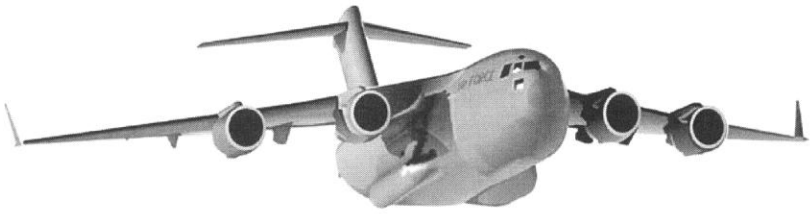
UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION
BOARD REPORT

C-17A, T/N 07-7189

437TH AIRLIFT WING
JOINT BASE CHARLESTON, SOUTH CAROLINA



LOCATION: FOB SHANK, AFGHANISTAN

DATE OF ACCIDENT: 23 JANUARY 2012

BOARD PRESIDENT: COLONEL KEVIN A. OLIVER

Conducted in accordance with Air Force Instruction 51-503

EXECUTIVE SUMMARY

AIRCRAFT ACCIDENT INVESTIGATION
C-17A, T/N 07-7189
FOB SHANK, AFGHANISTAN
23 JANUARY 2012

On 23 January 2012, at approximately 0749 Zulu (1219 Local), a C-17A Globemaster III aircraft, tail number 07-7189, assigned to the 437th Airlift Wing, Joint Base Charleston, South Carolina, landed on runway 34R at Forward Operating Base (FOB) Shank, Afghanistan. The mishap aircraft (MA) was unable to stop, departed the prepared runway surface, struck an embankment, and came to rest approximately 700 feet from the end of the runway. The MA sustained damage to the landing gear, cargo floor, undercarriage, antennas, and main structural components. There were no passengers, fatalities, significant injuries, or damage to civilian or other military property. The estimated cost to repair the MA is $69.4 million.

The 816th Expeditionary Airlift Squadron, in support of Operation ENDURING FREEDOM, operated the MA from Al Udeid Air Base, Qatar. The mishap crew consisted of the Mishap Pilot (MP), Mishap Copilot (MCP), Mishap First Pilot, Mishap Loadmaster 1, and Mishap Loadmaster 2. Additionally, a Mishap Flying Crew Chief was assigned as mission essential personnel.

The accident investigation board (AIB) president found, by clear and convincing evidence, that the cause of the mishap was the MP and MCP failed to identify that the landing distance required to safely stop the aircraft exceeded the runway length. Additionally, the AIB president found by the preponderance of evidence, that failure to assess runway conditions for fixed wing operations at FOB Shank substantially contributed to the mishap.

SUMMARY OF FACTS AND STATEMENT OF OPINION

AIRCRAFT ACCIDENT INVESTIGATION
C-17A, T/N 07-7189
FOB SHANK, AFGHANISTAN
23 JANUARY 2012

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COMMONLY USED ACRONYMS AND ABBREVIATIONS

1st Lt	First Lieutenant
18AF	18th Air Force
AB	Air Base
AC	Aircraft Commander
ACIQ	Aircraft Commander Initial Qualification
ACO	Airspace Control Order
ADC	Area Defense Counsel
ADO	Assistant Director of Operations
ADS	Aerial Delivery System
ADVON	Advanced Echelon
AEG	Air Expeditionary Group
AF	Air Force
AFB	Air Force Base
AFCENT	Air Force Central Command
AFI	Air Force Instruction
AFIP	Air Force Institute of Pathology
AFPAM	Air Force Pamphlet
AFTO	Air Force Technical Order
AFTRANS	Air Force Transportation
AFTTP	Air Force Tactics, Techniques, and Procedures
AGL	Above Ground Level
AIB	Accident Investigation Board
AIP	Aeronautical Information Publication
AIT	Advanced Individual Training
ALZ	Assault Landing Zone
ANC	Aircraft Control Number
AOB	Aviation Operation Group
AOC	Air and Space Operations Center
AOR	Area of Responsibility
AMC	Air Mobility Command
AMD	Air Mobility Division
APU	Auxiliary Power Unit
AR	Army Regulation
AS	Airlift Squadron
ASC	Anti-skid Controller
ATC	Air Traffic Control
ATIS	Automatic Terminal Information Service
ATOC	Air Terminal Operations Center
ATSCOM	Air Traffic Services Command
ATT	Attitude Hold
AW	Airlift Wing
CAC	Common Access Card
C	CASA
Capt	Captain
CAOC	Combined Air and Space Operations Center
CENTCOM	Central Command
CIP	Core Integrated Processor
Col	Colonel
Comm	Communication
CP	Command Post
CRM	Crew Resource Management
CT2	Combat Tracker 2
CTO	Control Tower Operator
CW2	Chief Warrant Officer 2
DA	Department of the Army
DAFIF	Digital Aeronautical Flight Information File
DEP DIV CHIEF	Deputy Division Chief
Det	Detachment
DFAC	Dining Facility
DLC	Direct Lift Control
DO	Director of Operations
DDO	Deputy Director of Operations
DNIF	Duties Not Including Flying
DOD	Department of Defense
DOT	Department of Transportation
DSST	Direct Signal Support Team
EAS	Expeditionary Airlift Squadron
EAMS	Expeditionary Air Mobility Squadron
ERO	Engine Running Offload/Onload
FAA	Federal Aviation Administration
FAF	Final Approach Fix
FCB	Flight Crew Bulletin
FEF	Flight Evaluation Folder
FIH	Flight Information Handbook
FLS	Forward Landing Strip
FM	Field Manual
FOB	Forward Operating Base
FOD	Foreign Object Debris/Damage
FPM	Feet Per Minute
ft	Feet
GCA	Ground Control Approach
GDSS	Global Decision Support System
GPS	Global Positioning System
GRIP	Global Reach Improvement Program
GSO	General Service Officer
HHC	Headquarters and Headquarters Company
HLZ	Helicopter Landing Zone
HR	Human Resources
HSC	Home Station Check
HUD	Heads up Display
IAW	In Accordance With
ICAO	International Civil Aviation Organization
IFM	Integrated Flight Manager
IFR	Instrument Flight Rules
IMA	Individual Mobilization Augmentee
IR	Infared
ITDY	Indeterminate Temporary Duty
ITT	International Telephone & Telegraph
JO	Joint Order
kt(s)	Knot(s)
L	Local time
LA	Legal Advisor
LACM	Left Additional Crewmember
LAMS	Large Area Maintenance Structure
lbs	Pounds
LC	Local Controller
LCIP	Legacy Core Integrated Processor

