Safety Integrity Level Assessment for Oil and Gas Assets Training Course

Introduction

The success of every company depends of each employee's understanding of the key business components. Employee training and development will unlock the companies' profitability and reliability. When people, processes and technology work together as a team developing practical solutions, companies can maximize profitability and assets in a sustainable manner. Training and development is an investment in future success - give yourself and your employees the keys to success

It is strategically important that your team understands the fundamentals of SIL Hazard analysis. This is the difference between being in the best quartile of operational safety and being in the last quartile. There is vast difference in the operational ability of operating companies and most benchmarking studies have confirmed this gap in operational abilities.

Whether you have a team of new or seasoned employees, an introduction or review of these concepts are very beneficial in closing the gap if you are not in the best quartile, or maintaining a leadership position. Most studies show that a continuous reinforcement of best practices in operational safety principles is the most effective way to obtain the desired results. Training and learning should be an on going continuous life long goal.

Course Objective

The three main risk questions are:

Hazard – What can go wrong?
Consequences – How bad could it be?
Likelihood – How often might it happen?

When answering these questions, the objective is to perform only the level of analysis necessary to reach a decision, because insufficient analysis may lead to poor decisions and excessive analysis wastes resources.

A suite of tools is available to accommodate varying analysis needs:

(1) tools for simple hazard identification or qualitative risk analysis include hazard and operability analysis (HAZOP), what-if/checklist analysis, and failure modes and effects analysis (FMEA),

(2) tools for simple risk analysis include failure modes, effects, and criticality analysis and layer of protection analysis (LOPA),

(3) tools for detailed quantitative risk analysis include fault trees and event trees. For example, some companies may judge the mere existence of an explosion hazard to be an unacceptable risk, regardless of its likelihood. Others may be willing to tolerate an explosion risk if proper codes and standards are followed. Still others may be unwilling to accept an explosion risk unless it can be shown that the expected frequency of explosions is less than 10-6/y by SIL analysis. SIL allocation using formal qualitative and quantitative techniques such as risk assessments, HAZOPs, and LOPA

A Safety Instrumented System (SIS) is one of the most important layers of protection against accidents and hazards in the hydrocarbon process industry. The Occupational Safety and Health Administration (OSHA) warrants that the design and implementation of a safety system meets good engineering practice.

Safety performance criteria for SIS should be defined by Safety Integrity Levels (SIL). The determination of the Safety Integrity Level required for the SIS will determine the configuration of SIS to meet the required integrity level, and in turn improve the reliability of the system.

- In order to conduct a SIL analysis, a combination of technical documentation (Piping & Instrumentation Diagrams (P&ID), Cause and Effect charts,
- safety studies/documentation review (HAZOP, QRA, Firefighting and detection system data)
- and economical parameters (equipment cost, product and raw material costs)

are required. This will lead to the identification of an initial risk level in terms of personnel safety, environmental loss, commercial impact.

Key steps in conducting a Safety Integrity Level study include:

1. Hazard and Risk Assessment: Begin by conducting a hazard and risk assessment to identify potential hazards, assess their likelihood and consequences, and determine the overall risk. This forms the basis for determining the appropriate safety measures.
2. Safety Instrumented Functions (SIFs) Identification: Identify the specific safety instrumented functions that are required to mitigate the identified hazards. A safety instrumented function is a specific control action taken by the safety instrumented system to reduce risk.
3. Determining SIL Requirements: Based on the risk assessment, assign a target SIL to each safety instrumented function. SIL levels range from SIL 1 (lowest) to SIL 4 (highest). The assigned SIL reflects the desired risk reduction and safety performance.
4. SIL Verification and Validation: Determine whether the existing safety instrumented systems meet the required SIL levels. This involves verifying and validating the design, performance, and reliability of the safety instrumented systems.
5. SIL Assessment Techniques: Various techniques are used to assess the safety instrumented systems and determine if they meet the required SIL. These techniques include fault tree analysis (FTA), failure modes and effects analysis (FMEA), and reliability analysis.
6. Safety Instrumented System Design: Design or modify the safety instrumented system to ensure that it meets the required SIL. This involves selecting appropriate sensors, logic solvers, final elements, and redundancy configurations.
7. Verification and Validation of Design: Verify and validate the design of the safety instrumented system to ensure that it meets the requirements for the assigned SIL. This may involve simulation, testing, and analysis.
8. Documentation and Reporting: Document all findings, decisions, and analysis results. This documentation is important for regulatory compliance, auditing, and ongoing maintenance of the safety instrumented systems.
9. Operation and Maintenance: Regularly monitor, test, and maintain the safety instrumented systems to ensure they continue to meet the required SIL and perform as intended.

