UNITED STATES AIR FORCE AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT

C-130H3, T/N 93-1458

156TH AIRLIFT SQUADRON
145TH AIRLIFT WING
NORTH CAROLINA AIR NATIONAL GUARD
CHARLOTTE, NORTH CAROLINA

LOCATION: EDGEMONT, SOUTH DAKOTA

DATE OF ACCIDENT: 1 JULY 2012

BOARD PRESIDENT: BRIG GEN RANDALL C. GUTHRIE

CONDUCTED IAW AIR FORCE INSTRUCTION 51-503

EXECUTIVE SUMMARY

AIRCRAFT ACCIDENT INVESTIGATION
C-130H3, T/N 93-1458
EDGEMONT, SOUTH DAKOTA
1 JULY 2012

On 1 July 2012, at approximately 1738 Local time, a C-130H3, Tail Number 93-1458, assigned to the 145th Airlift Wing, North Carolina Air National Guard, Charlotte Douglas International Airport (KCLT), Charlotte, North Carolina, crashed on public land managed by the United States Forest Service (USFS), while conducting wildland firefighting operations near Edgemont, South Dakota.

At the time of the mishap all members of the Mishap Crew (MC) were assigned or attached to the 156th Airlift Squadron, based at KCLT. The Mishap Crew (MC) consisted of Mishap Pilot 1 (MP1), Mishap Pilot 2 (MP2), Mishap Navigator (MN), Mishap Flight Engineer (ME), Mishap Loadmaster 1 (ML1) and Mishap Loadmaster 2 (ML2). For the mishap sortie, MP1 was the aircraft commander and pilot flying in the left seat. MP2 was in the right seat as the instructor pilot. MN occupied the navigator station on the right side of the flight deck behind MP2. ME was seated in the flight engineer seat located between MP1 and MP2, immediately aft of the center flight console. ML1 and ML2 were seated on the Modular Airborne Fire Fighting System (MAFFS) unit, near the right paratroop door. ML1 occupied the aft MAFFS control station seat and ML2 occupied the forward MAFFS observer station seat.

MP1, MP2, MN and ME died in the mishap. ML1 and ML2 survived the mishap, but suffered significant injuries. The mishap aircraft (MA) and a USFS-owned MAFFS unit were destroyed. The monetary loss is valued at $43,453,295, which includes an estimated $150,000 in post aircraft removal and site environmental cleanup costs. There were no additional fatalities, injuries or damage to other government or civilian property.

The Accident Investigation Board (AIB) president found by clear and convincing evidence the cause of the mishap was MP1, MP2, MN and ME’s inadequate assessment of operational conditions, resulting in the MA impacting the ground after flying into a microburst. Additionally, the AIB president found by the preponderance of evidence, the failure of the White Draw Fire Lead Plane aircrew and Air Attack aircrew to communicate critical operational information; and conflicting operational guidance concerning thunderstorm avoidance, substantially contributed to the mishap.

SUMMARY OF FACTS AND STATEMENT OF OPINION

AIRCRAFT ACCIDENT INVESTIGATION
C-130H3, T/N 93-1458
EDGEMONT, SOUTH DAKOTA
1 JULY 2012

TABLE OF CONTENTS

COMMONLY USED ACRONYMS AND ABBREVIATIONS

°	Degree(s)
28 OSS/OSW	28th Operations Support Squadron Weather Flight
A3	Operations Directorate
AC	Aircraft Commander
A/C	Aircraft
ACC	Air Combat Command
ADS	Aerial Delivery System
AEG	Aerospace Expeditionary Group
AETC	Air Education and Training Command
AF	Air Force
AFB	Air Force Base
AFF	Automated Flight Following
AFFS	Aerial Fire Fighting System
AFSC	Air Force Safety Center
AFI	Air Force Instruction
AFIP	Air Force Institute of Pathology
AFMES	Armed Forces Medical Examiner System
AFNORTH	Air Force Northern Command
AFRC	Air Force Reserve Command
AFTO	Air Force Technical Order
AFWA	Air Force Weather Agency
AGR	Active Duty Guard and Reserve
AGL	Above Ground Level
AIB	Aircraft Investigation Board
AIB PRES	AIB President
AIB LA	AIB Legal Advisor
AIB PILOT	AIB Pilot Member
AMC	Air Mobility Command
AMLO	Assistant MAFFS Liaison Officer
AMS	Academy of Military Science
AOD	Air Operations Branch Director
AODT	Air Operations Director Trainee
ANG	Air National Guard
ARMS	Aircrew Resource Management System
AS	Airlift Squadron
ASM	Aerial Supervision Module
ASOS	Automated Surface Observation System
ATA	Airlift Tanker Association
ATC	Air Traffic Control
ATCO	Air Tanker Control Officer
ATGS	Air Tactical Group Supervisor
ATP	Air Tactical Pilot
ATS	Air Tactical Supervisor
ATTC	Advanced Tactics Training Course
AW	Airlift Wing
AWADS	Adverse Weather Aerial Delivery
BIA	Bureau of Indian Affairs
BLM	U.S. Bureau of Land Management
CANX	Cancellation
Capt	Captain
CB	Center of Balance
CC	Commander
CDC	Center for Disease Control
CO	Carbon Monoxide
Col	Colonel
CP	Copilot
CSMU	Crash Survivable Memory Unit
CAP	Civil Air Patrol
CG	Center of Gravity
CRM	Crew Resource Management
CS	Concurrent Servicing
CSO	Combat System Officer
CSS	Concurrent Servicing Supervisor
CVR	Cockpit Voice Recorder
DC	Direct Current
DFDR	Digital Flight Data Recorder
DME	Distance Measuring Equipment
DO	Director of Operations
DoD	Department of Defense
DoD-HFACS	DoD Human Factors and Classification System
DOI	U.S. Department of the Interior
DZ	Drop Zone
EAS	Expeditionary Airlift Squadron
ECO	Electronic Combat Officer
E-dump	Emergency Dump
EDT	Eastern Daylight Time
ELT	Emergency Locator Transmitter
EMS	Emergency Management System
EP	Emergency Procedures
ER	Exceptional Release
EST	Eastern Standard Time
FAA	Federal Aviation Administration
FCIF	Flight Crew Information File
FDAU	Flight Data Acquisition Unit
FE	Flight Engineer
FEF	Flight Evaluation Folder
FOIA	Freedom of Information Act
FPM	Feet Per Minute
FS	Fuselage Station
FSI	Forest Service Instruction
ft	Feet, Foot
FTA	Fire Traffic Area
FTU	Formal Training Unit
FY	Fiscal Year
G081	Core Automated Maintenance System For Mobility
g	Gravitational Force
GACC	Geographical Area Coordination Center
GDSS	Global Decision Support System
GPC	Grams Per Cup
HSC	Home Station Check
HUD	Heads up Display

IAW	In Accordance With
IC	Incident Commander
ICS	Incident Command System
IFR	Instrument Flight Rules
IFS	Initial Flight Screening
IMIS	Integrated Maintenance Information System
IP	Instructor Pilot
IRC	Instrument Response Coordinator
ITV	In Transit Visibility
ISB	Interim Safety Board
ISB IO	ISB Investigating Officer
ISB IO 2	ISB Investigating Officer 2
ISB PRES	ISB President
ISO	Isochronal
JATO	Jet Assisted Takeoff
JATT	Joint Air Army Training
JeffCo	Jefferson County Airport (KBJC)
JFACC	Joint Forces Air Component Command
K	Thousand
KBJC	Rocky Mountain Regional Airport
KCAS	Knots Calibrated Airspeed
KCLT	Charlotte Douglas International Airport
KCOS	Peterson AFB, Colorado
KCYS	Cheyenne Regional Airport
KIAS	Knots Indicated Airspeed
KSA	Knowledge Skills and Aibilites
KTAS	Knots True Airspeed
kts	Knots
L	Local time
lb(s)	pound(s)
Lead B-5	Lead Bravo 5
LOA	Letter of Agreement
LM	Loadmaster
Lt Col	Lieutenant Colonel
MA	Mishap Aircraft
Maj	Major
MAJCOM	Major Command
MAFFS	Modular Airborne Fire Fighting System
MC	Mishap Crew
MDT	Mountain Daylight Time
ME	Mishap Flight Engineer
MEGP	Mission Essential Ground Personnel
MEP	Mission Essential Personnel
ML1	Mishap Loadmaster 1
ML2	Mishap Loadmaster 2
MN	Mishap Navigator
MP1	Mishap Pilot 1
MP2	Mishap Pilot 2
MS	Mishap Sortie
MSL	Mean Sea Level
Mud, Slurry	Fire Retardant
MIL-PRF	Military Performance Specification
MLO	Military Liaison Officer
MOU	Memorandum of Agreement
MX	Maintenance

NAFA	National Aviation Firefighting Academy
NAV	Navigator
NCANG	North Carolina Air National Guard
NEXRAD	Next Generation Radar
NICC	National Interagency Coordination Center
NICG	National Interagency Coordinating Group
NIFC	National Interagency Fire Center
NGB	National Guard Bureau
NM	Nautical Miles
NMAC	National Multi-Agency Coordinating Group
NMLO	National MAFFS Liaison Officer
NOTAMS	Notices to Airmen
NSSL	National Severe Storms Laboratory
NVG	Night Vision Goggles
NWCG	National Wildfire Coordinating Group
NWS	National Weather Service
OEF	Operation Enduring Freedom
OG	Operations Group
OIF	Operation Iraqi Freedom
Ops Tempo	Operations Tempo
ORM	Operational Risk Management
OSS	Operation Support Squadron
OPCON	Operational Control
PA	Public Affairs
PDM	Programmed Depot Maintenance
PHA	Physical Health Assessment
PIC	Pilot in Command
PLC	Programmable Logic Controller
P/N	Part Number
POC	Point of Contact
PR/BPO	Pre-Post Inspection
PR	Preflight Inspection
PSI	Pounds Per Square Inch
PSIG	Pounds Per Square Inch Gauge
QRC	Quick Reference Checklist
RAMCC	Regional Air Movement Control Center
RFA	Request for Assistance
RIF	Reduction in Force
ROSS	Resource Ordering and Status System
RTIC	Real Time In Cockpit
SAR	Search and Rescue
SEAT	Single Engine Air Tanker
SIB	Safety Investigation Board
SIB PRES	SIB President
SIB IO	SIB Investigating Officer
SIB PILOT	SIB Pilot Member
SIB MED	SIB Medical Member
SIB MX	SIB Maintenance Member
SIB HF	SIB Human Factors Member
SIB SCR	SIB Safety Center Representative
SIB WEATHER	SIB Weather Member
S/N	Serial Number
SOF	Special Operations Forces
TCAS	Traffic Collision Avoidance System
TCTO	Time Compliance Technical Order

TFR	Temporary Flight Restrictions
TH	Thru-Flight Inspection
TIT	Turban Inlet Temperature
T/N	Tail Number
TO	Technical Order
TOLD	Takeoff and Landing Data
TSD	Traffic Situation Display
UDM	Unit Deployment Manager
UPT	Undergraduate Pilot Training
US	United States
USAF	U.S. Air Force
USDA	United States Department of Agriculture
USFS	U.S. Forest Service
USNORTHCOM	U.S. Northern Command
VFR	Visual Flight Rules
VOCO	Verbal Order of the Commander
VVI	Vertical Velocity Indicator
WX	Weather
Z	Zulu time

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

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 3 July 2012, Lieutenant General Robert R. Allardice, Vice Commander Air Mobility Command (AMC) appointed Brigadier General Randall C. Guthrie to conduct an aircraft accident investigation of the 1 July 2012 crash of a C-130H3 aircraft, tail number (T/N) 93-1458, near Edgemont, South Dakota. The investigation occurred at Ellsworth Air Force Base (AFB), South Dakota, from 26 August 2012 through 6 October 2012. The following board members were appointed: Legal Advisor, Medical Member, Pilot Member, Maintenance Member, Flight Engineer Member, Weather Member, Loadmaster Member, Recorder and two Court Reporters (Tabs Y-3 to Y-10). A C-130 simulator functional area expert was also appointed (Tab Y-11).

b. Purpose

This is a legal investigation convened to inquire into the facts surrounding the aircraft 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

On 1 July 2012, at approximately 1738 Local time (L), a C-130H3, T/N 93-1458, assigned to the 145th Airlift Wing, North Carolina Air National Guard, Charlotte Douglas International Airport (KCLT), Charlotte, North Carolina, crashed on public land managed by the United States Forest Service (USFS), while conducting wildland firefighting operations near Edgemont, South Dakota (Tabs DD-21, DD-49, DD-50, EE-30).

At the time of the mishap all members of the Mishap Crew (MC) were assigned or attached to the 156th Airlift Squadron (AS), based at KCLT (Tab K-12). The Mishap Crew (MC) consisted of Mishap Pilot 1 (MP1), Mishap Pilot 2 (MP2), Mishap Navigator (MN), Mishap Flight Engineer (ME), Mishap Loadmaster 1 (ML1) and Mishap Loadmaster 2 (ML2) (Tab K-12). For the mishap sortie, MP1 was the aircraft commander and pilot flying in the left seat. MP2 was in the right seat as the instructor pilot. MN occupied the navigator station on the right side of the flight deck behind MP2. ME was seated in the flight engineer seat located between MP1 and MP2, immediately aft of the center flight console (Tabs K-12, EE-3 to EE-30). ML1 and ML2 were seated on the Modular Airborne Fire Fighting System (MAFFS) unit, near the right paratroop door. ML1 occupied the aft MAFFS control station seat and ML2 occupied the forward MAFFS observer station seat (Tabs V-29.15, V-34.10).

MP1, MP2, MN and ME died in the mishap (Tabs P-9, X-7). ML1 and ML2 survived the mishap, but suffered significant injuries (Tab X-9). The mishap aircraft (MA) and a USFS-owned MAFFS unit were destroyed (Tab D-3). The monetary loss is valued at $43,453,295, which includes an estimated $150,000 in post aircraft removal and site environmental cleanup costs (Tabs D-3, P-3, P-5, P-7). There were no additional fatalities, injuries or damage to other government or civilian property.

3. BACKGROUND

The MA was assigned to the 145th Airlift Wing (AW) based at KCLT (Tabs CC-11, DD-49). At the time of the mishap, all members of the MC were assigned or attached to the 156 AS (Tab K-12). The 156 AS is a component of the 145AW and the North Carolina Air National Guard (NCANG) (Tabs CC-11, CC-13).

a. Air Mobility Command

AMC is a major command headquartered at Scott AFB, Illinois. AMC provides worldwide cargo and passenger delivery, air refueling and aeromedical evacuation. The command also transports humanitarian supplies to hurricane, flood and earthquake victims both at home and around the world. AMC's mission is to provide global air mobility – right effects, right place, right time. More than 134,000 active-duty, Air National Guard (ANG), Air Force Reserve and Department of Defense (DoD) civilians make AMC's rapid global mobility operations possible (Tab CC-3).

b. Air National Guard

As provided in the United States (US) Constitution, the ANG has a federal and state mission. The federal mission is to provide a well-trained and equipped force available for prompt mobilization during national emergencies as well as supporting contingency operations. The ANG provides almost half of the US Air Force's (USAF) tactical airlift support, combat communications, aeromedical evacuations and aerial refueling. Additionally, the ANG has total responsibility for the air defense of the US (Tab CC-5).

c. North Carolina National Guard

The North Carolina National Guard is a team of citizen-Soldiers and Airmen from the Army National Guard and Air National Guard. Their mission is to provide ready forces to support federal and state requirements and to develop and participate in programs that add value to their members, families, employers and communities (Tab CC-9).

d. 145th Airlift Wing

The wartime mission of the 145 AW is to direct and support the NCANG. The 145 AW also provides world-wide humanitarian relief and airlift of supplies and personnel during emergencies or natural disasters. The 145 AW is one of four units that provide aerial firefighting capabilities using

MAFFS and trained crews in support of the United States Department of Agriculture (USDA) Forest Service wildland firefighting mission. The 145 AW operates the C-130H3 aircraft under the guidance of AMC (Tab CC-11).

e. 156th Airlift Squadron

The 156 AS is responsible for training and maintaining qualified C-130H3 aircrew members and support personnel capable of functioning in world-wide contingency operations. It provides tactical airlift, movement and delivery of personnel, equipment and supplies including aeromedical evacuation. Additionally, the 156 AS performs MAFFS wildland firefighting missions (Tab CC-13).

f. C-130 Hercules

The C-130 Hercules primarily performs the tactical portion of the AMC airlift mission. The aircraft, capable of operating from rough, dirt strips, is the prime transport for airdropping troops and equipment into hostile areas. The C-130, operating throughout the DoD, executes a wide range of operational missions in both peacetime and wartime situations. The aircraft is capable of executing diverse missions, including airlift support, Antarctic resupply, aeromedical evacuation, weather reconnaissance, aerial spray, humanitarian relief and wildland firefighting (Tab CC-15).

g. Modular Airborne Fire Fighting System

In the early 1970s, Congress established the MAFFS program to aid the USDA's firefighting mission. The initial unit consisted of a multi-pallet, five-tank design, engineered to fit inside the C-130 cargo compartment (Tab CC-19).

