UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION
BOARD REPORT

UH-1N, T/N 69-6603

512TH RESCUE SQUADRON
58TH SPECIAL OPERATIONS WING
KIRTLAND AIR FORCE BASE, NEW MEXICO

ACCIDENT LOCATION: NEAR KIRTLAND AIR FORCE BASE, NEW MEXICO

DATE OF ACCIDENT: 27 APRIL 2011

BOARD PRESIDENT: COLONEL CHRISTOPHER PLAMP

Conducted IAW Air Force Instruction 51-503

EXECUTIVE SUMMARY

AIRCRAFT ACCIDENT INVESTIGATION

UH-1N, T/N 69-6603
KIRTLAND AIR FORCE BASE, NEW MEXICO
27 APRIL 2011

On 27 April 2011, at approximately 1115 local time, a UH-1N, T/N 69-6603, crashed at a remote landing zone near Kirtland Air Force Base (AFB), New Mexico (NM). The mishap crew (MC) was performing hoist operations when the rescue device, in this case a forest penetrator, snagged on a stationary F-111 capsule. The mishap aircraft (MA) entered a descending right turn and impacted terrain. After the MA came to a rest, the MC egressed the MA unharmed. The MA is assigned to the 512th Rescue Squadron, 58th Special Operations Wing, Kirtland AFB, NM.

The MC was conducting an initial instructor flight engineer checkride involving hoist operations. The MC consisted of two pilots (MP1 and MP2) and two flight engineers (MF1 and MF2). During one of the hoist operations, the hoist cable was lowered to the ground with the forest penetrator attached. MF1 initiated a hoist malfunction to test MF2's ability to troubleshoot. During the operation, the MA's hover drifted forward and left. When MF2 cleared the malfunction the hoist cable retracted unexpectedly. When the cable retracted, the forest penetrator raised off the ground and swung forward, snagging a stationary F-111 capsule's window. The MA banked right and MP2 instinctively applied maximum power in an attempt to recover the MA. The MA entered a sharp descending right turn while tethered to the F-111 capsule. When the forest penetrator ripped free, the MPs leveled out the MA before impacting terrain. The MA's main rotor struck the ground twice and the MA came to rest on its left side. The MC egressed with no major injuries. A fire ignited shortly after impact completely destroying the MA. The total cost of the mishap is $4,811,580.00.

The Accident Investigation Board (AIB) President found by clear and convincing evidence that the cause of the mishap was a combination of four actions by the mishap crew (MC), including three by the mishap flight engineers (MF1 and MF2) and one by the mishap pilot (MP2). These actions included (1) MF2's troubleshooting sequence, (2) MF1's checkride supervision, (3) MF2's channelized attention, and (4) MP2's control inputs. In addition, the AIB President found by a preponderance of the evidence that the use of an old F-111 capsule as a training target during hoist operations and miscommunication between the crew substantially contributed to the incident.

Under 10 U.S.C. § 2254(d), any 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.

SUMMARY OF FACTS AND STATEMENT OF OPINION
UH-1N, T/N 69-6603
27 April 2011

TABLE OF CONTENTS

COMMONLY USED ACRONYMS AND ABBREVIATIONS

19 AF	19th Air Force
512 RQS	512th Rescue Squadron
58 OG	58th Operations Group
58 SOW	58th Special Operations Wing
AAA	Anti-Aircraft Artillery
ADF	Automatic Direction Finder
ADO	Assistant Director of Operations
AEF	Air Expeditionary Force
AETC	Air Education and Training Command
AFB	Air Force Base
AFI	Air Force Instruction
AFTO	Air Force Technical Order
AGL	Above Ground Level
AIB	Accident Investigation Board
AIE	Alternate Insertion/Extraction
AMDS	Aerospace Medicine Squadron
AMIC	Aircraft Mishap Investigation Course
ARM	Aviation Resource Management
Aux	Auxiliary
CAMS	Core Automated Maintenance System
CAP	Commander's Awareness Program
CGB	Combining Gearbox
CRM	Crew Resource Management
CSAR	Combat Search and Rescue
CSEL	Combat Survivor Evader Locator
CVR	Cockpit Voice Recorder
DA	Density Altitude
DNIF	Duties Not Including Flying
DO	Director of Operations
DoD-HFACS	Department of Defense Human Factors and Classification System
EPE	Emergency Procedure Evaluation
EPs	Emergency Procedures
EVM	Evasive Maneuver
FC	Formation Aircraft Crew
FDR	Flight Data Recorder
FE	Flight Engineer
FP1	Formation Aircraft Pilot
FP2	Formation Aircraft Co-Pilot
HIPAA	Health Insurance Portability and Accountability Act
IDAR	Integrated Data Acquisition Recorder
IP	Instructor Pilot
JOAP	Joint Oil Analysis Program
L	Local Time
LA	Legal Advisor
Lt Col	Lieutenant Colonel
LZ	Landing Zone
MA	Mishap Aircraft
MC	Mishap Crew
MEF	Mission Execution Forecast
MF1	Mishap Flight Engineer 1
MF2	Mishap Flight Engineer 2
MM	Medical Member
MOC	Maintenance Operations Center
MP	Mishap Pilot
MP	Mission Pilot
MP1	Mishap Pilot 1
MP2	Mishap Pilot 2
MS	Mishap Sortie
MSL	Mean Sea Level
MXM	Maintenance Member
NCO	Non-Commissioned Officer
ND	North Dakota
NM	Nautical Miles
NM	New Mexico
NOTAMs	Notices to Airmen
ODO	Operations Duty Officer
Ops Desk	Operations Desk
Ops Sup	Operations Supervisor
Ops Tempo	Operations Tempo
ORM	Operational Risk Management
PHA	Periodic Health Assessment
PM	Pilot Member
PR	Pre-Flight
REC	Recorder
RPM	Revolutions Per Minute
SA	Situational Awareness
T/N	Tail Number
TCTO	Time Compliance Technical Order
TOLD	Takeoff and Landing Data
TOT	Time on Target
WET PASTE	Winds, Elevation, Temperature, Power, Approach, Suitability, Touchdown, Escape Route
WOC	Wing Operations Center

