UNITED STATES AIR FORCE AIRCRAFT ACCIDENT INVESTIGATION BOARD REPORT

U-28A, T/N 0724

318th Special Operations Squadron
27th Special Operations Wing
Cannon Air Force Base, New Mexico

LOCATION: Clovis, New Mexico

DATE OF ACCIDENT: 14 March 2017

BOARD PRESIDENT: Brigadier General Brad Sullivan

Conducted IAW Air Force Instruction 51-503

UNITED STATES AIR FORCE ACCIDENT INVESTIGATION BOARD

EXECUTIVE SUMMARY
UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION

U-28A, T/N 0724
Clovis, New Mexico
14 March 2017

On 14 Mar 17, the Mishap Aircraft (MA), a U-28A, tail number 0724, callsign Demise 25, operated by the 318th Special Operations Squadron, 27th Special Operations Wing, departed Cannon Air Force Base (AFB), New Mexico (NM), at 1512 local time (L) for tactical training over Lubbock, Texas, followed by pilot proficiency training at Clovis Municipal Airport, NM (KCVN). The Mishap Crew (MC), comprised of a Mishap Instructor Pilot, a Mishap Copilot and a Mishap Combat Systems Officer, completed their tactical training, and departed Lubbock airspace at 1735L enroute to KCVN. The MC entered the KCVN traffic pattern at 1806L, where they conducted multiple approaches and landings prior to executing the mishap maneuver, a practice turnback Emergency Landing Pattern (ELP). During the practice turnback ELP, the MA entered an unrecoverable stall and impacted the ground at 1835L. All three crewmembers died upon impact. The aircraft, valued at $18,338,000, was destroyed. Cannon AFB personnel conducted environmental remediation of the crash site, which was located on privately owned farmland one-quarter mile south of KCVN.

The Board President determined that the MC lost control of the aircraft when it entered a stall at low altitude; there are no indications of mechanical malfunction. The Board President found by a preponderance of the evidence that the cause of the mishap was an overcontrolled/undercontrolled aircraft – executing the practice turnback ELP with 0˚ vice 15˚ flaps created negative performance trends that led to an aggressive attempt to arrest excessive nose-down attitudes, high descent rates, and an overshoot condition that decreased airspeed below 0˚ flap stall speed and the MA departed controlled flight. In addition, he found by a preponderance of the evidence that delaying actions necessary to prevent the aircraft from entering the stall envelope and failure to accurately assess increasing risk during execution of the practice turnback ELP substantially contributed to the mishap.

SUMMARY OF FACTS AND STATEMENT OF OPINION
U-28A, T/N 0724
14 March 2017

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ACRONYMS AND ABBREVIATIONS

°	Degrees
1LT	First Lieutenant
202	AFI 11-202
27 SOW	27th Special Operations Wing
318 SOS	318th Special Operations Squadron
A	Altitude
A&P	Airframe and Power (Mechanic)
A/C	Aircraft
AC	Aircraft Commander
ACFC	Air Commando Fieldskills Course
AD	Airworthiness Directives
ADO	Assistant Director of Operations
AF	Air Force
AFB	Air Force Base
AFE	Aircrew Flight Equipment
AFPET	Air Force Petroleum Office
AFI	Air Force Instruction
AFIP	Air Force Institute of Pathology
AFPAM	Air Force Pamphlet
AFPC	Air Force Personnel Center
AFRL	Air Force Research Laboratory
AFSEC Rep	Air Force Safety Center Representative
AFSOC	Air Force Special Operations Command
AGL	Feet Above Ground Level
AHRS	Altitude Heading Reference System
AIB	Accident Investigation Board
AIMWTS	Aeromedical Information Management Waiver Tracking System
AIS	Advanced Instrument School
ALTRAV	Altitude Reservation
AMP	Airframe and Power Mechanic (see A&P)
AOA	Angle of Attack
AOS	Air Operations Squadron
ARC	Airport Rescue
ASOS	Automated Surface Observation Weather
ATACNAV	Advanced Tactical Navigation Unit
ATC	Air Traffic Control
ATP	Acceptance Test Procedure
ATT	Advanced Tactical Training
Aux	Auxiliary
AV	Avionics
AVI	Avionics Technician
AVT	Avionics Technician
AWOS	Automated Weather Observation System
BAC	Basic Aircraft Commander
BASH	Bird/Wildlife Aircraft Strike Hazard
BFT	Blue Force Tracker
BIP	Basic Instructor Pilot
BLOS	Beyond Line of Sight
BP	Board President
Brig Gen	Brigadier General
CAFB	Cannon Air Force Base
CAFBI	Cannon Air Force Base Instruction
CAOC	Combined Air Operations Center
CAP	Crisis Action Procedures
Capt	Captain
CAWS	Central Advisory and Warning System
CB	Circuit Breaker
CBT	Computer Based Training
CC	Commander
CFD	Clovis Fire Department
CFR	Code of Federal Regulations
CG	Center of Gravity
CGO	Company Grade Officer
Civ Pil	Civilian Pilot
CMR	Combat Mission Readiness
CND	Could Not Duplicate
CO	Carbon Monoxide
CP	Copilot
CRM	Crew Resource Management
CSD	Curry Sherriff's Department
CT	Cypher Text
CTO	Compensatory Time Off
Ctr Instr	Contractor Instructor
Col	Colonel
CSO	Combat Systems Officer
CTAF	Common Traffic Advisory Frequency
CVN	Clovis Municipal Airport

CVS	Cannon AFB (aviation)
DD	Department of Defense (Form)
DE	Demise
Det	Detachment
DHA	Deployment Health Assessment
DHRA	Deployment Health Re-Assessment
Dir	Director
DO	Director of Operations
Doc	Doctor
DoD	Department of Defense
DoDI	Department of Defense Instruction
DOT	Training Shop
DR	Discrepancy Report
DRCVS	Discrepancy Report Cannon
EFMP	Exceptional Family Member Program
EGPWS	Enhanced Ground Proximity Warning System
ELP	Emergency Landing Pattern
ELT	Emergency Locator Transmitter
EMS	Emergency Medical Services
ENDEX	End of Exercise
EP	Emergency Procedure
EP	Evaluator Pilot
EQ+	A PC-12 Model
ER	Emergency Room
ER	Exceptional Release
ESOS	Expeditionary Special Operations Squadron
Exec	Executive Officer
EWO	Electronic Weapons Officer
FAA	Federal Aviation Administration
FAR	Family Assistance Representative
FAR	Federal Aviation Regulation
FBO	Fixed Base Operations
FCF	Functional Check Flight
FCIF	Flight Crew Information File
FCWU	Flap Control Warning Unit
FEB	Flying Evaluation Board
Flt/CC	Flight Commander
FGO	Field Grade Officer
Fm	Form
FMP	Full Mission Profile
FMS	Flight Management System
fpm	Feet per Minute
FST	Field Service Technician

ft	Feet
FTL	Flight Training Level
FTU	Flying Training Unit
FY	Fiscal Year
g	Gravitational Force
GA	General Aviation
Gen	General
GIG	Gigabyte
GPS	Global Positioning System
GT	Ground Training
HD	A PC-12 Model
HD+	A PC-12 Model
HF	High Frequency
HFACS	Human Factors Analysis and Classification System
H-Sys	H-System
HRS	Hours
HRT	Hurlburt Field, Florida
Hz	Hertz
IA	Inspection Authorization
IAW	In Accordance With
ICSO	Instructor Combat Systems Officer
IFOC	In-Flight Operations Check
ILS	Instrument Landing System
IMC	Instrument Meteorological Conditions
IO	Investigating Officer
IP	Instructor Pilot
IR	Infrared
IRC	Instrument Refresher Course
IRU	Inertial Reference Unit
ISB	Interim Safety Board
ISR	Intelligence, Surveillance and Reconnaissance
ISRG	Intelligence, Surveillance and Reconnaissance Group
JOC	Joint Operations Center
JORT	Joint Operations Readiness and Training
JPRA	Joint Personnel Recovery Agency
KAS	King Altitude Preselector
KCAS	Knots Calibrated Airspeed
KCVN	Clovis Municipal Airport
KCVS	Cannon AFB (aviation)
KIAS	Knots Indicated Airspeed
KS	Kansas
Kts	Knots

KUSS	Ku-Band Spread-Spectrum
L	Local Time
LA	Legal Advisor
LED	Light Emitting Diode
LMCO	Lockheed Martin Company
LNO	Liaison Officer
LOA	Letter of Agreement
LOS	Line of Sight
LP	Left Pilot
LPS	Local Proficiency Sortie
Lt Col	Lieutenant Colonel
MA	Mishap Aircraft
MAC	Mission Aircraft Commander
Maj	Major
MAJCOM	Major Command
MC	Mishap Crew
MCP	Mishap Copilot
MCSO	Mishap Combat Systems Operator
Med	Medical Member
MEL	Minimum Essential Level
METLs	Mission Essential Tasking List
MFLC	Military and Family Life Consultant
Mini	Miniature
MIP	Mishap Instructor Pilot
MIPs	Mission Instructor Pilots
MLG	Main Landing Gear
MOAS	Mother of All Schedules
MOC	Maintenance Operations Center
Mod	Modification
MOR	Manual Override
MRT	Mission Rehearsal Training
MS	Mishap Sortie
MSgt	Master Sergeant
MSL	Mean Sea Level
MSU	Magnetic Sensing Unit
MTS-A	Multi-Spectral Targeting System A
MTS-B	Multi-Spectral Targeting System B
Multilat	Multilateral (exercise)
Muni	Municipal
MWS	Missile Warning System
Mx	Maintenance Member
NATO	North Atlantic Treaty Organization
NAV	Navigation
NCO	Noncommissioned Officer
NM	Nautical Miles
NM	New Mexico
NOTAMs	Notices to Airmen
NSAv	Nonstandard Aviation
NVGs	Night Vision Goggles
NVRAM	Non-volatile Random Access Memory
OEM	Original Equipment Manufacturer
OH	Ohio
OK	Oklahoma
OPFOR	Opposition Force
Ops	Operations
Ops Tempo	Operations Tempo
ORM	Operational Risk Management
OSC	On-scene Commander
OTS	Officer Training School
P&W	Pratt and Whitney
PA	Public Affairs
PCL	Primary Control Lever
PCM	Primary Care Team
PCS	Permanent Change of Station
PDF	Personnel Deployment Function
PERSTAT	Personnel Status Report
PERSTEMPO	Personnel Tempo
PEX	Patriot Excalibur
Pil	Pilot
Pilot Pro	Pilot Proficiency
PHA	Physical Health Assessment
PM	Pilot Member
PME	Professional Military Education
POC	Point of Contact
PR	Portable Radio
PRC	Portable Radio Communications
Prop	Propeller
Pro Sup	Production Superintendent
PSI	Pounds per Square Inch
PT	Plain Text
PTTI	Precise Time and Time Interval
Pubs	Publications
QA	Quality Assurance
R12	Runway 12
R30	Runway 30
RAPCOM	See RAPCON
RAPCON	Radar Approach Control
Rec	Recorder
RMT	Realistic Military Training
RNAV	Radar Navigation
RP	Right Pilot

RPM	Revolutions per Minute
RTB	Return-To-Base
Rx	Receiver
SA	Situational Awareness
SAR	Search and Rescue
SD	A PC-12 Model
SERE	Survival, Evasion, Resistance and Escape
Sgt	Sergeant
SIB	Safety Investigation Board
SII	Special Interest Item
SIM	Simulator
SITREP	Situation Report
SM	Statute Miles
SNC	Sierra Nevada Corporation
SNCO	Senior Noncommissioned Officer
SOCOM	Special Operations Command
SOD	Squadron Officer of the Day
SOF	Special Operations Forces
SOG	Special Operations Group
SOLE	Special Operations Liaison Element
SOS	Special Operations Squadron
SOS	Squadron Officer School
SOSS	Special Operations Support Squadron
SOW	Special Operations Wing
Stan/Eval	Standardization/Evaluation
STRAT	Stratification
SYSLOGs	System Logs
Tac	Tactical
TCTO	Time Compliance Technical Order
TDY	Temporary Duty
Tech	Technical
Tech	Technical Sergeant
T/N	Tail Number
TOC	Tactical Operations Center
TOLD	Takeoff and Landing Data
TPD	Texico Police Department
TSO	Tactical Sensor Operator
TTC	Tactical Training Center
TTP	Tactical Training Plan
TTPs	Tactics, Techniques, Procedures
TTR	Tactical Training Roadmap
TX	Texas
Tx	Transmitter
Unilat	Unilateral (exercise)
UNS	Universal Avionic Systems
UPT	Undergraduate Pilot Training
USAF	United States Air Force
USAFA	United States Air Force Academy
VA	Virginia
VBMR	ViaSat Mobile Broadband Router
VCCS	Vapor Cooling System
VFR	Visual Flight Rules
VVI	Feet Per Minute Vertical Velocity Indication
W&B	Weight and Balance
WA	Washington
WIC	Weapons School
Wit	Witness
WOW	Weight on Wheels
WV	West Virginia
Wx	Weather
Z	Zulu

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

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 17 Mar 17, Lieutenant General Marshall B. Webb, Commander, Air Force Special Operations Command (AFSOC), appointed Brigadier General Brad Sullivan to conduct an Accident Investigation Board (AIB) for a 14 Mar 17 mishap involving a U-28A near Clovis, New Mexico (NM). (Tab Y-2 to Y-3) The AIB was conducted in accordance with Air Force Instruction (AFI) 51-503, *Aerospace and Ground Accident Investigations*, at Cannon Air Force Base (AFB), NM, from 27 Apr 17 to 7 Jul 17. The board members included a Legal Advisor (Lieutenant Colonel), a Pilot Member (Major), a Medical Member (Major), a Recorder (Captain), and a Maintenance Member (Chief Master Sergeant). (Tab Y-2 to Y-4)

b. Purpose

In accordance with AFI 51-503, *Aerospace and Ground Accident Investigations*, this accident investigation board conducted a legal investigation to inquire into all the facts and circumstances surrounding this Air Force aerospace accident, prepare a publicly releasable report, and obtain and preserve all available evidence for use in litigation, claims, disciplinary action, and adverse administrative action.

