SAFER®
SYSTEMS

Plan. Prepare. Protect.

310 North Westlake Blvd.
Suite 200
Westlake Village, CA 91362

P: 805.874.5414
E: sales@safersystem.com
www.SAFERsystem.com

PLAN

PREPARE

PROTECT

EFFECTIVE

RISK REDUCTION

FOR CHEMICAL PLANTS & REFINERIES

Risk Reduction is the ultimate measure of success for any PSM program. Risk is quantified by the frequency of occurrence and severity of impact. From high frequency-low severity to low frequency-high severity events and everything in between, chemical organizations face a wide breadth of situations with operational risks. There is no one-size-fits-all approach to risk mitigation. Prioritization and proactive engagement are required to effectively mitigate operational risks; however, in many cases, operational risks are not part of the executive level discussions regarding risk mitigation.

Often operational risks are managed on disparate systems relegated to support functions, with a focus on compliance.[1] Without corporate support of a comprehensive chemical safety program the effectiveness of corporate Environmental, Health, and Safety (EHS) efforts will continue to struggle. Reducing operational risks and aligning corporate business and chemical safety goals often require the support of a cross-functional executive team or a single executive champion.[2]

This paper will identify factors contributing to common operational risks at chemical and refining facilities, with an in-depth exploration of operational risks relating to the following:

- Monitoring Gaps
- Chemical Exposures
- Incident Response
- Consequence Analysis
- Non-Standard Operations
- Business Interruptions
- Compliance
- Corporate Brand

Potential costs for failure to mitigate the risks will be provided, along with key SAFER One features that help organizations address potential area(s) of concern.

SAFER® SYSTEMS

Plan. Prepare. Protect.

TABLE OF CONTENTS

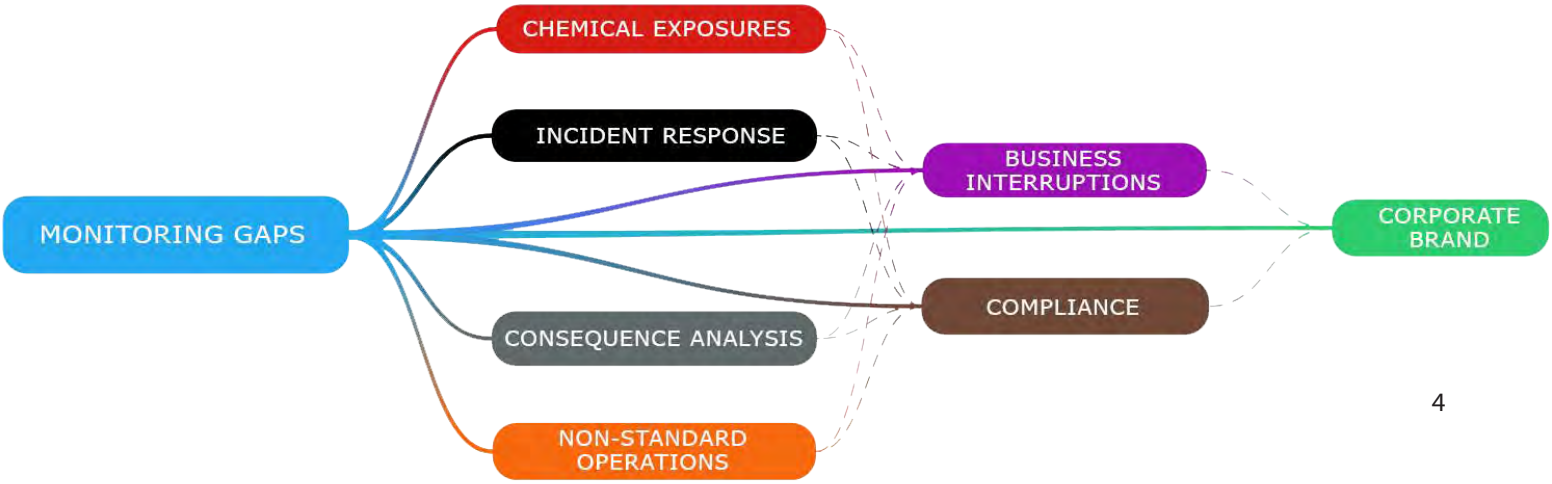
In SAFER's 35+ years of providing safety solutions for the chemical and energy industries, we often find that lack of accessibility to critical information is the most overlooked risk. "I believe our industry has many systems out there collecting data redundantly or possibly just collecting and storing data that are not recognized as useful," says Brian Clemons, Process Automation Manager at The Dow Chemical Company. "When actually it could be brought into a system and made into useful information."[3] Aggregating facility gas and meteorological data into a single platform is key to establishing an accurate common operating picture.

