



Lowell Center for Sustainable Production

UNIVERSITY OF MASSACHUSETTS LOWELL

Alternatives Assessment 119 Webinar:

The Role of Alternatives Assessment in Chemical Accident Prevention



MARCH 12, 2014

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**LOWELL CENTER FOR SUSTAINABLE PRODUCTION,
UMASS LOWELL**

** If you would like to ask a question or comment during this webinar please type your question in the Q&A box located in the control panel.*

Goals



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- Continuing education and dialog
- To advance the practice of alternatives assessment for informed substitution across federal, state, and local agencies through networking, sharing of experiences, development of common approaches, tools, datasets and frameworks, and creation of a community of practice.

Purpose of this call



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- Presidential Executive Order 13650 on Improving Chemical Facility Safety and Security of August 2013 requires that federal agencies more effectively coordinate activities to improve chemical plant safety.
- It specifically identifies the need to explore options to adopt safer chemicals and inherently safer technologies.
- A number of federal and state initiatives attempted to integrate the concepts of pollution prevention and chemical accident prevention around the concept of alternatives assessment and inherently safer process design is a principle of green chemistry.
- This webinar explores the role of alternatives assessment in chemical accident prevention and the opportunities the Executive Order presents for more effective interagency collaboration around safer chemicals.

Speakers



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- **Dr. Nicholas Ashford, MIT**
- **Dr Gerald Poje, Former Board Member
Chemical Safety and Hazard
Investigation Board**
- **Jordan Barab, Deputy Assistant
Secretary of Labor for the Occupational
Safety and Health Administration**

Discussion Questions



- What is the role of alternatives assessment in advancing inherently safer chemical processes?
- How can alternatives assessment be an effective tool in to both prevent catastrophic accidents and protect human and environmental health from chronic health hazards?
- How can agencies more effectively coordinate activities around informed substitution that address both chronic and acute hazards?



Webinar Discussion Instructions



- Due to the number of participants on the Webinar, all lines will be muted.
- If you wish to ask a question, please type your question in the Q&A box located in the drop down control panel at the top of the screen.
- All questions will be answered at the end of the presentations.

INTEGRATING POLLUTION PREVENTION & INHERENTLY SAFER PRODUCTION: The Role of Alternatives Assessment

Nicholas A. Ashford, PhD, JD
Professor of Technology and Policy
Massachusetts Institute of Technology

