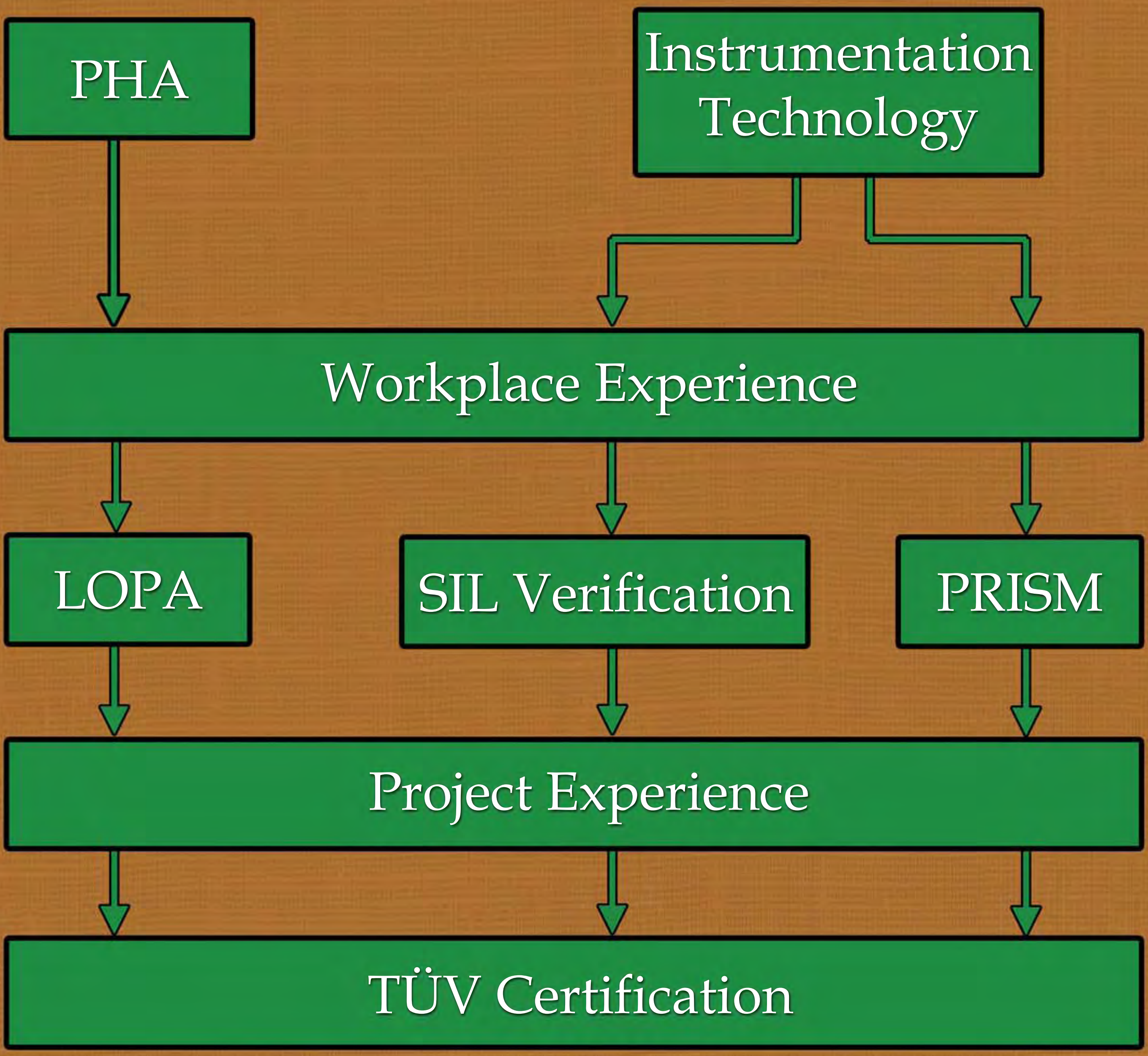
SIS-TECH Course Catalog

Recommended Course Paths



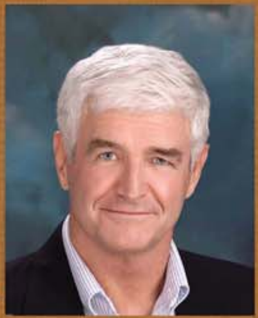
Course Instructors

Dr. Angela Summers

Dr. Summers has over twenty years of process, environmental, and safety instrumented system (SIS) design experience. Dr. Summers is a US representative to the international IEC 61508/61511 committee, is chair of the TR84.02 and TR84.04 committees and has authored a book on instrumented protective systems for CCPS. She is a recognized expert in the automation field and serves as a technical consultant on many other industrial standard committees.

