

40th Turbomachinery Symposium

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TURBOMACHINERY SYMPOSIUM PROGRAM

SHORT COURSES

Short Course T1

Centrifugal Compressors 101, **Mark Kuzdzal** and **Jay Koch** (Dresser-Rand Co., Olean, NY)

Short Course T2

Introduction to Steam Turbines, **Daryll Turner** (Elliott Co., Jeannette, PA) and **Keith Zanavich** (Ebara Group, Jeannette, PA)

Short Course T3

API 616 Gas Turbine, **Tim Hattenbach** (Bechtel Corporation, Houston, TX), and **Terry Roehm** (Marathon Oil Corp., Houston, TX)

Short Course T4

Lateral Rotordynamics of Petrochemical Equipment—Review, Examples, and Problems, **John Kocur** (ExxonMobil Research & Engineering, Fairfax, VA)

Short Course T5

Surge and Surge Control Systems, **J. Jeffrey Moore** (Southwest Research Institute, San Antonio, TX), **R.C. White** (Solar Turbines Inc., San Diego, CA), **Klaus Brun** and **Marybeth Nored** (Southwest Research Institute, San Antonio,

TX), and **Ken Devito** (Dresser-Rand, Houston, TX)

Short Course T6

Large Engineered Motors, Generators, and Variable Frequency Drive System Fundamentals for Mechanical Engineering, **Arthur J. Smith III** (Waldemar S. Nelson and Co., Inc., New Orleans, LA)

Short Course T7

Root Cause Failure Analysis in Industrial Turbomachinery, **David Ransom** and **Harold Simmons**

(Southwest Research Institute, San Antonio, TX); **David Seib** (Dresser-Rand, Olean, NY)

Short Course T8

Combined Cycle and Cogeneration Power, **Meherwan Boyce** (The Boyce Consultancy Group, Houston, TX)

LECTURES

Lecture T1

A Root Cause Failure Analysis for Recurring Impeller Failures in a 4.7 MM Ton LNG Train Propane Compressor, **Nicholas M. White** (RasGas Co., Ras Laffan, Qatar); **Scot J. Laney** and **Cory Zorzi** (Elliott Group, Jeannette, PA)

Lecture T2

Onsite Determination of the Control Line for Integrally Geared Compressors for Avoidance of Impeller Fatigue Failures, **Norbert G. Wagner**, **Georg Winkes**, and **Sven König**, (Siemens AG, Duisburg, Germany); **Stefan Süß** (Linde AG, Pullach, Germany)

Lecture T3

Tilting-Pad Bearings: Measured Frequency Characteristics Of Their Rotordynamic Coefficients, **D. Childs** (Texas A&M University, College Station, TX), **A. Delgado** (GE Research Center, Schenectady, NY), and **G. Vannini** (GE Oil and Gas, Florence, Italy)

Lecture T4

Development of a High Pressure Rotordynamic Test Rig for Centrifugal Compressors Internal Seals Characterization, **Giuseppe Vannini**, **Stefano Cioncolini**, and **Vincenzo Calicchio** (GE Oil & Gas, Florence, Italy), and **Francesco Tedone** (Master Thesis Student, Pisa University, Italy)

Lecture T5

New Approach to Torsional Vibration Monitoring, **Lorenzo Naldi** (GE Oil & Gas, Florence, Italy), **Mateusz Golebiowski** (GE Oil & Gas, Warsaw, Poland), and **Valerio Rossi** (GE Oil & Gas, Florence, Italy)

Lecture T6

Demonstration of the Rotordynamic Effects of Centrifugal Liquid Separation and Gas Compression in an Oil-Free Integrated Motor-Compressor, **Tim Griffin** (Dresser-Rand, Marietta, GA), and **Bill Maier** (Dresser-Rand, Olean, NY)

Lecture T7

Full Load Testing of a 12.5 MW Vertical High Speed Subsea Motorcompressor, **Giuseppe Vannini**, **Andrea Masala**, **Massimo Camatti**, **Massimiliano Ortiz Neri**, **Sergio Bondi**, and **Silvia Evangelisti** (GE Oil & Gas, Florence, Italy)

