

Root Cause Machinery Failure Analysis

December 5 - 7, 2005

ADMA-OPCO
Abu Dhabi, United Arab Emirates

presented by

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**Maximize Performance of Your Equipment and Machinery and
Achieve Greatest Cost Savings Using State-of-the-Art Root Cause
Failure Analysis Techniques**

Hear What Other People Said About Dr. Badgley's Courses

Advanced Vibration Course: 'Very good, balanced course for petrochem engineers' - Texaco Inc.

Advanced Vibration Course: 'Case studies related well to my machinery problems' - M.W. Kellogg

Advanced Vibration Course: 'Analysis methods and techniques were helpful in understanding my motor and pump problems' - Dow Chemical

Turbines, Compressors & Pumps Oil Analysis Course: 'Relevant and useful' – Brunei Liquefied Natural Gas

Turbines, Compressors & Pumps Oil Analysis Course: 'Excellent experience gained' – Brunei Liquefied Natural Gas

Turbines, Compressors & Pumps Oil Analysis Course: 'Outstanding instructor skill and

knowledge' – Brunei Liquefied Natural Gas

Capitalize On This Expert Knowledge To Gain Maximum Value On These Vital Issues

- GET a deeper and stronger understanding of how machinery failure occurs and learn effective methods of avoiding it
- BUILD practical problem solving techniques through case studies and best practices illustrations
- GARNER knowledge about new, advanced practices and relevant knowledge-based approaches to failure analysis
- DEVELOP a systematic thinking process to identify root causes based on measurement and analysis of a variety of symptoms
- APPLY time-proven techniques for dealing with causes of failure in your machinery and equipment
- EXAMINE critical elements for effective failure avoidance through monitoring system performance and behavior

Dr. Badgley's training courses are thoroughly researched and carefully structured to provide practical and exclusive training applicable to your organization.

Benefits include:

- Thorough and customized programs to address current market concerns
- Illustrations of real-life case studies
- Comprehensive course documentation
- Strictly limited numbers of attendees

Workshop Overview

For power generation, petrochemical and other processing industries, root cause failure analysis has been the technique of choice for identifying the underlying reasons for failure, and for avoiding future failures. The process utilizes detailed assessments of conditions and relationships which permit failure to occur. The process also identifies failure initiators and accelerators in critical pieces of machinery and equipment, with proven economic benefits. Great savings are realized by improving machine conditions for longer service life, reduced downtime and lower power consumption. The result can be greatly improved plant productivity.

Through presentations and discussions with our leading expert in vibration analysis, Dr. Robert Badgley, you will learn how to more effectively conduct analyses and measurements. This will enable you to quickly determine machinery condition, accurately identify and correct root causes of problems, and move away from 'find and fix' failure analysis strategies. This three-day practical course will offer you the opportunity to learn more about various aspects of machinery and equipment failure. During the course, advanced failure analysis approaches are presented with practicality in mind. The learning will be accentuated through discussion of case studies and industry best practices.

Facilitated discussion and exercises will allow you to share your challenges and opinions. Delegates can immediately apply the knowledge gained from the workshop to improve and analyze the mechanical conditions of machinery and equipment. Following this course, you will depart with a set of more advanced tools to improve your machinery performance and bring lasting changes to your organization.

DAY 1

PART 1 – INTRODUCTION

- Course objectives
- Description of course content
- Terminology
- General principles of root cause failure analysis
- General process for performing and documenting a root cause failure analysis
- Root cause failure analysis techniques

PART 2 – CONDITIONS CONTRIBUTING TO FAILURE

- Materials selection and applications
- Design deficiencies
- Software deficiencies
- Environment and unintended or unexpected operating conditions
- Maintenance deficiencies
- Procedures and/or processes deficiencies
- Management and/or management system deficiencies

PART 3 – CAUSE-EFFECT RELATIONSHIPS

- Individual cause-effect scenarios
- Joining cause-effect scenarios into cause-effect chains
- Joint staff reviews and expansion of cause-effect chains
- Identification of requirements for additional analyses
- Identification of requirements for additional measurements
- Integrating witness interviews
- Expansions and interconnections of cause-effect chains

