
Experiences of Implementing Aspects of IEC61508.

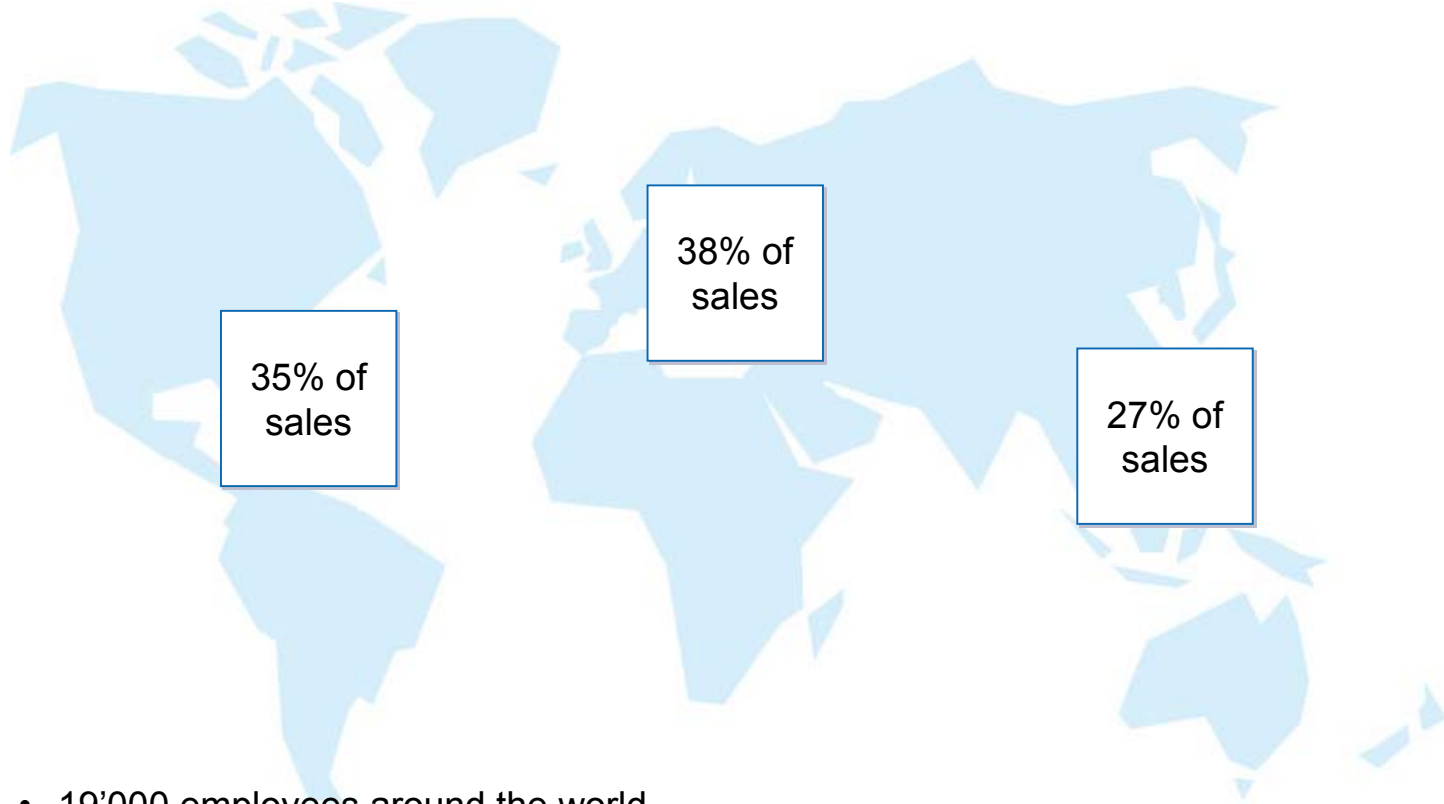
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Introduction

- Overview of Ciba.
- First Project.
- First Project - Safety Studies.
- Initial Reactor Shutdown System.
- Changes in Implementing IEC61508.
- Focus on IEC 61508.
- Reactor Shutdown System.
- Building the Same Plant Again.
- Organisational Boundaries.
- Hints & Tips.
- Conclusion & Learning.