LOGCAP	Logistics Civil Augmentation Program
LOX	Liquid Oxygen
Lt	Lieutenant
Lt Col	Lieutenant Colonel
LZ	Landing Zone
MA	Mishap Aircraft
Maj	Major
MAJCOM	Major Command
MATC1	Mishap Air Traffic Controller 1
MATC2	Mishap Air Traffic Controller 2
MC	Mishap Crew
MCP	Mishap Copilot
METARS	Meteorological Terminal Aviation Routine
MFCC	Mishap Flying Crew Chief
MFP	Mishap First Pilot
ML1	Mishap Loadmaster 1
ML2	Mishap Loadmaster 2
MLG	Main Landing Gear
MOS	Military Occupation Specialty
MP	Mishap Pilot
MPC	Mission Planning Cell
MS	Mishap Sortie
MSL	Mean Sea Level
MSgt	Master Sergeant
MTV	Medium Tactical Vehicle
N	Notice
NAF	Number Air Force
NCO	Noncommissioned Officer
NCOIC	Noncommissioned Officer In Charge
NLG	Nose landing gear
NM	Nautical Miles
NOTAM	Notice to Airmen
NTSB	National Transportation Safety Board
NVG	Night Vision Goggles
OBIGGS	On-Board Inert Gas Generating System
OCN	Other Country National
OEF	Operation ENDURING FREEDOM
OME	Operational Mission Evaluation
Ops	Operations
OPORD	Operations Order
OPR	Office of Primary Responsibility
ORM	Operational Risk Management
OSS	Operations Support Squadron
P&W	Pratt & Whitney
PA	Pressure Altitude
PA	Public Affairs
PAPI	Precision Approach Path Indicator
PAR	Precision Approach Radar
PAX	Passengers
PCO	Pilot Check Out
PDF	Portable Document Format
PFD	Predicted Flight Path Director
PHA	Physical Health Assessment
PIFR	Preferential Instrument Flight Route
PNC	Pavement Control Number
POC	Point of Contact
PR	Preflight
PTIDS	(Aerostat)
QAR	Quick Access Recorder
R	Right
R&R (R and R)	Rest and Relaxation
RACM	Right Additional Crewmember
RCR	Runway Conditions Reading
RNAV	Area Navigation
ROZ	Restricted Operating Zone
RPA	Remotely Piloted Aircraft
RSC	Runway Surface Condition
SA	Situational Awareness
SAA	Senior Airfield Authority
SAR	Search and Rescue
SC	South Carolina
SFDR	Standard Flight Data Recorder
SII	Special Interest Item
SIPR	Secret Internet Protocol Router
SK	Sikorsky
Spc	Specialist
SPINS	Special Instructions
SrA	Senior Airman
SOL	Special Operations Low Level
SOP	Standard Operating Procedure
STOL	Short Take Off and Landing
TACC	Tanker Airlift Control Center
TAF	Terminal Area Forecast
TAOG	Theater Aviation Operations Group
TAWS	Terrain Awareness and Warning System
TCAS	Traffic Collision Avoidance System
TCI	Time Change Item
TCTO	Time Compliance Technical Order
TF	Task Force
TH	Thru-Flight
T/N	Tail Number
TO	Technical Order
TOLD	Take Off and Landing Data
TOP	Tactical Operation Post
TMS	Training Management System
TR	Thrust Reverser
TRANSCOM	Transportation Command
UAS	Unmanned Aerial System
UAV	Unmanned Aerial Vehicle
U.S.	United States
USAF	United States Air Force
USB	Universal Serial Bus
VASI	Visual Approach Slope Indicator
Vbo	Maximum Brakes On Speed
VFR	Visual Flight Rules
VVI	Vertical Velocity Indication
WAP	Warning and Caution Annunciator Panel
WO1	Warrant Officer 1
XO	Executive Officer
Z	Zulu time

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

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 1 February 2012, Lieutenant General Robert R. Allardice, Vice Commander, Air Mobility Command (AMC) appointed Colonel Kevin A. Oliver to conduct an aircraft accident investigation of a mishap that occurred on 23 January 2012, involving a C-17A Globemaster III aircraft, tail number (T/N) 07-7189, at Forward Operating Base (FOB) Shank, Afghanistan. The investigation was conducted at Joint Base Charleston, South Carolina (SC), from 4 April 2012 through 2 May 2012 pursuant to Air Force Instruction (AFI) 51-503, *Aerospace Accident Investigations*, 26 May 2010. The following United States Air Force (USAF) personnel served as Accident Investigation Board (AIB) members (Tabs Y-3, Y-5, Y-6):

Colonel Kevin A. Oliver	Board President
Lieutenant Colonel (Redacted)	Airfield Management Member
Lieutenant Colonel (Redacted)	Medical Member
Major (Redacted)	Pilot Member
Major (Redacted)	Maintenance Member
Captain (Redacted)	Legal Advisor
Technical Sergeant (Redacted)	Recorder

b. Purpose

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

2. ACCIDENT SUMMARY

On 23 January 2012 at approximately 0749 Zulu (Z), a C-17A Globemaster III, T/N 07-7189, call sign Moose 89, landed on runway 34R at FOB Shank, Afghanistan (Tab EE-10). The Mishap Aircraft (MA) was unable to stop and departed the prepared runway surface (Tab EE-3). The mishap crew (MC) consisted of the Mishap Pilot/Aircraft Commander (MP), Mishap Copilot (MCP), Mishap First Pilot (MFP), Mishap Loadmaster 1 (ML1), and Mishap Loadmaster 2 (ML2). Additionally, a Mishap Flying Crew Chief (MFCC) was assigned as mission essential personnel (Tab K-2). After the mishap, the MC and MFCC exited the aircraft safely (Tabs V-20.14, V-24.9). There were no passengers, fatalities, significant injuries, or damage to civilian or other military property (Tab V-15.3). The MA sustained damage to the landing gear, cargo floor, undercarriage, antennas, and main structural components (Tabs S-12 to 14, S-17 to 19). The estimated cost to repair the MA is $69.4 million (Tab P-3).

3. BACKGROUND

The MA was assigned to the 437th Airlift Wing (AW), Joint Base Charleston, South Carolina. At the time of the mishap, the 816th Expeditionary Airlift Squadron (EAS), Al Udeid Air Base (AB), Qatar, operated the MA in support of Operation ENDURING FREEDOM (OEF) (Tabs K-2, K-3, EE-6). The 816 EAS reports to the 385th Air Expeditionary Group (AEG) and operates under the direction of the 618th Air and Space Operations Center (AOC)/Tanker Airlift Control Center (TACC). The MC was assigned to the 816 EAS, Al Udeid AB, Qatar (Tab K-3). FOB Shank airfield operations were controlled by Task Force (TF) Corsair, 3rd Battalion, 82d Aviation Regiment, 82d Combat Aviation Brigade, 82d Airborne Division, United States (U.S.) Army (Tab V-21.10).

a. Air Mobility Command

AMC, activated on 1 June 1992, is a major command (MAJCOM) headquartered at Scott Air Force Base (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, Air Force Reserve and Department of Defense (DoD) civilians make the command's rapid global mobility operations possible (Tab CC-3).

b. 18th Air Force

18 AF, headquartered at Scott AFB, Illinois, was reactivated 1 October 2003 as the operational component of AMC. It is AMC's only numbered air force (NAF) and the Air Force's largest NAF. 18 AF's mission is to present air mobility forces to combatant commanders. It is charged with carrying out AMC's operational role as Air Forces Transportation, the air component of U.S. Transportation Command (Tab CC-5).

c. 618th Air and Space Operations Center/Tanker Airlift Control Center

618 AOC/TACC is 18 AF's global AOC responsible for centralized command and control of Air Force and commercial contract air mobility assets 24-hours-a-day. It plans, schedules and tracks tanker, airlift and aeromedical evacuation aircraft worldwide to accomplish AMC's Global Reach mission (Tab CC-24).

d. 385th Air Expeditionary Group

The 385 AEG, based at Incirlik AB, Turkey, is comprised of deployed active duty, guard, and reserve Airmen. Comprised of three squadrons, its primary mission is to support the C-17 and KC-135 airlift and refueling mission in the wartime area of responsibility (AOR). The 385 AEG also provides humanitarian relief in the form of cargo, food, and critical air medical evacuation (Tab CC-22).