2. ACCIDENT SUMMARY

On 14 Mar 17, the Mishap Aircraft (MA), a U-28A, tail number (T/N) 0724, callsign Demise (DE) 25, operated by the 318th Special Operations Squadron (318 SOS), 27th Special Operations Wing (27 SOW), departed Cannon AFB, NM, (KCVS), at 1512 local time (L) for tactical training over Lubbock, Texas (TX), followed by pilot proficiency training at Clovis Municipal Airport (KCVN). (Tabs K-4, N-2, Q-7 to Q-9, V-1.10 to V-1.11, V-9.2, Z-11, and Z-14) The Mishap Crew (MC), comprised of a Mishap Instructor Pilot (MIP), a Mishap Copilot (MCP) and a Mishap Combat Systems Officer (MCSO), completed their tactical training, and departed Lubbock airspace at 1735L enroute to KCVN. (Tabs K-2, M-3 to M-5, N-2, Z-12, and Z-14). The MC entered the KCVN traffic pattern at 1806L, where they conducted multiple approaches and landings prior to executing the mishap maneuver, a practice turnback Emergency Landing Pattern (ELP). (Tabs M-4, Z-3 to Z-7, and Z-14) During the practice turnback ELP, the MA entered an unrecoverable stall and impacted the ground at 1835L. (Tab Z-8 to Z-9) All three crewmembers died upon impact. (Tab X-2) The aircraft, valued at $18,338,000, was destroyed. (Tab P-2) The crash site was located on privately owned farmland one-quarter mile south of KCVN. (Tabs P-2 and S-8)

3. BACKGROUND

a. Air Force Special Operations Command (AFSOC)

AFSOC provides Air Force special operations forces (SOF) for worldwide deployment and assignment to regional unified commands. (Tab DD-2) The command's core missions include battlefield air operations, agile combat support, aviation foreign internal defense, information operations/military support operations, precision strike, specialized air mobility, command and control, and intelligence, surveillance and reconnaissance (ISR). (Tab DD-2) AFSOC's unique capabilities include airborne radio and television broadcast for psychological operations, as well as aviation foreign internal defense instructors to provide other governments military expertise for their internal development. (Tab DD-2) The command's special tactics squadrons combine combat controllers, tactical air control party members, special operations weathermen and pararescuemen with other service SOF to form versatile joint special operations teams. (Tab DD-2) The command's forces are organized under four active-duty wings, one Reserve wing, two National Guard wings, one overseas group and several direct reporting units. (Tab DD-2)

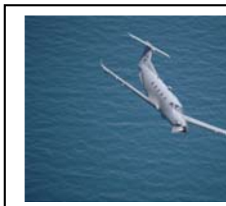
b. 27th Special Operations Wing (27 SOW)

The 27 SOW provides specialized airpower, capable across the spectrum of conflict . . . anyplace, anytime, anywhere. (Tab DD-4) Cannon AFB, home of the 27 SOW, lies in the high plains of eastern NM, near the TX, panhandle. (Tab DD-4) The base is eight miles west of Clovis, NM, and is 4,295 feet above sea level. The base itself sits on 3,789 acres of land. (Tab DD-4)

c. 318th Special Operations Squadron (318 SOS)

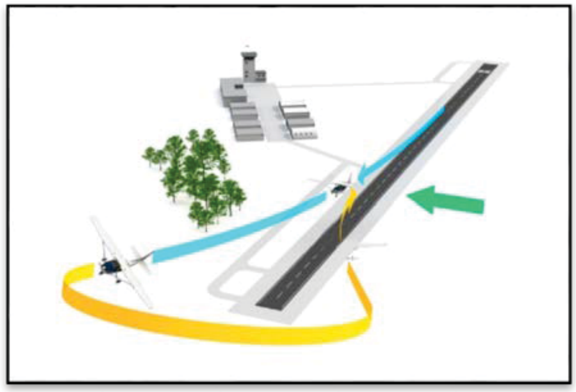
The 318 SOS operates U-28A aircraft, providing ISR capabilities to support special operations worldwide. (Tab DD-6 to DD-7)

d. U-28A



The U-28A provides a manned fixed-wing, on-call/surge capability for improved tactical airborne ISR in support of SOF. (Tab DD-7) The U-28A is a modified, single-engine Pilatus PC-12 that operates worldwide. (Tab DD-7) The initial block of U-28A aircraft were procured and modified for use in Operations Enduring Freedom and Iraqi Freedom. (Tab DD-7) The U-28A fleet evolved from commercially available aircraft that were purchased and then modified with communications gear, aircraft survivability equipment, electro-optical sensors, and advanced navigation systems. (Tab DD-7) The advanced radio-communications suite is capable of establishing Department of Defense (DoD)/North Atlantic Treaty Organization data-links, full-motion video, data, and voice communications. (Tab DD-7) The U-28A is certified to operate from short and semi-prepared airfields. (Tab DD-7)

e. Turnback Emergency Landing Patterns



The Emergency Landing Pattern (ELP) is designed to give single engine aircraft with an engine malfunction a method by which to safely maneuver to a runway or other suitable landing surface. (Tabs V.1-11 to V-11.2, Z-2, and BB-8) A turnback is a maneuver where after experiencing an engine failure shortly after takeoff, the aircraft is maneuvered 180 degrees (˚) to land on the runway from which they just departed in the opposite direction. (Tabs V-5.7, Z-2, and Z-7) The recommended steps to maximize the chances for a successful turnback are to configure the aircraft with 15˚ flaps, set the engine to the cut-off/feathered position and bank to 45˚, and no more than 60˚. (Tabs V-2.9 and BB-8) Once landing is assured place the gear down and extend full flaps. (Tabs V-2.9 and BB-8) Common mistakes attempting to accomplish this maneuver are failure to immediately (1) place flaps to 15˚, (2) place engine to the cut-off/feathered position, and (3) roll to and maintain a 45˚ bank angle. (Tab BB-8) Failure to correctly position the flaps and/or engine will result in excessive nose-down attitudes and high descent rates in order to maintain airspeed. (Tab BB-8) These steps are published as technique, but there is no official turnback ELP procedural guidance or a requirement to track turnback ELP maneuvers. (Tab BB-8)

4. SEQUENCE OF EVENTS

a. Mission

The Mishap Sortie (MS) was a local mission comprised of tactical training over Lubbock, TX, followed by pilot proficiency training at KCVN. (Tabs K-4, N-2, V-1.10 to V-1.11, V-9.2, Z-11, and Z-14) The 318 SOS Director of Operations (DO) authorized the MS. (Tab K-2)

b. Planning

Flight planning was completed by the MC prior to the MS. (Tabs K-4 to K-5, Z-12 to Z-13, and AA-2 to AA-3) Actions included filing the flight plan, checking weather (wx) and Notice to Airmen (NOTAMs), and validating the aircraft weight and balance. (Tabs K-4 to K-5, Z-12 to Z-13, and BB-2) MS flight planning was conducted in accordance with squadron standard practices and applicable regulations. (Tabs K-4 to K-5, Z-12 to Z-13, and BB-2)

The schedule changed on the day of the mishap to swap the copilots of DE 24 and DE 25 so that the MCP could accomplish a local proficiency sortie (LPS). (Tabs K-2, V-9.11, and V-12.2) An LPS consists of a Visual Flight Rules (VFR) pattern, two instrument approaches from different navigation sources, a holding or procedure, a circle and two emergency procedure events which equates to emergency landing procedures. (Tab V-9.11) An instructor pilot (IP) is required for an LPS and DE 24 did not have an IP-qualified crewmember. (Tabs K-2, V-1.13, and V-12.2) Show times for the two crews were within 30 minutes of one another and this change did not impact crew rest. (Tabs K-2 and V-12.2) The crew change was approved by the DO. (Tab K-2)

The Operational Risk Management (ORM) worksheet filled out by the MC assessed mission risk as "low to moderate." (Tab AA-2 to AA-3) Mission type, complexity, profile, Bird/Wildlife Aircraft Strike Hazard (bird watch condition moderate), and human factors (minor personal distractions) were highlighted as potential risk factors. (Tab AA-2 to AA-3) The MC-identified risk mitigation factors included checklist discipline, crew resource management, and altitude and warden (altitude deconfliction) compliance. (Tab AA-2 to AA-3). The assessed ORM did not require higher level approval. (Tab AA-2 to AA-3)

c. Preflight

All applicable mission planning paperwork was complete. (Tab K-2 to K-5) The MA had 1,700 pounds of fuel. (Tabs K-5 and Z-13) The MC showed at the MA at approximately 1430L. (Tab Z-12) The MA taxied out of KCVS parking at 1508L and onboard systems recorded takeoff at 1512L. (Tab Z-14)

d. Summary of Accident

The MA departed KCVS at 1512L for tactical training over Lubbock, TX, and pilot proficiency training at KCVN. (Tabs N-2, V.1-10 to V-1.11, V-9.2, and Z-12 to Z-14) The MC entered Lubbock airspace at 1545L, completed their tactical training, and departed Lubbock airspace at 1735L enroute to KCVN. (Tabs M-3 to M-5, N-2, and Z-14)

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Upon arrival at KCVN, the MA conducted four approaches and two landings prior to the mishap. (Tabs J-173, Z-3 to Z-7, Z-14, and BB-43) The MA entered the VFR pattern at 1806L. (Tab Z-14) The MC's first sequence included a VFR low approach (Figure A) followed by a VFR touch-and-go landing to runway 12 (R12) (Figure B). (Tabs J-173, Z-3 to Z-4, Z-14, and BB-43)

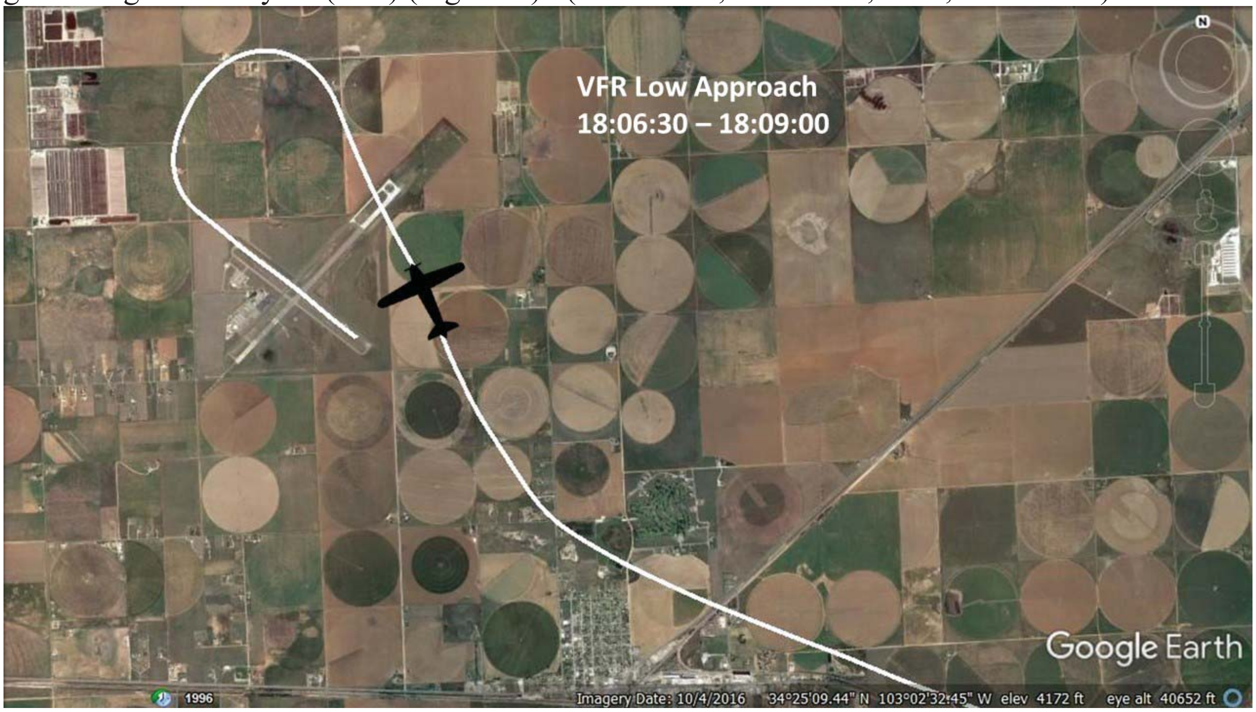

Figure A – VFR Low Approach (Tabs J-173, Z-3, Z-14, and BB-43)

Figure B – VFR Touch-and-Go (Tabs J-173, Z-4, Z-14, and BB-43)

Following the VFR approach and traffic pattern, the MC executed a radar navigation/global positioning system (RNAV/GPS) circling approach to a touch-and-go landing, also to R12. (Figure C). (Tabs J-173, Z-5, Z-14, and BB-43)

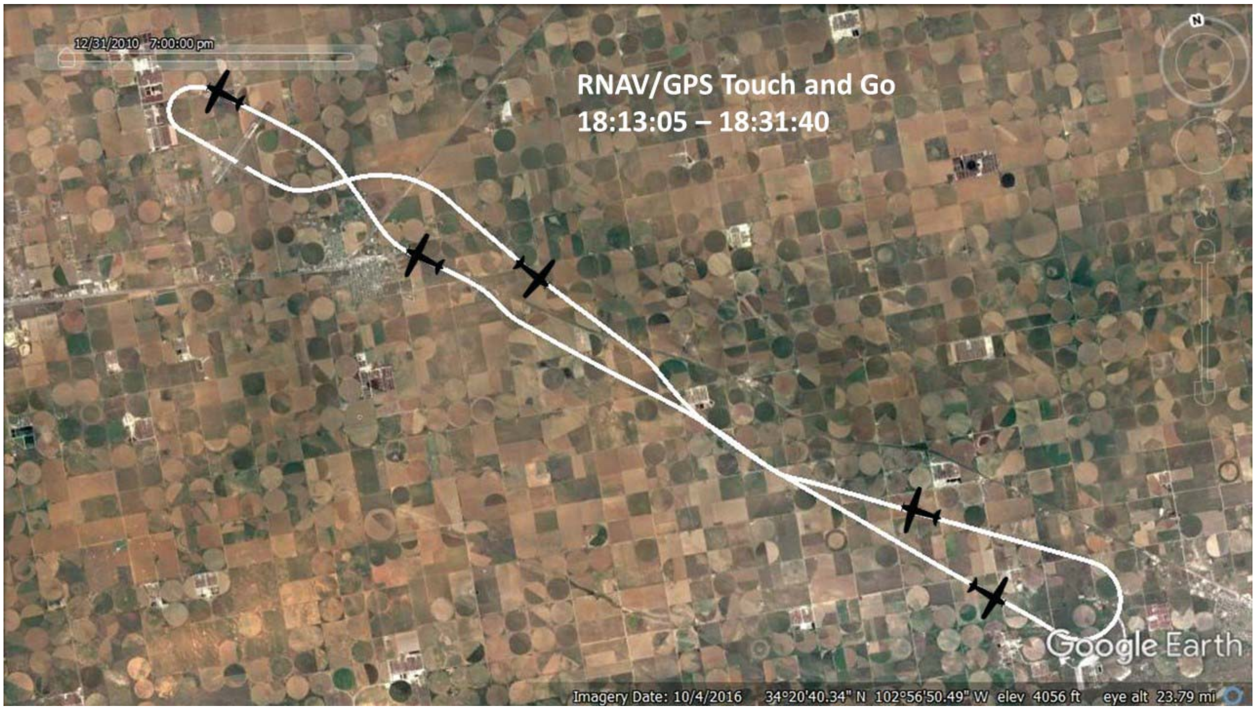

Figure C – RNAV/GPS Touch-and-Go (Tabs J-173, Z-5, Z-14 and BB-43)

Following the RNAV/GPS approach, the MC performed another VFR low approach to R12 (Figure D). (Tabs J-173, Z-6, Z-14, and BB-43)

