



Lessons from the West Fertilizer Company Explosion

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What is the CSB?

- The CSB is an independent U.S. Federal agency charged with investigating chemical accidents
- CSB conducts root cause investigations of chemical accidents at fixed industrial facilities.
- Board members are appointed by the President and confirmed by the Senate.
- The agency does not issue fines or citations.
- Primary policy lever is recommendations to firms, regulatory agencies, trade associations, standards developers, and labor groups.



We are an Open, Public Agency

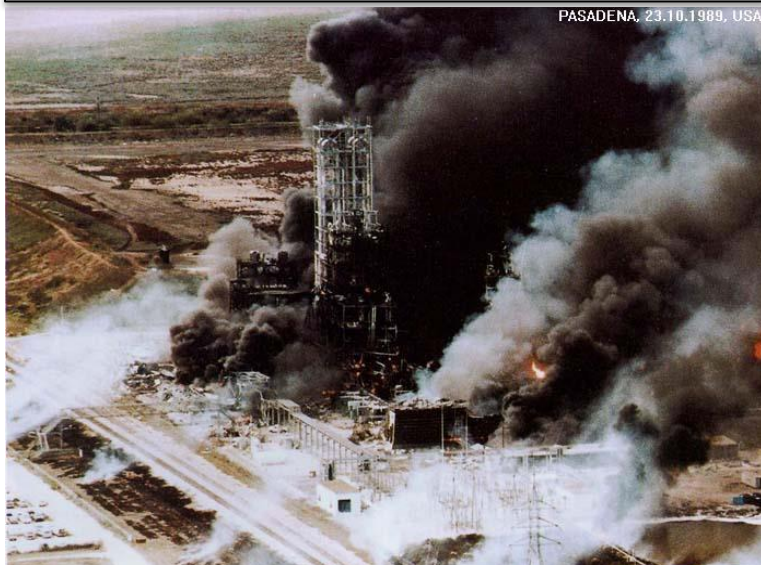
- Investigation reports and safety bulletins
- Safety videos
- Public meetings
- Press conferences
- Website: www.csb.gov



Events Leading to CSB Creation

October 23, 1989

Phillips 66 (Pasadena, TX)



23 Dead; 314 Injured; \$715 million in damage

Release of 85,000 lbs of highly flammable gases led to explosions and fire in polyethylene unit.

July 5, 1990

Arco Chemical (Channelview, TX)



17 Dead; 5 Injured; \$715 million in damage

Excessive oxygen in the vapor space of a waste water storage tank led to an explosion and fire in propylene oxide-styrene monomer unit.



Legal Foundation of the CSB

Formed by Clean Air Act Amendments of 1990

“The Board shall– (i) investigate (or cause to be investigated), determine and report to the public in writing the facts, conditions, and circumstances and the cause or probable cause of any accidental release resulting in a fatality, serious injury or substantial property damages;” 42 USC §7412(r)(6)(C)



Legal Authorities

- Can require the production of evidence and witness testimony
- Can subpoena entities to compel compliance
- Can enter any property where an accidental release causing a fatality, serious injury or substantial property damage has occurred and *do all things therein necessary for a proper investigation*
- Inspect at reasonable times records, files, papers, processes, controls, and facilities and take such samples as are relevant to such investigation
- Make recommendations and conduct studies

No part of the conclusions, findings, or recommendations of the Board relating to any accidental release or the investigation thereof shall be admitted as evidence or used in any action or suit for damages.



Incident Screening Program

- Office of Incident Screening and Selection established in 2009
 - Agency data goes back to 2001
- CSB has no reporting mandate
- Incident information via media reports, National Response Center, phone calls



Deployment Criteria

- Deaths or injuries onsite or offsite
- Substantial property loss
- Offsite public or environmental impact
- Broad national significance
- Issue of interest
- Available resources



Types of Accidents That We Investigate

- Accidents in chemical plants, oil refineries and facilities using chemicals
- Toxic gas releases
- Explosions
- Other fatalities, e.g., confined space, hot work
- Major environmental releases





What Investigators Do

- Respond quickly to scene
- Gather physical evidence
- Interview people
- Test equipment
- Comb through documentary evidence
- Draft reports with proposed recommendations for Board approval





Current Investigations/Deployments

Investigation	Location	Incident Date
Williams Olefins Plant Fire and Explosion	Geismar, LA	June 13, 2013
Freedom Industries Chemical Release	Charleston, WV	January 9, 2014
DuPont Toxic Chemical Release	La Porte, TX	November 15, 2014
ExxonMobil Refinery Explosion	Torrance, CA	February 18, 2015
Delaware City Refining Company	Delaware City, DE	November 29, 2015
Enterprise Products Partners Fire and Explosion	Pascagoula, MS	June 27, 2016
Sunoco Logistics Partners Flash Fire	Nederland, TX	August 12, 2016
Airgas Fatal Explosion	Cantonment, FL	August 28, 2016



Recently Closed Investigations

Investigation	Location	Incident Date
Caribbean Petroleum Refining Tank Explosion and Fire	Bayamón, Puerto Rico	October 23, 2009
Macondo Blowout and Explosion	Gulf of Mexico	April 20, 2010
West Fertilizer Explosion and Fire	West, TX	April 17, 2013
Tesoro Martinez Refinery Sulfuric Acid Spill	Martinez, CA	February 12, 2014

