2017 ASPECT Preliminary Report
Arkema Plant Response
Crosby, TX

August 31, 2017
0600 hrs to 0845 hrs

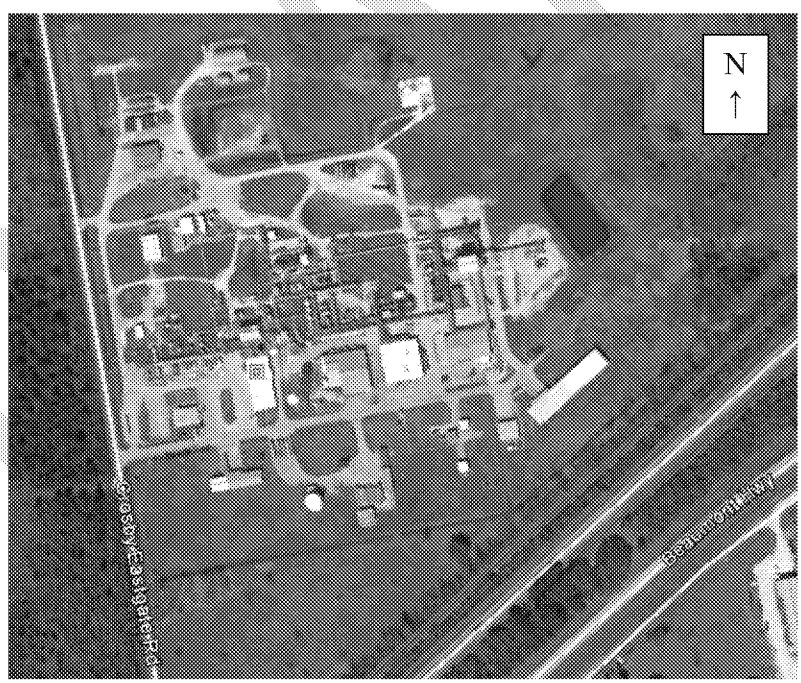

Figure 1: Google Earth Image of the facility, February 2017

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1 Background

On 30 August 2017 at 0445 hrs the US EPA Region 6 On Scene Coordinator Byrant Smalley contacted ASPECT Program Manager, Dr. Mark Thomas, to activate the ASPECT aircraft and respond to the Arkema Facility explosion located in Crosby, Texas. The facility produces liquid organic peroxides that are used mainly in the production of plastic resins. The explosion was a result of a loss of refrigeration in temporary storage trailers.

A mission order was developed and a pre-flight briefing was completed by 0550 hrs. ASPECT was airborne at 0605 hrs and was over the target at 0720 hrs.

2 Aircraft Capabilities used on this survey

Chemical Detection:
The US EPA ASPECT system collects airborne infrared (IR) images and chemical screening data from a safe distance over the site (about 2,800 AGL). The ASPECT System is an emergency response aircraft permitting remote chemical detection in support of the first responder. The system consists of an airborne high speed Fourier transform infrared spectrometer (FTIR) coupled with a wide-area IR line scanner. The ASPECT IR systems have the ability to detect compounds in both the 8 to 12 micron (800 to 1200 cm-1) and 3 to 5 micron (2000 to 3200 cm-1) regions. The 8 to 12 micron region is typically known as the atmospheric window region since the band is reasonably void of water and carbon dioxide influence. Spectrally, this region is used to detect carbon—non-carbon bonded compounds. The 3 to 5 micron region is also free of water and carbon dioxide but typically does not have sufficient energy for use. This band does show use in high-energy environments such as fires. The Carbon – Hydrogen stretch is very common in this region.

Photo Capabilities:
A still digital Nikon DX2 camera collects visible aerial imagery as part of the core data product package. It consists of a 12.4 mega pixel CMOS camera supporting a 3:5 aspect ratio frame. The system uses a 28 mm wide-angle lens and is slaved to the primary IR sensors and provides concurrent image collection when other sensors are triggered. All imagery is geo-rectified using both aircraft attitude correction (pitch, yaw, and roll) and GPS positional information. Imagery can be processed while the aircraft is in flight status or approximately 600 frames per hour can be automatically batch processed once the data is downloaded from the aircraft.

