



WHITE PAPER

A Better Approach to the Risk Management Challenges of Industrial Parks

An industrial park is a site zoned and developed for industrial use and accommodating several companies that are legally separate entities. Approximately 35 years ago, the industrial park model seemed to be a promising trend in industrial development, as it boasted the benefits of energy optimization, logistic convenience, and cost reductions related to economies of scale. However, experience has shown that industrial parks harbor risks sometimes more difficult to counteract than those of individual plants.

EVOLVING FROM SAFETY DISTANCES TO LAYERS OF PROTECTION (LOPS) AND RISK-BASED METHODS

Process safety challenges in industrial parks

The first major challenge to process safety in industrial parks is administrative in nature. Parks may be organized and administered in a variety of ways; for instance, in major user parks, the facility is run by the principal organization. Closed parks are run by an infrastructure company, and open parks are run by the participating companies in cooperation. Finally, some parks are simply clusters of factories located near each other and administered independently. Who sets the standards and policies for process safety in these scenarios may be unclear. Furthermore,

global companies often have a centralized rather than a local approach to safety, meaning that a park hosting several global facilities will feature an array of process safety management systems. The result of all this is divided responsibility and a patchwork of independent systems with the potential for conflict, overlap and gaps.

The second challenge arises from the first and is generally referred to as the domino effect. Should a disaster occur in one facility, the potential for it to spread or in some way affect those nearby is high. In the absence of a centralized safety management system, there is

most likely little sharing of information among individual facility owners regarding risks and hazards. In this scenario, the safety of the park is dependent on the strength of the separate process safety systems at each plant or facility.

Process safety management is complex and requires very careful identification of hazards, assessment of risks and implementation of risk management measures (such as Layers of Protection, or LoPs). These measures need to be maintained throughout the operational life of the facility and revisited whenever there is a change in the process. A lack of expertise in process safety can easily lead to overprotection and overspending, or, at worst, safety loopholes.

Establishing an effective process safety management system requires a thorough knowledge of the plant in question, its processes, procedures and materials, and is really only possible with the disciplined collaboration of experts and leaders. This kind of complexity is a serious challenge for a loose conglomeration of facilities owned and operated independently of each other, i.e. an industrial park.

The limits of safety distances and consequence analysis

Unfortunately, there is no dearth of examples of inadequate process safety in industrial parks. There have been many catastrophic incidents in China since the country started to develop chemical manufacturing in the 1980s. The Tianjin explosion on August 12, 2015 is an example of risk management failure, and an explosion this year in a chemical industrial park in Xiangshui county of Yangcheng in eastern China is another. What we can observe as China struggles to confront these issues is a sort of “compressed” version of the history of process safety: from safety distances to consequence analysis to risk based methods.

On the surface, one of the simplest measures to implement are “safety distances,” or boundaries around hazardous sites or industrial parks where residential and commercial zones are prohibited. The underlying thought is that when an accident occurs it is best to have a protective buffer around the affected area. In order to be truly effective, of course, this approach requires a reliable analysis of all the hazards and their consequences to ensure that the buffer is large enough to contain the impact of the disaster. For example, in the recent Xiangshui explosion, windows four



miles away were blown out of buildings by the force of the blast. Drains and waterways running from and through the area have been blocked to prevent toxins from escaping and contaminating the surrounding environment. The difficulty of containing the effects of the disaster through safety distances alone becomes immediately clear.

Even supposing that safety distances manage to protect people and the environment, this approach results in suboptimal land use, essentially extending a significant “no man’s land” around the periphery of the industrial park. More importantly, it does not incentivize the adoption of preventive measures which could actually make the site safer and disasters far less likely.

Consequence analysis, while including safety distances, takes it a step further by requiring the operators of industrial parks to identify their worst case scenarios and estimate their consequences. China’s safety authorities have taken this step, recognizing the insufficiency of safety distances after the Tianjin incident, and have been asking industrial parks to identify major hazard installations and risk profiles as the basis for emergency response plans. However, as evidenced by the latest disaster, there is still work to be done educating industrial park operators and enterprises about the concept of risk and implementing effective solutions. While consequence analysis is more precise than safety distance and allows slightly better land management, the problem of not incentivizing the adoption of preventive measures remains, leaving industrial parks, their workers and neighbors at risk.