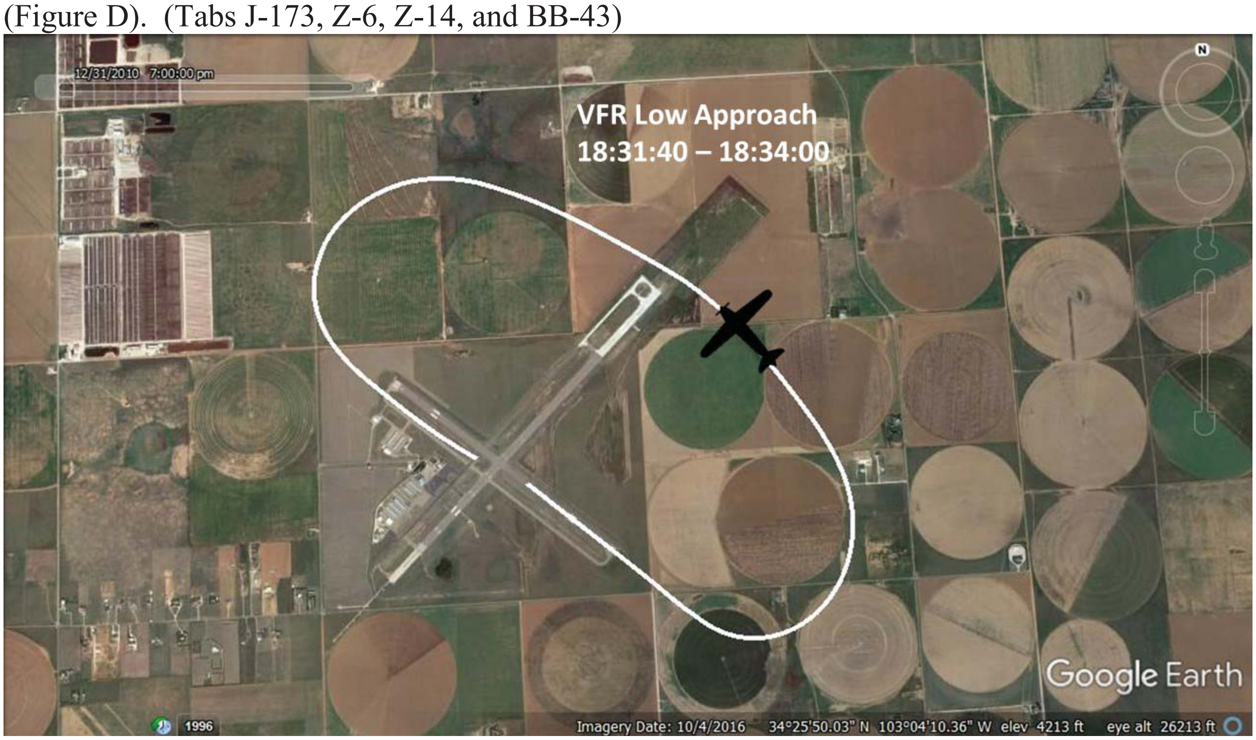

Figure D – VFR Low Approach 2 (Tabs J-173, Z-6 and Z-14)

After their low approach to R12 at 1834:00L, the MC set-up for a practice turnback ELP to runway 30 (R30) by climbing-out to the southeast (Figure E). (Tabs J-173, Z-6, and BB-43)

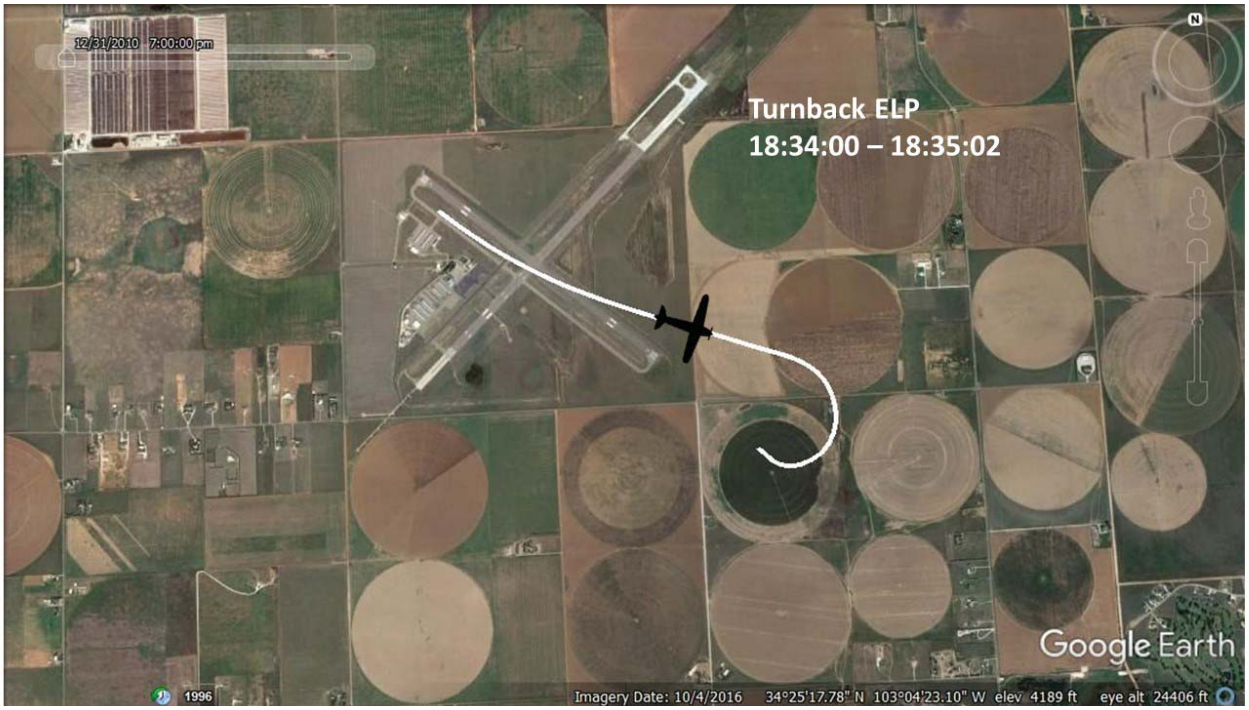

Figure E –Practice Turnback ELP (Tabs J-173, Z-7, and BB-43)

DE 25 initiated their practice turnback ELP maneuver at 1834:43L from approximately 1,450 feet above ground level (AGL) and 100 knots indicated airspeed (KIAS), with 0˚ flaps and a descending right hand turn toward R30. (Tabs J-139 to J-140, J-173, Z-8, Z-14, and BB-43) Six seconds into the maneuver, at 1834:49L, the MA was 110 KIAS, descending at -3,000 feet per minute vertical velocity (VVI), and 35˚ of right bank. (Tabs J-173, Z-9, Z-14, and BB-43) At 1834:52L, altitude and descent rate were approximately 1,000 AGL and -5,000 VVI respectively, which caused the MA's Enhanced Ground Proximity Warning System (EGPWS) to emit an aural "sinkrate" alert. (Tabs J-173, Z-9, Z-14, and BB-43) At 1834:54L, the EGPWS issued an aural "pull up" alert. (Tabs J-173, Z-8, Z-14, and BB-43) At this point, the MA was approximately 800 AGL, 124 KIAS, -5,200 VVI and 50˚ of right bank (Figures F and G). (Tabs J-173, Z-8 to Z-9, Z-14, and BB-43)

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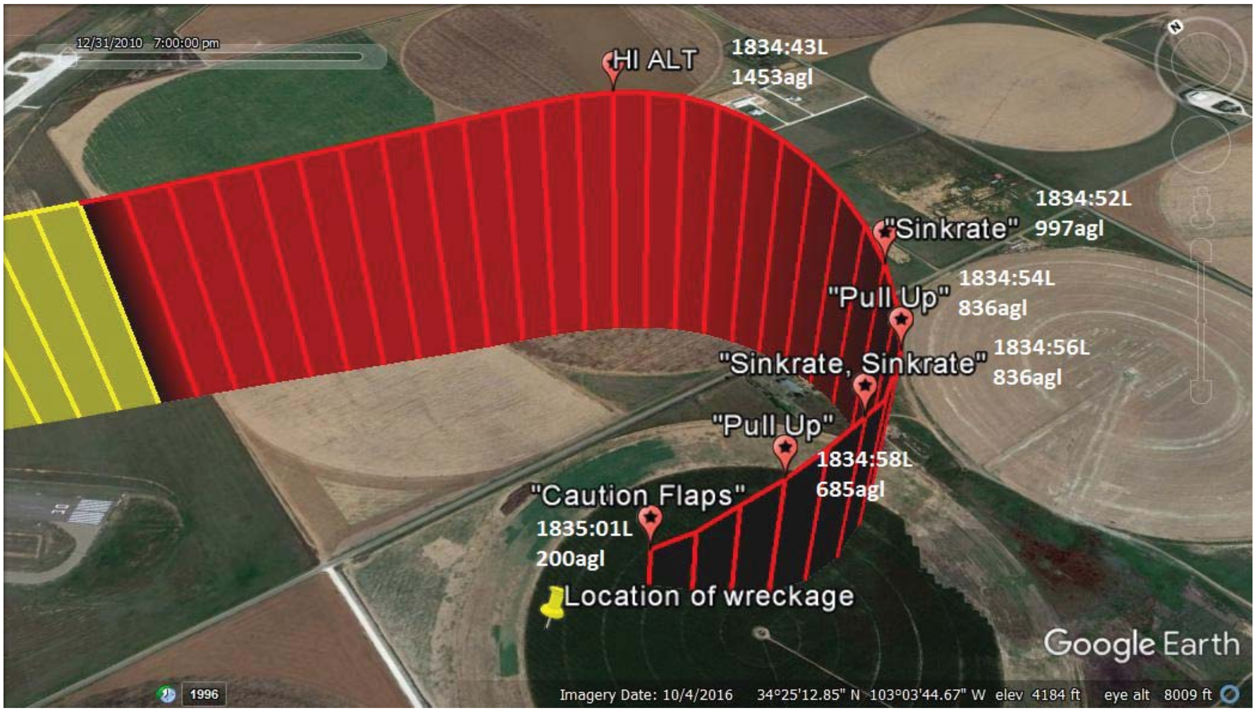
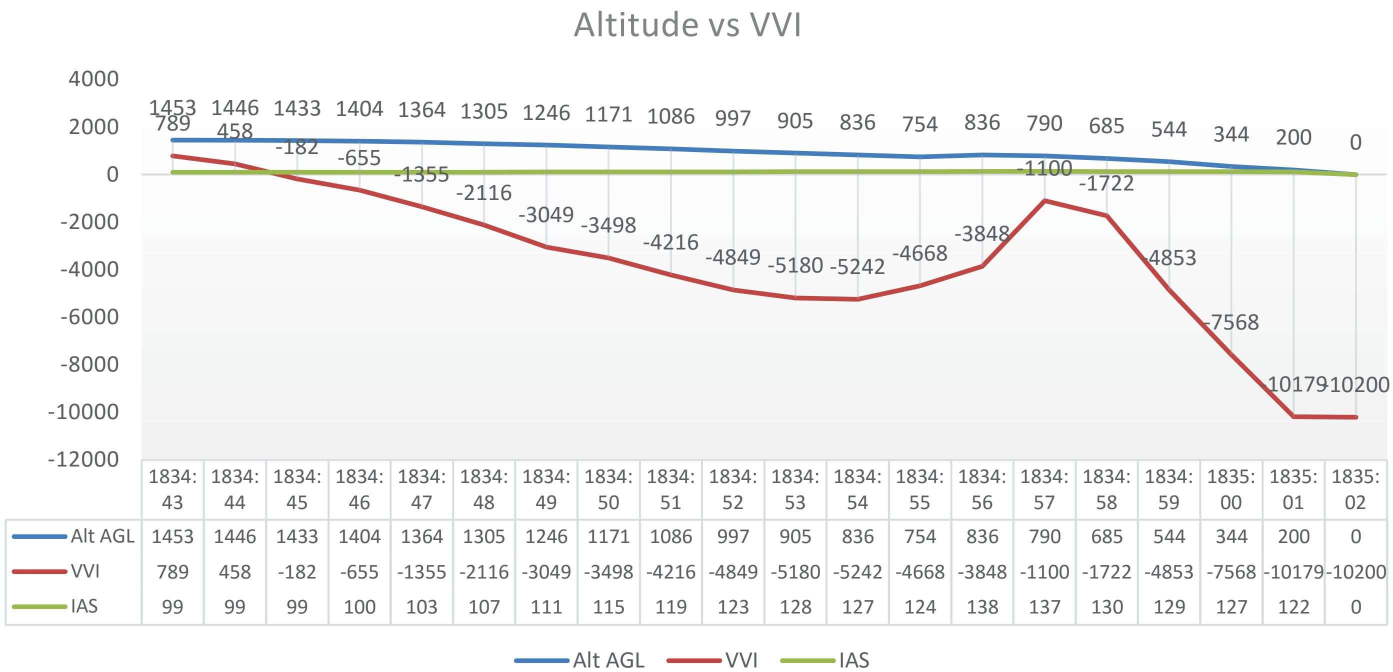


Figure F – Practice Turnback ELP with EGPWS Alerts, Altitude and Time Stamps (Tabs J-173, Z-8, and BB-43)

Coincident with the EGPWS aural "pull-up" alert, the MA VVI momentarily eased and AGL altitude increased, indicating the MC attempted to arrest their nose-down attitude and descent rate. (Figure G) (Tabs J-219, Z-8 to Z-9, Z-14, and BB-43) The MA performed a hard pull up at low altitude from an extreme nose-down angle. (Tabs R-10 to R-11, R-42, Z-9, Z-11, and BB-43) Following this initial reaction by the MC, the MA again increased descent rate and bank angle. (Tabs J-173, Z-8 to Z-9, and BB-43)



	1834:43	1834:44	1834:45	1834:46	1834:47	1834:48	1834:49	1834:50	1834:51	1834:52	1834:53	1834:54	1834:55	1834:56	1834:57	1834:58	1834:59	1835:00	1835:01	1835:02
Alt AGL	1453	1446	1433	1404	1364	1305	1246	1171	1086	997	905	836	754	836	790	685	544	344	200	0
VVI	789	458	-182	-655	-1355	-2116	-3049	-3498	-4216	-4849	-5180	-5242	-4668	-3848	-1100	-1722	-4853	-7568	-10179	-10200
IAS	99	99	99	100	103	107	111	115	119	123	128	127	124	138	137	130	129	127	122	0

Figure G: Altitude vs VVI and Airspeed (Tabs J-173, Z-9, and BB-43)

The MC received EGPWS aural alerts "sinkrate, sinkrate" at 1834:56L and "pull up" at 1834:58L. (Tabs J-219, Z-8, Z-14 and BB-43) From 1834:58L through impact, the MA descent rate increased while indicated airspeed decreased, indicative of a stall. (Tabs R-5, Z-8 to Z-9, Z-14, BB-13, and BB-43) Subsequent power increases and flight control inputs did not enable the aircraft to recover from the stall within remaining altitude. (Tab R-11) The MC added power approximately 3.5 seconds prior to impact. (Tabs R-10 to R-11, R-35, Z-11, BB-43). At 1834:59 the MA reached a maximum bank angle of 60˚. (Tabs J-173, Z-8, Z-14, and BB-43) At 1835:01 the descent rate was -10,179 VVI and the MC received an aural EGPWS "caution flaps" alert. (Tabs J-219, Z-7 to Z-9, Z-14, and BB-43) The MA impacted the ground at approximately 1835:02L in excess of -10,000 VVI and less than 120 KIAS with a 13˚ nose-high, 7˚ left-wing low attitude. (Tabs H-4, Z-8 to Z-10, and BB-43).

