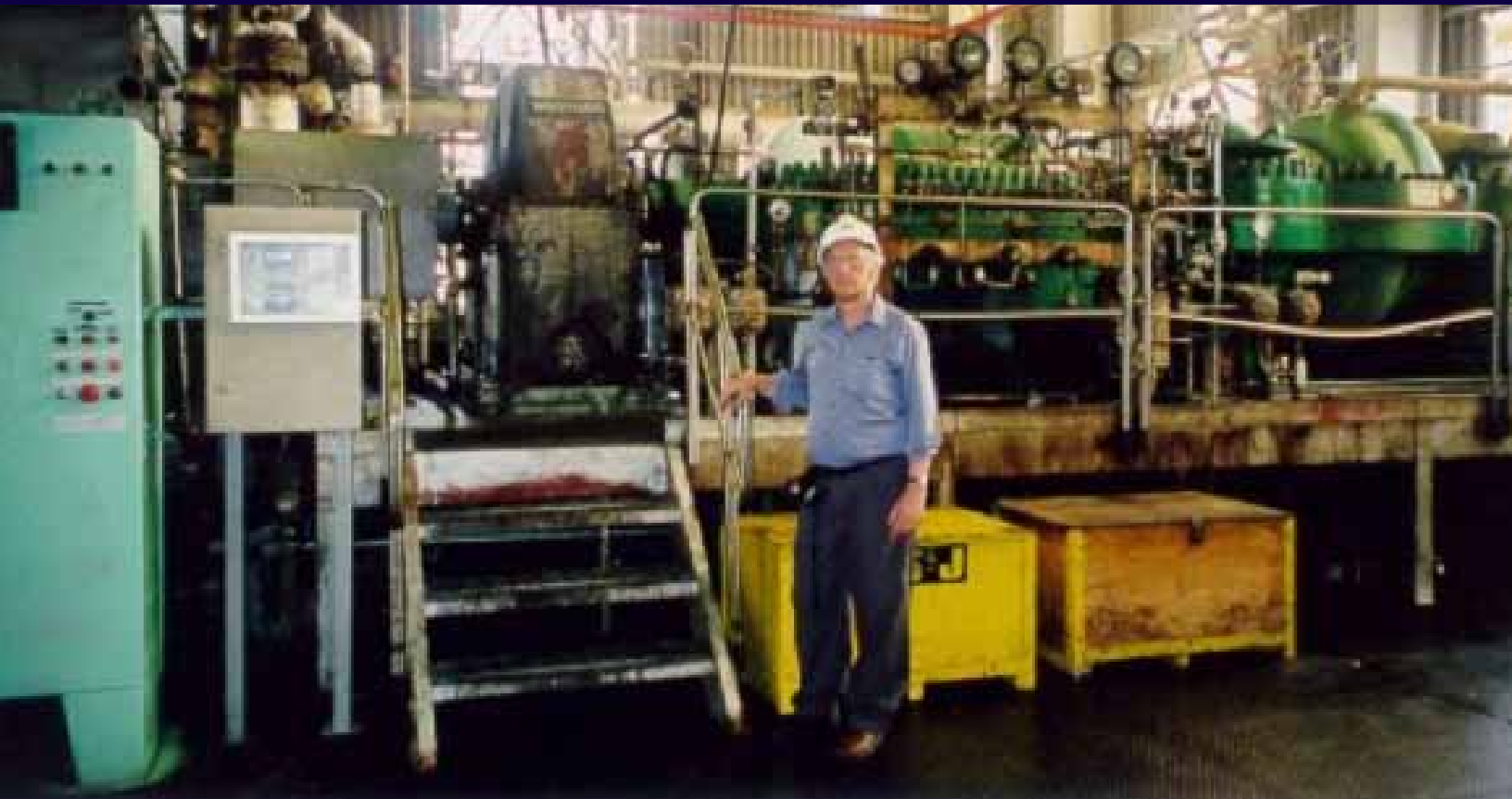


**ROTOR BEARING
SOLUTIONS**
INTERNATIONAL, LLC

ROTOR DYNAMICS AND FLUID FILM BEARINGS
+ INDUSTRIAL ROTATING MACHINERY CASE HISTORIES

3.5 Day Comprehensive Short Course

May 8 - 11, 2018
Charlotte, North Carolina



INDUSTRIAL MACHINE ANALYSIS AND BEARING FIX CASE HISTORIES:

- Horizontal and Vertical Pumps
- Single and Multistage Compressors
- Single and Multistage Steam Turbines
- Motors, Generators, Alternators
- Geared Systems
- Gas Turbines
- Turbochargers



TOPICS:

Rotordynamics

- Rigid and Flexible Rotor/Bearing Dynamics
- Rotor Unbalance Response and Balancing
- New API 8th Edition Vibration Specifications and Automated Analysis
- Stability Problems, Sub-synchronous Vibrations
- Turbocharger Rotor Dynamics

Fluid Film Bearings

- Fixed and Tilting Pad Bearing Properties
- Thrust Bearings
- Semi-Floating Bearings
- Squeeze Film Dampers

Seals

- Annular Gas and Water Seals

Geared Systems

- Spur and Helical Gears

Pump Fluid Forces

Substructure Effects

Rotor/Bearing Problems, Fixes and Repairs

COURSE DESCRIPTION, OBJECTIVES, AND LECTURERS

This combination of fundamental and advanced rotor/bearing dynamics short course is intended for engineering staff of companies using, repairing, or manufacturing rotating machinery of common types. The emphasis is on the vibration phenomena exhibited by a machine undergoing high vibration and the bearings in the system. Numerous industrial machine case histories including high vibration characteristics, bearing failures, causes of high vibrations, and fixes are presented. In many cases, the bearing is redesigned or replaced as a fix to the problem.

In each case history, the important individual components of the machines are described in detail and the influence of each component on the vibration is evaluated. Normally a computer model of the machine including the fluid film bearings is developed by the analyst to better evaluate the cause and the machine fix. This process is described in detail. The use of mathematics in this short course is minimized and, when discussed, is used primarily to indicate technical points of use in the solution.

LECTURE MATERIALS AND CONTINUING EDUCATION CREDIT

The material for all talks will be provided to attendees on a memory stick. Detailed questions on the course topics in particular and rotordynamics/fluid film bearings in general will be answered.

Certificates for 24 PDHs (Professional Development Hours) will be provided for attendees of the short course.

LECTURERS:

PAUL ALLAIRE, PH. D.,
ASME Fellow, Chief Technical Officer;
Retired Mac Wade Chaired Professor,
University of Virginia; Retired Long Time
Director of Rotating Machinery and
Controls Laboratory

TIMOTHY DIMOND, PH. D., P.E.,
President; Previously Principal Scientist of
University of Virginia Rotating Machinery
and Controls Laboratory

JIANMING CAO, PH. D., PENG.,
Vice President, and Manager
of China Region

SAEID DOUSTI, PH. D.,
Senior Technical Fellow

BRAD NICHOLS, PH. D.,
Senior Technical Fellow

ADDITIONAL CONTRIBUTORS:

JOHN NICHOLAS, PH. D.,
Former Owner and Chief Engineer,
Rotating Machinery Technology;
Former Engineering Fellow, GE-Lufkin-RMT

JOHN KOCUR, PH. D.,
Rotating Machinery Specialist,
Exxon Mobil

KRIS FARRAR,
President, Babbitting Services Inc.