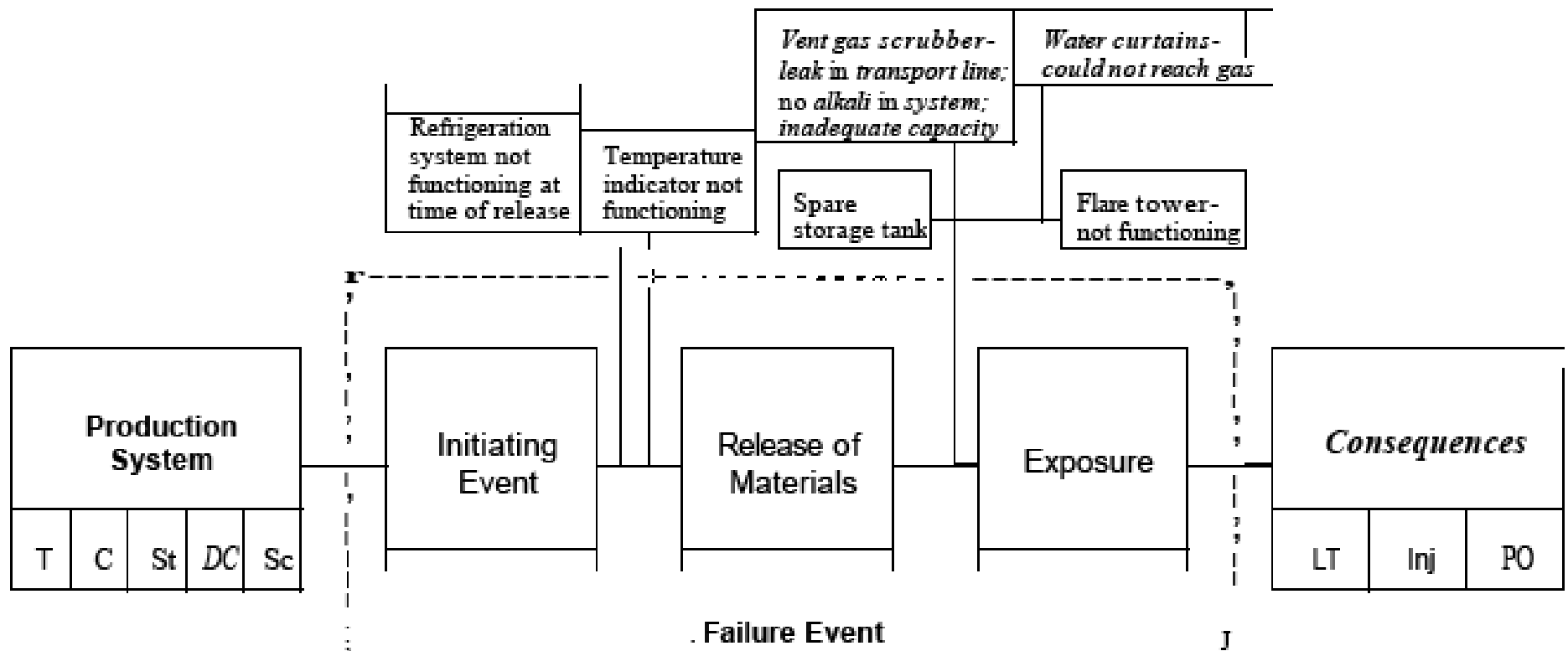
Pollution Prevention and Inherently Safer Production (ISP) have common elements

- **Input Substitution**
- **Final Product Reformulation**
- **Process Changes and Redesign**
- **Organizational Change**
- **Managerial Change**
- **Changes in Work Practices**

However, technologies that improve PP may not be the same as those required by ISP, and vice versa.

Definitions

- **Pollution Control** (end-of-pipe approaches) collection of emissions, effluents, and waste; off-site recycling and treatment
- **Pollution Prevention** (Toxics Use Reduction, Cleaner Production, Source Reduction, Green Chemistry) -- address gradual pollution which arises as the *expected byproducts* of production or is associated with products themselves.
- **Inherent safety**--sometimes also referred to as primary prevention--relies on the development and deployment of technologies that prevent the *possibility* or *significantly reduce the probability* of a *sudden and accidental release*, i.e., a chemical accident.
- **Secondary prevention** reduces the *probability* of a chemical accident by strengthening reaction hardware, providing neutralizing baths, etc. Secondary prevention professes to address the “root causes” of accidents. (Pollution control is also a form of secondary prevention.)
- **Mitigation and emergency responses** seek to reduce the *seriousness* of injuries, property damage, and environmental damage resulting from chemical accidents – known as tertiary prevention, or *injury prevention*.



