

Process Safety Consultancy

Stopford Projects Ltd



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Health and safety is a necessary consideration in many aspects of our everyday lives, for example wearing a seat belt in a car or having fire alarms in our homes. The process industry however has to take this element of their environmental, corporate and social responsibility even more seriously. A strict approach is vital due to the high temperatures, pressures and hazardous substances involved in process systems.

Past incidents have proven that carelessness and lack of preparation and mitigation have led to catastrophic failures of systems causing tragic accidents. The implementation of safety systems and conduction of regular checks may seem time consuming and costly, but they are necessary in order to avoid major disasters.

Stopford has dedicated Health, Safety and Environment experts integrated within their Process team to deliver high quality safety consultancy. At Stopford we apply our expertise to all of the industries we work in to assess, identify and quantify potential hazards, provide advice on mitigation and implement safety systems to minimise the risks. Our capabilities cover the following areas;

- HAZOP Studies
- HAZAN Studies
- Human Factors
- Pressure Relief (PEL)
- COSHH Studies (Control of Substances Hazardous to health)
- COMAH Studies (Control of Major Accident Hazards)
- ATEX/DSEAR
- LOPA
- Surge Analysis (FLOWMASTER)
- Fire Engineering
- Fire Risk Assessments
- Bespoke Process Safety Training



'For over three decades Stopford Projects has developed to become the balanced, high quality, skilled, innovative and dedicated team we see today'

Stopford Projects Director, Debnath Pal

Stopford Projects Ltd was formed in 1982 in the North West of England to provide cost effective detailed design and project management services to local industry. Stopford has developed over almost three decades to become the company it is today serving international clients from our offices in Cheshire, Lancaster and Luton. Stopford provide world class consultancy, multi-disciplined engineering design, project management and construction services in a variety of industrial sectors, to both UK and international clients. We offer a comprehensive range of engineering services from concept to complete engineering design through to total project implementation.

We pride ourselves on our flexibility to work with our clients in the most appropriate way and often tailor our methods to suit each individual project. Thus achieving the best possible results for all parties. All our work is carried out in accordance with the Stopford Quality System and to our ISO 9001:2008 certification.

The sectors we operate in are as follows:



Petrochemical &
Bulk Chemical



Fuel Storage &
Distribution



Fine Chemical &
Pharmaceutical



Renewable
Energy



Environment



Biotechnology



Paper



Nuclear

Deb Pal

Deb joined Stopford Projects as the Process Engineering Manager in 1999 and became its Process Director in 2003. He holds a BEng degree in Chemical Engineering and was elected as a Fellow of the Institute of Chemical Engineers in 2009.

Deb's responsibility is to develop the process engineering and consultancy capabilities of the business as well as carrying out Process Safety consultancy, and being the Responsible Director role for a number of key clients. He has lead over 30 HAZOP studies for a wide variety of clients and carried out training for clients in the areas of DSEAR/ATEX, Dust Explosions and Safety Instrumented Systems and assessment of safety integrity levels using techniques such as LOPA. Stopford is now seen as experts in these fields, providing process consultancy to clients on a world wide basis.



Deb Pal



Neil Thompson

Neil Thompson

Neil joined Stopford Projects as a Senior Process Engineer in 2009 and become Process Engineering Manager in 2010. He holds a BSc degree in Chemical Engineering and spent 20 years in chemical plant operations before joining Stopford.

Neil's responsibility is to manage the Process Engineering department to ensure compliance with legal and quality standards while delivering a safe and cost effective solution to clients.

Neil has experience of HAZOP as a participant, scribe and also as leader. He has experience of fault trees and LOPA for establishing the required SIL rating of protective systems. He has experience of design, from concept through to commissioning, operation and finally to decommissioning.

John Valavanis

John joined Stopford in July 2008 as the company's Health & Safety Manager. John holds a B.Eng degree in Mechanical Engineering, is a chartered safety and health practitioner (CMIOSH) and registered as an occupational safety and health consultant (OSHCR).

John has 35 years of experience (the last 20 as a H&S specialist) in a wide range of industrial environments including the chemical, petrochemical, pharmaceutical, general manufacturing and construction industries. He has developed and led Stopford's capabilities in Construction Safety, resulting in the successful delivery of construction projects for a number of major blue chip clients.

John's background in the chemical engineering and allied sectors has also enabled him to join Stopford's Process Safety department for the undertaking of DSEAR/ATEX studies, ignition risk assessments, fire risk assessments and hazardous area audits.



John Valavanis



Mercedes Martin

Mercedes Martin

Mercedes Martin has worked at Stopford for twelve years, prior to this she worked as a Research Associate at the University of Newcastle upon Tyne. Mercedes is now a Senior Process Engineer at Stopford and has worked on a great range of projects which have mostly involved process design work and safety studies, with specific focus on pressure relief systems, dust explosions and fire risk assessment. She worked for five years on a fine chemical manufacturing site, conducting product sitings and plant support.

In the last three years, her work has concentrated more on fire safety. After completing several fire engineering courses, she has conducted numerous fire risk assessments for petrol terminals and chemical plants and has also completed the detailed design of the fire protection systems for many of these facilities.

Hazard Studies

As an employer it is your responsibility to ensure the safety of your employees, the general public and the surrounding environment. Hazard studies enable you to identify potential hazards and implement strategies to reduce the risks of occurrence.

HAZOP Studies

Hazard and Operability Analysis (HAZOP) is a structured and systematic technique for identifying major potential hazards within new or existing facilities. HAZOP studies are typically conducted in 6 stages. The diagram below indicates when during a project each HAZOP stage should be conducted. Stages 1-3 are conducted during the design phase of a project, whilst stages 4 and 5 occur during commissioning. Stage 6 should be conducted approximately 1 year post commissioning.