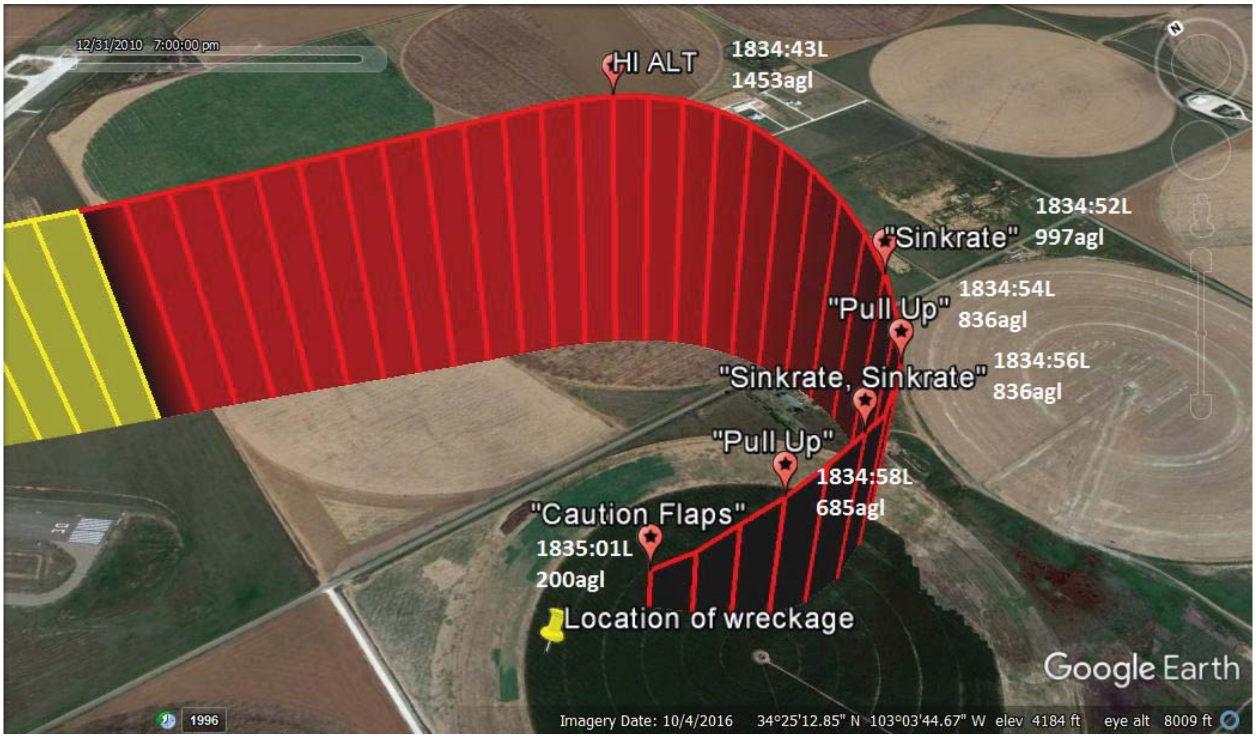


Figure F: Practice Turnback ELP with EGPWS Alerts, Altitude and Time Stamps (Tabs J-173, J-219, Z-8, and BB-43)

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e. Impact

The MA impacted the ground at approximately 1835:02L, 3 hours and 23 minutes into the sortie, in a freshly tilled field 0.34 nautical miles southeast of the end of R30. (Tabs H-3 to H-4, P-2, S-8, Z-8 and BB-43) At impact the MA was configured with gear down and 0˚ flaps. (Tabs J-139 to J-140, J-154 to J-161, R-34, Z-11, and BB-43) The MA attitude was 13˚ nose-high and 7˚ left-wing low. (Tabs H-4, Z-11, and BB-43) The MA impacted at a 38˚ angle of approach (Figure H). (Tabs H-14, Z-11, and BB-43)

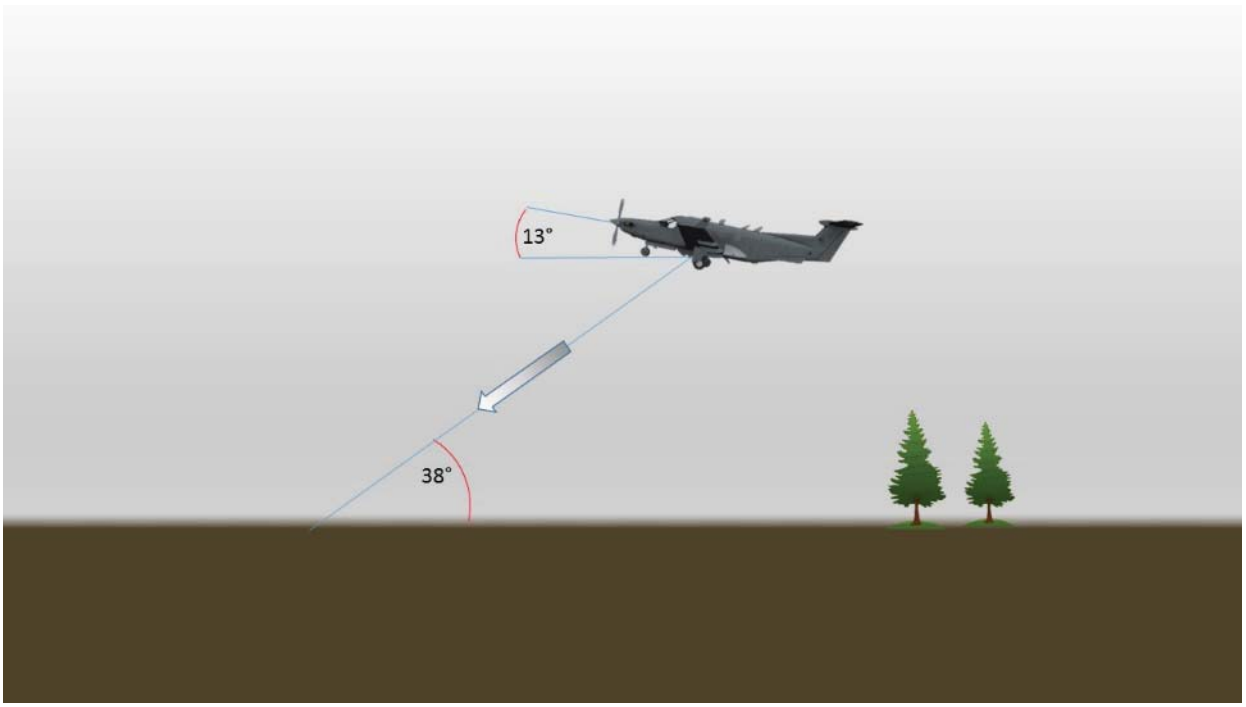

Figure H – Attitude and Angle of Approach at Impact (Tabs H-4, Z-11, BB-43)

The MA contacted the ground with the aft section of the tail first and then pitched down, striking the ground with the main section of the fuselage, which bounced and rolled once before coming to a stop. (Tab H-3 to H-4) During the impact sequence, the gear, wings, engine and propeller separated from the aircraft. (Tab H-4) The tail section was torn from the aircraft but remained connected by flight control cables and electrical wire bundles. (Tab H-4) The tail section did not roll with the fuselage. (Tab H-4)

Federal Aviation Regulation (FAR) Part 23.561 stipulates aircraft crash-worthiness standards. (Tab BB-9) Analysis shows that the MC experienced between 90 and 120g's (measure of force) on impact, far exceeding U-28A design limits, FAR Part 23.561 standards, and above human tolerance. (Tab H-5 to H-6 and H-9)

f. Egress and Aircrew Flight Equipment (AFE)

Displaced equipment racks, crew seats and loose items in the cabin would have greatly impeded egress efforts. (Tab H-8) The main cabin door was jarred loose upon impact. (Tabs H-4, H-8, and R-27) The MC did not attempt to egress and egress hatches were not applicable to this mishap. (Tab R-27)

The AFE was inspected and the Air Force Form 46 signed-off by an AFE representative and the MIP on 14 Mar 17. (Tab CC-2 to CC-5) In this aircraft, AFE is limited to an oxygen mask and survival equipment. (Tab CC-2) The aircraft is not equipped with ejection seats or parachutes. (Tab D-58 to D-77)

There is no evidence that AFE equipment was a factor in the mishap.

g. Search and Rescue (SAR)

The MA impacted the ground at 1835L. (Tabs R-13 and Z-14) Multiple civilian witnesses were first to the scene, including pilots from nearby KCVN and a motorist driving along the roadway near the incident. (Tab R-4, R-16, R-27, R-33, and R-42) Within minutes, at least three witnesses called 911. (Tab R-4, R-27, and R-42) The motorist was the first person to approach the MA and was able to see the MIP and MCP but noted there was no movement and no response to verbal challenges. (Tab R-27) The Curry County Sheriff's Office, Texico Police Department, Clovis Fire Department, AeroCare medical and KCVN personnel responded to the scene at approximately 1845L. (Tabs R-42 and EE-3 to EE-9) Clovis Fire Department paramedics determined that the MC did not survive the crash. (Tab EE-3 and EE-7) The Cannon AFB command post received notification of the mishap at 1855L. (Tabs Q-7 and EE-2) The Cannon AFB Fire Department was dispatched at 1856L and arrived at the scene at 1911L. (Tab EE-2) The Cannon AFB Fire Department assumed control of the scene for recovery operations. (Tab EE-2 and EE-7)

h. Recovery of Remains

Recovery efforts were accomplished by the Cannon AFB fire department and Mortuary Affairs. (Tabs X-2 and EE-6 to EE-7) All three MC members were recovered and transported to the New Mexico Office of the Medical Investigator in Albuquerque, NM, for autopsy. (Tab X-2)

5. MAINTENANCE

a. Forms Documentation

(1) Discrepancy Records

Aircraft maintenance and inspections on the Pilatus PC-12/U-28A aircraft are documented on Form DRCVS Discrepancy Report. (Tabs D-34 to D-45 and R-23) The maintenance and inspection historical actions are maintained in an electronic maintenance documentation system, M3. (Tab D-4) In addition to documenting routine and scheduled maintenance actions, these tools allow aircrew to report aircraft discrepancies and enable maintenance personnel to document actions taken to resolve reported issues. (Tab D-4 to D-45) Documentation includes work instructions, planned action, corrective action taken, the maintenance personnel who corrected and inspected the maintenance action (if required) and the date the problem was corrected. (Tab D-4 to D-45) Additionally, the discrepancy records and M3 provide maintenance personnel the information necessary to research past aircraft problems to effectively troubleshoot and resolve maintenance discrepancies. (Tabs R-47 and V-13.2)

Active discrepancy records are those that have not been corrected by maintenance personnel. (Tab D-19 to D-20) These discrepancies are evaluated to determine whether they affect the aircraft's airworthiness. (Tab R-22 to R-33) Airworthiness describes whether an aircraft has been certified as suitable for safe flight. (Tab BB-10) If it is determined that discrepancies do not affect airworthiness, the aircraft can be flown without corrective action. (Tab R-22 to R-23)

There were eight active discrepancy records at the time of the mishap flight, none of which affected airworthiness. (Tab D-34 to D-45)

Active Discrepancy Reports		
Record #	Discrepancy	Action Taken
CVS08540	Infrared (IR) lens required install on both main landing gear (MLG) lights	IR lens installed on landing lights. Requires removal from aircraft before transfer back to Hurlburt Field.
CVS08475	Portable Radio #5 radio no transmitter or receiver with ground or air players in plain test & cypher text	Mission equipment does not affect aircraft airworthiness. Replaced Portable, Radio, Communication, #5 radio. line of sight amp # A-320V1 on order.
CVS08564	H-System (H-sys) light on glare shield flickering. Difficult to see when lit.	Mission system does not affect airworthiness. Replaced Dimmer Distribution Unit. H-Sys control box on order.
CVS08702	M1 has blue discoloring on video. Flashes a blue color on dark surfaces of image.	Mission system does not affect airworthiness. Awaiting Multi-spectral Targeting System (MTS)-B replacement to MTS-A.
CVS08748	Wind carrot showing 50-60 knots right to left erroneous indication. Winds not in line with actual. On multiple approaches, winds were calm but carrot still displayed 50-60 right to left.	Performed operation check of the flight management system and air data computer system, no anomalies noted. In flight operational check requested.
CVS08854	Left pilot heading would not come up on attitude and reference heading system (AHRS). Cycled avionics (AV) 1/2 and AHRS 1/2 power twice with no fix. Heading came up in MSU.	Recycled AV1 and AV2 multiple times with no discrepancies. In flight operational check requested.
CVS08855	Cabin heater circuit breaker (CB) popped twice with cabin heater on while on ground.	Opened all of the heat vents. In flight operational check requested.

CVS08885	Left Pilot (LP) Wx radar "No Data". Power cycle and retest, no effect.	Recycled AV1 and AV2 with no discrepancies noted. In flight operational check requested.

Airworthiness Directives (AD) are legally enforceable rules issued by the Federal Aviation Administration (FAA) in accordance with the Code of Federal Regulations, Title 14, Part 39, to correct an unsafe condition in an aircraft, aircraft engine, propeller, or appliance. (Tab BB-10 to BB-12) There were 18 ADs issued by the FAA for the MA since acceptance of the MA by the Air Force on 30 May 09. (Tab U-2) Maintenance personnel complied with all 18 ADs and documented compliance in M3. (Tab U-3 to U-11)

Discrepancy records and M3 documentation from 1 Oct 16 to 14 Mar 17 revealed a recurring discrepancy with the aircraft stick pusher system. (Tab U-38 to U-45) This discrepancy was corrected by replacing a severely corroded right MLG weight-on-wheels switch cannon plug and back shell. (Tabs U-41 to U-42, V-13.3 to V-13.4, and V-14.6 to V-14.7) Following replacement, the MA flew 13 sorties, prior to mishap with no recurrences. (Tab V-14.7)

There is no evidence that any active discrepancies were a factor in the mishap.

(2) Aircraft Flight Hours/Engine Hours

Aircraft flight hours are tracked and documented to ensure that scheduled inspections are accomplished on time and to help determine overall wear and tear on the aircraft and its components. (Tab U-33 to U-37) Prior to the MS, the MA had 6,994.4 total flight hours (Tab D-52). Engine hours are tracked to monitor the total life of an engine, the total hours since last overhaul, the date of last install, and the hours since installation. Prior to the MS, the mishap engine, PT6A-67B, serial number PCE-PR0598, had 7,166.1 total engine hours. (Tab D-52) Overhauls are required every 3,500 hours on PT6A-67B engines. (Tab U-12) The engine was last overhauled on 4 Jan 16 and installed on the MA on 29 Jul 16. (Tab U-13 to U-20) Since the overhaul and installation, the engine accumulated 560.5 hours. (Tab D-52)

b. Inspections

(1) Preflight/Postflight

Maintenance personnel complete an inspection prior to and after each flight, which are referred to as preflight and postflight inspections respectively. (Tab U-21 to U-29 and U-31) The PC-12/U-28A Aircrew Operating Handbook, Volume 1, Section 2, directs these inspections, which are documented on a daily flight log. (Tab U-21 to U-30) The daily flight log also includes other pertinent flight data: airframe and engine data, servicing log, flare status, time before next inspection, maintenance release and flight times. (Tab D-52) Documentation was completed as required for the preflight inspection, servicing, and maintenance release of the MA on the daily flight log, dated 14 Mar 17. (Tab D-52)

(2) Progressive Inspection Program

The progressive inspection program is designed for high utilization aircraft. (Tab U-33) For every aircraft maintained under this program, a complete inspection cycle consists of six miniature (mini) or minor inspections and six phase inspections at alternating intervals every 100 hours. (Tab U-33) This inspection cycle must be complied with while not exceeding 1,200 hours time in service, or 12 months, whichever comes first. (Tab U-34) The mini inspection consists of a visual inspection of the wing, tail, fuselage, landing gear, fluid levels, cabin, cockpit, propeller, engine oil filter, and fuel filter. (Tab U-33) The phase one through six inspections include all 100-hour and annual tasks as well as time limited and overhaul tasks that fall within 12 calendar months. (Tab U-33) Once the 1200 hour cycle and all inspections in the program are completed, the cycle starts over. (Tab U-33)

The 100-hour phase inspections may be completed and signed off between 10 hours prior to or after the due time without altering the due time of the next 100-hour inspection. (Tab U-34) A 700-hour mini progressive inspection was conducted on the MA on 9 Feb 17, 8.2 hours prior to the accumulated 100 hours. (Tab U-34) The maintenance conducted in conjunction with the 700- hour mini progressive inspection is contained in the discrepancy records listed in M3 as well as discrepancy report #CVS08508. (Tab U-36 to U-37).