Lecture T8

Long Term Operating Experience with Corrosion Control in Industrial Axial Flow Compressors, **David Linden** (D.H. Linden Assoc., Inc., Allentown, PA)

Lecture T9

Development of Advanced Centrifugal Compressors and Pumps for Carbon Capture and Sequestration Applications, **J. Jeffrey Moore**, **Andrew Lerche**, and **Hector Delgado** (Southwest Research Institute, San Antonio, TX); **Tim Allison** (Southwest Research Institute, San Antonio, TX)

Lecture T10

Mechanical Performance of a Two Stage Centrifugal Compressor Under Wet Gas Conditions, **David Ransom** (Southwest Research Institute, San Antonio, TX); **Luigi Podesta** and **Massimo Camatti** (GE Oil & Gas, Firenze, Italy); **Melissa Wilcox** (Southwest Research Institute, San Antonio, TX)

Lecture T11

Operation of Centrifugal Compressors in Choke Conditions, **Michael Cave**, **Chester Lee**, and **Wolfgang Faller** (Solar Turbines Inc., San Diego, CA)

Lecture T12

Eliminating Turbine Compressor Fouling with HEPA Membrane Composite Air Intake Filters, **Wilson Poon**, *Modeling and Prediction of Sidestream Inlet Pressure for Multistage Centrifugal Compressors*, **Moulay Belhassan**, **Jay Koch**, and **James Sorokes** (Dresser-Rand, Olean, NY)

TUTORIALS

Tutorials T1

Gas Seal Contamination, **Raphael Bridon** and **Olivier Lebigre** (Dresser-Rand, Le Havre, France)

Tutorials T2

Range Versus Efficiency - Striking the Proper Balance, **James M. Sorokes** (Dresser-Rand, Olean, NY)

Tutorials T3

Pulsation, Vibration, and Noise Issues with Wet and Dry Screw Compress-

sors, **Donald R. Smith** and **Stephen M. Price** (Engineering Dynamics Inc., San Antonio, TX)

Tutorials T4

Guidelines for Reducing the Noise Level of a Centrifugal Air Compressor Installation, **John R. Badini** and **Paul A. Brown** (FS-Elliott Co., Export, PA)

Tutorials T5

Introduction to Engineering Ethics with Rotating Machinery Case

Studies, **Robert X. Perez** (Enterprise Products, San Antonio, TX)

Tutorials T6

Buying/Selling Serial Number One, **Michael Drosjack** (Drosjack Consulting, Houston, TX), **Harry F. Miller** and **James M. Sorokes** (Dresser-Rand, Olean, NY)

Tutorials T7

Stability Considerations-A Simplified

Approach, **Urs Baumann** (MAN Diesel & Turbo Schweiz AG, Zurich, Switzerland)

Tutorials T8

Successful Selection and Operation of Gas Turbine Inlet Filtration Systems, **Melissa Wilcox** (Southwest Research Institute, San Antonio, TX), **Rainer Kurz**, (Solar Turbines, San Diego, CA), and **Klaus Brun** (Southwest Research Institute, San Antonio, TX)

Discussion Group T1

Turbomachinery Operation and Maintenance, **Rainer Kurz**, Coordinator (Solar Turbines Inc., San Diego, CA), **Joe Moreno**, Coordinator (Lyondell Chemical Co., Channelview, TX), **Mike Pepper**, Coordinator (ExxonMobil Upstream Research Co., Houston, TX), and **Charlie Rutan** (LyondellBasell, Alvin, TX)

Discussion Group T2**

Monitoring Vibration and Other Critical Machine Conditions, **Steve Locke**, Coordinator (E.I. DuPont de Nemours & Co., Old Hickory, TN), and **Mike Pepper**, Coordinator (ExxonMobil Upstream Research Co., Houston, TX)

