



The Fire and Explosion at West Fertilizer Co. Plant

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Disclaimer: Orica compiled this presentation based on information that is publicly available. Neither Orica nor its personnel have had any involvement in the West Texas incident or any of the ongoing investigations of this incident. Orica does not warrant any of the information provided in this presentation.

Topics

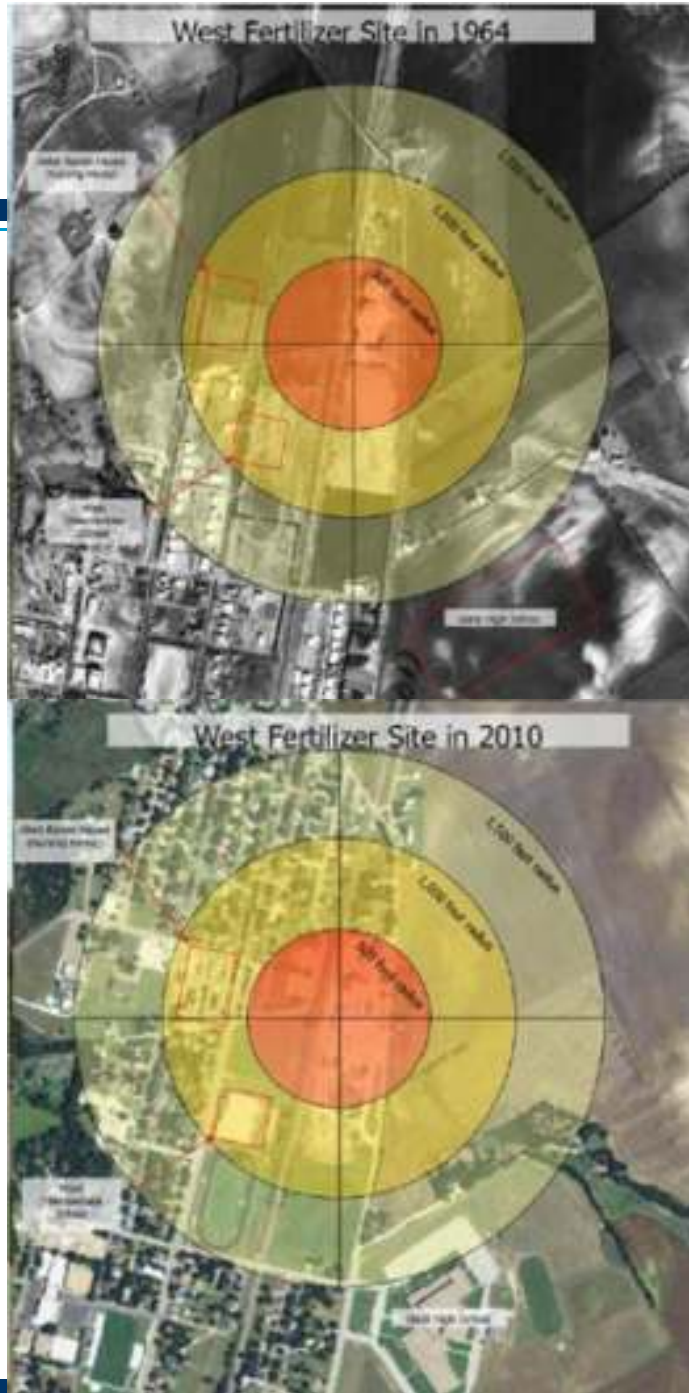


- Background
 - Sequence of Events
 - Analysis of public video
 - Consequences
 - Update - Texas Fire Marshall Office Report
 - Learnings
-

West Fertilizer*



- Built in 1961
 - When built area was rural
 - Over time residences, a nursing home, apartment complex, high school, intermediate school constructed within 2000ft radius
- Blending facility; no manufacturing
- Retail distribution center
- 15 employees
- AN prill stored in wooden bins in wooden warehouse building
- Warehouse also contained seeds, stored near bins
- No sprinkler or fire suppression system



Growth around West Fertilizer Plant

West Fertilizer Plant



- Grain Silo
- Dry Fertiliser Storage
- Pesticide and Parts Storage
- Liquid Fertiliser
- Anhy. Ammonia
- Office
- Nurse tanks

West Fertilizer Plant and Vicinity



- West Fertilizer
- Apartment Complex
- Nursing Home
- Intermediate School
- High School
- Middle School

