UNITED STATES AIR FORCE

AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT

TARS, T/N 4222
LAJAS, PUERTO RICO

LOCATION: LAJAS, PUERTO RICO

DATE OF ACCIDENT: 16 AUGUST 2011

BOARD PRESIDENT: LT COL BRENDAN O'BRIEN

Conducted IAW AFI 51-503, *Aerospace Accident Investigations*

DEPARTMENT OF THE AIR FORCE
HEADQUARTERS AIR COMBAT COMMAND
JOINT BASE LANGLEY-EUSTIS VA

OFFICE OF THE VICE COMMANDER
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JOINT BASE LANGLEY-EUSTIS VA 23665-2788

DEC 15 2011

MEMORANDUM FOR ACC/JA

SUBJECT: Accident Investigation Board Report: TARS, T/N 4222, Lajas, PR, 16 August 2011

I have reviewed the Accident Investigation Board Report regarding the TARS, T/N 4222, which crashed near Lajas, Puerto Rico. The report prepared by Lieutenant Colonel Brendan O'Brien complies with the requirements of AFI 51-503 and is approved.

WILLIAM J. REW
Lieutenant General, USAF
Vice Commander

Attachment:
Accident Investigation Board Report

Agile Combat Power

EXECUTIVE SUMMARY

AIRCRAFT ACCIDENT INVESTIGATION
TARS, T/N 4222, Lajas, Puerto Rico
16 August 2011

The mishap aerostat (MA) was launched on 15 August 2011 from the Lajas Tethered Aerostat Radar System (TARS) Site, Puerto Rico at 1241 ZULU (Z) (0841 local time) and remained aloft until the mishap. At approximately 1637Z on 16 August 2011, a line of thunderstorms hit the site from the SE. Heavy winds blew the MA abruptly to the NW of the site, pulling the mishap winch truck (MWT) off of the pad and into an embankment at the site perimeter. The MA tether was pulled along a steel anti-fouling cable and snapped. The MA broke away, climbed to 7,000 feet and ruptured, causing the associated equipment to impact the ground and be destroyed with total loss and damage estimated at $8,159,917.86. There were no injuries and no significant damage to private property. Clean up costs are pending for 71 gallons of spilled diesel fuel.

The TARS Program is managed by Air Combat Command's Acquisition Management and Integration Center (AMIC). ITT is the contractor responsible for operating and maintaining the Lajas TARS site, which is manned solely by ITT personnel.

The Mishap Flight Director (MFD) and Mishap Flight Crew (MFC) assumed responsibility for the MA on 16 August 2011 at approximately 1200Z, after completing a changeover briefing. The MFD was briefed that storms were forecast to occur after mid-day. At 1503Z, the MFD ordered an in-haul of the MA to the minimum operating altitude (MOA) of 2,100 feet. At 1535Z, the MFC received a watch for lightning within 10 and 20nm. By 1610Z, the nearest storms were at α nm, the distance at which guidance requires an in-haul to the MOA.

At 1619Z, with the nearest storms developing at β nm, the distance at which guidance requires a recovery, the MFD ordered recovery of the MA. At 1621Z, the MFC requested to reposition the MWT based on new surface wind direction. The MWT was repositioned from 1626Z to 1629Z, but chock blocks were never put into place as required by applicable guidance. At 1630Z, the MFC commenced in-haul to recover MA from the MOA. At 1637Z, thunderstorms and heavy winds hit the site and triggered the mishap sequence.

The AIB President found by clear and convincing evidence that the cause of the mishap was the late decision to recover the MA. This decision, while in compliance with all applicable guidance, was not made with sufficient lead time to recover and moor the MA prior to the arrival of thunderstorms. Additionally, the AIB President found by a preponderance of evidence that the MWT chock blocks were not positioned in accordance with applicable guidance, which substantially contributed to the mishap.

COMMONLY USED ACRONYMS & ABBREVIATIONS

§	Section
α	Distance for thunderstorms requiring in-haul of aerostat to minimum operating altitude
β	Distance for thunderstorms requiring recovery of aerostat
A_o	Operational Availability
ACC	Air Combat Command
AFI	Air Force Instruction
AFTO 95	Air Force Technical Order Form 95
AIB	Accident Investigation Board
AMIC	Acquisition Management and Integration Center
AMOC	Air Marine Operations Center
APGS	Airborne Power Generation System
CH1	Close Haul (Port Side) Operator
CH2	Close Haul (Starboard) Operator
CHT	Close Haul Trainee
CDRL	Contract Data Requirements List
DAR	Daily Activity Report
DPM	Deputy Program Manager
DS7i	DataStream 7i
FAE	Functional Area Expert
FD	Flight Director
FP	Fin Pressure
GMW	General Maintenance Worker
GPS	Global Positioning System
GSHS	Ground State of Health System
JTP	Job Training Package
LA	Legal Advisor
MA	Mishap Aerostat
MBS	Minimum Break Strength
MCH1	Mishap Close-haul (Port Side) Operator
MCH2	Mishap Close-haul (Starboard) Operator
MCHT	Mishap Close Haul Trainee
MFC	Mishap Flight Crew
MFD	Mishap Flight Director
MM	Medical Member
MNO	Mishap Nose Rope Operator
MRO	Mishap Remote Winch Control Operator
MSM	Mishap Site Manager
MWTO	Mishap Winch Truck Operator
MOA	Minimum Operating Altitude
MSL	Mean Sea Level
NM	Nautical Miles
NO	Nose Rope Operator
OWS	Operational Weather Squadron
PMI	Preventive Maintenance Inspection
OI	Operating Instruction
RDD	Rapid Descent Device
REC	Recorder
RO	Remote Winch Control Operator
SBIO	Safety Board Investigating Officer
SBP	Safety Board President
SM	Site Manager
SOP	Standard Operating Procedure
T&C	Telemetry and Control
TARS	Tethered Aerostat Radar System
TCC	TARS Control Center
TFD	Tether Footage Deployed
TSC	TARS Support Center
TPM	TARS Program Manager
TX	Transmit
UPS	Uninterruptable Power System
U.S.	United States
USAF	United States Air Force
UTC	Universal Time Coordinated
WO	Work Orders
WT	Winch Truck
WTO	Winch Truck Operator
WTS	Winch Truck System
Z	Zulu or Greenwich Mean Time

The above list was compiled from the Summary of Facts, the Statement of Opinion, the Index of Tabs, and Witness Testimony (Tab V).

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 16 September 2011, Major General Roger A. Binder, Vice Commander, Air Combat Command (ACC), appointed Lieutenant Colonel Brendan O'Brien as the Accident Investigation Board (AIB) President to investigate the 16 August 2011 mishap of a Tethered Aerostat Radar System (TARS), Tail Number (T/N) 4222. An AIB was conducted at Muniz Air Base, Puerto Rico, from 20 September 2011 to 14 October 2011, pursuant to Air Force Instruction (AFI) 51-503, *Aerospace Accident Investigations*. A Legal Advisor (LA), Medical Member (MM), Recorder (REC), TARS Functional Area Expert (FAE) and Weather FAE were also appointed. (Tabs Y-3, Y-5, Y-7)

b. Purpose

This is a legal investigation convened to inquire into the facts surrounding the aircraft or aerospace accident, to prepare a publicly-releasable report and to gather and preserve all available evidence for use in litigation, claims, disciplinary actions, administrative proceedings and for other purposes.

2. ACCIDENT SUMMARY

The mishap aerostat (MA) was launched at 1241Z (0841 local time) on 15 August 2011 from the Lajas TARS Site in Lajas, Puerto Rico and remained aloft until the mishap. (Tab AA-4) At approximately 1637Z on 16 Aug 2011, a line of thunderstorms associated with a tropical wave hit the site from the SE while the mishap flight crew (MFC) was attempting to recover and moor the MA. (Tab F-17) The MA was blown rapidly from the west to the north of the site, pulling the mishap winch truck (MWT) off of the pad and into an embankment on the site perimeter, damaging the MWT. (Tabs V-1.4, V-2.4, V-3.11, V-4.6, V-5.5, CC-4, HH) The tether was pulled tight across an anti-fouling cable, the tether snapped, and the MA broke away. (Tabs Z-13, Z-14) The aerostat quickly climbed to over 7,000 feet MSL and ruptured. (Tab CC-7) The MA, associated equipment and payload were destroyed upon impact with the ground. The total cost for the destroyed MA, payload and damaged ground equipment is approximately $8,159,917.86. (Tab P-4) There were no injuries. There was no significant damage to private property. (Tab P-5) Clean up costs are pending for 71 gallons of spilled diesel fuel. (Tab P-5)

3. BACKGROUND

a. Units and Organization

(1) Air Combat Command (ACC)

