INTERNATIONAL OCCUPATIONAL HEALTH AND SAFETY CONGRESS AND FAIR
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ISTANBUL METROPOLITAN MUNICIPALITY

Keys to Effective Management of Risks

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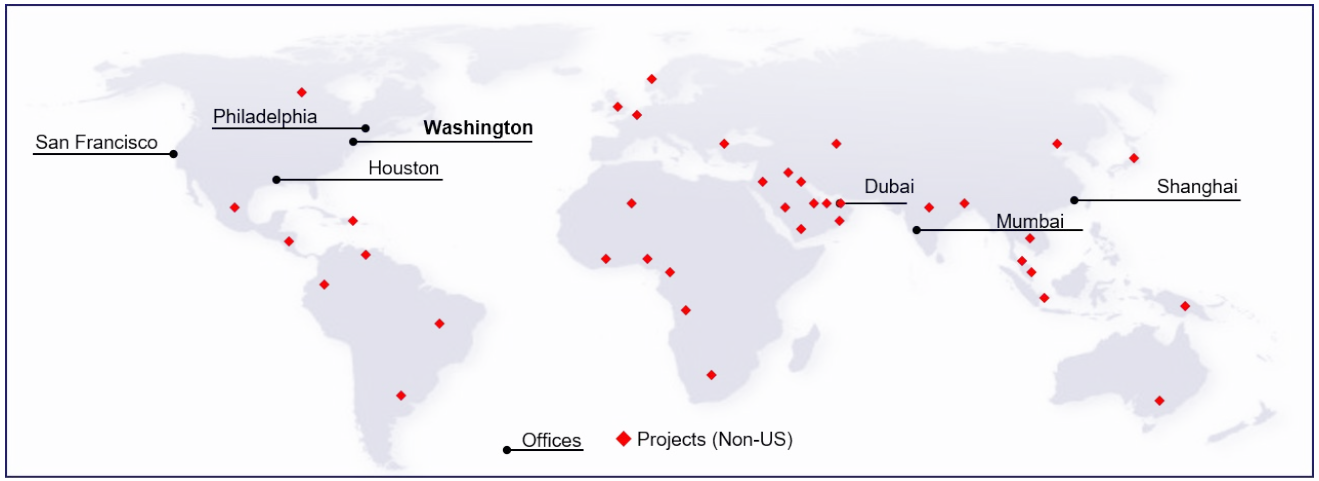
AcuTech
PROCESS RISK MANAGEMENT

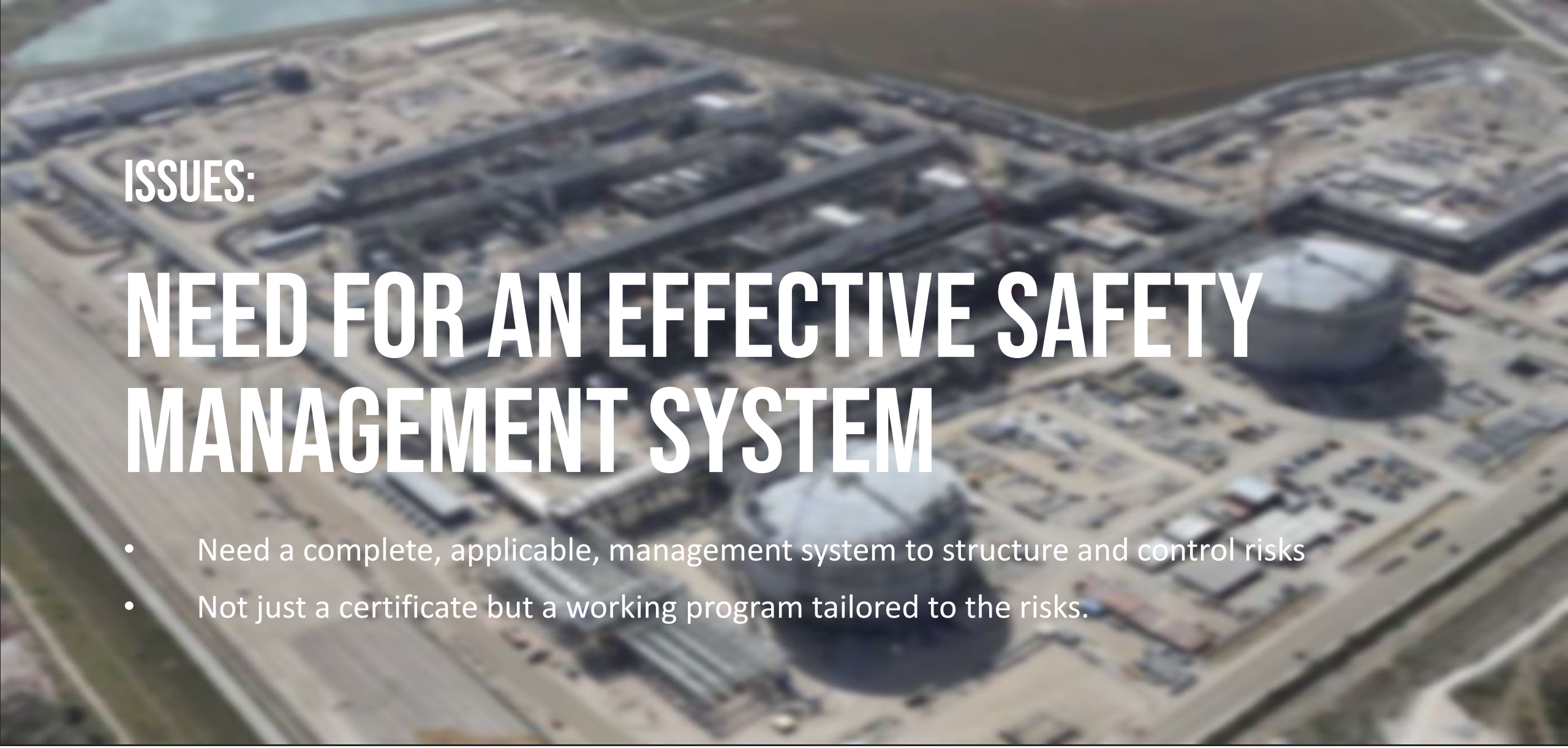
change plus

About AcuTech

- Based in Washington, DC, since 1994 AcuTech has been a global leader providing:
  - risk management and technical consulting services
  - the world-class AcuTech Training Institute
  - and a new enterprise risk management software “Acuity”
- for improving risk, safety, environmental, and security performance with an emphasis on companies handing hazardous materials.
- In Turkey we have worked with Tupras and SOCAR Star Refinery.