An Imperx mapping camera provides a similar aspect ratio and aerial coverage at a much higher resolution (29 mega pixels). Like the Nikon DX2, it is slaved to the primary IR sensors and provided concurrent image collection when other sensors are triggered. These images are often digitally processed in lower resolution so they can be transmitted via satellite communication. The high resolution images are pulled from the ASPECT after the sortie and often made available at a later time.

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Data are processed using onboard algorithms while the aircraft is in flight and preliminary results are sent using a satellite system to the ASPECT reach back team for QA/QC analysis. The reach back team is operating from small hanger offices located at Million Air, Addison, TX.

3 Results

Weather Conditions and Crew Report

0725 hrs: Weather conditions (Crosby, TX) at the time of data collection consisted of cloudy skies with about 10 miles of visibility. Winds were reported from the northwest at 1-2 Kts at ground level (pressure 1013 mbar). Upper level winds up to about 3,000 the winds remain calm. Above this altitude the wind speeds increase from the west to about 40 Kts. The surface temperature was 23°C with a humidity of 85%. Flight conditions at altitude were reported to be turbulent. The crew reported that they can see the fire but there was no visible plume over the facility.

Aerial Photographs

Figures 2 & 3 show a visible image of the facility with no observed plume and the flight path highlighted when IR sensors were active.

Figure 2: Low resolution aerial images pulled from the aircraft while in flight over the facility, 30 August 2017 at about 0730 hrs CST.

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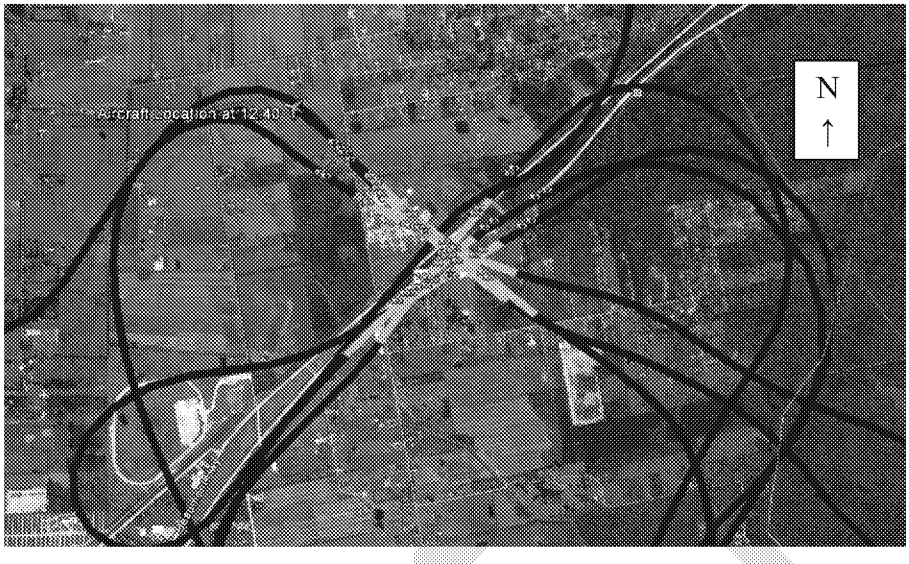

Figure 3: Flight path over the facility at 0731 hr CST (1231 hrs UTC) showing several passes where aerial imagery and IR sensors are active.

0810 hrs: The aircraft crew reported that it appears the fires has burned out.

0830 hrs: The aircraft was requested to return to base for high resolution data download.

There were ***no automated chemical detections***. Table 1 is a list of automated algorithms.