Air Combat Command is the primary force provider of combat airpower to America's war fighting commands. To support global implementation of national security strategy, ACC operates fighter, bomber, reconnaissance, battle-management and electronic-combat aircraft. It also provides command, control, communications and intelligence systems and conducts global information operations. (Tab II-3 to II-5)

(2) Acquisition Management and Integration Center (AMIC)

AMIC is headquartered at Langley AFB, VA and acts as a single leadership focal point for oversight of command service acquisition programs. AMIC aligns program management, functional support, quality assurance, and contracting in a single organization to produce mission-focused acquisitions. AMIC manages the TARS program. (Tabs II-7 to II-9, II-28 to II-29)

(3) ITT

ITT is a U.S. defense contractor that provides products and services, to include night vision technology, electronic warfare technology, communications, radar, intelligence, surveillance and satellite imaging technologies to meet the requirements of the U.S. military. ITT was awarded the TARS Program contract and took responsibility for operating and maintaining all TARS sites in October 2008. (Tab II-11 to II-15)

(4) Lajas TARS Site

The Lajas TARS Site is located on a parcel of land in the Municipality of Lajas owned by the Commonwealth of Puerto Rico. The use of the land and the operation of the Lajas TARS Site are accomplished in accordance with the provisions outlined in a 1993 Memorandum of Agreement between the Commonwealth of Puerto Rico and the United States Air Force. The TARS site is contractor operated and maintained and the incumbent contractor is ITT Systems Corporation. (Tab II-34)

b. Aerostat: Tethered Aerostat Radar System

(1) Mission

The TARS is an aerostat-borne, surveillance program. Using the aerostat as a stationary airborne platform for surveillance radar, the system is capable of detecting low-altitude aircraft at the radar's maximum range by mitigating curvature of the earth and terrain masking limitations. The

TARS provides detection and monitoring capability along the U.S.-Mexico border, the Florida Straits and a portion of the Caribbean in support of the Department of Defense Counter-drug Program.

The primary agencies using the TARS surveillance data include U.S. Northern Command in support of Customs and Border Protection (Air and Marine Operations Center and Caribbean Air and Marine Operations Center) and U.S. Southern Command in support of Joint Interagency Task Force-South. In addition to its counter-drug mission, TARS surveillance data also supports North American Aerospace Defense Command's air sovereignty mission for the continental United States. (Tab II-17 to II-18)

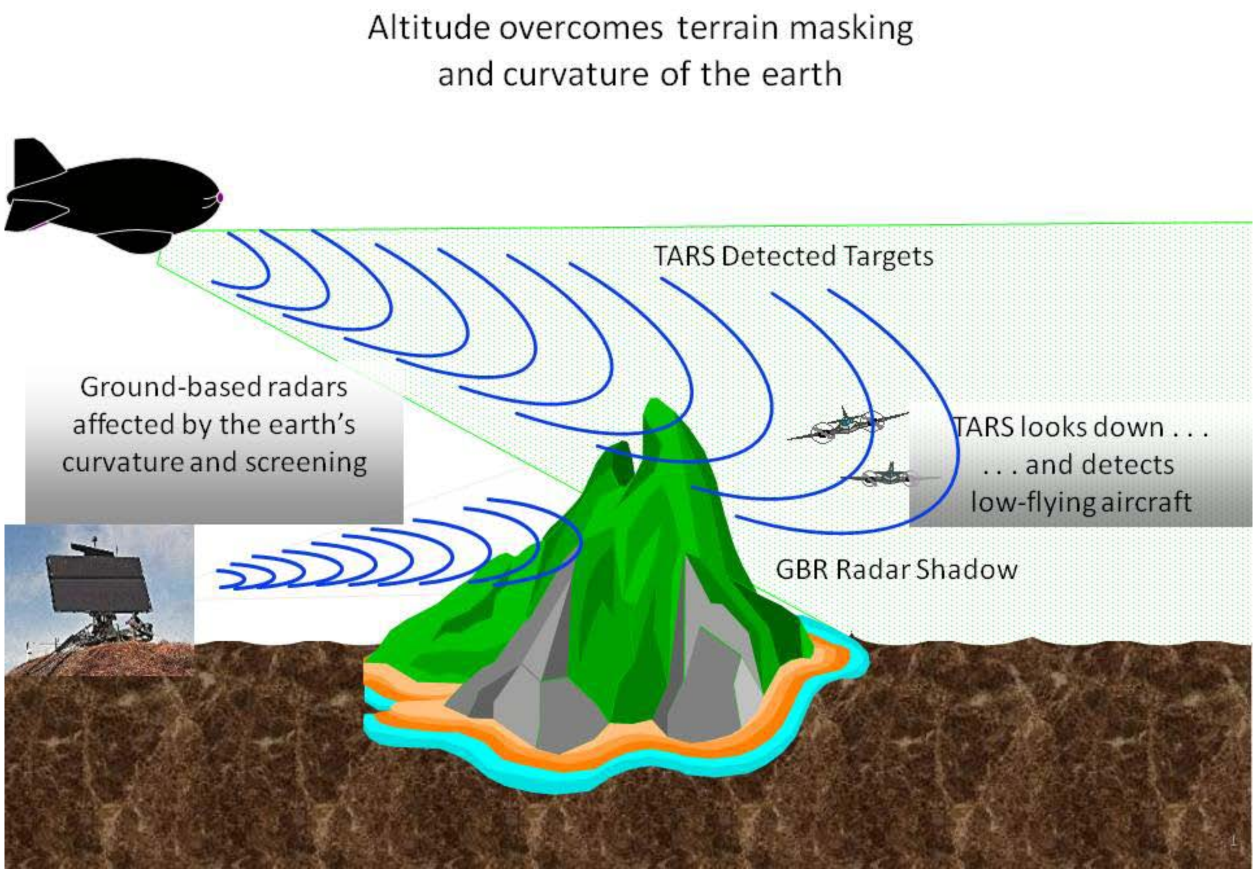

Figure 1. TARS Concept of Operations (Tab II-26)

(2) Features

The TARS consists of four major parts: the aerostat and airborne support equipment, the radar payload, the tether and winch system, and the ground station. The aerostat used on the TARS program is a large fabric envelope filled with helium and air. The hull of the aerostat contains two chambers separated by a gas tight fabric partition. The upper chamber is filled with helium, which provides the aerostat its lifting capability and the lower chamber is a pressurized air compartment (air ballonet). The aerostat hull is constructed of a lightweight Tedlar fabric that is resistant to environmental degradation, minimizes helium leakage and provides structural strength to the aerostat. There is also a pressurized windscreen compartment underneath the aerostat that contains and protects the radar. A sophisticated system of sensors, blowers and valves controls the air pressure within the air ballonet, maintaining the aerostat's aerodynamic shape.

The TARS program uses two different sizes of aerostats, categorized by volume. The 275,000 cubic foot, or 275K, aerostat is 186 feet long and 62.5 feet in diameter and the 420,000 cubic foot, or 420K, aerostat is 208.5 feet long and 69.5 feet in diameter. The 420K aerostat is the size in operation at Lajas. These aerostats can rise up to 15,000 feet mean sea level (MSL), while tethered by a single nylon and polyethylene constructed tether. The normal operating altitude varies by site, but the norm is approximately 12,000 feet MSL. Aerostat power is developed by an on-board, 400 Hertz generator.

The TARS program currently uses a Lockheed Martin L-88A or L-88(V)3 radar. All radar data is transmitted to the ground station, then digitized and fed to the various control centers for display. The ground station is where a flight director, seated before banks of meters and television screens, monitors the aerostat's performance. A Doppler weather radar, wind profiler and ground weather station are installed at each site to support flight operations. Each site also obtains forecasts and weather warnings from the Air Force Weather Agency.