> Focusing exclusively on technical solutions, for risk mitigation, is insufficient.
>
> *Effective Implementation of PSM to Reduce Risks*
>
> - DuPont Sustainable Solutions

With that in mind, SAFER developed SAFER One™, an integrated cloud-based platform for monitoring, modeling, and mitigating chemical incidents. Capable of integrating with facility gas detectors, meteorological stations, and Internet-based resources, SAFER One maintains an accurate common operating picture in and around your facility. Coupled with the integrated monitoring platform are patented modeling algorithms that dynamically develop and adjust models based on real-time sensor data! The spectrum of features in SAFER One makes it the ideal cross-functional platform for EHS and risk reduction efforts.

Quantifying risk and risk reduction has always been difficult, as only failures in risk mitigation produce tangible results. The best way to evaluate risk mitigation capabilities of an initiative or application is to consider the risk reduction capabilities and the potential costs associated with those risks. In their research on Effective Implementation of PSM to Reduce Risks, DuPont Sustainable Solutions admit that their experience and results have shown that focusing exclusively on technical solutions, for risk mitigation, is insufficient. Instead, an integrated approach to process safety management is required to achieve the desired level of risk mitigation.[1]

The risk of monitoring gaps often leads to additional risks associated with chemical exposures, inadequate incident response, non-standard operations, and inaccurate consequence analysis. The confluence of associated risks leads to risks of business interruptions and compliance violations which ultimately risk damaging the corporate brand.



REDUCING RISKS AT A CHEMICAL PROCESS FACILITY

According to a 2014 report, of the 100 largest losses in the Hydrocarbon industry between 1974–2013, not even one could be attributed to force majeure.[4] Most of the large-scale losses included in the Marsh report could have been prevented with better gas detection, which would have provided advanced warning of developing hazards. Investments in better gas and weather detection technologies are easily justified when you consider that refineries and petrochemicals dominate property damage values, accounting for more than half of the total losses in the 100 largest hydrocarbon accidents.[4]

"For a long time, people were saying that most accidents were due to human error and this is true in a sense but it's not very helpful. It's a bit like saying that falls are due to gravity."
– Dr. Trevor Kletz

Risk reduction is more than a checkbox, certificate, or a convenience; it's a constant effort to mitigate risks while leveraging the latest technologies to operate safer. However, a recent survey of over 40 chemical manufacturers, by Siemens, found "that chemical manufacturers lag behind other sectors in adopting innovative digital solutions that drive demonstrable time and cost savings."[3]

Those companies that due digitize their plants often find themselves in a quagmire of expanding application portfolios, digital infrastructure, and IT costs. Additionally, disparate gas detection solutions carry the risk of limited or delayed accessibility to critical data due to cross-functional application ownership and lack of compatibility between various applications. Effective risk reduction, therefore, requires that chemical organizations manage cross-functional EHS teams and leverage technology to align with corporate chemical safety goals.

MONITORING GAPS AT A CHEMICAL PROCESSING PLANT

The adage that knowledge is power holds especially true when it comes to chemical safety. Effective weather and gas detection in and around chemical plants and refineries are key to reducing risk and preventing chemical incidents. Considering that a major chemical incident in the U.S. can cost on average of $80 million, companies are well incentivized to improve chemical detection efforts at their facilities.[5] Protecting the people, property, and the environment in and around a plant is practically impossible without a comprehensive monitoring solution.

A solid monitoring solution is required to form an accurate common operating picture, which is critical for effective collaboration between EHS teams in order to:

1. Protect personnel and people in surrounding communities from chemical exposures
2. Effectively respond to a chemical incident
3. Conduct accurate consequence analysis and modeling
4. Improve safety during non-standard operations (Turnarounds, Unplanned Shutdowns, Maintenance, etc.)