Balanced global presence



- 19'000 employees around the world
- Sales in 120 countries
- 60 production sites in 23 countries
- 22 research centers in 11 countries



Segments focused on customer industries

Plastic Additives

Industries:

- Plastics
- Lubricants



Water & Paper Treatment

Industries:

- Water
- Paper
- Pollution Control



Home & Personal Care

Industries:

- Home & Fabric Care
- Personal Care



Coating Effects

Industries:

- Paints
- Imaging & Inks
- Electronics
- Plastics

Textile Effects

Industry

- Textiles

First Project – Bradford Site

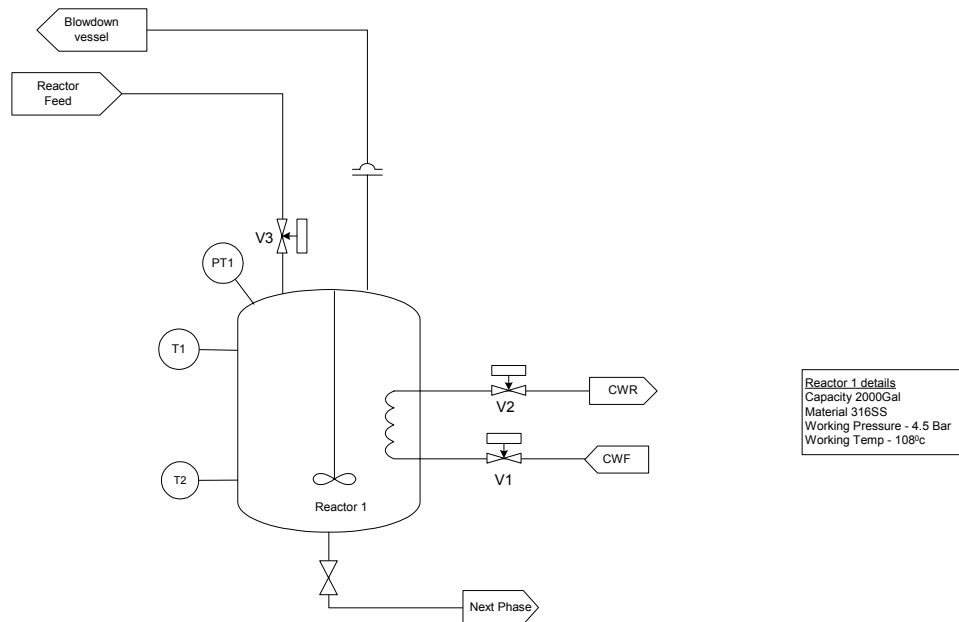
- Location highly populated residential area.
- Main Intermediates Plant for Water & Paper Treatments.
- Existing Plant was 15 years old, Panel control from Control Room labour intensive. Safety system, some hardwired and cooling water.
- Continuous Process
- Multi-million pound Upgrade sanctioned 1996, driving force EHS, increased production, quality and Regulations.
- Focus on Safety.
- Focus on Automation – New control system (DCS)
- Had to be installed while the Plant was running with minimum shutdowns. From 1997 – 2000.



Safety Studies – Existing Process

- Existing process systems
 - Safety Allocation Studies (SAS). Worst case!
 - From Thermal Hazards, requirements temperature not to rise above 128°C, second exotherm cause excursion, never been witness on Plant in the past, small chance it may!
- Basic Levels of protection – Reactor, before IEC61508.
 - DCS Control System.
 - Cooling water to Reactor Jacket.
 - Agitation.
 - Blow down Vessel with quench heel.
 - Independent Shutdown system.

Initial Reactor Safety Shutdown system



Changes in Implementing IEC61508

- Different focus on safety studies
 - Holistic view.
- Develop method for Integrity Level determination.
 - Expanded the 3X3 to 5X5 matrix cover Safety & Environment.
- Backing from senior management.
 - Re-do Risk Assessments
- External Training on 'Protective Systems' for engineers.
- Joined European steering group on the development of IEC 61508.