Operators launch the aerostat from a large circular launch pad containing a mooring system (fixed or mobile), depending on the site configuration. The mooring system contains a large winch with 25,000 feet of tether cable. During the launch sequence, the winch reels out the tether until the aerostat reaches operational altitude. When the aerostat is lowered, it is secured to a mooring tower. While moored, the aerostat weather vanes with the wind. (Tab II-17 to II-18)

(3) Flight Crew Recovery Positions

The basic crew positions required to recover an aerostat from flight are flight director, winch remote operator, winch truck operator, nose rope operator, and two close-haul operators. The site manager and a close-haul trainee were also present during the mishap. The basic responsibilities of the positions during a recovery are outlined below. (Tab II-31)

Site Manager: The Site Manager’s basic duties include but are not limited to management of site operations and personnel. (Tab II-31)

Flight Director: Responsible for all decisions related to aerostat launch, recovery and flying operations. Basic responsibilities during recovery may include but are not limited to ensuring announcement of aerostat recovery, ensuring notification is sent to the TARS Control Center (TCC), ensuring recovery briefing is conducted, management of pad crew operations, maintaining communication with pad crew, and evaluating weather conditions. (Tab II-31)

Winch Remote Operator: Basic duties during recovery include but are not limited to performing remote console pre-set-up and checks, operating remote console, moving close-haul cart into position, in-hauling aerostat when directed by Flight Director, and returning console to storage location following recovery. (Tab II-31)

Winch Truck Operator: Basic duties during recovery include but are not limited to performing winch truck inspections and start-up preparations/inspections, positioning winch truck, performing parking brake check, ensuring parking brake is fully engaged and wheel chocks are positioned following repositioning winch truck, ensuring outriggers are positioned and returning winch truck to normal parking area after recovery. (Tab II-31)

Nose Rope Operator: The nose rope operator duties during aerostat recovery include but are not limited to preparing mobile lift vehicles for operation and positioning for post flight operations, attaching messenger cable to nose rope, operating nose winch, and securing nose rope after in-haul. (Tab II-31)

Close-haul 1 Operator: The close-haul 1 operator (aerostat port side) duties during recovery include but are not limited to assisting with positioning mooring dolly and close-haul cart (as needed), attaching aerostat close-haul ropes to close-haul cart winch, and monitoring close-haul line during in-haul. (Tab II-31)

Close-haul 2 Operator: The close-haul 2 operator (aerostat starboard side) duties during recovery include but are not limited to assisting with positioning mooring dolly and close-haul cart (as needed), attaching aerostat close-haul ropes to close-haul cart winch, and monitoring close-haul line during in-haul. (Tab II-31)

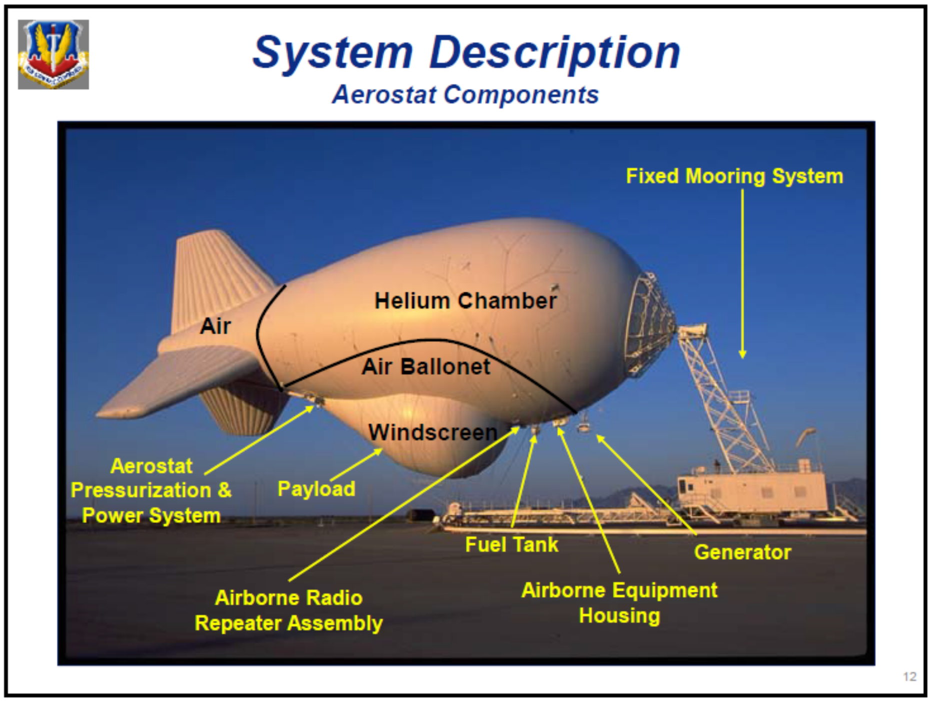

Figure 2a. Typical Aerostat Components. **(Tab II-23)**

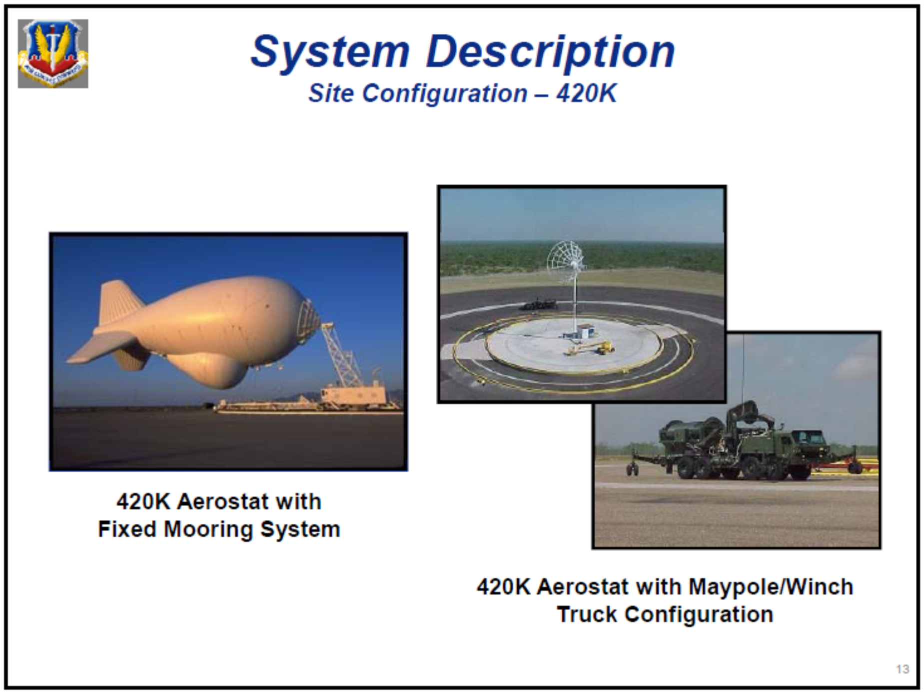

Figure 2b. 420K Site Showing Winch Truck Configuration. (Tab II-24)

4. SEQUENCE OF EVENTS

a. Summary of Previous Missions

Over the previous 90 days, 65 flights were conducted uneventfully. (Tab U-183 to U-185) The previous flight, Flight 269, was launched on 14 August 2011 and ended uneventfully at 0636Z on 15 August 2011. (Tab AA-3)

b. Planning

On 15 August 2011 at 1241Z, the Mishap Aircraft (MA) began Flight 270. (Tab AA-4) The MA was launched to provide persistent, long range detection and monitoring of low-level air and surface narcotics traffickers in support of U.S. Northern Command's and U.S. Southern Command's counter-drug/counter-narcotic trafficking missions. (Tab II-17) All missions are conducted by ITT personnel and authorized in accordance with the TARS Performance of Work Statement (PWS). (Tabs II-28 to II-29)

c. Pre-flight

The Mishap Flight Director (MFD) and the flight crew on duty from 1200Z to 2000Z on 15 August 2011 conducted pre-flight and launch of Flight 270 in accordance with Contract Data Requirements List A001 – Operating Instruction TARS Flight Operations Red Book (Red Book) and the 420K Winch Truck Systems Flight Crew Checklist (420K WTS FC Checklist). Pre-flight and launch were uneventful. (Tabs AA-4, AA-7, D-15 to D-18)

d. Summary of Accident

NOTE 1: Due to Operations Security considerations, the following Red Book limits have been substituted with symbols:

> α = A distance for thunderstorms/lightning and moderate to heavy rains tracking towards the site that requires aerostat in-haul to minimum operating altitude (MOA)
>
> β = A distance, less than α, for thunderstorms/lightning and moderate to heavy rains tracking towards the site that requires aerostat recovery

Following the launch of Flight 270 at 1955Z on 15 August 2011, the MFD ordered an in-haul from 9,800 feet Mean Sea Level (MSL) down to 4,000 feet MSL due to high winds above 4,000 feet MSL. (Tabs R-15, AA-5) A flight crew change-over occurred at 1930Z. (Tab AA-7) At 2212Z, GEOMET released a TARS Weather forecast for the Lajas TARS site. (Tab F-5) This product gave a 6-24 hour forecast indicating:

> a tropical wave moves toward the island and will pass south of the island… this will allow for the return of deep tropical moisture to the island allowing for a strong chance of scattered showers and thunderstorms by midday and through the afternoon and early evening hours… there is a moderate to high chance of redline exceedance anticipated for tomorrow.