The MA flew 26 sorties totaling 94.8 hours between the 700-hour mini progressive inspection and the MS. (Tab D-52)

c. Maintenance Procedures

Prior to launching an aircraft many maintenance actions and procedures must be completed and documented to include servicing, preflight, maintenance release, and time before next scheduled inspection. (Tabs D-52, U-21 to U-29, and V-14.4 to V-14.6) Documentation of these actions is required on a daily flight log. (Tab D-52) The most common servicing operations include fuel, engine oil, and tire pressure. Preflight inspections are completed and documented prior to each sortie. Once the servicing log and preflight inspection is complied with, a review of discrepancy records and M3 is conducted to ensure there is no maintenance action ongoing that would affect airworthiness of the aircraft. (Tabs U-21 to U-29 and BB-10 to BB-12) Once complete, a FAA certified Airframe and Powerplant (A&P) mechanic signs the maintenance release section. (Tabs D-52 and V-14.4)

At the end of the day’s flying period, additional actions are required. (Tab U-31) A postflight inspection is completed to verify the continued airworthiness of the aircraft. (Tab U-31) The day’s sorties are tallied to keep track of aircraft and engine operating time. (Tab U-31) This is recorded in M3 to ensure time-tracked components are changed per the item’s life expectancy, while also ensuring scheduled inspections are completed when required. (Tab U-31) The type of the next upcoming inspection and hours until due are included on the daily flight log. (Tab D-52)

There is no evidence that maintenance procedures were a factor in the mishap.

d. Maintenance Personnel and Supervision

The Sierra Nevada Corporation (SNC) is a contract logistics support organization that provides maintenance support for the U-28A at Cannon AFB, NM, and forward deployed locations. (Tabs V-1.14 and V-14.3) SNC employs FAA certified A&P mechanics, FAA certified Inspection Authorization (IA) mechanics and avionics specialists. (Tab V-13.1, V-14.3 and V-14.7)

Additionally, toxicology testing performed on all maintenance personnel after the mishap was negative for any improper substance use. (Tab FF-4)

There is no evidence that maintenance personnel were a factor in the mishap.

e. Fuel, Hydraulic, Oil, and Oxygen Inspection Analyses

(1) Fuel

The Air Force Petroleum Office (AFPET) laboratory at Vandenberg, California, conducted analysis of the Jet-A fuel onboard the MA and determined there was no detectable volatile contamination. (Tab J-107)

There is no evidence that aircraft fuel was a factor in the mishap.

(2) Engine Oil

The Air Force Research Laboratory (AFRL) at Wright-Patterson AFB, Ohio (OH), analyzed two turbine engine oil samples from the MA engine. (Tab J-101) One sample was from the gearbox and the other from the oil tank. (Tab J-101) The laboratory performed a Spectrometric Oil Analysis Program analysis and found no issues with the PT6A oil samples. (Tab J-101 to J-103)

There is no evidence that engine oil was a factor in the mishap.

(3) Engine Fuel Filter Bowl

The AFPET laboratory at Wright-Patterson AFB, OH analyzed MA's engine fuel filter bowl and found no detectable volatile contamination. (Tab J-107)

There is no evidence that the engine fuel filter bowl was a factor in the mishap.

(4) Oxygen

Two Aviator Breathing Oxygen bottles were sent to Analytical Chemistry Section at Tinker AFB, Oklahoma (OK), which determined both samples complied with specified technical order limits for tests performed. (Tab J-121)

There is no evidence that the oxygen was a factor in the mishap.

f. Unscheduled Maintenance

The last scheduled maintenance inspection was completed on 9 Feb 17. (Tab U-34) Between the 700 hour mini progressive inspection and the MS, aircrew reported 34 discrepancies resulting in unscheduled maintenance. (Tab D-19 to D-45) Each discrepancy was reported on a discrepancy report and documented in M3. (Tab D-19 to D-45) SNC personnel conducted maintenance on each system and cleared all discrepancies after operational checks were normal or three inflight operational checks passed (if applicable) with exception of the eight open discrepancies previously listed in paragraph 5.a.1. (Tab D-19 to D-45)

The most notable discrepancy involved the stick pusher and was reported on discrepancy report #CVS08588 on 16 Feb 17. (Tab U-38 to U-45) Discrepancy read: "Pusher failed momentarily <1 minute at level flight 1.4 hours into sortie." (Tab U-38 to U-45) This discrepancy was previously reported on discrepancy report #CVS08480 on 7 Feb 17. (Tab U-36 to U-45)

Stick pusher maintenance actions by date are as follows (Tab U-38 to U-45):

8 Feb 17:
- Adjusted elevator and stick pusher cable tension

9 Feb 17:
- Removed and replaced stick pusher computer
- Removed and replace left and right Angle of Attack sensors
- Removed and replaced Central Advisory and Warning System (CAWS) display unit
- Removed and replaced CAWS computer

10 Feb 17:
- Removed and replaced torque transducer

16 Feb 17:
- Removed and replaced oil pressure switch connector
- Removed and replaced wiring from oil pressure switch connector to P603 on firewall

22 Feb 17:
- Repinned wire #E29A24N and reinstalled into XP501

23 Feb 17:
- Removed and replaced stick pusher servo

28 Feb 17:
- Cleaned pusher interrupt switches on left and right pilot yokes
- Removed and replaced 2 each diodes from stick pusher computer to stick pusher servo
- Removed and replaced flap control warning unit
- Removed and replaced power control lever micro switch

3 Mar 17:

- Removed and replaced left and right MLG weight-on-wheel switches
- Identified right MLG weight-on-wheels switch connector severely corroded

5 Mar 17:

- Removed and replaced right MLG weight-on-wheels switch cannon plug and back shell

After replacement of the right MLG weight-on-wheels switch cannon plug and back shell, the MA flew 13 sorties, prior to the MS with no reoccurrences. (Tab V-14.7)

There is no evidence the stick pusher was a factor in the mishap.

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Structures and Systems

(1) Engine

(a) Powerplant

Pratt & Whitney Canada Service Investigation Facilities in Bridgeport, West Virginia, evaluated the recovered engine. (Tab J-11) The Pratt & Whitney Canada investigation concluded that: "The engine displayed contact signatures to its internal components that are consistent with an engine that was producing power at the time of impact. The engine displayed no indications of any pre-impact anomalies or distress that would have precluded normal engine operation prior to impact." (Tab J-13)

There is no evidence that the engine was a factor in the mishap. The engine was operating normally throughout the mishap sequence.

(b) Propeller

Hartzell Engineering Test Lab in Piqua, OH evaluated the mishap propeller. (Tab J-69) The Hartzell Propeller investigation concluded that: "There were no discrepancies noted that would prevent or degrade normal operation prior to impact with terrain. All damage was consistent with high impact forces. Damage indicated that the propeller was operating at high power with a blade angle in the normal range of operation at time of impact." (Tab J-71)

There is no evidence that the propeller was a factor in the mishap. The propeller was operating normally throughout the mishap sequence.

(2) Aircraft Systems

(a) Power Control Console

SNC analyzed the power control console consisting of the power control lever, condition lever, Manual Override (MOR) lever and the flap control lever with positioning resolver. (Tabs J-123 and J-162) These parts were inspected for correct installation and proper micro-switch adjustments for each control lever. (Tab J-162) SNC concluded:

> Due to the heavy intrusion from the incident the control console levers were set into a fixed position. The pedestal assembly was sheared at the forward attachment area of the center main panel and at the rear between the mission radio remote control heads and the power control quadrant. The control cables attached to the control levers are bent at a 90° angle.
>
> The MOR is correctly attached to the MOR control cable. The MOR control handle is properly stowed in the off position.
>
> The power control lever is 7 millimeters forward of idle detent. The power control lever is properly attached to the power control lever cable. The power control lever micro-switch was inspected and is correctly installed. The micro-switch actuates correctly.
>
> The condition lever is set to flight idle and is firmly in its detent to lock the condition lever in place. The condition lever is correctly attached to the condition lever cable. The condition lever idle cutoff guard is properly installed. The condition lever micro-switches were inspected for proper installation and correct actuation. The condition lever micro-switches are installed correctly and actuate correctly.
>
> The flap control handle is set to 0° (this matches the flap actuator M/S stop position and the flap actuator shaft position which is one and a half turns until the shaft bottoms).
>
> The wiring for each micro-switch was inspected from the connector to the individual micro-switches. All wires checked good for proper continuity and were in their correct pin location.

(Tab J-162 to J-163)

There is no evidence that the power control console was a factor in the mishap.

(b) Elevator

SNC inspected the elevator for proper attachment and correct installation. (Tabs J-123 and J-126) Additionally, "the control cables were inspected for proper installation, routing, pulley alignment and fraying." (Tab J-128) All evidence indicates correct attachment, installation, alignment and no fraying. (Tab J-128) The stick pusher capstan and bridle cables were correctly installed and the stick pusher servo cannon plug was connected properly. (Tab J-148) To ensure the elevator moved freely upon its axis, the damaged section of tail was cut to allow the elevator to operate normally. (Tab J-126) No defects were found with the operation of the elevator. (Tab J-126)

There is no evidence the elevator was a factor in the mishap.

(c) Horizontal Stabilizer

SNC inspected the horizontal stabilizer for proper attachment of the vertical stabilizer and the pitch trim actuator. (Tabs J-123 and J-129) "The horizontal stabilizer was properly attached to the vertical stabilizer. The horizontal stabilizer had shifted on the forward centerline to the right with the pitch trim actuator contacting the vertical stabilizer on the left flange due to the right elevator striking the ground during the incident." (Tab J-129)

There is no evidence the horizontal stabilizer was a factor in the mishap.

(d) Pitch Trim Actuator

SNC inspected the pitch trim actuator for proper attachment and electrical connection. (Tabs J-123 and J-130) "The actuator is properly installed and electrically connected. The pitch trim actuator rod extension was measured at 1.98 inches (2.54 inches is zero trim) which coincides with the trim takeoff placard mark observed on the left side of the vertical stabilizer." (Tab J-130)

There is no evidence that the pitch trim actuator was a factor in the mishap.

(e) Rudder Control

SNC analyzed the rudder. (Tab J-123 and J-131) "The rudder was extensively damaged during the incident showing heavy compression from the lower aft section and slightly less compression on the forward edge impacting the rudder cable quadrant and shearing the vertical stabilizer rudder attach bracket away from the vertical stabilizer." (Tab J-131)

"The upper rudder hinge attachment on the vertical stabilizer was intact and the rudder was correctly attached to the hinge point." (Tab J-132) "The autopilot bridle cables revealed no potential fray and was properly wound on the capstan." (Tab J-132) Additionally "the control cables were inspected for proper installation, routing, pulley alignment and fraying.) All evidence indicates correct attachment, installation, alignment and no fraying." (Tab J-145) "The rudder cable was found to be stretched during the incident. The pilot and copilot rudder pedals sustained extensive intrusion during the impact." (Tab J-152) "Inspection of the pedals were confined to proper attachment of associated components. The rudder pedal hardware was connected and installed properly." (Tab J-152)

There is no evidence that the rudder system was a factor in the mishap.

(f) Tail Section and Vertical Stabilizer

SNC analyzed the tail section, which was extensively damaged during the incident. (Tab J-123 and J-132)

> The inspection revealed that the tail section stringers and attaching skin had wrinkled from an upper forward to lower rear in all areas along the crease line. The vapor cycle cooling system (air conditioner unit) mounts located normally on the right forward section of the tail had been torn away. The aft tail shelf (contains the High Frequency (HF) and Emergency Locator Transmitter (ELT) equipment) had detached from its mount during the incident. The HF antenna coax was pulled from the antenna cannon plug and the ELT antenna coax cables were severed approximately four inches from the antenna connector.

(Tab J-132)

"The missile warning system (MWS) sensor mounts were inspected for proper installation and attachment. Left and right MWS sensors are installed correctly." (Tab J-133)

> The MTS-B lift assembly was torn away from its mount during the incident. The lift assembly attachment mount to the jackscrew was sheared allowing the ball mount assembly to travel downward during incident impact. The lift assembly became detached and impacted the aft access area frame crushing it as well as impacting the tail jacking mount area compressing it upward. The upper portion of the lift assembly penetrated the aft pressure dome tearing the dome in a spider radius. The lift assembly was inspected and found to be bent along the vertical axis of the lift rails. The MTS-B mount on the lift and the remaining ball plate are still attached. The ball mount assembly was inspected and is installed correctly.

(Tab J-133)

There is no evidence the tail section and vertical stabilizer were factors in the mishap.

(g) Aileron Control System

SNC analyzed the Aileron Control System. (Tab J-123 and J-134 to J-143)

i. Left Aileron

"The center aileron rod was found to have a radius bend from incident impact from the left MLG assembly." (Tab J-134) "The aileron was pushed out of its pivotal axis during the incident. The outboard portion of the aileron was pushed upwards and the inboard portion was pushed aft and downward." (Tab J-135) "The trim tab received outboard damage during the incident." (Tab J-136) Aileron control system connection rods, connection forks, bellcrank, roller guide assembly, rollers, trim tab, trim tab actuator, aileron bearing, and aileron attachment points were inspected for evidence of correct installation prior to MS. (Tab J-134 to J-137) All evidence indicates components were correctly installed. (Tab J-134 to J-137) The aileron was inspected for potential previous chafing or binding. (Tab J-135) No binding or chafing was found. (Tab J-135) The trim actuator shaft extension was measured and found to be in the centered (neutral position). (Tab J-136)

There is no evidence that the left aileron was a factor in the mishap.

ii. Right Aileron

"Aileron control system was inspected from the inboard connection point to the outboard aileron attachment point." (Tab J-142) "The center aileron rod was found to have a radius bend from incident impact from the right MLG assembly." (Tab J-142) The aileron was pushed out of its pivotal axis during the incident. (Tab J-143) "The outboard portion of the aileron was pushed upwards and the inboard portion was pushed aft and downward." (Tab J-143) Aileron control system connection rods, connection forks, bellcrank, roller guide assembly, rollers, trim tab, trim tab actuator, aileron bearing, and aileron attachment points were inspected for evidence of correct installation prior to MS. (Tab J-142 to J-143) All evidence indicates components were correctly installed. (Tab J-142 to J-143) The aileron was inspected for potential previous chafing or binding. (Tab J-143) No binding or chafing was found. (Tab J-143) "The flettner tab was properly installed and found to be in a 3˚ upward fixed position." (Tab J-136)

There is no evidence the right aileron was a factor in the mishap.

(h) Capstan, Cable, Servo, and Control Column

SNC analyzed the capstan, cable, servo and control column. (Tabs J-123, J-146 to J-147, J-151) "The capstan cable wind is correct and the cable is attached to the aileron segment correctly. The aileron autopilot servo and cannon plug is correctly installed." (Tab J-146) Additionally the control cables were inspected for proper installation, routing, pulley alignment and fraying. (Tab J-146) All evidence indicates correct attachment, installation, alignment and no fraying. (Tab J-146) The aileron control column was inspected for proper installation of the chain, chain wheel, chain connection and shaft attachment and was determined to be properly routed, installed, and connected. (Tab J-151) "The control wheel shafts are separated due to the impact during the incident." (Tab J-151)

There is no evidence that the capstan, cables, servo and control column were a factor in the mishap.