Keys to Effective Risk Management



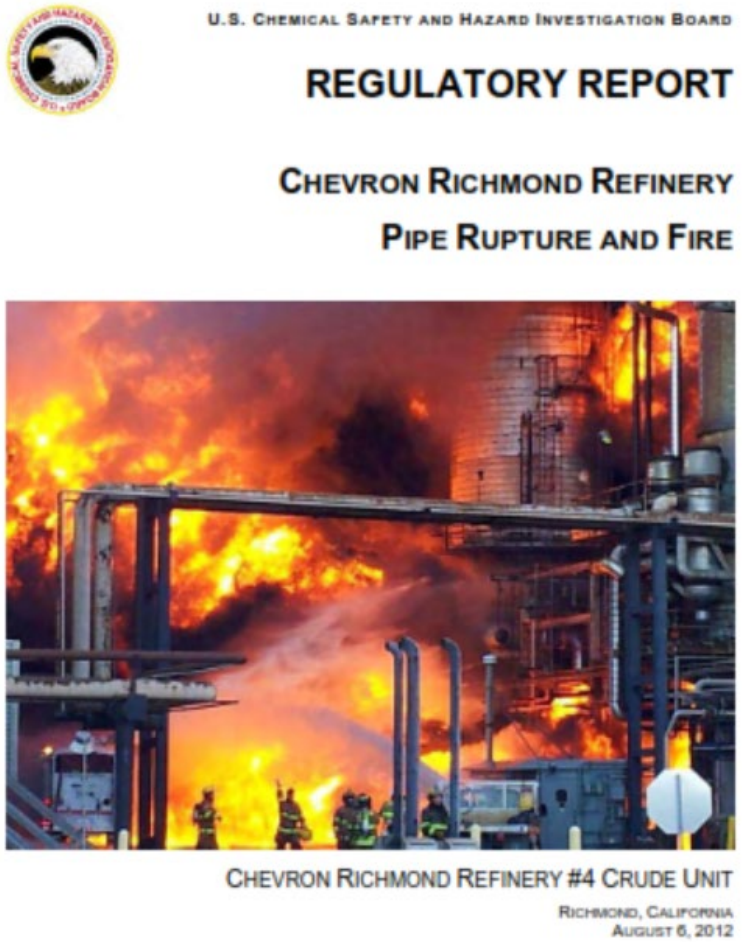
ISSUES:

NEED FOR AN EFFECTIVE SAFETY MANAGEMENT SYSTEM

- Need a complete, applicable, management system to structure and control risks
- Not just a certificate but a working program tailored to the risks.

Chevron Richmond California Refinery (8-2012)

- Release from containment and fire from piping in crude unit at 5-feet-long section carbon steel pipe in high-temperature service
- Resulted from accelerated sulfidation corrosion, which had low-silicon content (less than 0.10 wt% Si)
- Attempted to control the leak without shutdown and near miss to workers



Chevron Richmond California Refinery (8-2012)

- US Chemical Safety Board Conclusions:
  - Technical inspection methods deficient (Asset Integrity Management Element)
  - Management decision-making on actions required from inspections
  - Failure to stop operations when a leak had developed (Stop Work Authority)

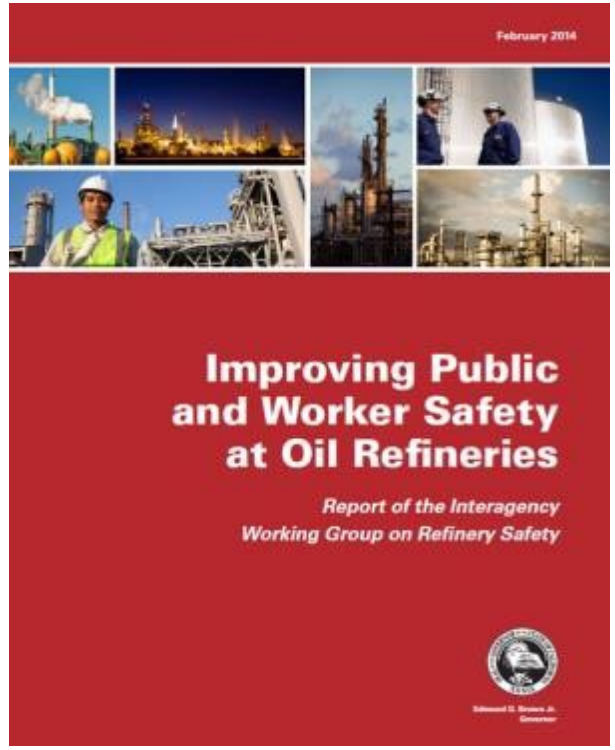
- A 2010 study by The RAD Group* of 2,600 workers (primarily oil and gas service employees) found that the surveyed employees directly intervene in only 39% of the unsafe acts that they observe on the job.
- The study concluded people did not stop unsafe work were primarily because (1) they worry the person who is performing the unsafe work will become angry or defensive, and (2) they do not believe they can effectively stop unsafe work.

*See Ragain, R., Ragain, P., Allen, M. & Allen, M. “Study: Employees Intervene in Only 2 of 5 Observed Unsafe Acts.” Drilling Contractor. January / February 2011.

California Governor's Report on Refinery Safety Recommendations:

Strengthen PSM and Cal ARP Programs:

1. Implement inherently safer systems to the greatest extent feasible;
2. Perform periodic safety culture assessments;
3. Adequately incorporate damage mechanism hazard reviews into Process Hazard Analyses;
4. Complete root cause analysis after significant accidents or releases;
5. Explicitly account for human factors and organizational changes; and
6. Use structured methods such as Layer of Protection Analysis to ensure adequate safeguards.



Additional areas: Reporting of leading and lagging indicators, increasing worker and community involvement, and exploring the safety case approach.