SIMON MUSHI, PH. D.,
Director of Magnetic Bearings and
Controls, Rotor Bearing Solutions
International

JOY PATTEN,
Rotating Machinery Engineer,
Solar Turbines

D. BLAKE STRINGER, PH. D.,
Kent State University professor



SHORT COURSE AGENDA

DAY 1 – TUESDAY, MAY 8, 2018

- Basic Rotor Dynamics - The Jeffcott Rotor
- API Specifications for Rotor Dynamics
- Rotordynamics of Centrifugal Compressors - Comparison of Historic (Kaybob and Ekofisk) and Modern Compressors
- Case History: Lateral Rotordynamic Analysis of Large Alternator/ Flywheel Rotor after Modification
- Case History: Vertical Pump Rotor Vibration Problems with Fixed Pad Bearings
- Understanding Fixed Pad Bearings 1
- Understanding Fixed Pad Bearings 2
- Dynamics of Fixed Pad Fluid Bearings: Plain, Axial Groove, Multilobe, Offset Halves Bearings
- Dynamics of Fixed Pad Fluid Bearings: Pressure Dam Bearings

DAY 2 – WEDNESDAY, MAY 9, 2018

- Case History: Steam Turbine/Gearbox Generator Instability and Repair with Pressure Dam Bearings
- Understanding Tilting Pad Bearings 1
- Understanding Tilting Pad Bearings 2
- Case History: Vertical Pump Rotor Vibration Problems with Tilting Pad Bearings
- Automated API Analysis with RotorDyna: Rotor Modeling, Stability, Critical Speeds, and Mode Shapes
- Modeling of Tilting Pad Bearings
- Automated API Analysis with RotorDyna: Compressor Stability
- Automated API Analysis with RotorDyna: Unbalance Response Analysis in accordance with API 617, 8th Edition
- Modeling of Compressor Seal Dynamic Properties for Rotor Dynamics Analysis
- Case History: Compressor Instability Due to Internal Seals and Tilting Pad Bearing Solution
- Effects of Reduced Oil Flow to Tilting Pad Bearings on a Flexible Rotor
- Morton Effect Instability in Overhung Compressors

SHORT COURSE AGENDA

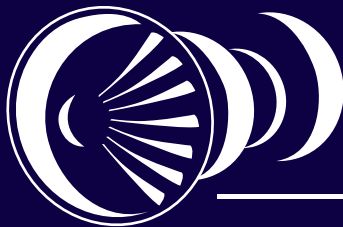
DAY 3 – THURSDAY, MAY 10, 2018

- Understanding Dynamic Properties of Geared Systems
- Using RotorDyna in Industry: Detailed Modeling of a Geared Motor Compressor System
- Case History: High Speed Gearbox Pinion Vibration Fix
- Understanding Squeeze Film Dampers
- Case History: Retrofitting a Large Steam Turbine with a Mechanically Centered Squeeze Film Damper
- Case History: Eliminating a Rub Induced Start-Up Vibration Problem in an Ethylene Drive Steam Turbine with Squeeze Film Damper
- Water Lubricated Bearing Modeling and Dynamics using HydroSol
- Case History: Practical Rotor Dynamics for Pumps - Wet and Dry Critical Speeds and Seal Effects Modeled with NonlinearDyna
- Case History: Fixing a Motor/ Compressor Train Excitation of Structural Vibration
- Fixed Pad Thrust Bearing Modeling and Design with ThrustDyna
- Tilting Pad Thrust Bearing Performance
- Hydrostatic Bearing Modeling and Design with StatDyna

DAY 4 – FRIDAY, MAY 11, 2018

- Nonlinear Transient Analysis of Rotor Dynamics on Tilting Pad Bearings and Squeeze Film Dampers using NonlinearDyna
- Modeling and Design of High Speed Turbochargers with Semi-Floating Bearings using NonlinearDyna
- Rotor Dynamics of a Gas Turbine Engine
- Magnetic Bearing Acuator Design with MagDesEM
- Case History: Contrls Design for High Speed Rigid Rotor Machines using ControlDes
- Rotor Drop Modeling and Auxiliary Bearing Design with RotorDrop





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