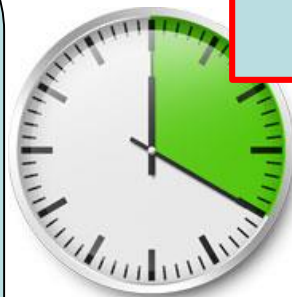
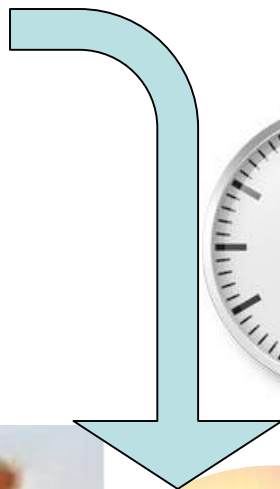


West Fertilizer Company Fire and Explosion (2013)





Consequences



**Less than 20
Minutes**

**15
Fatalities**

- 12 Firefighters and EMTs
- 3 Community Members

Injuries

- Over 260
- Community Members and Emergency Responders

**Community
Damage**

- Apartment Complex
- Schools
- Nursing Home
- Private Residences

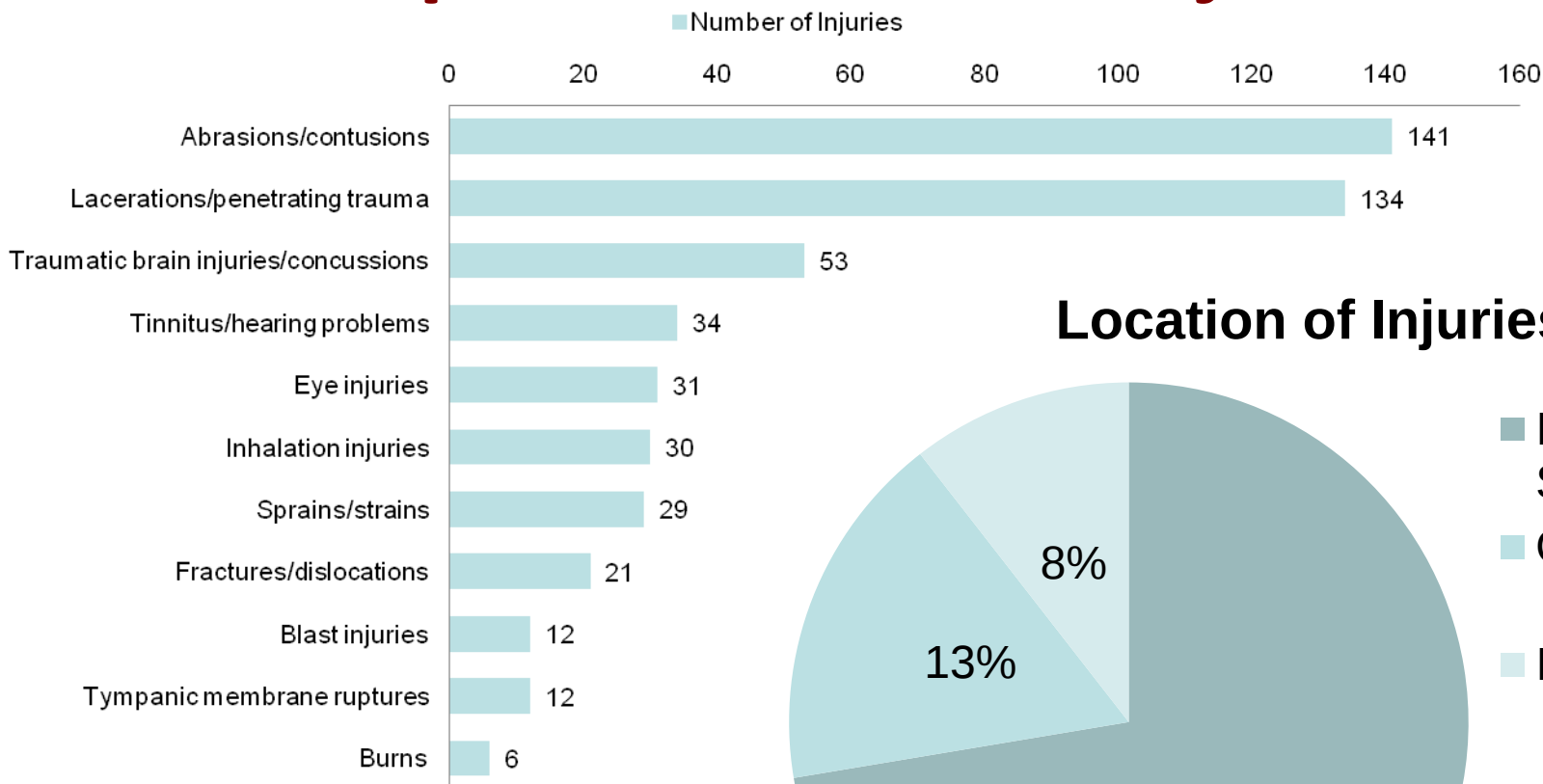


Video Footage of Community Property Damage