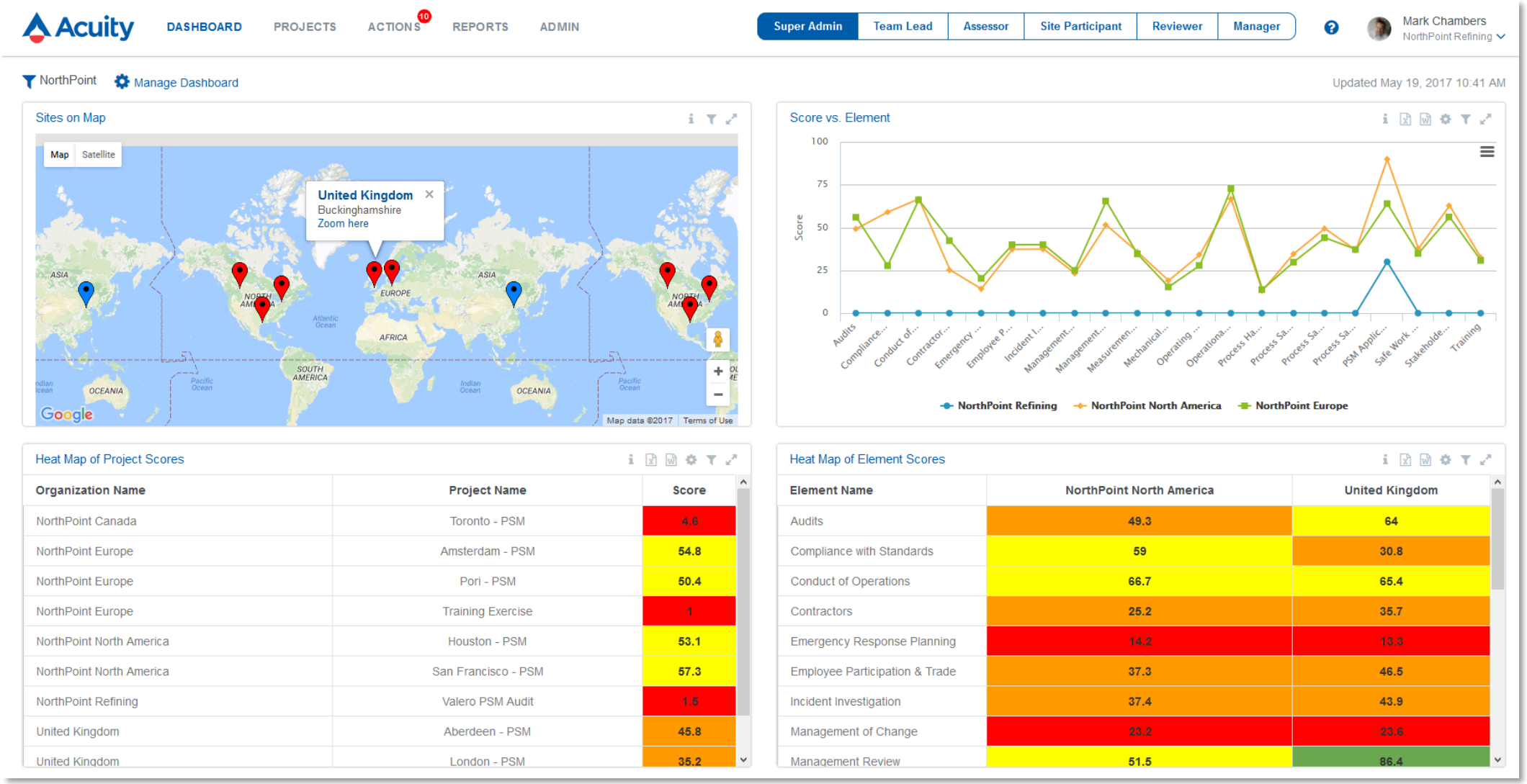
February, 2014

ISSUES:

NEED TO MAINTAIN RISK KNOWLEDGE AND CONTINUOUS RISK REDUCTION

- Need for clear and dynamic assessment and indication of risks for management attention to path for success, resource allocation, risk reduction, and measurement of progress

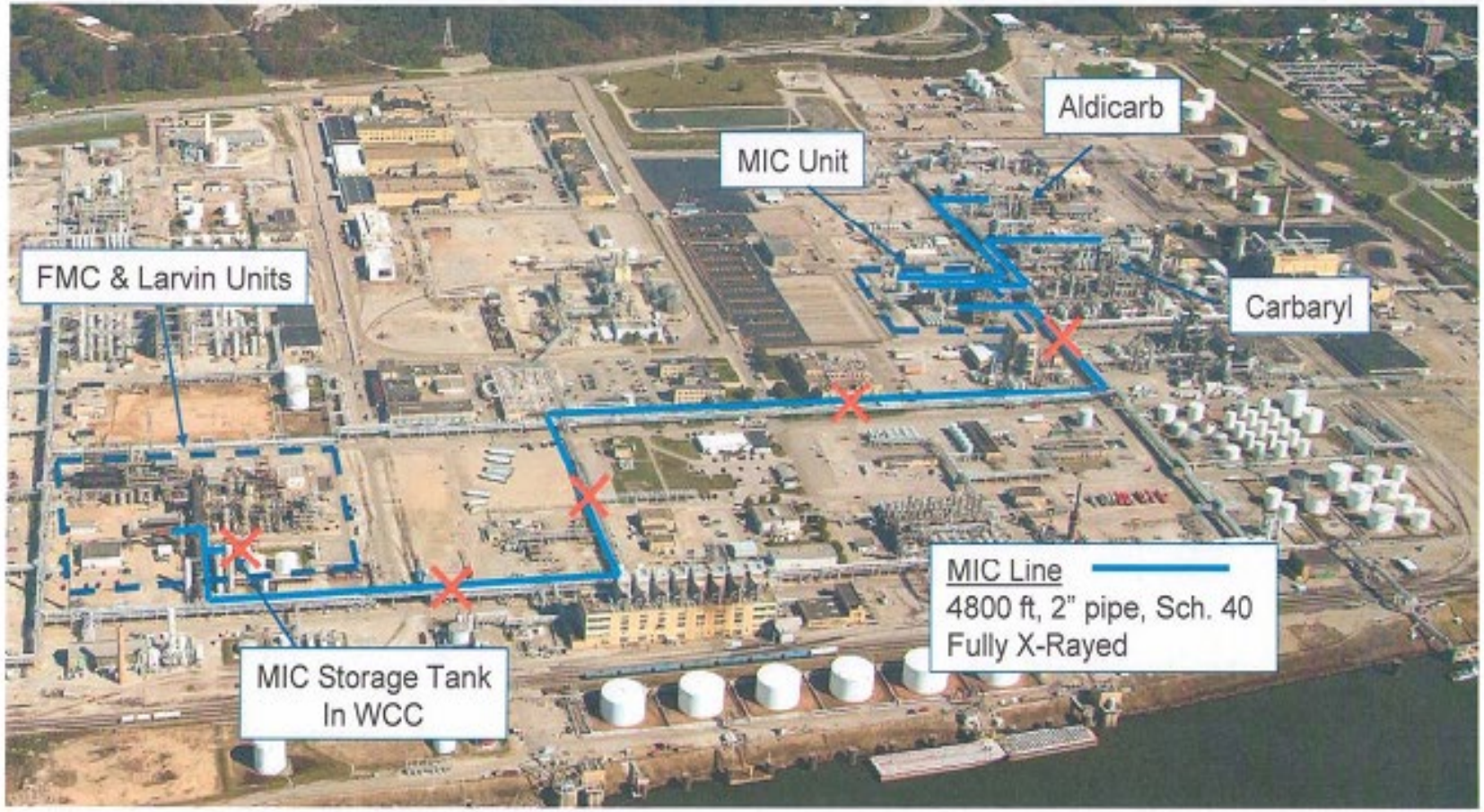
Need for Dynamic Risk Information on Leading and Lagging Indicators



