2017 ASPECT Preliminary Report
Rapids Needs Assessment &
Arkema Plant Response, Crosby, TX

September 2, 2017
0700 hrs to 2200 hrs

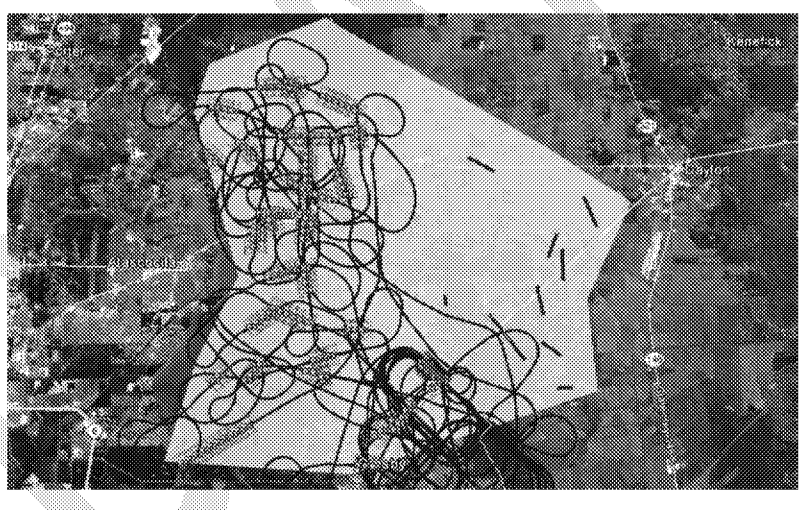

Figure 1: Rapid Needs Assessment flight lines showing aerial photographs. The lines are locations yet to be photographed. The Arkema facility is just northeast of Crosby. Flight occurred on 1 September 2017.

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1 ASPECT Description

The U.S. EPA ASPECT Program is the nation's only 24/7/365 emergency response airborne platform equipped with special chemical, radiological, and situational awareness instruments. ASPECT stands for Airborne Spectral Photometric Environment Collection Technology. It detects chemicals and radiation while collecting aerial photos and videos for situational awareness during an emergency (night or day). Critical information is automatically processed in the aircraft and transmitted via satellite to a team of highly skilled scientists who quickly review it before sending the results to decision makers on the ground. This can be done within 5 minutes. Because of its ability to quickly arrive onsite and turn data, ASPECT serves as an initial screening tool to help the field responders make more informed decisions based on actual measurements. ASPECT does not fly through the hazard. All the information is collected from a safe distance using remote sensing technologies. It usually flies at about 3,000 ft above the ground but can fly much lower (or higher) if needed. A crew of 4 fly and operate the aircraft. The size of the reach back team varies depending on the type and scale of an emergency, and can provide support at the command post or from anywhere in the world via satellite communications and secure internet coordination.

2 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.

After conducting three flights on 31 August 2017, the ASPECT aircrew moved their base of operations from Addison Airfield to Hobby Airfield. Pending any maintenance issues, this will position the aircraft closer to the target areas and reduce the transit time by more than one hour. The ASPECT technical reach-back team remains in Addison, TX.

A detailed summary of the ASPECT operations from 8/31 to 9/1 are available in different reports. This report will begin with a detailed summary of the ASPECT operations scheduled for 2 September 2017. Table 1 provides a brief summary of the ASPECT products to date.

Table 1. Summary Metrics from ASPECT Operations

Date	*# Sorties*	*Aerial Photos*	*Oblique Photos#*	*FTIR spectra**
30 August 2017	1	39	52	21,000
31 August 2017	3	173	221	117,000
1 September 2017	3	257	>70	>100,000

Some photos were not be viewable/usable due to poor lighting or weather conditions at the time they were taken. Highlight cells will be updated after the data is processed.
* The collection frequency of FTIR spectra is 70 spectra per second.

ASPECT continues to fly in the TFR area (Temporary Flight Restriction) under an assigned squawk code in close coordination with the U.S. Coast Guard. **The aircraft does not fly through known chemical plumes or take air samples.** It uses a passive remote sensing

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technology that can detection vapors at its routine survey altitude of about 3,000 ft above the hazard.

ASPECT products are viewable using Google Earth by using the Google Earth "n-link" file which can be made available by contacting EPA R6 officials.

3 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 ft 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 (IRLS). 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.

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.

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4 Results

Flight #9

0700 hrs: A pre-flight briefing was completed and ASPECT was airborne by 0750 hrs CST. The primary mission will continue to monitor the Arkema facility with periodic (30 to 45 minute) sweeps. Between these sweeps, ASPECT will continue with its photography mission for rapid needs assessment (RNA) in Zones 5 & 6.