Chemical Compound (detection limit in ppm)			
Acetic Acid (2.0)	**Cumene (23.1)**	**Isoprene (6.5)**	**Propylene (3.7)**
Acetone (5.6)	**Diborane (5.0)**	**Isopropanol (8.5)**	**Propylene Oxide (6.8)**
Acrolein (8.8)	**1,1-Dichloroethene (3.7)**	**Isopropyl Acetate (0.7)**	**Silicon Tetrafluoride (0.2)**
Acrylonitrile (12.5)	**Dichloromethane (6.0)**	**MAPP (3.7)**	**Sulfur Dioxide (15)**
Acrylic Acid (3.3)	**Dichlorodifluoromethane (0.7)**	**Methyl Acetate (1.0)**	**Sulfur Hexafluoride (0.07)**
Allyl Alcohol (5.3)	**1,1-Difluoroethane (0.8)**	**Methyl Ethyl Ketone (7.5)**	**Sulfur Mustard (6.0)**
Ammonia (2.0)	**Difluoromethane (0.8)**	**Methanol (5.4)**	**Nitrogen Mustard (2.5)**
Arsine (18.7)	**Ethanol (6.3)**	**Methylbromide (60)**	**Phosgene (0.5)**
Bis-Chloroethyl Ether (1.7)	**Ethyl Acetate (0.8)**	**Methylene Chloride (1.1)**	**Phosphine (8.3)**

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Chemical Compound (detection limit in ppm)			
Boron Tribromide (0.2)	**Ethyl Formate (1.0)**	**Methyl Methacrylate (3.0)**	**Tetrachloroethylene (10)**
Boron Triflouride (5.6)	**Ethylene (5.0)**	**MTEB (3.8)**	**1,1,1-Trichloroethane (1.9)**
1,3-Butadiene (5.0)	**Formic Acid (5.0)**	**Naphthalene (3.8)**	**Trichloroethylene (2.7)**
1-Butene (12.0)	**Freon 134a (0.8)**	**n-Butyl Acetate (3.8)**	**Trichloromethane (0.7)**
2-Butene (18.8)	**GA (Tabun) (0.7)**	**n-Butyl Alcohol (7.9)**	**Triethylamine (6.2)**
Carbon Tetrachloride (0.2)	**GB (Sarin) (0.5)**	**Nitric Acid (5.0)**	**Triethylphosphate (0.3)**
Carbonyl Chloride (0.8)	**Germane (1.5)**	**Nitrogen Trifluoride (0.7)**	**Trimethylamine (9.3)**
Carbon Tetraflouride (0.1)	**Hexafluoroacetone (0.4)**	**Phosphorus Oxychloride (2.0)**	**Trimethyl Phosphite (0.4)**
Chlorodifluoromethane (0.6)	**Isobutylene (15)**	**Propyl Acetate (0.7)**	**Vinyl Acetate (0.6)**

The ASPECT technical reach back team continues to manually inspect and analyze 21,000 FTIR spectral measurements. No significant deviations or anomalies were associated with the explosion and subsequent fire.

Commonly occurring air pollutants such as ozone and PAN (Peroxyacytyl nitrate) are being detected which confirms that the FTIR spectrometer is operating properly. Spectra images of these constituents are shown in Figures 4 & 5.