Bayer Institute WV Case Study (28 August, 2008)

- On at about 10:35 PM, a runaway chemical reaction occurred inside a 4,500 gallon pressure vessel, known as a Residue Treater, in a pesticides process unit causing the vessel to explode
- Exposure to a chemical tank of methyl isocyanate at the facility, in a separate unit.
- Two Bayer employees died in the incident and six volunteer firefighters were treated for possible toxic chemical exposure.
- Causes and contributing factors:
  - The intentional overriding of an interlock system.
  - Startup was begun prematurely, a result of pressures to resume production of the pesticides, and took place before valve lineups, equipment checkouts, a pre-startup safety review, and computer calibration were complete.
  - The company failed to perform a thorough Process Hazard Analysis.
  - Overly complex Standard Operating Procedure (SOP) that was not reviewed and approved
  - Incomplete operator training on a new computer control system
  - Inadequate control of process safeguards.
  - Critical operating equipment and instruments were not installed before the restart, and were discovered to be missing after the startup began.

Reduced MIC Activity – Transfer Line & WCC Storage Removal



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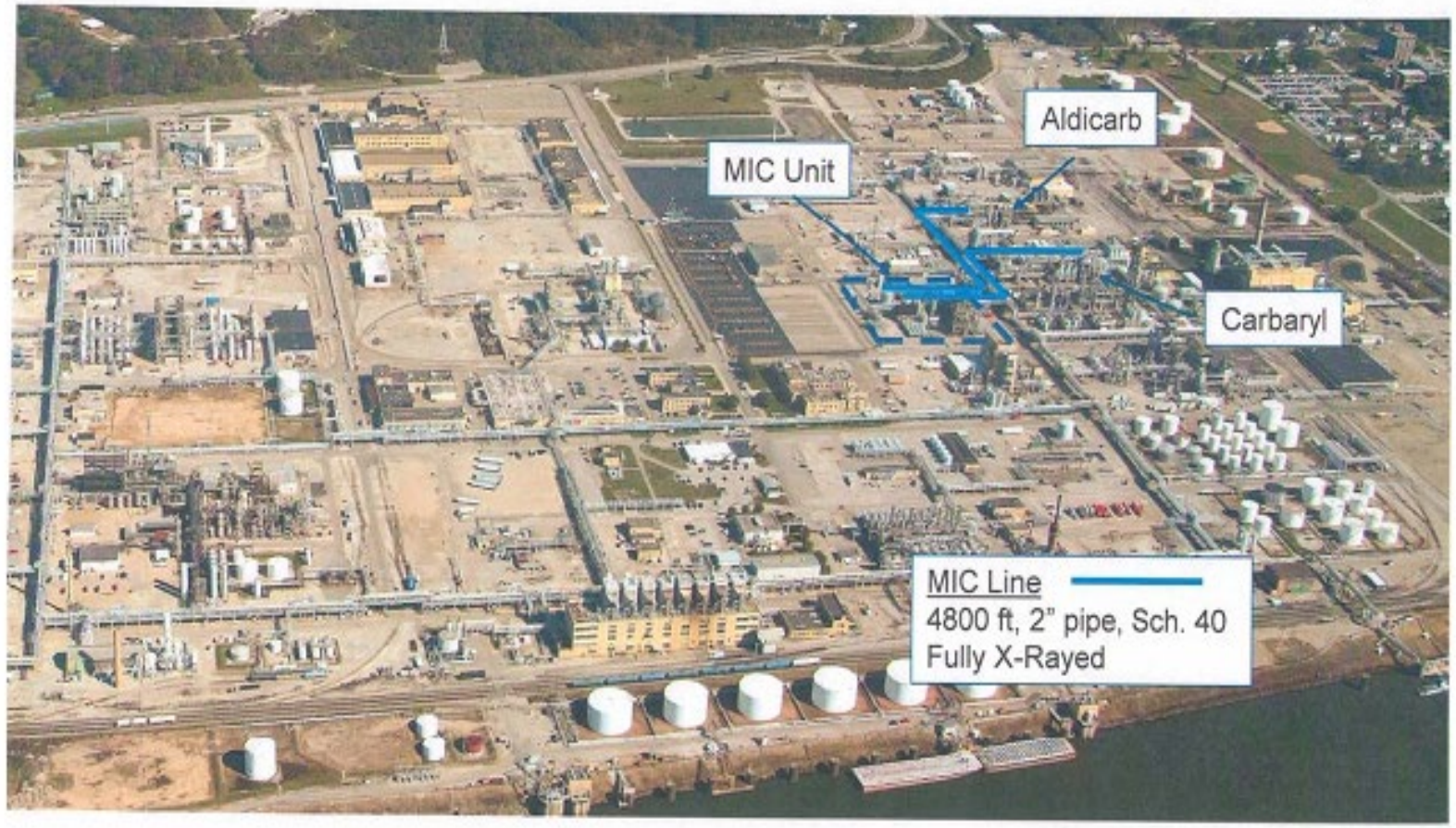
Bayer CropScience

Figure 1: Extent of MIC Operations at the Bayer CropScience, Institute, West Virginia Facility on August 2008