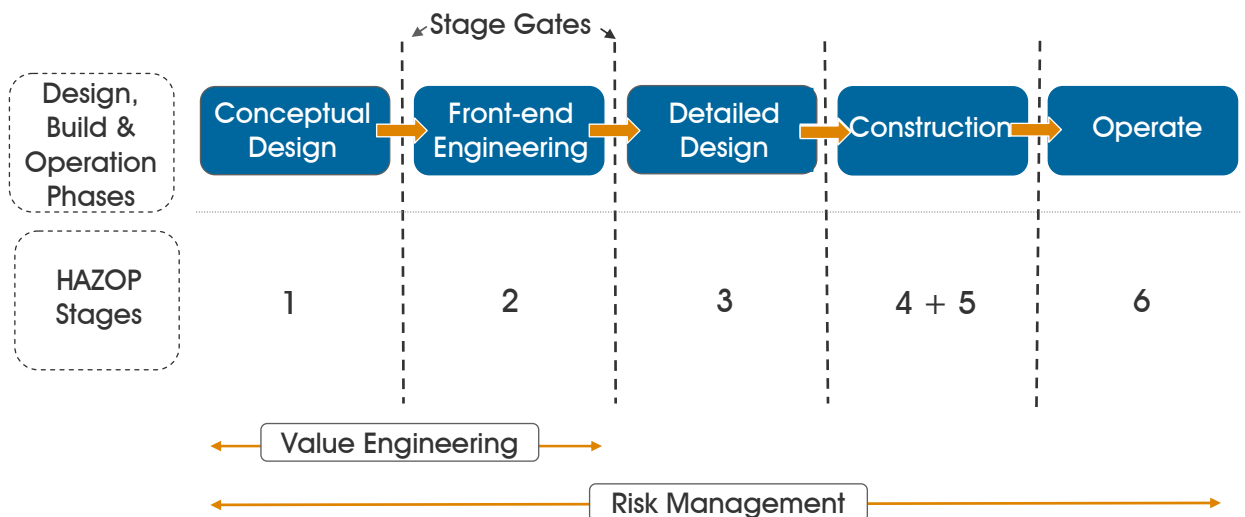


Figure 1. Outline of the phases of HAZOP in relation to the Stage Gate process.

We have carried out process hazard reviews/HAZOP1-6 for the following clients:



Avecia

HUNTSMAN



Air BP



HAZOP Case Study



Air BP

Project: Development of a generic approach to hazard studies

Location: Air BP 430 sites world wide

Our client wanted to develop an innovative approach that would enable all of their sites to be assessed, which effectively required adopting a generic approach

- Stopford developed and chaired the generic HAZOP studies and developed training for its' use.
- Stopford have conducted HAZOP/training for BP engineer - UK, S. America, Albania, Hungary, Kosovo, etc.



HAZAN Studies

Hazard Analysis (HAZAN) aims to provide specific information relating to a particular hazard through a detailed risk assessment. HAZAN studies assess the frequency of a potential hazard occurring (Fault Tree Analysis) and also the effect and extent of such and incident (Consequence Modeling). Through the conduction of an HAZAN study a facility can then be advised on the most suitable solutions for hazard prevention and mitigation.

Stopford has expert capabilities in the implementation of hazard studies. We can act as independent experts for the execution of HAZOP and HAZAN studies through the industries we operate in.

Hazard studies allow you to identify where and when potential hazards may occur. Stopford can assist you through this process and more importantly recommend the most appropriate safety mechanisms to ensure the risk to your employees, local people and surrounding environment is as low as reasonably practicable.

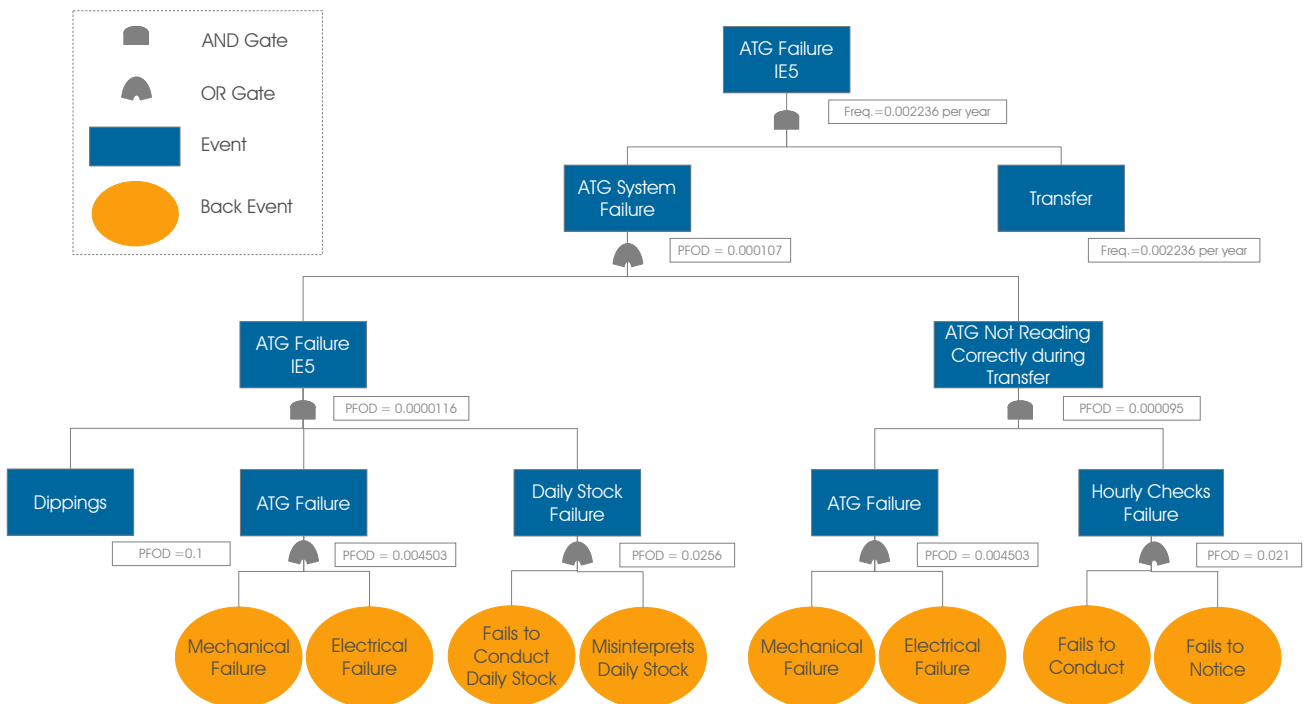


Figure 2. Schematic diagram of a typical Quantitative Risk Assessment (QRA)