Sequence of Events



April 17 2013

- Fire broke out at the facility, which was closed for the day, and unattended
 - At 19:29 fire was observed and reported to 911
 - Firefighters found warehouse building in flames and were in process of extending hoses to fight the fire
 - Firefighters aware of ammonia (from previous release), but not informed of ~60 tons FGAN inside warehouse
 - At 19:53 call received at 911 that there was an explosion
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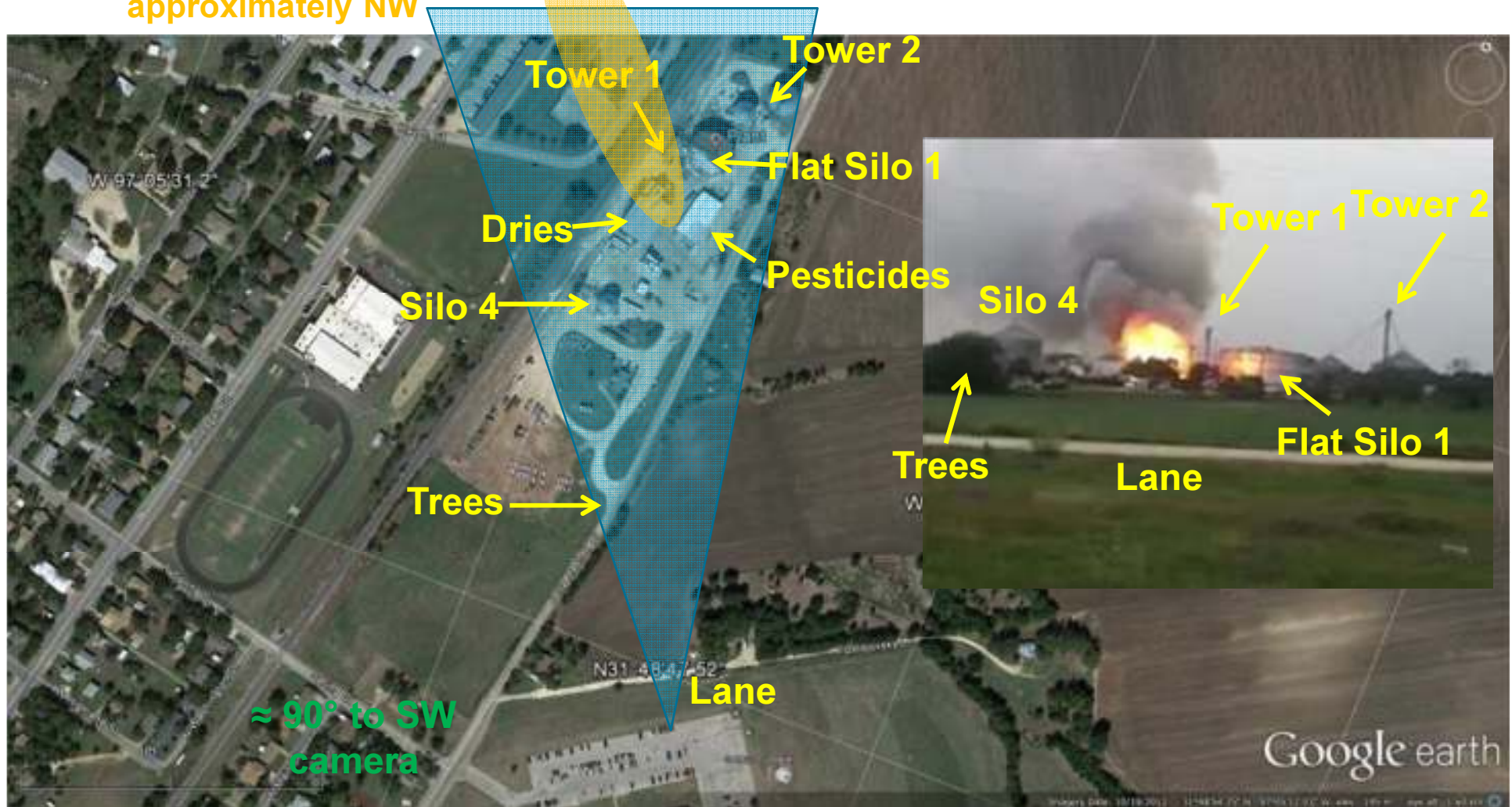
Likely location & field-of-view of SW camera (approximately 200 m from GZ)
Field of view



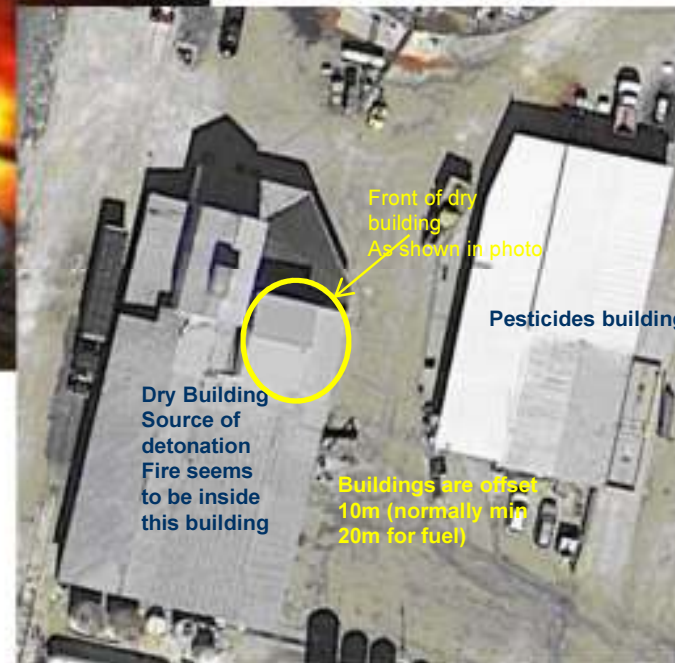
Likely location & field-of-view of SE camera (approximately 420 m from GZ)