Reduced MIC Activity – Transfer Line & WCC Storage Removal



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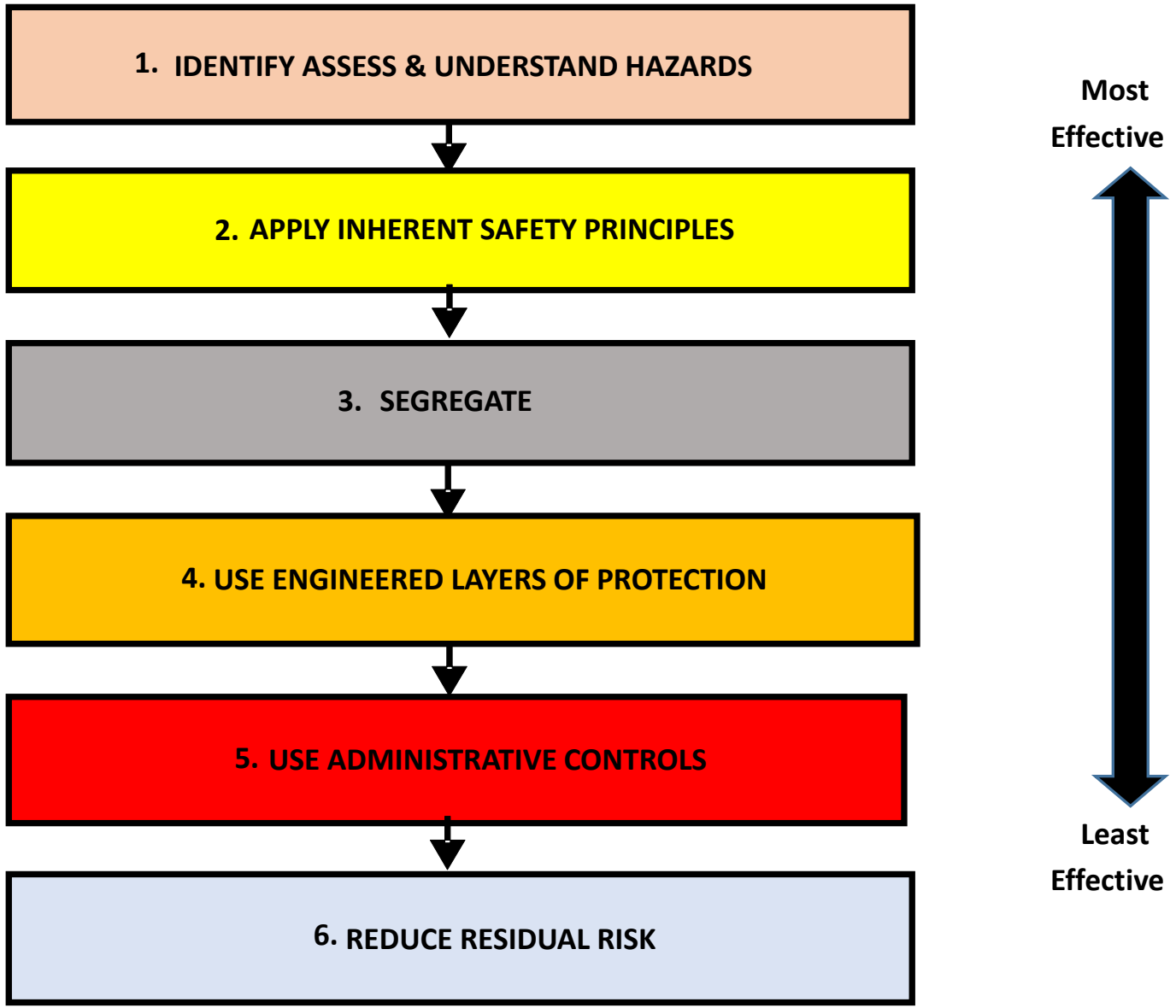
Bayer CropScience

Figure 2: Extent of Modified MIC Operations at the Bayer CropScience, Institute, West Virginia Facility, March 2011