Discussion Group T3

Machinery Purchasing, **Kazim Akhtar**, Coordinator (CB&I, Houston, TX), and **Cyrus Meher-Homji**, Coordinator (Bechtel Corp., Houston, TX)

Discussion Group T4

Overspeed Trip Systems, **Bruce Bayless**, Coordinator (Valero Energy Corp., Houston, TX), and **Kevin Yates**, Coordinator (The Dow Chemical Co., Freeport, TX)

Discussion Group T5

Verification of Protective Systems, **Lil**

Kassie, Coordinator (BP, Whiting, IN), **Steve Locke**, Coordinator (DuPont, Old Hickory, TN), and **Stanley Stevenson**, Coordinator (Siemens Demag Delaval Turbomachinery, Trenton, NJ)

Discussion Group T6

Dry Gas Seals, **Bernard Quiox**, Coordinator (Total E&P, Pau, France), and **Hans Weyermann**, Coordinator (ConocoPhillips, Houston, TX)

Discussion Group T7

Gas Turbine Operation and Maintenance, **Mehrewan Boyce**, Coordinator (The Boyce Consultancy, Houston, TX), **Rainer Kurz**, Coordinator (Solar Turbines, Inc., San Diego, CA), and **Francisco Gonzalez**, Coordinator (Enterprise Products Co., Houston, TX)

Discussion Group T8*

Couplings and Alignment, **Tom Davidson**, Coordinator (The Linde Group, Pasadena, TX), and **Terry Roehm**, Coordinator (Marathon Oil Co., Houston, TX)

Discussion Group T9

Gas Turbines and Compressors Performance Testing, **Hans Weyermann**, Coordinator (ConocoPhillips, Houston, TX), **Jeff Haught**, Coordinator (Anadarko, Houston, TX), and **Mark**

Sandberg, Coordinator (Chevron, Houston, TX)

Discussion Group T10

Gears, **Cliff Cook**, Coordinator (CVC Engineering, Houston, TX), and **Lisa Ford**, Coordinator (Lufkin Industries, Inc., Lufkin, TX)

Discussion Group T11

Reciprocating Compressors, **Bruce Bayless**, Coordinator (Valero Energy Corp., Houston, TX), and **Donald R. Smith**, Coordinator (Engineering Dynamics Inc., San Antonio, TX)

Discussion Group T12

Steam Turbine Design, Operation, and Maintenance, **Vinod Patel**, Coordinator (KBR, Houston, TX), **Stanley Stevenson**, Coordinator (Siemens Demag Delaval Turbomachinery, Trenton, NJ), and **Gampa Bhat**, Coordinator (ExxonMobil Chemical Co., Baytown, TX)

Discussion Group T13

Magnetic Bearings, **Gary Davis**, Coordinator (The Elliott Group, Jeanette, Pa), **Hans Weyermann**, Coordinator (ConocoPhillips, Houston, TX), and **Jeff Moore**, Coordinator (Southwest Research Institute, San Antonio, TX)

Discussion Group T14

Discussion Group/Tutorial on Wet and

Dry Screw Compressors, **Donald R. Smith**, Coordinator (Engineering Dynamics Inc., San Antonio, TX), and **John Whalen**, Coordinator (Turbo Components & Engineering, Houston, TX)

Discussion Group T15

Turbomachinery Bearings and Annular Seals, **Tom Davidson**, Coordinator (The Linde Group, Pasadena, TX), and **John Whalen**, Coordinator (Turbo Components & Engineering, Houston, TX)

Discussion Group T16

Integrally Geared Compressors, **Stanley Stevenson**, Coordinator (Siemens Demag Delaval Turbomachinery, Trenton, NJ), **Lisa Ford**, Coordinator (Lufkin Industries, Inc., Lufkin, TX), **Terryl Matthews**, Coordinator (Shell, Houston, TX), and **Kevin Kisor** (MAN Diesel & Turbo, Houston, TX)

Discussion Group T17

Advanced Topics in Centrifugal Compressor Design, **Mike Drosjack**, Coordinator (Drosjack Consulting Co., Houston, TX), and **Mark Sandberg**, Coordinator (ChevronTexaco Energy Technology Co., Houston, TX)