Plume of flames and smoke approximately NW

Field of view



West Fertiliser Texas explosion 18 April 2013



Photograph shows the fire developing in the dry building .
Very large amount of fuel involved

Frame: -002

Time: -0067 ms



SW camera



SE camera



- SE camera appears to have recorded at 30 fps, or 33 msecpf.
- SW camera appears to have recorded at a slower rate, but adapted to 30 fps during conversion to MP4 format; an occasional frame has apparently been duplicated during this conversion.

Frame: -001

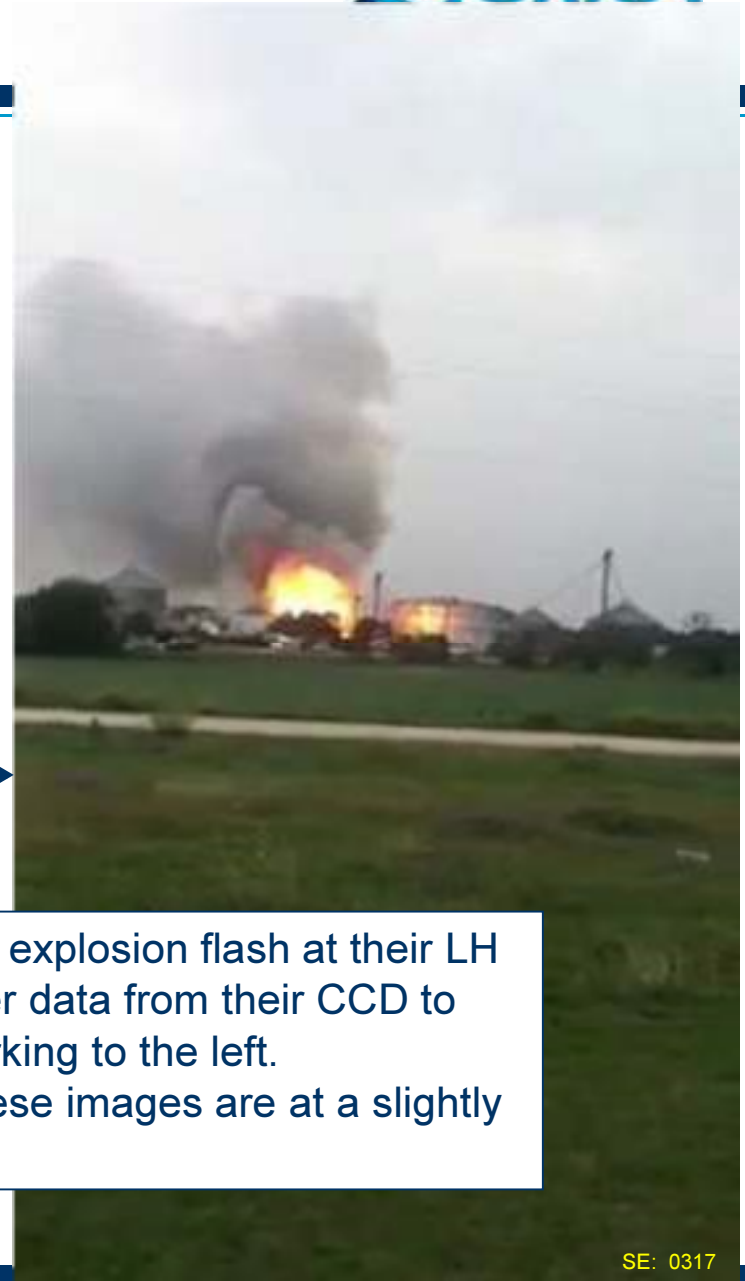
Time: -0033 ms



Flash from start of explosion illuminates smoke just prior to completion of frame capture.



Faint lightening of image along this edge.



- Both cameras have just caught start of explosion flash at their LH edge. Evidently, these cameras transfer data from their CCD to memory starting from the right and working to the left. In other words, the left-hand side of these images are at a slightly later time than their right-hand sides.

Frame: +000

Time: +0000 ms



Both cameras
oversaturate.

SW: 0893

SE: 0318

Frame: +001

Time: +0033 ms



SW: 0894



The wider-angle view starts to recover first.

SE: 0319

Frame: +002

Time: +0067 ms



This frame was duplicated during file conversion
SW: 0895



SE: 0320

Frame: +003

Time: +0100 ms



Main fireball
(from North
end of Dries?)

Secondary fireball
(from South
end of Dries?)

There appears to be a
secondary fireball below
and in front of the main
fireball.



