2017 ASPECT Preliminary Report
Rapids Needs Assessment

September 4, 2017
0600 hrs to 1900 hrs

Figure 1: Rapid Needs Assessment Targets

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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 9/3 are available in different reports. This report will begin with a detailed summary of the ASPECT operations scheduled for 4 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
4 September 2017	2	TBD	TBD	TBD

[#] Some photos may 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.

On 3 September 2017, the ASPECT reachback team moved its base of operations from the Million Air Terminal to the Airborne ASPECT Inc., hanger at Addison Airfield. The move was required because the Million Air network triggered ASPECT internet traffic as a potential cyber-attack due to the large amounts of data and bandwidth used by the program. On a typical day, the ASPECT can transfer up to 50 GB.

All of the trailers containing benzo peroxide at the Arkema site have burned. The last six trailers burned on 3 September 2017. ASPECT is now focused on the Rapid Needs Assessment (RNA) mission. The mission 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 surveyed after 3 September 2017. 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.

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

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

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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.

Automated Processing
Data are processed using automated algorithms onboard the aircraft and preliminary results are sent using a satellite system to the ASPECT reachback team for QA/QC analysis.

4 Results

0600 hrs: The technical reachback team prepared the flight mission, held a pre-flight briefing, and continues to do data management and photo validation for Flight #9 (222 aerial photos). These should be available on the n-link by the end of today. Aerial photos from Flights 10, 11, 12, and 13 require validation and contain 88, 0, 263, and 67 aerial photos respectively. These have been added to action item list.

The reachback team is consolidating all positive chemical detections from all flights and preparing tabular and geospatial products for the Region.

Flight #14
0800 hrs: ASPECT is airborne and en route to Chambers County (Zone 7) to photograph the remaining RNA targets (about 15) and then will proceed to RNA targets to Matagorda and Wharton Counties (Zone 4; about 110 targets). Figure 2 shows targets in Zone 7.

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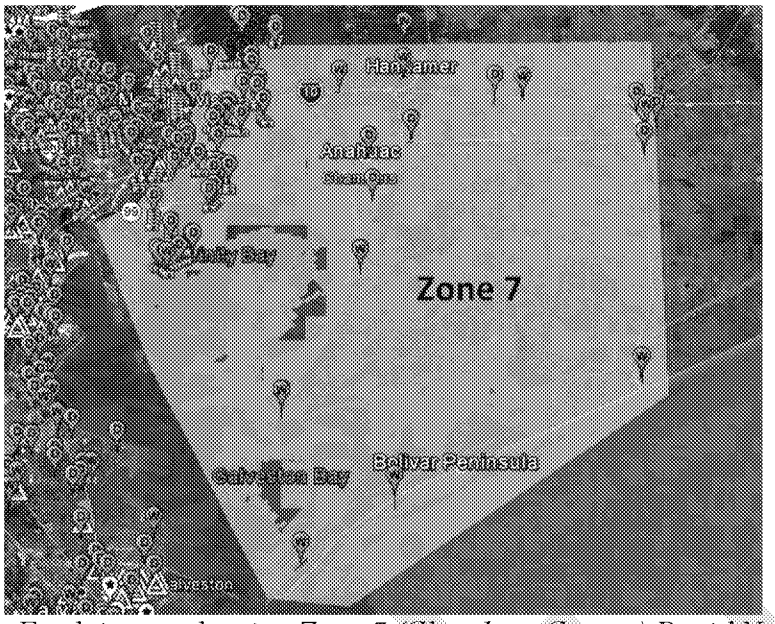

Figure 2: Google Earth image showing Zone 7 (Chambers County) Rapid Needs Assessment targets (>15 remaining targets, 15 flight lines). "D" represents drinking water facilities, "W" represents wastewater treatment facilities, and yellow triangle represent risk management plan sites, and a black star in 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.

0945 hrs: ASPECT arrives on station in Zone 7 to photo and survey the remaining targets (>15 targets, 15 flight lines).

1030 hrs: ASPECT completes the remaining RNA surveys in Zone 7 and had no chemical detections. The crew heads to Hobby Airfield to refuel, upload data, and eat lunch.

Flight #15

1220 hrs: ASPECT is airborne and en route to Matagorda and Wharton Counties (Zone 4) to photograph and survey RNA targets (about 110 targets; 85 flight lines). Figure 3 shows targets in Zone 4.

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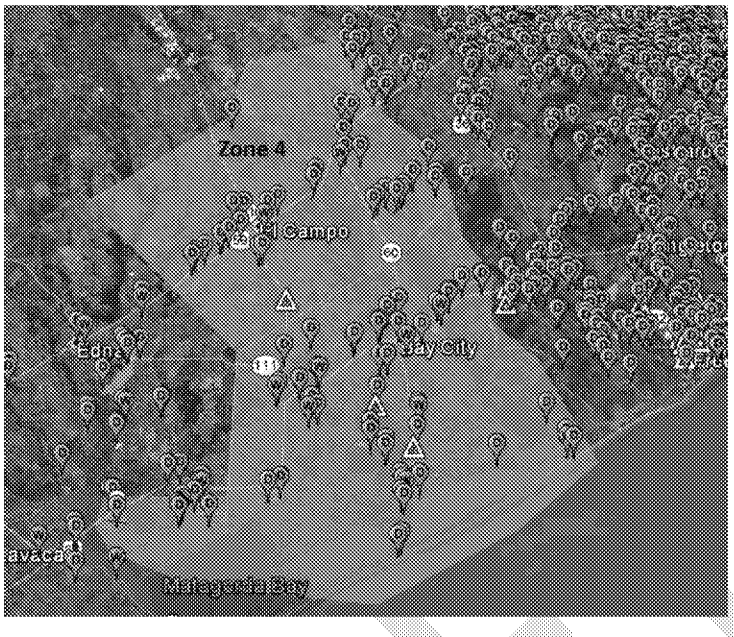

Figure 3: Google Earth image showing Zone 4 (Matagorda and Wharton Counties) Rapid Needs Assessment targets (>110 remaining targets, 85 flight lines). "D" represents drinking water facilities, "W" represents wastewater treatment facilities, and yellow triangle represent risk management plan sites, and 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.