*Pump and Turbo Combined

Case Study T1

Reliability Improvement for Reciprocating Compressor Valve in CCR Reformer, **Sang Suk Lee** (SK Energy, Ulsan, Korea)

Case Study T2

Reliability Improvements on Gas Transmission High Speed Reciprocating Compressors Through Bearing and Process Modifications, **James Cencula**, **Ray Gallagher**, and **Vinh Do** (GE Oil & Gas, Houston, TX); **Carlo Mazzali** (GE Oil & Gas, Sandvike, Norway), and **Greg Bone** (Miba Bearings, McConnellsville, OH)

Case Study T3

Higher Reliability of Bolt Tensioner for Larger Size of Steam Turbine Casing Bolt, **Satoshi Hata** (Mitsubishi Heavy Ind., Hiroshima, Japan)

Case Study T4

In-house Engineering for Resolution of Chronic Fourth Stage High Discharge Pressure Limitation on Carbon-Dioxide Reciprocating Compressor, **Ali Shallwani** (Engro Fertil-

izers Ltd., Daharki, Sindh, Pakistan)

Case Study T5

Balance Instability and Vibration on a 6 MW Induction Motor Rotor, **Barry Wood** (Chevron, Richmond CA), **Siddharth Shinde** (Chevron, Houston, TX), **Sameer S. Patwardhan** (Bechtel Corp., Houston, TX), and **Christer Spigelberg** (ABB AB, Machines, Västerås, Sweden)

Case Study T6

Advanced Vibration Analysis and Vibration Elimination of Gearbox in Centrifugal Compressor Train, **Udayashankar Ganapathy** (Suncor, Tar Sands, Fort McMurray, Canada)

Case Study T7

Vibration Issues Keyways, **Mark O'Neil** (Ameridrives Int., Erie, PA)

Case Study T8

Investigation of Engineer Vibration for Natural Gas Gathering and Transmission, **Francisco J. Gonzalez** (Enterprise Products Operating LLC), and **Troy Feese**, (Engineering Dynamics Inc., San Antonio, TX)

Case Study T9

Correction of a Chronic Thrust Bearing Failure on a Refrigeration Compressor, **Matthew D. Moll** (DuPont, Houston, TX), **John Whalen** (TCE, Houston, TX), **John C. Underwood** (DuPont, Houston, TX), and **Pamela T. Duliere** (DuPont, Washington, WV)

Case Study T10

Turbo-Expander Compressor Active Magnetic Bearing Trip Reduction, **Chong Ong** (RasGas Company Limited, Doha, Qatar), **James Cencula**, **Martin Bielecki**, and **Randy Wu** (GE Oil and Gas, Oshkosh, WI); **Matthias Lelanno** (S2M, St. Marcel, France)

Case Study T11

Speed Signal Deterioration at High Speeds in Electronic Governor and Trip Systems, **Bryan Barrington** (LyondellBasell Ind., Corpus Christi, TX)

Case Study T12

Reverse Rotation in Centrifugal Compressors, **Amr Gad** (RasGas Co. Ltd., Doha, Qatar)

Case Study T13

'Beating' Effect Caused by Two Closely Spaced Mechanical Frequencies Observed on Two-Shaft Gas Turbine Drive, **Robert X. Perez** (Enterprise Products Inc., San Antonio, TX), and **Andrew P. Conkey** (Texas A&M University Qatar, Doha, Qatar)

Case Study T14

Radial-Axial Coupled Vibrations for a 260MW, Partial-Admission/Extraction Steam Turbine, **Daisuke Kiuchi** and **Satoshi Hata** (Mitsubishi Heavy Industries Compressor Corporation, Hiroshima, Japan), and **Junichi Hotiba** (Mitsubishi Heavy Industries America, Inc., Houston, TX)

