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

September 3, 2017
0730 hrs to 2040 hrs

Figure 1: Remaining trailers at the Arkema site.

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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	88	171,000
2 September 2017	3	310	31	177,000
3 September 2017	2	330	381	210,000

[#] 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.

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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 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 reachback team for QA/QC analysis.

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The reachback team moved its base of operations from Million Air Terminal to a small office in the Airborne ASPECT Inc. hanger at the Addison Airfield.

4 Results

0730 hrs: The technical reachback team encountered a data transmission issue with the internet provider. The team continues to monitor the situation.

0800 hrs: The ASPECT Rapid Needs Assessment (RNA) mission for Neuces and Jackson Counties, TX were cancelled. The RNA mission will continue in geographic zones as created by the ASPECT reachback team. These are generally designed based on proximity to the airfield, length of flight, flight restrictions (if any), and number of sites. Some zones will be larger than others.

The mission of the RNA flights is to collect high resolution photos over target sites provided by the Region. In addition, chemical sensors were activated over sites associated with industrial facilities but this was later changed to monitor all sites based on inquiry from EPA PIOs. They wanted to know what air monitoring has been done as part of the hurricane response, with particular interest in Harrison county. They also wanted to know if ASPECT flew in areas aside from Arkema and, if so, where and what was noted. Every site photographed from this point forward (urban/rural/residential/industrial) will also have a chemical sweep.

Every photo will be geo-corrected and validated by the reachback team and then made available on the ASPECT "n-link" file. The validation process will delay the distribution/access to these files for at least one day.

Flight #12

1015 hrs: ASPECT is airborne and completed a chemical sweep over the Arkema site with no significant chemical detections.

1030 hrs: ASPECT technical reachback team experienced another critical failure of the FTP servers. See Operational Challenges for a full explanation. The team decided to move its base of operations to resolve the issues. The aircraft continued its RNA mission in Zones 6 &7, while the reachback team moved operations.

1230 hrs: ASPECT reachback team returns to full operational status at a new base of operations in a small office at the Airborne ASPECT Inc. hanger, Addison Airfield.

1410 hrs: ASPECT landed to refuel. It completed aerial photos & chemical sweeps for the remaining targets in Zone 6 and completed about 75% of the targets in Zone 7 (see Figure 2). Flight planning for the RNA mission continues. Data will be delivered to the reachback team this evening.

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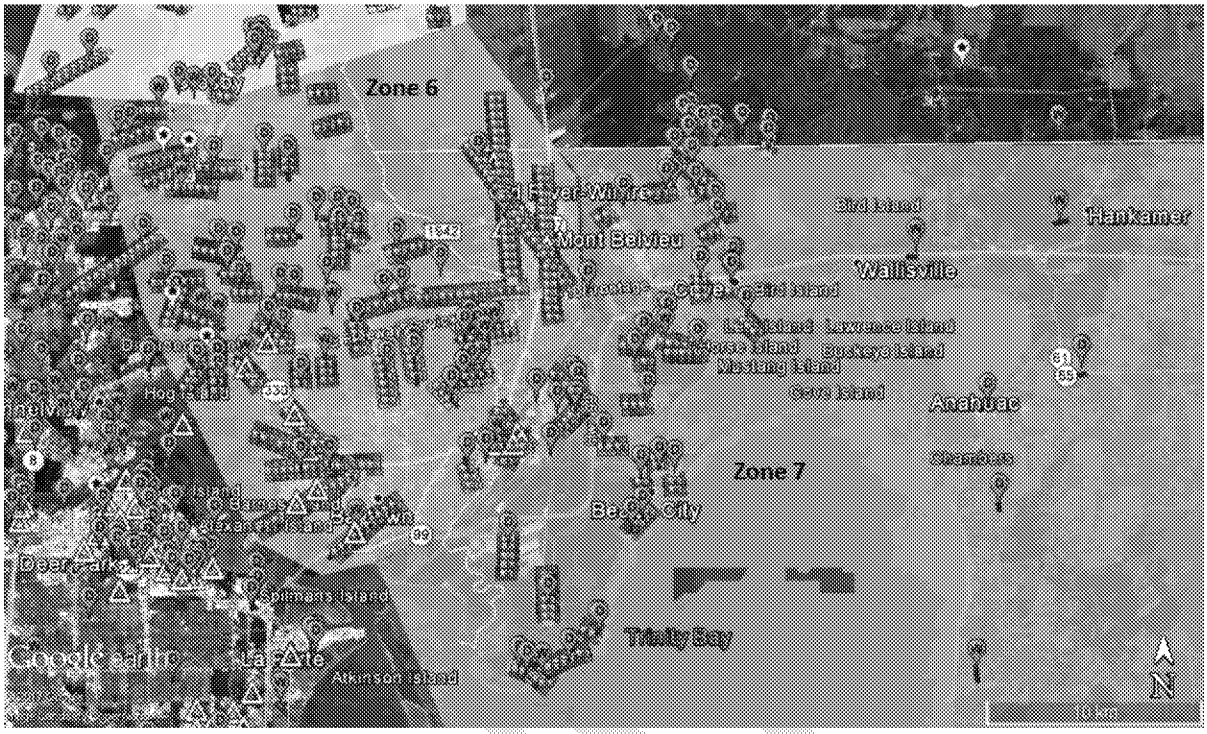

