Group, his primary responsibilities included the development, design, and analysis of all aerodynamic components of centrifugal compressors. In 2004, Mr. Sorokes was named Manager of Development Engineering whereupon he became involved in all aspects of new product development and product upgrades. In 2005, he was promoted to principal engineer responsible for various projects related to compressor development and testing. He is also heavily involved in mentoring and training in the field of aerodynamic design, analysis, and testing.

Mr. Sorokes is a member of AIAA, ASME, and the ASME Turbomachinery Committee. He has authored or co-authored over forty technical papers and has instructed seminars and tutorials at Texas A&M and Dresser-Rand. He currently holds three U.S. patents and has five others patents pending. He was elected an ASME Fellow in 2008.

Jim Hardin is a Senior Engineer in the Advanced Technology department at Elliott Group, in Jeannette, Pennsylvania, where he performs computational fluid dynamics (CFD) and other aerodynamic analyses for turbines and compressors. Previous experience includes CFD and other analyses on shipboard propulsion and piping systems with Westinghouse Electric Corporation, and turbine design support and testing at Elliott Company. He has 32 years of engineering experience, mostly in aerodynamics and fluid systems.

Mr. Hardin received a B.S. degree (Mechanical Engineering, 1981) from Carnegie-Mellon University, and is a registered Professional Engineer in the State of Pennsylvania.

Dr. Jeffrey Moore is the manager of the Rotating Machinery Dynamics Section at Southwest Research Institute in San Antonio, TX. He holds a B.S., M.S., and Ph.D. in Mechanical Engineering from Texas A&M University. His professional experience over the last 20 years includes engineering and management responsibilities related to centrifugal compressors and gas turbines at Solar Turbines Inc. in San Diego, CA, Dresser-Rand in Olean, NY, and Southwest Research Institute in San Antonio, TX. His interests include advanced compression methods, rotordynamics, seals and bearings, computational fluid dynamics, finite element analysis, machine design, controls and aerodynamics. He has authored over 30 technical papers related to turbomachinery and has one patent issued and two pending. Dr. Moore has held the position of Oil and Gas Committee Chair for IGTI Turbo Expo and is the Associate Editor for the Journal of Tribology. He is also a member of the Turbomachinery Symposium Advisory Committee, the IFToMM International Rotordynamics Conference Committee, and the API 616 and 684 Task Forces.

Mr. Colby is presently a Test Engineering Supervisor with Dresser-Rand Company in Olean, N.Y. He is responsible for developing test methods to meet objectives for production compressors and analytical aerodynamic testing centrifugal and axial compressors. Mr. Colby has held several engineering positions over his 39 year career at Dresser-Rand. His work experience has been in the thermodynamic performance of centrifugal compressors. He has more than 26 years experience in testing of compressors, both in-shop and field.

Mr. Colby studied Mechanical Technology at Alfred State University in New York. He has been a Tutorial Author, Discussion Group Leader and Short Course Speaker for the Turbomachinery Symposium and has authored several papers on hydrocarbon performance testing of compressors.

Robert C. White is a Principal Engineer for Solar Turbines, Inc. in San Diego, California. He is responsible for compressor and gas turbine performance predictions and application studies. In his former position he led the development of advanced surge avoidance and compressor controls at Solar Turbines. Mr. White holds 12 U.S. patents for turbomachinery related developments. He has contributed to several papers, tutorials, and publications in the field of Turbomachinery.

Course Overview:

This course supplements the Centrifugal Compressor 101 course by covering in greater detail four key areas related to centrifugal compressors as described below. It is intended for those who attended the 101 and wish to learn more about these topics. The course is also structured for those practicing rotating machinery engineers that have a basic understanding of the topics covered in Centrifugal Compressors 101 but wish to further their understanding in these key areas.

I. **Aerodynamics**
1. Compressor Design and Analysis
    a. Nomenclature review (Compressor 101 refresher)
    b. Analysis & design methods
    c. Design tools (i.e., 1D, 2D, 3D)
        i. Capabilities / Limitations / Assessment Criteria
2. CFD and its Role
3. Performance Issues
    a. Causes & Trends
    b. Trouble-shooting
    c. Rotating stall
        i. Most common types / sample cases

II. **Rotordynamics**
1. Basic vibration theory
2. Modeling procedures
3. Bearing and seal analysis
4. API requirements
5. Instrumentation used
6. Sample vibration phenomena and case studies

III. **Performance and Mechanical Testing**
1. API 617 and ASME PTC-10 requirements
2. Instrumentation and test methods
3. Test gas considerations
4. Sample testing pitfalls
5. Aerodynamic case studies

IV. **Surge Control**
1. What is Surge
2. Scenarios
3. Surge Control System Components
4. Surge Control System Layouts
5. Surge Control System Operation in different scenarios
6. Modeling of the Surge Control System
7. Surge control system design considerations
8. Integration of Compressor and Compression System