Frame: +004

Time: +0133 ms



SW: 0897



Passage of air
shock
displaces
apparent
location of tree

SE: 0322

Frame: +005

Time: +0167 ms

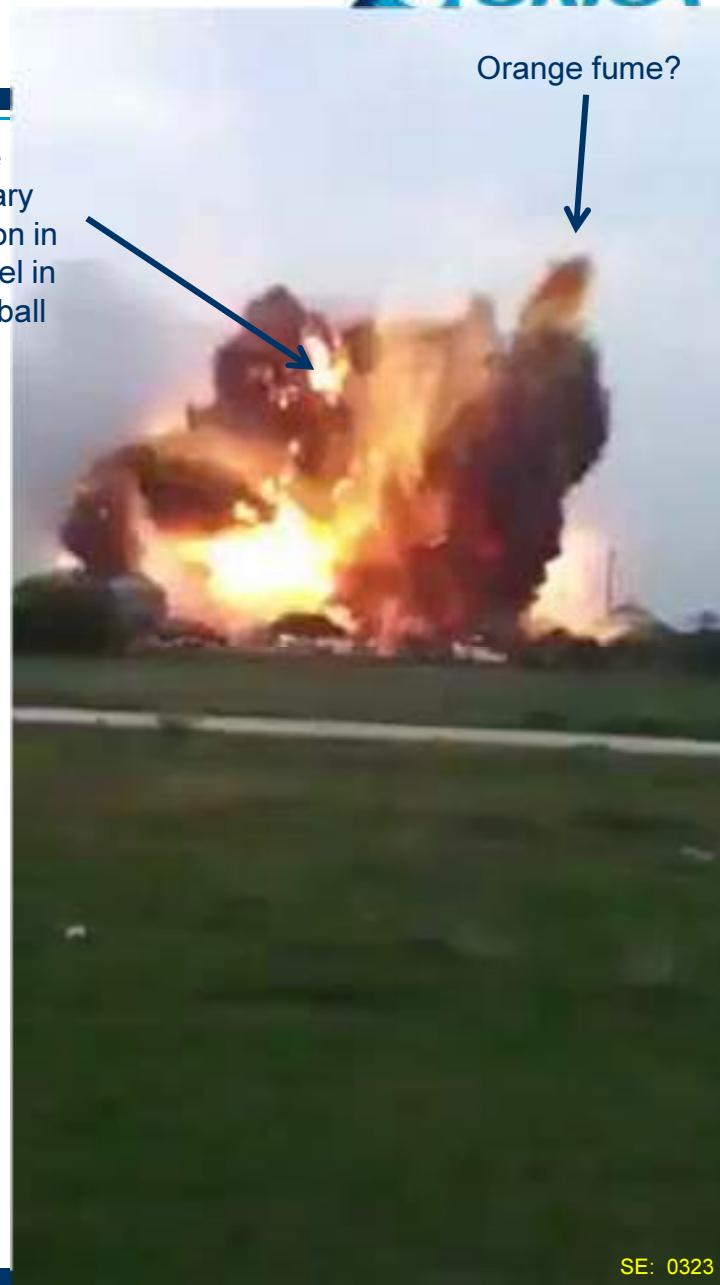


SW: 0898

Some secondary combustion in excess fuel in main fireball



Orange fume?



SE: 0323

Frame: +006

Time: +0200 ms



The main fireball looks consistent with some form of detonation through a material close to oxygen-balance, as very little apparent secondary combustion of excess fuel, yet no appreciable NOx production from

excess oxidiser

Frame: +007

Time: +0233 ms



SW: 0900



Condensation of atmospheric moisture to form Wilson clouds denotes onset of negative phase

SE: 0325

Wilson Cloud (Baker test of Operation Crossroads)



Frame: +008

Time: +0267 ms



Duplicated frame from format conversion

SW: 0901



SE: 0326

Frame: +009

Time: +0300 ms



Condensation of Wilson clouds in turbulent eddies created by passage of debris



The Wilson clouds, and hence by inference the negative phase, were surprisingly long lived some distance out from GZ. This indicates that there was no significant secondary shock generated by the collapse of the negative phase at GZ.

