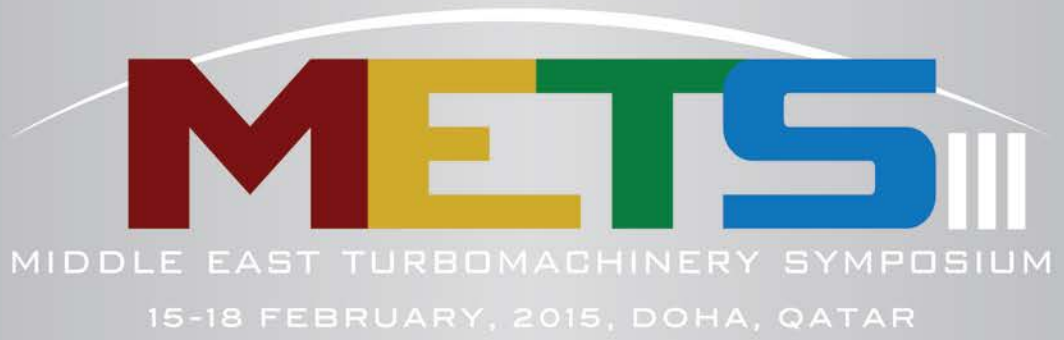

Short Course 1
Machinery Best Practices

- **William and Michael Forsthoffer**

TEXAS A&M UNIVERSITY

TEES TURBOMACHINERY LABORATORY
TEXAS A&M ENGINEERING EXPERIMENT STATION

MACHINERY BEST PRACTICES SHORT COURSE FOR METS - 2015

INTRODUCTION AND SHORT COURSE OVERVIEW

- **INTRODUCTION**
- **SHORT COURSE STRUCTURE AND FORMAT**
- **SHORT COURSE OBJECTIVES**
- **INSTRUCTOR'S BIOGRAPHY**
- **AGENDA**

INTRODUCTION

Welcome to our Machinery Best Practices Short Course for Mets 2015.

Based on W. E. Forsthoffer's Text "Forsthoffer's Best Practice Handbook for Rotating Machinery" published by Elsevier in 2011, Michael and William Forsthoffer will present 20 Machinery Best Practices (17 specifically selected for the METS III Attendee's and 3 or more if time allows of attendee requested Best Practices). The Best Practices to be presented are based on our Work in the Middle East, India, Pakistan and Asia since 1990.

This short course will present all of its 220 Best Practices which are designed for the Plant Machinery Engineers, Reliability Engineers, Maintenance and Operations Personnel. We have found that one of the major issues in Plants Worldwide is the low implementation rate of Machinery Reliability Improvement Recommendations. The objective of the Handbook and this Short course is to present information that we have gathered over the last 25 years concerning machinery selection, design, installation, commissioning, plant reliability procedures and communication that will enable plant personnel to attain the highest possible implementation rate of their recommendations to management.

SHORT COURSE STRUCTURE AND FORMAT

During this short course, all principles will be presented in a practical manner. Therefore, class props (machinery components, interesting “Items”) and “Case Histories” will be used to reinforce the principles and relationships covered. Since our teaching style is interactive, practical and, hopefully, interesting, high levels of class participation are both expected and encouraged. Feel free to bring up “Case Histories” of your own.

Each Best Practice will be presented in the following format:

- The Best Practice that significantly increased Plant Safety, Reliability and Revenue
- The Lesson Learned that resulted in significant reduced Safety, Reliability or Lost Revenue Issues
- The Benchmarks - where this Best Practice has been used and its results in terms of: Increased Plant Safety, Reliability and/or Revenue
- We will review the detailed supporting Information to enable plant personnel to make a successful management presentation.

SHORT COURSE OBJECTIVES

The objectives of this Short Course are presented in Figure 1.

SHORT COURSE OBJECTIVES

- PRESENT THE SELECTED REGIONAL “LESSONS LEARNED”
- DEFINE THE FAI GLOBAL BEST PRACTIES FOR THE LL’S
- COVER THE ESSENTIAL INFORMATION NECESSARY TO ASSURE THAT THE BEST PRACTICES PRESENTED CAN BE IMPLEMENTED AT YOUR PLANT SITE
- CONDUCT APPROPRIATE CLASSROOM EXERCISES TO ASSURE THAT ATTENDEE’S UNDERSTAND AND CAN JUSTIFY THE BEST PRACTICES PRESENTED

FIGURE 1

COURSE INSTRUCTORS

WILLIAM E. FORSTHOFFER

William (Bill) E. Forsthoffer is a graduate of Bellarmine College, Louisville, Kentucky, where he received his Bachelor of Arts degree in Mathematics. Bill continued his studies at the University of Detroit, Michigan, where he received a Bachelor of Science degree in Mechanical Engineering.

Bill spent six years at the Delaval Turbine Company, where he Designed and Tested Centrifugal Pumps and Compressors, Gears, Steam Turbines and Rotary (Screw) Pumps. Prior to leaving Delaval, Bill held the position of Manager of Compressor Projector Engineering responsible for the Aerodynamic and Mechanical Design of Centrifugal Compressors, Lube and Seal Systems and Auxiliaries.