Addressing a plant's monitoring gaps is the first step in effectively reducing operating risks at a chemical facility. SAFER One enables chemical organizations to maintain an accurate common operating picture by:

- Integrating with facility gas and weather sensors in real-time, including:
    - Fixed and portable point sensors
    - Open-Path sensors
    - Lightning detection systems
    - Weather stations
    - Wireless and solar-powered sensors
- Displaying facility sensors and Internet data sources on a single intuitive interface
- Easily scaling gas and weather detection solutions as needed
- Enabling remote access to sensor data

With patented sensor siting solutions, SAFER Systems can help your plant identify potential gaps in coverage, recommend additional sensor solutions, and provide a single integrated platform for real-time monitoring. SAFER One's ability to integrate facility and Internet resources on a single interface allows organizations to maintain an accurate operating picture in and around their facility.

POTENTIAL CHEMICAL EXPOSURES

Fugitive emissions often present chemical exposure risks with the potential to cause injury or death; that is why it is the goal of every plant operator to reduce the associated risks. The financial costs of community or on-site chemical exposures are increased regulatory oversight, financial penalties, and higher insurance premiums.

To explore the cost of chemical exposures, one can look at the recent Aliso Canyon leak in Southern California. In October of 2015, the LNG storage facility reported a methane leak and was subsequently shut down for almost 18 months. A challenge in restarting operations was the fact that the facility operator did not have historical sensor data to support the company's root cause analysis. Because the operator could not, with confidence, support their version of the events, they had to accept the regulatory agency's analysis. As a result, in late 2017, the facility was operating at only 28 percent of their maximum capacity.[6]

In their Q3 '17 filings, the owner of the LNG storage facility reported costs of $841 million related to the leak. Roughly two-thirds of the $841 million were spent on relocating and decontaminating 8,000 homes downwind of the storage facility. Even with $542 million in insurance receivables, the costs incurred by the company is in hundreds of millions of dollars.[7] The current costs do not include the additional 281 (private, business, and government) lawsuits working their way through the courts.[8]

Sustaining operations post a chemical incident is a challenge within itself, as the costs and compliance requirements can strain the cash flow of even the biggest company. In their quarterly filings, the owners of the Aliso Canyon facility admit that if issues with their insurance policies arose, the company's cash flow would be significantly impacted by this single incident.[7] That is why industrial hygienists constantly strive to:

1. Improve workforce protection
2. Enhance community protection
3. Identify hazards earlier

Protecting the people and property in and around a facility from the effects of chemical exposures is an around-the-clock effort. To reduce the risk of chemical exposures in and around the facility, SAFER One integrates additional data sources and comes with automated features, including:

- Integration with Google® Maps, Traffic, and Points-of-Interest
- Creation of custom places (muster points, employee quarters, etc.)
- Automatically triggers audible, visual, and email notifications in case of a potential hazard

The additional historical sensor data backups provide crucial information for root cause analysis and future process safety management. Automated alarms and the remote access capabilities improve the monitoring capabilities of any facility while reducing response times. The ability to visualize facility sensors, places, and surrounding points-of-interest allows plants to quickly identify those in danger and mitigate the potential risks.

CHEMICAL INCIDENT RESPONSE

In case of a chemical incident, the actions taken in the first few minutes of a response will often establish the character of the overall response —and ultimately its success or failure.[9] A Systematic Approach For Emergency Response (SAFER) consists of the ability to monitor, model, and mitigate a chemical incident in real-time. It is crucial to aggregate all critical information to establish control and respond with confidence during a chemical incident.

With SAFER One, chemical organizations can quickly answer:

1. What happened?
2. What chemicals are involved?
3. Where it happened?
4. Where it's headed?
5. Who's in danger?

In case of a chemical incident, every second counts, so why waste it on manual sensors' readings and static dispersion models? SAFER One's integration with facility gas and weather sensors allows for the industry's only dynamic modeling based on real-time sensor data. Additionally, SAFER One integrates the latest Emergency Response Guide, allowing HazMat responders and safety teams to initiate protective actions faster and with greater confidence. The included patented modeling algorithms in SAFER One include:

- Source Area Locator® (SAL) – quickly identifies the source of the emission
- Area Back Calculation® (ABC) – estimates the rate of release
    - ABC Laser™ – supports integration with open-path systems
- Combustion Analysis Model® (CAM) – visualizes particulate dispersion and deposition from chemical fires *(coming soon)*

In case of catastrophic failure, plant operators can access SAFER One remotely to maintain situational awareness and continue collaborating during the incident response as long as the facility sensors remain online. Additionally, the ability to review historical sensor data allows a chemical organization to:

- Conduct a thorough post-incident analysis for:
    - Regulatory reports
    - Training purposes
    - Procedure review
    - Litigation support
- Improve compliance
- Enhance PHA and PSM efforts

Additional capabilities to share incident reports and pre-defined scenarios further improve collaboration of on-site personnel, communities, and responding HazMat teams.