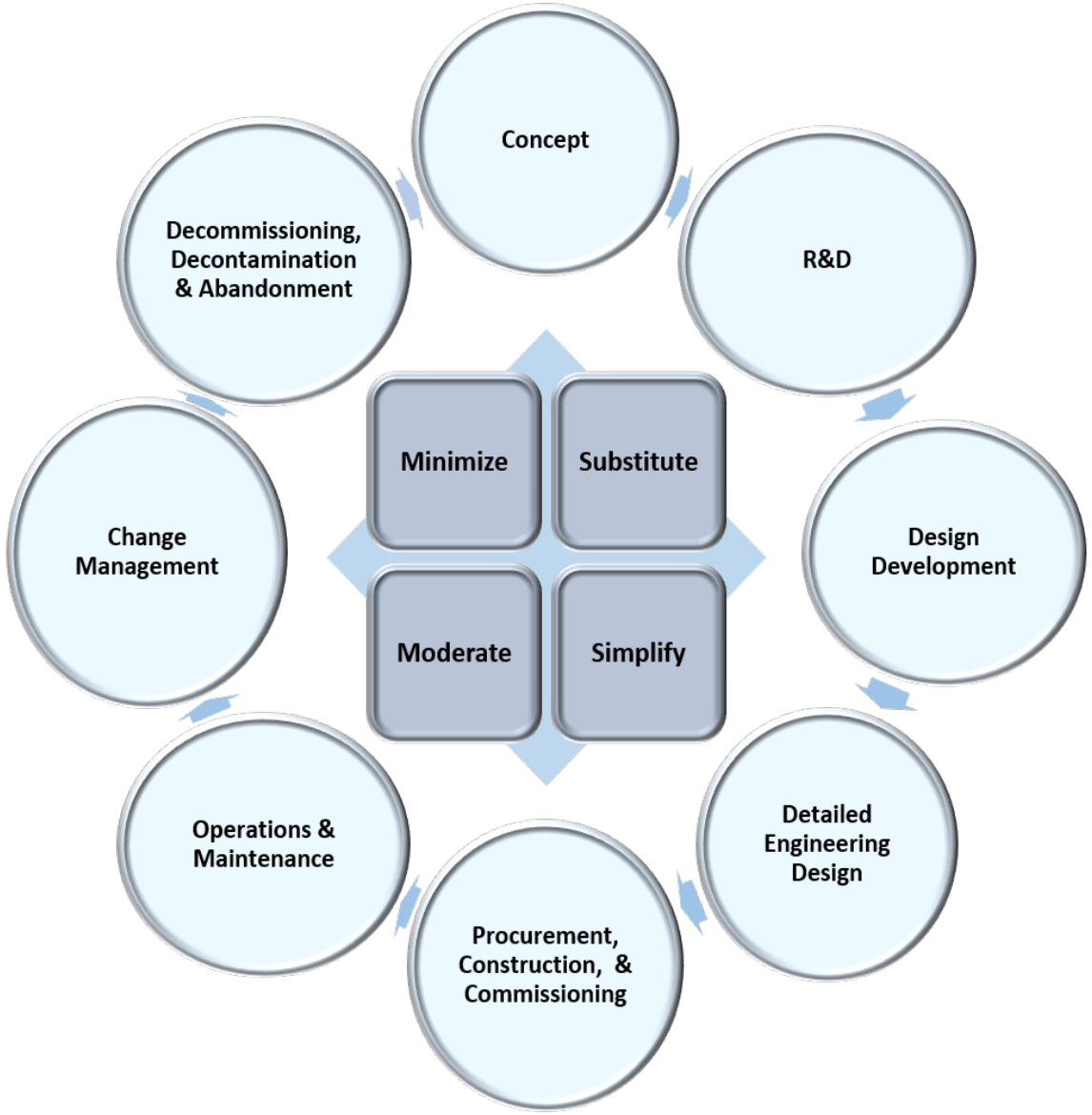
Inherently Safer Design Strategies

Strategy	Examples
Minimize	Use smaller quantities; eliminate unnecessary equipment; reduce size of equipment or volumes processed.
Substitute	Replace hazardous material with a less hazardous substance.
Moderate	Use less hazardous conditions, a less hazardous form of material or facilities which minimize the impact of a release.
Simplify	Design facilities which eliminate unnecessary complexity and make operating errors less likely.

Hierarchy of Controls



Inherent Safety Opportunities During the Entire Process Lifecycle



Inherent Safety Assessment of Existing Plant

- AcuTech conducted an Inherently Safer Design (ISD) assessment at a chemical plant in China from 26-29 November 2018
- ISD proved to be an enlightening way to identify and reduce key hazards by focusing on the hazards instead of adding layers of protection
- Using the four main strategies – Minimize, Substitute, Moderate, Simplify – the team identified 44 recommendations for further evaluation that will reduce process risks, OPEX, and CAPEX
- Lessons learned included broader issues that could benefit the company in general risk reduction

ISSUES:

LACK OF A PURPOSEFUL CULTURE TO FACILITATE GOOD SAFETY MANAGEMENT

Need for a defined effort to develop and sustain a culture of excellence in safety

DuPont LaPorte Texas Chemical Plant (15 November2014)

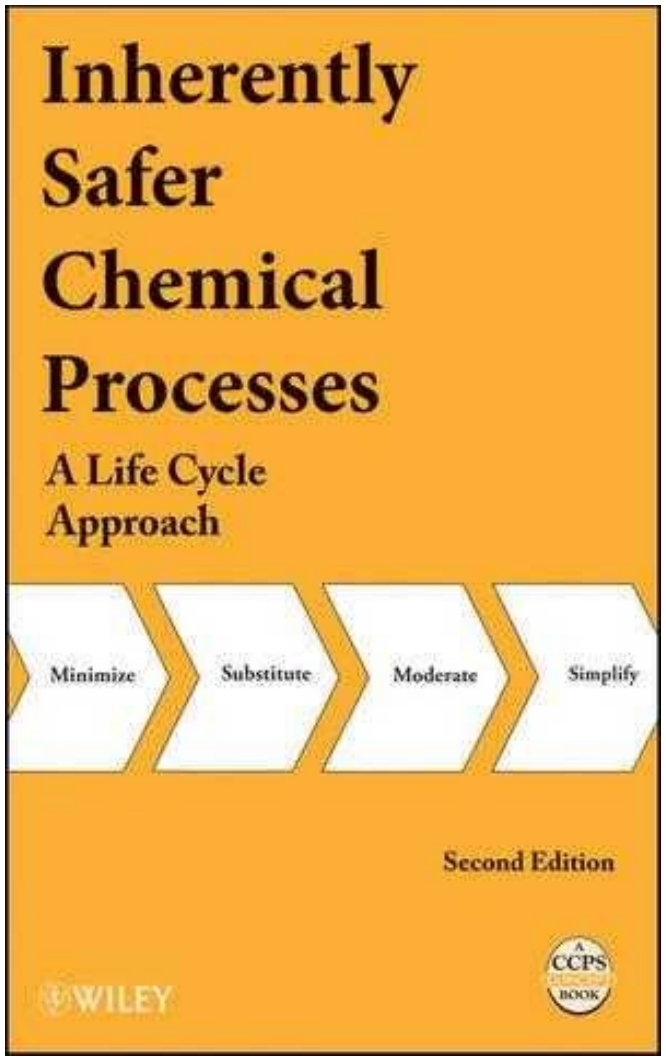
- The accident at DuPont's facility, located east of Houston, killed four workers and injured a fifth when methyl mercaptan, a toxic chemical used in the company's insecticide and fungicide manufacturing process, was released.
- Methyl mercaptan release from process into the vent header of a building while clearing a hydrate blockage due to due to cold weather from an improvised troubleshooting procedure.
- Errors in operations, failures of equipment, poor design issues, and complacency in not resolving a known, common hazard.
- Plant is now closed.

Inherent Safety Culture

- Inherent safety as a necessary and desirable concept should be ingrained in the mindset of all employees
- Make it a “way of doing business “.
- Evident it is an “inherent theme” of the day to day operations for all personnel.
- Everyone in the organization can understand, apply, and encourage the uses of ISD
- ISD can be a continual force-multiplier activity rather than only a one-off, special study

How to Make Inherent Safety Part of the Culture

- AcuTech prepared guidelines for AIChE/CCPS
- Need education to understand the principles
- Additional guidance clearly defining a process for practically applying inherent safety principles at all stages of a process lifecycle



ISSUES:

LACK OF SAFETY DRIVEN LEADERSHIP

Need for strong, clear, inspirational leadership for safety

Lessons Learned From Safety Audits Conducted by AcuTech

From many audits we have conducted, it is clear that:

1. A documented management system alone does not guarantee good safety performance
2. Management commitment is a clear indicator of success and is often weak or unclear
3. Poor implementation of safety always has failure of leadership as a contributing factor
4. Culture is one of the least understood and receives the least focus of all elements
5. The underlying culture of the organization determines the effectiveness of the program

Element – (element weight)	%
Applicability (2)	50.0%
Process Safety Culture (2)	38.9%
Compliance with Standards (1)	25.0%
Process Safety Competence (1)	60.4%
Employee Participation/Trade Secrets (2)	17.2%
PKM/Process Safety Information (3)	70.7%
HIRA/Process Hazard Analysis (3)	52.6%
Operating Procedures (3)	64.3%
Safe Work Practices (2)	90.3%
Asset Integrity/MI (3)	95.7%
Contractors (2)	62.7%
Training (2)	62.8%
Management of Change (3)	71.3%
Operational Readiness/PSSR (2)	35.7%
Conduct of Operations (1)	50.0%
Emergency Planning & Response (2)	86.5%
Incident Investigation (1)	61.0%
Metrics and Measurement (1)	40.2%
Audits (1)	64.0%
Management Review (2)	50.0%
Overall Weighted Score	70.4%