A Flight Director (FD) change-over occurred at 2330Z with Flight Director-B (FDB) assuming responsibility. (Tabs AA-7, AA-8) Another flight crew change-over occurred at 0330Z on 16 August 2011. (Tab AA-8) The MFD and Mishap Flight Crew (MFC) assumed responsibility for Flight 270 after a change-over briefing at 1200Z on 16 August 2011. (Tabs D-13, AA-8) FDB was the outgoing FD on 16 August 2011 and conducted the changeover briefing from approximately 1130-1200Z. Neither the MFD nor FDB annotated any forecasted weather information on the crew change-over report or the TARS Log. (Tabs D-13, AA-8) However, several witnesses indicated during interviews that FDB briefed the MFD on the possibility for storms after mid-day. (Tab V-3.5, V-4.3, V-6.4) 1200Z was the start of a regularly scheduled 12 hour shift for the MFD and an 8 hour shift for the MFC. (Tabs R-14, R-15) At the time of changeover, the MA was flying at 3,972 feet tether footage deployed (TFD), approximately 3,800 feet MSL. (Tab K-5)

A Lajas TARS Discussion/Planning Weather Forecast was received at approximately 1200Z from the 612 SPTS/OWF, valid from 1200Z-0000Z. (Tab F-3) This forecast indicated “mostly cloudy skies with showers and thunderstorms in the area today,” no significant surface winds, flight level winds within Red Book limits, and possible warnings or advisories after 1500Z.

From 1503Z to 1512Z, the MFD ordered the in-haul crew to the pad and conducted an in-haul from 3,900 feet MSL to the MOA of 2,100 feet MSL. (Tabs R-15, K-5) This was documented by the MFD on the TARS log as being “due to gusty winds at 4kft.” (Tab AA-8) At 1535Z, the Mishap Nose Rope Operator (MNO), who was covering the Operations Room and console for the MFD at the time, received a Lightning Watch for lightning within 10 and 20nm, valid from

1600Z to 2300Z. (Tabs F-11, R-17) According to MFD testimony, he was outside on the pad visually assessing the sky conditions and was unaware of the Lightning Watch until he reentered the Operations Room at approximately 1600Z. (Tab V-6.6) At 1600Z, the squall line was at α + 5 nm from the site. (Tab W-11) Sometime prior to 1619Z, the MFD told the MFC, who were having lunch in the break room, to expect a recovery soon. (Tab V-6.7)

At 1619Z, the MFD ordered "recovery, crew to the pad" over the radio. (Tab K-5, N-3) At 1619Z, storms from the tropical wave were developing at β nm from the site. (Tab W-12) At approximately 1621Z, the MFC requested to reposition the mishap winch truck (MWT) prior to commencing the in-haul. (Tab N-3) The reposition was needed in order to align the MWT properly, based on the current surface wind direction, for mooring of the MA. The MFC repositioned the MWT from approximately 1627Z to 1629Z. (Tab HH-7) The Red Book and 420K WTS FC Checklist both call for the parking brake to be set, chock blocks to be positioned, and outriggers to be set (4-6 inches nominal) after repositioning the winch truck. (Tabs O-3, O-24) The Mishap Winch Truck Operator (MWTO) set the parking brake, which was verified by the Mishap Close-haul 1 Operator (MCH1). (Tabs V-2.6, V-4.5) The MWT outriggers were already in place prior to the reposition. During interviews, no one on the MFC could recall positioning the chocks. (Tabs V-1.5, V-2.6, V-3.17, V-4.5, V-6.17) Photographic evidence shows the chocks ended up in the grassy area between the pad and the entrance road. (Tabs Z-6, Z-8)

At 1630Z in-haul commenced, initially at 250 ft/min, but was reduced to 100 ft/min almost immediately due to excessive tether tension. (Tabs K-5, R-16, AA-8) At 1630Z the thunderstorms were 5nm inside of β from the site. At 1637Z, the thunderstorms arrived at the site with measured surface wind gusts greater than 35 knots and winds aloft greater than 50 knots. (Tab CC-4) At this time, the MFC observed the MA's fins collapse, the MA nose over and move rapidly from the west of the site to the north of the site while descending from approximately 1,200 feet MSL to 300 feet MSL in a period of 20 to 25 seconds (Tabs V-1.4, V-2.4, V-3.11, V-4.6, V-5.5, CC-4). The MWT was then pulled backwards, rotated to the right, and pulled forward to the NNW. (Tab HH-7) Photographic evidence and testimony indicate the MWT driver side outriggers impacted a storage CONEX on the edge of the pad, bending the outriggers and tearing the outrigger wheels off. The passenger side outriggers impacted a diesel fuel trailer at the edge of the pad, followed by an embankment, bending the outriggers and tearing the outrigger wheels off. (Tabs R-7, Z-6 to Z-9) The MWT was pulled over two embankments in the grassy area between the pad and entrance road. The MWT was stopped when it impacted a third embankment near the perimeter of the site and underneath the site utility lines which are topped by a steel anti-fouling cable (Tab Z-8). The anti-fouling cable is a legacy item from previous aerostats, which had powered tethers, designed to protect site personnel in the case of a breakaway. The tether was pulled tight across the anti-fouling cable, resulting in approximately 18 feet of severe abrasion on the tether's protective jacket from the anti-fouling cable (Tabs Z-13, Z-14). Within seconds, the tether snapped at the point where it met the anti-fouling cable (Tabs Z-8, Z-9, V-3.11, V-4.7).

The breakaway occurred at approximately 16:37:57Z. (Tabs CC-5, HH-7) At 1638Z, the Mishap Site Manager (MSM), who was now in the Operations Room with the MFD, armed and commanded destruct on the Rapid Descent Device (RDD). (Tabs CC-5, R-3, V-6.19) The RDD did not activate. (Tabs R-3, GG-3) The MFD and MSM then activated the helium blowers to attempt to deflate the balloon. (Tabs R-3, V-6.19) The aerostat quickly climbed to just over 7,000 feet MSL and ruptured due to excessive pressure build-up at approximately 16:39:51Z, causing the MA, associated equipment and payload to impact the ground. (Tab CC-7) The MA's associated equipment and payload were destroyed upon impact. (Tab P-4)

e. Impact

Between approximately 1640Z and 1642Z on 16 August 2011, the MA impacted the ground at seven different sites, with the furthest being two miles from the Lajas TARS site. (Tab Z-3) All MA wreckage was recovered by ITT and local authorities with the exception of one section of aerostat fabric that remains unrecoverable in a swampy area, and a small carbon dioxide cylinder that was never found. The total cost for the destroyed MA, payload and damaged ground equipment is approximately $8,159,917.86. (Tab P-4)

There was no significant damage to private property. (Tab P-5)

Clean up costs are pending for 71 gallons of spilled diesel fuel from the Airborne Power Generation Subsystem (APGS) fuel tank. (Tab P-5)

f. Egress and Aircrew Flight Equipment

This section is not applicable for mishaps involving aerostats.

g. Search and Rescue

This section is not applicable for mishaps involving aerostats.

h. Recovery of Remains

This section is not applicable for mishaps involving aerostats.

5. MAINTENANCE

a. Forms Documentation

The accumulated MA flying hours recorded as of 0000 Zulu on 16 August was 7,286.3 hours. (Tab K-1) The APGS, serial number (S/N) C-071, had 172.3 hours remaining before its 200 hour required service milestone was reached. (Tab K-1)

A detailed review of active and historical MA Air Force Technical Order Form 95s, *Significant Historical Data* (AFTO 95), revealed no maintenance discrepancies. No mechanical or flight control anomalies existed on the MA at the time of its 15 August 2011 launch. (Tab D-4 to D-9) A thorough review of the aerostat AFTO 95s for the 90 days preceding the mishap indicated mechanical, structural and electrical systems to be fully functional and ready for flight. (Tab D-4 to D-9) The computer-based Datastream 7i (DS7i) work order records for the 90 days prior to the mishap were used to validate and confirm all form entries. No open work orders restricted the MA from flying. (Tabs U-11 to U-43)

The MA flew a total of 65 flights in the 90 days prior to the mishap. (Tab U-183 to U-185) The MA experienced three tether re-termination actions during that time. The re-termination procedure requires cutting off the old eye splice and specified lengths from the end of the tether for minimum break strength (MBS) testing by the manufacturer, and manufacturing a new tether eye splice. MBS testing is used to ensure the tether still meets minimum tension requirements. (Tab BB-9) In accordance with Operating Instruction (OI) Tether Inspection Program guidance, tether break test samples were sent to the manufacturer for testing. Aerostat operations are permitted to continue during the MBS testing process. All three tether samples met and exceeded the MBS threshold, allowing the tether to remain operational. (Tabs U-109 to U-112)

There were no maintenance discrepancies that would have prevented the MA from accomplishing Flight 270. A detailed records review revealed no recurring maintenance problems with the MA. (Tabs D-4 to D-9)

A detailed review of the active and historical mishap winch truck (MWT) AF Form 1828, *Vehicle Historical Record*, and the MWT's winch platform AFTO 95s revealed no maintenance discrepancies. No mechanical anomalies existed on the mishap winch truck/platform at the time of the 15 August 2011 launch. A thorough review of the AFTO 95 and AF Form 1828 for the 90 days preceding the mishap indicated mechanical, structural and electrical systems to be fully functional and ready for MA launch. (Tabs U-129, U-155 to U-156) An annual brake inspection was conducted on 11 July 2011 and the brakes were rated as fully functional. (Tab J-7) The DS7i work order records for the 90 days prior to the mishap were used to validate and confirm all form entries. No open work orders restricted the MA from launching. (Tabs U-11 to U-43, U-167 to U-180)