ACCURATE CONSEQUENCE ANALYSIS

"If you know the enemy and know yourself, you need not fear the result of a hundred battles. If you know yourself but not the enemy, for every victory gained you will also suffer a defeat. If you know neither the enemy nor yourself, you will succumb in every battle."

Sun Tzu

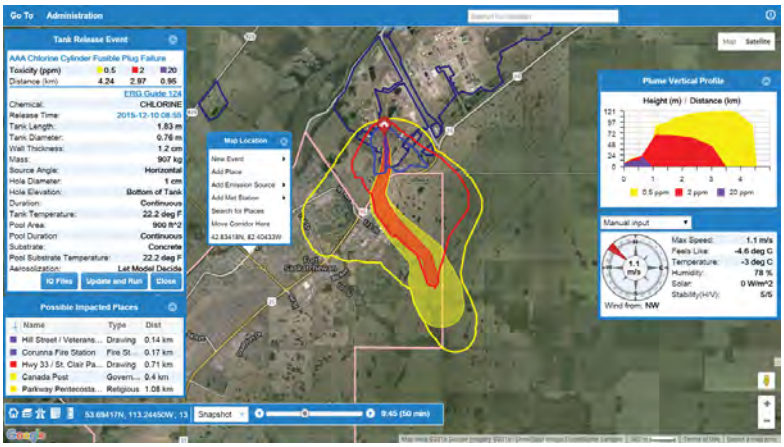
The advice from ancient Chinese military tactics and strategy can be applied to modern chemical process safety efforts, and rightfully so. Maintaining an inventory of the facility's resources and risks is crucial to effective risk mitigation efforts. Those that have an accurate understanding of the plant's resources, limitations, and risks can operate confidently. Knowing the available resources and limitations of a plant without having a proper understanding of the risks is gambling every day of facility operations—while being unfamiliar with the chemical plant's resources, limitations, or operating risks will almost certainly lead to disaster.

Modeling the consequences of hazardous chemical releases is an integral part of any risk management, compliance, or root cause analysis project. For that reason, SAFER One comes with a robust suite of available models to enable chemical plants to model a variety of chemical incidents. With the ability to review historical gas and weather data, companies are able to focus on the most probable, based on historical emission and weather data, release scenarios when they:

1. Visualize Worst Case Scenarios
2. Visualize Alternative Release Scenarios

Additionally, SAFER One can import points-of-interest from Google® Maps, as well as support user generate places, allowing organizations to quickly identify those that are in harm's way and take preventative measures. This feature is coupled with an extensive suite of SAFER One's models, which includes:

- Puddle and Pool
- Tank and Pipe
- Stack and Jet
- Dispersion
- Particulate Dispersion and Deposition
- Multi-Component Evaporation
- Fire and Explosion
- Building Infiltration and Exfiltration
- Source Area Locator® (SAL)
- Advanced Back Calculation® (ABC)
- Combustion Analysis Model® (CAM) – *coming soon*



SAFER One offers an intuitive interface for monitoring and modeling a chemical incident on a single screen.

Organizations can save the modeled scenarios for use at later date, during training or incident response. Additionally, most of SAFER's models are proprietary and are updated for improved accuracy as new data and best practices emerge. Such is the case with an upcoming update to the Chlorine dispersion model which incorporates dry and wet deposition of Chlorine gas onto underlying surfaces; the update is based on the results of the Jack Rabbit II study.