Layer of Protection Analysis, SIL Solver, SIL Verification, PRISM, TUV Rheinland FSE Eng.

William Hearn



Bill Hearn is a TÜV Functional Safety Expert with more than 30 years of engineering and project management experience focused on instrumentation, process measurement, and safety systems. His experience ranges from managing major project installations to performing risk assessments and drill down compliance audits. He was a member of the API Task Group on Tank Overfill Prevention and actively supports several ISA Working Groups.

Layer of Protection Analysis, SIL Solver, SIL Verification, PRISM, TUV Rheinland FSE Eng.

Watson Dupont

Watson has more than 30 years of of process safety management experience. He has extensive knowledge in project operations, environmental, and safety where he gained experience with numerous risk mitigation techniques and PSM compliance.

PHA

Shane Pirtle

Shane has more than 30 years of experience in the Chemical/Petrochemical Industry. His experience includes serving on numerous site and global teams to establish the most appropriate technologies for instrumentation and control. He has been a Dow instructor and an instructor for Brazosport College. Shane has extensive experience in maintenance, design engineering and technology support

Instrumentation Technology

Process Hazards Analysis

Time: 1st Day - 8:30am to 4:30pm
2nd Day - 8:30am to 3:30pm
CEUs: 1.4

Audience: Process Safety and Engineering groups.

Prerequisites: None

Course Description: This course covers the basic fundamentals of how to facilitate a Process Hazard Analysis (PHA) on operating processes and Management of Change projects. These analyses are to address the federal regulatory requirements using the different methodologies and techniques in facilitating Process Hazard Analysis. The course presents a series of examples in a workshop format to illustrate the methodologies. This course is designed for future facilitators that have participated as a team member in previous PHA's.

1st Day

- Process Hazard Analysis (PHA) Overview
- OSHA Expectations for Study Compliance
- PHA Methodologies/Techniques
- What is Process Safety Information
- Understanding Noding
- Deviations (Guidewords and Parameters for HAZOP)
- Causes
- Consequence

2nd Day

- What are Safeguards
- Understanding and Evaluating Risk
- Writing of Recommendations
- Multiple PHA Workshop Examples

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LAYER OF PROTECTION ANALYSIS

Audience: Process Safety, Process Engineering, Operations, and Instrumentation and Electrical
Time: 1st Day - 8:30am to 4:30pm
2nd Day - 8:30am to 3:30pm
CEUs: 1.4
Prerequisite: PHA course with subsequent experience or workplace experience with PHA/LOPA

Course Description: Layer of protection analysis (LOPA) is a popular risk analysis technique. It is conducted after a process hazards analysis has identified hazardous events needing further analysis to better understand the functional and risk reduction requirements for the safeguards. This course discusses the fundamentals of Layer of Protection Analysis, including the risk criteria, key work process elements, and methodology options. The course uses workshop examples to illustrate the methodology and emphasize key learning points.

<table>
<tr>
<td>
<u>1st Day</u>

Risk Management
Process Risk Measurements
PHA Workshop
Risk Criteria
Hazardous and Harmful Events
Enabling Conditions and Conditional Modifiers
LOPA Criteria
Frequency Workshop
Independent Protection Layers (IPL)
Types
Assessing Independence
Independence Workshop
Core Attributes
Core Attributes Workshop

</td>
<td>
<u>2nd Day</u>

LOPA Methodology
Initiating Cause Frequency
IPL Risk Reduction
Independence of control and instrumented safety functions
LOPA IPL Workshop
IPLs and Side Effects
Understanding Secondary Consequences
Multiple LOPA Workshop Examples

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SIL SOLVER COURSE

Time: 8:30am to 3:30pm
Audience: New and Experienced SIL Solver users

<u>Overview</u>

The SIL Solver course is a one-day jump-start designed to energize new users in efficient use of SIL Solver to perform verification of the safety integrity level of safety instrumented functions. Experienced users will also benefit from awareness of new software capabilities and the structured review of examples. The morning lectures provide an overview of software use, discuss software constraints and assumptions, and explain how to use advanced features that make the calculations more efficient. Key topics are as follows:

1. Identifying the required SIF functionality
2. Variables affecting SIL
    a. Fail Dangerous/Fail Safe Failure Rate
    b. Voting
    c. Testing Interval
    d. Mean Time to Repair
    e. Diagnostic Coverage & Diagnostic Interval
    f. Common Cause Factor
3. Data sheets and Selection
4. Basic and Advanced SIL Solver features

In the afternoon session attendees will receive a series of cases which they are required to execute. The cases allow the attendee to practice what was discussed during the morning lectures using examples from real-world applications. The course instructor will review each case with the attendees and explain how the cases should be modeled and what the results mean from a design and maintenance standpoint.