Batch process for manufacturing Carbarylpesticide with MIC

Ingress of water into storage tank, initiated runaway exothermic reaction

Exothermic reaction, increased temperature and pressure of gas

Cloud transport to Bhopal

*2,000+ dead
200,000 injured
long term toxic effects*

Figure 13.4
Union Carbide at Bhopal

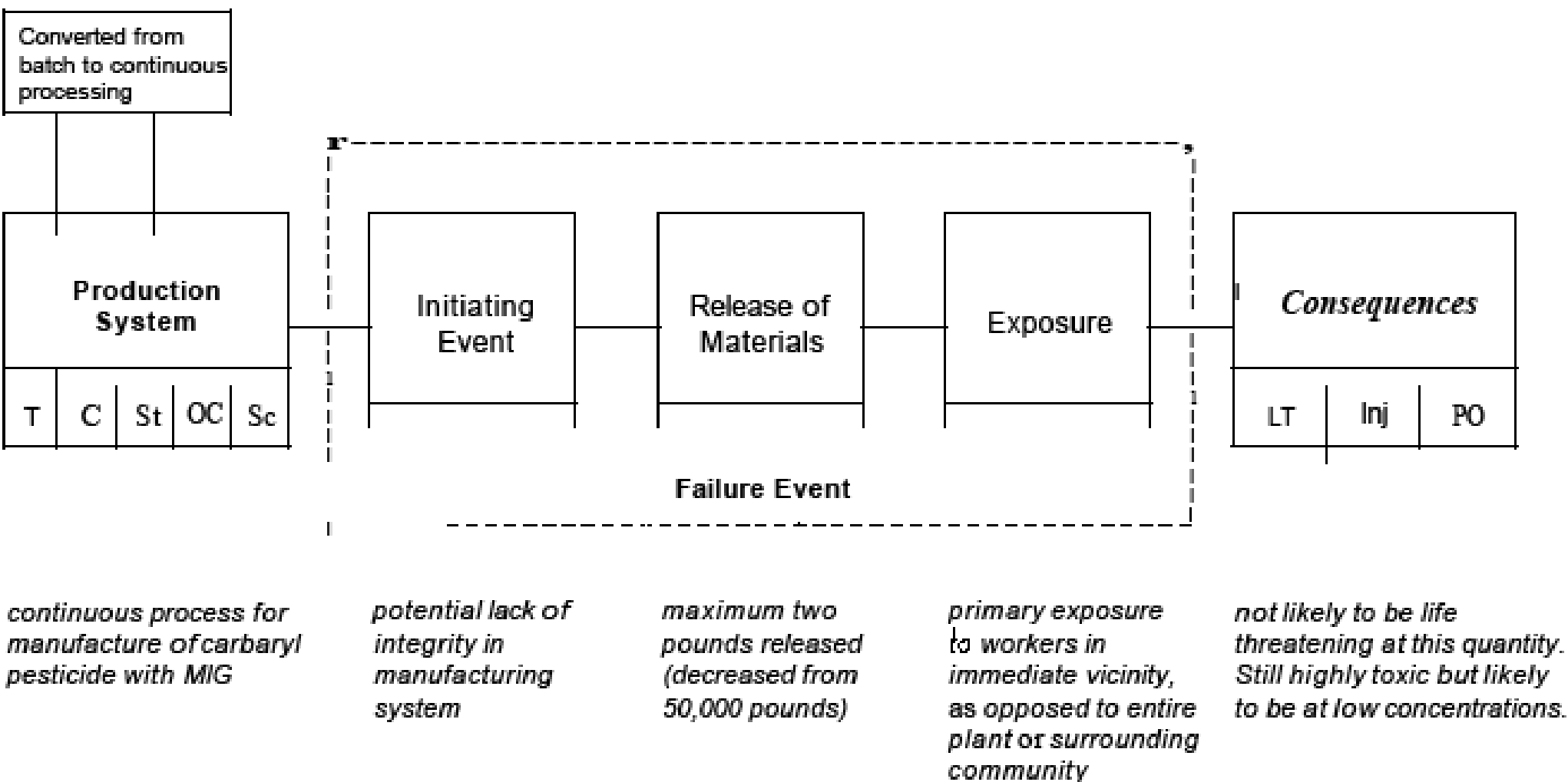


Figure 13.6
DuPont.