Course Syllabus

The goal of the course would be to refresh the knowledge of those who have a basic understanding of SIL techniques and to build a foundation for those who are new to the SILs.

Introduction

- Overview of the Offshore, Midstream, and Downstream Chemical Processing Industry

Review of Process Incidents

- Safety for the Chemical Processing Industry

Fundamentals of Petroleum Chemistry

- Description of a Hydrocarbon Molecule
- Types of Hydrocarbon Molecules

Risk Assessment

- Society Acceptable Risk
- Understanding Risk
- Understanding Consequence
- Understanding Likelihood
- Typical Risk Matrix
- Risk Probability

Introduction to Safety Instrumented Systems

- Definitions
- Code Requirements
- Typical Applications

Risk Management & Reliability

- Typical Risk Management Requirements
- Code Reliability Requirements

Process Hazard Analysis

- Hazard Assessment Definition
- Review of actual industry hazards
- PHA Study Objectives
- Introduction of PHA Techniques / Probability Matrix
- Team Leader Responsibilities
- Preparation and Organization of PHA Studies
- Importance of Business Records / PHA Terminology
- Selection of Study Nodes / Design intent of node
- Introduction of Guide words
- Guidelines for managing the team
- Recording Study Results / Maintaining Quality Control
- Management of Results and Recommendations
- Communication of Results to Management

Layer of Protection Analysis

- Concept, purpose and principles of LOPA
- LOPA methodology (selecting scenarios, the LOPA process, describing scenarios, estimating initiating event frequencies, independent protection layers and their reliability)
- LOPA study and documentation
- Advanced aspects
- Facilitating a LOPA study
- Responsibilities and challenges

Safety Integrity Level selection

- Determining SIL Requirements: Based on the risk assessment, assign a target SIL to each safety instrumented function. SIL levels range from SIL 1 (lowest) to SIL 4 (highest). The assigned SIL reflects the desired risk reduction and safety performance.

- SIL Verification and Validation: Determine whether the existing safety instrumented systems meet the required SIL levels. This involves verifying and validating the design, performance, and reliability of the safety instrumented systems.

Probability of Failure Demand

- Guidance Documentation for Failure on Demand (PFD)
- Acceptable PFD for systems

Hardware Fault Tolerance

- Guidance for Hardware Reliability

Who Should Attend

- People who are making day to day decisions regarding operation, design, maintenance, and economics of process industry plants.

    1. 1st Line Operations personnel,
    2. Operation Supervisors,
    3. 1st Line Maintenance personnel,
    4. Maintenance Supervisors,
    5. Senior Plant Supervisors,
    6. Operations Engineers
    7. Process Support Engineers,
    8. Design Engineers,
    9. Cost Engineers

- Engineers, Operating Personnel, PSM Coordinators, HSE Managers and Engineers

- Ideal for veterans and those with only a few years of experience who want to review or broaden their understanding of process safety.

- Other professionals who desire a better understanding of the subject matter.

What You Can Expect To Gain

- Overview of Safety Integrity Levels
- Learn Core Knowledge needed in a SIL Review
- How to perform a SIL for Process Safety Management
- Gain an understanding of Risk Management
- Review of Engineering Controls