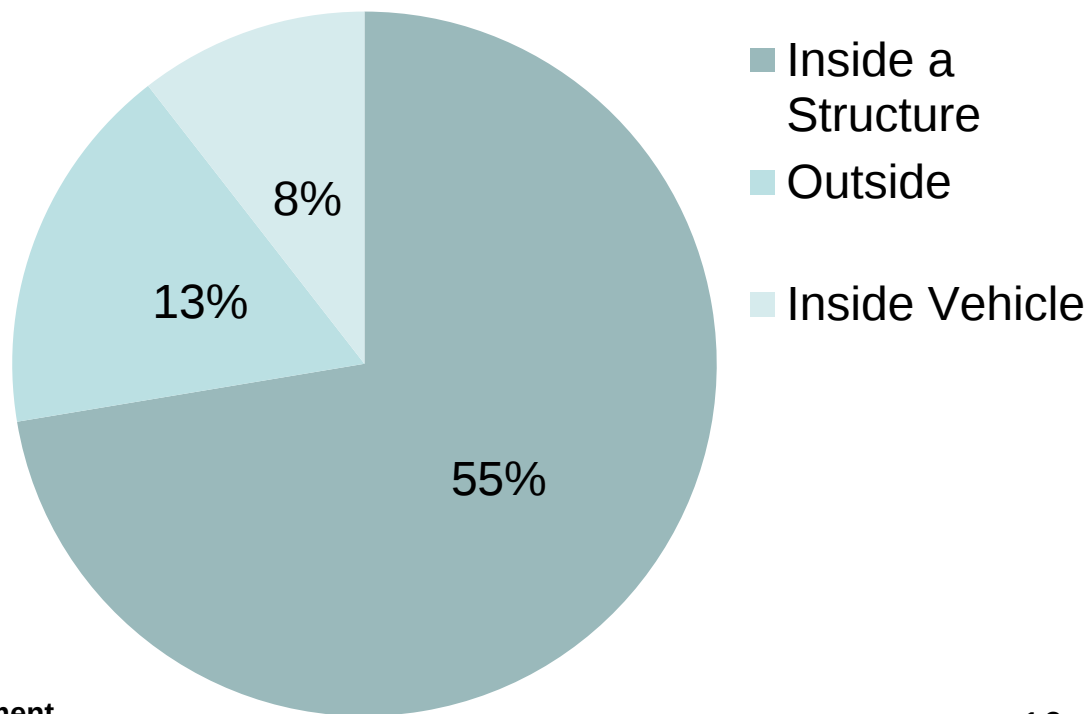




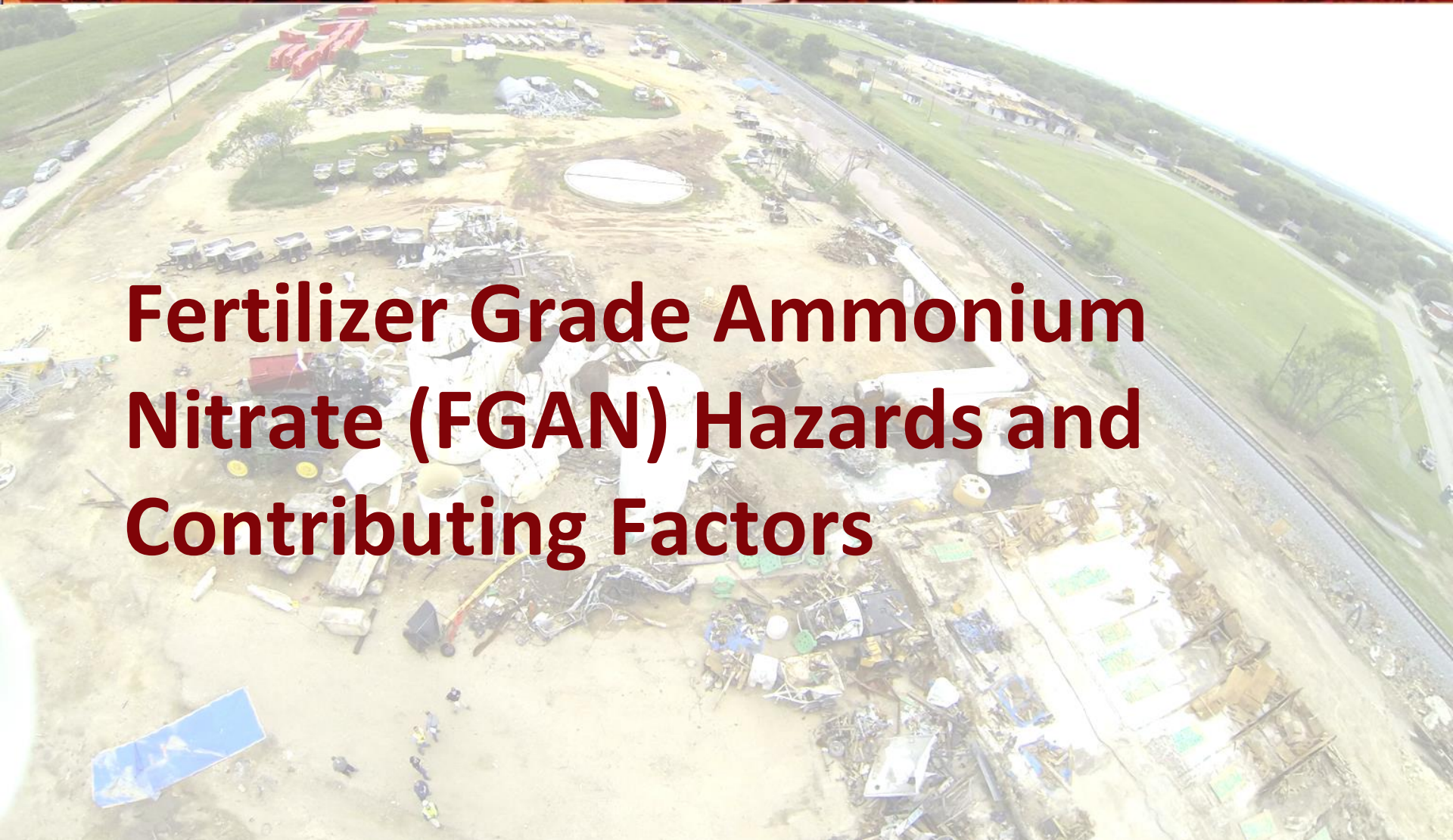
252 Explosion-Related Injuries



Location of Injuries



Source: Waco-McLennan County Public Health Department

An aerial photograph of an industrial facility, likely a fertilizer plant, showing various storage tanks, pipes, and structures. The site is surrounded by green fields and a road. The image is overlaid with a semi-transparent white box containing the title text.