Human Factors

It is an established fact that human errors have contributed to the cause of several accidents in the process sector. Stopford use the HEART (Human error assessment reduction technique) to assess human factors, a table showing a previously partial assessment is shown below:

Table 1. Partial Human Error Assessment

Error	Available ullage overestimated				
Type of task	E	Nominal Human Unreliability	0.02		
EPC- Error Producing Conditions			Total HEART effect	Proportion of Effect (prp)	Assessed Effect
15	Supervisor inexperience		3	0.1	1.2
17	Little of no independent checking or testing of output		3	0.5*	2
			Nominal likelihood of failure		0.048

Pressure Relief

Pressure relief systems are vital for the safe operation of plants in many industrial scenarios.

All facilities containing materials or substances at pressure, or that have the potential to become pressurised, must be adequately equipped to withstand irregular pressure changes. Thus it is vital to assess the need for implementing or improving a pressure relief system. This is not just to comply with the numerous regulations assigned to pressurised systems, but more importantly to reduce the risk of disastrous consequences.

Stopford have experienced engineers qualified to design and verify pressure relief streams. Our service offering ranges from initial investigations to design and implementation of required systems.

- Pressure relief audits.
- Vessel pressure review.
- Pressure yield calculations.
- Relief rates calculations.
- Reaction force assessments.
- Scenario mapping & identification of worse case scenario.
- Chemical hazard studies.
- Reaction studies.
- Specification of most suitable relief device/devices.
- Two phase flow calculations.
- Design of new relief systems or improvement of existing systems.
- Development of venting philosophies.
- Complete turnkey relief system.

Pressure Relief Case Studies

Stopford carried out a Pressure Relief review for a client. The process under review had the potential for a runaway reaction. Stopford carried out Chemical Hazard Assessments with the client so that scenarios that could lead to an exothermic reaction were identified. Based on the findings from the Chemical Reaction Hazard Assessments certain calorimetry studies that had to be carried out were identified. Stopford then carried out a pressure relief study using the results from the calorimetry. Pressure relief calculations were carried out using the HSE's "Workbook for chemical reactor relief system sizing" using Leungs method or the Clausius Clapeyron relationship to estimate the relief flowrate and the Omega method to estimate the two phase flow capacity per unit area of the vent pipework. Most of the reacting systems were tempered vapour pressure systems, with one system being an untempered hybrid. Some overpressure scenarios gave rise to relief sizes larger than could be physically installed on the reactor, in these cases the frequency of a particular scenario was quantified using Hazard Analysis. These studies highlighted the cooling system and temperature control of the exothermic reactions was critical, parts of the system were altered to improve the reliability of the system.

On an Upper Tier COMAH site, a pressure relief study was undertaken on a new plant. All credible over and under pressure scenarios were investigated from external fire to contamination of the feedstock. Two phase and single phase calculations were undertaken based on calorimetry data to size the relief systems. As part of the exercise a study was undertaken to recommend the most appropriate venting scheme to ensure that the risks were ALARP-as low as reasonably practicable. Dispersion modelling was carried out to ensure that the off-site effects were minimal. Once the venting system was chosen the relief capacity of the system was calculated using specialised software to calculate the two phase relief capacity. This study showed that on a couple of the reactors because of the change of diameter of the relief lines due to layout considerations this resulted in flashing of the relief stream and choking, restricting the flow. By altering the piping and removing unnecessary expansions the flow capacity of the system could be increased to the required level.

LOPA

LOPA is a risk assessment tool that is semi-quantitative in nature, it can be used to demonstrate that the risks from a process are as low as reasonably practicable. It is also the preferred method to determine the safety integrity level (SIL) for safety instrumented systems under IEC 61511.