A new generation MAFFS unit, known as MAFFS II, attained initial operational capability in February 2009. The new system as shown in Figures 1 and 2 below, is a three-pallet, single tank platform with a paratroop door plug to accommodate the retardant dispersal assembly (Tabs CC-20, DD-24). The forward pallet contains an electronic control module and two large air compressors. The center section consists of the retardant tank and two high-pressure air tanks. The aft pallet contains the operator controls, foam distribution and hydraulic systems (Tab DD-24). The door plug, which fits into the left paratroop doorframe, allows the aircraft to drop retardant while pressurized (Tab DD-24, Figure 2).

The MAFFS unit is secured in place with aircraft dual rail locks, restraint chains and locking devices. Electrical power is supplied by the number one and four engine-driven generators, or a ground service cart when aircraft power is not available (Tab DD-24). MAFFS-equipped aircraft drop retardant from an optimal altitude of 150-200 feet (ft) above ground level (AGL). A MAFFS unit is capable of discharging a 3,000 gallon, 27,000 pound (lb), payload of retardant in less than five seconds, covering an area one-quarter of a mile long and 60 ft wide (Tab CC-19).

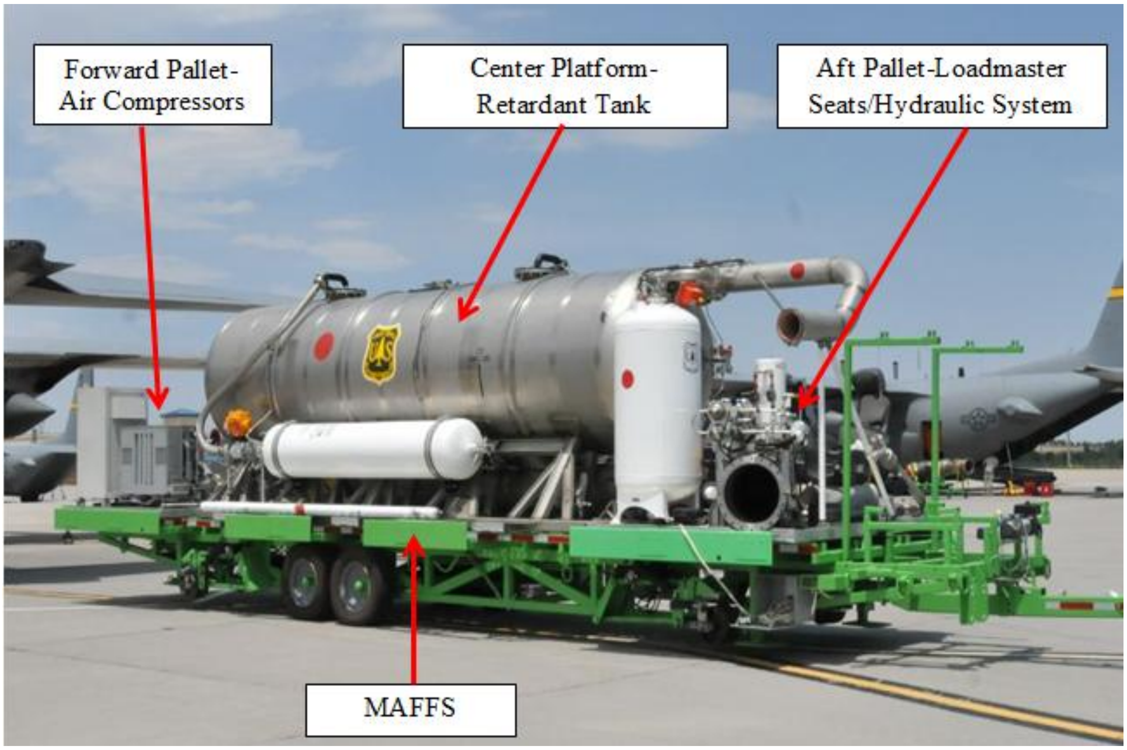

Figure 1. MAFFS Unit

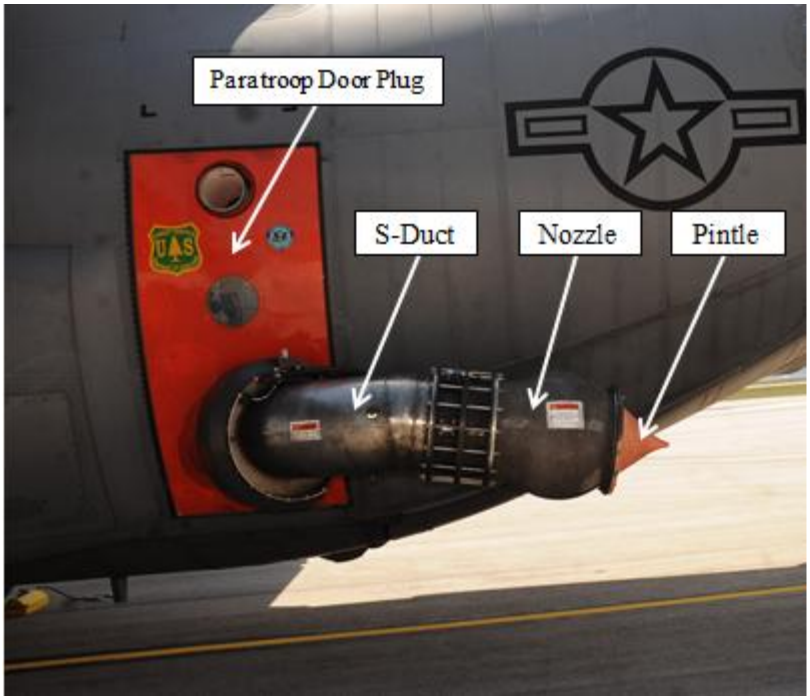

Figure 2. Left Paratroop Door Plug and Dispersal Assembly

During wildland firefighting season, the National Interagency Coordination Center in Boise, Idaho, is responsible for ascertaining the availability of commercial contract air tankers. If all commercial tanker assets are depleted, additional tankers can be activated through military channels (Tab BB-34). Once it is determined that additional support is required, the National MAFFS Liaison Officer is responsible for approving a request for assistance (RFA) (Tabs BB-34, BB-109). Activation of C-130 military aircraft is under the authority and responsibility of the DoD (Tab BB-34).

After the validation process, the RFA is forwarded to the Commander, US Northern Command (USNORTHCOM). As the supported command, USNORTHCOM requests C-130 aircraft and MAFFS qualified crews from the Commander, US Transportation Command, who in turn tasks AMC as the force provider. Through coordination with the ANG and the Air Force Reserve Command (AFRC), AMC provides the necessary personnel and equipment (Tabs BB-109, CC-11).

There are only four Air Force squadrons, with a total of eight MAFFS units, that provide MAFFS capabilities; three ANG units and one AFRC unit (Tab CC-11). On an annual rotating basis, one of the four MAFFS units staff an Air Expeditionary Group (AEG) located in Boise, Idaho (Tabs V-22.2, V-22.3). Once the RFA is validated then the AEG is activated. The AEG assumes the wing identifier of the lead unit. Then, an Expeditionary Airlift Squadron (EAS) is created. The EAS Commander is appointed based on the preponderance of forces and geographic considerations (Tab BB-112).

For the 2012 fire season, the 153 AW, Wyoming ANG was the lead unit and assembled the AEG on 23 June 2012 (Tab V-22.3). Peterson AFB, Colorado (KCOS) was the initial MAFFS base of operations (Tabs DD-15, DD-27).

Fire suppression management is under civilian control (Tabs V-38.13, V-38.17, BB-123). An Incident Commander (IC) controls each fire area and is responsible for developing the organizational structure necessary to manage the fire incident (Tab BB-123). When needed, an IC requests air tanker support, which, through a plethora of civilian coordination, will directly task a MAFFS-equipped C-130 for retardant drops on a particular fire area (Tabs V-38.13. V-38.16, BB-123). Within a Fire Traffic Area (FTA) an aircraft that is designated with Air Attack duties has a crewmember, the Air Tactical Group Supervisor, who coordinates with the IC to manage the FTA assets within the airspace above the fire area (Tabs V-38.12, V-39.4). Lead plane aircrews are responsible for the safe, effective and efficient use of air tanker operations within the FTA (Tabs V-38.11, V-38.12). A lead plane is also responsible for leading air tankers to a low-level, where fire retardant can be safely dispensed (Tab V-38.11). If needed, a lead plane's aircrew may execute Air Tactical Group Supervisor duties as well as low-level management duties (Tabs V-38.11, V-38.12, V-39.4).

4. SEQUENCE OF EVENTS

a. Mission

By 28 June 2012, all eight MAFFS-equipped C-130 aircraft were requested for activation due to increased wildland fire activity in the Rocky Mountain Region and were directed to KCOS (Tabs

DD-15, DD-27). By 29 June 2012, orders reached the 145 AW; then the 156 AS commander (156 AS/CC) assembled and approved the MC (Tabs K-12, V-18.9, V-18.10). On 30 June 2012 at 0946 Eastern Daylight Time (EDT), the MA, call sign MAFFS 7, departed home station, KCLT, and arrived at KCOS at 1216 Mountain Daylight Time (MDT) (Tabs K-11, DD-9).

b. Planning and Preflight

On 30 June 2012 at approximately 2000L, the MC entered crew rest (Tabs R-397, V-34.6). On 1 July 2012 at approximately 0800L, the MC met in their hotel lobby and drove to KCOS (Tab V-29.10). After arriving at KCOS, all participating aircrews, including the MC, attended a MAFFS mission briefing (Tab W-23). The mission briefing, conducted by the USFS and the 731 EAS Commander, consisted of safety, local and regional weather, fire outlook and Notices to Airmen (Tabs K-7, K-8, W-23). The MC rated the mission as "low" on the Operational Risk Management worksheet (Tabs K-13, K-14).

c. Summary of Accident

At 0953L, Casper Interagency Dispatch Center, Casper, Wyoming, tasked the KCOS MAFFS Operations Center to provide three MAFFS aircraft to the Arapahoe Fire burning in the Laramie Range of central Wyoming (Tab K-15). At 1045L, the MA departed KCOS and successfully dropped 2,700 gallons of retardant in support of Arapahoe Fire suppression efforts. At 1235L, the MA landed at the Rocky Mountain Regional Airport (KBJC), Broomfield, Colorado, to upload 2,505 gallons of retardant. The MA then departed KBJC, executed a second retardant drop at the Arapahoe Fire and returned to KBJC. At 1505L, the MA departed KBJC with 2,346 gallons of retardant (Tabs V-13.4, DD-11).

At 1544L, while en route for a third drop on the Arapahoe Fire, Casper Dispatch radioed the MC to divert the MA to the Highlands Fire in the Black Hills, approximately 18 miles west of Custer, South Dakota (Tab DD-59). Casper Dispatch further advised that their lead aircraft would arrive at the fire after the MA so they would need to loiter (Tabs EE-38, EE-39). At this time, the MA was approximately 40 nautical miles (NM) northwest of Cheyenne Regional Airport (KCYS), Cheyenne, Wyoming (Tab DD-59). Due to the added distance to the Highlands Fire, the distance from a tanker base, and requirement to loiter, the MC diverted to KCYS for additional fuel (Tab DD-59). At 1608L, the MA landed at KCYS, fueled and was airborne again at 1636L (Tab DD-59).

At approximately 1650L, Great Plains Dispatch, Rapid City, South Dakota, diverted a lead plane, call sign Lead Bravo 5 (Lead B-5), from the Highlands Fire to the White Draw Fire (Tab EE-39). Lead B-5, a Beechcraft King Air C90 twin-engine turboprop aircraft, was operated by Air Tactical Pilot (ATP) and Air Tactical Supervisor (ATS) (Tabs V-26.10, V-40.2). ATP, a USFS employee, was the pilot flying in the left seat (Tab V-40.2). ATS, a Suemez Tribal Council employee, was the initial White Draw Fire air tactical group supervisor and was seated in the right seat (Tabs R-23, V-40.2). At that time, the White Draw Fire, located approximately five miles northeast of Edgemont, South Dakota, had been actively burning for three days and was 10 percent contained (Tab DD-21). The fire had consumed nearly 3,000 acres of grassland and timber (Tab DD-21). Steep terrain and forecast winds combined to create a high risk that the fire would rapidly spread and endanger nearby structures and utilities (Tab DD-43).

After MN made contact, Lead B-5 directed the MN to divert the MA to the White Draw Fire, which was approximately 27 miles south of the Highlands Fire (Tabs DD-59, EE-39). At approximately 1658L, MN contacted Lead B-5 and received updated fire area coordinates and radio frequency information (Tabs EE-39, EE-40). At 1706L, as the MA approached the White Draw FTA from the southwest, the MC agreed to take a wide berth around the thunderstorm to the southeast of the fire (Tab EE-3).

At approximately 1721L, the MA entered the White Draw FTA and both MP2 and MP1 made visual contact with Lead B-5 (Tab EE-15). At 1728L, a third aircraft (Air Attack), a Beechcraft King Air C90 twin-engine turboprop, entered the White Draw FTA while descending to 7,000 ft Mean Sea Level (MSL) due to "more than moderate turbulence" (Tabs R-136, V-43.4, EE-18, EE-20). Piloting the Air Attack aircraft from the left seat was Air Attack 3 (AA3), and in the right seat was Air Tactical Group Supervisor (ATGS) (Tabs V-7.2, V-43.4). Both were employed by the State of South Dakota (Tabs V-7.2, V-43.2). Upon arrival at the FTA, ATGS assumed the duties of the White Draw Fire Air Tactical Group Supervisor (Tab V-40.18). ATGS duties were to manage air and ground firefighting assets in and around the FTA (Tab V-39.4).

At 1729L, Lead B-5 executed a "show me" run while the MC observed from a higher altitude (Tabs EE-20). A show me run is a standard maneuver executed by the lead plane in preparation for a retardant drop (Tabs V-40.8, DD-57). The show me run aids MAFFS aircrew in identifying the retardant drop path and potential hazards, as well as, establish an escape route (Tabs R-212, V-40.8, DD-57).