Fertilizer Grade Ammonium Nitrate (FGAN) Hazards and Contributing Factors



Fertilizer Grade Ammonium Nitrate (FGAN)



Prills (pellets) of FGAN piled in
wooden storage bin





Hazards of Ammonium Nitrate

Fertilizer Grade
Ammonium Nitrate (FGAN)



- High-density Prill
- Division 5.1 Oxidizer

Technical (Explosive) Grade
Ammonium Nitrate (TGAN)



- Low-density Prill
- Division 5.1 Oxidizer

Stable under normal
conditions

Ammonium Nitrate



Minimal health
hazards

Will react with
combustible
material

Oxidizer – supports
combustion



Hazards of Ammonium Nitrate

3 MAIN HAZARDS in fire situations:



AN is **unpredictable** when exposed to fire.
Always assume an AN fire can detonate.

1. Uncontrollable Fire

- Oxidizing properties support combustion
- Can increase the flammability or explosibility (or both) of other combustible substances when it decomposes after exposure to heat

2. Decomposition

- Can produce toxic and flammable by-products during thermal decomposition
- The reactions release gases such as nitric acid (HNO_3), ammonia (NH_3), nitrogen oxides (NO , NO_2), nitrous oxide (N_2O), nitrogen, oxygen, and water vapor

3. Explosion

- May undergo detonation when heated under confinement
- Contaminants such as combustible materials, metal fines, flammable liquids, and sulfurs can decrease AN stability and increase its sensitivity to detonation



West Fertilizer Fire and Explosion: Contributing Factors

- 1. Contamination of the FGAN pile**
 - Combustible construction materials
 - Storage of combustible materials near the FGAN pile
 - PVC and roofing materials
- 2. Heating and ventilation inside the fertilizer building**



Combustible Construction





Combustible Construction

- In fires, FGAN-saturated wood burns with greater intensity
- The wood constructed bins at WFC likely led to the intensity and spread of the fire throughout the fertilizer building



Heating and Ventilation

- Oxygen depleted as the fire progressed from the seed room



Cupola with
ventilation louvers
on top

Limited
ventilation at
ground level

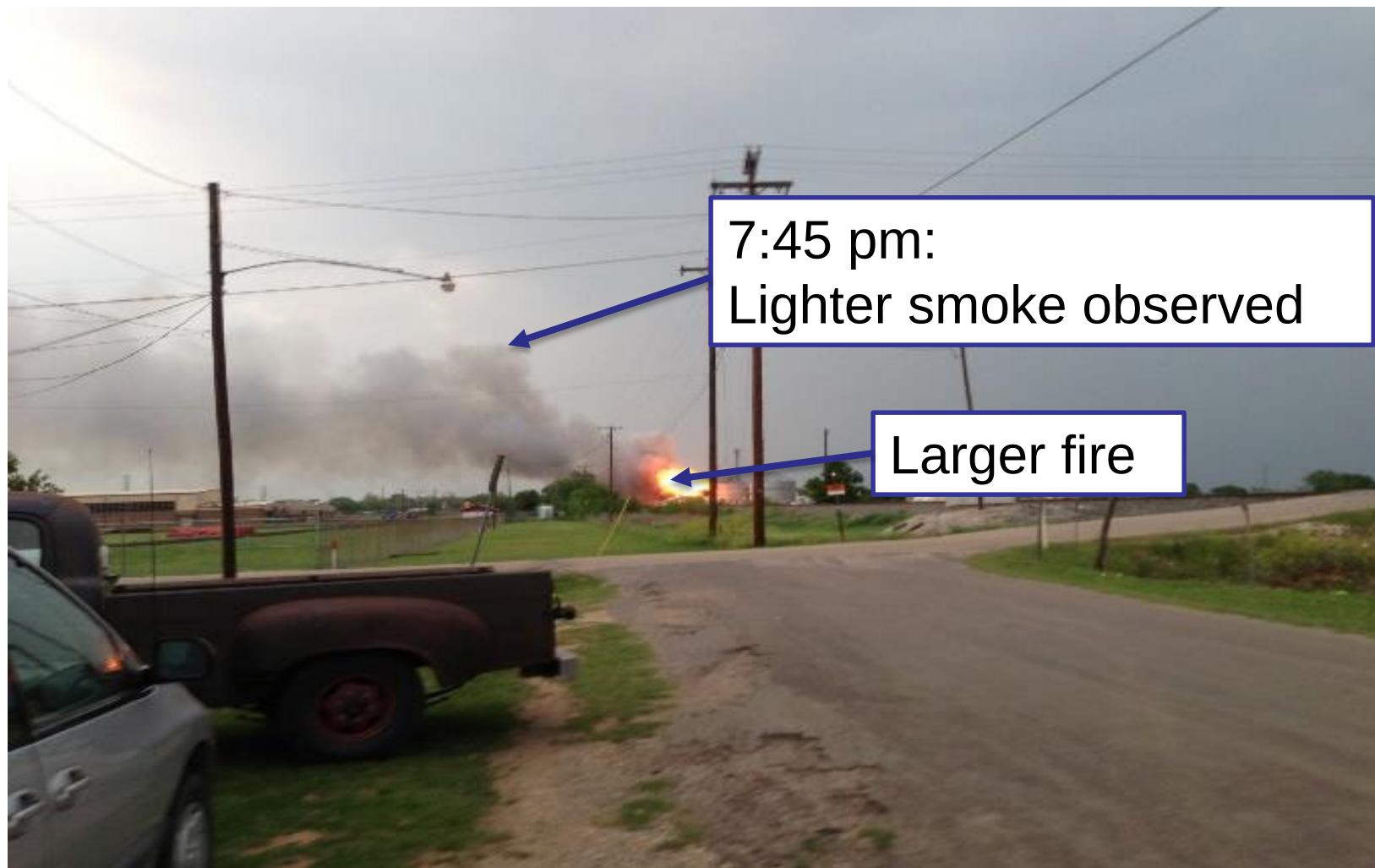


Heating and Ventilation





Heating and Ventilation





Historical FGAN Explosions

- **Most explosions resulted from a massive fire**
- **Occurred within 20 min. to 1 hour from the initial report of the fire**
- **Slight variations in storage conditions, such as ventilation, construction materials, or nearby combustible storage can impact AN detonability during fires**