There were no MWT or winch platform maintenance discrepancies that would have prevented the MA from launch and accomplishing Flight 270. A detailed records review revealed no recurring maintenance problems with the MWT or the winch platform. (Tabs U-129 to U-136, U-155 to U-164)

b. Inspections

(1) Aerostat Preventive Maintenance Inspection (PMI)

PMIs are regularly scheduled maintenance actions performed on Air Force aircraft and equipment at prescribed intervals. The last aerostat inspections before Flight 270 were an Airborne Radio Repeater Assembly test (PMI F18-M-001), a Blower Test and Verify Operation (PMI E02-W-001), and an Aerostat Fuel Sample (PMI M04-W-001). The inspections were accomplished in accordance with applicable guidance. (Tab U-5 to U-9) At 1230Z on 15 August 2011, the MFD performed the pre-flight checklist and launched the MA to begin Flight 270. The launch was routine and uneventful. (Tab AA-4, U-184)

(2) Mishap Tether

The MA's tether, S/N 133, had initial Quality Control oversight accomplished on 24 January 2007 following its manufacture. Initial break tests exceeded minimum break strength requirements. (Tabs U-93 to U-108, U-123 to U-128) The tether arrived on site on 11 November 2009 with no discrepancies noted. Tether installation on the MWT was completed at Lajas on 19 May 2010**.**

During the 12 months prior to Flight 270 the tether experienced 17 tether re-terminations. (Tabs D-26 to D-30, U-93 to U-108, U-123 to U-128) A tether re-termination is required to create a new eye splice which allows the tether to be reconnected to the aerostat's flying lines. Some examples of re-termination reasons include but are not limited to tether breaks, repairs or cutting samples for break strength testing. Due to stress placed on the aerostat, a common reason for re-termination is repair of a neck down (observed tether area that has a noticeably reduced diameter and/or the exterior jacket has gathered forming an accordion appearance). The following spreadsheet provides additional details on the various re-terminations of the tether during the 12 months preceding the mishap.

Action	Reason	Date	W/O
Retermination	Neckdown	8/14/2011	208537
Retermination	Neckdown	7/15/2011	203258
Retermination	Jacket Break	6/11/2011	197761
Retermination	Neckdown	5/13/2011	192699
Retermination	Low Strength Test	3/19/2011	183732
Retermination	Neckdown	3/14/2011	182967
Retermination	Low Strength Test	2/18/2011	177577
Retermination	Neckdown	2/13/2011	176797
Retermination	Low Strength Test	1/23/2011	173427
Retermination	Jacket Break	1/14/2011	171564
Retermination	Jacket Break	12/9/2011	166042
Retermination	Neckdown	12/4/2011	165198
Retermination	Neckdown	11/23/2011	163542
Retermination	Neckdown	10/24/2010	158612
Retermination	Neckdown	10/21/2010	158014
Retermination	Jacket Break	9/9/2010	150812
Retermination	Neckdown	9/3/2010	149943

Table 1. 12 Month History for Tether Re-terminations.

The final four tether re-terminations were accomplished due to neckdown repairs on 13 May, 11 June, 15 July and 14 August 2011. The 13 May 2011 through 14 August 2011 tether break strength test results exceeded MBS threshold requirement. (Tab U-109 to U-112)

Based on established tether replacement considerations (i.e., inspection status, break strength, remaining length of tether), tether S/N 133 was within approved guidelines for use on Flight 270. (Tab U-109)

(3) Mishap Winch Truck

The last MWT PMIs before Flight 270 were the Winch Truck/Check Bronze Nuts (PMI M08-W-001) and Winch Truck Service Batteries (PMI E08-M-001). The inspections were accomplished in accordance with applicable guidance. (Tab U-139 to U-142)

(4) Mishap Winch Platform

The last winch platform inspection before Flight 270 was the Winch Platform/Inspect Frame for Cracks (PMI M08-Q-004). The inspection was accomplished in accordance with applicable guidance. (Tab U-165)

c. Maintenance Procedures

A detailed review of recent and historical AFTO 95s and AF Form 1828 revealed no deviations from established maintenance procedures. The DS7i records for the 90 days prior to the mishap were used to validate and confirm all form entries. (Tabs D-4 to D-9, Tabs U-123 to U-128, U-129 to U-136, U-155 to U-164)

d. Maintenance Personnel and Supervision

Aerostat maintenance was performed by properly trained and qualified personnel.

e. Fuel, Hydraulic and Oil Inspection Analysis

This section is not applicable for this mishap.

f. Unscheduled Maintenance

The AIB reviewed all maintenance activities and work orders associated with the MA, MWT, winch platform and tether since completion of the last scheduled PMI. The MA was recovered on 15 August 2011 to complete scheduled maintenance/inspections. (Tab U-184) No unscheduled maintenance occurred following last MA, MWT, tether and winch platform PMI.

6. AIRCRAFT AND AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Condition of Systems

The MA was destroyed when it ruptured in-flight and the associated equipment and payload were destroyed upon impact with the ground. (Tab P-3 to P-4) After the mishap, one section of tether was recovered at the crash site attached to the aerostat and another section remained attached to the winch truck. Both tether sections were damaged due to contact with the perimeter tether anti-fouling cable. Three sections of the tether were sent for strength testing. Two sections were taken from the winch truck tether drum, one at 100 feet and one 300 feet from the break point. The third section was from the crash site taken 100 feet from the break point. (Tab J-3)

b. Engineering Evaluations and Analyses

The three sections of tether were sent to Tension Member Technologies (TMT) Laboratories for MBS testing. Both sections taken from the winch truck storage drum exceeded the MBS threshold. The section taken from the crash site failed at 98.3% of the MBS threshold. (Tab J-3)

The MA's Rapid Descent Device (RDD) system was sent for testing. The evaluation of the RDD determined the failure was not attributable to the actions of the MFC. (Tab GG-3)

7. WEATHER

a. Forecast Weather

The Lajas TARS site receives weather forecasts from three main sources: the 612 SPTS/OWF and 25 OWS, both based at Davis-Monthan AFB AZ, and GEOMET Technologies, LLC. The product from GEOMET covering 16 August 2011 was received at 2212Z on 15 August 2011 (Tab F-5), and gave a 6-24 hour forecast indicating:

> a tropical wave moves toward the island and will pass south of the island… this will allow for the return of deep tropical moisture to the island allowing for a strong chance of scattered showers and thunderstorms by midday and through the afternoon and early evening hours… there is a moderate to high chance of redline exceedance anticipated for tomorrow.

This tropical wave would eventually form into Hurricane Irene. (Tab W-3) A Lajas TARS Discussion/Planning Weather Forecast was received at approximately 1200Z on 16 August 2011 from the 612 SPTS, valid from 1200Z-0000Z. This forecast indicated "mostly cloudy skies with showers and thunderstorms in the area today," no significant surface winds, flight level winds within Red Book limits, and possible warnings or advisories after 1500Z. (Tab F-3) The 25 OWS issued watches for lightning within 10nm and 20nm of the Lajas site at 1535Z, valid from 1600-2300Z. (Tabs F-11, R-17)

b. Observed Weather

The Lajas TARS site maintains an Hourly Weather Updates log. This weather log indicates observed conditions on the surface and aloft, including average and maximum winds. Conditions on the surface were recorded as calm winds from 0700-1400Z with Level II to Level IV rain showers to the S/SE of the site. Winds aloft from 0700-1400Z were recorded between 22 and 31 knots at 4,000 feet. No observation was recorded at 1500Z. The entry for 1600Z indicates max surface winds of 12 knots and max winds aloft (2,100 feet) of 16 knots. (Tab F-13)

The Lajas TARS site is equipped with a Doppler radar. Tabs W-9 through W-14 show the radar picture at select intervals from 1507Z through 1639Z. Select wind data from both the Hourly Weather Updates log (Tab F-13) and the Ground State of Health System (GSHS) data (Tab CC) is summarized below:

GPS UTC Time	GPS Alt (MSL)	Wind Speed (Aloft)	Wind Speed (Sfc)	Wind Dir (Sfc)
12:00	4000	27*	3*	174*
13:00	4000	27*	5*	046*
14:00	4000	24*	3*	123*
15:00		No observation recorded		
15:50:40	2119	11.8	7.1	160.3
16:00:00	2119	12.2	11.5	134.2
16:10:00	2118	13.5	15	131.4
16:15:00	2116	16.3	9.7	137.1
16:20:00	2110	20.1	11.4	140.2
16:25:00	2110	23.3	12.3	124.3
16:30:00	2099	29.2	37.5	138.4
16:35:00	1448	43.2	33.2	135.5
16:36:00	1347	45.7	16.7	128.6
16:37:00	1267	52.7	19.4	136.8
16:37:30	1132	34.8**	24.5	142.5
16:39:51	7096	64.9	33.3	136.6

** Indicates average wind speed/direction for the previous hours*

*** The wind speed aloft recording at 16 37 30 is unreliable as the MA was kiting to the NW at this time.*

Table 2. Select Wind Data.