1620 hrs: ASPECT completes 51 of 85 flight lines in Zone 4 (Matagorda County) and lands at Hobby Airfield. Figure 4 shows a typical geo-corrected aerial image from the RNA mission. Data from this flight are being processed and results should be available tomorrow.

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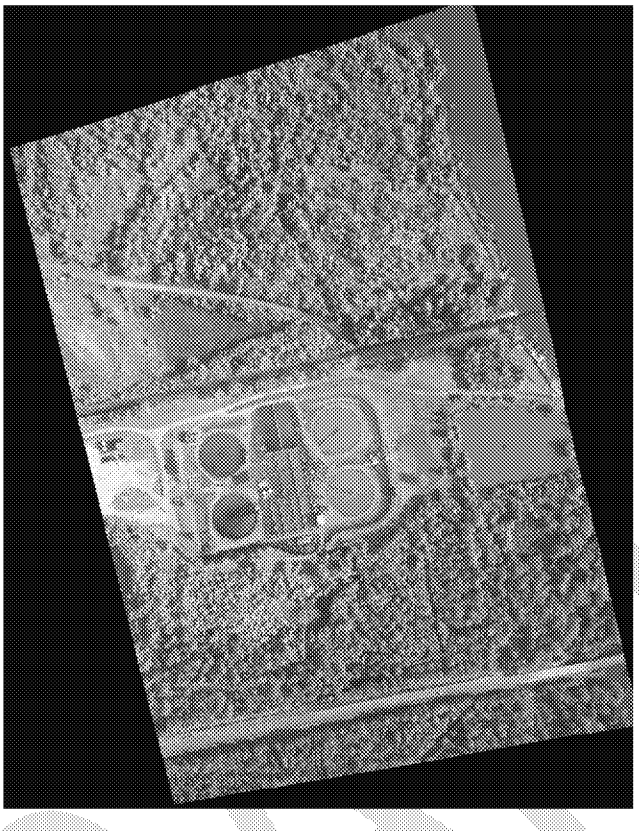

Figure 4: Example geo-corrected photograph from the RNA mission. These are validated by the reachback team and then made available through the Google Earth ASPECT n-link file.

5 Operational Challenges

1. 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. The aircraft landed at Addison Airfield on 3 September so the team could perform maintenance on the IRLS. It is expected the IRLS will be back in operation and ready for service on 6 September 2017.

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6 ASPECT Status Tables

ASPECT Flights

Flight #	Date	Primary Mission	Comments
1	8/29	Systems Check	
2	8/30	Arkema Site	
3	8/31	Arkema Site	Foggy Conditions
4	8/31	Arkema Site	
5	8/31	Arkema Site	
6	9/1	Arkema Site	
7	9/1	Arkema Site & Zone 5 RNA	Started Zone 5 RNA
8	9/1	Arkema Site	Fires
9	9/2	Arkema Site & Zones 5 & 6 RNA	Completed Zone 5 RNA Started Zone 6 RNA
10	9/2	Arkema Site & Zone 6 RNA	
11	9/2	Arkema Site	Aborted Controlled Burn
12	9/3	Zone 6 & 7 RNA	Completed Zone 6 RNA Started Zone 7 RNA
13	9/3	Arkema Site	Controlled Burn
14	9/4	Zone 7 RNA	Completed Zone 7 RNA
15	9/4	Zone 4 RNA	Started Zone 4 RNA (Matagorda County)
16	9/5	TBD	TBD

ASPECT Rapids Needs Assessment Status

Zone	Date	Flight #s	#Targets	#Flight Lines	Comments
1	Cancelled (3 September 2017)				
2					
3					
4	9/4	15	>110	85	Matagorda & Wharton Counties
5	9/1	7, 9	>50	36	Contains Arkema Site
6	9/2	9, 10, 12	>70	49	South of Arkema Site
7	9/3	12, 14	>60	46	Mostly Chambers County
8	TBD	TBD	>110	104	SW Brazoria County
…	TBD				
		Totals	>400	320	

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ASPECT Flight Statistics

Flight #	Aerial	Oblique	FTIR*	Comments
1				System Test
2	39	52	21,000	Arkema
3	38	96	24000	Arkema
4	97	107	63000	Arkema
5	38	18	30000	Arkema
6	35	0	30,000	Arkema
7	162	19	75,000	Arkema & Zone 5 RNA
8	60	69	66,000	Fire ER
9	222	5	108,000	Arkema & Zones 5 & 6 RNA
10	88	26	45,000	Arkema & Zone 6
11	0	0	24,000	Arkema Aborted Controlled Burn
12	263	5	156,000	Zone 6 & 7 RNA
13	67	376	54,000	Arkema Trailer Burn
14				Zone 7 RNA
15				Zone 4 RNA
TOTALS	1,109	773	696,000	

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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