e. 816th Expeditionary Airlift Squadron

The 816 EAS executes missions as directed by 18 AF in support of U.S. Central Command. 816 EAS is assigned to the 385 AEG as a forward-deployed organization, a segment of the larger AMC effort originating out of U.S. based cargo hubs like Joint Base Charleston (Tabs CC-11, CC-12).

f. 437th Airlift Wing

With more than 50 assigned C-17A Globemaster III aircraft, the 437 AW provides a significant portion of AMC's Global Reach airlift capability. The precise, flexible and responsive air mobility capability provided by the wing backs U.S. resolve and promotes worldwide stability. The 437th Airlift Wing's mission is to safely provide precise, reliable airlift – worldwide, and its vision is to continue as the Nation's Airlift Wing of choice – proven excellence, leading through innovation. The wing commands assigned airlift and supporting units to maintain assigned C-17A aircraft, load and unload passengers, out-sized equipment, bulk cargo and aeromedical evacuation. The Wing delivers passengers, equipment and supplies whenever and wherever required via airland or airdrop missions. The 437 AW trains and executes the only C-17A special operations capability in the Air Force (Tab CC-7).

g. Task Force Corsair

Embedded under TF Pegasus, TF Corsair's mission is International Security Assistance Force, Regional Command - South, and Operation Enduring Freedom forces to enable freedom of movement and sustain combat operations and thereby contribute to the legitimacy of the government of the Islamic Republic of Afghanistan (Tab CC-17).

h. Aircraft

The C-17A is capable of rapid strategic delivery of troops and all types of cargo to main operating bases or directly to forward bases in the deployment area. The aircraft can perform tactical airlift and airdrop missions and can transport litters and ambulatory patients during aeromedical evacuations when required. The inherent flexibility and performance of the C-17A force improve the ability of the total airlift system to fulfill the worldwide air mobility requirements of the U.S. (Tab CC-13).

4. SEQUENCE OF EVENTS

a. Mission

The mishap mission was conducted in support of OEF and was planned to consist of three sorties (Tab K-3). The first sortie was from Al Udeid AB, Qatar, to Kuwait City International Airport, Kuwait, and was uneventful (Tab V-23.8). The second sortie carried 111,498 pounds (lbs) of cargo from Kuwait City International to FOB Shank (Tabs K-3, K-28). The final sortie, a return flight from FOB Shank to Al Udeid AB, Qatar, was cancelled due to the mishap (Tab V-8.5). The MC was authorized to conduct the mission by the 816 EAS Director of Operations (DO) (Tab K-2).

b. Planning and Preflight

On 8 January 2012, initial mission planning was completed by the Tanker Airlift Control Center (TACC) Integrated Flight Manager (IFM) section at Scott AFB, Illinois (Tabs K-9, V-10.8). TACC mission planning duties included an operational risk assessment (Tab V-10.6). TACC rated the mission risk as high on the Operational Risk Management (ORM) worksheet due to the planned crew show time (Tab K-9). The TACC risk assessment did not evaluate risk for aircraft weight, landing distance, or runway length (Tab V-10.10).

On 22 January 2012, at approximately 1030Z (fourteen hours prior to initiation of the mishap mission) the MC was put into crew rest at Al Udeid AB, Qatar (Tab V-20.3). At approximately 2045Z (three hours and forty-five minutes prior to the mishap mission), the MC was alerted to report for duty (Tab V-20.4). At approximately 2130Z, the crew reported for duty at the 816 EAS operations building (Tab V-20.4). Once the MC arrived at the 816 EAS operations building, they received the mission products, including the mission schedule, flight plan, computer flight plan, weather, ORM worksheet, and NOTAMs (Tabs K-3 to K-19, V-20.4). After reviewing the mission products, the MP called TACC to discuss updating them with the corrected aircraft tail number (Tab V-23.6). Based on his review of the mission products, the 816 EAS Assistant Director of Operations (ADO), discussed the potential for aircraft icing with MP (Tabs V-19.2 to V.19-3).

The MC then attended tactics and intelligence briefings (Tabs V-20.4, V-20.5). The briefings covered itinerary, airfield information, terrain, threats, airfield imagery, departure weather, weather en route, destination weather, special interest items (SII), and NOTAMs (Tabs V-20.4, V-23.5, V-24.3). The briefings also covered safety information with an emphasis on landing distance (Tabs V-24.11, EE-16). At the conclusion of the intelligence and tactics briefings, the MP conducted a crew briefing (Tab V-20.5). The crew briefing covered the mission itinerary, mission administrative requirements, crew duties, egress procedures, NOTAMs, ORM, crew resource management (CRM), aircraft load and fuel configurations, and flight plan routing (Tabs V-20.5, V-23.6).

c. Summary of Accident

At approximately 0034Z, the MA departed Al Udeid AB, Qatar, and at 0145Z completed an uneventful sortie to Kuwait City International Airport, Kuwait (Tabs V-23.8, V-24.5, EE-10). At Kuwait City International, the MC uploaded 111,498 lbs of cargo, 43,921 lbs of fuel, and

received the mission paperwork for the mishap sortie (Tabs D-5, K-28, V-20.5). The total gross weight of the MA when it departed Kuwait City International was 565,526 lbs (Tab K-28). The MC considered the MA to be "heavy," but within limits (maximum permitted takeoff gross weight of a C-17A is 585,000 lbs) (Tabs K-28, V-23.9, V-24.4).

At 0030Z, the FOB Shank day shift sweeper crew, ITT Exelis contract employees, reported for duty and at 0045Z began snow removal operations on runway 34R. Upon arrival at runway 34R, the sweeper crew noted that it was snowing and several inches of snow covered the runway (Tab V-17.6). At 0200Z, the sweeper crew completed removing the bulk of the snow off runway 34R (Tab V-17.7). However, approximately one-half of an inch of snow and ice remained on the runway (Tab V-17.8). At 0300Z, the SWEEPER applied deicing fluid to runway 34R (Tab N-22). At 0400Z, the SWEEPER finished applying deicing fluid to runway 34R (Tabs N-22, V-17.10). While waiting for the deicing fluid to work the SWEEPER began snow removal operations on other parts of the airfield (Tabs N-22, V-17.11). At approximately 0400Z, the SWEEPER SUPERVISOR told the FOB Shank Mishap Air Traffic Controller 1 (MATC1) that the runway would be clear at 0500Z. The SWEEPER SUPERVISOR intended to communicate to Tower that at 0500Z runway 34R would be clear of men and equipment, not that the runway would be clear of ice and snow (Tabs R-25, V-1.10). However, MATC1 understood SWEEPER SUPERVISOR's communication to mean that runway 34R was "clear and deiced" (Tab V-4.11).

At 0437Z, the MA departed Kuwait City International for FOB Shank (Tab EE-10). The takeoff and cruise phase of flight into Afghanistan were uneventful (Tab V-23.15). For the sortie to FOB Shank, the MP was in the left pilot's seat, the MCP was in the right pilot's seat. The MFP was seated in the Right Additional Crewmember (RACM) seat and the ML2 was seated in the Left Additional Crewmember (LACM) seat. The ML1 was seated downstairs at the forward loadmaster station and the MFCC was seated in the crew rest area (Tab V-14.5).