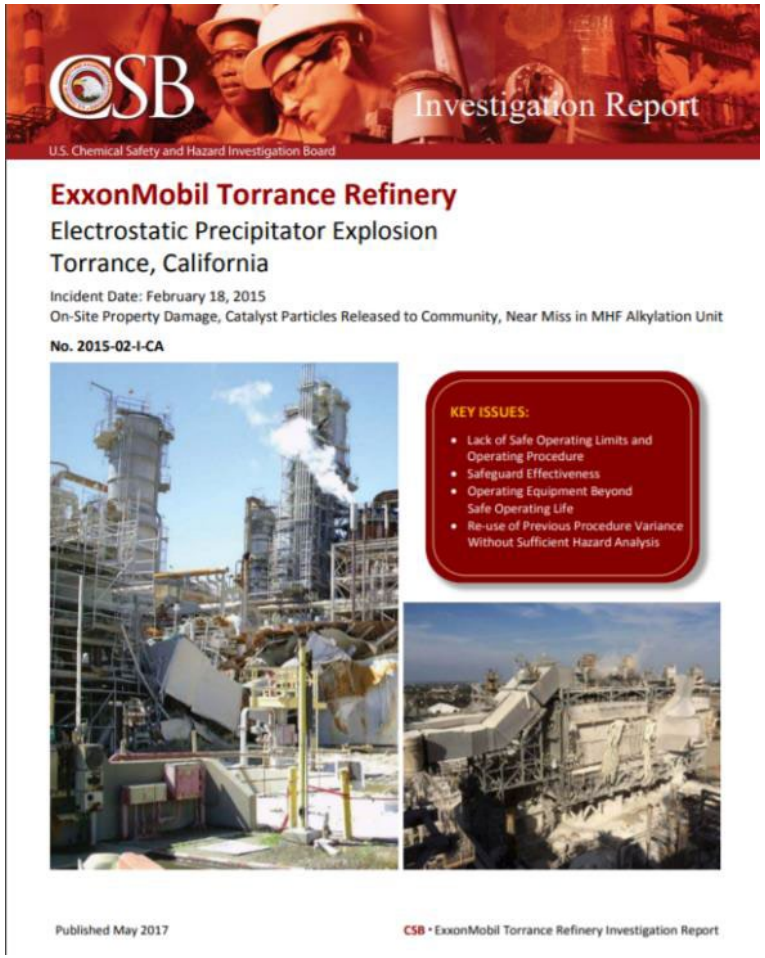
ISSUES:

LACK OF OPERATIONAL DISCIPLINE

Need for organizations to live to their safety objectives on a strict, continual basis

ExxonMobil Torrance California Refinery FCCU (8-2012)

- Electrostatic Precipitator explosion due to air ingress at process unit
- Air leak due to lack of effective barrier (slide valve leakage)
- Root cause was lack of operating discipline - reuse of previous operating variance (old procedure for operating with this condition) without fresh recognition of hazards
- No fatalities or injuries
- Near miss to Hydrofluoric Acid Alkylation tank, which may have posed a significant worker and public risk if loss of containment