Bill joined Mobil Research and Development Corporation (MRDC) in Princeton, New Jersey in 1974, where he was directly involved with Rotating Equipment Selection, Design, Testing and Start-Up of Fluid Cat Cracker Units, Reformers, Hot Gas Expanders and Low Density Polyethylene Plants. From 1980 to 1985, Bill directed the Application, Selection, Design, Testing, Site Pre-Commissioning and Start-Up of the Yanbu Petrochemical Complex in Yanbu, Saudi Arabia. Following his overseas assignment, Bill returned to MRDC where he established a Technical Service Program for Mobil affiliates to provide Application, Trouble-Shooting and Training Services for Rotating Equipment.

Bill left Mobil in January of 1990 to found his own company. Forsthoffer Associates, Inc. was founded February 1, 1990 with the company objective being:

"The Optimization Of Rotating Equipment Safety And Reliability Through Understanding And Vendor-User Communication"

MICHAEL S. FORSTHOFFER

Michael Forsthoffer, a 2003 Graduate of RIT in Mechanical Engineering, has been working with Rotating Equipment since 1998.

During School

- 2000 - 6 month Co-op – Fluid Systems, NJ – Lube/Seal/Control System Design and Testing
- Work with FAI from 1998-2002
    - Citgo – Corpus Christi Refinery, Texas - Lube/Seal System Problems Resolution
    - Compressor Seal Testing and Troubleshooting, DGS, Bushing and Contact Seals
    - Saudi Aramco – Rabigh Refinery, KSA – Pump and Compressor Performance Evaluation
    - Citgo, Corpus Christi, Texas – Centrifugal Compressor and Steam Turbine Performance Evaluation
    - Alberta Envirofuels MTBE Plant – Compressor and Steam Turbine Performance Evaluation
    - Methanex Methanol and Ammonia Plants, Kitimat BC Canada – Centrifugal Compressor Evaluation
        - Ammonia
        - Syn Gas
        - Air Compressor
- 2002 – 6 month Co-op – Dresser Rand, Olean, NY – Aftermarket Service – Aerodynamic Upgrades, Seal Upgrades, Bearing Upgrades

After School

- 2004 –contract – Dakota Gasification, Beulah, ND – Set up Program for real time Performance Monitoring of 30 + Compressors.
- 2005-2008 – John Crane, Inc
    - Applications Engineer (6 months) – Support Salesmen and perform RCFA for Northeast Branch.
    - On-Site Reliability Engineer (3 years) – Hovensa Refinery, St. Croix, VI – Mechanical Seal Technical Support for Maintenance and Reliability. This included field troubleshooting of seals and aux. systems and application of new seals.

MACHINERY BEST PRACTICES SHORT COURSE AGENDA FOR METS III– 2015

Session	Description	Section
1	Introduction and Short Course Overview • Short Course Objectives • Short Course Agenda and Schedule • Instructor Bio's **Project Best Practices** BP 1.1 The importance of early input into a project of Lesson Learned BP 1.8 The Concept of Pre- Bid Meetings and guidelines	1
2	**Pump Best Practices** BP 2.7 Operate Centrifugal Pumps in the EROE (Equipment Reliability Operating Envelope) for optimum Safety and Reliability BP 2.16 Centrifugal Pump Minimum Flow Bypass Guidelines	2
3	**Compressor Best Practices** BP 3.14 Use Centrifugal Compressor performance calculations and phase angle changes to confirm fouling BP 3.20 Thrust Bearing pad temperature as well as axial displacement must be present for excessive thrust pad load	3
4	**Steam Turbine Best Practices** BP 5.4 Trend after first stage pressure vs. steam flow and phase angle change in steam turbines to detect fouling BP 5.11 Perform coupled overspeed trip checks for steam turbines with electronic governors	4

Session	Description		Section
5	**Gas Turbine Best Practices**		5
	BP 6.1	Always consider Aero Derivative /Industrial Power Turbine Gas Turbine Units when their size is acceptable	
	BP 6.3	Size Gas Turbine output power for a minimum of 10% above the driven machine rated power (Gas Turbine power at site conditions)	
6	**Lube/Control Oil Best Practices**		6
	BP 7.11	Always test oil system relief valves on the oil console and not on a PSV test rig	
	BP 7.26	Check oil system transient functions immediately before turnarounds	
7	**Dry Gas Seal Best Practices**		7
	BP 9.1	End User's must be proactive in selecting Dry Gas Seal Systems based on their specific plant environment	
8	**Installation, Pre- Commissioning, Commissioning & Start-up Best Practices**		8
	BP 10.7	Best Practice oil flushing procedure for optimum results in minimum time	
9	**Preventive and Predictive Maintenance Best Practices**		9
	BP 11.1	Always use Component Condition Monitoring (CCM) Trends to minimize PM's and extend PM intervals	
	BP 11.3	Optimize pump unit MTBF's by changing over pumps every 3 to 6 months	
	BP 11.7	Always trend all rotating equipment performance along with mechanical parameters - IE: Use FAI CCM approach	
	Class selected BP		
	Class selected BP		
	Class selected BP		