IEC 61508 Focus.

- Cooling Water & Reactor stirrer as a safety function.
 - Cooling Water to keep Temperature below 108°C
 - Agitate no hot spots, prevents polymerisation
- Problems
 - Guarantee Cooling Water Supply & Temperature.
 - Guarantee Agitation.
- Issues
 - Failure to supply cooling water, make cooling tower SIL 1
 - Not practical too many moving parts, and power supplies.
 - Make Agitator SIL 1,
 - Too many parts, gearbox, couplings etc, inverter driven and electrical supply.

Resolution

- To use a Chlorine based inhibitor direct in the reactor, outcome from Thermal Hazards.
- Benefits of Chlorine Based system.
 - Safety wise completely kill's the Reaction instantly.
 - Achieve SIL 1 rated system.
- Challenges with using a Chlorine Based System
 - Created other issues not associated with safety.
 - That if the inhibitor was activated the cocktail that remained how do we dispose off? Estimated in the hundred's of £1,000's.
 - The inhibitor is a strong Chloride solution damage caused to the Stainless steel Reactor and associated equipment + down time of lost production. Estimated in the hundred's of £1,000's.



Final Control Safety Levels

- Split into 3 levels
- Level 1 – Cooling & Agitation
 - Cooling on the reactor & agitation control via Control System. Set at 108°C
- Level 2 – Cooling Only
 - Via Independent hardwired temperature measurement. Set at 118°C
- Level 3 – Inhibitor Dump – SIL 1
 - To inhibitor Dump – Final Mechanism when Temperature Reaches 128°C.
 - Based on 2oo4 voting temperature probes to prevent spurious tripping 1 hardwire & 1 Shutdown System.

Level 3 Considerations

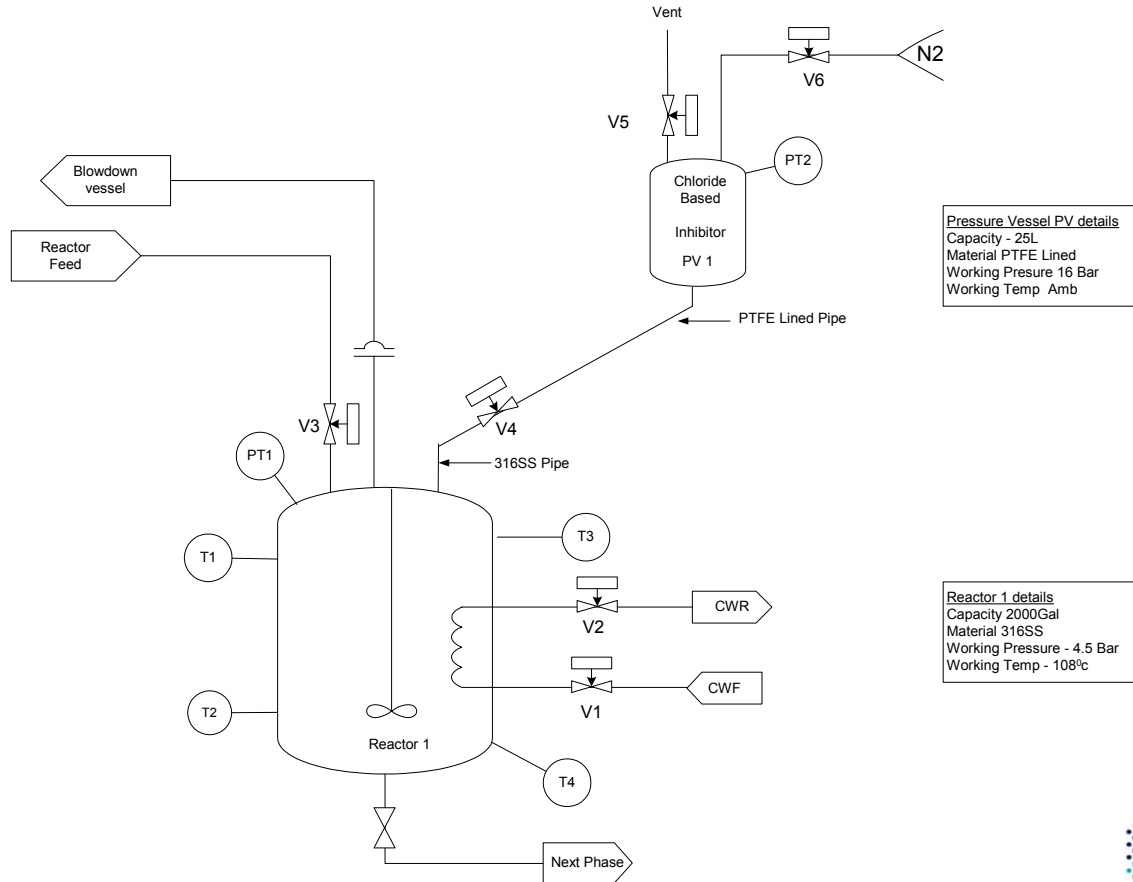
- Caution applied as the design went on, remember the SAS was only to prevent second exotherm. But know we had introduced a system that made the process safe but, would be very costly in both lost production, Plant equipment and environmental disposal issues.
- Caution to the design.
 - Voting system 1 hardwired temperature probe and one shutdown probe must sense the same high temperature.
- Aware that we may be designing in elements to prevent spurious trips, by increasing the reliability of trips.
- Added 2 solenoid valves to the valves in the Chlorine line, 2 different air sources both on N₂ Back-up 1 with air cylinder. Power supply back up to the ESD systems via UPS.



