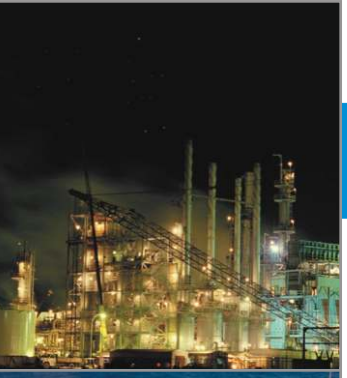


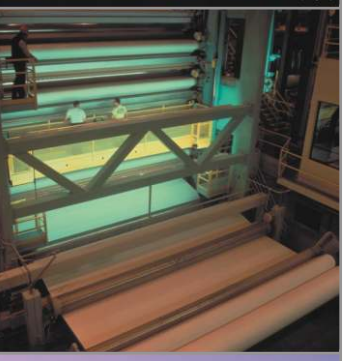

Hazards Analysis Experience

Risk Management and Prevention Program

For a major supplier of magnetic media, Aptech Engineering Services, Inc. (APTECH) performed a formal Risk Management and Prevention Program (RMPP) for two inorganic acids as requested by the County government. The public disclosure report documented the site location; equipment and operations history; safety, audit, and inspection procedures; emergency response plans; and actions recommended as a result of a HAZOPS study. As a part of the RMPP, APTECH also prepared process flow diagrams, conducted a seismic walkdown, prepared a HAZOP study, and prepared an off-site consequence analysis for several worst-case chemical release scenarios.

Life Assessment for Canadian Refinery

For a Canadian refiner, APTECH conducted a life assessment study for major classes of equipment , such as columns, pressure vessels, heat exchangers, fired heaters, compressors, tanks, and piping. Over 200 pieces of equipment were evaluated. The majority of this equipment had been in continuous operation for about one design lifetime. Major degradation modes evaluated included creep rupture; stress rupture; corrosion; stress corrosion cracking; high temperature hydrogen attack; wet H_2S cracking; and fires and explosions. APTECH identified those pieces of equipment with limited remaining life and for which the client's current maintenance program did not make adequate provisions. Further, utilizing the results of prior risk assessments conducted for the facility, APTECH identified a list of unusually critical equipment which, upon failure, would result in a loss of production of 6 months or more.

Natural Gas Migration and Explosion in an Apartment Building

In this project, APTECH was hired by the local natural gas utility company to evaluate the origin and cause of a gas explosion in a downtown apartment building. APTECH visited the accident scene shortly after it had occurred and performed analyses to investigate the following: (1) the likelihood of a gas leak from nearby gas regulators; (2) the likelihood of gas migration across the road to the location of the apartment building; and (3) the significance of mechanical tool marks on gas piping and gas fittings. APTECH's analysis eliminated all of the component failure events that could reasonably be responsible for the gas explosion. It was later concluded that the root cause of this explosion was due to human intervention.

Gasoline Tank Farm Explosion and Fire

Gasoline was being delivered by a tanker truck to one of many above-ground storage vessels in a tank farm. During the delivery, an explosion of a cloud of gasoline vapors occurred near the storage vessel. Besides destroying several buildings, the explosion breached the piping system. This led to an extensive release of gasoline, which caught fire and contaminated the soil. APTECH was hired by the plant's owner to determine how the explosion caused the failure of the piping system. Our metallurgical examination and fluid mechanics calculations indicated that the gasoline vapor explosion had severely distorted a swing check valve. This event blew off a threaded plug in the body of the valve. The absence of the plug allowed the free flow of gasoline. The gasoline continued to feed the fire and contaminate the soil until the pump was shut down.

Fire and Explosions at a Chemical Processing Plant

A fire of unknown origin broke out at a large chemical processing plant. The fire quickly got out of control, and eventually led to the detonation of thousands of pounds of the chemical stored at the site. The detonation demolished the plant and its shock wave caused significant property damage. APTECH was hired to investigate the accident. Our work included examining and documenting the accident site, testing subscale chemical containers, reconstructing and locating the explosion sequence, and analyzing the metallurgical condition of an underground natural gas pipeline.

Evaluation of Water Hammer Potential in Service Water System at Trojan Nuclear Plant

The service water system was evaluated by APTECH to determine if it would maintain its safety-related function following a water hammer event. The original engineering study was reviewed to verify locations and magnitude of postulated water hammer events. The effect on pressure of rapid closure of check valves and control valve actuation was determined. The significance of water hammer on the integrity of those piping components was evaluated. The study indicated that the piping is capable of handling these forces without failure.

Probabilistic Risk Analysis for Justification of Eliminating the Need for Emergency Cooling of Steam Generators Utilizing Sea Water

A comprehensive risk analysis was done to determine whether there would be a need to use sea water for emergency cooling of steam generators. The first analysis performed considered a safe shutdown earthquake event with loss of off-site power. A second analysis considered severe weather missile impact on yard water storage tanks with loss of off-site power. Specific recommendations were made for plant modifications and procedure changes to increase safety margins by improving access to existing stores and sources of fresh water. Results showed an extremely low probability of requiring sea water cooling of the steam generators during emergency conditions.

Evaluation of Postulated Propane Explosion

An evaluation was performed to determine the effects of an explosion resulting from the postulated rupture of a propane line. Four types of analyses were performed:

- Thermal-hydraulic
- Diffusion
- Structural
- Probabilistic

The **thermal-hydraulic** analyses determined the rate amount of propane gas that would evolve from a postulated line rupture. The analysis considered line design, operating conditions, controls, and operator actions. A transient blowdown analysis was performed to determine a mass release time history.

The **diffusion** analysis determined the size and combustible content of the vapor cloud as a function of distance from the break for various atmospheric conditions.

The **structural** analysis determined the conditions required to cause unacceptable structural damage to the facility of concern. The analysis determined the energy from various size vapor clouds and their effects on the structure based on detonations occurring at varying distances from the structure.

The **probabilistic** analyses considered the following probabilities in determining whether an unacceptable explosion could occur:

- Pipe rupture occurrence
- Explosion of vapor cloud
- Wind direction
- Wind velocity - The vapor cloud would only be stable enough to remain as an explosive moisture far enough away from the break for limited wind velocities
- Atmospheric stability
- Delay in ignition - The ignition had to be delayed until the vapor cloud was in close proximity to the target source. This analysis considered available ignition sources, as well as historic data on proximity of ignitions to gas releases.

For more information, please contact our Houston Office.

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