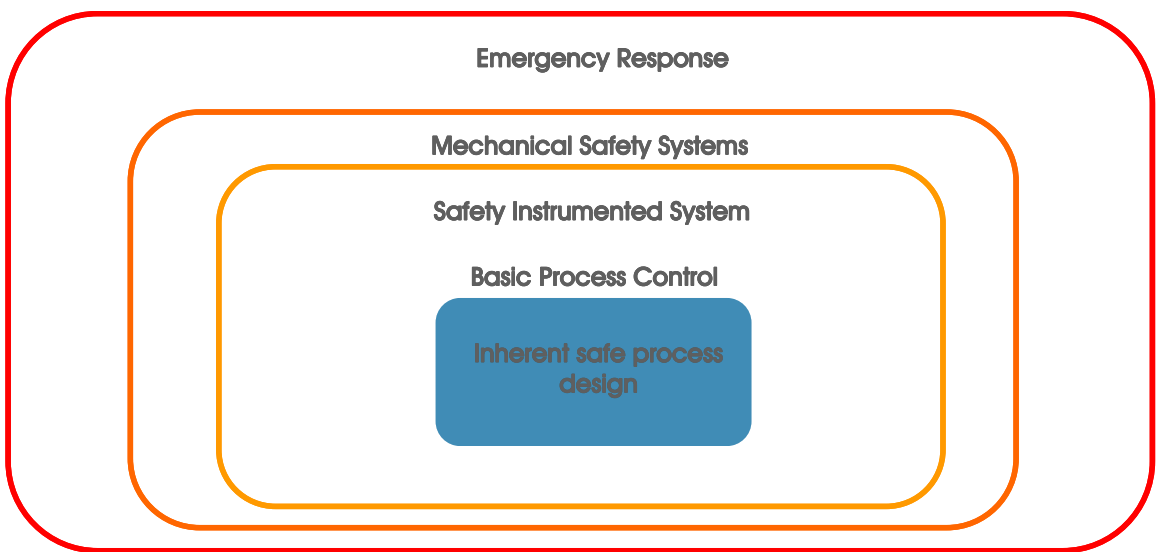


Figure 3. Schematic diagram outlining the levels for which LOPA can be associated.

Stopford have extensive experience in carrying out LOPA studies for a wide range of industries. Providing our clients with the information they need to make informed risk management decisions.

Our services include;

Following the Buncefield incident in 2005, Total appointed Stopford to assess the reliability of their overfill systems and to carry out LOPA assessments so that the SIL rating of new overfill systems could be specified.

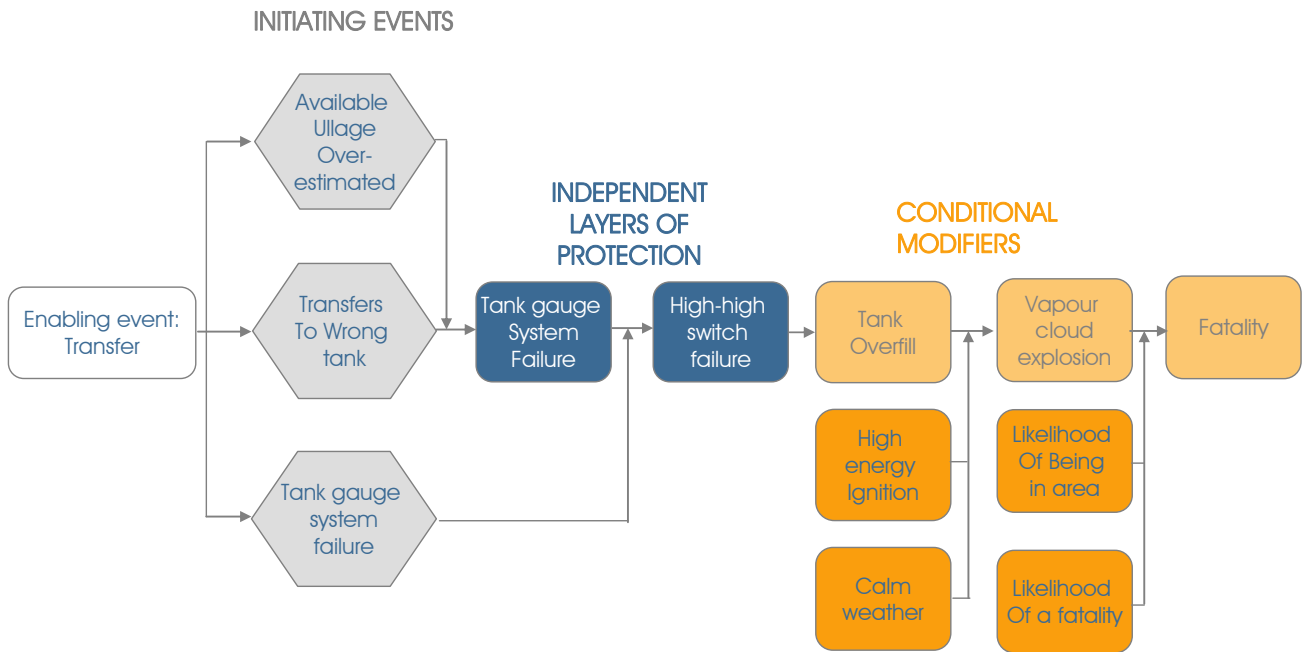
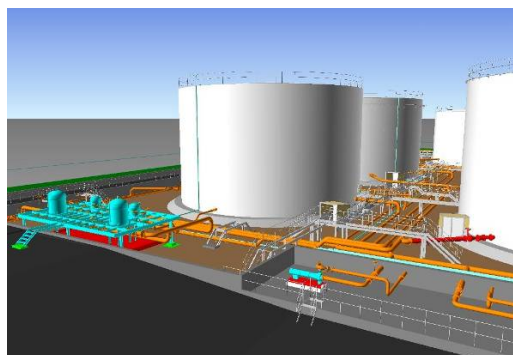


Figure 4. Diagrammatic representation of the LOPA technique.



Stopford developed a sophisticated Excel spreadsheet that would be able to used by the asset engineers to conduct LOPA with minimal training/guidance.

Stopford also produced and delivered a training package to accompany the LOPA spreadsheet that was developed for the client.



ATEX/DSEAR

ATEX (Explosive atmosphere) and DSEAR (Dangerous Substances and Explosive Atmosphere Regulations) enforce stringent pieces of legislation that require attention and consideration at many industrial sites. The legislation aims to protect workers and local communities from potential explosion risks.

To ensure our clients are compliant with the regulations Stopford offers the complete ATEX and DSEAR consultancy package. Assistance can be provided within any industry that requires ATEX and DSEAR support. A client may wish to implement procedures and documentation to gain compliance for the first time or simply ensuring compliance is still being gained at a previously assessed site.

Stopford's services include;

- Comprehensive risk assessments of all fire and explosion hazards.
- Area classification studies.
- Inspections and certification.
- Equipment certification (mechanical and electrical equipment).
- Continual review and maintenance to ensure compliance.
- Documentation analysis (review current documents to check they are sufficient and up to date).
- Production of required documentation to ensure compliance.
- Training provision to ensure the work force understand the importance of compliance.