(i) Flap Control System

SNC analyzed the flap control system. (Tabs J-123 and J-138 to J-143)

i. Left Flap

"The flap assembly inboard flap extension was crushed from a downward motion. The center portion of the flap is bent upwards and has tire marking on the underside from the left main gear tire striking the flap assembly. The outboard portion of the flap is sheared and rotated out of alignment." (Tab J-138) The flap assembly mechanism, and flap arm supports were inspected for proper installation. (Tab J-138) The inboard and outboard flexshafts and flap position resolvers were also inspected. (Tab J-138) All evidence indicates components were correctly installed.

There is no evidence that the left flap assembly was a factor in the mishap.

ii. Right Flap

"The flap assembly inboard flap extension was crushed from a downward motion. The center portion of the flap is bent upwards and has tire marking on the underside from the right main gear tire striking the flap assembly. The outboard portion of the flap is sheared and has the outboard flap arm attached." (Tab J-143) The flap assembly mechanism, and flap arm supports were inspected for proper installation. (Tab J-143) The inboard and outboard flexshafts and flap position resolvers were also inspected. (Tab J-144) All evidence indicates components were correctly installed. (Tab J-143 to J-144)

There is no evidence that the right flap assembly was a factor in the mishap.

iii. Flap Actuators

"The left inboard flap actuator was found attached to the lower inboard portion of the rear spar (rear spar is detached from the main wing section). The flap actuator was inspected and found in the zero flap position (jackscrew was in the retract position and the ring gear M/S stop was at the 5:30 position). The rear portion of the flap actuator jackscrew shaft was sheared at the base of the flap actuator housing." (Tab J-139)

"The left outboard flap actuator was inspected for proper installation and position. The flap actuator was found to be correctly installed and set to a zero flap position. The rotational sensor on the outboard side of the actuator was found to be separated at the base of the actuator attachment point. The rotational sensor electrical connector was found to be connected properly." (Tab J-140)

"The [right] inboard flap actuator was found attached to the lower inboard portion of the rear spar (rear spar is detached from the main wing section). The flap actuator was inspected and found in the zero flap position (jackscrew was in the retract position and the ring gear M/S stop was at the 5:30 position). The rear portion of the flap actuator jackscrew shaft was sheared at the base of the flap actuator housing." (Tab J-144)

"The [right] outboard flap actuator was inspected for proper installation and position. The flap actuator was found to be correctly installed and set to a zero flap position. The rotational sensor on the outboard side of the actuator was found to be installed correctly. The rotational sensor electrical connector was found to be connected properly. (Tab J-144)

There is no evidence that the flap actuators were a factor in the mishap.

iv. Left Outboard Flap Actuator Analysis

The left outboard flap actuator was submitted to the AFRL/Material Integrity Branch at Wright-Patterson AFB, OH, for evaluation. (Tab J-343 and J-345) The shaft rotated freely and radiography did not reveal any anomalous conditions. (Tab J-351 to J-353)

There is no evidence that the left outboard flap actuator was a factor in the mishap.

(j) Flap Indicator

The flap indicator was submitted to the AFRL/Materials Integrity Branch at Wright-Patterson Air Force Base, OH, for evaluation. (Tab J-246 and J-250) "The needle was positioned at the zero degree tick mark, but was free to move when the indicator was handled." (Tab J-251) No physical damage to the housing was observed. (Tab J-251) Radiographic examination revealed no evidence of internal damage or broken components. (Tab J-251) "Examination of the dial face revealed two possible witness marks. The first possible mark was adjacent to the zero degree tick mark. The second possible mark was adjacent to the fifteen degree tick mark. However, the second possible mark appeared to be outside the normal sweep of the indicator needle tip." (Tab J-251) Further examination of the indicator needle stops revealed material transfer to the 0˚ stop from the indicator needle post. (Tab J-252) This correlates with the physical position of the flap actuators. (Tab J-139 to J-140)

There is no evidence the flap indicator was a factor in the mishap.

(k) Flap Control and Warning Unit (FCWU)

The FCWU was sent to EMCA Electronic Aktiengesellschaft, Switzerland, where they performed an Acceptance Test Procedure (ATP). (Tab J-178) "The unit showed external signs of scoring and dents but was generally not deformed." (Tab J-179) "The light emitting diode (LED) on the front of the unit was found broken (sheared off)." (Tab J-180) "The unit passed the full ATP without flaws except obviously for the check points where the LED would have illuminated." (Tab J-180)

The Error Code Log contained two entries (Tab J-180):
0122 – 03:57:23 – E210
0000 – 00:02:56 – E206

"The error code E206 was most likely generated during the post-installation test of the FCWU." (Tab J-180) "The flap asymmetry code E210 was generated after the 122nd weight-on-wheels event since reset of the FCWU." (Tab J-180)

Physical inspection of the flap actuators confirmed that all four actuators were set to the 0˚ position, the flap indicator showed a mark at 0˚ tick mark, and the flap control handle was confirmed set to zero. (Tabs J-139 to J-140, J-144 and J-251)

(l) Landing Gear System

SNC analyzed the landing gear system. (Tab J-123 and J-153)

i. Landing Gear Handle and Selector Valve

The landing gear handle and selector valve were inspected for proper installation of attaching components and the gear handle position prior to the incident. (Tab J-164) "The landing gear selector valve sustained major intrusion due to the incident. The landing gear handle interconnect rod to the service selector valve is bent at a 60 degree bend around the aileron pulley. The landing gear handle attachment to the lower instrument panel is sheared." (Tab J-164) "The gear handle was inspected and is in the down position with the lock engaged." (Tab J-164) The selector valve is in the relative down position due to the bend in the interconnecting rod. (Tab J-164)

There is no evidence the landing gear handle and selector valve were a factor in the mishap.

ii. Nose Landing Gear

"The nose landing gear was confirmed down by the damage assessed to the engine firewall, indicating the nose landing gear made tire contact with the wheel well structure while the nose landing gear actuator was in an extended position and the data obtained from the Enhanced Ground Proximity Warning System (EGPWS) from the Honeywell vendor indicating the gear was down." (Tab J-158)

There is no evidence that the nose landing gear was a factor in the mishap.

iii. Left Main Landing Gear

The left MLG was "confirmed down by extension/locking of the MLG actuator, assessment of damage to the upper wing/lower flap surfaces and initial ground scarring. The forward attachment fitting on the forward wheel well was inspected and confirmed proper installation. The aft fitting could not be inspected due to the extent of the damage to the aft wheel well structure." (Tab J-154 to J-155)

There is no evidence the left MLG was a factor in the mishap.

iv. Right Main Landing Gear

The right MLG was "confirmed down by extension/locking of the MLG actuator, assessment of damage to the upper wing/lower flap surfaces and initial ground scarring. Inspection of the forward attachment fitting on the forward wheel well confirmed proper installation. Inspection of the aft attachment fitting was not accomplished due to the extent of the damage to the aft wheel well structure." (Tab J-156)

There is no evidence that the right MLG was a factor in the mishap.

v. Landing Gear Position Annunciators

Two separate analyses were done on the landing gear position annunciators in order to confirm which lights were illuminated. (Tab J-309 and J-326) The first analysis was performed at the Air Force Sustainment Center at Tinker AFB, OK. (Tab J-309) The second analysis was performed at the AFRL/Materials Branch at Wright-Patterson AFB, OH. (Tab J-326) This follow-on inspection "employed a scanning electron microscope at high magnification to more accurately determine filament state at the time of power loss estimating the approximate age in hours of each filament by the amount of notching observed." (Tab J-326)

Combining the two analyses shows the following:

- Nose landing gear: Indicated green at time of power loss (Tab J-316)
- Right MLG: Indicated green at time of power loss (Tab J-338)
- Left MLG: Indicated both red and green at time of power loss (Tab J-338)

Although the left gear showed both red and green, physical examination and analysis of all landing gear, position of landing gear handle, and ground scarring correlates that all gear were down and locked at the time of impact. (Tabs H-4, J-134, J-154 to J-156, and J-158) The left landing gear was the first gear to impact the ground. (Tab H-4) The impact aftermath likely caused the red light to illuminate. (Tabs H-4 and V-14.8)

(m) Universal Avionic Systems (UNS)-1Lw Flight Management System (FMS)

"The UNS-1Lw FMS was removed from the aircraft for data recovery. Upon inspection, the outer case showed moderate damage and the outer shell had been bent such that the internal cards were exposed to the elements. The unit was hand-carried to the Original Equipment Manufacturer (OEM) research and development facility in Redmond, Washington (WA). Disassembly of the unit showed notable amount of dust within the inner case. The memory card appeared to be in very good condition and the conformal coating was intact thus protecting the boards from exposure to the elements. The OEM was able to recover data up to 1835L, one second prior to assumed impact." (Tab J-172) This data was processed and used to recreate the MA's flight track. (Tabs J-173, Z-3 to Z-7 and Z-14)

There is no evidence the UNS-1Lw FMS was a factor in the mishap.

(n) Blue Force Tracker (BFT)

The BFT, a device that provides data on the flight path, was removed and inspected by Big Safari. (Tabs J-165 and J-173) "The power switch was still in the "ON" position but no lights were illuminated. The unit was in very good condition and is believed to be fully functional since the BFT was still sending out messages twenty minutes after impact at a rate of one message every two and a half minutes." (Tab J-173)

There is no evidence the BFT was a factor in the mishap.

(o) Stick Pusher Computer

The stick pusher computer was sent to EMCA Electronic Aktiengesellschaft, Switzerland, where they performed an ATP. (Tab J-179) "The unit showed external signs of scoring and dents but was generally not deformed" and it "passed the full ATP without flaws," and was therefore working properly at the time of the mishap. (Tab J-179)

There is no evidence that the stick pusher computer was a factor in the mishap.

(p) Circuit Breaker and Wire Bundle Testing

A connector with associated wiring, along with seven CBs, were submitted to the AFRL/Materials Integrity Branch at Wright-Patterson AFB, OH, for evaluation. (Tab J-187 to J-188) "The connector, P415, mated directly to the stick pusher actuator." (Tab J-191) The CBs (651, 654, 821, 571, 611, 412, 413A, 413B, 413C) consisted of the stall warning unit, pusher system, fire warning system, hydraulic control, cabin heater, underfloor heater and automatic direction finder. (Tab J-191)

The AFRL evaluation concluded that:

> Rough edges along cuts on the wire insulation, clean and shiny exposed conductor, and impact witness marks on the conductors indicate the damage from the wiring was not present before the mishap occurred. The wiring harness connector and sockets were clean and exhibited no damage anomalies.
>
> No evidence of electrical arcing or overcurrent events having caused the CBs to trip was identified during the analysis. Two CBs (611 and 413 section B (section B is unused) were found during electrical testing which failed maximum limit of ultimate trip testing. This type of failure means it would require more current than normal to trip the breaker and would be slower to respond to sustained overcurrent events. One CB (821) was found to fail minimum limit of ultimate trip testing. This type of failure means the CB could trip at current levels lower than specification and, in this case, under conditions of sustained current loads greater than approximately 80 percent of rated current. This circuit breaker would also be susceptible to tripping early on shorter duration overcurrent events should they have existed. Other reasons for this circuit breaker being found in the trip condition would include tripping as a result of the crash (impact shock) and manually being pulled. The remaining CBs passed electrical testing. These CBs may have tripped as a result of the crash if impact shock exceeded the 75g limit stated on the specification sheet.

(Tab J-194)

There is no evidence the CBs were tripped prior to the mishap and therefore they were not a factor in the mishap.

(q) Enhanced Ground Proximity Warning System (EGPWS)

The EGPWS was recovered and forwarded to Honeywell in Redmond, WA, for analysis. (Tab J-219) They noted that the most up-to-date version of the terrain database was not in use. (Tab J-219) Honeywell confirmed that the outdated database did not affect EGPWS operation. (Tab J-219) They compared terrain data between the version in use and the most updated version and found that there were no differences in the terrain elevations. (Tab J-219) The EGPWS circuit board was found to be in good physical condition. (Tab J-219) Honeywell was able to download the flight history which was used to prepare graphics of alerts that occurred during flight. (Tabs J-219 and Z-8)

There is no evidence that the EGPWS was a factor in the mishap.

(r) Airspeed Indicator

The airspeed indicator was recovered and submitted to the AFRL/Materials Integrity Branch at Wright-Patterson AFB, OH, for evaluation. (Tab J-246) No physical damage to the housing was observed. (Tab J-250) Radiographic examination revealed no evidence of internal damage or broken components. (Tab J-251) "Examination of the dial face revealed two distinct witness marks. The first mark (distinct and thin) was observed between the 135 and 140 knot tick marks. (The second mark (fainter and wider) was observed between the 300 and 320 knot tick marks. Both witness marks aligned with the sweep of the indicator needle tip." (Tab J-251) Blacklight illumination of the dial face did not reveal any luminescent transfer on the airspeed indicator. (Tab J-251)

There is no evidence the airspeed indicator was a factor in the mishap.

(s) KCP 220 Flight Computer

The KCP 220 Flight Computer was sent to Honeywell at Olathe, Kansas (KS), for evaluation. (Tab J-271) The unit was visually and electrically tested. (Tab J-271) Visual inspection revealed impact damage resulting in a warped chassis, dented cover and bent bottom frame. (Tab J-271) The unit contained all applicable mods and latest software. (Tab J-271) Further inspection found that the impact caused the power supply cover (ground) to contact the case of transistor Q332, shorting 28 volts to ground. (Tab J-271) Fuse 301 was replaced and test adapters were installed to facilitate testing. (Tab J-271) The KCP 220 passed all acceptance tests. (Tab J-271) Honeywell concluded that: "No pre-impact defects were noted for the KCP 220." (Tab J-274)

There is no evidence the KCP 220 Flight Computer malfunctioned or was a factor in the mishap.

(t) King Altitude Selector (KAS) 297 Altitude Preselector

The KAS 297 Altitude Preselector was sent to Honeywell at Olathe, KS, for evaluation. (Tab J-271) "The KAS 297C was impact damaged and could not be tested. The non-volatile memory chip was removed and inserted into a host unit to determine the last settings entered into the unit. The settings recovered were 6,000 feet and a 2,000 feet per minute descent. It cannot be determined if these settings were entered during the accident flight." (Tab J-273) Honeywell concluded that: "No pre-impact defects were noted for the KAS 297C." (Tab J-273)

There is no evidence the KAS 297 altitude preselector malfunctioned or was a factor in the mishap.

(u) Emergency Locator Transmitter (ELT)

The ELT was recovered and forwarded to ACR Electronics, Inc at Fort Lauderdale, Florida, for evaluation. (Tab J-300) A summary of the evaluation stated the ELT passed "all RF [Radio Frequency] transmission and power output tests per original design specifications." (Tab J-303) However, the ELT did not pass the G-Switch centrifugal test. (Tab J-303) ACR Electronics, Inc. concluded that:

1. The battery has 48 hours and 24.5 minutes runtime as proven when the non-volatile random-access memory was read. This indicates a lengthy activation.
2. The ELT performed to design specifications on all RF and self-test levels, when connected to a test battery.
3. The in-line G-switch did not pass within specification. It needs to be taken into account that the functional tests we did was on a post-incident beacon. ACR does not have the service records of the beacon, or information about the incident, thus cannot vouch an opinion on a reason for the failure of the switch.

(Tab J-303)

There is no evidence the ELT malfunctioned or was a factor in the mishap.