Figure 2: Google Earth image showing areas where ASPECT has collected aerial photos over selected targets provided by the Region as part of the Rapid Needs Assessment. "D" represents drinking water facilities, "W" represents wastewater treatment facilities, and yellow triangle represent risk management plan sites, and a black star in a yellow balloon represent National Priority List sites. Every photo will be geo-corrected and validated by the reachback team and then made available on the ASPECT "n-link" file. The validation process will delay the distribution/access to these files for at least one day.

Flight #13

1540 hrs: ASPECT reports fire at the Arkema site and initiated a series of chemical sweeps. Figure 3 shows an aerial photo and infrared image that was pulled from the aircraft and shared with the Region EOC.

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Figure 3: Aerial photo (left) taken at 5,000 ft of the Arkema trailers. Infrared image taken from the IR video showing the heat signature of the fire.

1615 hrs: ASPECT has completed several passes over the Arkema fire and detected trace concentrations of peroxide (limit of detection about 5 ppm), as well as PAN (peroxyacyl nitrates) and ozone which are consistently found in fire emissions.

1720 hrs: ASPECT was requested to make a chemical sweep about 1 mile to the West (downwind). Results showed no significant chemical detections which was confirmed by multiple passes and independently verified by the reachback team.

Figures 4, 5 and 6 show aerial and oblique photos of the Arkema trailers before, during, and after they burned.

Figure 4: Before (left) and after (right) the Arkema site trailers burned

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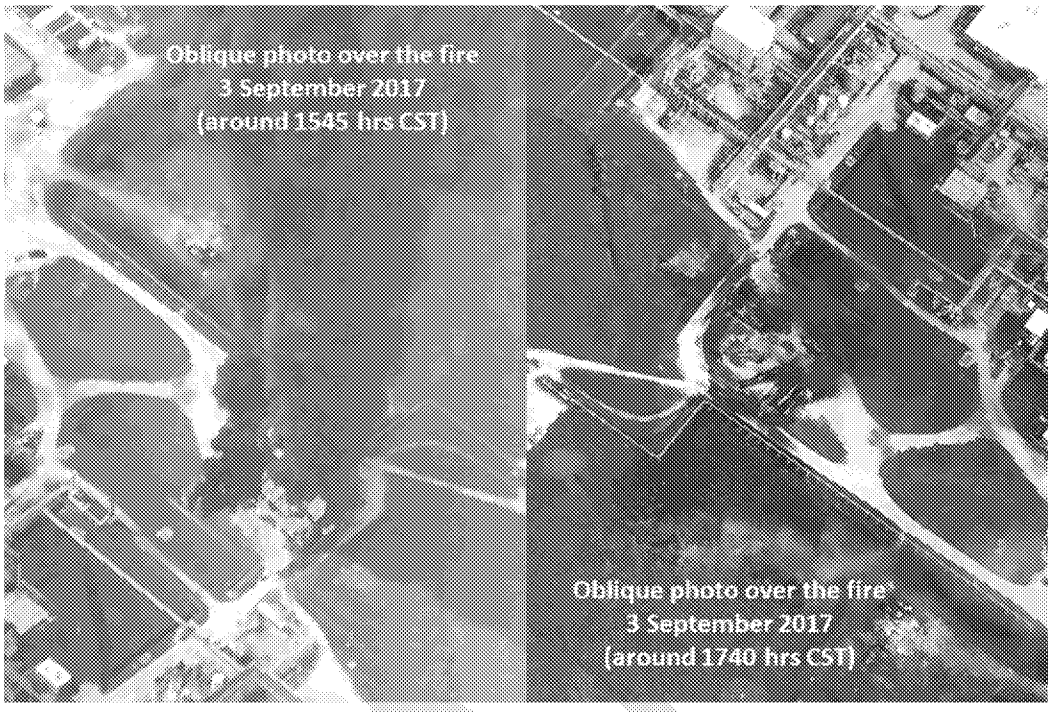

Figure 5: Oblique photos of the Arkema fire take FTIR results are showing low concentrations of peroxide (2 ppm) about 50 meters downwind. The air crew reports just a little fire and very little smoke. The detection limit was lower since we were looking down a thicker plume. Please see the attached IR image, note the greatly reduced with only the trailers showing a hot signature.n from ASPECT aircraft.