Frame: +010

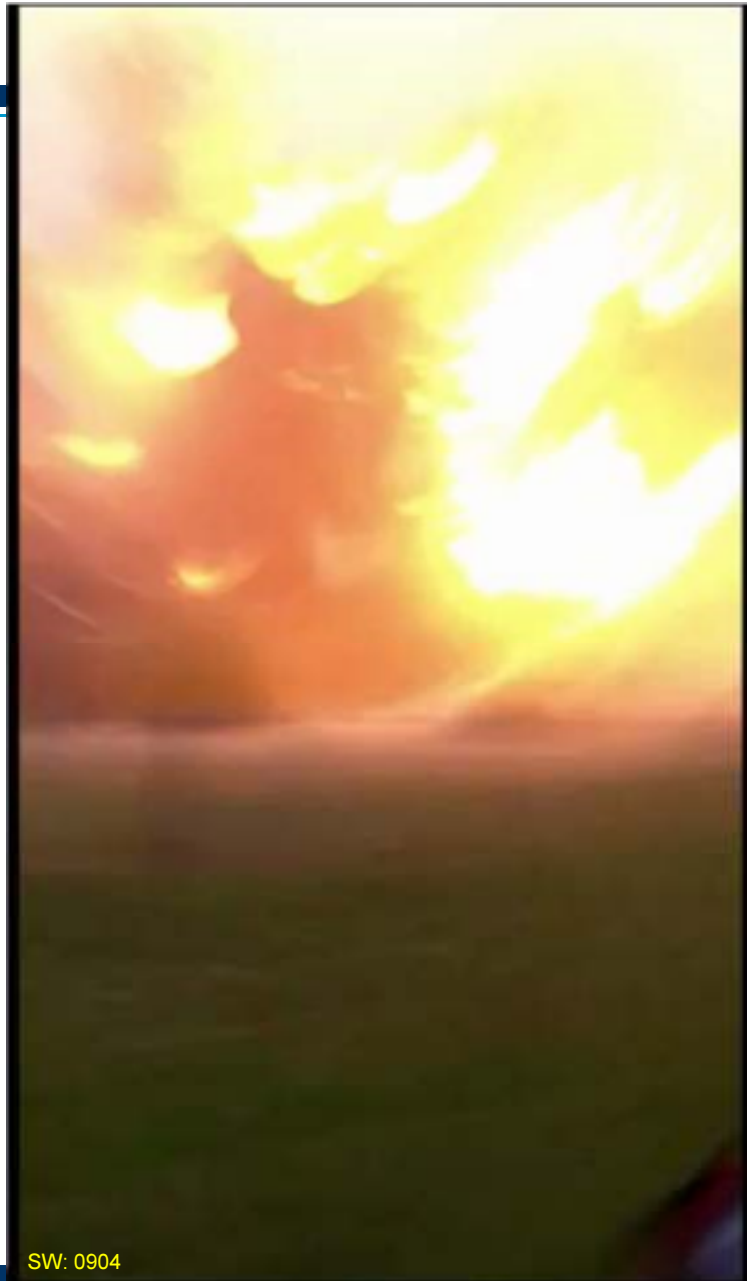
Time: +0333 ms



The secondary fireball intensified, reaching peak brightness at about 500 ms. Whatever caused it, it is not pure AN detonating (wrong fireball colour, too bright, wrong behaviour, wrong fume colour). Seems to be a deflagration through some sort of oxidiser/fuel mixture, as it doesn't appear to be dependant on access to external oxygen from mixing with air to burn.