ATEX/ DSEAR Case Studies

Stopford provided a site wide area classification and DSEA risk assessment for a local energy company. The project involved identification of fire and explosion risks, an area classification exercise, risk analysis for the plant, recommendations to eliminate/reduce the risks identified and visual inspections of electrical and mechanical equipment in classified areas. Reports were generated to prove ATEX/DSEAR compliance. All work followed the British Standard BS EN 60079-10: 2003.

Lubrizol, Bromborough.

Stopford carried out a full area classification and DSEAR compliance work, including equipment inspection and assessment against the declared Zones, in 2003/2004.

This was a large study that covered the entire manufacturing site including raw material and product handling and storage, process operations and utility delivery. Significant changes in the existing zones were required, which enabled rationalisation of unnecessary zones, which previous had caused compliance problems.

Anglo American-New Cement Plant, Buxton.

Stopford undertook a review of DSEAR compliance and a Fire Precautions Study for the whole site.

GE Infrastructure, Widnes.

Stopford provided a site wide area classification and DSEA risk assessment. The project involved identification of fire and explosion risks, area classification exercise, risk analysis for the plants at risk, recommendations to eliminate/reduce the risks and visual inspections for electrical and mechanical equipment in classified areas. Reports have been generated to prove ATEX/DSEAR compliance. All work followed the British Standard BS EN 60079-10: 2003.

CompEx

European legislation in the form of ATEX regulations requires that each item of electrical equipment installed in a hazardous area is regularly inspected and maintained to ensure that the equipment is safe to operate, and continues to be safe to operate. Accurate records should be maintained to demonstrate compliance to these regulations. In the UK, the Health and Safety Executive (HSE) are responsible for ensuring that plant operators comply with these regulations.

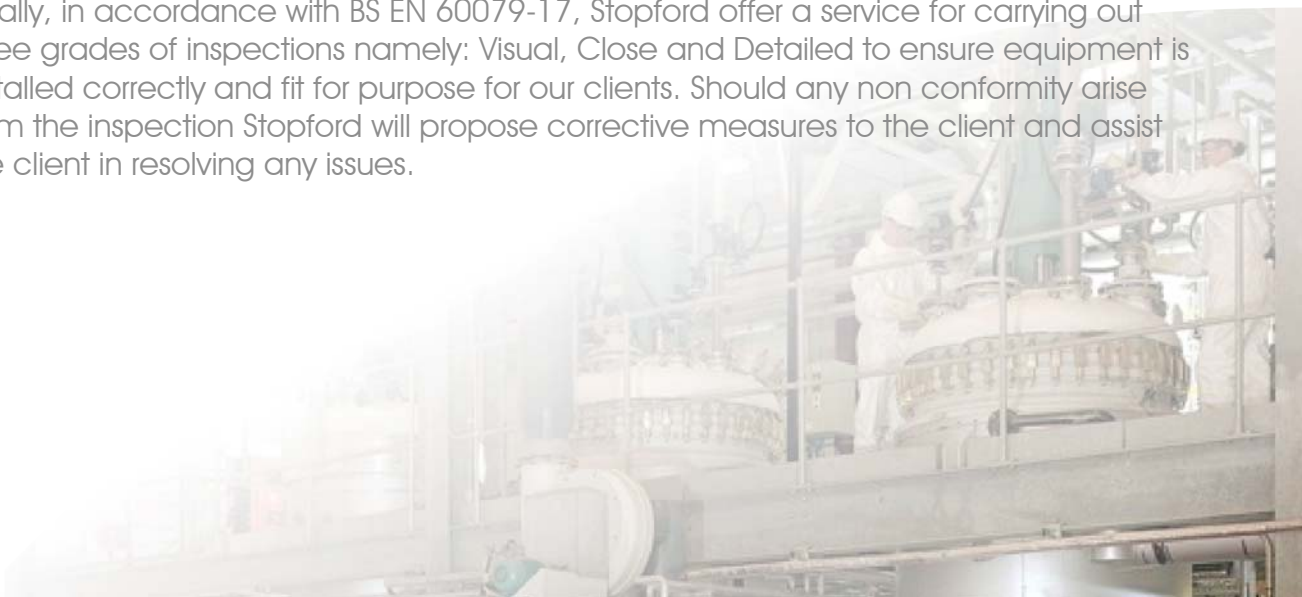
CompEx is Competency Validation and Certification for electrotechnical and mechanical craftspeople working in potentially hazardous or explosive atmospheres.

Stopford have the competency to design and inspect installations according to CompEx units Ex01 (Installation of Ex d, Ex e and Ex n equipment), Ex02 (Inspection of Ex d, Ex e and Ex n equipment), Ex03 (Installation of Ex ia and Ex ib equipment) and Ex04 (Inspection of Ex ia and Ex ib equipment) which comply with BS EN 60079-17 – Explosive Atmospheres: Electrical installations, inspection and maintenance.

Stopford is able to create an ATEX Register which ensures easy traceability of all hazardous area equipment installed on site and can be used for planned maintenance purposes, which satisfies the requirements for the above mentioned regulations.

For clients with existing installations Stopford offer a gap analysis of all the installed equipment and can suggest recommendations for corrective measures should any non conformity arise.

Finally, in accordance with BS EN 60079-17, Stopford offer a service for carrying out three grades of inspections namely: Visual, Close and Detailed to ensure equipment is installed correctly and fit for purpose for our clients. Should any non conformity arise from the inspection Stopford will propose corrective measures to the client and assist the client in resolving any issues.