Inherently Safer Building Design

Traditional Storage Practices

Wooden
FGAN
storage
bins

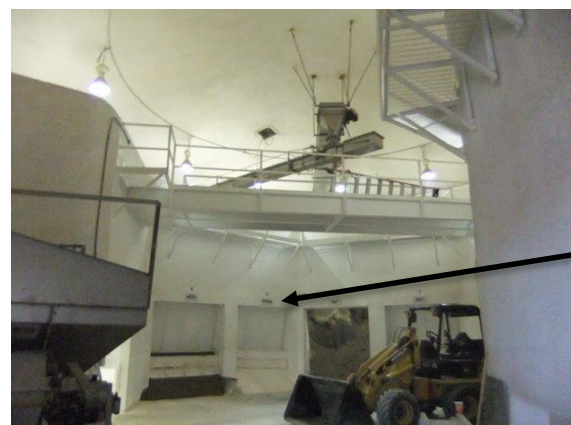


Wooden
construction
materials



Safer Storage Options

Concrete
bins



Concrete
storage
dome





Land Use Planning





Land Use Planning

Why was the City of West located so close to the WFC facility?

- **The City expanded in the direction of the WFC facility over time**
 - **The WFC facility was constructed and began operations in 1962**
- **A lack of zoning regulations**
 - **At the local, state, and federal levels**



West Through the Years





Land Use Planning

- Zoning codes are typically adopted as ordinances at the county or local level
- However, at all levels of government there has been a failure to adopt codes concerning the siting of many types of hazardous facilities near communities
 - This includes FGAN facilities



Land Use Planning

- Land use planning and zoning codes typically do not apply to existing AN storage facilities
- Facilities that are covered:
 - Facilities constructed after zoning codes haven been enacted
 - Existing facilities which undergo significant modifications after code enactment

