Course Description

The course covers Root Cause Failure Analysis capable to lead an oil & gas company to a pacesetter performance comprising of:

- Root causes are considered as Process Safety Management system deficiency that has lead to the incident / accident.
- Defining root in the management system, which failed to provide a series of barriers / defenses in form of organization, standards, practices, procedure to ensure safe and effective operation of the hydrocarbon processing plant?
- Knowledge and Best Practices to develop effective root cause analysis (operation, design and maintenance) to reach the world class performance.
- Knowledge a workable, proven and readily implemented physical failure investigation method based on Equipment Failures Templates for machinery, fixed, instrument, electrical and other equipment.

Who Should Take the Course

The course is ideal for persons with assigned responsibilities for failure analysis and incident investigation in the operation, technical, reliability and maintainability area, as well as managers who want to increase awareness of the payoffs of improvements managements.

Engineers who need to know the incident investigation as they apply to developing improvement programs. Design engineers, technical specialists, maintenance specialists, operations technical specialists, reliability specialists, and product/program managers will benefit from the course.

What Will You Learn

The participants will gain knowledge of Root Cause Failure Analysis to achieve safety and equipment reliability improvements to reach target performance. They will learn the proven Best Practices that are appropriate to apply for different incident and equipment failures as well as the basics of implementing the practices to reach reliability, availability and maintenance cost reduction targets.

Included Materials

Attendees will receive a copy of:

- Course Text Book
- Course Slides

Course Outline

Incident Definition

- Describe all observations of the incident / accident / breakdown.
- Physical examination of the incident / accident / machines involved and a detailed description of the actual failure. In not checking all aspects, there is a high probability of missing the cause. It is important to begin the data collection phase of root cause analysis immediately following the occurrence identification to ensure that data are not lost. (Without compromising safety or recovery, data should be collected even during an occurrence.)
- The information that should be collected consists of conditions before, during, and after the occurrence; personnel involvement (including actions taken); environmental factors; and other information having relevance to the occurrence.

Physical Mechanism of Failure

- Physical Mechanism of Failure is the investigation of materials, products, structures or components that fail or do not operate/function as intended, causing personal injury or damage to property. The key task in many such investigations is to identify the failure mechanism by examining the failed part using physical and chemical techniques.
- Methods used in Physical Mechanism of Failure investigations include reverse engineering, inspection of witness statements, a working knowledge of current standards, as well as examination of the failed component itself. The fracture surface of a failed product can reveal much information on how the item failed and the loading pattern prior to failure.
- Physical Mechanism of Failure analysis, also commonly called failure analysis, is the evaluation of information pertaining to the failure of a mechanical or structural component. The analysis carefully examines the failed component, its design, its fabrication and its operating history for clues that help explain how and why the component failed.

Sequence of Events

- Sequence of Events provides a structure for investigators to organize and analyze the information gathered during the investigation and identify gaps and deficiencies in knowledge as the investigation progresses. The Sequence of Events chart is simply a sequence diagram with logic tests that describes the events leading up to an occurrence, plus the conditions less that expected surrounding these events.

- Preparation of the Sequence of Events chart should begin as soon as investigators start to collect information about the occurrence. They begin with a skeleton chart that is modified as more relevant facts are uncovered. The Sequence of Events should drive the data collection process by identifying data needs.

- Data collection continues until the investigators are satisfied with the thoroughness of the chart (and hence are satisfied with the thoroughness of the investigation). When the entire occurrence has been charted out, the investigators are in a good position to identify the major contributors to the incident, called Performance Less than Expected. Performance Less that Expected are those contributors (human errors and component failures) that, if eliminated, would have either prevented the occurrence or reduced its severity.

Active Changes from Expected

Active Changes from Expected are human errors or equipment problems that directly led to the loss event or allowed the consequences of the event to be more severe.

Active Changes from Expected are human errors classified as:

- Slips
- Lapses
- Knowledge Based Mistake
- Rule Based Mistake
- Violations

Precondition Changes from Expected

Precondition Changes from Expected are supervisory errors or work environment problems that directly led to the loss event or allowed the consequences of the event to be more severe.

Precondition Changes from Expected are errors classified as:

- Supervision
- Work Place Environment
- Inspection for the tools or equipment
- Communications between inspection and maintenance departments
- Maintenance documentation
- Planning and co-ordination of maintenance activities
- Personal protections against environment
- Condition of people at the time of operations (people ill, drunk, very frightened, stressed)

Document Change from Expected for Each Step in Sequence of Events.

- PSM systems Changes from Expected relative to control the work process and the appropriate actions and / or inappropriate actions. Typical PSM systems Change from Expected should involve elaboration of elements:
- Employee Participation
- Process Safety Information
- Process Hazard Analysis
- Operating Procedures
- Training
- Subcontractor Safety

- Pre-Startup Safety Review
- Mechanical Integrity
- Non-routine Work Authorizations (Hot Work Permits)
- Management of Change
- Incident Investigation
- Emergency Planning and Response

Devise and Evaluate Action to Prevent Incident from Reoccurring in this and Similar System and Instances, Evaluate Deterioration of PSM elements

Solution analysis considers if barriers and controls have deteriorated in other system , equipment and situations. Generalization of the specific issue at hand is a very difficult task. Without those generalization and assessment of overall PSM system deterioration actions to improve only circumstances leading to current incident are fruitless. Actions need to be be devised to fit the characteristics of the overall PSM system effectiveness.

- Feasibility: The actions need to be devised within the company's circumstances considering resources and schedule.
- Effectiveness: The solutions need to have a reasonable probability of solving the problem associated with other systems, equipment and work situations.
- Budget: Solution must be appropriate for the extent of the problem.
- Employee Involvement: The departments and personnel affected by the problem need to be involved in creating the solution.
- Focus on Systems: The solutions should be focused on systemic PSM issues. Operators do make mistakes, but that is not usually the root cause of the problem.
- Contingency Planning: Actions should have expectation of success. Critical elements of the solution should have contingency plans available to prevent failure of the entire PSM system.

Devise Implementation Plan

Improvement should be based on consideration of performance of similar systems considering:

- Technology
- Benchmark
- Best Practices
- Reliability Management System

Implementation plan must be based on the key active, contributory and PSM system causes. To prevent recurrence of

an incident, PSM system must improve in the broad aspect to prevent reoccurrence in other systems, equipment and work situations..
It may be necessary to conduct risk assessments to assist in the process of prioritization, and to maintain sufficient documentation about the investigation.

Course Instructor: Namik Kosaric is a Canadian Professional Engineer with experience with PETRONAS, Bahrain Petroleum Company and ESSO Petroleum Canada in reliability improvements and maintenance cost reduction, mechanical design, project engineering and technical support of Oil Refineries and Oil Production Facilities.

For the last 8 years in PETRONAS Namik Kosaric was responsible for providing technical and knowledge leadership in development, coordination and implementation of plant reliability and integrity improvements and program to PETRONAS OPU's to improve and support the overall Petroliam Nasional Berhad objectives.

In BAPCO, Namik Kosaric, pioneered and implemented a root cause failure analysis of lost profit opportunities and chronic failures using a multi-disciplinary teams to improve plant reliability, availability, safety and to ultimately reduce operating costs. Significant cost savings were achieved as a result of over 200 completed investigations.

For 23 years in ESSO Petroleum Canada, Namik Kosaric has made significant contribution worldwide in reliability improvements, design, projects and maintenance cost reduction in upstream and downstream facilities.