I NON-STANDARD OPERATIONS

Operating a chemical processing plant is not without risk during standard operations. The operating risk grows exponentially during non-standard operations such as turnarounds, unplanned shutdowns, or equipment maintenance. In 2016, researchers from University of Gothenburg, Sweden, found that workforce exposure to benzene was higher during facility turnaround operations than during normal operations.[10] That's because tens of thousands of additional procedures are associated with non-standard operations which create a spike in the number of risks that need to be mitigated.[11] To safely conduct non-standard operations, a chemical process facility requires:

1. Additional gas and weather monitoring
2. Identifying new/temporary muster points, shelter in place locations, etc.
3. Additional monitoring personnel

SAFER One's integration capabilities allow organizations to scale their gas detection based on facility needs. SAFER One seamlessly integrates with portable gas detectors, with support for wireless communication protocols and solar-powered options. SAFER One is the secure and scalable platform that:

- Seamlessly scales weather and gas detection needs
- Reduces digital infrastructure requirements
- Provides remote data access

In case of a chemical incident, the SAFER One platform can deploy and detect portable gas sensors in minutes! Additionally, the cloud-based SAFER One platform allows chemical organizations to scale not only gas detection but the number of users as well. With multiple user permissions available, adding additional safety monitors to keep an eye on fugitive emissions is a breeze.

THE COST OF

NON-COMPLIANCE

Complying with the ever-changing local, state, and federal laws, rules, and regulations can be tough. Failing to do so will be costly. According to the EPA, in FY2016, the agency levied $6 billion in administrative, civil, and criminal fines and penalties. That is half of the $13.7 billion invested by companies in equipment and services to control pollution as part of their settlements with the EPA.[12] Considering what's at stake, why wait until the next inspection to find out if you are complying with air quality monitoring regulations?

In reviewing recent environmental legislation, a clear trend calling for increased transparency in community air quality monitoring and incident reports emerges. Because EHS efforts are implemented through a patchwork of systems and ad-hoc solutions, it becomes increasingly difficult to aggregate sensor data for:

1. Compliance Reports
2. Litigation Support
3. Training Review

Because SAFER One integrates with gas and weather sensors at plants and maintains an encrypted historical back-up, it allows chemical organizations to easily:

- Retrieve historical sensors data
- Quickly run and share reports
- Promote collaboration between cross-functional teams

One of the main advantages of SAFER One is that it establishes a single source of truth for gas and weather detection date. This, in turn, allows companies to standardize data in various reports, which improves collaboration while reducing compatibility issues, helping to reduce risks and improve compliance efforts across facility and corporate levels. In the long run, this can save organizations millions in fines, penalties, and legal services.

Email sales@safersystem.com for more info!

BUSINESS

INTERRUPTIONS

A business interruption and the ensuing loss of production can cost a refinery or chemical plant millions in losses. Business interruptions claims in the energy sector are two to three times, if not more, the size of the property loss value.[13] Those numbers do not account for canceled projects that were in progress or reduced production capacity while under regulatory review.

The case study of a Southern California gas storage facility that recently experienced a large methane release is the perfect example of the far-reaching consequences of poor risk mitigation on business operations. The facility remained shut down for 18 months during the regulatory investigation and, upon startup, was ordered to operate at 28 percent capacity by state regulatory agencies. There is also a risk to ongoing projects, valued at approximately $244 million, which are at stake as regulators consider the fate of the facility.[7]

Recovering from unplanned business interruptions while dealing with the additional — regulatory scrutiny, litigation, and community mistrust — can strain the company's cash flow due to higher operating costs and additional capital expenditures, jeopardizing the future of the plant.

Many operational and compliance risks contribute to the risk of a business interruption; that is why plants require chemical safety solutions that:

1. Provide comprehensive fugitive emissions monitoring
2. Simplify monitoring of meteorological conditions
3. Enable earlier detection of potential hazards
4. Provide confidence during response

The capabilities of SAFER One allow chemical plants to easily integrate existing site infrastructure with the platform and scale when additional needs or resources arise. SAFER One integrates disparate gas and meteorological sensors into a single solution, allowing chemical organizations to easily:

- Monitor gas and weather sensors 24/7 in real-time
    - Including Lightning Detection Solutions
- Access critical information from a single interface
- Automate audible, visual, and email alerts
- Remotely monitor chemical facilities

Establishing an accurate common operating picture is a core feature of SAFER One. The platform integrates with standard gas and weather sensors, Internet data sources, and emerging technologies like Open-Path and Lightning Detection Systems to provide the most accurate operating picture in and around your facility.

PROTECTING THE CORPORATE BRAND

Perhaps the hardest risk to quantify is the risk to the corporate brand. Companies and consultants alike struggle to define and quantify the cost of a brand. One thing is certain: checkered safety records can quickly ensue in a poor public perception, resulting in community resistance in new or expansion projects. Although today's reliance on petroleum, petrochemicals, and other chemicals makes it unlikely that a company could face a complete consumer boycott, perception and business interruptions can strain the bottom line.