RNA targets were provided by Region 6 and include Remedial Management Plan (RMP) locations, wastewater facilities, water treatment facilities, and National Priority List (NPL) sites. Flight paths are being developed to collect aerial images over about several hundred target sites. These targets have been arbitrarily categorized by the ASPECT team into geographic area designated by chronological zone numbers. Zone 1 is the sourthernmost geographic area and they extend northeast to Port Arthur. Figure 2 shows the current zones being surveyed today. Zones 5 & 6 are being flown because of their proximity to the Arkema site.

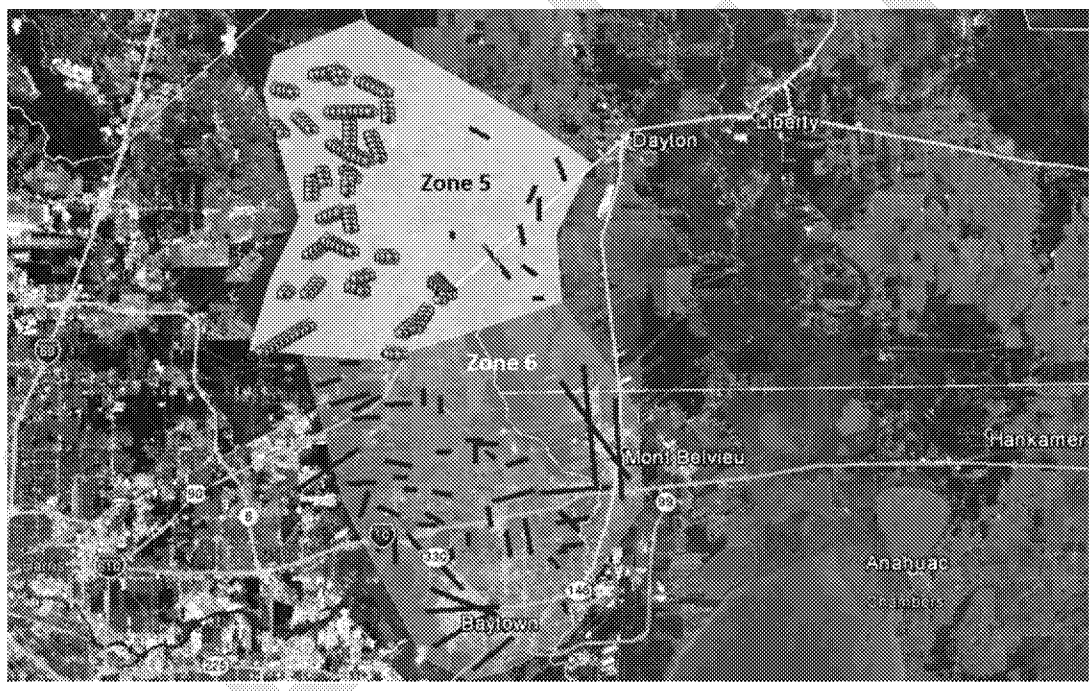

Figure 2: Flight lines in Zones 5 & 6 showing where aerial photography was taken over selected targets on 1 September 2017 for the rapid needs assessment.

On 1 September 2017, ASPECT completed about 50% of Zone 5 (Crosby to Huffman) consisting of approximately 50 targets (36 flight lines). Zone 6 (Crosby down to Baytown) consists of more than 50 targets (49 flight lines).

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0740 hrs: ASPECT completes a pass over the Arkema facility and reports no significant chemical detections. Figure 3 contains two images taken from the IR video showing a heat signature from the remnants of the trailers that burned on 1 September and the remaining refrigerated trailers.