Reasons why firms are adopting cleaner production/pollution prevention:

- the costs of waste transport/treatment and pollution control can be high, and
- there is increased liability for environmental damage =>
- there is a ready calculus for risk avoidance; it is economically rationale to avoid gradual pollution and contaminated products
- there is increased transparency of toxic releases (through the TRI) and public awareness
- the Pollution Prevention Act, the IPPC Directive, EMAS, ISO and 14000 all provide pressure for a search for solutions
- In Massachusetts, requiring state-of-art review reporting encourages adoption of pollution prevention

Reasons why firms are not adopting inherently safer technology:

- the costs of [rare] accidents are not apparent until after the event, and
- the probabilities/risk assessments for sudden and accidental releases are problematic (worst-case scenarios are not believed, and perhaps are not believable) =>
- there is *no* ready calculus for risk avoidance decisions; it may not seem economically rationale to prevent accidents
- chemical engineers have a simplistic view of 'root causes'.
- Section 112r of the Clean Air Act was minimally implemented; requiring technology options analysis was rejected by the Clinton Administration.
- Inherent safety not given prominence; compare Seveso II
- there has been limited public awareness of the risk ...but 9/11 is changing all that

Implementation of inherent safety through a two-step process

- **An *inherent safety opportunity audit* (ISOA)**
 - that identifies *where* in a specific facility inherently safer technology is needed.
- **A *technology options analysis* (TOA)**
 - that identifies *specific inherently safer options* that will advance the primary prevention, i.e., that will alter production systems and final products so that there are less inherently unsafe risks.
 - Both the *adoption*, and the *development*, of inherently safer options need to be considered

US Pollution Prevention & Inherent Safety Legislation

- **The Pollution Prevention Act of 1990**
 - » Preferred hierarchy of input substitution, product reformulation, and process redesign over pollution control
 - » Gradual pollution
 - » Sudden and accidental releases
 - » Amends Community Right to Know Act by requiring additional reporting of pollution prevention activities
 - » Requires examination of all prior standards to ensure a pollution prevention approach
- **The Clean Air Act**
 - » Risk Management Plans (and “worst case scenarios”)
 - » General duty to *identify* hazards, *design & maintain* a safe facility, and *minimize* consequences of accidental releases.
- **The OSHA Act**
 - » Process Safety Management rule for workers
 - » Material Safety Data Sheets (MSDSs)
- **Executive Order 13650 Improving Chemical Facility Safety & Security**

Policy Recommendations

- The promotion of the concept of *cleaner* and *inherently safer production* via the dissemination of governmental policy statements and publications, and through legal instruments, where appropriate (cf. the Executive Order).
- This should be complemented by the development of training/education on cleaner and inherently safer production for industry, policy makers, and safety inspectors in the areas of pollution & accident prevention (both for occupational and environmental exposures).
- The establishment of economic incentives (e.g., tax incentives) or requirements for firm-based review of inherently safer technological options -- both an Inherent Safety Opportunity Audit and a Technology Options Analysis should be encouraged or, where appropriate as in the case of particularly hazardous operations, required.

Catastrophic risk reduction

Promoting Inherently Safer Alternatives

Gerald V. Poje, Ph.D.