At 1731L, after observing the show me run, MP1 gave a One Minute Advisory in preparation for the first of two planned drops on the White Draw Fire (Tab EE-22). One minute later, MP1 positioned the MA approximately one-half mile behind Lead B-5 in a loose formation while the MC verbally reviewed retardant drop and escape parameters (Tabs V-40.9, EE-23).

From 1732L to 1733L, the MC configured and slowed the MA to drop parameters of flaps 100 percent and 120 knots indicated airspeed (KIAS) (Tabs EE-23, EE-24). Approaching the initial drop, MP1 had difficulty maintaining desired airspeed despite maximum power and the MA slowed to approximately 110 KIAS (Tabs EE-23, EE-24). MP1 directed MP2 to reposition the flaps from 100 percent to 70 percent. MP2 immediately repositioned the flaps to 70 percent and the MC made no additional comments regarding low airspeed during the drop. The MC successfully completed the first drop precisely on target and repositioned the flaps to 50 percent during the escape maneuver (Tab EE-24).

While positioning for the second and final drop, the MC critiqued the first drop and MP1 decided the final drop would be accomplished with 70 percent flaps (Tabs EE-25, EE-27). At 17:37:41L, ME commented on an increase in surface winds and fire growth (Tab EE-29). By 17:37:48L, the MA had descended to the assigned altitude of 4,500 ft MSL, and MP2 verbalized flaps were positioned to 70 percent, in preparation for the final drop (Tabs M-3, M-4, EE-29).

Unbeknownst to the MC, at about this time, the crew of Air Attack again experienced severe turbulence (Tab R-136). Air Attack was approximately one mile from the MA and at an altitude of approximately 7,000 ft MSL (Tabs V-7.9, DD-59).

At this point, Lead B-5 hit a “bad sinker”, meaning the bottom dropped out from underneath the aircraft; this caused the airplane to rapidly lose altitude and airspeed (Tabs V-40.9, V-40.10, V-40.21). At 17:38:00L, MP2 verbalized seeing Lead B-5 get “backed up” (Tab EE-29). ATP struggled to maintain control of Lead B-5, at one point coming within 10 ft of the ground (Tabs R-85, V-40.9, V-40.10, V-40.21). At 17:38:02L, ATP radioed to the MC, “I got to go around.” A call for a go around is most commonly heard regarding misalignments for drops rather than urgent situations (Tabs V-21.6, V-23.7, V-40.17). One second later, MP2 stated, “Yeah. Let's go around, out of this.” At 17:38:12L, MP2 instructed MP1 to “Keep going. Get us some” (Tab EE-29).

Thirteen seconds after announcing the go-around, ATP radioed the MC to “Dump your load when you can” (Tab EE-29). Three seconds later, MP1 called “E-dump, e-dump” (Tab EE-29). An “e-dump” is an emergency release of remaining retardant executed by the copilot or loadmaster, which will increase aircraft performance by decreasing aircraft gross weight (Tabs R-347, R-348). At 17:38:21L, MP2 confirmed the e-dump (Tabs Z-7, EE-29,). One second later, ME stated, “attitude” indicating concern for the MA orientation (Tab EE-30).

The final MC intercom transmissions are as follows (Tab EE-30):

17:38:25L, MP2 stated, “Bring some power.”

17:38:26L, MP1 stated, “Power’s in.”

17:38:26L, MP2 stated, “Power”

17:38:26L, Unknown stated, “Power”

17:38:26L, MP1 stated, “Power’s in.”

17:38:28L, ME stated, “Blee…”

17:38:28L, MP2 stated, “We’re going in.”

17:38:30L, ME stated, “Bleed’s closed.”

17:38:30L, MP1 stated, “Hold on, Crew.”

d. Impact

On 1 July 2012, shortly after 17:38:30L, the MA’s right wing tip passed through several tree branches (Tabs J-78, J-81, Z-3, Z-8, EE-30). The MA then traveled approximately 20 ft before the rear section of the fuselage impacted the ground (Tabs J-78, J-82). At impact, the MA was in a nose up, right bank attitude of at least five degrees (°) (Tabs J-78, Z-3).

The MA skidded along the ground for approximately 60 ft, in a right-wing low orientation, until the outboard portion of the right wing struck a tree and separated from the MA (Tabs J-56, J-78, J-83, Z-9). Then the number four propeller repeatedly struck the ground and separated from the MA (Tabs J-19 to J-21, J-78, J-83). The right wing tree impact simultaneously caused the MA to pivot to the right and induce a left roll (Tabs J-78, J-83).

The number one propeller then repeatedly struck the ground and separated from the MA (Tabs J-30, J-78, J-83, J-84). The MA continued for approximately 20 ft, when the left wing tip contacted the ground (Tabs J-78, J-84). While continuing a left roll, the left wing separated from the center wing box, outboard of the number two engine (Tabs J-79, J-85). The number two propeller then repeatedly struck the ground, but remained attached to the engine until the MA impacted a ravine (Tabs J-11, J-79, J-85).

The MA impacted up-sloping, lightly-wooded, rolling terrain, sliding through a tree-lined ravine before coming to rest approximately 410 ft from the initial point of impact (Tabs J-27, J-49, Z-3). The ravine is approximately eight ft deep by thirty to forty ft wide (Tabs J-49, Z-11). Immediately prior to reaching the ravine, it is likely the MA briefly established a relatively level attitude (Tab J-79). The number two and three engines were still operating and the cockpit and cargo compartment were relatively intact (Tabs J-79, J-85). Shortly thereafter, the number three propeller contacted a tree (Tab J-79). The number three propeller separated from the MA however it is unknown exactly when it occurred (Tab J-79).

The left forward side of the fuselage then contacted several trees along the south edge of the ravine, indicating the MA was again rolling to the left (Tabs J-79, J-86). At this point, the rest of the right outer wing, outboard of the number three engine, separated from the MA, however the exact point when the wing separated is unknown (Tab J-79).

As the MA moved across the ravine and struck the opposite side, the fuselage forward of the main landing gear was displaced, partially separating from the rest of the fuselage structure. The left horizontal stabilizer then struck trees and separated from the MA (Tabs J-79, J-80, J-86 to J-88).

When the MA came to rest, the aft fuselage was almost completely separated from the center fuselage and was oriented parallel to the crash path. The center fuselage was oriented approximately 45° to the right of the crash path. The remainder of the forward fuselage was oriented approximately 90° to the right of the crash path, and was severely damaged by impact with the far side of the ravine and the momentum of the center fuselage, which still housed the intact MAFFS unit (Tabs J-80, J-89, Z-3, Z-4, Z-6). The forward fuselage no longer resembled aircraft structure and only portions could be identified (Tabs J-74, Z-6).

e. Egress and Aircrew Flight Equipment

During the impact sequence, the number four propeller forcibly removed the right paratroop door, creating the presumed egress point of ML1 and ML2. Due to extensive damage and fire in the center fuselage, it is highly unlikely ML1 and ML2 were able egress anywhere other than through the right paratroop door opening. ML1 and ML2 have no memory of egressing the MA (Tabs V-29.13, V-34.18, Z-7, Z-8).

There is no evidence Aircrew Flight Equipment was a factor in the mishap.

f. Search and Rescue

Approximately 15 minutes after the mishap, firefighting helicopter crews on the ground at Edgemont Municipal Airport, Edgemont, South Dakota, became aware of a potentially serious situation. However, specific details were unavailable as the situation was still developing (Tab V-31.3).

At approximately 1803L, ML1 called 9-1-1 from his personal cellular phone and informed the operator he was at an airplane crash but did not know his location (Tab V-1.3). At this point, ML1 had egressed the MA and was upwind of the mishap site (Tab V-1.4).

At 1812L, a notification regarding the mishap was given to the helicopter crews at Edgemont Municipal Airport (Tabs R-21, V-3.3). However, at that time heavy rain, gusty, erratic winds and a low ceiling prevented immediate departure (Tab V-3.3). While waiting for the weather to clear, EMT1, a qualified Emergency Medical Technician – Intermediate, loaded medical equipment on N935CH (Tabs V-5.5, V-31.4). When the weather improved, the two helicopters at Edgemont Municipal Airport, N911FS, call sign H-535, and N935CH, call sign 5CH, departed and proceeded toward the mishap site (Tabs V-3.8, V-31.4).

The MA's Emergency Locator Transmitter (ELT) failed to activate therefore the helicopters proceeded to what was relayed as the mishap site using coordinates provided by Air Operations Director Trainee (AODT) (Tab V-31.4). For discussion of ELT analysis see section 6(b)(6) of this report. Upon arrival, the crews did not see the MA, realized the coordinates were not accurate, and initiated a grid search (Tabs V-3.11, V-31.4). Approximately eight minutes after initiating the grid search, using additional information from the Air Attack aircrew, a retardant line was identified which led to the debris field and the mishap site (Tabs V-3.11, V-31.4).

At approximately 1850L, the first helicopter, N911FS, arrived on scene (Tabs V-1.13, V-3.4). A few minutes later, the second helicopter, N935CH, landed and EMT1 departed the aircraft to meet ML1 who was walking towards N935CH and talking on his cell phone with the 9-1-1 operator (Tabs V-3.5, V-5.6 to V-5.8). EMT1 assessed and began treating ML1 while the other helicopter crewmembers proceeded to the main wreckage to search for additional survivors (Tabs V-3.5, V-31.5, V-5.6). ML2 was discovered wandering near the mishap site by responding helicopter crewmembers and was led to EMT1 for treatment (Tabs V-5.8, V-31.5, V-31.6).

As ML1 and ML2 required urgent medical care, they were immediately evacuated in N935CH while the remaining helicopter crewmembers continued to search for survivors (Tabs V-3.5, V-3.6, V-31.6, V-5.8). Only having one backboard, ML1 was placed on the backboard and floor-loaded while ML2 was seated in the helicopter (Tab V-5.8). After ML1 and ML2 were secured, N935CH departed for Custer County Airport, South Dakota (Tabs V-5.8, 5.9, V-10). Approximately 10 minutes later, N935CH landed at Custer County Airport where ML1 was transferred to an emergency medical helicopter and ML2 was transferred to a ground ambulance (Tabs R-60, V-5.9, V-5.10).

The helicopter crewmembers were relieved by local fire and law enforcement personnel that had arrived on scene (Tabs R-20, V-3.5, V-3.6, V-31.8). The remaining helicopter crewmembers then departed the mishap site on N935CH which returned after evacuating ML1 and ML2 (Tab R-20).

g. Recovery of Remains

The 28th Force Support Squadron, Ellsworth AFB, South Dakota accomplished the recovery operation (Tab V-11.2). On 2 July 2012, at approximately 1000L, the recovery team arrived at the mishap site (Tab V-11.2). They initiated the search operation significantly north of the mishap site, completing a sweeping east-west search working south, ending approximately 20 ft short of the MA fuselage (Tabs V-11.3, V-11.4, V-11.10). Then they went significantly south of the site and began a similar sweeping search heading north (Tabs V-11.5, V-11.10). The next two sweeps were intense grid sweeps of the areas immediately east and west of the fuselage (Tabs V-11.5, V-11.10). The team then recovered the remains of MP1, MP2 and MN (Tabs V-11.6, V-11.10). Approximately two hours later, the remains of ME were recovered (Tab V-11.6). At approximately 1830L, the recovery operation concluded and the remains were transported via helicopter to Ellsworth AFB (Tabs V-11.6, 11.7). On 4 July 2012, USAF mortuary affairs personnel transported the remains to Dover AFB, Delaware, for autopsy (Tab V-11.7).

5. MAINTENANCE

a. Forms Documentation

The 145th Aircraft Maintenance Squadron, 145 AW, maintained the aircraft forms for the MA. All maintenance was documented on Air Force Technical Order (AFTO) 781 forms and in G081 (Core Automated Maintenance System for Mobility). The purpose of an AFTO 781 form is to document various maintenance actions performed on an aircraft. Pursuant to Technical Order (TO) 00-20-1, G081 is an automated database which maintains aircraft discrepancies, maintenance repair actions, inspection cycles and flying history. Normally, the current AFTO 781s are maintained in a binder that is specifically assigned to each aircraft and kept on board during flight (Tab DD-55). As the most recently transcribed AFTO 781s are dated 29 June 2012, it can be assumed the AFTO 781s from 29 June to 1 July 2012 were onboard the MA and destroyed in the mishap (Tab DD-55). The aircraft forms, dated prior to 29 June 2012, contained very few minor documentation errors, commonly found in maintenance forms (Tabs DD-55, DD-56). These minor errors were of no significance to the condition of the MA (Tabs DD-55, DD-56). A detailed 90-day review of all AFTO 781 forms and G081 records revealed no evidence of mechanical, structural, or electrical failure, which could have contributed to the mishap (Tabs DD-55, DD-56).

Time Compliance Technical Orders (TCTOs) are inspections or maintenance procedures mandated by higher headquarters that are required before specific dates or a particular flight. The AFTO 781 forms and G081 track TCTO compliance times and dates. No TCTOs restricted the MA from flying (Tabs U-84, U-87). Records revealed all required TCTOs were accomplished in accordance with (IAW) applicable guidance (Tabs U-84, U-87). TCTO non-compliance did not contribute to the mishap (Tabs DD-55, DD-56).

Prior to the mishap sortie, the MA's total aircraft time was 6,495.3 hours (Tab D-3). All four engines were Rolls-Royce/Allison T-56-A-15 turbo prop engines (Tab J-29). The number one engine, which is the left outboard engine, serial number (S/N) 113858 had 5,784.6 hours total engine operating time. The number two engine, which is the left inboard engine, S/N 114042 had 7,766.1 hours total engine operating time. The number three engine, which is the right inboard engine, S/N 112850 had 9,004.2 hours total engine operating time. The number four engine, which is the right outboard engine, S/N 114263 had 8,865.5 hours total engine operating time (Tab D-3).

The MA flew 11 flights, for a total of 21.8 hours, within 30 days of the mishap (Tabs D-3, D-5, D-6). There were no major maintenance discrepancies that would have prevented the MA from accomplishing the MAFFS mission on 1 July 2012. Additionally, historical records did not reveal any recurring maintenance problems (Tabs U-15 to U-64, DD-55, DD-56).

b. Inspections

(1) Mishap Aircraft

Pursuant to TO 00-20-1, Programmed Depot Maintenance (PDM) is an inspection requiring skills, equipment or facilities not normally possessed by operating locations. On 10 January 2010, a PDM inspection for the MA was accomplished at Warner-Robins Air Logistics Center, Macon, Georgia (Tab D-3). The next PDM was not due until October 2015 (Tab U-82). The PDM inspection was current and not contributory to the mishap.

Isochronal (ISO) inspections are a periodic cycle of in-depth inspections conducted IAW TO 00-20-1 to ensure airworthiness. ISO inspections are completed every 540 days or 1200 airframe hours – whichever interval is reached first (Tab BB-80). On 20 June 2011, the latest ISO inspection was completed with the next inspection due on 11 December 2012 (Tab U-81). The ISO inspection was current and not contributory to the mishap.

Home Station Check (HSC) is part of the ISO inspection interval and is performed 270 days after the completion of the preceding ISO inspection (Tab BB-66). On 4 April 2012, the last HSC was completed with the next inspection due on 30 December 2012 (Tab U-81). The HSC inspection was current and not contributory to the mishap.

A Pre-Post Inspection (PR/BPO) combines the inspection criteria of both Pre-Flight and Post-Flight Inspections. It consists of checking the aircraft for flight preparedness by performing visual examinations and specified checks of structural and system components to ensure that no conditions exist which could cause accidents or aborted missions. Once completed, the PR/BPO validity period is 72-hours (Tabs BB-52, BB-53, BB-58, BB-59, BB-65, BB-66). On 29 June 2012 at 1300 EST, the latest PR/BPO was performed (Tabs U-93, V-16.5). The PR/BPO inspection was current and not contributory to the mishap.