Frame: +011

Time: +0367 ms



SW: 0904



SE: 0329

Frame: +012

Time: +0400 ms



Frame: +013

Time: +0433 ms



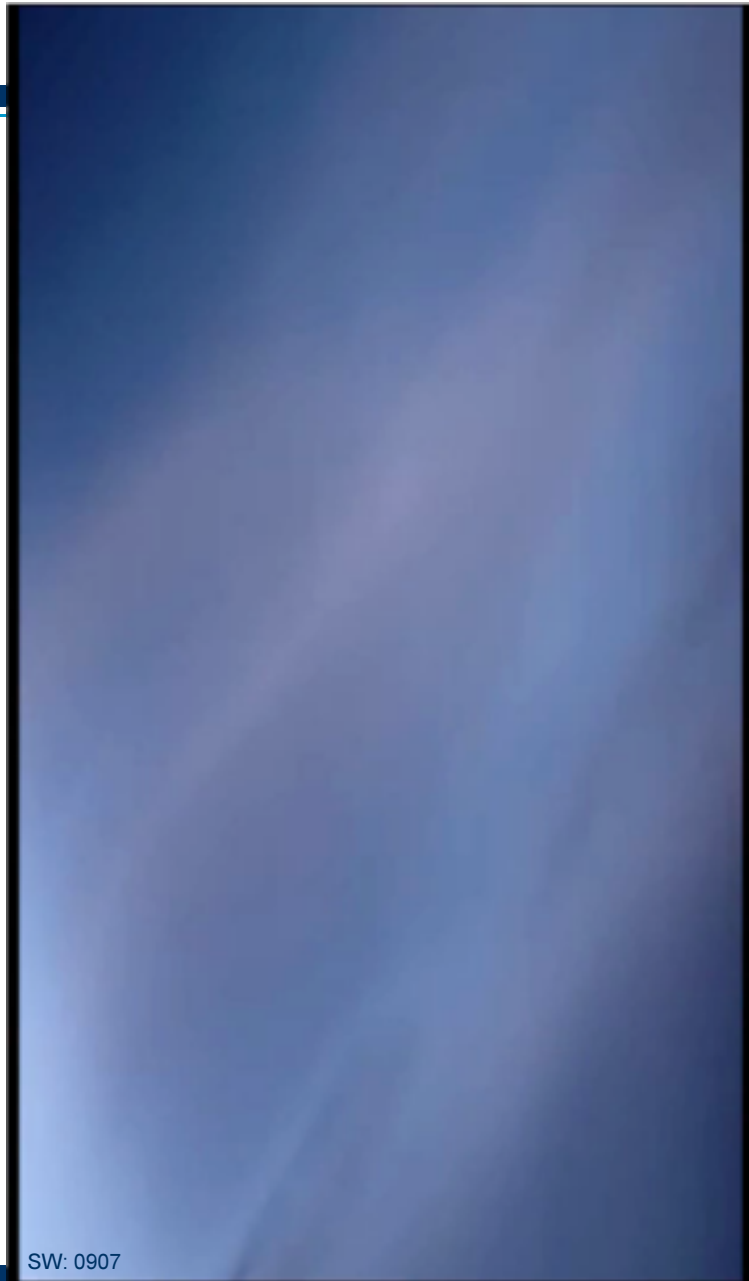
SW: 0906



SE: 0331

Frame: +014

Time: +0467 ms



SW: 0907



SE: 0332

Frame: +015

Time: +0500 ms



SE: 0333

Plumes from West Explosion and Bryan Fire



West, Texas 2013



Bryan, Texas 2009

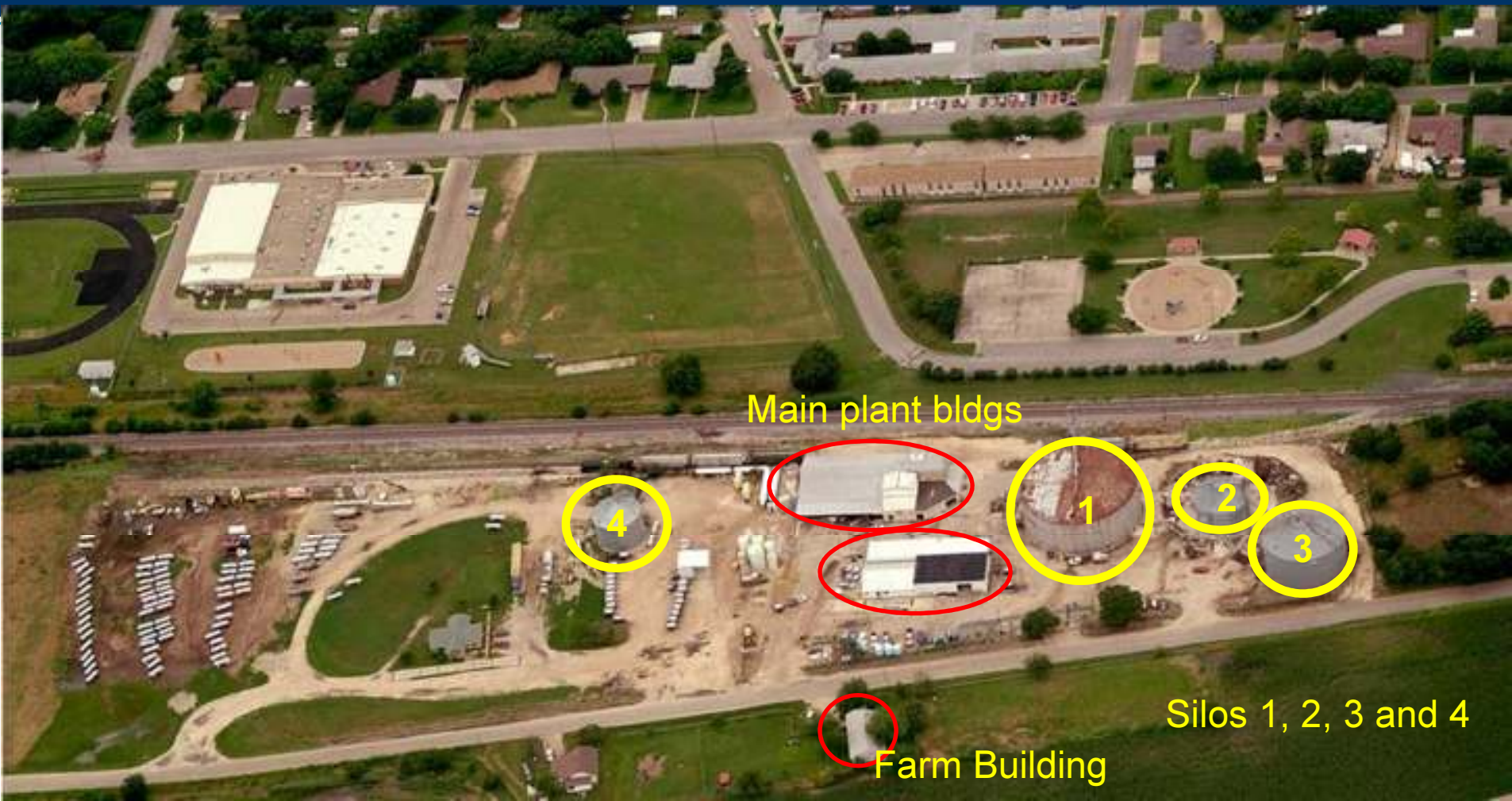
Consequence of Explosion



April 17 2013

- 12 firefighters and ER personnel, and 2 members of the public were killed.
 - 14 patients at West Rest Haven Nursing Home have passed away since the event, dying at twice the expected rate
 - Nursing home and apartment complex destroyed
 - High School and Intermediate School damaged beyond repair
 - Middle School also badly damaged
 - ~200 homes severely damaged
 - Total damages estimated > \$230M
 - Population is 2,800
-