At 0631Z, the MP conducted the Combat Entry brief, discussed the upcoming landing at FOB Shank, and noted they had a maximum brakes on speed (Vbo) (DD-20). Vbo is the highest speed at which maximum braking effort should be initiated (Tab-BB-29). The C-17A Flight Manual cautions pilots to not apply wheel brakes above Vbo, as damage to the brakes and tires could result if this restriction is not observed (Tab BB-29).

Approximately 15 minutes later, the MC discussed the NOTAM that closed the first 1,500 ft of runway 34R and the need to use the full length of the runway (Tabs K-12, DD-21).

At 0635Z, a CASA-212 (C-212) short takeoff and landing aircraft, landed on runway 34R at FOB Shank and reported to the FOB Shank Air Traffic Control Tower (Tower) a braking action of "fair" (Tabs V-1.12, V-4.11). Braking action of "fair" is a runway condition report indicating reduced braking action level, with a corresponding increase in aircraft landing distance (Tabs BB-20, BB-21, BB-28, BB-29).

At 0650Z, the MC discussed the landing at FOB Shank and identified a "Vbo split" of 2,000 ft (Tab DD-23). "Vbo split" indicates that the aircraft touchdown speed is higher than Vbo (Tab BB-29, V-23.20). Using the Vbo procedures increases aircraft landing distance due to the delay in brake application (Tabs V-23.26, BB-29, EE-15). The resulting landing distance is called "Vbo landing distance" (Tab BB-29).

At 0653Z the MC ran the Combat Entry checklist and called the Combat Entry brief complete (Tabs DD-24, DD-25).

At 0718Z, the MC ran the Descent checklist and discussed the approach for FOB Shank (Tab DD-32). The MC identified a "20 knot (kt) split between touchdown and Vbo," stated the Vbo landing distance as "just 6,000" ft, and discussed delaying braking until the MA was under Vbo (128 kts) (Tab DD-35).

At 0731Z, the MC established radio contact with the Tower and requested the current weather conditions (Tabs N-4, DD-37). The MATC1 responded with the most current observation: "Sir, as of 0655 Zulu, visibility is unrestricted, sky conditions are clear, temperature's minus zero six [Celsius], dew point minus one one [Celsius], altimeter's three zero two six, aerostat is down sir, and as of 0635, braking action for runway three four right was a fair from C-212, how copy?" (Tabs N-4, DD-37).

The MCP responded, "Moose 89 copies all, can I get current winds and runway in use?" MATC1 replied, "Roger sir, winds estimated two five zero at three, runway in use three four right" (Tabs N-4, N-5, DD-37).

At 0732Z, the MCP stated to Tower, "I'd like to confirm that the full length of the runway will be useable. We're going to need full length to land" (Tabs N-5, DD-37). MATC1 responded, "that's a negative sir, full length landing will be at pilot's own discretion due to personnel and equipment east of the tower, and that area is not visible from the tower, sir...you can make a go-around if you need to or overfly but, landing will be at pilot's own discretion." During MATC1's response there was a simultaneous radio transmission from Kabul center to the MC on a different frequency (Tabs N-5, DD-37).

Approximately one minute later, MATC1 asked the MC, "Moose 89, did you copy full length will be at pilot's own discretion?" (Tabs N-5, DD-37). The MP responded, "affirmative" and again stated, "yeah, we'll need full length. Did you say you can coordinate for the personnel to be out of the way though?" (Tabs N-5, DD-37). MATC1 responded, "Moose 89 standby, we'll contact airfield management" (Tab DD-38).

The MC then began a descent from flight level 27,000 ft down to 17,500 ft (Tab DD-38).

At 0738Z, MATC1 contacted MC and responded, "I talked to the ATC Chief, and they're basically saying the same thing sir, they said you can do a low approach or a touch and go if you need to sir, they would not move the equipment, they are unable to and full length will be at pilot's own discretion" (Tabs N-8, DD-40).

At 0741Z, the MP asks the MCP, "...what's your thoughts (sic) on this runway thing he's talking about; we have to land 1200 feet down?" (Tabs N-10, DD-42). The MCP responded, "They've been there the whole time, they are not on the runway, I think well...as we're on the approach, if we see anything that looks fishy, we'll go around" (Tabs N-10, DD-42). The MP responded, "Yeah...we can't land super long" (Tabs N-10, DD-42).

At 0742Z, the MC entered a Visual Flight Rules (VFR) downwind pattern from the north and ran the Approach checklist (Tabs N-11, DD-43). As part of the Approach checklist, both the MP and MCP stated, "TOLD checked" (Tabs N-12, DD-43). The MP's crew brief was "right base for three four, full flap, full stop, complete" (Tab DD-44). The VFR pattern was stable, in accordance with criteria from C-17 Operations Procedures (Tab EE-23).

At 0745Z, the MCP visually acquired the airfield environment and stated, "I'm not making out the runway yet though. I think I'm seeing it but it actually just looks pretty, like snow covered, but I think it's just white" (Tabs N-13, DD-44).

At 0746Z, the MC turned to the final approach course and ran the Before Landing checklist (Tabs DD-45, DD-46). At this time, the Tower called and stated, "Moose 89, check wheels down, landing full length runway 34R will be at pilot's own discretion, landing area is not visible from the tower, wind estimated two seven zero at three, report clear of the active" (Tabs N-14, DD-45, DD-46). The MCP responded, "Moose 89 is gear down, cleared to land, and understand all" (Tabs N-14, DD-46).

At 0747Z, the MA was established on the final approach course and the MP stated, "I got the runway in sight." The MCP responded, "I've got the runway in sight as well, so it looks like the landing zone is…." MP interrupted, "black and little pieces of white" (Tabs N-15, DD-47). The MP then stated, "Cleared to land. Expect poor…fair he said." The MCP then stated, "I'm gonna go ahead and give us a twelve on that" (Tabs N-16, DD-47). At this time, the MCP attempted, but failed, to enter RCR of 12 into the mission computer (Tabs N-16, V-20.15, DD-47, EE-18). RCR of 12 correlates to the reported braking action of "fair" (Tab BB-20). RCR is the measure of the coefficient of friction between the aircraft tires and the runway surface. RCR values less than 23 indicate that aircraft stopping performance is degraded (BB-29). The MA was stable on final approach, in accordance with criteria from C-17 Operations Procedures (Tab EE-23).

At 0749Z, the MA touched down, on speed, approximately 1000 ft - 1,200 ft past the approach end of runway 34R (Tabs V 14.5, 14.11, V 20.9, V-23.25, Tab EE-23). The MCP then stated, "Good ground spoilers…four blue…brakes" (Tabs N-17, DD-48). This indicated the ground spoilers and all four thrust reversers deployed, and the MA was below Vbo (Tab V-20.12). The MP applied MA brakes and noted less than expected deceleration (Tab V-23.21, DD-48). The MCP noted the minimal deceleration and also applied his aircraft brakes (Tab V-20.12). Post mishap analysis found no defects with the anti-skid system or aircraft brakes (Tab EE-18).

d. Impact

Approximately 20 seconds after the MA touched down on runway 34R, the MA departed the runway, struck an embankment, and came to rest approximately 700 ft past the end of the runway (Tabs EE-10, EE-18). The nose landing gear (NLG) was destroyed on impact with the embankment and the front of the MA came to rest on its belly (Tabs S-12, S-19, Z-10). The rear of the MA remained supported by both the left and right main landing gear (MLG) assemblies (Tab S-18). When the MA departed runway 34R, the brake pedals were fully depressed, slats were extended, the flaps were fully extended, and all four thrust reversers (TRs) deployed (Tabs Z-12, EE-18).