A Thru-Flight Inspection (TH) consists of checking the aircraft for flight preparedness by performing visual examinations and checks of structural and system components to ensure that no conditions exist which could cause accidents or aborted missions. A TH is performed between flights when scheduled ground time exceeds 6 hours, not to exceed the 72-hour PR validity period (Tab BB-56). On the evening of 30 June 2012, a TH was performed with no discrepancies noted (Tabs V-14.4, V-14.5). The TH inspection was current and not contributory to the mishap.

(2) Mishap Aircraft Engines

On 2 March 2012, an engine performance run was conducted. All four engines were found to be running at over 100 percent efficiency (Tab J-4). The inspection cycles for all four engines were current and not contributory to the mishap (Tab D-3).

c. Maintenance Procedures

In April 2012, during an HSC, the number one propeller was removed and replaced, and the number four propeller was resealed on the MA. All maintenance actions were performed IAW applicable technical data. Additionally, an aileron push-pull rod was disconnected to gain access to the number four main fuel tank to repair a fuel leak. The push-pull rod was subsequently reconnected and an operational check was performed IAW applicable technical data (Tabs U-18, U-26, U-46, U-49, V-16.4). There were no maintenance procedure issues that contributed to the mishap.

On 30 June 2012, upon arrival at KCOS, the MA had no aircrew-reported discrepancies and MX3 performed a TH inspection with no discrepancies noted. MX3 then secured the MA for the night (Tabs V-14.4, 14.5). On 1 July 2012, the MA departed KCOS for a day of MAFFS operations (Tab DD-11). The MA landed at KCYS at approximately 1608L to refuel (Tabs V-12.5, V-15.4, DD-59). The landing and departure at KCYS were uneventful with no maintenance discrepancies noted (Tabs V-20.9, V-32.5). The MA then proceeded to the White Draw Fire which turned out to be the mishap sortie (Tab EE-39).

d. Maintenance Personnel and Supervision

All pre-mission activities were normal and all personnel involved in the recovery, refuel and launch of the MA were highly experienced and competent. A thorough review of maintenance training records and Special Certification Rosters revealed all involved personnel were properly trained and qualified (Tab DD-55).

e. Fuel, Hydraulic and Oil Inspection Analyses

The 153rd Logistics Readiness Squadron, Fuels Laboratory, Wyoming ANG, Cheyenne, Wyoming, sent fuel samples from the truck that refueled the MA to the Air Force Petroleum Agency, Wright-Patterson AFB, Ohio for testing IAW TO 42B-1-1. All fuel samples were within limits and free of contamination (Tabs D-43 to D-46).

Samples of hydraulic fluid, engine lubricating oil, and fuel from the MA's flight control and several propulsion systems were collected at the mishap site. These samples were sent to the Air Force Petroleum Agency, Wright-Patterson AFB, Ohio for testing IAW TO 42B-1-1. Engineering analysis found no anomalies in fluid properties that were contributory to the mishap (Tabs U-65 to U-69, U-91 to U-92).

f. Unscheduled Maintenance

Several unscheduled maintenance actions were performed on the MA after the April 2012 HSC until the date of the mishap (Tabs U-15 to U-61, DD-55). A thorough review of the historical maintenance forms revealed that all actions were performed in IAW appropriate technical data (Tabs DD-55, DD-56). None of these unscheduled maintenance actions were contributory to the mishap.

6. AIRFRAME SYSTEMS

a. Airframe Structures and Systems

The AIB performed a thorough inspection of all MA systems and concluded all systems performed normally up to the time of impact. Analysis was verified by engineers at Warner-Robins and Oklahoma City Air Logistics Centers as well as propulsion experts from Rolls-Royce/Allison Engine Company. Although the MA broke apart during the crash sequence, many of the aircraft systems were recovered from the mishap site including: engines, propellers, flight control surfaces, hydraulic components, nose and both main landing gear, fuselage structure and the MAFFS unit (Tabs J-3 to J-90, Z-3, Z-4, Z-6, Z-9). The forward fuselage suffered the most damage, which prevented much of the aircraft computers and instrumentation from being analyzed (Tab J-74). The Digital Flight Data Recorder (DFDR) was recovered and analyzed by the Air Force Safety Center and L3 Communications Aviation Recorders. However, as discussed in Section b (5), the last 12.8 hours of data from the DFDR were corrupt and therefore unusable for investigation purposes (Tab U-73).

b. Evaluation and Analysis

(1) Engine Performance

Just prior to the mishap sequence, all four engines were set to maximum power (Tabs EE-30). Propulsion specialists analyzed the engines and propellers post-mishap to determine the power settings of both. Based on the observed damage, they determined all four engines were operating with significant rotational force prior to contacting the terrain. This was further verified by several observations: 1) all four engines exhibited compressor blade damage consistent with engine rotation at the time of impact; 2) all sixteen propeller blades exhibited propeller-strike damage consistent with power delivery at the time of impact; 3) the propeller blades that did not have excessive impact damage were at a blade angle representative of maximum power; and 4) the number three engine coordinator control system was intact and found near the 90° position, indicating a high power setting. All available evidence is consistent with power delivery by all four engines and propellers at the time of impact (Tabs J-22, J-23, J-44). Engine performance was not contributory to the mishap.

(2) Hydraulic Systems Performance

The C-130H3 has three independent hydraulic systems, booster, utility and auxiliary, which operate at 3,000 pounds per square inch (PSI). The booster and utility systems are powered by engine-driven hydraulic pumps and the auxiliary system is powered by an electrically-driven hydraulic pump. The booster system furnishes hydraulic power to a portion of the flight control boost system. The utility system normally operates the landing gear, wing flaps, brakes, nose wheel steering and a portion of the flight control boost system. The auxiliary system normally operates the cargo door and ramp, provides emergency pressure for brake operation and emergency extension of the nose landing gear (Tabs BB-44 to BB-48). A combination of post-mishap structural analysis, witness testimony, and Cockpit Voice Recorder (CVR) data provides strong evidence that all hydraulic systems were operating properly and not contributory to the mishap (Tabs J-3 to J-90, V-12.5, V-15.4, EE-2 to EE-30).

(3) Flight Control Systems Performance

The flight control system of the C-130H3 is separated into three categories: primary flight controls, trim systems and flaps. The primary flight controls include the ailerons, rudder and elevators (Tab BB-84).

The ailerons control roll around the longitudinal axis which is a theoretical line running from the nose to tail of the aircraft. There are two ailerons mounted near the outboard end of each wing. The rudder system provides directional control around the vertical axis which is a theoretical line running vertically through the center of the aircraft fuselage. The rudder system moves the nose of the aircraft to the left or right. There is one rudder mounted on the aft edge of the vertical stabilizer portion of the tail. The elevator system controls the rotation around the pitch axis which is a theoretical line running from wing tip to wing tip. The elevator system raises and lowers the nose of the aircraft. There are two elevators attached to the rear beam of the horizontal stabilizer of the tail. Each primary flight control system is actuated by a hydraulically powered booster assembly. Additionally, each primary flight control system has an associated trim tab system which aids the pilot in reducing the control yoke or rudder inputs required to maintain a desired attitude. Attitude is the orientation of an aircraft's axes relative to a reference line or plane, such as the horizon. The trim tab systems are controlled by an electrically powered actuator (Tabs BB-84 to BB-91).

The purpose of the flaps system is to increase the surface area of the wing, forward to aft. When extended, the flaps change the area of the wing into a high-lift configuration, reducing required speeds for takeoff, approach, and landing. There are four flaps located along the trailing edges of the wings – two per side. The flaps run from the wing root to the aileron (Tab BB-91).

A combination of post-mishap structural analysis, witness testimony and CVR data provides strong evidence that all flight control systems were operating properly and not contributory to the mishap (Tabs J-3 to J-90, V-12.5, V-15.4, EE-2 to EE-30).

(4) Aircraft Structural Integrity

A C-130 structural engineering specialist from Warner-Robins Air Logistics Center conducted an on-site analysis of the wreckage to determine if there were any deficiencies with the MA structures prior to impact. Based on the analysis, there were no indications that the MA had any structural failures or deficiencies prior to the mishap. All failures were consistent with overload beyond structural design limits due to the mishap and post-impact fire damage. Additionally, the evidence indicates that although the various fuselage components had significant damage, the forward, center, and aft fuselage components were still acting as one integral structure until the aircraft reached the tree-lined ravine just prior to where the MA came to rest (Tabs J-90, Z-3, Z-4, Z-6, Z-11). The structural integrity of the MA was not contributory to the mishap.

(5) Digital Flight Data Recorder

The DFDR system is completely automatic and records the last 50 hours of airplane flight performance data when power is applied. The recorder is located on the right side of the aft cargo compartment adjacent to the cargo ramp. Inputs to the recorder are received from a Flight Data Acquisition Unit (FDAU). The FDAU is located in an overhead rack along the centerline of the airplane, near the front of the cargo compartment. The FDAU serves as a signal conditioner, interfacing with the DFDR and the sensors providing data. All of the analog and discrete sensor signals are converted to digital data by the FDAU and are transmitted to the DFDR (Tabs BB-76 to BB-78).

The MA was equipped with an L3 Communications DFDR model FA2100-4042. The DFDR was removed from the MA and shipped to the Air Force Safety Center (AFSC) for data retrieval and analysis. The AFSC analyzed the data for the time of the mishap and discovered the last 12.8 hours of data was corrupt. The AFSC then forwarded the data to L3 Communications for additional analysis. After performing a number of tests, L3 Communications concurred that the data was corrupt and unusable for investigation purposes. Additionally, they concluded the data corruption likely occurred upstream of the DFDR. Analysis was unable to determine the precise cause of the data corruption (Tab U-73).

(6) Emergency Locator Transmitter

An Emergency Locator Transmitter (ELT) system will sense an impact force above a predetermined amplitude and duration, which activates the transmitter. The transmitter and antenna will then continuously broadcast signals on emergency radio frequencies. These transmissions will continue until the ELT battery pack is depleted or the ELT is deactivated. The ELT system is located on top of the aircraft near the tail, encapsulated in a dorsal fin-like unit (Tabs BB-96, BB-97).

Pointer, Incorporated manufactured the ELT system on the MA. In February 2009, the ELT battery pack was manufactured by a different company. On 17 November 2010, the battery pack was installed in the ELT on the MA (Tabs U-75, U-76). The C-130 technical order requirements dictate battery replacement two years after installation, thus, it was due to be replaced on 17 November 2012 (Tabs U-17, U-18, BB-118). On 2 April 2012, an operational check of the MA's ELT was performed during the HSC IAW applicable technical data with no defects noted (Tabs D-41, BB-68 to BB-74).

No ELT transmissions were heard after the mishap (Tabs V-9.10, V-31.13). A post-mishap photograph shows the ELT's "On" light was not illuminated. The MA's ELT system was sent to Pointer, Incorporated for analysis. A test battery was installed because the mishap battery was depleted. The test results indicated the transmitter was operational and activated when sufficient forces were applied. Additional tests were performed on the original battery pack. The battery displayed no mechanical or heat damage, but failed to provide enough voltage to power the ELT.

The interconnecting coaxial cable and antenna for the ELT were not available for analysis. Heat or mechanical damage to either item could have prohibited a signal transmission. Also, the fact that the ELT's "On" light was not illuminated indicates that either the transmitter did not activate on impact or the battery was completely discharged or damaged. Additionally, the time interval between the impact and removal of the transmitter was not available. Therefore, one of three things likely happened. One, impact forces were not sufficient to activate the ELT. Two, the battery pack had an insufficient charge to transmit the signal or three, damage to the coaxial cable or antenna prevented transmission (Tabs U-75, U-76, Z-10).

(7) MAFFS Unit

There is no evidence the MA MAFFS unit was a factor in the mishap. Prior to the mishap, the MAFFS unit was operating at 100 percent capability and an emergency dump was successfully completed (Tabs V-4.5, V-29.18, Z-4, Z-7, Z-15, EE-29). Additionally, there is no evidence the MA Center of Gravity (CG) or total aircraft weight contributed to the mishap (Tabs DD-51, DD-52).

7. WEATHER

a. Forecast Weather

On 1 July 2012, the 21st Operations Support Squadron, Weather Flight, Peterson AFB, Colorado provided a mission execution weather forecast to the EAS/CC located at KCOS (Tabs F-3 to F-9, W-23). The mission package contained airfield weather forecasts for KCOS and Pueblo, Colorado, regional weather for the western portion of the US and detailed information for mission purposes for the Waldo Canyon Fire in Colorado (Tabs F-3 to F-9, K-19 to K-23). The EAS/CC did not verbally brief the weather forecast rather he distributed the weather information documents in hard copy format during the mass operational briefing attended by all MAFFS aircrews, including the MC (Tab W-23). The mission execution weather forecast did not contain weather information for South Dakota or the White Draw Fire because the mission was planned for the Rocky Mountain Region, no update was requested when the MA was diverted (Tabs F-4, K-19 to K-23, W-23). Additionally, the thunderstorm forecast charts were for the western continental US and did not include forecast thunderstorms for South Dakota (Tabs F-6, F-7).

On 1 July 2012 at 1650L, the National Weather Service issued a severe thunderstorm watch for northeast Wyoming and western South Dakota encompassing the area surrounding Edgemont, South Dakota and the White Draw Fire. The severe thunderstorm watch, valid from 1650L to 2300L, was issued for potential hail up to two inches in diameter and wind gusts up to 70 miles per hour (Tabs W-7, W-8). However, there was no evidence the MC requested or received forecast weather information for South Dakota or the White Draw Fire area at any time on 1 July 2012 (Tab W-23).

b. Observed Weather

(1) Inflight Weather

The Red Canyon Automated Surface Observation System (ASOS) is located approximately 2.2 miles northeast of the mishap site (Tab F-29). The ASOS records and disseminates weather observations 57 minutes past each hour (Tab F-30). The 1757L ASOS observation from 1 July 2012 recorded a maximum wind speed of 36 miles per hour during the previous hour (Tab F-30). The observation for that hour also indicated winds had shifted from the east-southeast to the west-southwest and a drop in surface temperature from 91º to 85º Fahrenheit (Tab F-30). The drop in temperature, wind shift, and strong surface winds indicated that an outflow boundary from the storm to the southwest passed the ASOS during that time period (Tab F-30).

All accounts of the observed weather conditions outlined below were obtained post-mishap from the Red Canyon ASOS, Doppler Radar, the CVR and eye witness testimony.

On 1 July 2012, a low-pressure system was located over eastern Montana (Tab W-21). As the effects of the low-pressure system moved east towards South Dakota, an area of intense thunderstorms developed ahead of the front (Figure 3). As depicted in Figure 3, at 1629L a strong thunderstorm was located approximately 22 miles west-southwest of the future mishap site. Post-mishap, using radar animation, it was determined the thunderstorm was moving to the east-northeast at 20 miles per hour (Figure 3 to Figure 7).