Before



After – showing direction of railcar shot and damaged silos



Ground zero.
Building obliterated

2nd Building also
obliterated

Farm Building

Image of Railcar (Getty Images)



Ammonia Tanks



http://stateimpact.npr.org/texas/files/2013/04/11412381_H22037023.jpg

Alternate View (distorted rail line)



Still from Video of Apartment Complex (CSB)



Apartment Building

CSB

ATFE and Fire Marshall Investigation



- **The State Fire Marshal's Office and ATF Conclude Scene Investigation at the West Fertilizer Plant**

Fire Ruled As Undetermined

- WEST, TX – The Texas State Fire Marshal's Office (SFMO) and the Bureau of Alcohol, Tobacco, Firearms and Explosives National Response Team (ATF), along with ATF Special Agents from the Houston Field Division, announce the conclusion... Both agencies have ruled the cause of the fire as "undetermined."
- Robert Champion, ATF Special Agent in Charge, said, "ATF and SFMO had eliminated the following causes: rekindling of an earlier fire, spontaneous ignition, 480 volt electrical system, anhydrous ammonia, ammonium nitrate, smoking, and weather. The following causes could not be eliminated: 120 volt electrical system, a golf cart, and an intentionally set fire."



CSB Findings and Observations

In US Senate Testimony hearing on June 27, Chairperson Moure-Eraso of CSB reported 18 observations and preliminary findings, subject to revision and development as investigation unfolds. Among these were (paraphrased):

- Explosion resulted from intense fire in a wooden warehouse building that led to the detonation of ~30 tons AN stored inside wooden bins. There also was a significant amount of combustible seeds which likely contributed to the intensity of the fire.
 - There was no fire detection and suppression system.
 - Many of the safety provisions are quite old (1953) and appear to be confusing or contradictory, even to code experts.
 - Firefighters were not made aware of the explosion hazard from the AN stored.
 - In summary the safety of AN fertilizer falls under a patchwork of US regulatory standards and guidance
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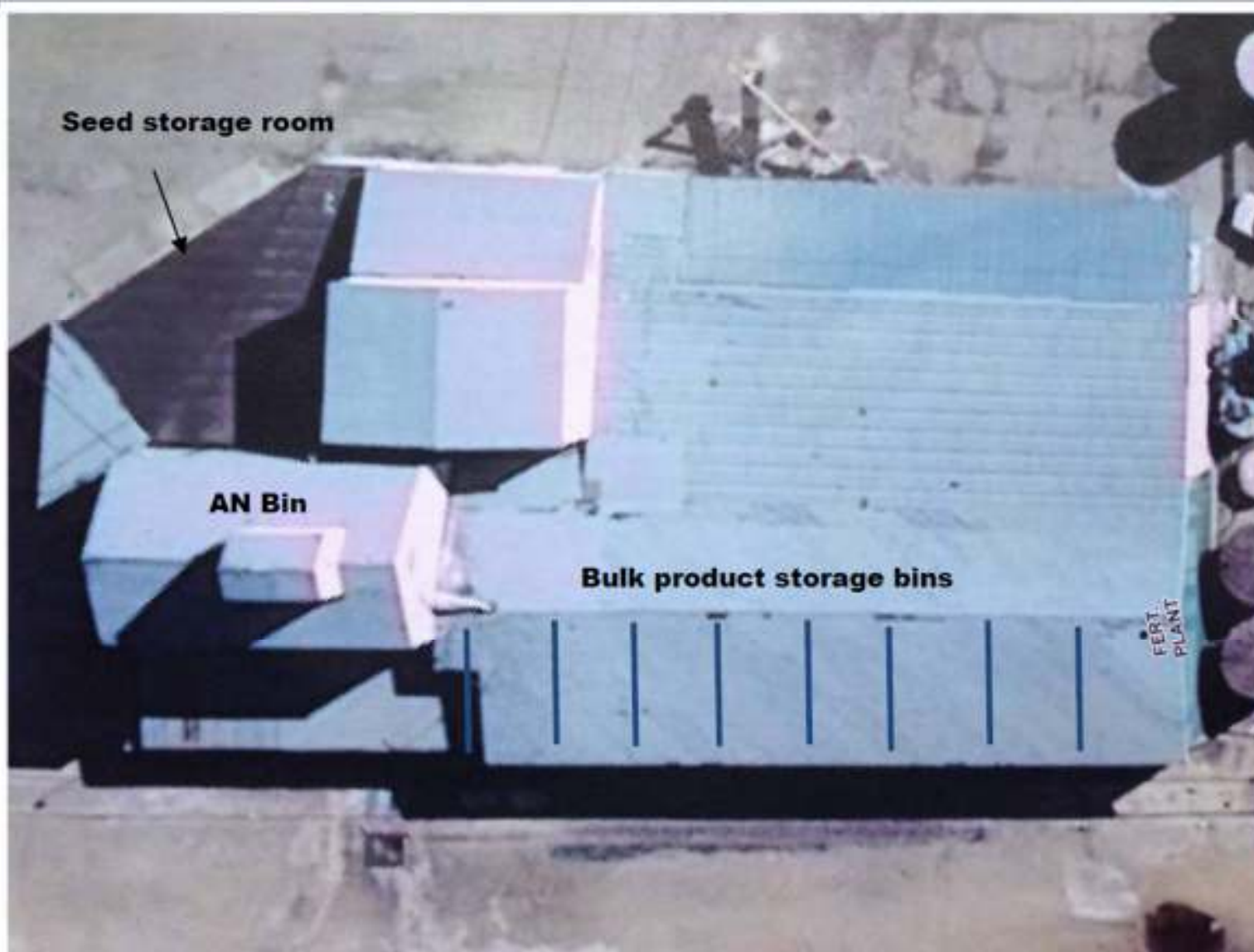
View from the North East