Case Study T15-T16

Polymer Seal Use in Centrifugal Compressors—Two Users Experiences over 15 Years, **John K. Whalen** (TCE, Houston, TX), **John R. Dugas** (DuPont, Retired), **Jonathon Cardell** (DuPont, Orange, TX), and **Jim Allen** (Nova Chemicals Corp., Red Deer, AB, Canada)

PUMP USERS SYMPOSIUM PROGRAM

Short Course P1

Rolling Element Bearing Fundamentals and Pump Bearing Application Engineering, **Miles Woodard**, **Scott Morehead** (NSK Corp., Ann Arbor, MI), **Geoff Bidlack** (NTN Corp., Nercross, GA)

Short Course P2

The Relationship of Vibrations to Problems in Turbomachinery, **Bill Marscher** (Mechanical Solutions Inc., Whippany, NJ)

Short Course P3

Sealing Systems Energy Efficiency, **Michael Huebner** (Flowserve Corp., Deer Park, TX), **Henri Azibert** (A.W. Chesterton Co., Groveland, MA), **Eric Vanhie** (EagleBaugmann Seals, Houston, TX), and **Eric Boyce** (John Crane, Houston, TX)

Short Course P4

Pump Hydraulics with a Minimum of Mathematics, **John Joseph** (Texas Petrochemicals LP, West Newton, PA)

Short Course P5

Fundamentals of Centrifugal Pump and System Interaction, **Michael Volk** (Volk & Associates, Inc., Oakland, CA)

Short Course P6

Pump Cavitation Physics, Prediction, Control, Troubleshooting, **Bruno Schiavello** (Flowserve Pump Div., Philisburg, NJ), and **Frank C. Visser** (Flowserve Pump Div., Etten-Leur, The Netherlands)

Lecture P1 – Technical

Assistance to the Manufacture, Construction, and Assembly of Osorio-Canoas Oil Pipeline Flow Pumps, **Kellson Takenaka Menezes**, **Jose Carlos Coelho Costa**, **Diana Nogueira**, **Joilson de S. Rangel Jr.**, **Raphael Timbó Silva**, and **Edson Mesquita Marinho** (Petrobras, Rio de Janeiro, Brazil)

Lecture P2

Fifteen Years of Field Experience in LNG Expander Technology, **Vinod Patel**, (KBR, Houston, TX) and **Hans Kimmel** (Ebara International Corp)

Lecture P3

4-Quadrants Characteristics of Centrifugal Pump and Unsteady Computations of Abnormal Operating Points, **Laurent Gros**, **Anthony Couzinet**, **L. Landry**, and **Daniel Pierrat** (CETIM, Cedex, France)

Lecture P4

Submerged Pumps and Expanders with Magnetic Coupling for Hazardous Applications, **Vinod Patel** (KBR, Houston, TX), and **Steve Rush**, (Ebara Int'l Corp., Sparks, NV)

Lecture P5

Cavitation in Reciprocating Positive Displacement Pumps, **Karsten Opitz** (University of Erlangen-Nuremberg, Erlangen, Germany), **Oliver Schade** (Linde AG, Pullach, Germany), and **Eberhard Schlücker** (University of Erlangen-Nuremberg, Erlangen, Germany)

Lecture P6

Influence of Impeller Leading Edge Profiles on Cavitation and Suction Performance, **Ravi Balasubramanian**, **Eugene Sabini**, and **Simon Bradshaw** (ITT Goulds Pumps, Seneca Falls, NY)

Lecture P7

Centrifugal Pumps for CO2 Applications, **Lorenzo Bergamini** (GE Oil & Gas)

Tutorials P1

ISO 13709 2nd Edition, Centrifugal Pumps for Petroleum, Petrochemical, and Natural Gas Industries/ API 610 Eleventh Edition Highlights, **Frank J. Korkowski** (Flowserve Pump Div., Vernon, CA), **Roger L. Jones** (consultant, Houston, TX), and **Jack D. Sanders** (Fluor, Sugar Land, TX)