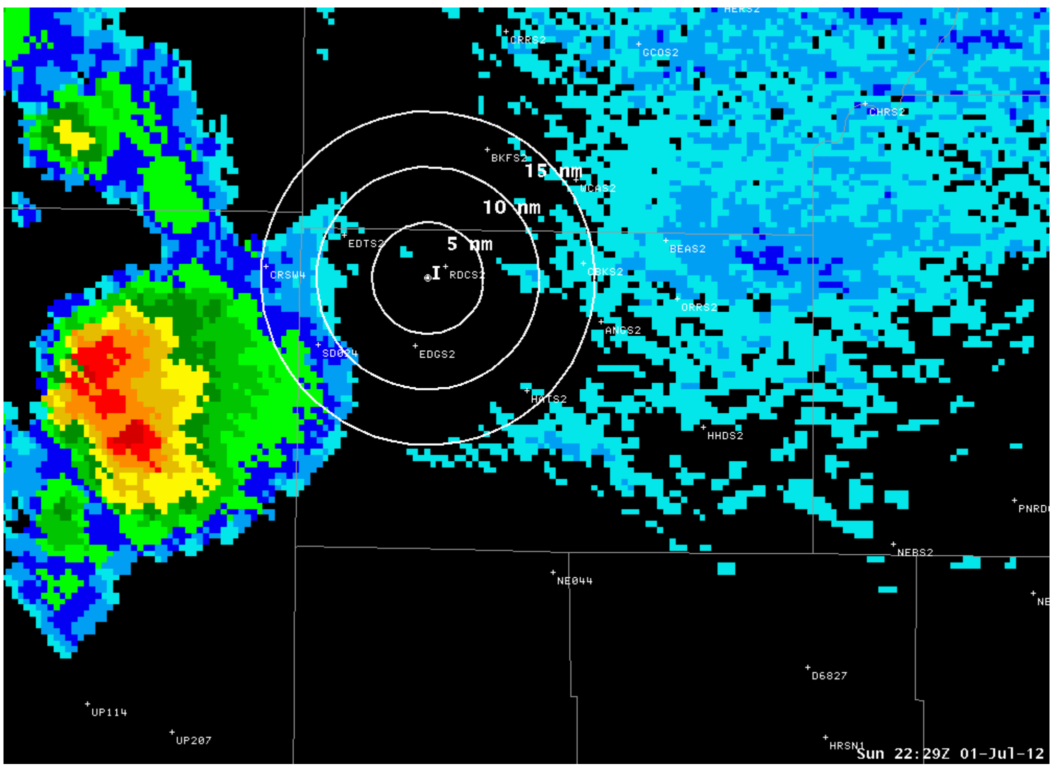

Figure 3. Doppler Radar at 1629L
Center of Inner Circle is Future Mishap Site

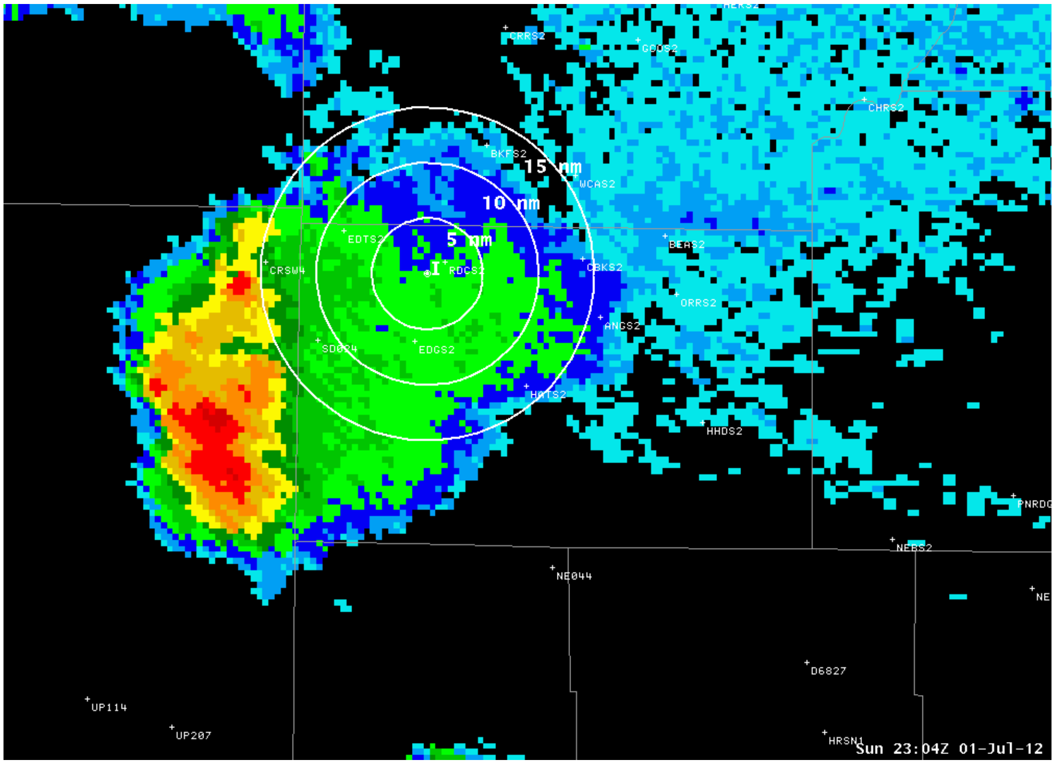

Figure 4. Doppler Radar at 1704L

At 1706L, as the MA approached the White Draw FTA from the southwest, the MC agreed to take a wide berth around the thunderstorm to the southeast of the fire as depicted in Figure 4 (Tab EE-3).

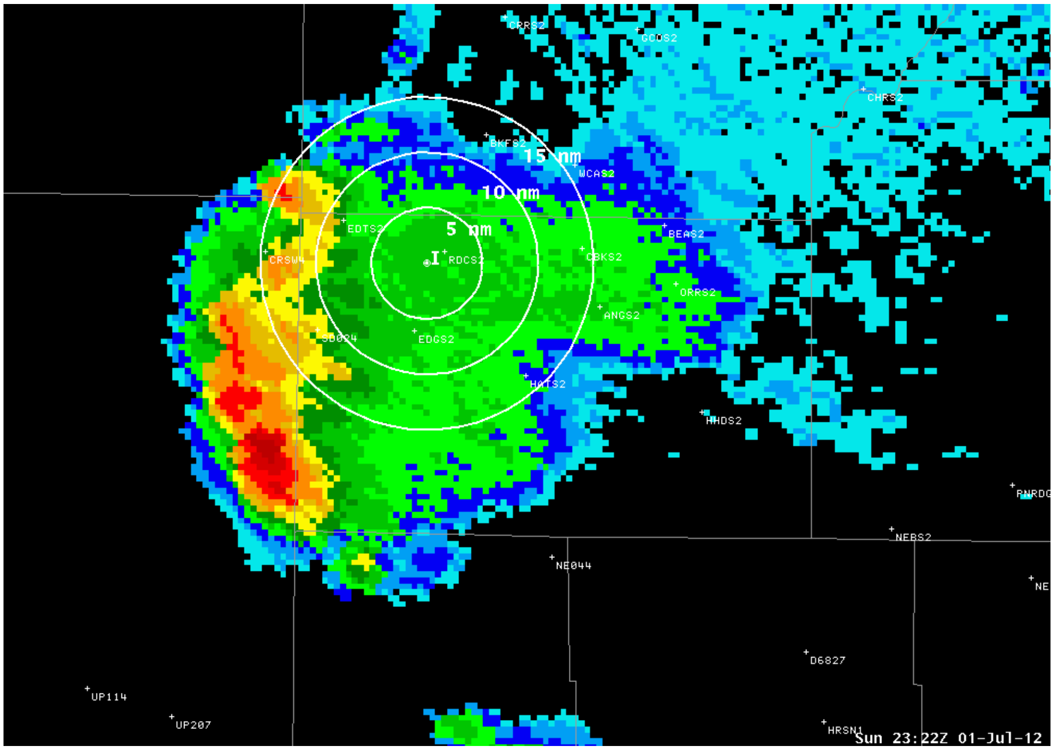

Figure 5. Doppler Radar at 1722L

While waiting for Lead B-5 to reach the White Draw FTA, ME witnessed lightning (Tab EE-15). At 1722L, MP1 made visual contact with Lead B-5 (Tab EE-15). Just moments later, MP2 stated the storm was "inside of 10 now" (Tab EE-16). As depicted in Figure 5, the leading edge of the thunderstorm was 13 miles west-southwest from the future mishap site. Showers were developing ahead of the thunderstorm as it moved across the Black Hills.

At approximately 1725L, Helicopter Pilot (HELO3) and Helicopter Manager (HELO MGR) helicopter personnel involved with firefighting efforts, departed the Edgemont Heliport, moving their helicopter to the Custer County Airport in Custer, South Dakota, because there was a strong chance of high winds and hail (Tabs V-9.4, V-9.6, V-42.2, V-42.3, EE-17). En route, HELO3 encountered variable winds at 25-35 knots and HELO MGR witnessed virga (Tabs V-9.12, V-42.10). According to the National Weather Service, virga is streaks of precipitation falling from a cloud but evaporating before reaching the ground (See http://w1.weather.gov/glossary/index).

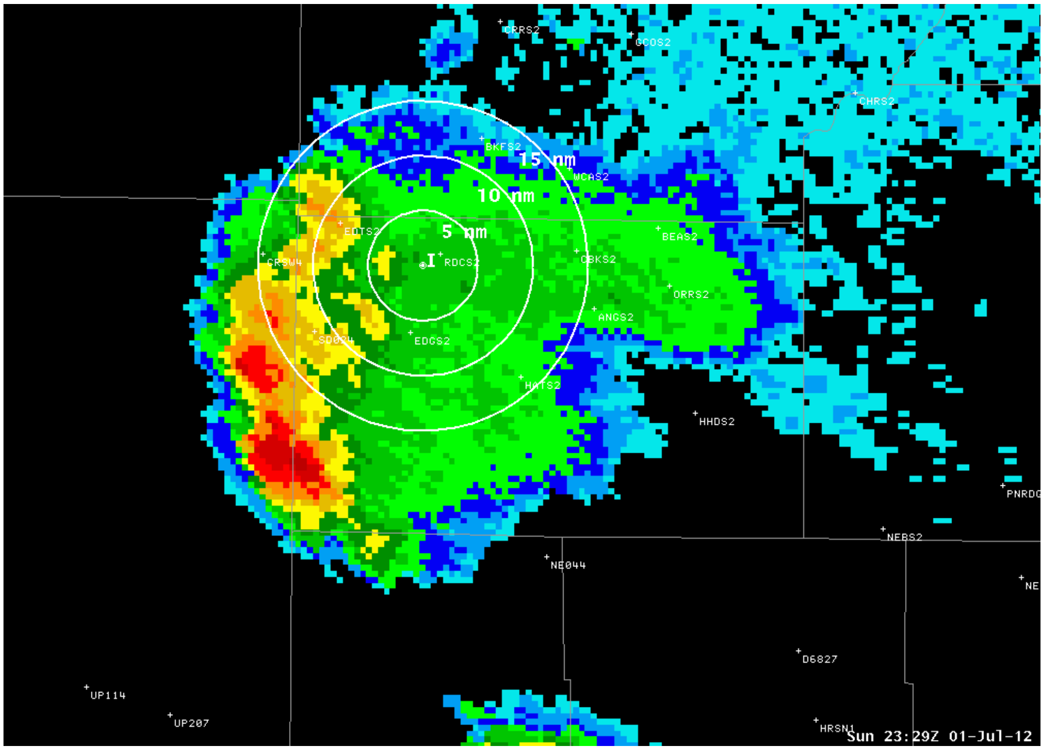

Figure 6. Doppler Radar at 1729L

At 1728L, in Air Attack, AA3 and ATGS witnessed virga and experienced "more than moderate turbulence" (Tabs R-141, V-7.8, V-43.9, V-43.10, EE-20). After the mishap, AA3 actually described the turbulence as severe (Tab R-136). Shortly thereafter, AA3 descended from an altitude of 9,500 to 7,000 ft MSL (Tabs R-136, V-43.9). During the "show-me" run, MP1 and MP2 acknowledged they were experiencing a "little bit of rain" (Tab EE-20). At approximately 1729L, rain showers were developing approximately five miles to the west of the White Draw Fire area as depicted in Figure 6.

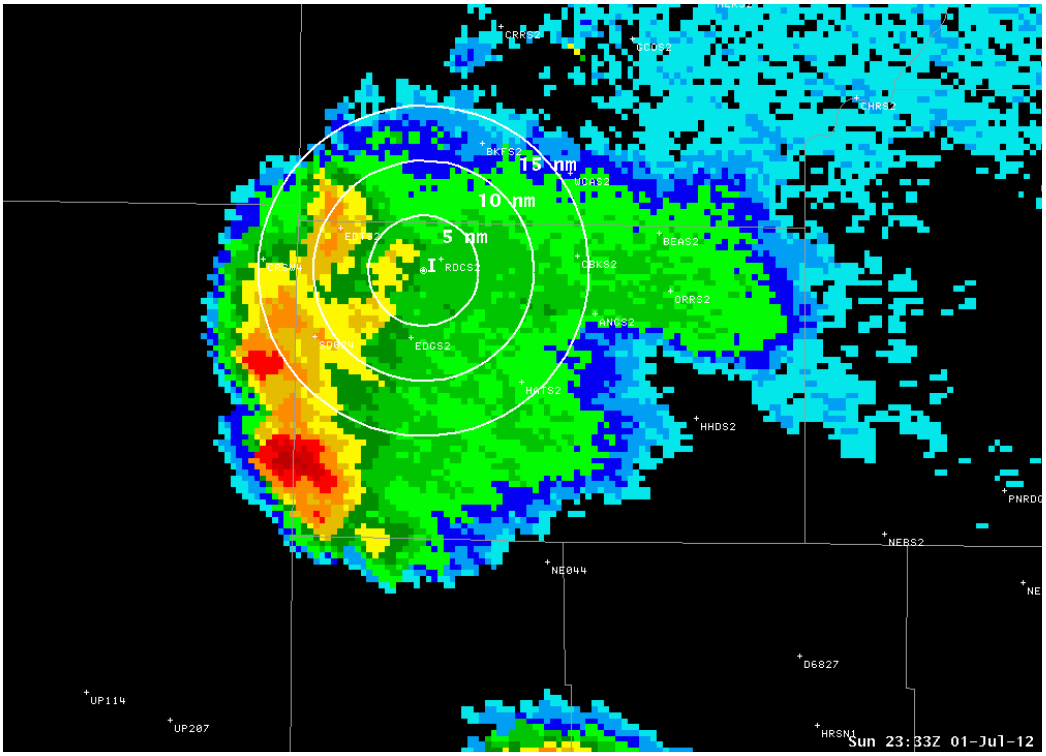

Figure 7. Doppler Radar at 1733L

At 1733L, a moderate rain shower was located approximately 2 miles west of the future mishap site as seen in Figure 7.

At approximately the same time, during the approach for the first retardant drop, ATP experienced air speed fluctuations of 10-15 KIAS (Tab EE-22). Seconds later, MP2 also acknowledged turbulence (Tab EE-22). MP1 advanced the throttles to maximum power but the MA still approached the drop location 10 knots slow. During the first drop, the MA descended to a minimum altitude of 160 ft AGL (Tabs EE-23, EE-24). After completion of the first drop, MP1 stated, "I was not liking the way that was feeling" (Tab EE-25).

At approximately 1736L, ME observed the sky was "getting darker" and "you can see that fire a lot better now" (Tab EE-28). At 1737L, ATP stated, "we got some pretty bad turbulence here" (Tab EE-28). Approximately one minute prior to the mishap, ME and MP2 observed surface winds had "picked up" and the fire was blazing (Tab EE-29). ME stated "looks like that thing got bigger"; MP2 responded, "that thing is moving into the fire" (Tab EE-29).