The MA sustained damage to the landing gear, cargo floor, undercarriage, antennas, and main structural components (Tabs S-12 to 14, S-17 to 19). Additionally, a pallet in the aerial delivery system (ADS) broke free during the impact. The pallet slid forward, struck the forward bulkhead, and caused damage to the flight deck stairs, lavatory, and loadmaster station (Tabs S-13, Z-11). There were no passengers, fatalities, significant injuries, or damage to civilian or other military property (Tab V-15.3). The estimated cost to repair the MA is $69.4 million (Tab P-3).

e. Egress and Aircrew Flight Equipment (AFE)

Once the MA came to rest, the MCP announced, "evacuate, evacuate, evacuate" (Tabs N-18, DD-48). While the MP and MCP ran the ground evacuation checklist, the RACM opened the maintenance-ditching hatch at the top of the MA and helped ML1, ML2 and MFCC egress the MA (Tab V-24.9). The MCP opened the right side flight deck window and egressed the aircraft (Tab V-23.22). The MP also egressed through the right side flight deck window (Tab V-20.13). Once the MC and MFCC safely egressed, the MP conducted a head count and accounted for all personnel (Tab V-24.9). The egress equipment worked properly, however, the ML1 was unable to open the forward emergency escape door because it was damaged during the mishap (Tabs V-15.4, V-20.14, Z-11).

f. Search and Rescue (SAR)

Not applicable.

g. Recovery of Remains

Not applicable.

5. MAINTENANCE

a. Forms Documentation

Air Force Technical Order (AFTO) 781 forms, a 180-day Core Automated Maintenance System for Mobility maintenance history, a listing of Time Compliance Technical Orders (TCTO), and a list of Time Change Items (TCI) from the MA were reviewed after the mishap. There were no relevant reoccurring discrepancies noted and all maintenance actions were completed and documented IAW Technical Order (TO) 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures*, 15 June 2011.

b. Inspections

(1) Global Reach Improvement Program / Heavy Fleet Maintenance (GRIP): A periodic five-year cycle of in-depth inspections performed IAW TO 00-20-1. There were no GRIP inspections performed on the MA as it was less than five years old. The first GRIP inspection was due in July 2014 (Tab D-2).

(2) Home Station Checks (HSC) are periodic inspections conducted IAW TO 00-20-1 to ensure airworthiness and are completed every 180 days. The HSC was completed on 18 August 2011 and was due on 14 February 2012 (Tab D-2).

(3) A Pre-Flight (PR) is a flight preparedness inspection that is a valid for 72 hours. IAW TO 00-20-1, the purpose is to visually inspect and operationally checkout various areas and systems of the aircraft in preparation for a flying period. The most recent PR, completed on 20 January 2012, at 1300Z, was current at the time of the mishap (Tab D-4).

(4) A Thru-Flight (TH) inspection is a flight preparedness inspection performed between scheduled flights. A TH is performed when a new PR is not required. TH inspections are performed IAW TO 00-20-1. A TH was completed on 22 January 2011 at 1230Z (Tab D-4). The TH inspection was current at the time of the mishap (Tab D-4).

c. Maintenance Personnel and Supervision

Maintenance personnel from the 8th Expeditionary Air Mobility Squadron (EAMS) serviced and performed maintenance on the MA prior to the mishap (Tab D-5). Review of training records confirmed the maintenance personnel who serviced and performed maintenance on the MA prior to the mishap were current on the tasks they performed (Tab EE-18).

d. Fuel, Hydraulic and Oil Inspection Analyses

No fuel, engine oil, or hydraulic fluid analysis was completed and there is no evidence to support they were a factor warranting further investigation (Tab D-5). All four hydraulic systems were operational and supplied proper pressure to all hydraulic systems, to include the aircraft brakes, at the time of the mishap (Tabs EE-18).

e. Unscheduled Maintenance

A review of the MA forms indicated the number 11 brake was changed the day prior to the mishap (Tab D-18). Training records confirmed maintenance personnel were current on the tasks they performed on the MA (Tabs EE-18, EE-20). The maintenance recovery team performed a visual inspection of the number 11 brake and confirmed it was properly installed and serviceable (Tab EE-18).

6. AIRFRAME

a. Structures and Systems

(1) Anti-skid Controller

The anti-skid system prevents brake lockup and resulting wheel skid. The anti-skid controller (ASC) receives and compares wheel speed signals, determines wheel skid status, and commands the anti-skid servo valves to modulate open or closed. It is programmed to recognize all significant system malfunctions. The control unit opens and/or closes appropriate valves and switches to maintain an operable brake system and stores failure data (Tabs BB-4, BB-5).

(2) Engine Thrust Reversers (TR)

Each engine incorporates a fan and core reverser for reverse thrust. The reverse thrust is outward and upward, through fixed cascades in the engine cowl, and aids aircraft deceleration (Tab BB-10).

Prior to the mishap sortie, the MA's total aircraft time was 4,335.9 hours. All four engines were Pratt and Whitney F117-PW-100 turbofan engines with 4,349.1 hours total engine operating time (Tab D-2).

(3) Core Integrated Processor (CIP)/Mission Computer

The aircraft mission computer contains software that mirrors the performance capability documented in TO 1C-17A-1-1, *Flight Manual Performance Data*. Pilots enter runway, aircraft, and weather data into the mission computer to calculate TOLD (Tab BB-27).

b. Evaluation and Analysis

(1) Anti-skid Controller

After the mishap, Hydro-Aire of Crane Aerospace and Electronics Company, in coordination with engineers from the Boeing Company, evaluated the ASC unit and found no defects with the ASC unit. The ASC recorded no faults with the Anti-skid system (Tab EE-18).

(2) Thrust Reversers

The data from the Standard Flight Data Recorder (SFDR), evaluated by the Boeing Company, indicated all four thrust reversers deployed as commanded and were operational on landing (Tab EE-18).

(3) Core Integrated Processor/Mission Computer

Both CIPs were removed from the MA and sent to the Boeing Company for analysis. Boeing engineering confirmed the following TOLD values were in the mission computer when the MA touched down on runway 34R at FOB Shank on 23 January 2012 (Tabs EE-15, EE-18).

- RCR: 23
- Vbo landing distance: 6,047 ft
- Landing distance: 4,457 ft

7. WEATHER

a. Forecast Weather

The forecasted weather at the time of the mishap at FOB Shank was: winds from 280 degrees at 6 knots, temperature 23 degrees Fahrenheit (-5 degrees Celsius), mist, visibility 2.5 statute miles, clear skies, altimeter setting 30.11, pressure altitude 6,424 ft (Tab F-2). Forecasted weather, provided by the 618 AOC/XOWO (Tanker Airlift Control Center weather division), was

included in the Integrated Flight Management printout provided to the MC prior to departing Al Udeid AB, Qatar (Tabs F-2, K-8, V-23.4 to V-23.5).

b. Observed Weather

Observed weather for FOB Shank at the time of the mishap was: unrestricted visibility, sky clear, temperature -5 degrees Celsius, dew point -11 degrees Celsius, altimeter setting 30.26, winds estimated 250 degrees at 3 kts, reported braking action from a C-212 aircraft was "fair" for runway 34R (Tabs N-4, DD-37).