Alternatives Assessment Network

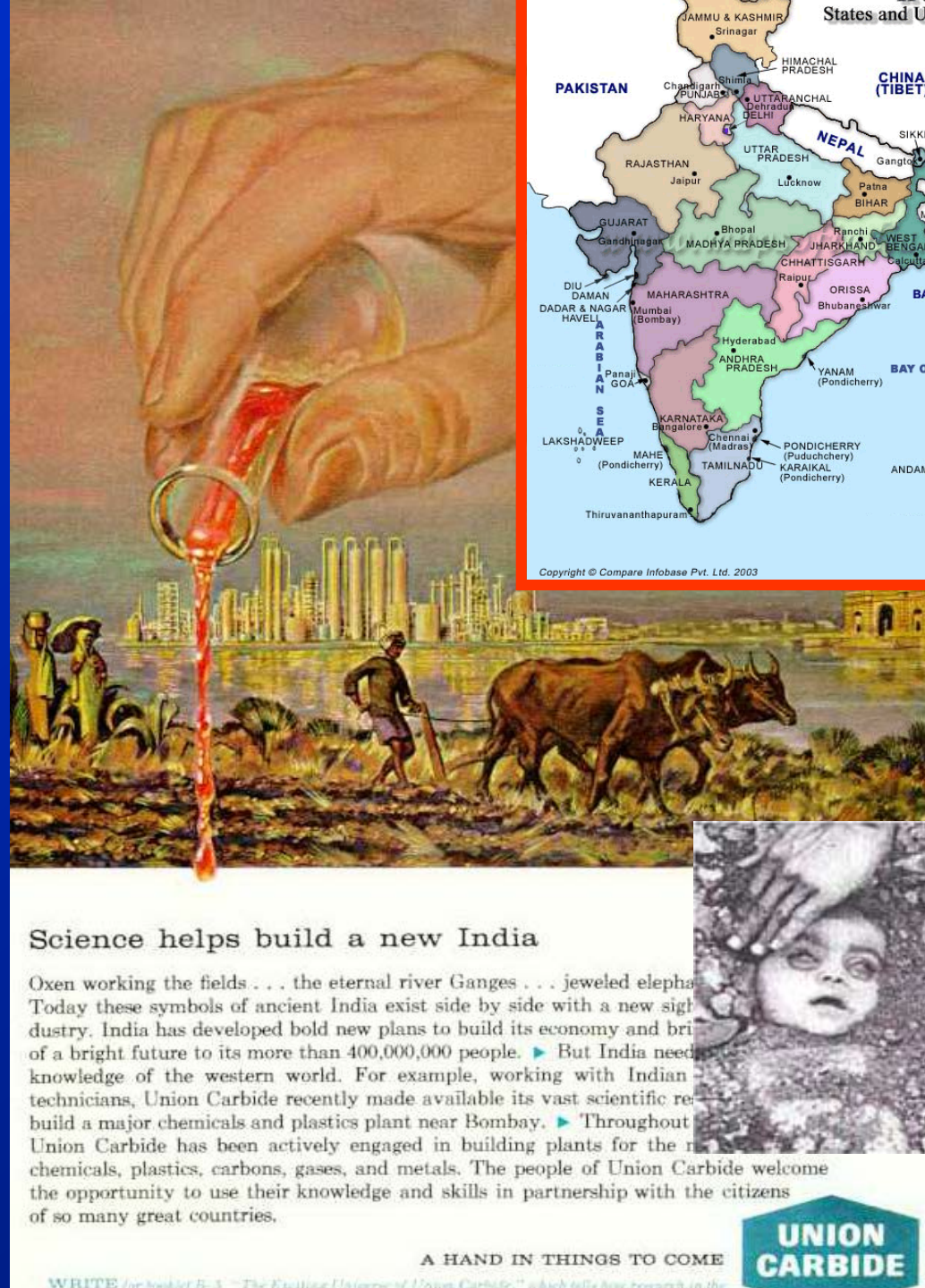
March 12, 2014

Bhopal Disaster

December 2-3, 1984

Key Facts

- Green Revolution?
- Runaway chemical reaction
- 6-20,000 killed
- 300,000+ injured
- multinational U.S. corporation
- Management systems issues
- Policy stimulus



Science helps build a new India

Oxen working the fields . . . the eternal river Ganges . . . jeweled elephants . . . Today these symbols of ancient India exist side by side with a new sight . . . industry. India has developed bold new plans to build its economy and bring a bright future to its more than 400,000,000 people. ► But India needs knowledge of the western world. For example, working with Indian technicians, Union Carbide recently made available its vast scientific resources to build a major chemicals and plastics plant near Bombay. ► Throughout the world, Union Carbide has been actively engaged in building plants for the production of chemicals, plastics, carbons, gases, and metals. The people of Union Carbide welcome the opportunity to use their knowledge and skills in partnership with the citizens of so many great countries.