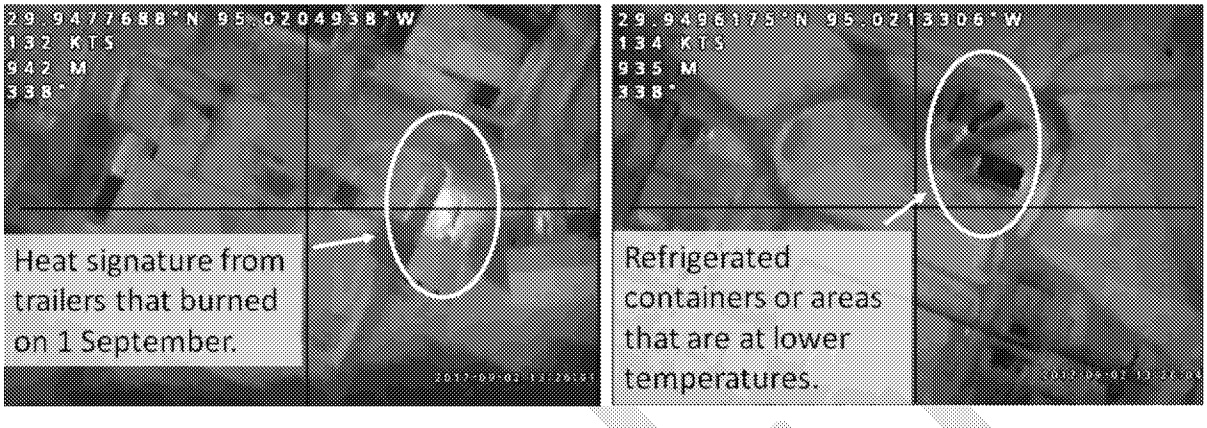

Figure 3: Infrared images taken from the video (0813 hrs CST) showing the heat signature from the trailers that burned on 1 September (left) and the refrigerated trailers (right).

0820 hrs: ASPECT completes a pass over the Arkema facility and reports no significant chemical detections. Figure 4 is an image taken from the IR video showing the remaining refrigerated trailers.

Figure 4: Infrared image taken from the IR video over the six remaining refrigerated trailers.

The image in Figure 4 shows that the trailers appear to be cooler than the surrounding environment at this time suggesting that the ground may be solar heating and increasing the contrast between the trailers and ground.

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0900 hrs: Aerial photos taken as part of the RNA are being geo-corrected for geospatial viewing in a variety of GIS platforms.

1030 hrs: A VIP temporary flight restriction (TFR) was instituted near Houston, TX and will last from 1030 hrs to 1500 hrs. ASPECT has authority to fly with the TFR under an emergency response squawk code from the Federal Aviation Administration (FAA).

1145 hrs: ASPECT completes a pass over the Arkema facility and reports no significant chemical detections. IR video continues to show similar images as shown in Figure 4.

1200 hrs. ASPECT landed at Conroe Airfield to refuel. No data were uploaded to the FTP site because this was a fast fuel turn to get the aircraft back on station as fast as possible.

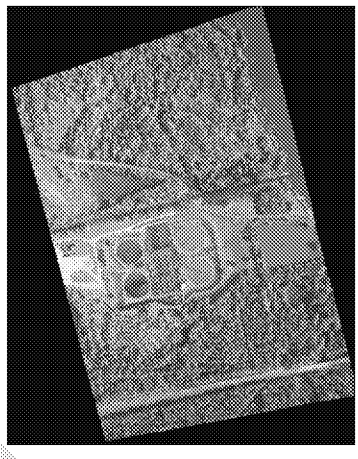

Figure 5: Example of a geo-corrected aerial photo over a water treatment facility. These are part of the rapid needs assessment mission.

Flight #10

1300 hrs: ASPECT is airborne to continue Arkema monitoring and collect RNA photos in Zone 6.

1400 hrs: Robert Bernier, R6 OSC, contacted ASPECT ground control and stated that the Sheriff overflight reported that yellow material was seeping from the six trailers on the ground (see Figure 6). He requested high resolution photos. ASPECT was redirect from the RNA mission to support this request.

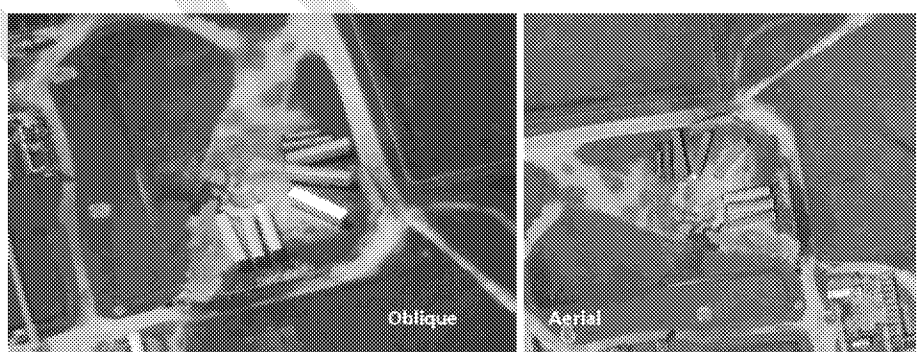

Figure 6: Oblique (left) and Aerial (right) photos pulled from the aircraft and shared with the R6 EOC. The oblique image is slightly distorted due to the aircraft windshield. Oblique photos are not typically pulled from the aircraft because the camera is not connected to the aircraft computer system. The crew was able to download this image to the computer so the reach back team could access it via satellite.

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1417 hrs: Robert Bernier, R6 OSC, contacted ASPECT ground control and stated that there is smoke at the trailers.

1500 hrs: ASPECT continues to make several passes over the Arkema facility about every 10 to 15 minutes. A series of passes had measurable chemical detections consistent with peroxide above the detection limit (about 5 ppm) downwind from the trailers (south and west).

