
Inherently Safer Plant Design, Pressure Relief and Safeguarding Training Course

14 – 18 March 2027
Doha





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Programme Summary

Inherently safer plant design, pressure relief and safeguarding is a five-day training course for senior process engineering, operations and technical safety leaders at advanced level, culminating in an equipment safeguarding review for a selected process unit. Many loss-of-containment events start at equipment designed with avoidable hazards, protected for the wrong scenario or run outside its limits. The approach moves from hazard elimination at design stage to overpressure protection, instrumented safeguards and disciplined operation. Mars Training Centre UK delivers this programme in inherently safer plant design, pressure relief and safeguarding.

The Business Case

Equipment holding more inventory, pressure or temperature than the process needs, or relying on unverified safeguards, exposes the organisation to fires, explosions, toxic releases and long shutdowns. Leaders who challenge design early, confirm every credible overpressure case is covered and hold operations to defined limits reduce that exposure at lower cost than retrofits.

- Loss of Primary Containment: Falls as hazards are reduced at source and relief paths proven adequate.
- Lifecycle Safeguarding Cost: Reduces as inherently safer options are chosen before detailed design.
- Unplanned Shutdowns: Decrease as operating limits, alarms and trips are set and respected.

Principles and Evidence Base

- Inherently Safer Design Principles minimise, substitute, moderate, simplify: Structure the design challenge in Session 1.
- ISO 4126 Safety Devices for Protection Against Excessive Pressure: Frames relief device selection in Session 3.
- IEC 61511 Functional Safety for the Process Industry Sector: Guides safety instrumented function specification in Session 4.
- Layers of Protection Analysis: Allocates independent safeguards to each scenario in Session 4 and Session 5.

Intended Participants

- Leaders who approve design choices and equipment specifications for new units.
- Managers accountable for relief, flare and instrumented protection systems.
- Heads of technical safety who verify that safeguards match credible scenarios.
- Operations leaders who set and enforce safe operating limits on running plant.



The programme serves oil and gas, refining and petrochemicals, chemicals and power generation.

Learning Outcomes

1. Participants will be able to evaluate process and equipment options against inherently safer design principles.
2. Participants will be able to diagnose the dominant hazards of vessels, exchangers, rotating equipment and fired heaters.
3. Participants will be able to justify the governing relief case for an item of equipment.
4. Participants will be able to assess relief, flare and safety instrumented protection for adequacy and independence.
5. Participants will be able to construct safe operating limits with linked alarms and trips.
6. Participants will be able to prioritise safeguarding gaps into an action plan for a process unit.

Programme Structure

Day 1: Inherently Safer Plant Design Principles

Which hazards can be removed or reduced before any safeguard is added?

- Hierarchy of Hazard Control in Process Design
- Minimise, Substitute, Moderate and Simplify Strategies
- Inventory Reduction and Process Intensification Options
- Plant Layout, Spacing and Siting Considerations
- Inherent Safety Indices for Comparing Design Options

Day 2: Process Equipment Hazards

Where do vessels, exchangers, rotating equipment and heaters fail?

- Pressure Vessels, Design Margins and Brittle Fracture Risk
- Heat Exchanger Tube Rupture and Fouling Hazards
- Pump and Compressor Seal Failure and Surge
- Fired Heater Firebox Explosion and Tube Overheating
- Corrosion, Erosion and Damage Mechanism Screening

Day 3: Overpressure Scenarios and Pressure Relief Systems

Which overpressure cases govern, and is the relief path able to handle them?

- Blocked Outlet, Fire Case and Utility Failure Scenarios
- Governing Relief Case Selection and Load Summaries
- ISO 4126 Relief Valve and Bursting Disc Selection
- Inlet Pressure Loss, Backpressure and Chatter Checks
- Flare Headers, Knock-Out Drums and Depressuring



Day 4: Instrumented Safeguards and Alarm Design

How are trips and alarms specified so they act when needed?

- Layers of Protection Analysis for Scenario Safeguarding
- IEC 61511 Safety Instrumented Function Specification
- Safety Integrity Level Targets and Proof Testing
- Alarm Rationalisation and Operator Response Time
- Bypass, Override and Inhibit Controls

Day 5: Safeguarding Review and Safe Operation

How do design choices, relief and trips combine into one safeguarding plan?

- Safe Operating Limits and Integrity Operating Windows
- Applied Inherently Safer Design Challenge for a Participant Unit
- Applied Relief Case Check for Critical Equipment
- Applied Safeguard Independence Test Using Layers of Protection
- Equipment Safeguarding Review Completion and Presentation

Methodology

The programme relies on case analysis of process units from refining, chemicals and gas processing. Participants compare design options, work through relief scenarios, test safeguard independence and review incidents where equipment protection failed, then apply each method to their own unit.

- Suggested activity: Ranking three reactor design options on inherent safety.
- Suggested activity: Identifying the governing relief case for a distillation column.
- Suggested activity: Testing an alarm and trip for independence from the initiating cause.

Capstone Output

Each participant completes an equipment safeguarding review for a selected process unit, listing inherently safer opportunities, overpressure scenarios with the governing relief case, instrumented safeguards, safe operating limits and prioritised gaps with owners, ready for a review board.

Frequently Asked Questions

Is inherently safer plant design training suitable for operations leaders without a design background?

Yes. It suits operations and technical safety leaders who approve changes and run plant. It assumes familiarity with process units; Session 1 and Session 2 set out the design concepts.



Which standards support inherently safer plant design, pressure relief and safeguarding?

The programme rests on inherently safer design principles, the ISO 4126 series for relief devices, IEC 61511 for safety instrumented systems and layers of protection analysis.

How is the pressure relief and safeguarding review used at work?

You can use it to brief a review board, scope relief and instrumentation studies and plan modifications for the unit you assessed.

How does pressure relief and safeguarding training differ from process safety management programmes?

It works at equipment level, testing design choices, relief cases and trips, rather than designing the surrounding management system and audits.