The Doppler radar pictures and wind data indicate a tropical wave 30nm to the south of the Lajas TARS site at 1535Z, moving WNW. (Tab W-9) At 1556Z, sea breeze thunderstorms developed along the coast in the vicinity of Ponce, Puerto Rico and the tropical wave was now on a NW track with the leading edge of thunderstorms now just outside 20nm, indicating a wave speed of movement of 35kts. (Tabs W-3, W-9)

Figure 3. Doppler radar at 15:35:00Z

Figure 4: Doppler radar at 15:56:22Z

Figure 5. Doppler radar at 16:16:30Z

From 1616Z to 1637Z, the tropical wave continued to track NW towards the site, at speeds of at least 35 knots. At the same time, sea breeze thunderstorms continued to dissipate and develop to the east of the site, tracking W towards the site. (Tabs W-3, W-11 to W-13)

Figure 6. Doppler radar at 16:19:20Z

The combination of the tropical wave storm cells and sea breeze storm cells developing and dissipating rapidly created numerous outflow boundaries (the leading edge of gusty, cooler surface winds from thunderstorm downdrafts) to the E and SE of the site, with outflow speeds reaching as high as 30 knots in all directions. These numerous outflows contributed to the development of new cells. (Tab W-4)

Figure 7. Doppler radar at 16:30:00Z

At 1637Z, numerous cells from the tropical wave were overhead and the nearest sea breeze cell was 10nm to the ENE. Additionally, the outflows interacted with land, giving a large boost to upward development resulting in numerous new storms along the coast. (Tabs W-4, W-14)

Figure 8. Doppler radar at 16:37:20Z

The tropical wave direction of movement tilted more E to W than previous, which would have added slight rotation to the storms but would not likely have triggered any kind of tornadic activity. (Tab W-4) The observed surface winds of greater than 35 knots and winds aloft greater than 50 knots are a rare occurrence in Puerto Rico. According to the 14WS, both of these occur less than 0.01 percent of the time. (Tabs W-5, W-7)

c. Operations

The GEOMET forecast for 16 August 2011 indicated a strong chance for showers and thunderstorms in the area after mid-day. (Tabs F-6) Winds aloft were steady at 24-27 knots from 1200Z to 1400Z, but began gusting sometime before 1500Z, prompting the MFD to order an in-haul to 2,100 feet (MOA). (Tabs F-13, AA-8) At 1535Z, the site received the Lightning

Watches, valid after 1600Z, and by 1600Z the tropical wave storms were 20nm from the site and tracking towards the site at 35 knots. (Tabs F-11, W-11) At 1619Z, the MFD ordered the recovery. (Tab N-3) At 1637Z, while the MFC was still conducting recovery operations, numerous cells and/or outflows arrived overhead triggering the mishap sequence. (Tab W-14)

8. CREW QUALIFICATIONS

The mishap site manager (MSM) had been with the TARS program for 17 years, with 15 years at the Lajas TARS site. He had experience in all flight crew positions with the exception of Remote Winch Operator. He was also certified as a flight director. (Tabs V-7.1 to V-7.2, II-30)

The mishap flight director (MFD) began with the TARS program in January 2011. He was certified as a solo flight director in May 2011. He was not certified in any other flight crew positions. (Tab V-6.2) Review of MFD training records identified a Flight Director training start date of 24 January 2011. The exact training completion/certification date cannot be verified by MFD training records. (Tab II-30)

Training records indicate the mishap flight crew (MFC) for Flight 270 was qualified and proficient in their assigned flight crew duties. (Tab II-30) The MFC had a wide breadth of experience, having held previous trade and flight crew positions, and together had a combined 60 years of TARS experience. (Tabs V1.2, V-2.2, V-3.3, V-4.2, V-5.2, V-6.2, V-7.2)

9. MEDICAL

a. Qualifications

This section is not relevant for TARS flight crew members.

b. Health

There were no known health issues for the MSM, MFD or MFC.

c. Pathology

In accordance with the TARS PWS, the MFC were tested for the presence of drugs or alcohol. Drug and alcohol tests were negative. (Tab JJ-3)

d. Lifestyle

No lifestyle factors were found to be relevant to this mishap.

e. Crew Rest and Crew Duty Time

This section is not relevant for TARS flight crew members.

10. OPERATIONS AND SUPERVISION

a. Operations

Operations tempo was investigated and found not to be a factor in this mishap.

The MFC had anywhere from 8 months to 17 years of experience in the TARS program, with all but two having over ten years experience. (Tabs V-1.2, V-2.2, V-3.3, V-4.2, V-5.2, V-6.2, V-7.2) Flight crew experience was not a factor in the mishap.

b. Supervision

The Lajas TARS site operations supervision consists of each of the FDs reporting directly to the site manager (SM). The SM reports directly to the DPM. The FD is responsible for all decisions related to aerostat flying operations. The MFD had seven months experience in the TARS program and was certified three months prior to the mishap in May 2011. The MFD was not certified in any other flight crew positions. (Tabs R-11, V-6.2)

The MSM was a certified FD with approximately 17 years of experience in the TARS program and 15 years experience at the Lajas TARS site. (Tab V-7.2) The MSM was on-site at the time of the mishap. The MSM did not become involved in the direct supervision of operations until after the recovery commenced and he heard radio communications indicating difficulty with the recovery. (Tabs R-3, V-7.8)

11. HUMAN FACTORS ANALYSIS

The Department of Defense Human Factors Analysis and Classification System (DoD-HFACS) is a systematic and comprehensive tool that is comprised of a list of potential human factors that can be contributory or causal to a mishap. The DoD-HFACS classification taxonomy is contained in AFI 91-204, *Safety Investigations and Reports*, Attachment 5 (24 September 2008), and describes four main tiers of human factors including Acts, Pre-Conditions, Supervision, and Organizational Influences, which are briefly described below:

> *Acts* are those factors that are most closely tied to the mishap, and can be described as active failures or actions committed by the operator that result in human error or unsafe situation.
>
> *Preconditions* are factors in a mishap if active and/or latent preconditions such as conditions of the operators, environmental or personnel factors affect practices, conditions or actions of individuals and result in human error or an unsafe situation.
>
> *Supervision* is a factor in a mishap if the methods, decisions, or policies of the supervisory chain of command directly affect practices, conditions, or actions of individuals and result in human error or an unsafe situation.

Organizational Influences are factors in a mishap if the communications, actions, omissions or policies of upper-level management directly or indirectly affect supervisory practices, conditions or actions of the operator(s) and result in system failure, human error or an unsafe situation.

Three human factors were identified as potential factors in this mishap:

a. AE102 Checklist Error

Checklist Error is a factor when the individual, either through an act of commission or omission makes a checklist error or fails to run an appropriate checklist and this failure results in an unsafe situation.

The Red Book and 420K WTS Checklists require that chock blocks be set during the recovery of the aerostat. (Tabs O-3, O-24) None of the members of the Mishap Crew were able to recall setting the chocks during the attempted recovery. (Tabs V-1.5, V-2.6, V-3.17, V-4.5, V-5.8) After the mishap, the chocks were discovered in the grassy area to the northwest of the recovery pad. (Tab Z-8) Additionally, a review of the mishap videos did not reveal the Mishap Crew placing the chocks. The crew did not catch the checklist error through cross-monitoring each other's performance. (Tabs V-1.5, V-2.6, V-3.17, V-4.5, V-5.8, V-6.17, N-3) Placing the chocks would have increased the force necessary to move the winch truck and reduced the probability of the winch truck being moved by the aerostat.

b. PP101 Crew/Team Leadership

Crew/Team Leadership is a factor when the crew/team leadership techniques failed to facilitate a proper crew climate, to include establishing and maintaining an accurate and shared understanding of the evolving mission and plan on the part of all crew or team members.