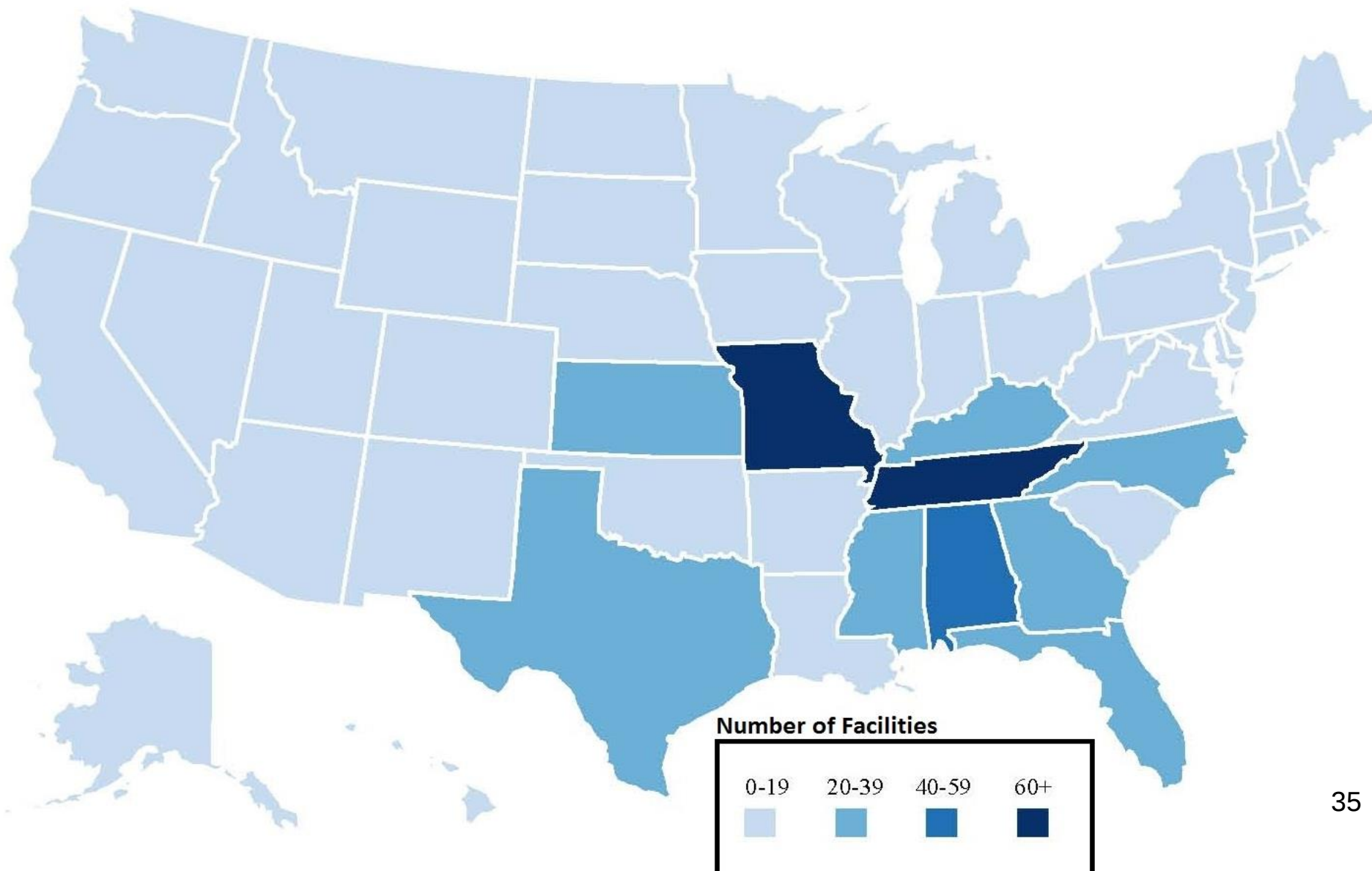


Land Use Planning

- **The issue of locating AN facilities near the community is not limited to the WFC incident**
 - **There are over 1,350 bulk AN retail facilities nationwide**
- **In Texas alone, the CSB identified 19 FGAN facilities in the State being located within a half-mile of a school**



AN Fertilizer Storage





Emergency Response





Emergency Response

The explosion fatally injured emergency responders and nearby residents

Organization	Casualties
West Volunteer Fire Department	5
Abbott Volunteer Fire Department	2
Navarro Mills Volunteer Fire Department	1
Dallas Fire Department	1
EMT (West Volunteer Fire Department)	1
Members of the public	5



Key Contributing Factors

- Incident command system
- Incident management system
- HAZMAT Training
- Pre-incident planning
- Limited and conflicting technical guidance on FGAN
 - Inconsistent firefighting measures



Regulatory Analysis





Agency	OSHA		EPA	
Rule	Explosives and Blasting Agents Standard	Process Safety Management Standard	Risk Management Program Rule	Emergency Planning and Community Right- to-Know Act
Requirements	Based on prior versions of NFPA Codes (has not been revised since 1971)	Covered processes must follow 14 minimum performance-based elements	Based on Program Level classification for covered processes	Emergency planning and reporting sections based on chemicals covered at specified thresholds
Applicability	Storage, use, and transportation of explosives and blasting agents	Chemicals at or above specified threshold quantities on the PSM list of covered chemicals	Substances at or above specified threshold quantities on the RMP list of covered flammables and toxics	Substances and chemicals covered at specified thresholds
Covers FGAN	✓	✗	✗	✓
WFC Compliance	✗	✓	✓	✓