Surge Analysis

Pipelines containing/transporting fluids are prone to pressure surges. These surges occur when a change in pressure arises, thus effecting the velocity of the fluid

Pressure surges are commonly caused by rapid closure of valves or pump trips

These surges can cause excessively high pressures in the pipes and apply high forces to pipe supports, leading to loss of materials and equipment damage. The largest risk is associated with long pipes that have significant changes in elevation. However good engineering design can minimise surge pressures and reduce the risk of damage being caused.

Stopford are able to conduct surge analysis studies to indentify potential problems and minimise to risk of surge pressures. An initial assessment would be carried out using Joukowski calculations to establish the maximum theoretical. Form this initial assessment its is then possible to determine if a more details analysis is required. In this case Stopford would model the system using FLOWMASTER:

After modelling a system Stopford is able to provide recommendations and establish designs that will ensure pressure surges are minimised within the system. This may include;

- Change to pipeline specification.
- Valve types (rapid closing and correctly located).
- Valve closure times.
- Topography changes.
- Flywheel sizing.
- Surge alleviator sizing.
- Limited flowrates and flow velocities.
- Pipe supports, although stress analyses would be required.
- Implementation of fire systems where appropriate.

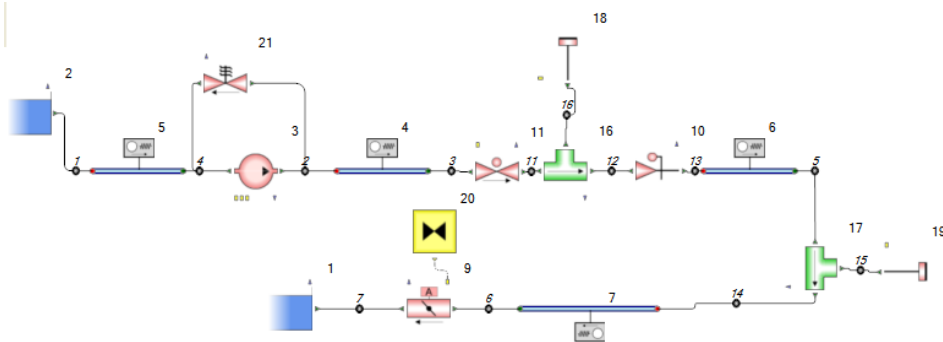


Figure 5. Systematic diagram of system nodes for surge analysis

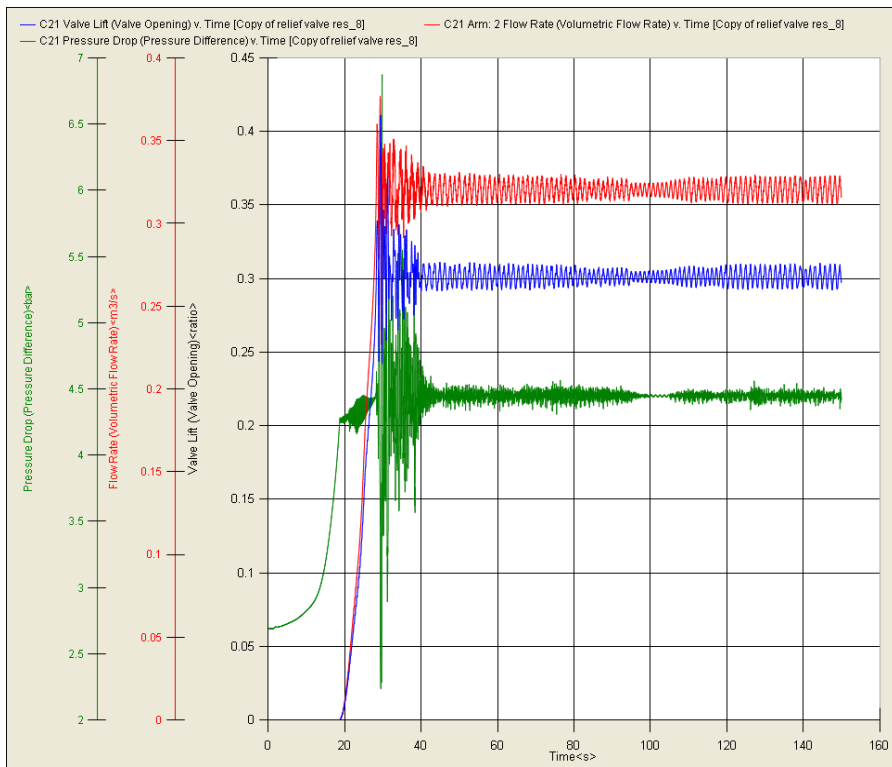


Figure 6. Typical Pressure Profile

Fire System Engineering

General fire safety in England and Wales is delivered through compliance with the Regulatory Reform (Fire Safety) Order 2005. By virtue of this Order, the responsible person should carry out a fire risk assessment on their premises, implement appropriate fire precautionary and protection measures, and maintain a fire management plan. The main purpose of the order is to prevent fire and minimise risk and to ensure safety of everyone in the premises and in the near vicinity. The requirements by this Order are applicable to premises whilst in operation.

Stopford's high level expertise on chemical, petrochemical plants and other industries in process and safety design coupled together with Stopford's trained and experienced engineers in fire risk assessments and fire protection can help companies to comply with this Order and also to minimise economical losses by providing cost-effective and relevant Fire and Explosion Hazard Management Strategies.

Stopford can undertake the following activities:

- Fire Risk Assessments.
- Design and Specification of Fire Detection and Protection Systems.
- Fire Protection Reviews in Plant Buildings (e.g. means of escape, emergency lighting).
- Emergency Response Plans.
- Quantitative Risk Assessments.
- Heat Radiation Modelling.
- Pressure Surge Analysis.
- Calculation of water deluge and foam rates.

Stopford work closely with the suppliers of specialist fire equipment to successfully deliver active fire fighting systems that complies with the appropriate codes and fully satisfies the client requirements.