View during examination and reconstruction



Site layout



View of the East side at ~19:38



<http://www.tdi.texas.gov/reports/fire/documents/fmloddwest.pdf>

View (from SE) at ~19:40



<http://www.tdi.texas.gov/reports/fire/documents/fmloddwest.pdf>

View (from N) at ~19:48



<http://www.tdi.texas.gov/reports/fire/documents/fmloddwest.pdf>

View (from SE) at ~19:50



<http://www.tdi.texas.gov/reports/fire/documents/fmloddwest.pdf>

Post blast plume



19:41:50



“ Before Firefighter Kevin Maler left the area he received a phone call from Brian Renegar. Renegar is a former West VFD firefighter and former West Fertilizer Plant employee. Renegar advised that they needed to evacuate the plant to at least a quarter mile distance because of the risk of explosion.”

“ The 2000-gallon water tender driven by Fire Chief George Nors, Sr. arrived and parked on the roadway near the east entrance. Chief Nors did not report his arrival. He got out of the water tender as Brian Renegar drove by. Renegar stopped briefly and told Chief Nors that he should get everyone out, that “it’s gonna blow”. Chief Nors did not take command. Chief Nors approached Captain Dragoo and told him what Renegar had said about leaving because of the risk of explosion. Dragoo said he didn’t think an explosion would happen. Chief Nors turned and walked back toward the water tender. Chief Nors did not give an order to withdraw. “

Learnings (from Fire Marshall Office Report)



Finding 1: Standard Operating Procedures

The initial responding fire department did not have standard operating procedures (SOPs) or standard operating guidelines (SOGs) for emergency operations.

Finding 2: Pre-fire Planning

There was no pre-fire or pre-incident plan of this facility.

Finding 3: Incident Management

The West Fertilizer Company incident clearly demonstrates the critical importance of establishing a comprehensive incident management system (IMS) to provide command, control, and coordination of emergency operations. Fire department officers failed to provide supervision of subordinate members, implement an IMS, establish an incident command post, and properly identify an incident commander (IC). The absence of command and control and the failure to create and communicate an incident action plan resulted in an uncoordinated and unmanaged fire ground operation.

Learnings (from Fire Marshall Office Report)



Finding 4: Strategy and Tactics

4.A. The fire department did not approach this fire as a commercial structure with hazardous materials, but rather initiated residential structural firefighting practices, with which they were familiar.

4.B. Fire department officers did not determine an appropriate firefighting strategy (e.g., offensive, defensive, including evacuation) or coordinated tactical plan, which are key factors in controlling and mitigating fire incidents and protecting firefighters.

Learnings



- Storage of AN away from combustible and incompatible materials
- Materials of construction for storage must be non-combustible
- Emergency response procedures specify do not fight fires involving AN
- External first responders must know what substances are on site and what to do in an emergency situation

Guides:

- SAFEX Good Practice Guide for Storage of AN
- IME Safety and Security Guidelines for AN
[http://www.ime.org/userfiles/files/AN%20Guidelines_IAFC-IME-NSSGA\(FINAL\)\(1\).pdf](http://www.ime.org/userfiles/files/AN%20Guidelines_IAFC-IME-NSSGA(FINAL)(1).pdf)

Ongoing



- CSB investigation
 - Investigation report not out yet
 - US Presidential Executive Order
 - Addresses gaps cited in CSB Testimony
 - NFPA Code 400
 - Being revised for AN
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Thank you