Key Findings

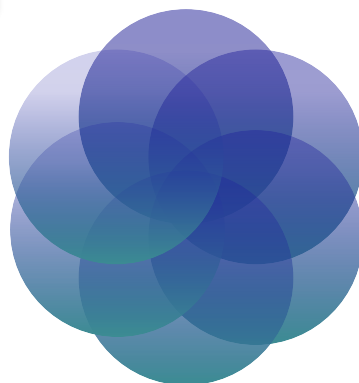


**Land Use
Planning**

**Emergency
Planning**



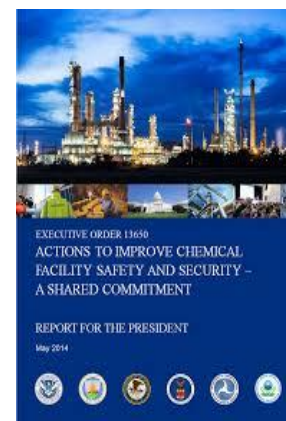
Technical



**Emergency
Response**



Regulatory

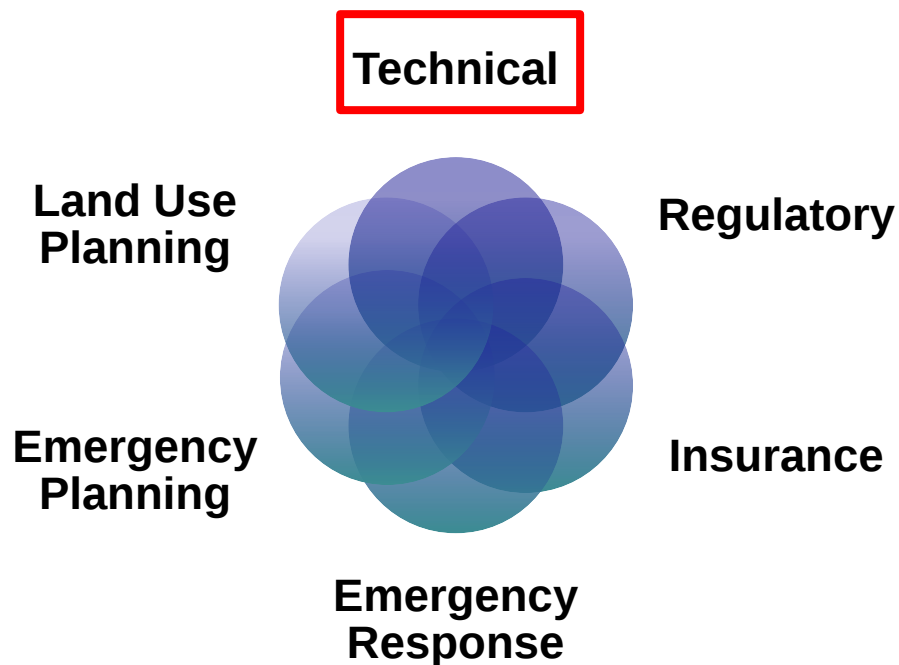


Insurance





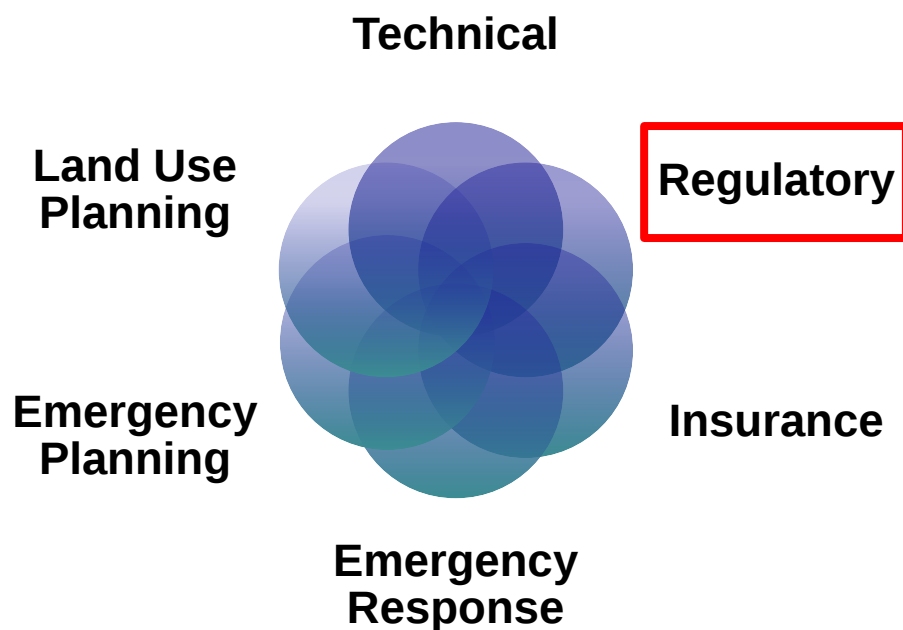
Key Technical Findings



- Combustible material contributed to the intensity of the fire
- Burning asphalt shingles and soot likely contaminated fertilizer-grade ammonium nitrate (FGAN) pile leading to detonation
- West Fertilizer Company (WFC) had no fire suppression system



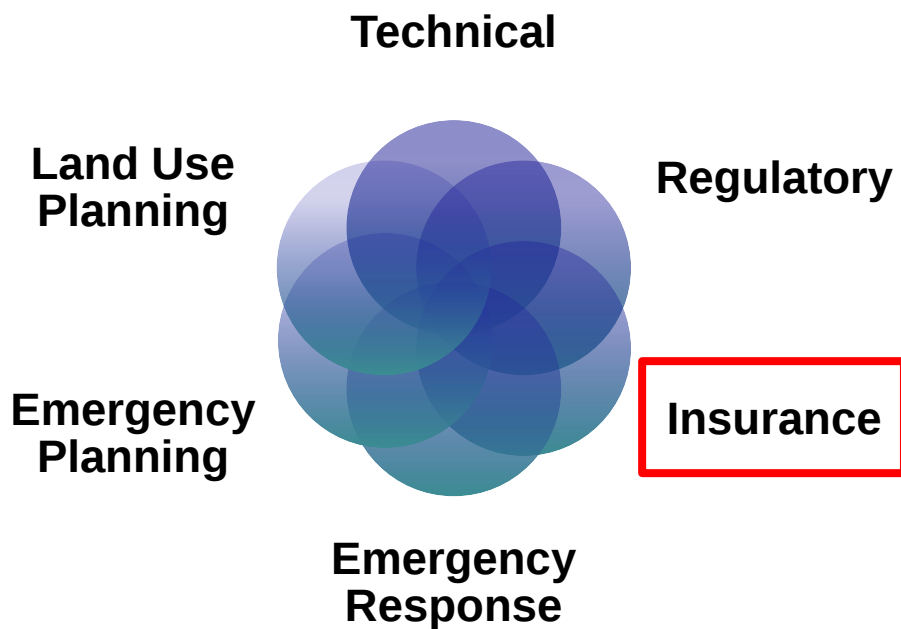
Key Regulatory Findings



- Limited oversight for FGAN storage requirements
- Regulations covered anhydrous ammonia but not FGAN
- FGAN not on OSHA PSM or EPA RMP list of chemicals



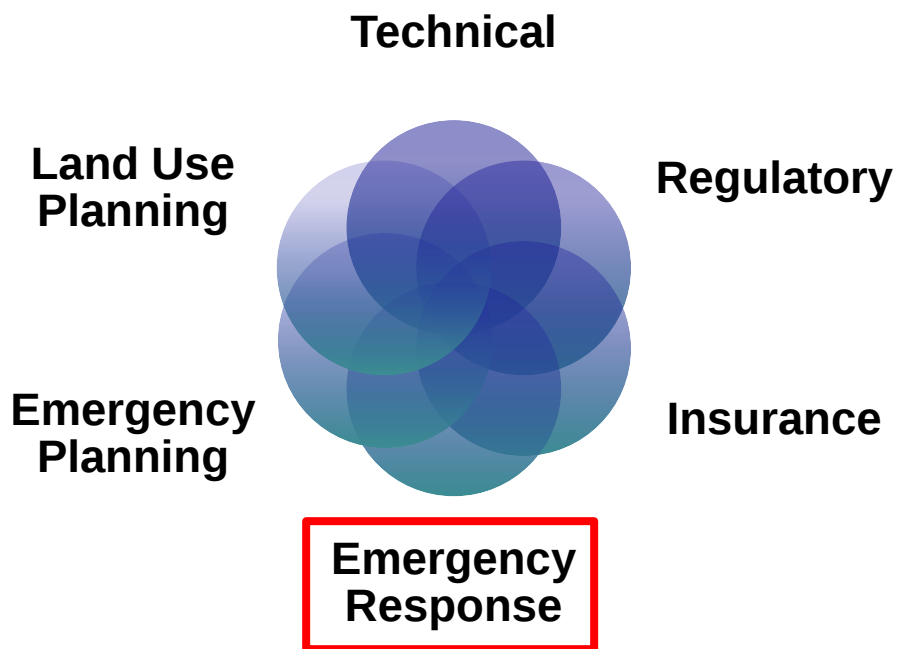
Key Insurance Findings



- WFC dropped by previous insurance provider for non-compliance
- WFC insurance providers did not focus on FGAN hazards