1515 hrs: A discussion was held with the Robert Dernier, R6 OSC, to discuss the reported ASPECT detections. The ASPECT aircraft is loitering near the site, ready to respond, should the situation deteriorate. The RNA mission has been suspended.

1630 hrs: ASPECT is returning to the Hobby Airfield to refuel, upload data, and rest. The crew will be ready to respond in an emergency.

Flight #11

1920 hrs: ASPECT ground team was informed that the local authorities are planning to manually ignite the Arkema trailers. The flight crew is planning to be airborne at 1945 hr CST.

1950 hrs: ASPECT is airborne and will loiter in a safe location near the Arkema site.

2100 hrs: The manual ignition of the trailers was cancelled. Locals report that one of the trailers is leaking on its own. ASPECT confirmed smoke and made a chemical sweep directly over the trailers. Many chemical detections were made consistent with light hydrocarbons (e.g., 1,3-butadiene) caused by the heated constituents emitted from the trailers. These hydrocarbons were all measured slightly above the limit of detection (about 5 ppm). Other downwind passes (50 m to 100 m) did not show chemical detections above the detection limits. Figure 7 shows two infrared images from independent passes 30 minutes apart.

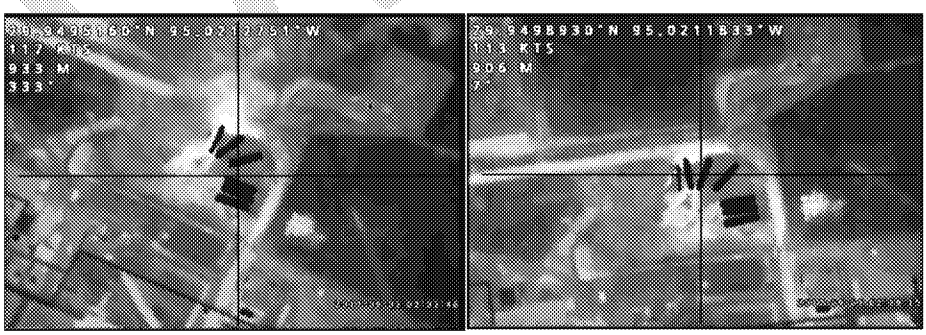

Figure 7: Infrared images (2100 hrs on left; 2130 hrs on right) taken from IR videos show one of the trailers expelling heat from both ends.

2200 hrs: ASPECT returned to Hobby Airfield.

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5 Operational Challenges

1. Satellite communications continue to be unstable and have required multiple re-starts throughout the day. We continue to monitor this situation. The vendor is actively investigating to determine if the cause is due to a software or hardware issue.

2. The technical reach-back team continues to actively address recording issues with the infrared line scanner (IRLS) system. The recording computer failed in the aircraft on 31 August 2017. The team replaced the IRLS motherboard and conducted a test flight the evening of 31 August 2107. Initiate results indicated that the issue had been resolved but during Flight 6 (1 September 2017) similar faults were observed, suggesting that the cause is more complex. Currently this capability is not available. The night vision camera has been reconfigured as a thermal imaging system as a backup. Efforts to fix the IRLS continue, however a fix cannot occur until the team completes a critical examination of the system. That work cannot occur while the aircraft is stationed at Hobby Airfield.

3. Adding people to the ASPECT_Harvey@epa.gov email distribution list requires outside support from EPA IT personnel. This adds unnecessary delays and increases the likelihood that some individuals may not get timely information if they are accidently left off the update emails.

4. The secure FTP site used to store ASPECT files has experienced a critical failure. The root cause remains unknown, however, IT tech support is investigating. It is expected to be repaired within 24 hours. In the meantime, EPA OEI will provide FTP space for data transfer.

4.

DRAFT

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6 ASPECT Team and Crew

Dr. Mark Thomas, ASPECT Program Manager
Dr. John Cardarelli II, ASPECT Radiological / Tech Lead
Mr. Timothy Curry, ASPECT Logistics/Finance Lead
Dr. Robert Kroutil, Kalman Co Inc.ASPECT Chemical / GIS Lead (contractor)
Dr. Brian Dess, Kalman Co Inc. ASPECT Chemical / IT support (contractor)
Mr. Jeff Stapleton, Kalman Co Inc. (remote support)
Ms. Malia Smolenski, Kalman Co Inc. (remote support)

Sam Fritcher, Airborne ASPECT Inc., CEO
Beorn Leger, Airborne ASPECT Inc., Chief Pilot
Ned Conner, Airborne ASPECT Inc., Pilot
Tom Cruise, Airborne ASPECT Inc., ATP/Operator
Dallas Sley, Airborne ASPECT Inc., Equipment Operator
Robert Kirby, Airborne ASPECT Inc., Engineer
Bruce Dingman, Airborne ASPECT Engineering Tech.

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