Level 3 Considerations cont

- Calculate theoretical spurious trip rate which came out at 99.6%. Original 95%.
- SIL 1 reliability calculation 48.5yrs, testing every 6 months.
- Before upgrade safety level did not achieve SIL 1.

Reactor Safety Shutdown System



Building the same Plant Again

- On new Plant the design would be completely differently.
 - Design out the inhibitor system.
 - Design out the Shutdown System (E/E/PES).
- Achieved on another site in the US, on a Greenfield site.
 - Achieved designing out the inhibitor system.
- Other facts.
 - UK Plant has 30 SIL 1 loops, complicated E/E/PES system.
 - USA Plant has 8 SIL 1 simple loops hardwired. Achieved from the learning on the UK site.
- See from above the cost saving and benefits gained.
- Impossible to replicate on the Bradford site due to the radical change in design.



Organisation Boundaries

- Difficultly in UK/European/Swiss/USA cultures to implement IEC61508
- Ciba already had good safety procedures based on NAMUR & DIN, could see no reason to adopt IEC61508, in the USA S84 adopted.
- Not recognised in Switzerland.

Realised short falls in NAMUR, time to change!

- Now, these have been brought together all standards, reviewed globally, changed and incorporated IEC61508.
- Taken a number of years to get a harmonised standard for all cultures.
- Starting the next phase global roll-out.

Hints & Tips

- Design out Integrity Levels.
 - Use KISS (Keep It Stupidly Simple).
- Robust methodology for defining Integrity Level
- Team work for defining Integrity Level
- Independent Challenge internally, aids focus and understanding.
- Continuous development and learning.
- Extra effort required for cut & carve Projects.
- Include other benefits such as Environmental &/or Asset.
- Be aware if masking spurious trips events, ensure you fully understand the consequences.
- Don't fit and forget.
- Include feedback for when Plant/Process change.



Conclusion & Learning

- Don't take your eye off the ball and concentrate on Safety alone, get the holistic view.
- Crossing organisational boundaries can be difficult.
- On like for like Projects make sure to review the Safety, just because it was done before does not make it correct, learn by redoing and incorporating the learning, will lead in the long run to a safer and cost effective solution.
- Continue to review Procedures, incorporate learning.
- Buying from management is a must to achieve the benefits of IEC 61508.

Thank You