Tutorials P2

API 682 Mechanical Seals for the Petroleum, Chemical, and Pipeline Industries, **Michael Huebner** (Flowserve, Deer Park, TX), **Gordon Buck** (John Crane, Inc., Baton Rouge, LA) and **Henri Azibert** (A.W. Chesterton, Groveland, MA)

Tutorials P3

A Guide to Gasketing Principles and Best Practices, **Henri Aizbert** (Fluid Sealing Association)

Tutorials P4

How to Use Decision Trees to Improve Operator Confidence and Reduce Operating Errors, **Julien LeBleu** (SageGuides.com, Lake Charles, LA)

Tutorials P5

Witness Testing of API 610 Centrifugal Pumps and API 611 Steam Turbines, **Nirmal K. Ganatra** and **Rajanikant C. Patel** (Bechtel Oil, Gas & Chemicals, Inc., Houston, TX)

Tutorials P6

Bearing Troubleshooting and Engineering Services that Extend Pump Life, **Miles Woodard** and **Mark Wolka** (NSK Corp., Ann Arbor, MI)

Tutorials P7

Pressure Pulsations and Pipeline Vibrations: Reasons and Solutions, **Eberhard Schlücker** (Lehrstuhl für Prozessmaschinen und Anlagentechnik (Institute of Process Machinery and Systems Technology), Erlangen)

Tutorials P8

Rotordynamics for End Users, **Bill Marscher** (Mechanical Solutions, Inc., Whippany, NJ)

SHORT COURSES

LECTURES

TUTORIALS

Discussion Group P1

Centrifugal Pump Operation, Maintenance, and Reliability, **Jacek Jarosz**, Coordinator (Celanese Chemical, Houston, TX), **Kerry Gunn**, Coordinator, **Jamie Lucas**, and **Stuart Simmons** (Lyondell Houston Refining, Houston, TX); **Watson Tomlinson** (Flowserve Corp., Mt. Holly, NC), and **Bruce Weathersby** (INVISTA, Salisbury, NC)

Discussion Group P2

Mechanical Seals, **Mike Huebner**, Coordinator (Flowserve Corp., Deer Park, TX), **Henri Azibert**, Coordinator, and **Shifeng Wu** (A.W. Chesterton Co., Groveland, MA)

Discussion Group P3

Bearings and Lubrication, **Leslie Thilgan** (KBR Energy and Chemicals, Houston, TX), and **Matt Gaydon** (Bechtel Power Corp., Frederick, MD)

Discussion Group P4*

Couplings, Alignment, and Pipestrain, **Michael Johnson**, Coordinator (RRI Energy, Houston, TX), **John Stokes**, Coordinator (Shell Chemical Co., Deer Park, TX), **Tom Davidson**, Coordinator (The Linde Group, Pasadena, TX), and **Terry Roehm**, Coordinator (Marathon Oil Co., Houston, TX)

Discussion Group P5

Vertical Pump Problems and Solutions, **Mike Cugal**, Coordinator (Grundfos CBS, Inc., Pittsburgh, PA), **Kevin Dostal**, Coordinator (Enterprise Products, Kearney, MO), **Robert Davis** (Sulzer Pumps Houston, Inc., Brookshire TX), **Dwayne Hughes** (JCI Industries, Lee's Summit, MO), and **Terry Wold** (Afton Pumps, Houston, TX)

Discussion Group P6**

Monitoring Vibration and other Critical Machine Conditions, **Bill Marscher**, Coordinator (Mechanical Solution Inc., Whippany, NJ), and **Ron Adams**, Coordinator (Sulzer Pumps (US) Inc., Houston, TX)

Discussion Group P7

Sealless Pumps, **Ron Carlson**, Coordinator (Flint Hills Research, Corpus Christi, TX), **Dan Wood**, Coordinator (DuPont Engineering, Wilmington, DE), **Dennis Fegan** (Lederle Hermetic, Humble, TX), and **James Lobach** (Chempump, Warminster, PA)

Discussion Group P8

Pipeline Application, **Bruce Weber**, Coordinator (Champion, Houston, TX), **Bill Litton**, Coordinator (Magellan Midstream Partners LP, Tulsa, OK), **Morg Bruck** (Marathon Petroleum Co. LLC, Findlay, OH),