The diagram below shows the different layers of protection for a fire event. Stopford put a big emphasis on minimising the requirements for fixed fire protection by fire prevention through process controls and plant procedures.

Following a preliminary fire risk assessment, liaison with the client and/or fire brigade is important when specifying the fire detection and protection to ensure the approach taken by Stopford fit with the clients policy and local fire brigade capabilities.

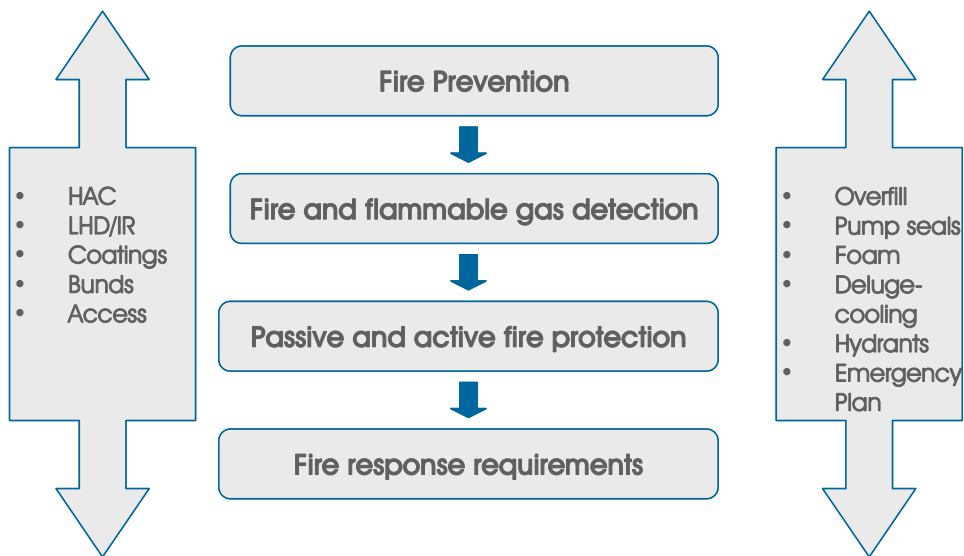


Figure 7. Layer of protection required in the event of a fire

Fire Risk Assessment

A fire risk assessment is carried out by following an organised and methodical study to:

- Identify fire hazards.
- Reduce the risk of those hazards causing harm to as low as reasonably practicable.
- Decide the physical fire precautions and management arrangements required to ensure mainly the safety of people on the premises if a fire starts but also environmental and economical factors if required.

As part of the assessment, Stopford evaluate all the potential credible incidents, assesses the potential consequences of each incident and list the resources required to minimise the risk. A detailed quantitative assessment may be required for some scenarios to justify the implementation of some of the protection.

The five steps needed to carry out a fire risk assessment are shown diagrammatically below:

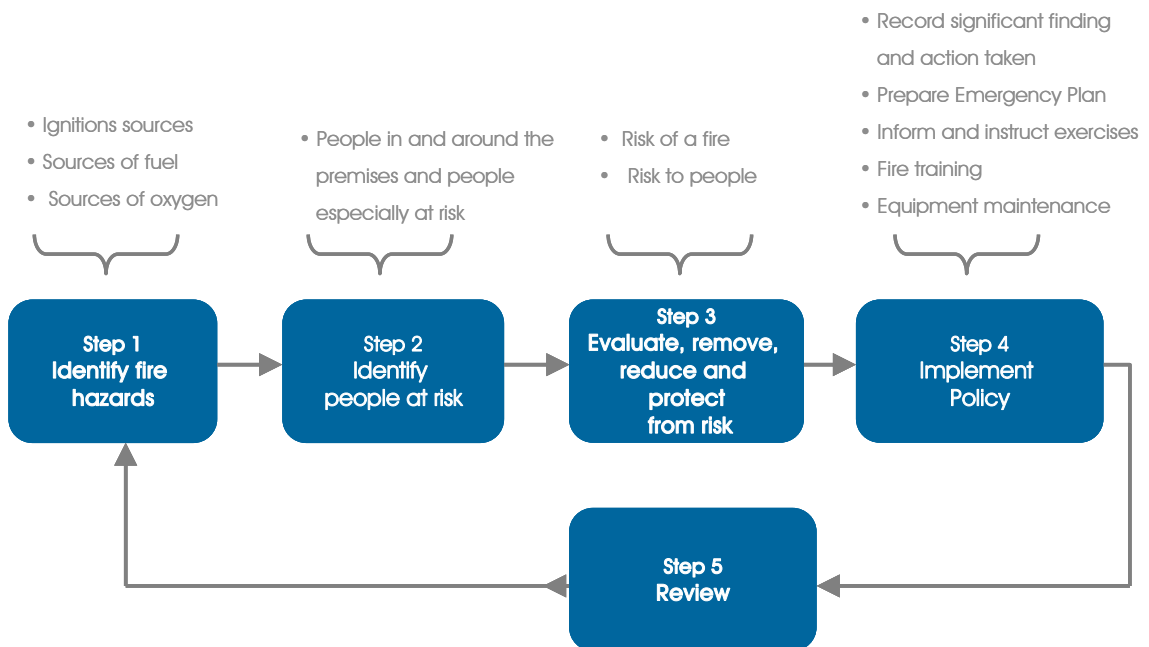


Figure 8. Flow chart of the 5 steps of a fire risk assessment.