The MFD did not communicate effectively with the MFC before attempting recovery. A mission briefing was not conducted. (Tab V-6.11) Instead, the MFD briefed the crew on the possibility of a recovery while the crew ate lunch in the break room. (Tab V-6.7) MCH2 indicated that she only heard the recovery directive over the public address speakers, and she was unaware of the approaching weather. (Tab V-1.3) MCH1 and MRO also had no recollection of being warned of approaching storms. (Tabs V-2.3, V-3.9) Only the MNO, who had been working in the control room prior to recovery, specifically remembered being aware of the weather prior to heading to the pad. (Tab V-4.3) Positions were not assigned by the MFD. Instead, the crew decided positions amongst themselves on their way to the pad. (Tab V-6.11-12) Red Book guidance states that crew positions are to be assigned during the change-over briefing. (Tab O-15) The MFC also decided to bring out MCHT to train her as a close-haul operator. (Tabs V-3.12-13, V-5.4, V-6.13)

After inhaul began, MFD began telling the crew to hurry up with their repositioning of the winch truck or they would "get wet." (Tab V-6.11) He also told them to stop conducting training. (Tab V-6.13, Tab N-3)

There was approximately a 7 minute delay between the MFD ordering recovery at 1619Z and the MFC beginning to reposition the MWT. (Tab HH-4) Approximately 10 minutes had elapsed from the recovery order by the time the MWT was repositioned. (Tab HH-4) The delay between briefing the crew in the break room and ordering recovery, along with the omission of any mention of approaching weather, did not convey a sense of urgency to the MFC. The MFD's failure to create a shared understanding of the weather situation led to the crew's lack of urgency during the initial stages of the recovery attempt.

c. OP003 Procedural Guidance/Publications

Procedural Guidance/Publications is a factor when written direction, checklists, graphic depictions, tables, charts or other published guidance is inadequate, misleading or inappropriate and this creates an unsafe situation.

The Red Book did not provide the MFD and MFC with sufficient guidance on how to handle the weather event they experienced on 16 August 2011. Red Book guidance does not require a MFD to recover an aerostat until thunderstorms/lightning and moderate to heavy rains (Level III) are within β nm of the site. (Tab O-9) This guidance does not take into account the speed of an approaching storm. Crew members estimated that a recovery from the MOA can take between 20-45 minutes by the time they can reposition the winch truck one or more times, inhaul, and moor the aerostat. (Tabs V-1.2, V-3.4, V-5.3-4) Given the length of time required for a recovery, an aerostat recovery should begin well before an approaching storm comes within β nm. MFD's actions were in accordance with this guidance; nevertheless, the MFC did not have adequate time to safely recover the aerostat before the arrival of dangerous weather.

Flight Directors are provided with more detailed guidance during their operational refresher training. (Tab DD) This training instructs flight directors to compute the speed of an approaching storm and factor in the time required for inhaul from flying altitude. While this training takes into account the need to slow in-haul as the aerostat gets closer to the pad, it does not account for time required to reposition the winch truck. While better developed than Red Book guidance, the method suggested in this training has not been incorporated into formal guidance. The MFD did not document any attempt to compute the speed of the approaching storms. The log they use to report weather conditions only requires updates on an hourly basis. No entry was made at 1500Z. (Tab F-13) Based on the MFD's testimony, he left a qualified T&C operator (MNO) to monitor the console and spent much of his time outside assessing the weather and would not have seen the initial Doppler radar indications of storms tracking towards the site. (Tabs V-6.6) This indicates that he could not have computed the speed of the storm until 1600Z at the earliest.

The Red Book does not provide guidance on how rules for dealing with high wind speeds are to be read in conjunction with rules for recovering due to thunderstorms. Specifically, Red Book guidance provides that the aerostat should only be recovered in emergency situations when surface winds exceed Ψ knots. (Tab O-7) Emergency situations are not defined. It is not stated whether a thunderstorm in close proximity constitutes an emergency situation. Finally, the Red Book does not state whether the aerostat should be recovered when winds aloft exceed red line conditions. Winds aloft at the site exceeded red line conditions during the breakaway. (Tab CC-6)

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Primary Operations Directives and Publications

(1) CDRL A001 - OI TARS FLIGHT OPERATIONS RED BOOK, Revision 4, 16 February 2011 (Tab O1)
(2) 420K Winch Truck System Flight Crew Check List, Revision 1, 13 August 2010 (Tab O2)

b. Maintenance Directives and Publications

(1) CDRL A001 - OI Tether Inspection Program, Revision 5, 17 December 2009 (Tab BB-9)

c. Other Guidance and Permissions

(1) Air Force Instruction 51-503, *Aerospace Accident Investigations*, 26 May 2010
(2) Air Force Instruction 91-204, *Safety Investigations and Reports*, 24 September 2008, DOD HFACS
(3) Memorandum For Accident Investigation Board, dated 13 Oct 11 (Tab EE-3)

d. Known or Suspected Deviations from Directives or Publications

Two deviations from 420K Winch Truck System Crew Check List and Red Book requirements were identified. The MFC did not set the chock blocks as discussed in Section 11(a) above. Additionally, crew positions were not assigned at the change-over briefing as discussed in Section 11(b) above.

13. NEWS MEDIA INVOLVEMENT

The aerostat mishap was a major story in the local Puerto Rico news media. The mishap received coverage from both TV and newspaper outlets. There is also non-government video footage of the aerostat wreckage on YouTube.com. Additionally, Lajas has been a hot-spot for UFO enthusiasts. UFO sightings in Lajas are frequently reported on UFO enthusiast web sites. Local government has only encouraged this speculation in hopes of spurring tourism, with the area immediately surrounding the aerostat site being dubbed the “UFO Capital of Puerto Rico.” The highway signs on PR-303 are labeled “Ruta Extraterrestre” and have a drawing of a flying saucer. News stories featuring UFO enthusiasts have attempted to connect the mishap to UFO activity. They claim to have spoken to witnesses who saw a ball or beam of fire from the sky attack the aerostat.

Figure 10. "Extra-Terrestrial Highway" Sign in Lajas, PR.

14. ADDITIONAL AREAS OF CONCERN

a. Flight Director Experience

Flight Director experience is an additional area of concern. A TARS flight director is responsible for the operation of an eight million dollar system that forms part of a strategic capability. He is also responsible for the leadership and safety of a six person flight crew. The policies and programs in place to hire, train and certify a flight director for solo operations are not commensurate with the level of responsibility inherent in the position and do not set flight directors up for success. While it takes two years of training to qualify a rated officer in his primary Mission Design Series (MDS), it only takes four months of academics and training to certify a flight director for unsupervised operations in the TARS system. (Tabs R-10, G-1.7, V-6.2) Additionally, flight directors are not required to be certified in any other flight crew positions prior to achieving certification. (Tabs R-11, V-6.2) The short duration of training and direct supervision appears insufficient to give a new FD the experience (flight operations, flight crew positions, weather, emergencies, etc.) and seasoning required to expertly lead a flight crew and assume responsibility for a United States strategic capability.

b. Red Book Thunderstorm Guidance and Flight Director Refresher Training

Thunderstorm avoidance practices appear to be more art than science and are an additional area of concern. Red Book guidance for approaching thunderstorms is written for the best case, not requiring a recovery until storms are within β nm and tracking towards the site. (Tab O-9) The speed of the storm is not taken into account and there is no safety margin discussed. FD refresher training included a better developed method for calculating the recovery decision. (Tab DD-3) Neither the Red Book nor FD refresher training take into account the possibility of WT repositioning or the need to get the flight crew safely indoors well prior to the arrival of hazards such as lightning, hail, and heavy rains. From testimony, it appears that FDs are given the leeway to take a more aggressive or conservative approach as they see fit. (Tab V-6.14, V-7.6 to V-7.7) This results in disparate techniques amongst flight directors that do not uniformly protect the safety of the flight crew and an eight million dollar system.

c. Checklist Discipline

Checklist discipline is an additional area of concern. The 420K WTS FC Checklist states the oncoming FD will assign launch and recovery crew positions as part of the change-over briefing. (Tab BB-8) It was clear from witness testimony that this did not consistently happen, and did not happen on the day of the mishap. Some witnesses stated that the flight crew themselves determine which positions they will work, sometimes waiting as late as reporting to the pad for a recovery to do so. (Tabs V-3.5 to V-3.6, V-5.4, V-6.12, V-7.5) In addition, documentation on the change-over reports for 15 and 16 August 2011 was inconsistent and incomplete. Specifically, the change-over report for the oncoming MFC and MFD did not include any documentation of forecast weather, while the previous change-over report did document the forecast weather. (Tabs D-12, D-13) These practices are not in compliance with the 420K Winch Truck Systems Checklist, do not create a shared mental understanding of the mission between the FC and the FD, do not reinforce the leadership role of the flight director, and create unnecessary and avoidable confusion and delays in the execution of launch and recovery operations.

d. Winch Truck Chock Size and Positioning

The size and positioning of the winch truck chocks in use at the Lajas TARS site are an additional area of concern. The chocks appear to be too small for the size of the winch truck tires. The chocks are approximately 5 inches high, 10 inches wide at the base and 10 inches long, while the winch truck tires are approximately 4 feet tall. (Tabs Z-11, Z-12) The tread depth on the winch truck tires is also significant (approximately 0.5 to 1 in) and could negate some of the height of the chocks (just 5 in) depending on positioning (Tab Z-12). Additionally, the 420K Winch Truck System Flight Crew Checklist for Launch requires the chocks to be positioned “ahead of wheel 1 and 3 on the driver’s side and behind wheel 2 and 4 on the passenger’s side.” (Tab BB-4) While this may have provided additional protection against forward and backward movement of the truck, it did not provide any additional protection against rotation of the truck.