Gary Daileda (TEPPCO, Houston, TX), **George Maddox** (Best Pumpworks, Tyler, TX), **Mike Nigro** (Weir Services, Deer Park, TX), and **Leith Watkins** (Explorer Pipeline, Tulsa, OK)

Discussion Group P9

Energy Savings through Facility Organization, **Joe Silvaggio**, Coordinator (Siemens Demag Delaval Turbomachinery, Inc., Trenton, NJ), and **Chris Zielewski**, Coordinator (ExxonMobil Chemical, Baton Rouge, LA)

Discussion Group P10

Improving Mean Time between Pump Failures, **John Joseph II**, Coordinator (Rotating Equipment Systems Tech. Assoc., LLC, Friendswood, TX), **Bill Litton**, Coordinator (Magellan Midstream Partners, LP, Tulsa, OK), and **Morg Bruck** (Marathon Ashland Petroleum, Findlay, OH)

*Pump and Turbo Combined

Case Study P1

Seal and Bearing Failure on a Two-Stage Overhung Pump, **John Schmidt** (Sulzer Pumps, Portland, OR); **Chris Henderson** and **Simon Daou** (Sulzer, Toronto, Canada)

Case Study P2

Bearing Failure on a Boiler Feed Water Pump, **Kevin Karban** and **Kerry Gunn** (LyondellBasell, Houston, TX)

Case Study P3

Hermetic Pump Failure, **Vineet Jindal** (Shell Singapore Jurong Island –MEG Plant)

Case Study P4

Upgrading a Set of Large Cooling Water Pumps with the Aim to Increase Capacity at Least 13 Percent and Minimize Impeller

Cavitation, **Frank C. Visser** (Flowserve- FSG, Etten-Leur, The Netherlands)

Case Study P5

Rotor Retrofits Improve Pump Station Vibration, **Jeffrey R. West** (BTC Pipeline Co., Nikiski, AK)

Case Study P6

Root Cause Analysis on a Multistage Centrifugal Pump in a Power Plant Due to Shaft Crack–Based on ODS and FEA, **Maki M. Onari** (Mechanical Solutions, Inc., Whippany, NJ)

Case Study P7

Performance Loss Investigation Using Thermal Imaging, **Scott McPherson** (Sulzer Pumps, LaPorte, TX)

Case Study P8

The Elimination of VOC Emissions from a Reciprocating Pump Stuffing Box, **Gary Dyson** (ClydeUnion Pumps, Penistone, Sheffield, UK), and **Mike Bixler** (ClydeUnion Pumps, Battle Creek, MI)

Case Study P9

High Pressure Sealing Systems for Boiler Circulating Pumps, **Alton Smith** and **Eric Vanhie** (EagleBurgmann, Houston, TX)

Case Study P10

Evaluating the Long-Term Performance of Composite Wear Rings in Centrifugal Pumps, **Robert Aronen** (Boulden International, LLC, Windhof, Luxembourg), and **Martin Russek** (Sunoco, Inc., Marcus

Hook, PA)

Case Study P11

Wear Reducing Technology Newly Applied to Severe Pumping Services, **Terry Wiltz** and **Dave Hertel** (ExxonMobil, Baton Rouge, LA); **Doug Kimball** (Kennametal), **Tom Newman** (ClydeUnion Pumps, Houston, TX) and **Chris Zielewski** (ExxonMobil, Baton Rouge, LA)

Case Study P12

Hazards of Reverse Pump Rotation, **Bob Talbot** (Sulzer Pumps, Portland, OR)

*Pump and Turbo Combined

Pump, Turbo and ChemInnovations: Three Great Exhibitions in *ONE* Hall!

40th Turbomachinery Symposium

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9:30 a.m. - 12:00 p.m.



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*In compliance with the Americans with Disabilities Act (ADA), please contact Jen Swartz
jswartz@tamu.edu or 979-845-2924 with special accommodation requests.*