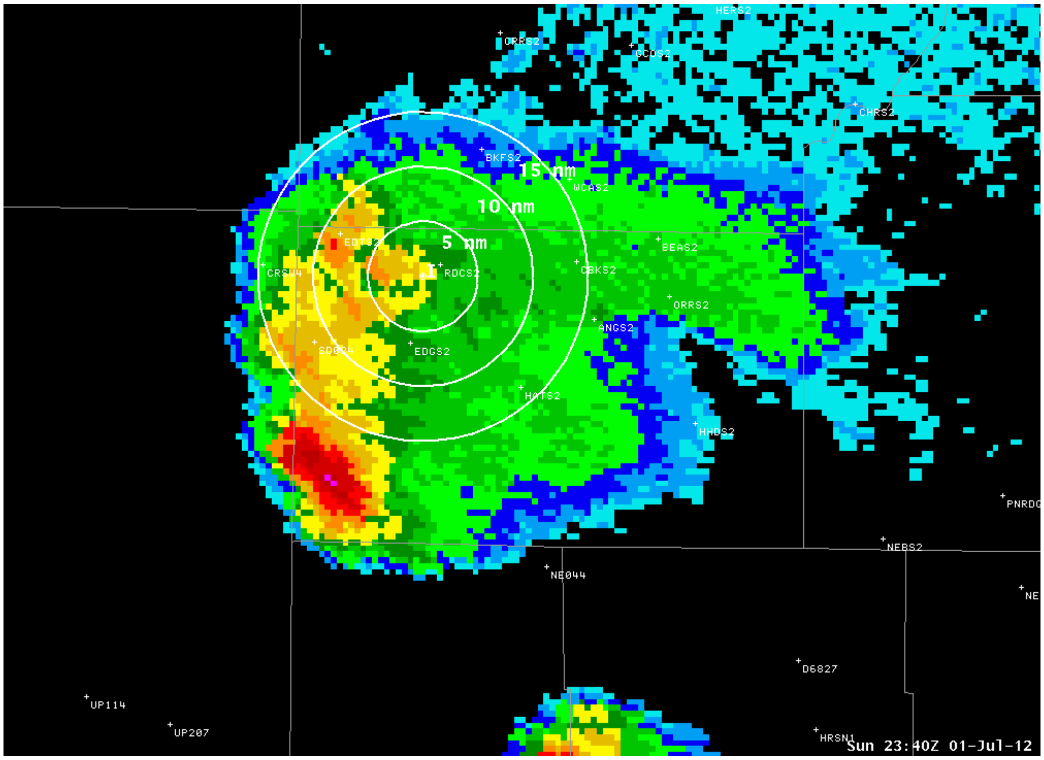

Figure 8. Doppler Radar at 1740L

At 1738L, as the MC prepared for the second retardant drop, HELO3's flight path was in close proximity to the MA and Lead B-5. HELO3 witnessed dust kicking up behind the MA and experienced strong surface winds (Tabs V-9.12, V-9.13, V-42.11).

At the same time, MP2 saw Lead B-5 get "backed up" and ATP indicated he had to "go around" (Tab EE-29). One second later MP2 acknowledged that the MA would also "go around out of this" (Tab EE-29). ATP experienced a "sinker," "extreme" turbulence and loss of altitude (Tab V-40.10). Lead B-5's airspeed dropped to 90 knots as he struggled to avoid trees and a rock formation (Tab V-40.10). At one point, ATP came within 10 ft of the ground, over-temping the aircraft engines while attempting to recover Lead B-5 (Tabs V-40.10, V-40.21).

At 17:38:18L, MP1 ordered an e-dump of the retardant, which was immediately conducted (Tab EE-29). At the same time, Firefighter 1 (FF1) a ground firefighter, was located approximately 1.5 miles west-southwest of the future mishap site (Tab V-4.15). FF1 witnessed the MA jettison their retardant load, at which time she experienced variable surface winds with estimated gusts up to 50 miles per hour (Tabs V-4.5, V4.6). At the same time, in Air Attack, ATGS observed the smoke lying down and "sheeting" of the fire, indicating to him "hellacious" surface winds (Tabs R-101, V-7.8). ATGS and AA3 lost altitude, experienced updrafts and downdrafts with airspeed fluctuations of 20 to 40 KIAS and severe turbulence (Tabs R-85, R-136, R-140, V-7.10, V-43.10). Air Attack lost an estimated 1,000 ft due to the weather conditions (Tabs R-140, V-40.11). ATGS did not see the MA jettison the retardant load (Tab R-93).

Between 1730L and 1745L, Incident Commander 1 (IC1), a member of the Army National Guard, was traveling on a motorcycle, southbound on Highway 18 approximately seven miles north of Edgemont attempting to get to an 1800L meeting at the White Draw Fire incident command center in Edgemont, South Dakota (Tabs V-10.2, V-10.3). While heading towards Edgemont, IC1 witnessed the MA flying to his right, approximately one mile away, making a bank as the MA prepared for their approach to the drop area (Tab V-10.3). IC1 lost sight of the MA while going down the hill towards Edgemont, at that same instant, IC1 was "hit with this extreme, fierce wind" (Tab V-10.3). IC1 described it as side wind because it "pushed me over to the other side of the highway" (Tab V-10.3).

At approximately 17:38:30L, MP1 told the MC to "Hold on, Crew" which was the last voice transmission (Tab EE-30).

(2) Post Mishap Weather

Shortly after the mishap, a thunderstorm moved over the White Draw Fire area as depicted in Figure 8 above. As Air Attack moved away from the fire area, ATGS witnessed the weather cell on his weather display (Tab R-85). ML1 witnessed a thunderstorm coming and then experienced rain after the mishap (Tab V-1.7). Air Attack and Lead B-5 attempted to get back into the mishap site, but the turbulence was too strong (Tabs R-49, R-136, R-137, V-40.11). Due to the thunderstorm over the White Draw Fire area, as indicated in Figure 9, Air Attack had to loiter approximately 30 minutes for the storm to pass before reaching the mishap site (Tabs R-137, EE-45, EE-46). At approximately 1850L, the first rescue helicopter landed at the mishap site after waiting for the thunderstorm to pass (Tabs R-21, V-1.13, V-3.8 to V-3.9).

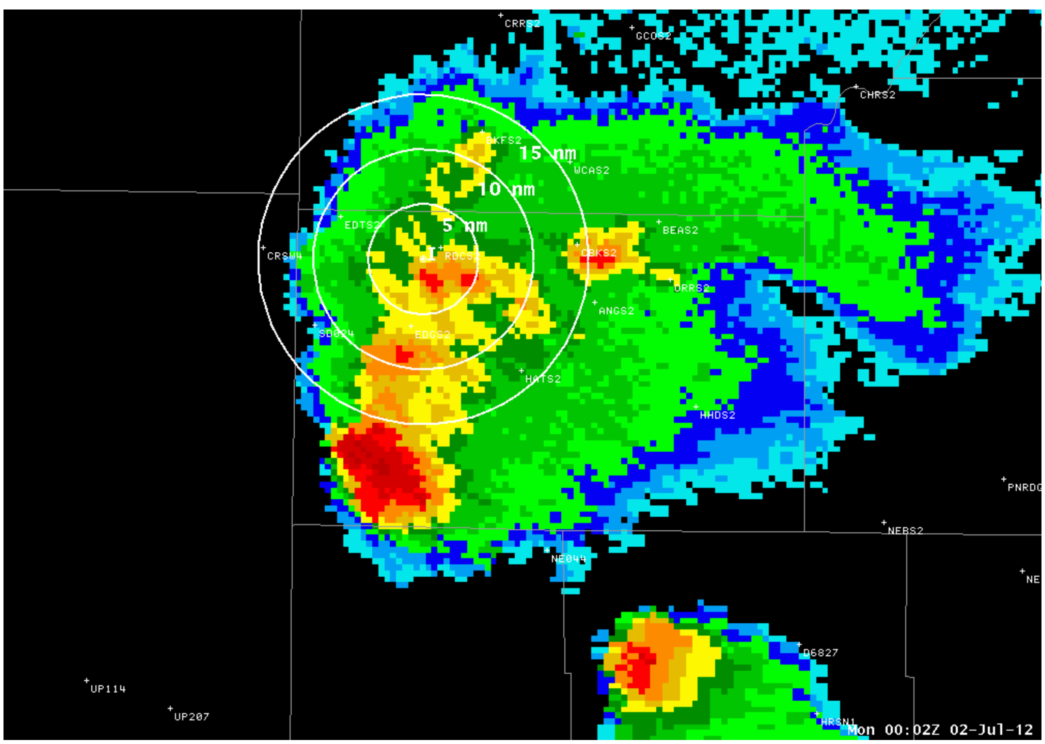

Figure 9. Doppler Radar at 1802L

c. Space Environment

Not applicable.

d. Operations

IAW Air Force Instruction 11-2C-130, Volume 3, *C-130 Operations Procedures*, dated 23 April 2012, paragraphs 6.21.3 and 6.21.3.1.3, if an aircrew is unable to vertically clear thunderstorms or cumulonimbus clouds by 2,000 ft, the aircrew should avoid them by a minimum of five NM for tactical low-level operations, below 23,000 ft MSL, if the outside air temperature is at or above 0° Celsius at flight altitude. Aircrews must avoid gust fronts and winds preceding a rapidly moving thunderstorm. Paragraph 6.21.3.1.4 also cautions aircrew that aircraft damage may occur up to 20 NM from any thunderstorm.

To the contrary, on 20 July 2010, the National Guard Bureau (NGB) sent a memorandum to the 153 OG/CC, 145 OG/CC, AFRC/A3V and AMC/A3V stating when any portion of the MAFFS II unit extends outside the C-130, the aircraft should avoid thunderstorms by at least 25 NM. On 1 July 2012, the 20 July 2010 NGB memorandum was still in effect (Tab BB-125).

On 1 July 2012, the regulatory guidance regarding weather avoidance for MAFFS operations was conflicting. This issue is discussed further in Human Factors, Section 11 of this report.

e. Weather Evaluation and Analysis

The National Severe Storms Laboratory (NSSL), Norman, Oklahoma conducted a meteorological analysis of the Rapid City, South Dakota radar data for the time of the mishap. The NSSL concluded the storm environment and radar data are both consistent with the possibility of a microburst (Tab W-9).

A microburst is a severe localized wind blasting down from a thunderstorm that covers an area less than 2.5 miles in diameter and is of short duration, usually less than 5 minutes (Tab BB-42). A dry microburst is a microburst with little or no precipitation reaching the ground; most common in semiarid regions. Dry microbursts may develop in an otherwise fair-weather pattern. Visible signs may include a cumulus cloud or small cumulonimbus with a high base and high-level virga, or an orphan anvil cloud from a dying rain shower. At the ground, the only visible sign might be a dust plume or a ring of blowing dust beneath a local area of virga (Tab BB-41).

National Weather Service (NWS), Rapid City, South Dakota conducted a meteorological analysis of the Rapid City, South Dakota radar data and general atmospheric conditions near the White Draw Fire area for the time of the mishap. The NWS concluded the C-130 encountered a microburst at the time of the mishap (Tab W-25).

The 28th Operations Support Squadron Weather Flight (28 OSS/OSW), Ellsworth AFB, South Dakota conducted a meteorological analysis of the Rapid City, South Dakota radar data for the time of the mishap. The 28 OSS/OSW noted the radar data indicated a storm was rapidly decreasing in intensity, which would have created an environment where downward vertical velocities were probable. The 28 OSS/OSW concluded that a microburst was over the area around the same time as the mishap (Tab W-11).

8. CREW QUALIFICATIONS

a. Mishap Pilot 1

MP1 was a current and qualified Senior Pilot with 1,966.9 total C-130 hours, including 116.4 instructor hours (Tabs G-6, G-7, G-10). MP1 served his entire Air Force flying career with the NCANG. MP1 deployed five times in support of Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF), conducting 473 sorties and recording 727.7 hours in theater (Tab DD-53).

MP1s flight time for the 90 days before the mishap (Tab G-7):

MP1	Hours	Sorties
Last 30 Days	19.2	10
Last 60 Days	37.3	22
Last 90 Days	47.8	27

b. Mishap Pilot 2

MP2 was a current and qualified Command Pilot with 3,647.2 total C-130 hours, including 402.8 instructor hours and 52.6 evaluator hours (Tabs G-25, G-29). MP2 joined the NCANG after his service on active duty. Since that time, he deployed five times in support of OEF/OIF conducting 375 sorties and recording 707.8 hours in theater (Tab DD-53).

MP2's flight time for the 90 days before the mishap (Tab G-26):

MP2	Hours	Sorties
Last 30 Days	12.8	6
Last 60 Days	23.8	15
Last 90 Days	31.1	19

c. Mishap Navigator

MN was a current and qualified Senior Navigator with 2,200.5 total C-130 hours, including 69.6 instructor hours (Tabs G-42, G-46). MN recently joined the NCANG after ten years on active duty where he achieved an evaluator qualification (Tab V-35.9). While on active duty, MN deployed numerous times to support humanitarian relief efforts both domestically and abroad (Tab DD-53).

MN's flight time for the 90 days before the mishap (Tab G-43):

MN	Hours	Sorties
Last 30 Days	7.2	2
Last 60 Days	16.6	11
Last 90 Days	16.6	11

d. Mishap Engineer

ME was a current and qualified Chief Airman Aircrew Flight Engineer with 7,866.5 total C-130 hours, including 677.4 instructor hours and 31.8 evaluator hours (Tabs G-57, G-61). ME deployed five times in support of OEF/OIF conducting a total of 567 sorties and recording a total of 832.9 flight hours (Tab DD-53).

ME's flight time for the 90 days before the mishap (Tab G-58):

ME	Hours	Sorties
Last 30 Days	22.5	10
Last 60 Days	41.7	27
Last 90 Days	49.6	31

e. Mishap Loadmaster 1

ML1 was a current and qualified Chief Airman Aircrew Loadmaster with 13,219.5 total C-130 hours, including 1,623.3 instructor hours and 489.8 evaluator hours (Tabs G-72, G-76).

ML1's flight time for the 90 days before the mishap (Tab G-73):

ML1	Hours	Sorties
Last 30 Days	28.5	16
Last 60 Days	67.2	38
Last 90 Days	77.3	44

f. Mishap Loadmaster 2

ML2 was a current and qualified Senior Airman Aircrew Loadmaster with 1,917.6 total C-130 hours, including 26.3 instructor hours (Tabs G-88, G-91).

ML2's flight time for the 90 days before the mishap (G-89):

ML2	Hours	Sorties
Last 30 Days	11.6	4
Last 60 Days	13.7	5
Last 90 Days	17.1	7

9. MEDICAL

a. Qualifications

At the time of the mishap, all members of the MC had current annual physical examinations and were medically qualified for flight duty without restrictions (Tabs X-3, X-4). MP1, ME and ML1 had current and valid medical waivers (Tabs X-3, X-4). MN had an expired medical waiver, however, the condition was stable and not relevant to the mishap (Tab X-3).

b. Health

The AIB medical member reviewed all available medical records as well as the written histories documenting MP1, MP2, MN and ME's health and well-being for the 72-hour and 14-day time periods prior to the mishap (Tabs X-3, X-4). The MC were all in good health and there was no evidence any medication or medical condition contributed to the mishap (Tabs X-3, X-4). Additionally, evidence provided by a USAF flight surgeon from the 145th Medical Group who had been the Mishap Squadron Medical Element flight surgeon until recently, and knew the MP1, MP2, ME and ML1 personally and professionally, did not reveal any known medical conditions (Tab X-11).

The AIB medical member reviewed post-mishap medical records for ML1 and ML2. The medical records revealed extensive injuries directly related to the mishap (Tab X-9).

c. Pathology and Toxicology

On 2 July 2012, post-mishap toxicology specimens were obtained from ML1 and ML2. During autopsy, toxicology specimens were obtained from the remains of MP1, MP2, MN and ME (Tabs X-5, X-6). All specimens were sent for examination for carbon monoxide (CO), cyanide, volatiles (including alcohol) and drugs (Tab X-5). Specimens from MP2, MN and ME were not adequate for detection of CO or cyanide (Tabs X-5, X-6).