In 2010, a coal mining company suffered a fatal incident, and although it was able to keep its production levels, its brand suffered irreparable damage. The company stock plunged from $50 a share to around $30 a share until potential buyouts were speculated a few months after the incident.[14] In the end, the company was bought out by its rival, as the operator faced business interruptions, higher operating costs, civil as well as criminal litigation, regulatory scrutiny, and vocal community opposition to their continued operations.

Transparency and building of common shared value with the surrounding communities is key to managing the brand perception of any chemical company. Additionally, new laws increasingly require greater community input and collaboration. Community support is, therefore, becoming more crucial than ever before for successful business operations. Companies considering these factors are engaged in:

1. Ways to improve transparency
2. Increased collaboration with communities
3. Building common shared value

Recently, some regulatory agencies are beginning to consider and implement community air quality monitoring programs requiring organizations to monitor beyond the fenceline. Organizations can use these opportunities to harbor goodwill by leveraging SAFER One and its vast capabilities, including:

- Simple historical reports to support responses to community and regulatory complaints
- Modeling capabilities for tabletop training with Local Emergency Planning Committees (LEPC)
- Integration of Google® Maps and Points-of-Interest for a more in-depth understanding of release impacts

Organizations are able to leverage SAFER's 35+ years of industry expertise to establish a single point of contact for all of their monitoring, modeling, hardware, and training needs while demonstrating their commitment to chemical safety to the surrounding communities.

INTEGRATED

CHEMICAL SAFETY

A SAFER APPROACH

"The whole is greater than the sum of its parts."
– Aristotle

It is understandable that addressing all the possible risks at once is impossible, but treating each as a separate issue is perilous. A patchwork of safety solutions presents inefficiencies, increased points of failures, data accessibility, collaboration, and compatibility issues. Without aligning their cross-functional Environmental, Health, and Safety teams with corporate goals, organizations will not realize the full benefits of comprehensive risk reduction.

SAFER One allows organizations to take a major step forward in reducing operational risks while improving collaboration and alignment with corporate safety goals. The innovative platform supports organizations as they plan, prepare, and protect their plant and people from chemical incidents by:

- Simplifying gas and weather detection by integrating with facility hardware in real-time
- Aggregating sensor and Internet data in a single intuitive graphic user interface
- Dynamically modeling various incidents by integrating sensor data with an extensive modeling library
- Improving collaboration and compliance through a robust set of reporting and sharing features

SAFER One is the energy sector's only solution with capabilities to address multiple levels and facets of operational risk in real-time. SAFER Systems has provided a single point of contact — for *monitoring, modeling, training,* and *hardware* needs — to chemical companies for over 35 years. Helping organizations improve gas and weather detection efforts and to leverage real-time data for comprehensive risk mitigation at facility and corporate levels.

With SAFER, organizations are able to start small today and scale as needs or resources change. *It all starts with a simple desire to operate safer.*

For more information on how SAFER Systems can help you reduce risks at your plant call 805.874.5414 or email sales@safersystem.com today!

REFERENCES:

1. Dupont Sustainable Solutions: Effective Implementation of PSM to Reduce Risks
2. Harvard Business Review: 75% of Cross-Functional Teams Are Dysfunctional
3. Siemens: Chemicals – The Digital Catalyst
4. Marsh: The 100 Largest Losses 1974-2013 - Large Property Damage Losses in the Hydrocarbon Industry
5. AIChE: The Business Case for Process Safety
6. U.S. Energy Information Administration: Today in Energy
7. Sempra Energy Quarterly Report
8. Southern California Public Radio: Lingering Leak Woes
9. Chemical Hazards Emergency Medical Management: Initial Response to a Chemical HazMat Incident
10. International Archives of Occupational and Environmental Health: Personal exposure to benzene and 1,3-butadiene during petroleum refinery turnarounds and work in the oil harbor
11. Houston Chronicle: What Happened – Plant Turnarounds Proven Dangerous
12. EPA: Annual Enforcement Results for FY 2016
13. Marsh: The 100 Largest Losses 1974-2015 - Large Property Damage Losses in the Hydrocarbon Industry
14. Investor Point: Historical Stock Prices