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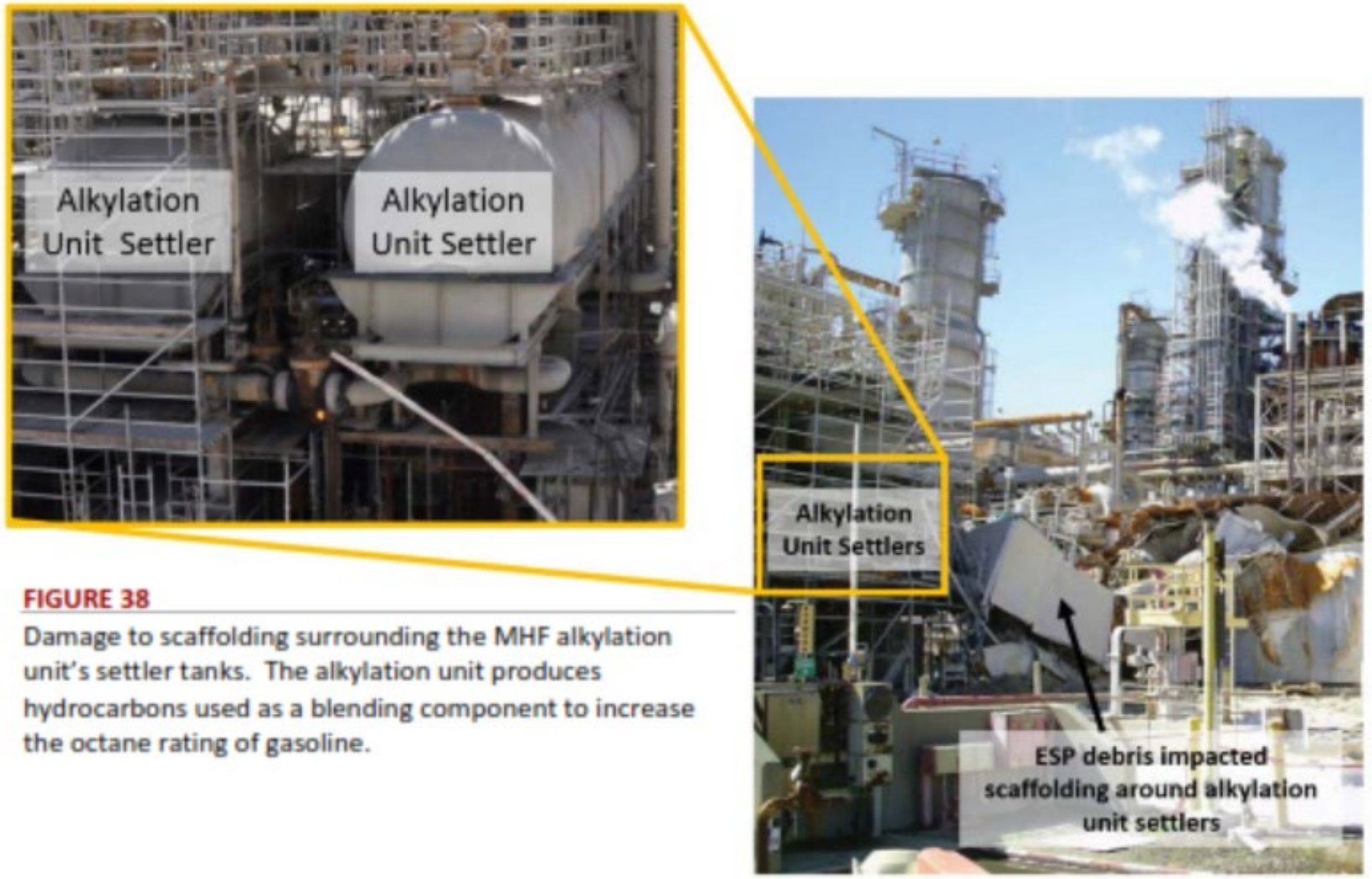
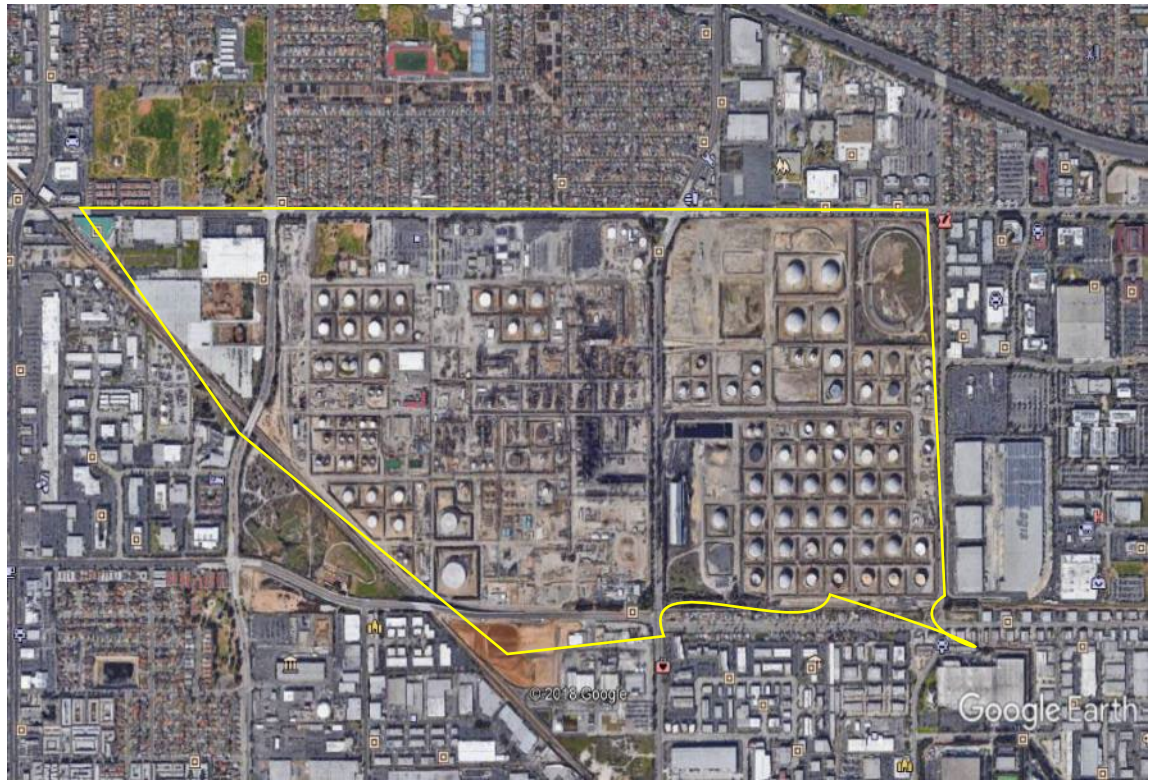


FIGURE 38

Damage to scaffolding surrounding the MHF alkylation unit's settler tanks. The alkylation unit produces hydrocarbons used as a blending component to increase the octane rating of gasoline.

ExxonMobil Torrance Refinery



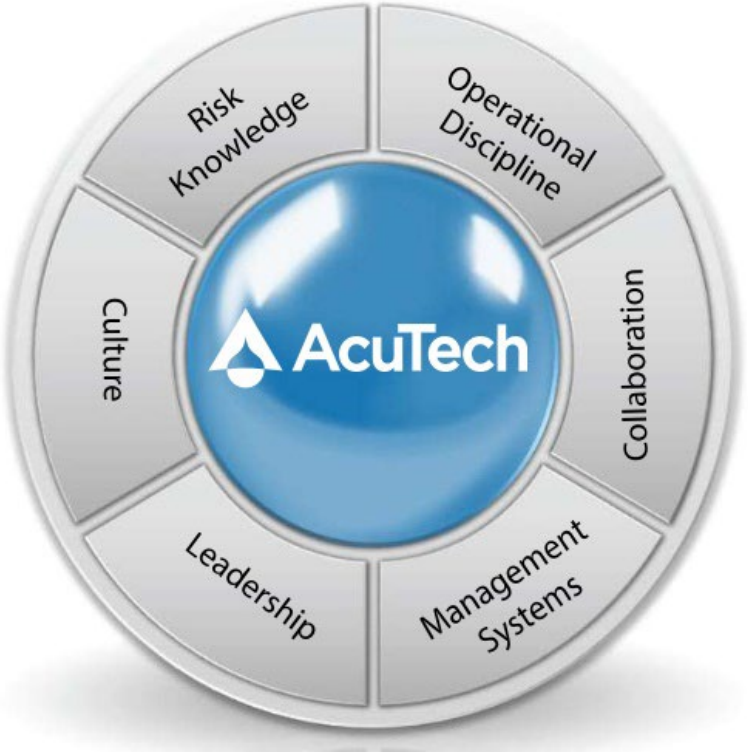
ISSUES:

LACK OF WORKFORCE AND STAKEHOLDER COLLABORATION

Need for consultation with and continual collaboration with all employees, contractors, suppliers, customers, the public, and other stakeholders to drive trust and understanding

Summary - Essential Components of a Successful Risk Management Program

- **A Management System** - essential to structure the process and maintain management control.
- **Risk Knowledge and Action** - Identify opportunities for greatly reducing hazards before adding layers of controls and continually reducing risks
- **Operational Discipline** - To be responsible and to excel, system elements have to be high caliber and followed to a high degree of discipline.
- **Leadership** – Strong positive leadership energizes and steers the entire effort and sets the tone.
- **Culture** – A defined effort to develop and sustain a culture of excellence in safety facilitates the program.
- **Collaboration** - All businesses have to maintain trust through engagement and good performance in order to survive; If your company doesn't, the competition will!



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