Root Cause Machinery Failure Analysis

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Energy Milestones Corporation

Advancing Professionals to the next level

Energy Milestones is proud to be accredited, partner and associated with the following association bodies:

Root Cause Machinery Failure Analysis

Overview

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. This course will highlight two different approaches to fault investigation: 1. addressing sporadic failures and 2. solving inherent, chronic or recurring faults in equipment and systems. The course is based on the existence of three distinct levels of causes: immediate or physical causes, human causes, and latent root causes. The course will demonstrate how to perform data analysis to identify and resolve recurring failures by examining real-life equipment failure events. Participants are also encouraged to bring their own failure statistics for manual (plotting) or computerised failure pattern analysis. Finally, it will be demonstrated how to prepare recommendations based on fault-finding investigations and ensure their effectiveness by organising effective follow-up processes. By reference to specific case studies involving equipment components, such as centrifugal pumps and reciprocating compressors, it will be demonstrated that a systematic program can lead to significant reductions in failures and thus contribute to continuous improvement.

Course Objectives

- Gain an understanding of structured, results-oriented root cause failure analysis methods.
- Learn how parts fail and why they fail in a given mode related to the cause.
- Approach the analysis of failures that happen either sporadically or chronically.
- Establish failure analysis teams and gain a thorough understanding of the importance of collecting failure and repair data.
- Gain knowledge in applying statistical techniques in the analysis of available historical failure data, enabling them to formulate maintenance and operating strategies.
- Practice with several techniques that they can apply immediately in their daily work to overcome challenges and failures.

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Course Content

1. RCFA and Structured Problem Solving
- Cause analysis
- Problem-Solving Sequences
- Situation Analysis
- Action Generation
- Decision Making
- Where RFCA First In
- Planning for Change

2. Cause Analysis
- RFCA Steps
- Failure Causes
- Benefits to RCFA
- Why We Don't Have Time to Do RCFA

3. Two-Track Approach
- The RCFA Selection Process
- How to Determine the Vital Few
- Different Approaches to RCFA
- Failure Classifications

4. Failure Types
- Sporadic
- Chronic
- How Failure Appears
- Examples from Your Operation

5. The Three Levels of Cause
- Selecting the Right Failures
- Cost Spreadsheet

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Course Content

6. Collecting Failure Data
- The Five P's of Root Cause Failure
- Analysis
- Why a Logic Tree?

7. Parts and Position
- Sisal Agents of Failure (FRETT)
- Metallurgical Failures
- Equipment Component Failures
- Piping Failures
- Examples of Equipment
- Component Failures

8. The Analysis Process
- Describing the Failure Event
- Taking Failure Mode Inventory
- Building hypotheses
- Determining the Causes
- Describing the Process

9. Data Analysis I
- Scatter Plots
- Correlation
- Example Using Process Pump
- Failure Management Data

10. Data Analysis II
- Weibull Analysis (Exercise Using Process Pump and Furnace Tube Failure Data)
- Modelling and Simulation

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Course Content

11. Data Analysis III
- Operating deflection (FEA)
- Vendor Experience

12. Another Way
- Competing Approaches to Fault Analysis
- The KT Approach
- Example of an Elusive Centrifugal Process Pump Failure (VPS Bottoms Pump Analysis)

13. Human Root Causes
- Human Performance Reliability (HPR)
- Unintended Error
- Physical and Mental Limitations
- Purposeful Wrongdoing
- PR Example

14. Solutions
- Requirements for Good Solutions
- Purpose and Design of Computerised Maintenance Management Systems (CMMS)
- CMMS and Its Role in Failure Analysis

15. Stewardship of RCFA Results
- Life Cycle of Recommendation and Follow Up
- Service Factor committees
- Reliability Teams
- Documentation and Reporting
- Example A: Process Pump Failure Reduction Program
- Networking

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Targeted Audience

This course is designed for professionals in operating, manufacturing, and equipment reliability, as well as supervisors and engineers involved in plant reliability and availability management. Additionally, personnel from process industries, including refining, petrochemical, chemical, mining, pharmaceutical, and paper manufacturing, as well as food processing and utilities, will benefit from this program.

Course Methodology

Facilitated by an experienced professional trainer, this training course will be conducted as a highly interactive workshop session. A variety of training methodologies and facilitation techniques will be employed before and during the course, as applicable. These methods are aimed at enhancing individual and group interaction while maximising learning. Some of these methods are:

- Online Pre-post Test
- Colourful Visual Aids
- Gamification
- Self-Assessment Instruments
- Simulations
- Case Studies
- Videos
- Group Exercises & Discussions
- Role-plays
- Indoor & Outdoor games