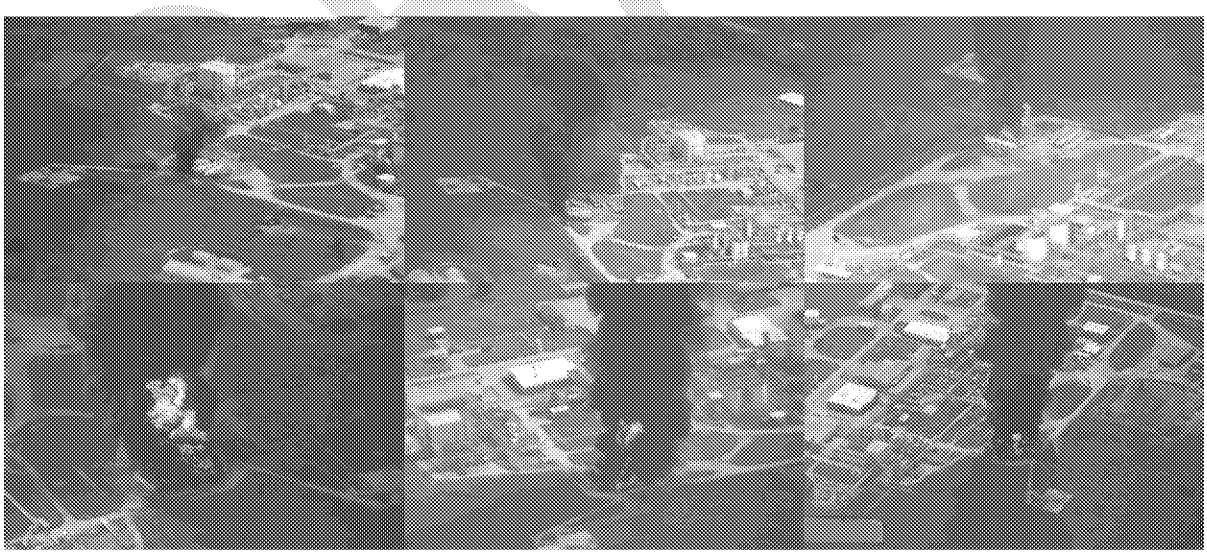

Figure 6: Series of oblique photos showing the progress of the Arkema trailers burning.

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1800 hrs: ASPECT continued to make passes directly over the trailers and downwind (about 50 m) while they burned. Initial FTIR results showed low concentration of peroxide (about 2 to 5 ppm) about 50 m downwind.

Figure 7: Infrared image taken from the IR video (1650 hrs CST) showing the trailers producing a heat signature near the end of the burn.

5 Operational Challenges

1. Satellite communications appear to have been resolved.

2. The technical reachback 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. Initial 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. The aircraft is returning to the Addison Airfield tonight where the IRLS computer will be pulled for maintenance.

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3. Adding people to the ASPECT_Harvey@epa.gov email distribution list requires outside support from EPA OEI personnel. The support provided by EPA OEI has been outstanding in meeting this challenge by adding new people to this distribution list in a timely and efficient manner.

4. Access to the secure FTP site used to store ASPECT files experienced a critical failure. The problem was caused by the large amounts of data and bandwidth being used by the ASPECT program triggering alarms as a potential cyber-attack on the networks. We learned that the Addison Million Air (technical reachback team base of operations) and Hobby Million Air (aircrew team base of operations) cyber security network algorithms identified our internet traffic as a threat and classified our servers as a Distributed Denial of Service (DDoS) attack. A DDoS is defined as an attack on a system via moving a large enough amount of data such as to clog the bandwidth or overwhelm a server, usually malicious and intentional using junk data or rapidly cycled connections. The ASPECT technical reachback team moved its base of operations to another location at the Addison Airfield and the problem appears to have resolved.

6 Rapid Needs Assessment Status

This table is a work in progress to help track metrics for the ASPECT RNA mission.

Zone	Date	Flight #s	#Targets	#Flight Lines	Comments
1	Cancelled (3 September 2017)				
2					
3					
4	TBD	TBD	>110	TBD	
5	9/1	7, 9	>50	36	Contains Arkema facility
6	9/2	9	>70	49	South of Arkema facility
7	9/3	12	>60	46	Mostly Chamber County
8	TBD				
…	TBD				
Totals					

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7 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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