Observed weather for FOB Shank, on 23 January 2012, at 0805Z (recorded immediately after the mishap), was: variable winds at 3 knots, temperature 23 degrees Fahrenheit (-5 degrees Celsius), unrestricted visibility, clear skies, and the dew point was 14 degrees Fahrenheit (-10 degrees Celsius) (Tab F-8).

c. Space Environment

Not applicable.

d. Operations

The weather at the time of the mishap was within the operational limits of the MA (Tabs F-2, N-4). The runway conditions reported at the time of the mishap were outside the landing distance limits of the MA (Tab EE-15).

8. CREW QUALIFICATIONS

a. Mishap Pilot (MP)

(1) Training

At the time of the mishap, the MP was a current and qualified C-17A Aircraft Commander (Tabs G-36, K-6).

(2) Experience

At the time of the mishap, the MP had a total flight time of 3,845.6 hours, with 974.8 hours in the C-17A (Tabs G-36, G-9). The MP had 2,870.8 hours and an Evaluator Pilot rating in the KC-135 (Tabs G-36, G-9). The MP's flight time for the 30, 60, and 90 days prior to the mishap were as follows (Tab G-5):

MP	Hours	Days Flown
Last 30 Days	43.3	11
Last 60 Days	77.7	15
Last 90 Days	95.3	18

b. Mishap Copilot (MCP)

(1) Training

At the time of the mishap, the MCP was a current and qualified C-17A Aircraft Commander (Tabs G-64, K-6).

(2) Experience

At the time of the mishap, the MCP had a total flight time of 2,036.9 hours in the C-17A (Tab G-15). The MCP's flight time for the 30, 60, and 90 days prior to the mishap were as follows (Tab G-11):

MCP	Hours	Days Flown
Last 30 Days	49.7	10
Last 60 Days	147.9	24
Last 90 Days	218.4	36

c. Mishap First Pilot (MFP)

(1) Training

At the time of the mishap, the MFP was a current and qualified C-17A Pilot (Tabs G-85, K-6).

(2) Experience

At the time of the mishap, the MFP had a total flight time of 348.6 hours in the C-17A (Tab G-20). The MFP's flight time for the 30, 60, and 90 days prior to the mishap were as follows (Tab G-17):

MFP	Hours	Days Flown
Last 30 Days	34.6	9
Last 60 Days	84.2	16
Last 90 Days	150	27

d. Mishap Loadmaster 1 (ML1)

(1) Training

At the time of the mishap, the ML1 was a current and qualified C-17A Loadmaster (Tabs G-106, K-6).

(2) Experience

At the time of the mishap, the ML1 had a total flight time of 279.5 hours in the C-17A (Tabs G-G-29). The MFP's flight time for the 30, 60, and 90 days prior to the mishap were as follows (Tab G-26):

ML1	Hours	Days Flown
Last 30 Days	78.2	15
Last 60 Days	176.6	32
Last 90 Days	242.2	45

e. Mishap Loadmaster 2 (ML2)

(1) Training

At the time of the mishap, the ML2 was a current and qualified C-17A Loadmaster (Tabs G-103, K-6).

(2) Experience

At the time of the mishap, the MFP had a total flight time of 2302.7 hours in the C-17A (Tab G-G-24). The MFP's flight time for the 30, 60, and 90 days prior to the mishap were as follows (Tab G-22):

ML2	Hours	Days Flown
Last 30 Days	56.9	10
Last 60 Days	56.9	10
Last 90 Days	59.1	11

9. MEDICAL

a. Qualifications

At the time of the mishap, the MC was medically qualified for flight. Additionally, MATC1 was medically qualified for duty (Tab EE-13).

b. Health

The AIB medical member reviewed the MC and MATC1 medical records and histories documenting nutrition, medications, hydration, sleep patterns, fatigue, and exertion, for the 72-hour and 14-day time periods prior to the mishap. The MC and MATC1 had no medical conditions that contributed to the mishap (Tab EE-14).

c. Toxicology

On 23 January 2012, blood and urine samples of the MC and MATC1 were collected by the TF Corsair flight surgeon at FOB Shank, Afghanistan. The blood samples from the MC were tested for the presence of carbon monoxide. Blood samples from MC and MATC1 were tested for the presence of ethanol (alcohol). Urine samples from MC and MATC1 were tested for drugs of abuse (amphetamine, barbiturates, benzodiazepines, cannabinoids, cocaine, opiates, and phencyclidine). All carbon monoxide levels were within normal limits. All toxicology testing resulted in negative findings for ethanol and drugs of abuse (Tabs EE-13, EE-14).

d. Lifestyle

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

e. Crew Rest and Crew Duty Time

Air Force Instructions require aircrew to have proper crew rest prior to performing in-flight duties and adhere to proper duty time requirements as defined in AFI 11-202, Volume 3, *Flying Operations-General Flight Rules,* Chapter 9, dated 22 October 2010. No crew rest or crew duty time requirements were violated or found to be a factor in the mishap. There was no evidence that fatigue was a factor in the mishap (Tab EE-14).

10. OPERATIONS AND SUPERVISION

a. Operations

There was nothing unusual about the 816 EAS, MC, or FOB Shank Tower operations tempo or workload during the timeframe relevant to the mishap (Tabs V-1.8, V-4.7, V-12.3). The MC's experience level was appropriate for the mission (Tabs V-12.4, V-12.5).

b. Supervision

(1) 816 EAS

The leadership of 816 EAS provided appropriate supervision. They ensured each member of the MC was current and qualified, and assembled the MC based on qualification and skill level (Tabs V-12.4, V-12.5). ORM assessment for this mission was scored in the "high" category because of crew show time (Tabs V-12.7 to V-12.9). The 816 EAS leadership mitigated this risk by providing an additional pilot (Tabs V-12.6, V-12.7). There is no evidence to suggest squadron supervision was a factor in the mishap.

(2) TF Corsair

TF Corsair airfield supervision did not ensure airfield management personnel conducted a daily airfield inspection IAW Army Field Manual 3-04.300, *Airfield and Flight Operations Procedures*, Paragraph 3-17, August 2008 (Tab V-13.28).

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. All human factors enumerated in Attachment 5 to AFI 91-204, including channelized attention, task saturation, complacency, and distraction, 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 (AFI 91-204, attach 5).

b. Causal

(1) AE 103 Procedural Error

Procedural Error is a factor when a procedure is accomplished in the wrong sequence or using the wrong technique or when the wrong control or switch is used. This also captures errors in navigation, calculation or operation of automated systems (AFI 91-204, attach 5).

Although the MP and MCP both correctly correlated the reported braking action of "fair" to an RCR value of 12, four procedural errors prevented them from identifying the correct landing distance. After Tower relayed a reported braking action of "fair" to the MC, the following procedural errors occurred:

a. The MP and MCP called "TOLD-Checked" on the approach checklist without recognizing the mission computer did not contain the RCR value of 12, and therefore without noting the Vbo landing distance was greater than the runway length (Tabs DD-43, BB-27). IAW TO 1C-17A-1, paragraph 2-126, the aircrew is required to check the TOLD to be used for the approach and landing (Tab BB-27).

b. The MP failed to brief the Vbo landing distance as part of the crew brief on the approach checklist. IAW TO 1C-17A-1, paragraph 2-126, the pilot flying conducts a comprehensive briefing to prepare the crew for the approach (Tab BB-27).

c. After the approach checklist was completed, the MCP attempted, but failed, to update the TOLD in the mission computer with an RCR value of 12 (Tabs V-20.10, EE-18). TO 1C-17A-1, paragraph 2-126, warns pilots to adjust their TOLD in the primary aircraft computer for reported wet/slushy conditions on the runway (Tab BB-27).

d. The MP failed to verbalize landing distance during the VFR pattern (Tabs DD-43 to DD-48). IAW AFTTP 3-3.C-17, paragraph A3.3.1.12.1, during a VFR pattern the pilot flying always states the value of the mission computer Vbo landing distance or ground roll (Tab BB-17).