<u>Objective</u>

The course participants will gain an understanding of the following:

- How to define of a safety instrumented function.
- How SIL Solver executes the calculation.
- How to navigate in SIL Solver.
- Where the SIL Solver data comes from.
- How to build your own data sheets.
- How to backup your data sheets.
- How basic and complex safety instrumented functions are modeled using SIL Solver.
- How changes to the safety instrumented function design, operation, and maintenance affect the target SIL, reliability, and maintainability.
- How to efficiently update SIL calculations with SIL Solver.
- Report printing.

These objectives are achieved through workshop examples of SIL verification using SIL Solver Software. Since this is a hands-on course, participants must bring a laptop computer with an authorized version of SIL Solver installed.

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Instrumentation Technology

Time: 1st Day - 8:30am to 4:30pm
2nd Day - 8:30am to 4:30pm
3rd Day - 8:30am to 3:30pm
CEUs: 2.3
Audience: Control systems engineers, production engineers, instrument engineers, process engineers, instrument technicians, plant operators
Prerequisites: None

Course Description: Industrial Instrumentation Technology is the selection, sizing, installation, maintenance and calibration of devices used in the automation of industrial processes. These devices measure and control the pressure, temperature, level and flow of processes used in automated manufacturing and production.

This 3 day course will provide an in-depth introduction to instrument measurementation in the petrochemical industry. The course is designed to provide process related personnel with less than 5 years experience or who have had limited measurement experience, with a functional knowledge of instrumentation. This training will review piping, process, chemical, pneumatic, hydraulic, electrical, electronic, computer, networking technologies, signal processing, ancillary devices, final control elements and a detailed overview of technologies for temperature, pressure, level, flow. The class will include measurement sizing, selection criteria, application issues, loop wiring, loop verification and troubleshooting. Some instrument devices available for demonstration and daily quizzes will be used for review.

1st Day
- Measurement
- Temperature
- Pressure

2nd Day
- Level

3rd Day
- Flow

Course developed by Shane Pirtle

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SAFETY INTEGRITY LEVEL (SIL) VERIFICATION

Time:	1st Day - 8:30am to 4:30pm 2nd Day - 8:30am to 3:30pm
CEUs:	1.4
Audience:	Control systems engineers, instrument engineers, and process safety specialists
Prerequisite:	Instrumentation Technology course or equivalent experience

Course Description: A two-day course on the performance verification of safety instrumented functions, including calculation of the probability of failure on demand (PFD and spurious trip rate (STR). This course covers fundamental concepts, such as failure modes and effects, failure rate data, key design parameters, and the calculation methodology. The course presents a series of examples as workshops to illustrate the important concepts and assumptions implicit in the calculations.

1st Day

- Overview of SIS standards
- Failure fundamentals-Failure Modes and Effects Analysis (FMEA)
- Introduction to the math for probability of failure on demand and spurious trip rate
- Key Elements
  - Integrity – where do you get data from? What does it mean?
  - Voting/Fault Tolerance – why do you need redundancy? How does it help?
  - Test Interval – how does the test interval affect the integrity?
  - Diagnostic Coverage – what effect does diagnostics have?
  - Common Cause – how is this modeled?
- Periodic Workshops throughout the day
  - How to read manufacturer certification reports
  - How to model SIF based on LOPA recommendations
  - Understanding mean time to failure and useful life
  - Partial stroke testing and diagnostic coverage

2nd Day

- Example System
  - Impact of diagnostics and need for compensation measures
  - Calculation demonstration showing the impact of redundancy
- Workshops -- problems worked by students. Various cases will be modeled showing how changes to design and maintenance strategy affect results.

Course developed by Dr. Angela Summers and William Hearn

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3-DAY PRISM Certified

Audience: Control systems engineers, instrument engineers, electrical engineers, and process safety specialists
Time: Day 1 8:30 am to 4:30 pm Day 2 8:30 am to 4:30 pm Day 3 8:30 am to 4:00 pm
CEU: 2.3
Prerequisite: Instrumentation Technology course with subsequent experience or workplace experience in instrumentation & control design and implementation

Course Description: This 3-day course explains how risk analysis techniques, such as layer of protection analysis (LOPA), are used to identify the need for administrative and engineered safeguards. When LOPA determines that a safety instrumented system (SIS) is required, the required risk reduction becomes the performance target for the SIS. IEC 61511 establishes requirements for designing and managing SISs to achieve specified safety integrity levels (SIL), which are related to order of magnitude ranges of risk reduction. These requirements are presented using a lifecycle framework and supplemented with several industry guidance documents.