CO levels in ML1 and ML2 were slightly elevated however the CO level in the post-mortem specimen obtained from MP1 was within normal limits (Tab X-6). This indicates ML1 and ML2's carbon monoxide exposure resulted from breathing post-mishap smoke rather than any pre-mishap inhalation (Tabs X-5, X-6). The toxicology specimen from ML1 contained a trace presence of morphine (Tab X-6). However, ML1 had been hospitalized and administered morphine for pain control prior to the specimen being obtained (Tab X-6). There is no evidence that CO, cyanide, volatiles (including alcohol) or drugs contributed to the mishap.

The AIB medical member reviewed autopsy reports completed at the Armed Forces Medical Examiner System, Dover AFB, Delaware (Tab X-7). The remains of MP1, MP2, MN, and ME were positively identified (Tab X-7). Based on the evidence, MP1, MP2, MN and ME died during the crash impact, before the post-crash fire. This evidence includes: autopsy lung tissue samples, lack of detectable products of combustion, including CO, in MP1, and the non-survivable injury findings in all four flight deck crewmembers (Tabs X-5 to X-7).

d. Lifestyle

No lifestyle factors were found to be relevant to the mishap (Tabs X-3, X-4, X-11).

e. Crew Rest and Crew Duty Time

AFI 11-202, Volume 3, *General Flight Rules*, 22 October 2010, requires aircrew members have proper "crew rest" prior to performing flight duties. AFI 11-202 defines normal crew rest as a minimum 12-hour non-duty period before the designated flight duty period begins. During this time, an aircrew member may participate in meals, transportation or rest, as long as they have the opportunity for at least eight hours of uninterrupted sleep.

Based on review of the flight deck crew's 72-hour histories and interviews with ML1 and ML2, no crew rest or crew duty time requirements were violated or found to be a factor in the mishap (Tabs X-3, X-4, V-29.1 to 29.24, V-34.1 to 34.20). There was no evidence that fatigue was a factor in the mishap.

10. OPERATIONS AND SUPERVISION

a. Operations

The MC demonstrated exceptional commitment to the MAFFS mission by immediately responding to the activation (Tabs V-18.9 V-18.10, DD-15, DD-27). In 2012, the squadron maintained a relatively high operations tempo but it was not out of the ordinary (Tabs V-18.9, V-18.10). In late March 2012, the unit returned from a 120-day OEF deployment (Tab V-29.7). In May 2012, the unit conducted MAFFS annual refresher training, which coupled with normal flying currency, followed by MAFFS activation two days prior to the mishap maintained, a high operations tempo (Tabs V-18.9, V-18.10, V-29.9, DD-15, DD-27). However, the MC was prepared and ready for the MAFFS deployment. Overtasking is not a factor in this mishap.

MP1 had limited experience flying MAFFS sorties as an Aircraft Commander (AC), but he was crewed with MP2, a more experienced MAFFS AC, who was also a MAFFS Instructor Pilot (Tabs V-18.9, V-18.10, DD-63). MN was on his first MAFFS rotation but he had ten years of active duty flying experience as a navigator (Tabs V-18.9, V-18.10, V-35.6, V-35.9). ML1 and ME were seasoned veterans with approximately 21,000 hours of combined flight time (Tabs G-57, G-72). ML1 was mentoring ML2 who had above-average experience in the MAFFS mission (Tab V-29.6). The crew as a whole was very experienced. Due to the infrequent activation of MAFFS, pairing seasoned crewmembers with less experienced members is the safest method to get junior crewmembers practical experience (Tabs V-18.9, V-18.1, V-29.6, DD-63). The operations tempo of the 156 AS was no different from other MAFFS units (Tab DD–63). Crew experience level was not a factor in the mishap.

b. Supervision

Due to its unique nature, the responsibility for the oversight of executing a MAFFS mission is two-fold. First, for all MAFFS activated units, tactical control is formally delegated to the AEG, in Boise, Idaho (Tabs V-36.4, V-38.13, BB-110, BB-111). Second, due to the need for swift reaction to live fires, the practical supervision of executing a MAFFS mission, by default, is under civilian control (Tab BB-123). An Incident Commander (IC) controls each fire area (Tab BB-123). An IC is responsible for developing the organizational structure necessary to manage the incident (Tab BB-123). The White Draw Fire IC and other members of the command center were located at Edgemont, South Dakota (Tab V-10.3). The IC for the White Draw Fire also had Air Operations Branch Director, AOD, who was responsible for advising the IC on the use of air assets (Tab V-6.3).

11. HUMAN FACTORS

a. Overview

A DoD taxonomy was developed to identify hazards and risks, called DoD Human Factors Analysis and Classification System (DoD-HFACS), referenced in Attachment 5 of AFI 91-204, Safety Investigations and Reports, 24 September 2008. This guide is designed for use as a comprehensive event, human error investigation, data identification, analysis and classification tool. It is designed for use by all members of the investigation board in order to accurately capture and recreate the complex layers of human error in context with the individual, environment, team and mishap. All human factors enumerated in Attachment 5 to AFI 91-204 were carefully analyzed for possible contribution to the mishap sequence. The relevant human factors are discussed below. The DoD-HFACS taxonomy nanocodes are also included for reference. There are four tiers of human factors: acts, preconditions, supervision and organization, each are discussed below (Tabs BB-8, BB-11, BB-25, BB-28).

MP1, MP2, MN and ME died in the mishap (Tabs X-7 to X-9). ML1 and ML2 survived but have varying recollection of the mishap events (Tabs V-29.13, V-34.4, V-34.18). Human factors are extrapolated from CVR data, witness testimony, radar logs, and reconstruction of the accident through a simulator. There is a certain level of uncertainty inherent in the human factors cited below.

b. Acts

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 situations (Tab BB-8).

(1) AE201 Risk Assessment – During Operation

Risk Assessment – During Operation is a factor when the individual fails to adequately evaluate the risks associated with a particular course of action and this faulty evaluation leads to an inappropriate decision and subsequent unsafe situation. This failure occurs in real-time when formal risk-assessment procedures are not possible (Tab BB-9).

As the MA approached the White Draw FTA, MP1, MP2, MN and ME recognized and avoided a nearby thunderstorm (Tab EE-3). While loitering, ME and MP2 commented on lightning and realized the thunderstorm was within 10 NM (Tabs EE-15, EE-16). They also heard HELO3 moving to avoid the storm (Tab EE-17). During the show me run, MP1 and MP2 noticed “a little bit of rain” (Tab EE-20). At the same time, the crew of Air Attack, ATGS and AA3, experienced “more than moderate” turbulence and, in an effort to avoid the turbulence, descended from 9,500 to 7,000 ft MSL (Tab EE-20). MP1, MP2, MN and ME acknowledged the turbulence comment by Air Attack (Tab EE-20). On the first retardant drop, despite the use of full power, the MA came in 10 knots slower than planned and was slow to respond to the application of power. MP1, commenting on the drop execution, stated, he “was not liking the way that was feeling” (Tabs EE-23, EE-24, EE-25).

While preparing for the mishap drop, ME recognized the sky was "getting darker," the fire was more visible, and ATP indicated, "got some pretty bad turbulence here" (Tab EE-29). Referencing the storm, ME stated that "thing got bigger" and MP2 then stated, "that thing is moving into the fire" (Tab EE-29). ME also commented "The wind picked up. Started the blaze going good" indicating the surface winds increased which, in turn, intensified the fire activity (Tab EE-29).

c. Preconditions

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 (Tab BB-11).

(1) PC214 Response Set

Response Set is a factor when the individual has a cognitive or mental framework of expectations that predispose them to a certain course of action regardless of other cues (Tabs BB-16, BB-17).

As the second drop was planned to occur less than five minutes after the first successful drop, it is highly probable the MC continued preparing for the second drop with the expectation that the operational conditions would remain similar, despite deteriorating weather conditions (Tabs M-3, M-4, EE-15, EE-28, EE-29). MAFFS aircrew members attested that a call for a go around is most commonly heard regarding misalignments for drops rather than urgent situations (Tabs V-21.6, V-23.7, V-40.17). It is possible that ATP's call for a go around while meant to abort the mishap drop, was not interpreted by the MC as significantly urgent, based on their prior experience (Tabs V-21.6, V-23, V-40.10, V-40.17).

(2) PP106 Communicating Critical Information

Communicating Critical Information is a factor when known critical information was not provided to appropriate individuals in an accurate or timely manner (Tab BB-23).

As Air Attack approached the White Draw FTA, AA3 observed virga beneath the clouds and experienced severe turbulence (Tabs R-136, R-141, V-7.8, V-43.9, V-43.10, EE-20). However, when relaying this information over the FTA frequency, the crew of Air Attack did not report the virga and only described the turbulence as "more than moderate" (Tab EE-20).

Prior to ATP calling the go around, ATGS witnessed the White Draw Fire "sheeting" and "running hard," and "the smoke was laying down," indicating extremely strong surface winds (Tabs R-85, R-101, R-136, R-140, V-7.8, V-7.10, V-43.10). Additionally, Air Attack encountered sudden updrafts and downdrafts with airspeed fluctuations between 20 to 40 knots, which forced the aircraft into bank angles of approximately 90 degrees (Tabs R-140, V-7.8, V-43.10).

The primary responsibility of the Air Attack crewmembers, AA3 and ATGS, was to circle at the top of the FTA and manage the incident airspace by controlling air traffic (Tabs V-38.12, V-39.4). As such, AA3 and ATGS were in the best position to ascertain and relay operational conditions however, they did not report the virga, sheeting fire, drastically increased surface winds and severe turbulence (Tabs R-136, R-141, V-7.8, V-43.9, V-43.10, EE-20).

The primary mission of the lead plane pilot in a FTA is to ensure the safe, efficient and effective use of air tankers in the management of wildland fires (Tabs V-38.11, V-38.12). Just prior to the mishap, Lead B-5 experienced a severe and sudden loss of altitude (Tab V-40.10). However, other than ATP stating, "I got to go around" the crew of Lead B-5 did not report critical information regarding the severe conditions encountered (Tab EE-29). For the 12 seconds after announcing the go around, ATP struggled to recover the aircraft (Tabs V-40.10, V-40.11, V-40.21). After recovering, ATP calmly advised the MC to "drop your load when you can" (Tab EE-29).

d. Supervision

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 an individual and result in human error or an unsafe situation (Tab BB-25).

(1) SP004 Limited Total Experience

Limited Total Experience is a factor when a supervisor selects an individual who has performed a maneuver, or participated in a specific scenario, infrequently or rarely (Tab BB-26).

The overall flying experience of the MC was high (Tab X-11). However, MP1 had limited experience as a MAFFS aircraft commander and MN was participating in his first MAFFS mission (Tabs V-18.10, V-35.9). MP1 was a current and qualified Senior Pilot with over 1,900 total C-130 hours, however prior to the day of the mishap he had accomplished only seven drops as a MAFFS copilot and zero drops as a MAFFS aircraft commander (Tabs G-6, G-7, G-10, DD-63). MN was a current and qualified Senior Navigator with over 2,200 total C-130 hours, however as this was MN's first MAFFS mission, he had participated in zero MAFFS drops prior to the day of the mishap (Tabs G-42, G-46, V-35.6, 35.9, DD-63).

e. Organizational Influences

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 (Tab BB-28).

(1) 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 thus creates an unsafe situation (Tabs BB-30, BB-31).

(a) Conflicting guidance applicable to weather avoidance

AFI 11-2C-130, Volume 3, *C-130 Operations Procedures*, 23 April 2012, paragraph 6.21.3.1.3, directs avoidance of thunderstorms:

> by five nautical miles for tactical low-level operations below flight level 23,000 ft MSL, provided the outside air temperature is at or above 0° Celsius at flight altitude. Avoid gusts fronts and winds preceding a rapidly moving thunderstorm.

Additionally AFI 11-2C-130, Volume 3, paragraph 6.21.3.1.4 cautions,

> Aircraft damage may occur up to 20 NMs from any thunderstorms. Aircrews must familiarize themselves with information on thunderstorm development and hazards.

Memorandum from NGB/A3 dated, 20 July 10 states:

> Weather Avoidance: until bonding measures are accomplished, the MAFFS II nozzle assembly creates an increased risk of lightning strikes. Avoid thunderstorms by at least 25 NM when any portion of the MAFFS II unit extends outside the aircraft (Tab BB-125).

The MA was operating well within 10 NM of a thunderstorm when the mishap occurred (Tabs EE-15, EE-16). However, because the MA was equipped with the nozzle assembly unit outside the aircraft, the MC should have avoided all thunderstorms within 25 NM IAW the NGB/A3 memorandum (Tab BB-125).

Post-mishap, multiple aircrew members from the mishap unit were uncertain which guidance was controlling on 1 July 2012 (Tabs V-18.3, V-21.6, V-23.9, V-25.12, V-26.7, V-27.6, V-28.10, V-35.8). Witness accounts also varied regarding the emphasis provided to the NGB memorandum (Tabs V-18.3, V-21.6, V-23.9, V-25.12, V-26.7, V-28.10, V-35.8). These varying accounts indicated a lack of understanding as to what guidance controlled during live MAFFS operations on 1 July 2012.

(b) Unsafe Pre-Slowdown Checklist

The C-130H MAFFS Operations Cockpit Crew Checklist, Page 2, Pre-Slowdown Checklist, Item 8 states:

> GCAS/GPWS Circuit Breaker(s) – Pulled (On Some Airplanes) (E) (Tab BB-127).

Accomplishing this step at this time during the drop sequence is considered unsafe (Tabs V-17.6, V-33.6, V-33.7). Pulling this circuit breaker disables the Traffic Collision Avoidance System which is critical regarding situational awareness of all aircraft in the area, including the lead plane (Tabs V-17.6, V-33.6 V-33.7). In practice, pulling this circuit breaker is delayed until the MAFFS pilot has visually acquired the lead plane (Tabs V-17.6, V-22.9, V-33.6, V-33.7). This last item had no direct effect on the mishap, but is significant in regards to aircraft safety.

(2) OP004 Organizational Training Issues/Programs

Organizational Training Issues/Programs are a factor when one-time or initial training programs, upgrade programs, transition programs or other training that is conducted outside the local unit is inadequate or unavailable and this creates an unsafe situation (Tab BB-31).

IAW Forest Service Instruction (FSI) 12-001, *MAFFS Operating Plan*, 24 February 2012, paragraph 2.5.1.1, requires MAFFS flight crews attend a training exercise with USFS personnel at home station on a biennial basis. However, FSI 12-001 also requires annual currency, which can be regained by dropping at least three retardant loads on a live fire.

Prior to FY2012, annual MAFFS refresher training was done as a mass training event with all four MAFFS units (Tabs V-23.5 to V-23.7, V-38.5). The training rotated annually varying geographical locations throughout the US (Tabs V-23.5 to V-23.7, V-38.5). As of 2012, annual training guidelines for MAFFS squadrons directed, local training at each of the four MAFFS unit (Tabs R-244, R-251, V-8.6, V-8.7, V-18.7).

Local training did not include different terrain conditions, density altitudes and congested pit operations, all of which are essential components in order to comprehend what live MAFFS operations entail. Additionally, all four MAFFS units were not integrated in order to provide a more realistic learning environment for new and seasoned MAFFS crewmembers (Tabs V-8.11, V-18.8).

