



# ME180: Root Cause Failure Analysis & Reliability





## Training Description:

This course presents a systematic approach to fault diagnosis and failure analysis in the process, manufacturing, power generation and mining industries. A highly effective root cause failure analysis (RCFA) method is explained in detail.

The course will highlight two different approaches to fault investigation: One, addressing sporadic failures and two, solving inherent, chronic or recurring faults in equipment and systems. The course is based on the existence of three distinct levels of causes, namely immediate or physical causes, human causes and latent root causes. The course will illustrate how to perform data analysis to solve recurring failures by investigating real life equipment failure events. Participants are also encouraged to bring their own failure statistics for manual (plotting) or computerized failure pattern analysis.

Finally, it will be shown how to prepare recommendations based on faultfinding investigations and assure results by organizing effective follow-up processes. By reference to specific case studies, dealing with equipment components, centrifugal pumps and reciprocating compressors, it will be demonstrated that such a systematic program can lead to significant failure reductions and thus contribute to continuous improvement.

Upon completion of this course, participants will gain an understanding of structured, results-oriented root cause failure analysis methods. Participants will learn how parts fail and why they fail in a given mode related to cause. Participants will be able to approach the analysis of failures that happen either sporadically or chronically. They will also learn how to set up failure analysis teams and gain a thorough understanding of the importance of failure or repair data collecting. They will gain knowledge in applying statistical techniques in the analysis of available historical failure data enabling them to formulate maintenance and operating strategies. Everyone will leave with several techniques that they could apply right away in their daily work of failure fighting.

## Training Objectives:

**By the end of the training, participants will be able to:**

- ✓ Apply and gain an in-depth knowledge on machinery root cause failure analysis (RCFA)
- ✓ Recognize the difference between structured problem solving and RCFA by comparing the problem-solving sequences, situation analysis, action generation, decision making and planning for change
- ✓ Identify RCFA steps, failure causes and benefits to RCFA in relation to cause analysis as well as the RCFA selection process and the failure classifications for the two-track approach
- ✓ Enumerate the different failure types and explain the three levels of cause by selecting the right failures and cost spreadsheet as well as the five P's of root cause failure analysis in collecting failure data
- ✓ List the parts and position related to RCFA which includes physical agents of failure (FRETT), metallurgical failures, piping failures and examples of equipment component failures
- ✓ Illustrate the analysis process, different levels of data analysis which includes weibull and operating deflection (FEA), and the KT approach as another way or approach to fault investigation
- ✓ Determine the human root causes including the unintended error and purposeful wrongdoing of failure to come up with the requirements for good solutions and apply computerized maintenance management systems (CMMS)



- ✓ Employ life cycle of recommendation and follow-up and recognize the importance of service factor committees and reliability teams in the stewardship of RCFA results

### Training Designed for:

This course is intended for Maintenance, Operating, Manufacturing and Equipment Reliability Professionals, Supervisors, Rotating Equipment Senior Inspector, Stationary Equipment Engineer I, and other Technical Staff involved in plant maintenance, operating, reliability and availability management. Personnel from process industries such as refining, petrochemical, chemical, mining, pharmaceutical, fertilizer, power, metal manufacturing, food processing and utilities will profit.

### Training Program:

#### DAY ONE:

- ❖ PRE-TEST
- ❖ Introduction
- ❖ Structured Problem Solving and RCFA
  - Problem Solving Sequences
  - Situation Analysis
  - Cause Analysis
  - Action Generation
  - Decision Making
  - Planning for Change
- ❖ Cause Analysis
  - RCFA Steps
  - Failure Causes
  - Benefits to RCFA
  - Why We Don't Get Around to Doing RCFA?
- ❖ Two-Track Approach
  - The RCFA Selection Process
  - How to Determine the Vital Few
  - Different Approaches to RCFA
  - Failure Classifications
  - Exercise: Why We Spend More Time on Problems than on Opportunities?
- ❖ Failure Types
  - Sporadic
  - Chronic
  - Examples from Your Operation

#### DAY TWO:

- ❖ The Three Levels of Cause
  - Selecting the Right Failures
  - Cost Spreadsheet
  - Exercise in Selecting What Failures Need to be Addressed to Impact the Bottom Line
- ❖ Collecting Failure Data
  - The Five P's of Root Cause Failure Analysis
  - Why a Logic Tree?





❖ **Parts and Position**

- Physical Agents of Failure (FRETT)
- Metallurgical Failures
- Equipment Component Failures
- Piping Failures
- Examples of Equipment Component Failures

DAY THREE:

❖ **The Analysis Process**

- Describing the Failure Event
- Taking Failure Mode Inventory Building Hypotheses
- Determining the Causes, Exercise Featuring a Valve Cap
- Failure on a Reciprocating Compressor

❖ **Describing the Process**

- Exercise: Piston Rod Failure on a Reciprocating Process Compressor

❖ **Data Analysis I**

- Scatter Plots
- Correlation
- Example Using Process Pump Failure Management Data

DAY FOUR:

❖ **Data Analysis II**

- Weibull Analysis (Exercise Using Process Pump and Furnace Tube Failure Data)
- Modeling and Simulation

❖ **Data Analysis III**

- Operating Deflection (FEA)
- Vendor Experience

❖ **Another Way**

- Competing Approaches to Fault Analysis
- The KT Approach
- Example of an Elusive Centrifugal Process Pump Failure

❖ **Human Root Causes**

- Human Performance Reliability (HPR)
- Unintended Error, Physical and Mental Limitations
- Purposeful Wrongdoing, HPR Example

DAY FIVE:

❖ **Solutions**

- Requirements for Good Solutions
- Purpose and Design of Computerized Maintenance Management Systems (CMMS)
- CMMS and its Role in Failure Analysis

❖ **Stewardship of RCFA Results**

- Life Cycle of Recommendation and Follow-Up
- Service Factor Committees, Reliability Teams
- Example: A Process Pump Failure Reduction Program

❖ **Practical Sessions**

- This hands-on and includes simulator, real-life case studies and exercises



- Networking
- ❖ Course Conclusion
- ❖ POST-TEST and EVALUATION

### Training Requirement:

“Hands-on practical sessions, equipment and software will be applied during the course if required and as per the client’s request.”

Practical sessions will be organized during the course for participants to practice the theory learnt. Participants will be provided with an opportunity to carryout various exercises using the “iLearnVibration” simulator.

Please note that the above topics can be amended as per client’s learning needs and objectives. Further, it should be forwarded to us a month prior to the course dates.

### Training Methodology:

This interactive training course includes the following training methodologies as a percentage of the total tuition hours:

- 30% Lectures, Concepts, Role Play
- 70% Workshops & Work Presentations, Techniques, Based on Case Studies & Practical Exercises, Software & General Discussions
- Pre and Post Test

### Training Certificate(s):

Internationally recognized certificate(s) will be issued to each participant who completed the course.

### Training Fees:

**As per the course location** - This rate includes participant’s manual, hand-outs, buffet lunch, coffee/tea on arrival, morning & afternoon of each day.

Note: The 5% VAT (Value Added Tax), will be effective starting 01<sup>st</sup> of January 2018 as per the new regulation from the UAE Government. The VAT applies for all quotation both for local and abroad.

### Training Timings:

#### Daily Timings:

07:45 - 08:00	Morning Coffee / Tea
08:00 - 10:00	First Session
10:00 - 10:20	Recess (Coffee/Tea/Snacks)
10:20 - 12:20	Second Session
12:20 - 13:30	Recess (Prayer Break & Lunch)
13:30 - 15:00	Last Session

**For training registrations or in-house enquiries, please contact:**

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