(v) Central Advisory and Warning System (CAWS) Panel

The CAWS panel was sent to the Air Force Sustainment Center at Tinker AFB, OK, to determine whether the panel was functional and what indications were present at the time of impact. (Tab J-324) The CAWS panel uses rows of LEDs to illuminate each of 48 separate available indicators, arranged in six columns of eight indicators each. (Tab J-309) Each indicator is lit by a row of six LEDs which emit either a red, amber, or green light, depending on the indication they illuminate. (Tab J-309) LEDs do not retain any indications which can be used to determine their state of illumination at the time of the crash, so it was not possible to determine which indications may have been illuminated and which were not. (Tab J-310) All LEDs were electrically tested and found to be functional. (Tab J-310) All illuminated the color they normally would emit. (Tab J-310) They concluded that the CAWS panel was functional at the time of impact and should have displayed any applicable indications. (Tab J-324)

There is no evidence the CAWS panel malfunctioned or was a factor in the mishap.

(w) Pilot and Copilot Master Caution and Master Warning Annunciator Lights

The pilot and copilot master caution and master warning annunciator lights were sent to the Air Force Sustainment Center at Tinker AFB, OK, to determine whether the annunciators were on at the time of impact. (Tab J-324)

"The master caution annunciators each use two light bulbs to illuminate the annunciator." (Tab J-311) On the left pilot master caution light, "both bulbs showed significant signs of distortion and stretching of the filament coils, indicating the left pilot master caution light was illuminated at the moment of impact." (Tab J-311) On the right pilot master caution light, "both bulbs showed similar distortion and stretching as found on the left pilot's indicating the right pilot master caution light was also illuminated at the moment of impact." (Tab J-311)

"The master warning annunciators each use two light bulbs to illuminate the annunciator." (Tab J-313) On the left pilot master warning light, "both bulbs contained unbroken filaments with coils intact and showing no signs of stretching or distortion, indicating the left pilot master warning light was not illuminated at the moment of impact." (Tab J-313) On the right pilot master warning light, "the filament on Bulb One was broken midway between the support posts, but the filament coils were not stretched or distorted. Bulb Two had unbroken filaments, with coils intact and showing no signs of stretching or distortion indicating the right pilot master warning light was also not illuminated at the moment of impact." (Tab J-313)

There is no evidence the master caution and master warning annunciators malfunctioned or were factors in the mishap.

(x) Hydraulic Pack

The hydraulic pack was submitted to the AFRL/Materials Integrity Branch at Wright-Patterson AFB, OH, for evaluation. (Tab J-343 and J-345) The hydraulic pack and hydraulic pack motor were disassembled for inspection. (Tab J-346 to J-350) Examination during the disassembly of the hydraulic pack did not identify any anomalous conditions. (Tab J-347) The shaft could rotate freely and there was no evidence the pump was spinning at impact. (Tab J-347)

During disassembly of the hydraulic pack motor, it was noted that there was deformation of the outer housing, fan and one fastener was fractured. (Tab J-348 to J-350) The shaft could not be rotated by hand and there was no evidence that the motor was rotating at impact. (Tab J-350)

There is no evidence the hydraulic pack malfunctioned or was a factor in the mishap.

(y) Stick Shaker Actuator

The stick shaker actuator was submitted to the AFRL/Material Integrity Branch at Wright-Patterson AFB, OH, for evaluation. (Tab J-343 and J-345) Examination revealed one loose screw and shaft bending consistent with aircraft impact. (Tab J-360) Wear to the end of the shaft does not appear to be consistent with impact. (Tab J-360)

There is no evidence the stick shaker actuator malfunctioned or was a factor in the mishap.

(z) Computers

Big Safari analyzed the four computers onboard as part of the mission system suite of the U-28A. (Tab J-165 and J-169) These computers are identified as Left Pilot (LP), Right Pilot (RP), CSO (OP1), and Auxiliary (AUX). (Tab J-169)

i. LP Computer

"Analysis of the event log showed there was not a shutdown command initiated by the user which supports the assumption that power was removed abruptly while the computer was in an operational state." (Tab J-169) Files were retrieved from the LP operating system drive and from the digital video recorder drive for use in the investigation. (Tab J-169)

ii. RP Computer

"The windows event log revealed that the RP computer was shut down by a user on board at approximately 00:21z [18:21L]. There was no additional analysis of the RP computer due to the configuration of mission systems in that the mission data is written to the LP computer." (Tab J-170)

iii. OP1 Computer

"There was no analysis of the OP1 computer due to the configuration of mission systems in that the mission data is written to the LP computer." (Tab J-170)

iv. AUX Computer

"The AUX computer hosts a program called AUX server which records navigation data (DX data) from the aircraft inertial navigation system commonly referred to as the ATACNAV Mini. Analysis of the DX data showed that the server and AUX computer were shut down by a user at 00:21:17z [1821:17L]. Once the server is shut down the DX data no longer logs the navigation data. The analysis of the DX data revealed that there were settings incorrectly configured in the ATACNAV Mini which lead to some data not being recorded and may be a factor as to why the AUX system onboard was not operational during the mission sortie. Additional analysis of the DX data also revealed that firmware in the AUX control box was not properly updated to the latest approved firmware corresponding to the AUX server version." (Tab J-170)

There is no evidence the computers malfunctioned or were a factor in the mishap.

(aa) ATACNAV Control Box

The ATACNAV control box was submitted to Dahlgren, Virginia, for evaluation. (Tab J-265 and J-267) "The box was configured with software version 3.9. From the data reviewed on the AUX drive, the rest of the system had 3.10 installed. The box should have been loaded with software version 3.10. This is not an approved condition for H-Sys. Mechanically the box was slightly damaged." (Tab J-267) Power was applied and the box was operational. (Tab J-267)

Power was able to be applied to the ATACNAV enclosure. (Tab J-267) The correct operational flight system was installed. (Tab J-267) "However, the device was not configured correctly. All of the available messages were turned on, including high rate gyro data at 300 hertz. Only the 5000 (gigabyte data message) and the 5006 precise time and time internal time mark message) should be enabled." (Tab J-267)

There is no evidence the ATACNAV control box malfunctioned or was a factor in the mishap.

(bb) Ku-Band Spread-Spectrum (KUSS) Inertial Reference Unit (IRU)

"The KUSS system is the primary means of Beyond-Line-Of-Sight (BLOS) communications on the U-28A. (Tab J-170) The KUSS IRU was removed from the aircraft and analyzed by Big Safari for GPS positional information. (Tab J-165 and J-170) The last know position and altitude data were successfully recovered and were consistent with the assumed ground impact point. (Tab J-170) Since the IRU is powered by the mission power bus it can be assumed that mission power was still on at ground impact. (Tab J-170)

There is no evidence the KUSS-IRU malfunctioned or was a factor in the mishap.

(cc) Ku-Band Spread-Spectrum ViaSat Mobile Broadband Router (VMBR)

"The VMBR is a device in the KUSS system that provides configuration parameters, command/control of antenna pointing and converts network traffic to RF signals for transmission offboard the aircraft." (Tab J-171) Big Safari was able to extract the internal logger and system logs (SYSLOGS). (Tab J-165 and J-171) Analysis of the SYSLOGS revealed that the KUSS antenna hit a mechanical stop at 00:34:56z [1834:56L] indicating that the bank angle of the aircraft caused the antenna to lose sight of the satellite. (Tab J-171) The SYSLOG stopped reporting at 00:35:02z [1835:02L] which is believed to be a result of power loss. (Tab J-171) "This supports the assumption that mission power was on at time of impact." (Tab J-171)

There is no evidence that the KUSS VMBR malfunctioned or was a factor in the mishap.

(dd) Ku-Band Spread-Spectrum Beyond-Line-Of-Sight Video

"Video is sent over the KUSS system to a ground based video server hosted by AFSOC. That video was retrieved and analyzed. The sensor 1 and 2 videos stop at 00:34:54z [1834:54L] which is a result of aircraft maneuvering causing the KUSS antenna to lose sight of the satellite and dropping a network link." (Tab J-172)

There is no evidence the KUSS BLOS malfunctioned or was a factor in the mishap.

(ee) Seats

The Structural and Mechanical Systems Branch at the Air Force Safety Center analyzed MA's seats. (Tab H-3)

i. Pilot Seat

> The pilot and copilot seats consist of an upper and lower section. The lower section is attached to the seat track on the cockpit floor and has a retractable pin on each side to allow fore-aft adjustment. The lower seat section remained attached to the seat track and floor. The retractable pins were bent and wedged in the track holes from forward impact. The upper seat section is attached to the lower section by a vertical track and rollers with retractable pins for height adjustment. The upper seat section was completely broken free from the lower section, and the retractable pins were bent forward and down from impact. Most of the track rollers and attaching bolts were broken free, with deformation and elongation indicating forceful removal in the forward and down direction. The seat pan was deflected downward, and witness marks with crushing were on the bottom of the seat and the floor, indicating the seat bottomed out on the floor and slid forward after breaking free. The forward leg extensions of the seat pan were bent up and backwards from forceful contact with structure in the forward portion of the cockpit. The headrest post on the right side was bent aft and broken from the seat back.

(Tab H-7)

ii. Copilot Seat

The copilot seat lower section was broken free of the seat track on the cockpit floor. The cockpit floor and seat track had significant structural deformation from ground impact and fuselage crushing, contributing to the seat attachment failure. The floor track retractable pins were bent from forward impact. The seat upper section was broken free from the lower section. The retractable pin for height adjustment on the left side was bent down and forward from impact. The retractable pin on the right side was recessed in the hole with no bending or deformation, indicating it was not engaged in the height adjustment track. Most of the height adjustment track rollers and attaching bolts on both sides were broken free, indicating forceful removal in the forward and down direction. The seat pan was deflected downward, and witness marks with crushing were on the bottom of the seat and the floor, indicating the seat bottomed out on the floor and slid forward after breaking free. The forward leg extensions on the seat pan were bent up and backwards from forceful contact with structure in the forward portion of the cockpit. The seat back to seat bucket connecting rod was bent downward on the left side, indicating a high downward load. The head rest was broken free from the seat back in a front to back direction, indicating the seat moving forward and contacting an object. There were impact marks on both the front and back of the headrest.

(Tab H-7 to H-8)

iii. CSO Seat

The CSO seat broke free from the seat tracks at first impact. The legs on the left side of the seat were failed in the left lateral, forward, and downward direction, and the right side seat rail was pulled free from the seat track in the left and forward direction. The seat pan failed at the rear attach point, and witness marks on the bottom of the pan indicate it made forceful contact with the floor of the aircraft. A significant contribution to the seat failure was floor/track deformation from the intrusion of the rear wing carry through bulkhead up through the cabin floor. The CSO seat is positioned between the forward and rear wing carry through bulkheads, with the rear legs of the seat mounted directly over the rear bulkhead. The aft portion of the seat rails were deflected upwards approximately 12 inches, consistent with fuselage crushing and wing bulkhead intrusion into the cabin.

(Tab H-6 to H-7)

(ff) Cockpit Voice Recorder

The U-28A is not equipped with a cockpit voice recorder. (Tab L-2)

7. WEATHER (WX)

a. Forecast Weather

Forecast wx at KCVN was clear skies, a minimum of 7 statute miles (SM) visibility and winds from the southeast at 130˚ and 7 knots. (Tab F-2 to F-6)

b. Observed Weather

Observed wx at KCVN was clear skies, 10SM visibility and winds from the southeast at 120˚ and 8 knots. (Tab F-7 to F-11) The sun was still up at the time of the mishap. (Tab R-9)

c. Space Environment

Not applicable.

d. Operations

Forecast and observed wx were within operational limits for the U-28A and for the maneuvers to be accomplished.

There is no evidence weather was a factor in the mishap.

8. CREW QUALIFICATIONS

a. Mishap Instructor Pilot (MIP)

The MIP was a Senior Pilot with 750 total sorties and 3,400 hours total time. He had logged 3,199 hours in the PC-12/U-28A with 429 of those as an instructor. (Tab G-5) MIP completed instructor pilot (IP) training on 18 Dec 14 and accomplished a simulator refresher course on 2 Feb 17. (Tab G-10 and G-39) His last flight evaluation was on 4 May 16 (Tab G-33). All events, including an ELP, were accomplished within AFI 11-2U-28V2 standards. (Tab BB-31 and BB-34 to BB-35)

The MIP was current and qualified in all MS events; this was not a factor in the mishap.

Recent flight time is as follows (Tab G-6):

MIP	Hours	Sorties
30 days	21.5	6
60 days	48.2	13
90 days	51.7	14

b. Mishap Copilot (MCP)

The MCP was a Pilot with 59 total sorties and 448 hours total time. (Tab G-15) The MCP had logged 213 hours in the PC-12/U-28A. (Tab G-15) MCP completed his initial U-28A training on 18 Jul 16. (Tab G-132) MCP accomplished a no notice flight evaluation on 7 Mar 17. (Tab G-132) All events, to include an ELP, were accomplished within to AFI 11-2U-28V2 standards. (Tab BB-31 and BB-34 to BB-35)

The MCP was current and qualified for all MS events; this was not a factor in the mishap.

Recent flight time is as follows (Tab G-16):

MCP	Hours	Sorties
30 days	19.5	6
60 days	39.2	11
90 days	63.9	18

c. Mishap Combat Systems Officer (MCSO)

The MCSO has 158 total sorties and 638 hours total time. (Tab G-25) The MCSO had logged 603 hours in the PC-12/U-28A. (Tab G-25) The MCSO completed initial U-28A training on 3 Oct 14. (Tab G-190) The MCSO’s last flight evaluation was accomplished on 12 Dec 16 and all events were accomplished within AFI 11-2U-28V2 standards. (Tab G-190)

The MCSO was current and qualified for all MS events; this was not a factor in the mishap.

Recent flight time is as follows (Tab G-26):

MCSO	Hours	Sorties
30 days	19.7	5
60 days	36.8	10
90 days	40.2	11

9. MEDICAL

a. Qualifications

(1) MIP: The MIP’s most recent Preventive Health Assessment (PHA) and Flight Physical took place on 30 Mar 16, and Cannon AFB Flight Medicine issued a Medical Recommendation for Flying or Special Operational Duty (DoD Form 2992 [DD-2992]) on the same date indicating medical clearance for Pilot duties following his periodic medical examination. (Tab FF-2) A review of Aeromedical Information Management Waiver Tracking System (AIMWTS) indicated that the MIP never required a medical waiver for flying duties. (Tab FF-2)

The MIP was medically qualified to perform pilot duties at the time of the incident.

(2) MCP: The MCP's most recent PHA and Flight Physical was performed on 30 Jun 16, and Hurlburt Field Flight Medicine issued a DD-2992 indicating that he was cleared for flying or special operational duty on 6 Jul 16 following his periodic medical examination. (Tab FF-2) A review of AIMWTS indicated that the MCP never required a medical waiver for flying duties. (Tab FF-2)

The MCP was medically qualified to perform Pilot duties at the time of the incident.

(3) MCSO: The MCSO's most recent PHA and Flight Physical took place on 10 Mar 16, and Cannon AFB Flight Medicine issued a DD-2992 on that same date indicating that he medical clearance for flying or special operational duty following his periodic medical examination. The medical record indicates that the MCSO participated in the Aircrew Soft Contact Lens Program and was current in this program with his most recent optometry appointment occurring on 13 Mar 17. (Tab FF-2) A review of AIMWTS indicated that the MCSO never required a medical waiver for flying duties. (Tab FF-2)

The MCSO was medically qualified to perform CSO duties at the time of the incident.