Moving toward risk-based process safety management

Several catastrophic accidents in the 1980s (mainly Bophal, India and San Juan Ixhuatepec, Mexico) highlighted very clearly that safety distances and consequence analysis were insufficient. Nonetheless, change has been slow, as China's efforts in this direction have shown.

Traditionally, risk management by the Chinese government was limited to emergency responses. In recent years, China's State Emergency Management Department (formerly called SAWS) has been asked to supervise risk management more actively and to take preventive approaches, so that identifying major hazards and risk monitoring is slowly becoming the focus. For example, SAWS has revised some regulations on enterprises involved with highly hazardous chemicals or highly hazardous processes or major hazard installations. These regulations emphasize the application of process hazard analysis (PHA) and Quantitative Risk Assessments (QRA) to identify the major risks to the public of chemical installations. Moreover, Chinese authorities are inviting industrial safety and engineering experts to inspect those installations of concern, especially industrial parks, to identify what the major hazards and the IPLs (Independent Protection Layers) are. They want to know what to inspect when they visit a site. DEKRA consultants are invited to participate in such events, e.g. Tianjin NanGang Harbor Major Hazard Scenarios Identification, National Expert Cruise Inspections.

This indicates progress toward making industrial parks safer, since the Chinese government's previous focus on emergency plans ignored the other layers of protection necessary for a robust process safety system:

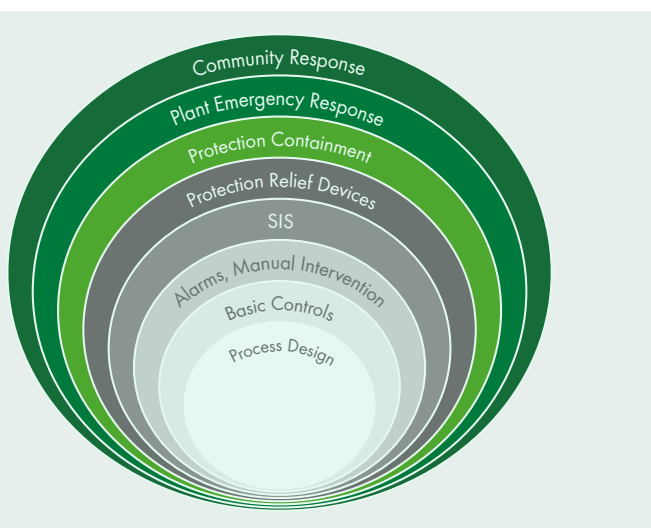


Figure 1: Protection Layers

Emergency plans, it should also be noted, are mitigating LoPs, meaning “something” has already happened. For a system to be effective, hazards must be identified, risks assessed, LoPs implemented and maintained.

Following the LoP model in figure 1, DEKRA Safety Consulting supports the development of many of the layers of protection:

- > Process design: Intrinsic safety or Inherently Safer Technology (IST); proper engineering; proper maintenance (RBI, RBM)
- > Basic controls: proper engineering; sequence control program (a trend in batch processes in the fine chemical industry)
- > Alarms, manual intervention: alarm rationalization
- > Safety Instrumented Systems (SIS): functional safety
- > Relief devices: proper design - special attention to reactive cases and/or changes/revamps
- > Containment: proper engineering; proper maintenance

Benefits of a risk-based approach to process safety

Luckily, the procedures and standards to “do it right” when it comes to process safety are well established and proven. The DEKRA Safety Consulting team helps industrial parks around the world understand what needs to be considered and what the best practices are.

Risk-based methodologies are a good starting point, as they allow for appropriate consideration of preventive measures and both identify and rank the elements that contribute significantly to the risk. These methods also include human factor considerations, which are only poorly or not at all considered when safety distances and consequence analysis are exclusively employed. In addition, a risk-based approach takes into account the probability that an event will come to pass and verifies the effectiveness of the various preventive and mitigating measures proposed.

The use of risk-based techniques underpins the management of risk as summarized in figure 2 below. This cycle is universal for every type of risk, including process safety. To ensure appropriate operation of the model, each of the boxes in figure 2 needs adequate tools. In the case of process safety, DEKRA Safety Consulting has a well-established toolkit in every single box. These tools can also be related to the layers of protection in place (refer to figure 1).