The course is designed to provide the student with an understanding of the management system, how to perform LOPA to identify the need for an SIS and to assign the SIL, how to design the SIS to meet the specified SIL, how to verify that the SIL can be achieved, and how to develop an operating plan to maintain the SIL throughout the SIS life.

DAY 1 – GETTING STARTED

- Module 1 SIS Standards Overview
- Module 2 Planning
- Module 3 Process Risk and Protection Layers
- Module 4 Establishing Risk Evaluation Criteria

DAY 2 – RISK ANALYSIS TO DESIGN

- Module 5 Layer of Protection Analysis (LOPA)
- Module 6 Safety Requirements Specification Part 1
- Module 7 Safety Requirements Specification Part 2
- Module 8 Selection of Devices

DAY 3 –VERIFICATION AND OPERATING BASIS

- Module 9 Data Estimation
- Module 10 Design Decisions
- Module 11 Verification Example
- Module 12 Operating Basis

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DAY 1 – GETTING STARTED

Module 1 SIS Standards Overview

The course begins with a brief introduction to the various good engineering practices that apply to safety instrumented systems (SISs) implemented in process industry facilities. Special focus is given to international standards, such as IEC 61511 and 61508, and recognized guidance documents, such as the CCPS Guidelines books and several ISA technical reports.

Module 2 Planning

An overview of IEC 61511 is presented followed by detailed requirements for the safety management system contained in Clauses 5 through 7. Key elements are competence, independent review, verification, functional assessment, management of change, and auditing.

Module 3 Process Risk and Protection Layers

Process risk derives from process miss-operation and is an inherent part of process design. This inherent risk must be reduced below internationally accepted risk criteria using independent protection layers (IPLs) that are designed and managed to meet seven (7) core attributes.

Module 4 Establishing Risk Evaluation Criteria

The risk assessment phase is addressed in IEC 61511 Clauses 8 and 9. The initiating events for process hazards are identified and the frequency and consequence severity of each potential event is estimated. Depending on the type of risk analysis, various conditional modifiers may also be considered when assessing the risk. Once the risk is understood, a risk reduction strategy can be developed.

DAY 2 – RISK ANALYSIS TO DESIGN

Module 5 Layer of Protection Analysis

Layer of protection analysis (LOPA) is covered in the CCPS book, Layer of Protection Analysis: Simplified Process Risk Assessment. LOPA identifies the initiating events and their frequency, the consequences and their severity, the required risk reduction, and the protective functions implemented in each protection layer to achieve the required risk reduction.

Module 6 Safety Requirements Specification (SRS) Part 1

The SRS in IEC 61511 Clause 10 is a collection of information that specifies the SIS design basis required to ensure process safety during all operating modes. The SRS defines the functionality, integrity, reliability, operability, and maintainability requirements based on operational goals, intended operating modes and process safety time limitations.

Module 7 Safety Requirements Specification Part 2

IEC 61511 Clause 11 provides many specific design requirements including the need for fault tolerance and separation of the SIS from the BPCS.

Module 8 Selection of Devices

SIS device selection is addressed in IEC 61511 Clause 11.5. ISA TR84.00.04 guidance is presented related to field devices and logic solvers. Emphasis is placed on demonstrating that the device is user-approved for safety based on a review of manufacturer information and actual field experience.

DAY 3 – VERIFICATION AND OPERATING BASIS

Module 9 Data Estimation

IEC 61511 Clause 11.9 requires verification of the SIS performance through calculation of the probability of failure on demand (PFD) and the spurious trip rate of the SIS as specified and maintained. Various types of data estimates are discussed with an emphasis on collecting internal and industrial data.

Module 10 Design Decisions

The voting architecture, diagnostic coverage, proof test interval, and common cause failure potential affect the achievable PFD and the spurious trip rate. The impact of each design decision is discussed and typical examples are presented.

Module 11 Example Verification

An example SIF will be assessed to illustrate how choices in field device architecture, test interval, and logic solver technology affect the achievable PFD and spurious trip rate.