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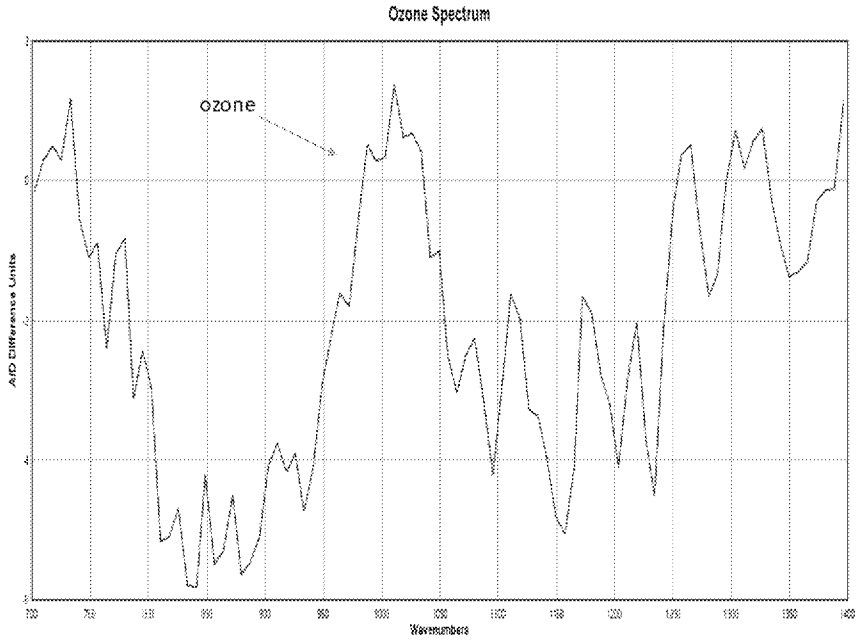

Figure 4: Passive (remotely detected at 2,800 ft AGL) FTIR spectra showing ozone, a commonly occurring air pollutant. This confirms that the instrument was operating properly.

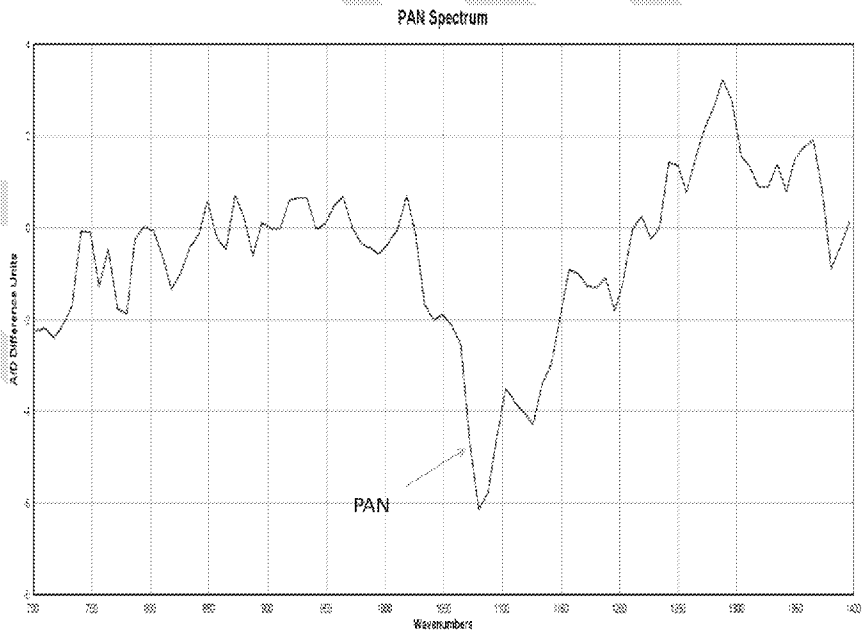

Figure 5: Passive (remotely detected at 2,800 ft AGL) FTIR spectra showing PAN (Peroxyacytyl nitrate), a commonly occurring air pollutant. This confirms that the instrument was operating properly.

0930 hrs: ASPECT landed at it based of operations, Addison Airport.

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4 Observations

Operational Challenges

1. Satellite communications continue to limit the amount of data that can be pulled from the aircraft. Aerial photos create the largest demand on the system. Another demand on the system is multiple users. We are experiencing a transmission rate of about 1/10 normal.

2. Actively addressing recording issues with the IR system while in flight.

3. Upon returning to base, the ASPECT technical reach back team will conduct immediate maintenance on the aircraft to fixed line scanner difficulties encountered during the morning flight.

4. Byrant Smalley, R6 OSC, requested that ASPECT be returned to operation ASAP. It is anticipated the aircraft can be airborne within an hour (or earlier) after refueling. We hope to have it airborne by 1015 hrs CST.

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