e. Weather Forecasts and Weather Assessment

Inconsistent and infrequent weather forecasts and flight director weather assessment are additional areas of concern. The Lajas TARS site receives weather support from three different organizations: the 612 SPTS/OWF, 25 OWS, and GEOMET. Site forecasts are provided by GEOMET and the 612 SPTS/OWF; however, documentation and testimony indicate that these forecasts do not arrive consistently and at uniform times each day. (Tabs F-5 to F-8, V-6) While 612 SPTS/OWF is the primary USAF source for weather support, GEOMET forecasts appear to be the most relied on source of forecasts for the Lajas TARS site. The GEOMET forecasts arrive just once per day sometime in the afternoon or evening. The most current GEOMET forecast at the time of the mishap was over 18 hours old, and a new GEOMET forecast was received 25 minutes after the mishap. While the 612 SPTS/OWF forecast was received just over four hours prior to the mishap, it was not tailored to TARS operations like the GEOMET forecast.

For real time weather support, the site relies on watches, warnings, and advisories from the 25 OWS by phone or e-mail. (Tab V-6) At 1502Z, MFD ordered a recovery based on concern over the gusty winds. (Tab AA-8) Based on the MFD's testimony, he left a qualified T&C operator (MNO) to monitor the console from 1535Z to 1600Z. (Tab V-6.6) The MFD spent much of this time outside assessing the weather and would not have seen the initial Doppler radar indications of storms tracking towards the site. (Tabs V-6.6) The MFD's practices on the day of the mishap indicated he relied more on local observations than on information from outside agencies. (Tabs R-12, R-15, R-17) During the time the MFD was outside, the tropical wave storms shifted from an E to W track to a SE to NW track and moved from 30 nm to 20 nm from the site. (Tabs W-9, W-11) The MFD may have observed this shift using the on-site Doppler radar had he been in the Operations Room when it occurred, integrating his local observations with the professional support of a qualified AF weather forecaster using state and national products.

13 December 2011

BRENDAN D. O'BRIEN, Lt Col, USAF
President, Accident Investigation Board

STATEMENT OF OPINION
TARS T/N 4222 ACCIDENT
16 August 2011

Under 10 U.S.C. § 2254(d), any opinion of the accident investigators as to the cause of, or the factors contributing to, the accident set forth in the accident investigation report, if any, may not be considered as evidence in any civil or criminal proceeding arising from the accident, nor may such information be considered an admission of liability of the United States or by any person referred to in those conclusions or statements.

1. OPINION SUMMARY:

I find by clear and convincing evidence that the cause of the mishap was the late decision to recover the Mishap Aerostat (MA). This decision, while in compliance with Flight Operations Red Book (Red Book) guidance, was made at 1619Z giving only 18 minutes to recover and moor the MA from the minimum operating altitude (MOA) prior to the 1637Z arrival of strong winds that triggered the mishap sequence. Additionally, I find by a preponderance of evidence that the winch truck chock blocks were not positioned in accordance with the Red Book and the 420K Winch Truck Systems Checklist (420K WTS Checklist), which substantially contributed to the mishap.

On the morning of 16 August 2011, a tropical wave that would eventually form into Hurricane Irene was passing approximately 30nm south of the Lajas Tethered Aerostat Radar System (TARS) site. This tropical wave was covered in the GEOMET forecast received on 15 August 2011 at 2212Z with an associated forecast for "a strong chance of scattered showers and thunderstorms by mid-day" and "a moderate to high chance of redline exceedance anticipated for tomorrow."

At approximately 1200Z, another weather forecast product was received from the 612th Support Squadron Operations Weather Flight (612 SPTS/OWF) which indicated "showers and thunderstorms in the area today" and the possibility for warnings and advisories after 1500Z. This product did not indicate the possibility for strong winds.

At 1512Z the MFD conducted an in-haul "due to gusty winds at 4kft" to the MOA of 2,100 feet MSL. At 1535Z, a Lightning Watch for lightning within 10 and 20nm, valid from 1600Z to 2300Z, was received by the Mishap Nose Rope Operator (MNO). The MFD was outside taking visual observations of sky conditions and was unaware of the Lightning Watch until he reentered the Operations Room at approximately 1600Z. At 1600Z, the tropical wave thunderstorms were at β+10 nm from the site, approaching at a speed that could put them at the site in as little as 25 minutes. (β is the distance from the site for approaching thunderstorms at which the Red Book requires recovery of the aerostat) At some point between 1600Z and 1619Z, the MFD told the MFC to expect a recovery soon.

At 1619Z, with the nearest thunderstorm at β nm from the site, the MFD ordered the MFC to the pad for recovery. The MFD did not tell the MFC about the approaching storms. The MFD did not assign flight crew positions, allowing the MRO to assign the positions once arriving at the pad. At approximately 1621Z, the MFC requested to reposition the mishap winch truck (MWT) to align it properly for MA mooring based on the new surface wind direction, prior to commencing the in-haul. The MFC repositioned the MWT from approximately 1626Z to 1629Z. The winch truck chock blocks were not put into place in accordance with the Red Book and 420K WTS Flight Crew Checklist.

At 1630Z in-haul commenced, initially at 250 ft/min, but was reduced to 100 ft/min almost immediately due to excessive tether tension. At 1630Z the nearest thunderstorm was β-5nm from the site. At 1637Z, thunderstorms arrived at the site with measured surface winds gusting over 35 knots and winds aloft gusting over 50 knots. At this time, the MFC observed the MA fins collapse, the MA nose over, move rapidly from the west to the north and descended from 1,200 to 300 feet MSL, all in a period of about 20 to 25 seconds. The MWT was then pulled backwards, rotated to the right, and pulled NNW off of the pad, impacting a storage CONEX, fuel trailer, and several embankments, damaging the MWT. The MWT came to a stop against an embankment at the perimeter of the site. The tether was pulled tight across the anti-fouling cable at the perimeter of the site, resulting in severe abrasion on the tether's protective jacket. Within seconds, the tether snapped at the point where it met the anti-fouling cable and the breakaway occurred. The MA climbed to over 7,000 feet MSL and ruptured.

2. DISCUSSION OF OPINION:

a. Cause

Despite the MFD's relatively short experience, the infrequent and inconsistent weather forecast products available, and the lack of a documented weather briefing from the previous FD, the MFD had sufficient real-time weather information and reach-back forecaster support available on 16 August 2011 to assess the speed and track of the storms. While the MFD did comply with Red Book guidance to recover the MA before thunderstorms are inside of β nm, he was late to recognize the speed of the approaching storms. Based on testimony from several of the MFC, the average time to recover and moor an aerostat from the MOA of 2,100 feet MSL would be from 20 to 45 minutes. The best case of 20 minutes does not include any additional time for flight crew assignments, repositioning of the winch truck, or reducing the in-haul rate due to excessive tether tension. In this mishap, the MFC did not share the MFD's sense of urgency, flight crew assignments had not yet been assigned, a reposition of the MWT was required, and the in-haul rate was reduced almost immediately due to tether tension. Therefore, an amount of time somewhat greater than 20 minutes was needed to recover and moor the MA. The decision to recover the MA was made only 18 minutes prior to the arrival of the thunderstorms. Even under ideal conditions with an experienced flight crew exhibiting a shared sense of urgency, 18 minutes would not have been enough time to reposition the MWT, in-haul the MA, moor the MA and safely evacuate the MFC from the pad.

b. Substantially Contributing Factor

It is clear from testimony, video, and photographic evidence that the MWT chock blocks were not installed after the MWT was repositioned. While the force exerted on the MWT by the MA's tether may have been enough to overcome the additional rolling resistance offered by the chock blocks, and while this board had concern over the small size and positioning of the chocks, it is more likely than not that the truck would not have moved if the chocks had been installed. While this would have prevented the damage to the MWT, it cannot be determined with certainty if the tether would have held and the breakaway been prevented if the MWT was fixed in place, or if the MA would not have otherwise been destroyed due to ground impact or rupture.

3. CONCLUSION

I find by clear and convincing evidence the cause of this mishap was the late decision to recover the mishap aerostat. I have also determined that a preponderance of the evidence shows that the winch truck chock blocks were not positioned in accordance with the Flight Operations Red Book and 420K Winch Truck Systems Checklist, which substantially contributed to the mishap.

13 December 2011

BRENDAN D. O'BRIEN, Lt Col, USAF
President, Accident Investigation Board