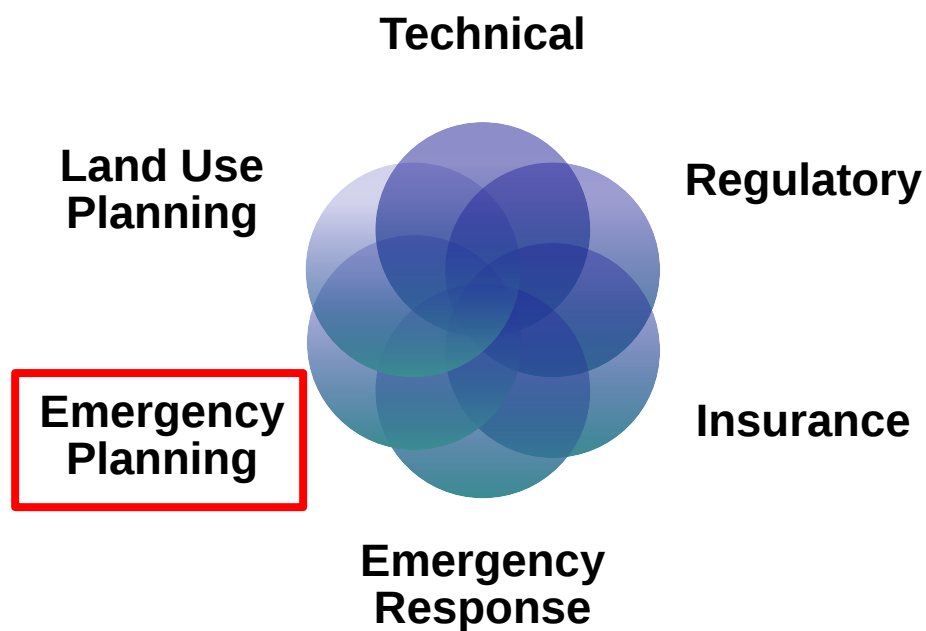
Key Emergency Response Findings



- Responders had insufficient information about WFC to conduct a safe response
- Lessons learned from previous FGAN fires not shared with WVFD
- Current training curriculum places little emphasis on FGAN Emergency Planning



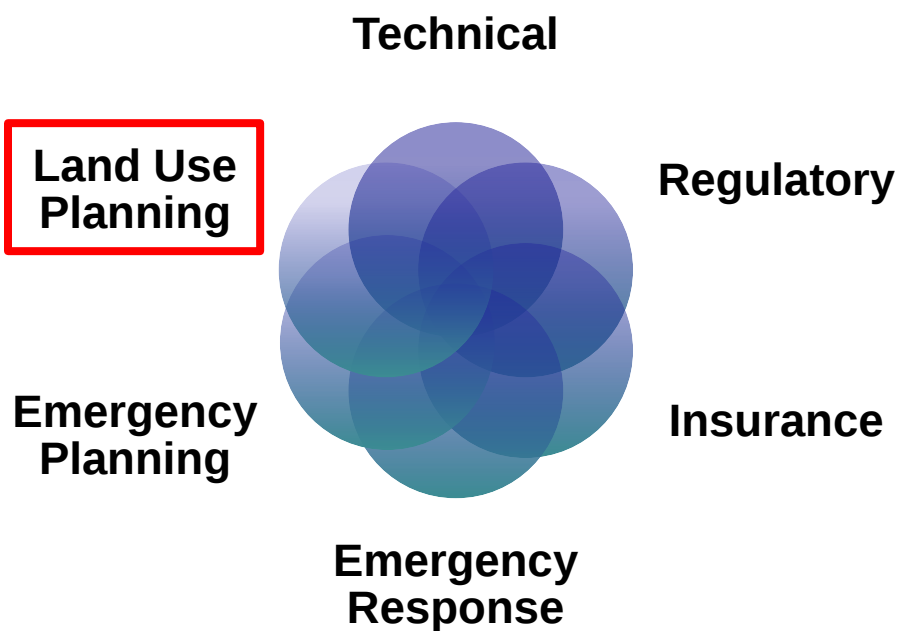
Key Emergency Planning Findings



- West Volunteer Fire Department did not conduct drills and exercises at the WFC facility
- No emergency response plan was in place for personnel responding to incidents
- Right-to-Know regulation lacks clear information on which facilities fall under the Agricultural Use Exemption



Key Land Use Findings



- No zoning regulations existed at the time WFC began operations
- City of West developed over the years and expanded toward WFC
- WFC facility was not subject to zoning regulations governing the siting of a FGAN facility



Selected Recommendations

- Change International Fire Code requirements for FGAN storage facilities
- Include FGAN on EPA Risk Management Program list
- Strengthen OSHA FGAN regulation through explosions standard or by adding to List of Highly Hazardous Chemicals, Toxics and Reactives
- Fund training for emergency responders on responding to fires involving FGAN
- Strengthen guidance for community notification



Stay in Touch with the CSB

EVENTS

- Sep 21** CSB September Business Meeting
- Sep 28** Public Meeting in Charleston, WV
- Oct 26** CSB October Business Meeting

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