Landing distance is the total distance from a 50 foot height above the runway to the point where the aircraft can be completely stopped and ground roll is the total runway distance from touchdown to a point where the aircraft can be completely stopped (Tabs BB-28, BB-29). Vbo landing distance and ground roll are based on delaying brake application until maximum brakes on application speed (Vbo) to prevent damage to aircraft brakes and tires (Tab BB-29).

The AIB reconstructed the MA TOLD with a mission computer in the C-17A simulator (Tab EE-15). Using variables identical to those in the MA mission computer at the time of the mishap, including aircraft gross weight, temperature, winds, pressure altitude, runway available, and RCR, the AIB confirmed the Vbo landing distance of 6,047 ft (Tab EE-15). Leaving all other variables unchanged, the AIB changed the RCR to 12 (Tab EE-15). The mission computer then no longer displayed a value for landing distance or Vbo landing distance, an indication that the landing distances exceeded the available runway (Tabs EE-15, BB-30). The mission computer in the aircraft operates identically (Tab BB-30). When the AIB manually changed the runway

available in the mission computer in order to generate landing distances, the values were 7,930 ft for landing distance and 8,642 ft for Vbo landing distance (Tab EE-15). Both of these values exceed the runway length at FOB Shank (Tab BB-31). The main runway on FOB Shank, runway 34 right (R)/16 Left (L), is 7,425t (ft) long, including 300 ft overruns at both ends of the runway (Tabs V-20.6, BB-31).

The mission computer displays a calculated landing distance only if this distance is less than runway available, or a ground roll distance if it is less than runway available and runway available is less than landing distance (Tab BB-30). In the AIB reconstruction, when the RCR value was changed to 12, the mission computer calculated a ground roll of 6,587 ft and a Vbo ground roll of 7,288 ft (Tab EE-15). Both ground roll and Vbo ground roll distances were less than the length of runway 34R. However, use of the ground roll distance when a Vbo is indicated in the mission computer requires procedures cautioned against in the C-17 Flight Manual (Tab BB-27). Use of Vbo ground roll distance in this case would allow for a touchdown zone of only 137 ft.

c. Contributory

(1) PP 112 Miscommunication

Miscommunication is a factor when correctly communicated information is misunderstood, misinterpreted, or disregarded (AFI 91-204, attach 5).

Snow removal and deicing operations on runway 34R were in progress, not completed, at the time of the mishap (Tabs V-17.6, V-17.11, V-25.10, V-25.26). At approximately 0400Z, the SWEEPER SUPERVISOR told the FOB Shank Mishap Air Traffic Controller 1 (MATC1) that the runway would be clear at 0500Z. The SWEEPER SUPERVISOR intended to communicate to Tower that at 0500Z runway 34R would be clear of men and equipment not that the runway would be clear of ice and snow (Tabs R-25, V-1.10). However, MATC1 understood SWEEPER SUPERVISOR's communication to mean that runway 34R was "clear and deiced" (Tab V-4.11). Due to this miscommunication, Tower thought runway 34R was clear of ice and snow when the MA arrived (Tab V-4.14). An inspection conducted immediately following the accident revealed a combination of water, slush, ice and snow covered runway 34R (Tab V-9.11).

(2) PP 111 Task/Mission-In-Progress Re-Planning

Task/mission-in-progress re-planning is a factor when crew or team members fail to adequately reassess changes in their dynamic environment during mission execution and change their mission plan accordingly to ensure adequate management of risk (AFI 91-204, attach 5).

The MP and MCP failed to evaluate the risk of landing on runway 34R once they received the reported braking action of fair and correlated this braking action to an RCR of 12.

(3) SI 004 Supervision-Policy

Supervision-Policy is a factor when policy or guidance or lack of a policy or guidance leads to an unsafe situation.

TF Corsair did not have local policies or guidance requiring daily airfield inspections at the time of the mishap (Tab V-13.28). Further, TF Corsair did not have a standard process to verify that snow and ice removal operations were completed, and runway 34R was safe to use for fixed wing operations (Tabs V-21.9, V-21.15).

(4) OR 002 Airfield Resources

Airfield Resources are a factor when runways, taxiways, ramps, terminal ATC resources or nav-aids, lighting systems, SOF/RSU resources or the environment surrounding the airfield are inadequate or unsafe (AFI 91-204, attach 5).

TF Corsair did not have equipment capable of determining an RCR reading at the time of the mishap (Tab V-13.16). In addition, Tower personnel could not see the entire fixed-wing runway due to the location of the ATC tower at FOB Shank (Tab V-1.19). Tower personnel relied upon communication from sweeper personnel to assess the runway conditions (Tab V-13.16, V-13.28).

d. Non-Contributory

The high-interest non-contributory human factors are discussed below.

(1) PC105 Negative Transfer

Negative Transfer is a factor when the individual reverts to a highly learned behavior in a previous system or situation and that response is inappropriate or degrades mission performance (AFI 91-204, attach 5).

The MP attempted to ground loop the MA immediately before departing the runway, a procedure he remembered from the KC-135. A ground loop is not an authorized maneuver in the C-17A (Tab V-23.21). There is no evidence that this contributed to the mishap.

(2) SP 006 Risk Assessment – Formal

Risk Assessment – Formal is a factor when supervision does not adequately evaluate the risks associated with a mission or when pre-mission risk assessment tools or risk assessment programs are inadequate (AFI 91-204, attach 5).

TACC mission planners conducted an operational risk assessment for the mishap mission on 8 January 2012, and did not modify the risk assessment on the day of execution (Tab V-10.8). The NOTAM that closed the first 1,500 ft of runway 34R resulted in an available runway length of 5,925 ft beginning on 20 December 2011, and was active at the time of the mishap (Tab K-12). TACC therefore tasked the MC for a mission where Vbo landing distance exceeded runway available (Tab V-10.10). There is no evidence that this contributed to the mishap.