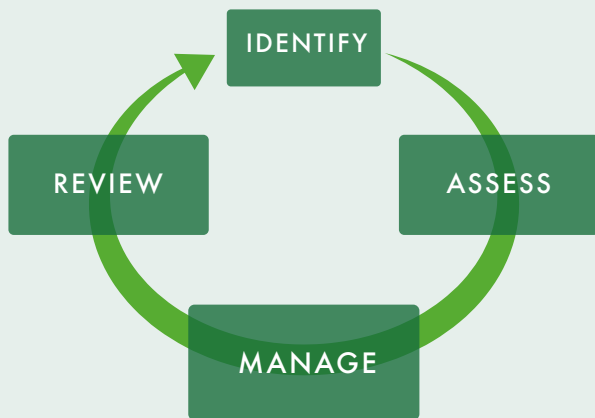


Figure 2: Risk-based process safety management

Our references

Our DEKRA Safety Consulting team helps industrial parks determine areas of concern, key protection layers, inspection procedures and best practices. We can help design effective emergency response plans and organize emergency response resources and drills. Our team has been active at the following sites:

- > **Tianjin NanGang Industrial Park** - Identified the critical layers of protection for major hazard installations and helped the park administration develop inspection checklists and techniques.
- > **International chemical company in Ningbo** – Quantitative risk assessment on a newly installed LNG storage tank to assess the add-on risk and provided recommendations for managing the risk.

In the case of industrial parks, the DEKRA Safety Consulting team has ample experience in supporting the park administration authority (no matter the organizational model) in preventing major incidents. To name a few of many projects, we have conducted a safety analysis and designed emergency response plans and software support for all major Spanish ports as well as some in Tunisia. For the Tarragona industrial chemical park in Spain, we also carried out a safety analysis and created an emergency response plan and, in addition, wrote the internal regulations for an interconnecting pipe rack. With the right approach and expertise, industrial parks can fulfill their promise of economic advantages without unnecessary risks.

- > **International food process company in Northeast China** – Developed an effective emergency response plan and actions which can be used as a template for other companies in industrial parks.
- > **Local chemical company in Yantai** – Developed an environmental health and safety and a process safety management auditing system to improve risk monitoring and management at the corporate level.

As a multinational company, DEKRA can build on the experience of other regions of the world and support clients everywhere in their progress towards process safety excellence.

DEKRA Process Safety

The breadth and depth of expertise in process safety makes us globally recognized specialists and trusted advisors. We help our clients to understand and evaluate their risks, and work together to develop pragmatic solutions. Our value-adding and practical approach integrates specialist process safety management, engineering and testing. We seek to educate and grow client competence to provide sustainable performance improvement. Partnering with our clients we combine technical expertise with a passion for life preservation, harm reduction and asset protection. As a part of the world's leading expert organization DEKRA, we are the global partner for a safe world.

Process Safety Management (PSM) Programs

- > Design and creation of relevant PSM Programs
- > Support the implementation, monitoring, and sustainability of PSM Programs
- > Audit existing PSM Programs, comparing with best practices around the world
- > Correct and improve deficient Programs

Process Safety Information/Data (Laboratory Testing)

- > Flammability/combustibility properties of dusts, gases, vapors, mists, and hybrid atmospheres
- > Chemical reaction hazards and chemical process optimization (reaction and adiabatic calorimetry RC1, ARC, VSP, Dewar)
- > Thermal instability (DSC, DTA, and powder specific tests)
- > Energetic materials, explosives, propellants, pyrotechnics to DOT, UN, etc. protocols
- > Regulatory testing: REACH, UN, CLP, ADR, OSHA, DOT
- > Electrostatic testing for powders, liquids, process equipment, liners, shoes, FIBCs

Specialist Consulting (Technical/Engineering)

- > Dust, gas, and vapor flash fire and explosion hazards
- > Electrostatic hazards, problems, and applications
- > Reactive chemical, self-heating, and thermal instability hazards
- > Hazardous area classification
- > Mechanical equipment ignition risk assessment
- > Transport & classification of dangerous goods

We have offices throughout North America, Europe, and Asia.

For more information, visit www.dekra.com/en/process-safety-solutions

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