Module 12 Operating Basis

There are many day-to-day operation and maintenance activities that must take place for the SIS to sustain its expected performance throughout its installed life. Operation and maintenance procedures must be developed and verified prior to the introduction of hazards into the process unit. These procedures support the detection and response to faults and process alarms, the initiation of manual shutdown, reset after shutdown, and proof tests.

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TÜV FSEng Training/Certificate

Audience: Control systems engineers, instrument engineers, electrical engineers, and process safety specialists.

Certification: Requires a minimum of 3 years experience in the field of functional safety, a Bachelor's degree in Engineering or equivalent engineer level responsibilities status certified by employer and a minimum grade of 75% on the test.

Time:

Day 1	8:30 am to 4:30 pm	Day 2	8:30 am to 4:30 pm	Day 3	8:30 am to 4:30 pm
Day 4	8:30 am to 11:30 am	Test	1:00 pm to 4:00 pm		

CEU: 2.3

Prerequisite: Instrumentation Technology, SIL Verification, and/or PRISM pathway; or PHA, LOPA pathway; and 3-5 year minimum project experience

Course Description: This 3 and 1/2-day course plus test explains how hazards identification techniques are used to identify the need for risk reduction from administrative and engineered safeguards. When a safety instrumented system (SIS) is required, the required risk reduction must be demonstrated through proof of compliance to the requirements of an international standard, IEC 61511. This standard establishes lifecycle requirements for designing and managing SISs to achieve specified safety integrity levels (SIL), which are related to order of magnitude ranges of risk reduction. These requirements are presented in the course using a lifecycle framework and these requirements are supplemented by guidance from several industry publications.

The course is designed to provide the student with an understanding of the management system, how to perform layers of protection analysis to identify the need for an SIS and to assign the SIL, how to design the SIS to meet the specified SIL, how to verify that the SIL can be achieved, and how to develop an operating plan to maintain the SIL throughout the SIS life.

Course developed by Dr. Angela Summers and William Hearn

<u>DAY 1 – GETTING STARTED - PLANNING</u>

- Module 1 SIS Standards Overview
- Module 2 Management of Functional Safety
- Module 3 Process Risk and Protection Layers
- Module 4 Establishing Risk Evaluation Criteria

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DAY 2 – RISK ANALYSIS TO DESIGN - DO

- Module 5 Layer of Protection Analysis (LOPA)
- Module 6 Safety Requirements Specification Part 1
- Module 7 Safety Requirements Specification Part 2
- Module 8 User Approval

DAY 3 –VERIFICATION AND OPERATING BASIS - CHECK & ACT

- Module 9 Data Estimation
- Module 10 Design Decisions
- Module 11 Verification Example
- Module 12 Operating Basis

DAY 4 –Exercises and Test

- Module 13 Walkthrough of ISA TR84.00.04 Part 2
- Module 14 Practical Exercise
- Module 15 TÜV Rhineland FSE
- Certification Examination

DAY 1 – GETTING STARTED

Module 1 SIS Standards Overview

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<u>DAY 4 – Exercises and Test</u>

Module 13 *Walkthrough of ISA TR84.00.04 Part 2*

Module 14 *Practical Exercise*

Module 15 *TÜV Rhineland Functional Safety Engineer Module*

Certification Examination

Evaluation exam will last approximately 4 hours consisting of 50 multiple choice and 15 multiple part questions. Students may use class notes.

Certifications

These 4 courses are offered through the Mary Kay O'Connor Process Safety Center: Process Hazards Analysis Facilitation, Layers of Protection Analysis, SIL Verification, and SIS Implementation (same as PRISM Certified course). Every attendee of a course taught through the Mary Kay O'Conner Process Safety Center receives a certificate of completion and CEUs from Texas A&M University.

PRISM-Certified is a 3-day course that meets the requirements of a certificate program. The course pre-requisite is experience and knowledge in designing & implementing instrumentation and controls. A test is administered by SIS-TECH as part of the course to assess the attendee's grasp of key learning points. The attendee receives a certificate stating that they are PRISM-Certified if they pass the test. Otherwise, they receive a certificate of completion only.

TUV Functional Safety Engineer is a 3 1/2 day course with 1/2 day test. The applicant is certified by TUV Rheinland, so it requires a test and application fee to be paid to TUV in addition to the course fee. The course pre-requisite is experience and knowledge in implementing instrumentation and controls. The applicant must prove the course pre-requisite as part of the application to TUV Rheinland. The applicant must have a minimum of 3 years of experience and an engineering degree or equivalent engineer level responsibilities as certified by their employer. A comprehensive test requires application of the key learning points to case studies.

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inft@sis-tech.com

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