Fire Safety in Flammable Storage Areas

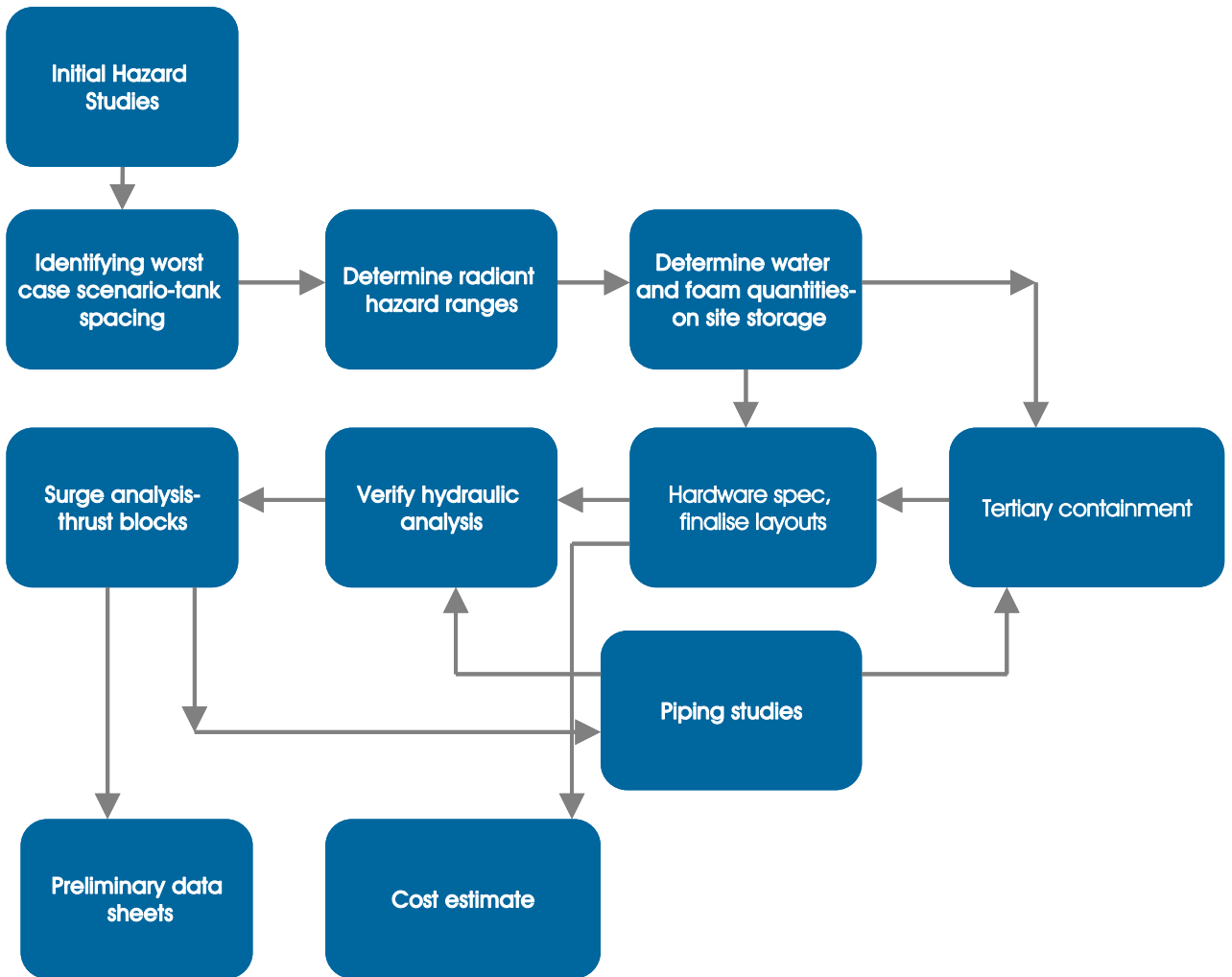


Figure 9. Flow diagram of the consultancy required to apply fire safety in facilities that store flammable substances..

Fire Consultancy Case Studies

Stopford also has experience in reviewing and specifying the fire protection for Industrial Buildings with clients including Port of Tyne and Tarmac.

These studies included:

- Identification of potential scenarios with semi-quantification of event probability.
- Effect on life safety.
- Assessment of means of escape
 - Emergency lighting
 - Signage
 - Portable fire extinguishers
- Review of existing fire detection and alarms and active fire protection.
- Evaluation of hydrants, fire mains and water supply.
- Assessment of access for the fire service.
- Preliminary assessment of building structures.
- Potential for fire escalation to nearby buildings or structures.
- Review of management procedures.

Stopford have been involved recently in several projects related to Fire Safety.

- Review of fire protection for rail sidings at Nottingham for Total.
- Fire risk assessment and producing fire system specifications for a \$220 million Waste to Energy Plant.
- Fire risk assessment for fuel storage and into-hydrant depot facility at Bahrain Airport for Air BP.
- Fire risk assessments for several new ethanol facilities at petrol terminals for BP.
 - Kingsbury
 - Northampton
 - Hamble
 - Hemel

The fire risk assessments included recommendations on equipment needed for active fire protection and water and foam requirements as well as preliminary design of the fire water main.

Detailed design and installation of fire protection (detection and fixed fire fighting equipment) for ethanol facility at petrol terminal at Kingsbury for Chevron. This project is ongoing and includes the provision of a new foam line and hydrants to a new storage area and the extension of the existing foam line to serve a new loading area. An assessment has been carried out on the existing fire water main to check the size is adequate for the new duty.

Bespoke Process Safety Training

We offer bespoke process safety training courses for both public and private sector organisations. After conducting process safety consultancy for a number of our clients Stopford were asked to provide training to their employees to ensure the systems Stopford were recommending were implemented effectively.

Areas in which we can deliver bespoke training packages include:

- Engineering Design & Project Management
- Process Safety
- Health, Safety and Environment
- Waste to Energy

Bespoke Safety Consultancy Packages

Many industrial facilities require assistance in various aspects of process safety. Stopford offer bespoke safety consultancy packages, which focus specifically on the requirements of the client to comply with the numerous safety regulations imposed upon their specific industry. This can include the provision of any number and combination of the services highlighted within this capability statement.