(4) The DD-2992s for MCP and MCSO contained administrative errors that did not affect their medical qualifications. (Tab FF-2 to FF-4)

b. Health

The outpatient medical and dental records, as well as the military electronic medical records for each member of the MC were reviewed. No significant health issues were identified for any member of the MC. (Tab FF-2)

There is no evidence the health of the MC was a factor in this mishap.

c. Pathology

27th Special Operations Force Support Squadron Mortuary Affairs transported MC remains to the New Mexico Office of the Medical Investigator in Albuquerque, NM. (Tab X-2) New Mexico Medical Investigator Personnel performed autopsies on each member of the MC. (Tab X-2) The Forensic Toxicology Laboratory, part of the Armed Forces Medical Examiner System, performed toxicology tests for alcohol, cyanide and common drugs on each member of the MC. (Tab X-2) All tests performed on MC samples were negative. (Tab X-2) The Forensic Toxicology Laboratory attempted analysis carbon monoxide (CO) testing for the members of the MC, but available samples were not suitable for CO testing. (Tab X-2)

The cause of death for each member of the MC was blunt trauma sustained in an aircraft crash. The manner of death for each member of the MC was accidental. (Tab X-2).

d. Lifestyle

Review of the medical record indicated that the MIP had significant personal stressors. Squadron, group and wing leadership knew of these stressors related to a family member's medical condition and took appropriate steps to mitigate them. (Tabs V.1-8, AA-2, and FF-2) There is no evidence that these stressors were a factor in the mishap

There is no evidence that the lifestyle of any crew member was a factor in the mishap.

e. Crew Rest and Crew Duty Time

AFI 11-202, Volume 3, AFSOC Supplement indicates that the crew rest period is normally at least a 12-hour non-duty period before the aircrew enters the flight duty period. (Tab BB-32) The purpose of crew rest is to ensure the aircrew member is adequately rested before performing flight or flight related duties. Crew rest is free time, and includes time for meals, transportation and rest. Aircrew members require at least ten continuous hours of restful activities (including an opportunity for at least eight hours of uninterrupted sleep) during the 12 hours immediately prior to the flight duty period (Tab BB-5 and BB-32).

Review of the available scheduling information demonstrates that the MC was afforded an adequate crew rest period in the time leading up to the mishap. (Tab G-8, G-18, and G-28)

There is no evidence crew rest and crew duty time were factors in this mishap.

10. OPERATIONS AND SUPERVISION

a. Operations

At the time of the mishap, the 318 SOS was executing its non-deployed operational battle rhythm. (Tab V-1.6 and V-1.10) Although capable of running 24-hours a day, seven days a week, the majority of squadron activities were conducted Monday through Friday during duty hours. (Tab V-1.6 to V-1.7) The 318 SOS flying schedule gains fidelity as day of execution approaches. (Tabs V-1.6 to V-1.7 and BB-6) Three weeks prior to execution, leadership ensures mission profiles comply with the squadron's tactical training roadmap. (Tab BB-5) The 318 SOS uses a tactical training roadmap to focus scenarios on each of the U-28A mission sets to ensure every crewmember is ready for deployment. (Tabs V-1.3 to V-1.4 and BB-2 to BB-7) Prior to the flying schedule being finalized, individual inputs are prioritized by squadron flight, training, and standardization and evaluation leadership on a weekly basis. (Tab BB-2 to BB-7) The squadron has a tiered approval system for the number of times an individual crewmember can be tasked on a given week with any member scheduled more than three times requiring Commander (CC) approval. (Tabs V-1.4 and BB-2 to BB-7) Once finalized the week prior to execution, flying schedule changes must be approved by a flight authorization authority – Assistant DO, DO, or CC. (Tab BB-5)

There is no evidence squadron operations tempo was a factor in this mishap.

This mission was approved by the 318 SOS/CC and properly authorized by the 318 SOS/DO. (Tab K-2) A records review showed that all MC were current and qualified to participate in the scheduled sortie. (Tab G-199)

There is no evidence homestation procedures, planning, preparation and briefing were a factor in this mishap.

b. Supervision

Leadership assessed mission risk as low. (Tab AA-1 to AA-2) The squadron has tiered approval for the number of times an individual crewmember can be tasked on a given week. (Tabs V-1.4 and BB-5) The CC holds approval for any squadron member to be scheduled for more than three full day events in one week. (Tabs V-1.4 and BB-2 to BB-7) The 318 SOS also has a circadian rhythm policy that states aircrew will not be scheduled to fly a night sortie followed by an early morning sortie within a 24-hour period; that aircrew will be progressively shifted right throughout the week provided a gradual shift is made spanning 72 hours; and that no aircrew will fly at night with a significant training event within eight hours of the schedule start. (Tab BB-5) The circadian rhythm policy waiver authority is the DO or Top-3. (Tab BB-5)

There is no evidence supervision was a factor in this mishap.

11. HUMAN FACTORS

a. Introduction

As defined by AFI 91-204, *Safety Investigations and Reports*, a human factor is any environmental factor or psychological factor a human being experiences that contributes to or influences performance during a task. (Tab BB-15) AFI 91-204 and the most current DoD Human Factors Analysis and Classification System, Version 7.0 (DoD HFACS), establishes several potential human factors for assessment during a mishap investigation. (Tab BB-15) Broadly, DoD HFACS are divided into four categories that may have varying degrees of involvement in the mishap. (Tab BB-16, BB-19, BB-26 and BB-29) These categories are as follows:

(1) 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 situation. (Tab BB-16)

(2) 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-19)

(3) 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 individual actions and result in human error or an unsafe situation. (Tab BB-26)

(4) 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-29)

b. Human Factors Present in Mishap

The MC entered the practice turnback ELP with 0˚ flaps. (Tab J-139 to J-140 and J-154 to J-161) Configuring with 0˚ flaps led to increased aircraft nose-down attitudes and higher descent rates required to maintain a safe angle of attack versus a comparative 15˚ flap approach. (Tab BB-8) In addition, 0º flap stall speeds are higher than 15º flap stall speeds – 15 to 25 knots higher for the range of bank angles flown by the MC during the practice turnback ELP. (Tabs J-173, Z-14 and BB-13) The MC was also late to achieve the bank angle required to enable the MA to align with the extended centerline for the runway resulting in an overshoot condition. (Tabs J-173, Z-7, Z-9, Z-14, and BB-8) The MC attempted to arrest their excessive nose-down attitude, descent rate, and shallow bank angle by pulling back on the aircraft yoke and increasing bank angle. (Tabs R-10 to R-11, R-42, Z-8 to Z-9, and Z-14) The g- load from the MC pull back, coupled with the MA's increased bank angle, slowed the MA airspeed below 0˚ flap stall speed and it departed controlled flight. (Tabs Z-9, Z-14, BB-8 and BB-13) Subsequent power increase and flight control inputs would not have enabled the aircraft to recover from the stall within remaining altitude. (Tabs R-11, Z-9, and Z-14) After entering the stall, the MC increased power; however, it was not enough to overcome the descent rate. (Tabs R-10 to R-11, Z-9, and Z-14) At no point during the practice turnback ELP did the MA performance reflect a MC intent to abort the practice ELP maneuver. (Tab Z-9 and Z-14)

(1) Human Factor 1 - AE104 Overcontrolled/Undercontrolled Aircraft

Overcontrolled/Undercontrolled Aircraft/Vehicle/System is a factor when an individual responds inappropriately to conditions by either over- or undercontrolling the aircraft/vehicle/system. The error may be a result of preconditions or a temporary failure of coordination. (Tab BB-16)

The MC attempted to arrest their excessive nose-down attitude, descent rate, and shallow bank angle by pulling back on the aircraft yoke and increasing bank angle. (Tabs J-173, R-10 to R-11, Z-9 and Z-14) The g-load from the MC pull back, coupled with the MA's increased bank angle, slowed the MA airspeed below 0˚ flap stall speed and it departed controlled flight. (Tabs J-173, Z-9, Z-14, BB-8, and BB-13)

(2) Human Factor 2 - AE107 Rushed or Delayed a Necessary Action

Rushed or Delayed a Necessary Action is a factor when an individual takes the necessary action as dictated by the situation but performs these actions too quickly or too slowly. (Tab BB-17)

The MC's delay configuring with 15˚ flaps changed the MA performance envelope. (Tabs J-139 to J-140, J-154 to J-161, BB-8, and BB-13) The MC's failure to address MA bank angle prior to overshoot required greater bank to regain the runway. (Tabs J-173, Z-9, Z-14, BB-8, and BB-13) These factors, combined with the MC's failure to abort the maneuver or increase power prior to onset of the stall culminated in an inability to recover the MA. (Tabs R-10 to R-11, Z-9, and Z-14)

(3) Human Factor 3 - AE201 Inadequate Real-Time Risk Assessment

Inadequate Real-Time Risk Assessment is a factor when an individual fails to adequately evaluate the risks associated with a particular course of action and this faulty evaluation leads to inappropriate decision-making and subsequent unsafe situations. (Tab BB-17)

The MC's delay configuring with 15˚ flaps changed the MA performance envelope. (Tabs J-139 to J-140, J-154 to J-161, BB-8, and BB-13) The MC failure to address the MA bank angle prior to overshoot required greater bank to regain the runway. (Tabs J-173, Z-9, Z-14, BB-8, and BB-13) These factors, combined with the MC's failure to abort the maneuver or increase power prior to onset of the stall indicate the MC failed to recognize the increasing risk they incurred as they progressed through the mishap maneuver. (Tabs J-173, Z-9 and Z-14)

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publically Available Directives and Publications Relevant to the Mishap

AFI 11-202, Volume 1, *Aircrew Training*, dated 22 Nov 10
AFI 11-202V1_AFSOCSUP, *Aircrew Training*, dated 11 Mar 13
AFI 11-202, Volume 2, *Aircrew Standardization/Evaluation Program*, dated 13 Sep 10
AFI 11-202V2_AFSOCSUP, *Aircrew Standardization/Evaluation Program*, 23 Jul 13
AFI 11-202, Volume 3, *General Flight Rules*, dated 10 Aug 16
AFI 11-202V3_AFSOCSUP, *General Flight Rules*, 26 May 15
AFI 11-2-U28A, Volume 1, *U-28A Aircrew Training*, dated 13 Mar13
AFI 11-2-U28A, Volume 2, *U-28 Aircrew Evaluation Criteria*, dated 9 Oct 14
AFI 11-2-U28A, Volume 3, *U-28 Operations Procedures*, dated 6 Nov 12
AFI 11-2U-28V3_CL-1, *Aircrew Checklist*, dated 6 Nov 12
Code of Federal Regulations Title 14, Part 39
Federal Aviation Regulation Part 23.561

NOTICE: All directives and publications listed above are available digitally on the Air Force Departmental Publishing Office website at: http://www.e-publishing.af.mil, www.efcr.gov, or www.faa.gov/regulations.

b. Other Directives and Publications Relevant to the Mishap

Aircrew Operating Handbook for the U-28A EQ, EQ+ and PC-12 Trainer Aircraft, Volumes 1, 2.1 and 2.2
Pilot's Guide Flat Panel Guide
Operators' Manual Flight Management System
PC-12 Pilot's Information Guide
Pilatus PC-12 Emergency Procedure Guide

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7 July 2017

BRAD SULLIVAN
Brigadier General, USAF
President, Accident Investigation Board

STATEMENT OF OPINION

U-28A, T/N 0724
Clovis, New Mexico
14 March 2017

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

On 14 Mar 17, at 1835 local time (L), a U-28A, tail number 0724, crashed one-quarter mile south of Clovis Municipal Airport (KCVN), New Mexico (NM). This aircraft was operated by the 318th Special Operations Squadron, 27th Special Operations Wing, Cannon Air Force Base (AFB), NM. The aircraft was destroyed and all three crewmembers died upon impact.

The Mishap Aircraft (MA) departed Cannon AFB at 1512L for tactical training over Lubbock, Texas, followed by pilot proficiency training at KCVN. The Mishap Crew (MC) entered Lubbock airspace at 1545L, completed their tactical training, and departed Lubbock airspace at 1735L enroute to KCVN. The MC entered the KCVN traffic pattern at 1806L, where they conducted multiple approaches and landings prior to executing the mishap maneuver, a practice turnback Emergency Landing Pattern (ELP).

The MC entered the practice turnback ELP with 0˚ flaps. Configuring with 0˚ flaps led to increased aircraft nose-down attitudes and higher descent rates required to maintain a safe angle of attack versus a comparative 15˚ flap approach. In addition, 0˚ flap stall speeds are higher than 15˚ flap stall speeds – 15 to 25 knots higher for the range of bank angles flown by the MC during the practice turnback ELP. The MC was also late to achieve the bank angle required to enable the MA to align with the extended centerline for the runway resulting in an overshoot condition. The MC attempted to arrest their excessive nose-down attitude, descent rate, and shallow bank angle by pulling back on the aircraft yoke and increasing bank angle. The g-load from the MC pull back, coupled with the MA's increased bank angle, slowed the MA airspeed below 0˚ flap stall speed and it departed controlled flight. Subsequent power increase and flight control inputs would not have enabled the aircraft to recover from the stall within remaining altitude. After entering the stall, the MC increased power; however, it was not enough to overcome the MA descent rate. At no point during the practice turnback ELP did the MA performance reflect a MC intent to abort the maneuver. The MA impacted the ground with a 13˚ nose-high, 7˚ left-wing low attitude.

2. CAUSE

I find by a preponderance of the evidence that the cause of the mishap was an "Overcontrolled/Undercontrolled Aircraft," resulting in the MC losing control of the aircraft when it stalled at low altitude. The MC attempted to arrest their excessive nose-down attitude, descent rate, and shallow bank angle by pulling back on the aircraft yoke and increasing bank angle. The g-load from the MC pull back, coupled with the MA's increased bank angle, slowed the MA airspeed below 0˚ flap stall speed and it departed controlled flight.

3. SUBSTANTIALLY CONTRIBUTING FACTORS

I also find by a preponderance of the evidence two additional human factors that substantially contributed to the mishap, "Rushed or Delayed a Necessary Action" and "Inadequate Real-Time Risk Assessment."

a. Rushed or Delayed a Necessary Action

MC delay configuring with 15˚ flaps changed the MA performance envelope. MC failure to address MA bank angle prior to overshoot required greater bank to regain the runway. These factors, combined with the MC's failure to abort the maneuver or increase power prior to onset of the stall culminated in an inability to recover the MA.

b. Inadequate Real-Time Risk Assessment

MC delay configuring with 15˚ flaps changed the MA performance envelope. MC failure to address MA bank angle prior to overshoot required greater bank to regain the runway. These factors, combined with the MC's failure to abort the maneuver or increase power prior to onset of the stall indicate the MC did not recognize the increasing risk they were incurring as they progressed through the mishap maneuver.

4. CONCLUSION

The MC lost control of the aircraft when it entered a stall at low altitude; there are no indications of mechanical malfunction. I find by a preponderance of the evidence that the cause of the mishap was an overcontrolled/undercontrolled aircraft – executing the practice turnback ELP with 0˚ vice 15˚ flaps created negative performance trends that led to an aggressive attempt to arrest excessive nose-down attitudes, high descent rates, and an overshoot condition that decreased airspeed below 0˚ flap stall speed and the MA departed controlled flight. In addition, I find by a preponderance of the evidence that delaying actions necessary to prevent the aircraft from entering the stall envelope and failure to accurately assess increasing risk throughout execution of the practice turnback ELP substantially contributed to the mishap.

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7 July 2017

BRAD SULLIVAN
Brigadier General, USAF
President, Accident Investigation Board

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