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Flight Operations

(1) TO 1C-17A-1, *Flight Manual*, C-17A Aircraft, Change 4 – 15 May 2011
(2) TO 1C-17A-1-1, *Performance Data*, C-17A Aircraft, Change 3 – 1 November 2010
(3) TO 1C-17A-1-2, *Mission Computer*, C-17A Aircraft, Change 2 – 15 May 2011
(4) AFTTP 3-3.C-17, *Combat Aircraft Fundamentals C-17*, 20 October 2010
(5) AFI 11-2C-17, Volume 1, *C-17 Aircrew Training*, 25 June 2010*
(6) AFI 11-2C-17, Volume 2, *C-17 Aircrew Evaluation Criteria*, 19 April 2005*
(7) AFI 11-2C-17, Volume 3, *C-17 Operations Procedures*, 16 November 2011*
(8) AMC/A3V, *C-17 Mission Briefing Guides*, 13 April 2011
(9) AFI 11-202, Volume 3, *General Flight Rules*, 22 October 10*

b. Maintenance

(1) TO 00-20-1, AMC Supplement 1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies, and Procedures,* 14 August 2011
(2) TO 1C-17A-2-00GV-00-1, *General Vehicle Manual*, 8 December 2011
(3) TO 1C-17A-2-32GS-00-1, *Landing Gear*, 1 February 2011
(4) TO 1C-17A-2-41GS-00-1, *Cargo Handling/Mission Systems*, 29 September 2011
(5) TO 1C-17A-2-71GS-00-1, *Power Plant*, 1 February 2012
(6) TO 1C-17A-9, *Loading Instructions* C-17A Aircraft, 1 November 2011
(7) TO 1C-17A-2-34GS-00-1, *Navigation*, 20 October 2011

c. Airfield Operations and Management

(1) Federal Aviation Administration (FAA), Joint Order (JO) 7110.65T, *Air Traffic Control*, 11 February 2010***
(2) FAA JO 7110.65U, *Air Traffic Control*, 9 February 2012***
(3) FAA Notice JO 7110.564, *Runway Construction*, 22 September 2011***
(4) FAA JO 7930.2M, *Notices to Airmen (NOTAM)*, 25 September 2008 (incorporates Change 1, dated 22 February 2010, and Change 2, dated 20 October 2011)***
(5) AFI Interservice Publication 11-208, Army Regulation 95-10, OPNAVINST 3721.20D, *Department of Defense Notice to Airmen (NOTAM) System*, 3 June 2011*
(6) Army Regulation 95-2, *Airspace, Airfields/Heliports, Flight Activities, Air Traffic Control and Navigational Aids*, Rapid Action Revision Issue date, 16 October 2008***
(7) Army Field Manual (FM) 3-04.300 (Change 2), *Airfield and Flight Operations Procedures*, 10 December 2010**
(8) Department of Defense (DoD) Joint Publication 3-17, *Air Mobility Operations*, 2 October 2009****

d. Other Directives and Publications

(1) FAA JO 7220.1B, *Certification and Rating Procedures for DoD Personnel*, 20 October 2008***
(2) FM 3-04.120 (FM 1-120), *Air Traffic Services Operations*, February 2007
(3) TC 3-10.81 (FM 3-04.303), *Air Traffic Control facility Operations, Training, Maintenance, and Standardization*, October 2010
(4) AFI 51-503, *Aerospace Accident Investigations*, 26 May 2010*
(5) AFI 91-204, *Safety Investigations and Reports*, 24 September 2008*

* Available digitally at: http://www.e-publishing.af.mil.
** Available digitally at: http://www.apd.army.mil.
*** Available digitally at: http://www.faa.gov.
**** Available digitally at: http://www.dtic.mil/dtic.

e. 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.

2 May 2012

KEVIN A. OLIVER, Colonel, USAF
President, Accident Investigation Board

STATEMENT OF OPINION

C-17A, T/N 07-7189
FOB SHANK, AFGHANISTAN
23 JANUARY 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 that the cause of the mishap was the mishap pilot (MP) and mishap copilot (MCP) failed to identify that the landing distance required to safely stop the aircraft exceeded the runway length. Additionally, I find by the preponderance of evidence, that failure to conduct airfield inspections, and miscommunication between FOB Shank snow removal and Air Traffic Control tower personnel, substantially contributed to the mishap.

2. DISCUSSION OF OPINION

a. Cause: the MP and MCP failed to identify that the landing distance required to safely stop the aircraft exceeded the runway length

The mishap crew (MC) completed mission planning and preflight duties at Al Udeid Air Base (AB), Qatar, and flew a sortie to Kuwait City International Airport, Kuwait, without incident. At Kuwait City International, the MC received the mission data for the mishap sortie, and uploaded 43,219 pounds (lbs) of fuel and 111,498 lbs of cargo. After loading and refueling, the MA was close to maximum allowable gross weight. Enroute to FOB Shank, the MC discussed the MA takeoff and landing data (TOLD) and calculated a landing distance, based on maximum brakes-on speed (Vbo) of approximately 6,000 feet (ft) for FOB Shank.

When the MC made initial radio contact with the FOB Shank ATC tower, tower personnel relayed a reported braking action of "fair" to the MC, and the MP and MCP correctly correlated this reported braking action to a Runway Condition Reading (RCR) value of 12. A reported braking action of fair indicates a reduced braking level on the runway, with a corresponding increase in landing distance. RCR is the value used in TOLD calculations to represent a reported braking action of fair.

The MCP attempted to enter the RCR value of 12 into the mission computer, but was unsuccessful. The MCP did not verify the updated RCR and therefore did not identify an increase in the MA Vbo landing distance. In addition, the MP failed to verify the change to RCR in the mission computer, did not verbalize the MA Vbo landing distance, and did not equate a decrease in RCR with an increase in Vbo landing distance. Data retrieved from the MA revealed the following values for TOLD were in the mission computer at the time of the accident: Vbo landing distance of 6,047 ft, RCR of 23. The RCR value of 23 correlates to a dry runway.

The AIB reconstructed the MA TOLD with a mission computer in the C-17A simulator. Using variables identical to those in the MA mission computer at the time of the mishap, including aircraft gross weight, temperature, winds, pressure altitude, runway available, and RCR, the AIB confirmed the Vbo landing distance of 6,047 ft. Leaving all other variables unchanged, the AIB changed the RCR to 12. The mission computer then no longer displayed a value for landing distance, an indication that the landing distance exceeded the available runway. Instead, the mission computer displayed a cautionary message to check landing weight and displayed the value for Vbo ground roll of 7,288 ft. The runway length for 34R at FOB Shank is 7,425 ft. Had the MC identified that the landing distance required to safely stop the aircraft exceeded the runway length, the mishap would not have occurred.

b. Substantially Contributing Factor: failure to assess runway conditions for fixed wing operations at FOB Shank

Task Force (TF) Corsair airfield management personnel did not conduct daily inspections of runway 34R, and did not inspect runway 34R on 23 January 2012 prior to the mishap. In addition, TF Corsair did not possess equipment capable of determining the runway surface condition at the time of the mishap. Further, tower personnel relied upon FOB Shank sweeper personnel to communicate the status of the runway conditions. Immediately prior to the mishap, miscommunication between sweeper personnel and FOB Shank tower resulted in tower personnel concluding the runway was clear of snow and ice. The tower personnel therefore did not communicate the actual runway conditions to the MC. An inspection conducted immediately following the accident revealed a combination of water, slush, ice and snow covered runway 34R. Failure to assess runway conditions for fixed wing operations at FOB Shank substantially contributed to the mishap.

3. CONCLUSION

I developed my opinion by inspecting the mishap site and the mishap aircraft, examining witness testimony, factual data from historical records, reviewing applicable directives and guidance, engineering analysis, data from on-board recorders, reconstruction of the mishap sortie in a C-17A simulator, computer animated reconstruction, and consulting with subject matter experts.

I find by clear and convincing evidence that the cause of the mishap was the MP and MCP failed to identify that the landing distance required to safely stop the aircraft exceeded the runway length. Additionally, I find by the preponderance of evidence, that failure to assess runway conditions for fixed wing operations at FOB Shank, substantially contributed to the mishap.

2 May 2012

KEVIN A. OLIVER, Colonel, USAF
President, Accident Investigation Board