A HAND IN THINGS TO COME

UNION
CARBIDE

Taft, Louisiana

December 11, 1982

Key Facts

- acrolein tank contaminated with rainwater
- runaway reaction in high volume bullet tank
- explosions and fires
- 20,000 evacuated



Union Carbide, St. Charles Parish

Institute, WV

August 28, 2008



Key Facts

- Methomyl residue tank runaway reaction
- explosion, multiple containment breaches, fire
- 2 workers killed
- poor emergency response
- potential impact on MIC above ground tank
- prompted Inherent Safety NAS study



**AZF Agrochem Facility,
TotalFinaElf Group**

Post Bhopal Policy Paradigm Shift

Superfund Amendment Reauthorization Act

- Community Rights-to-Know**
- Worker Education and Training**
- Interdisciplinary Basic Research**

Post 1990 Policy Paradigm Shift

Clean Air Act

- OSHA PSM
- EPA RMP
- CSB

Post 9-11

- DHS CFATS

Layers of Protection Prevention Hierarchy

- Inherently safer design – chemistry and technology
- Basic controls, process alarms
- Critical alarms, operator supervision
- Automated action (SIS or ESD)
- Physical protection (relief devices, dikes)
- Plant emergency response
- Community emergency response

Texas City, TX

April 16, 1947



Key Facts

- 570+ killed;
3500 injured
- extensive damage to industrial complex, homes and schools
- NH_4NO_3 ship explosions
- safety/technology transfer issues



Grande Camp Explosion

Toulouse, France

September 21, 2001



Key Facts

- NH_4NO_3 explosion (20-40 Ton TNT equivalence)
- 30 killed (some public), 800+ hospitalized, 2242 injured
- 3.4 on the Richter scale, 65x54x7 meter crater
- 27,000 housing units and 74 schools damaged; 1.5B Euros
- Releases and damages at other facilities; 1300 companies
- Broad land use policy impact



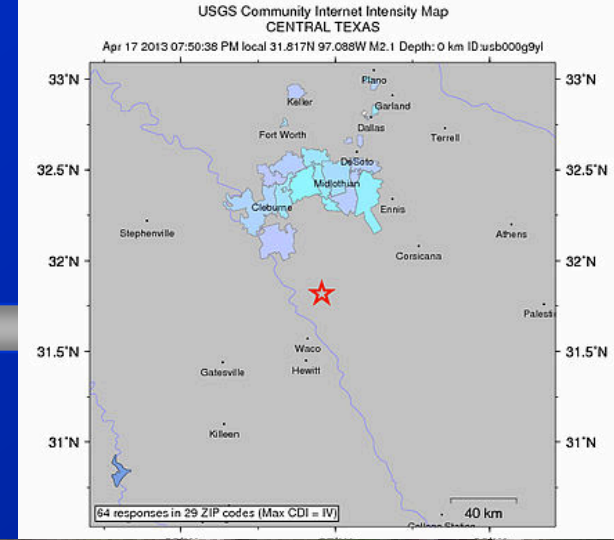
**AZF Agrochem Facility,
TotalFinaElf Group**

West, Tx

April 17, 2013

Key Facts

- NH_4NO_3 explosion
- 15 killed (emergency responders and public), 160 injured
- 60-80 houses and apartment complex destroyed; school damaged; nursing home damaged
- High political attention
- Obama Executive Order on Chemical Facility Safety and Security



West Texas Fertilizer Facility

E.O. 13650

Policy Paradigm Shift?

Section 6. Policy, Regulation and Standards Modernization

- OSHA PSM RFI**
- Broad Outreach and Input**



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Next Webinars



Lowell Center for Sustainable Production
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- **Alternatives Assessment 120: Alternatives Assessment for Engineered Nanoparticles**
- *Friday, March 21, 2014 at 12pm Eastern/ 9am Pacific*
- Register for the webinar now
at: <https://gc3.webex.com/gc3/onstage/g.php?d=664550311&t=a>
- The webinar will feature:
 - **Molly Jacobs, Lowell Center for Sustainable production**
 - **Dr. Jennifer Sass, Natural Resources Defense Council**
 - **Dr. Lauren Heine, Clean Production Action**



Webinar Audio & Slides



The audio recording and slides shown during this presentation will be available at:

<http://www.chemicalspolicy.org/alternativesassessment.webinarseries.php>