DAY 2

PART 4 – FAILURE ANALYSIS STAGES AND TOOLS

- Identification and descriptions of root cause analysis tools

PART 5 – FAILURE ANALYSIS PROCESS

- Written statement of the problem

- Detailed written description of the problem
- Written statements of possible cause(s)
- Integration of cause-effect relationships
- Focused data acquisition via analysis and measurement in support of statements of possible cause(s)
- Narrowing down the possible cause options
- Integration of full cause-effect chains
- Finding the root cause

PART 6 – GENERAL CAUSES OF MACHINERY FAILURE

- Causes and consequences of excessive temperatures
- Causes and consequences of inadequate lubrication
- Causes and consequences of excessive mechanical vibration

DAY 3

PART 7 - CASE STUDIES

- Case Study 1 - Chain-Coupling Drive Failure
- Case Study 2 - Starter Motor Coil Failures
- Case Study 3 - Air Handling Unit (AHU) Fan Shaft Failure
- Case study 4 - Induced Draft Fan Motor Rotor Failure
- Case Study 5 - LM2500 Gas Turbine Component Failures
- Case Study 6 - Steel Rolling Mill Drive Gearbox Failure
- Case Study 7 - Large Industrial Fan Failures
- Case Study 8 - Automobile Fire

Challenges for Discussion

Dr. Badgley encourages delegates to bring challenges / issues from their home organizations to the workshop for discussion.

Why You Should Attend

This is a highly impactful workshop to provide you with a solid and comprehensive understanding of root cause failure analysis as a tool for quickly identifying and correcting machinery and equipment problems, achieving precise tolerances and improving machinery performance beyond what is expected for a new machine. Dr. Badgley will share with you some advanced knowledge and solutions for problems resulting from design errors, unintended or unexpected operating conditions, maintenance deficiencies, and effects of various external environments. This is a course developed based on proven methodology and Dr. Badgley's over 50 years of experience in machinery and equipment troubleshooting and failure. Through a series of practical illustrations and real life case studies, you will return with a new set of perspectives and practical skills.

Who Should Attend?

This training program is uniquely designed to provide valuable insight for:

- Head of Maintenance or Operations
- Rotating Equipment Engineers
- Reliability Engineers
- Instrumentation and Control Engineers
- Vibration Monitoring Engineers
- Mechanical Engineers
- Equipment Specialists
- Technical Managers/Engineers
- Process Engineers
- Production Engineers
- Project Engineers
- Plant Engineers
- Lubrication Managers
- Facilities Managers

About Your Course Facilitator

Dr. Robert Badgley is owner of Emcon Systems, which offers a range of professional technical consulting services for machinery of many types and sizes (compressors, turbines, bearings, generators, marine equipment etc.)

At Emcon Systems, Dr. Badgley currently provides expert technical consulting services and training to a range of firms at US and international locations. The focal point of Dr. Badgley's services is forensic engineering, directed at understanding and resolving machinery failure problems, sometimes catastrophic, in various types of plant machinery, including fans, blowers, motors, generators, compressors and turbines

With over 50 years of experience, Dr. Badgley has built up a wealth of practical experience with organizations throughout the world. He has undertaken successful projects in Canada, Europe, the Middle East, and Asia, as well as extensively in the US. His partial client list includes:

- ADMA-OPCO, Abu Dhabi
- ARCO Dubai
- Baker Engineering and Risk Consultants, Inc.
- BP · Syncrude
- Canadian Forces
- ChevronTexaco
- ExxonMobil
- General Electric
- Global Santa Fe
- Haier
- Pemex
- PetroCanada
- Rolls Royce Inc
- Seagate Technology

- Singapore Air Force
- Smithsonian Air & Space Museum
- Suncor
- TECO-Westinghouse Motor Company
- US Air Force
- US Army
- US Coast Guard
- US Navy – Naval Air Systems Command
- US Navy – Naval Sea Systems Command
- Washington Gas

Dr. Badgley is registered as a Professional Engineer in the State of New York, and is a Life Member of the American Society of Mechanical Engineers. He has authored or co-authored 43 technical publications. He received the Bachelor of Science degree in Mechanical Engineering from Rutgers University, the Master of Science degree in Nuclear Engineering from Massachusetts Institute of Technology, and the Ph.D. degree in Mechanical and Industrial Engineering from Cornell University.

Program Schedule

(Days 1, 2, and 3)

08:30	Registration
09:00	Morning Session Begins
10:40 - 11:00	Refreshments & Networking Break
12:45	Luncheon
14:00	Afternoon Session begins
15:30 - 15:50	Refreshments & Networking Break
17:00	Course Ends