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Flight Operations

1. AFI 11-2C-130, Volume 1, *C-130 Aircrew Training*, 30 April 2010*
2. AFI 11-2C-130, Volume 2, *C-130 Aircrew Evaluation Criteria*, Change 1, 3 February 2010*
3. AFI 11-2C-130, Volume 3, *C-130 Operations Procedures*, 23 April 2012*
4. AFI 11-2C-130, Volume 3, *Addenda A, C-130 Operations Configurations/Mission Planning*, 13 August 2009*
5. AFI 11-202, Volume 3, *General Flight Rules*, 22 October 2010*
6. AFI 11-401, *Aviation Management*, 10 December 2010*
7. TO 1C-130(K)H-1, *Flight Manual*, Change 12, 14 May 2012
8. TO 1C-130H-1-1, *Flight Manual*, Change 16, 17 July 2012
9. TO 1C-130(K)H-1CL-1, *Pilot's Flight Crew Checklist*, Change 9, 21 June 2012
10. TO 1C-130(K)H-1-CL-2, *Engineer's Flight Crew Checklist*, Change 8, 14 May 2012
11. TO 1C-130(K)H-1CL-3, *Navigator's Flight Crew* Checklist, Change 6, 14 May 2012
12. TO 1C-130(K)H-1CL-4, *Loadmaster's Flight Crew Checklist*, Change 6, 11 July 2011
13. TO 1C-130A-9, *Cargo Loading Manual*, Change 6, 26 October 2011

b. Maintenance

1. AFI 21-101, *Aircraft and Equipment Maintenance Management*, 26 July 2010*
2. AFI 21-103, *Equipment Inventory, Status and Utilization Reporting*, 26 January 2012*

3. TO 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures*, 15 June 2011
4. TO 1C-130A-6WC-10, *Preflight Inspection*, Change 2 – 15 May 2012
5. TO 1C-130A-6WC-11, *Thruflight Inspection*, Change 2 – 1 May 2012
6. TO 1C-130A-6WC-12, *Postflight Inspection*, Change 2 – 15 May 2012
7. TO 1C-130A-6WC-13, *Pre-Post Inspection*, Change 2 – 1 June 2012
8. TO 1C-130A-6WC-14, *Home Station Check*, Change 2 – 1 May 2012
9. TO 1C-130A-6WC-15A-3, Operational Supplement, *Minor and Major Isochronal Inspection*, 15 June 2012
10. TO-1C-130H-2-25JG-00-1, *Equipment and Furnishings*, Change 48 – 15 March 2012
11. TO 1C-130H-2-25GS-00-1, *Equipment and Furnishings*, Change 21 – 15 February 2012
12. TO 1C-130H-2-27GS-00-1, *Flight Control Systems*, Change 12 – 15 December 2012
13. TO-1C-130H-2-31GS-00-1, *Indicating and Recording System*, Change 17-1 March 2012
14. TO 1C-130H-2-31GS-00-1, *Indicating and Recording System*, Change 17 – 1 March 2010

c. Other Directives and Publications

1. Aero-Union Corp., *Operations Manual*, 12 December 2008 (Change 1 – 16 January 2009)
2. AETC Handout, *Flying Training*, *Introduction to Aerodynamics*, January 2002
3. AFI 48-123, *Medical Examinations and Standards*, Change 2, 18 October 2011*
4. AFI 51-503, *Aerospace Accident Investigations*, 26 May 2010*
5. AFI 51-503, AMC Supplement, *Aerospace Accident Investigations*, 18 May 2012*
6. AFI 91-204, *Safety Investigations and Reports*, 24 September 2008*
7. AFWA, Technical Note 98/002, *Meteorological Techniques*, 13 February 2012
8. FSI *12-001*, *MAFFS Operating Plan*, 24 February 2012
9. Memorandum from NGB/A3, *Modular Airborne Fire Fighting (MAFFS) II, Operational Approval*, with attachments, 20 July 2010
10. NIFC, *Interagency Standards for Fire and Fire Aviation Operations*, January 2012
11. NIFC, *Military Use Handbook*, NFES 2175, July 2006
12. NIFC, *National Interagency Mobilization Guide*, NFES 2092 - March 2012
13. NWCG, *Interagency Aerial Supervision Guide*, PMS 505, NFES 2544, January 2011
14. USNORTHCOM, *Wildland Firefighting (WFF) Concept of Operations*, May 2010

*Available digitally at: *http://www.e-publishing.af.mil.*

d. Known or Suspected Deviations from Directives or Publications

Except as described above, there were no known or suspected deviations relevant to the cause of the mishap.

13. ADDITIONAL AREAS OF CONCERN

None.

27 October 2012

Brig Gen, USAFR
President, Accident Investigation Board

STATEMENT OF OPINION

C-130H3, T/N 93-001458
EDGEMONT, SOUTH DAKOTA
1 JULY 2012

Under 10 U.S.C. § 2254(d), the opinion of the accident investigator 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 the cause of the mishap was Mishap Pilot 1 (MP1), Mishap Pilot 2 (MP2), Mishap Navigator (MN) and Mishap Flight Engineer's (ME) inadequate assessment of operational conditions, resulting in the MA impacting the ground after flying into a microburst. Additionally, I find by the preponderance of evidence, the failure of the White Draw Fire Lead Plane aircrew and Air Attack aircrew to communicate critical operational information; and conflicting operational guidance concerning thunderstorm avoidance, substantially contributed to the mishap.

On 1 July 2012, at approximately 1738 Local time (L), a C-130H3, T/N 93-1458, assigned to the 145th Airlift Wing, North Carolina Air National Guard, Charlotte Douglas International Airport (KCLT), Charlotte, North Carolina, crashed on public land controlled by the United States Forest Service (USFS), while conducting wildland firefighting operations near Edgemont, South Dakota.

At the time of the mishap all members of the Mishap Crew (MC) were assigned or attached to the 156th Airlift Squadron, based at KCLT. The MC consisted of MP1, MP2, MN, ME, Mishap Loadmaster 1 (ML1) and Mishap Loadmaster 2 (ML2). For the mishap sortie, MP1 was the aircraft commander and pilot flying in the left seat. MP2 was in the right seat as the instructor pilot. MN occupied the navigator station on the right side of the flight deck behind MP2. ME was seated in the flight engineer seat located between MP1 and MP2, immediately aft of the center flight console. ML1 and ML2 were seated on the MAFFS unit, near the right paratroop door. ML1 occupied the aft Modular Airborne Fire Fighting System (MAFFS) control station seat and ML2 occupied the forward MAFFS observer station seat.

After three uneventful sorties, the Mishap Aircraft (MA) entered the White Draw Fire Traffic Area (FTA) in South Dakota. The lead plane for the MA was Lead B-5. Lead planes are responsible for the safe, effective and efficient use of air tanker operations within an FTA. A lead plane is also responsible for leading air tankers to a low-level, where fire retardant can be safely dispensed. Air Tactical Pilot (ATP) piloted Lead B-5 from the left seat and Air Tactical Supervisor (ATS) occupied the right seat. ATS initially acted as the airspace manager for the White Draw FTA. However, prior to conducting the retardant drops a third aircraft, Air Attack, entered the White Draw FTA and took over airspace management duties. Air Attack 3 (AA3) piloted Air Attack from the left seat and Air Tactical Group Supervisor (ATGS) was in the right seat.

Upon entering the FTA, the MC noticed a thunderstorm and witnessed lightning between 10 and 20 nautical miles away. ATP determined two retardant drops were needed. Lead B-5 and the MA performed the first drop precisely on target, but the MA's airspeed was 10 knots slower than planned. As the MA positioned for the second drop, ME and MN noticed an increase in fire activity and surface winds changing in both velocity and direction. Lead B-5 then experienced a rapid "sinker" and ATP stated, "I got to go around." ATP struggled to keep Lead B-5 under control. In response, MP2 commanded a go-around "out of this" and MP1 pushed the throttles up. Twelve seconds later, ATP advised the MC to dump their load and the MC complied. Despite MA engines at maximum power, airspeed and altitude continued to deteriorate, ultimately resulting in the mishap. The MA impacted lightly-wooded, rolling terrain and slid through a tree-lined ravine which was approximately eight feet deep, before stopping roughly 410 feet (ft) from the initial point of ground impact. MP1, MP2, MN and ME died in the mishap. ML1 and ML2 survived, but suffered significant injuries.

The mishap aircraft (MA) and a USFS-owned MAFFS unit were destroyed. The monetary loss is valued at $43,453,295, which includes an estimated $150,000 in post aircraft removal and site environmental cleanup costs. There were no additional fatalities, injuries or damage to other government or civilian property.

2. DISCUSSION OF OPINION

a. Cause: MP1, MP2, MN and ME's inadequate assessment of operational conditions

Despite multiple objective indicators of deteriorating operational conditions, MP1, MP2, MN and ME inadequately assessed the sum of the individual cues in time to successfully abort the mishap drop. As the MA approached the FTA, MP1, MP2, MN and ME recognized and avoided the nearby thunderstorm. While loitering, MP2 and ME commented on lightning and the thunderstorm within 10 NM. During the "show me" run, MP1 and MP2 noticed "a little bit of rain." A "show me" run aids MAFFS aircrew in identifying the retardant drop path, potential hazards and establishing an escape route. At the same time, the aircrew of Air Attack, ATGS and AA3, relayed they were experiencing "more than moderate" turbulence and descended from 9,500 to 7,000 ft above mean sea level (MSL), to avoid the turbulence. On the first retardant drop, the MA approached the drop 10 knots slower than planned, the aircraft was sluggish to respond despite the use of full power, after the drop MP1 commented, he "didn't like how that felt."

While maneuvering for the mishap drop, ME commented the sky was "getting darker," and "you can see that fire a lot better now." About a minute later, turning to the final drop heading, ME, commenting on the fire stated, "looks like that thing got bigger." MP2, referring to storm activity stated, "that thing is moving into the fire." The ME also noticed the surface winds had "picked up" and the fire was blazing. As the MA lined up for the mishap drop behind Lead B-5, MP2 saw Lead B-5 get "all backed up," and ATP simultaneously announced "I got to go around." In response, MP2 immediately commanded a go around "out of this." ATP called the “go around” because he hit a “bad sinker,” and rapidly lost altitude and airspeed, at one point coming within 10 ft of impacting the ground.

Approximately 13 seconds after ATP’s go around call, ATP stated, “Dump your load when you can” and MP2 immediately complied. MP1 and MP2 applied full power, ME closed the bleeds, but the MA continued to descend. As the MA dropped below radar coverage, it was observed in an extremely nose high attitude, indicating MP1 was attempting to avoid impact. At that point, despite the mishap crew’s best efforts and the use of aircraft maximum power, the MA crashed.

The approaching thunderstorm created a phenomenon known as a dry microburst. A dry microburst is a severe localized wind, blasting down from a thunderstorm that most commonly occur in semiarid regions. While a dry microburst is a unique weather phenomenon, there were multiple objective cues of the deteriorating operational conditions for MP1, MP2, MN and ME to recognize the unsafe situation and abort the mishap drop.

Prior to the mishap drop, MP1, MP2, MN and ME acknowledged the approaching thunderstorm, witnessed lightning, heard Air Attack report “more than moderate” turbulence. Additionally, on the first retardant drop, after dropping 10 knots below targeted speed, the MA responded sluggishly despite the use of maximum power. Finally, as the MA approached the mishap drop, MP1, MP2, MN and ME acknowledged darker skies, increased surface winds and fire activity, and MP2 saw Lead B-5 get “backed up” and rapidly lose altitude.

b. Substantially Contributing Factors

(1) Failure to communicate critical information

As Air Attack approached the White Draw FTA, AA3 observed virga beneath the clouds and experienced severe turbulence. However, when relaying this information over the FTA frequency, AA3 failed to report the virga and described the turbulence as “more than moderate.”

Prior to ATP calling go around, ATGS witnessed the White Draw Fire “sheeting” and “running hard,” and “the smoke was laying down,” indicating extremely strong surface winds. Additionally, Air Attack encountered sudden updrafts and downdrafts with airspeed fluctuations between 20 to 40 knots, which forced the aircraft into bank angles of approximately 90 degrees.

The primary responsibility of the Air Attack crewmembers, AA3 and ATGS, was to circle at the top of the FTA and manage the incident airspace by controlling air traffic. As such, AA3 and ATGS were in the best position to ascertain and relay operational conditions however, they failed to report the virga, sheeting fire, drastically increased surface winds and severe turbulence.

The primary mission of the lead plane aircrew in a FTA is to ensure the safe, efficient and effective use of air tankers in the management of wildland fires. Just prior to the mishap, Lead B-5 experienced a severe and sudden loss of altitude. However, other than ATP stating, “I got to go around” the aircrew of Lead B-5 failed to report critical information regarding the severe conditions encountered. For the 12 seconds after announcing the go around, ATP struggled to recover the aircraft and presumably was unable to relay information to the MC. However, after recovering, ATP calmly advised the MC to “drop your load when you can.” The aircrew of Lead

B-5 again failed to communicate critical information regarding the severe conditions they had encountered.

(2) Conflicting operational guidance

At the time of the mishap, there was conflicting operational guidance regarding aircraft weather avoidance. On 20 July 2010, the National Guard Bureau (NGB) disseminated a memorandum to Air National Guard MAFFS operating groups, this included the 145th Operations Group, Charlotte, North Carolina. The memorandum declared the MAFFS II unit operational and established MAFFS II interim C-130H Operating Procedures. Due to an increased risk of lightning, the memorandum required MAFFS II equipped aircraft to avoid thunderstorms by at least 25 NM when any portion of the MAFFS II unit extends outside the aircraft.

In contrast, Air Force Instruction (AFI) 11-2C-130 Volume 3, *C-130 Operations Procedures*, dated 23 April 2012, paragraph 6.21.3.1.3, required C-130 aircraft flying in tactical low-level operations to remain at least five NM from thunderstorms. Additionally, the AFI advised avoiding winds preceding a rapidly moving thunderstorm and provided a specific cautionary note that aircraft damage may occur up to 20 NM from any thunderstorm.

There was no standard interpretation amongst MAFFS aircrew from the 145 AW regarding the NGB memorandum. Furthermore, it is not clear what emphasis, if any, was given to the weather avoidance directive since it was issued.

Prior to 1 July 2012, the NGB guidance was never formalized in flight crew information files, flight crew bulletins or reconciled with the AFI. MP1, MP2, MN and ME knowingly operated the MA within 10 NM of a thunderstorm during the mishap sequence however, there is no indication they willfully violated applicable guidance. Rather, the evidence supports the MC were arguably following the AFI guidance which authorized low-level tactical operations outside 5 NM of a thunderstorm. However, it is unlikely the MC would have been in a position to be affected by adverse weather if the MC understood the NGB memorandum was controlling.

3. CONCLUSION

I developed my opinion by inspecting the mishap site and wreckage, as well as analyzing factual data from the following: historical records, Air Force directives and guidance, USFS and Interagency guidance, reconstructing the mishap sortie in a C-130H3 simulator, engineering analysis, witness testimony, flight data, weather radar data, computer animated reconstruction, consulting with subject matter experts and information provided by technical experts. The failure of the Digital Flight Data Recorder severely complicated the recreation of the mishap, and impacted my ability to determine facts in this investigation.

I find by clear and convincing evidence the cause of the mishap was MPl, MP2, MN and ME's inadequate assessment of operational conditions, resulting in the MA impacting the ground after flying into a microburst. Additionally, I find by the preponderance of evidence, the failure of the White Draw Fire Lead Plane aircrew and Air Attack aircrew to communicate critical operational information; and conflicting operational guidance concerning thunderstorm avoidance, substantially contributed to the mishap.

27 October 2012

Brig Gen, USAFR
President, Accident Investigation Board