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

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 8 June 2011, Lieutenant General Douglas H. Owens, Vice Commander, Air Education and Training Command (AETC), appointed Colonel Christopher Plamp to convene an aircraft accident investigation under Air Force Instruction (AFI) 51-503, *Aerospace Accident Investigations*. The Accident Investigation Board (AIB) investigated the 27 April 2011 mishap of a UH-1N aircraft, tail number (T/N) 69-6603, near Kirtland Air Force Base (AFB), New Mexico (NM). The investigation was conducted at Kirtland AFB, NM from 30 June 2011 to 30 July 2011. Technical advisors were the Maintenance Member (MXM), Legal Advisor (LA), Pilot Member (PM), Medical Member (MM), and Recorder (REC). (Tabs Y-3 thru Y-22)

b. Purpose

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

2. ACCIDENT SUMMARY

At approximately 1115 hours local time (L), 27 April 2011, the Mishap Aircraft (MA), a UH-1N, T/N 69-6603, was destroyed after impacting a remote landing zone near Kirtland AFB, NM. (Tabs J-39, J-49, S-6, V-10.21) The MA and three members of the Mishap Crew (MC) were assigned to the 512th Rescue Squadron (512 RQS), 58th Special Operations Wing (58 SOW), Kirtland Air Force Base, NM. One member of the MC was assigned to the 54th Helicopter Squadron, Minot AFB, North Dakota (ND). The MC was conducting an initial instructor flight engineer checkride involving hoist operations. During a hoist operation, the rescue device, in this case a forest penetrator, snagged on a stationary F-111 escape capsule while the cable was retracting. The MA entered a sharp descending right turn, the forest penetrator ripped free, and the MA leveled out shortly before impacting terrain. (Tabs V-8.22, V-10.14 through V-10.20) All four members of the MC egressed the MA with no significant injuries. (Tabs V-7.40, V-7.41, V-9.29) A fire ignited shortly after impact. (Tab V-8.25) The MA was completely destroyed in the post mishap fire, resulting in a cost of $4,811,580.00. (Tab P-3) The mishap impact site was not on private property. The mishap response command post was set up on private property next to the mishap site. (Tab P-5) Media interest was local and brief.

3. BACKGROUND

a. Air Education and Training Command (AETC)

AETC's mission is to develop America's Airmen today for tomorrow by delivering air, space and cyberspace education and training. The command includes the Air Force Recruiting Service, Air University, and two numbered air forces. AETC provides basic military, non-flying technical, expeditionary, and flying training for the Air Force.

The command has more than 56,000 active duty members, 4,000 Air National Guard and Air Force Reserve personnel, and 14,000 civilian personnel. The command also has more than 11,700 contractors assigned to it. AETC is responsible for approximately 1,500 aircraft. (Tabs CC-3 thru CC-8)

b. 19th Air Force (19 AF)

19 AF is located at Randolph AFB, San Antonio, Texas. 19 AF is one of two numbered air forces assigned to AETC. The 19 AF mission is to manage all flying training within AETC. 19 AF includes 25 training locations and active duty units and has operational oversight over three Air National Guard units. It commands more than 31,000 personnel and operates over 1,800 aircraft of 21 different models flying more than 580,000 hours annually.

The Headquarters is responsible for the execution of Air Force initial qualification and follow-on combat crew flying training programs with graduates reporting to war-fighting commands. It ensures compliance with Headquarters AETC policies and instructions through clear, concise execution guidance to subordinate units. 19 AF also conducts annual air crew standardization and evaluation visits to its units to assess the effectiveness of its training programs.

Eleven organizations provide specialized and joint undergraduate pilot training and joint undergraduate navigator training, introduction to fighter and bomber fundamentals training, air weapons controller and air battle management training, and initial and instructor enlisted aircrew member training. The organization also provides initial, upgrade, and advanced training for helicopter and special operations aircrews. Other training includes tanker/airlift aircrew training, fighter aircrews, and aircrew survival training. In total, 19 AF provides training for more than 19,000 students annually. (Tabs CC-9 through CC-11)

c. 58th Special Operations Wing (58 SOW)

Located on Kirtland Air Force Base (AFB), the 58th Special Operations Wing (58 SOW) serves as a training site for Air Force special operations and combat search and rescue aircrews. The wing provides undergraduate, graduate and refresher aircrew training for special operations, rescue, missile site support and distinguished visitor airlift helicopter, fixed-wing, and tilt-rotor operations.

The 58 SOW employs more than 1,800 personnel and trains over 2,000 students a year. The wing operates seven different weapon systems: UH-1H, UH-1N, HH-60G, HC-130P/N, MC-130P, MC-130H, and CV-22, totaling more than 60 assigned aircraft. The wing teaches more than 100 courses in 18 different crew positions including pilot, navigator, electronic warfare officer, flight engineer, communications system operator, loadmaster and aerial gunner. Additionally, the wing responds to worldwide contingencies and provides search and rescue support to the local community. (Tabs CC-12 through CC-14)

d. 58th Operations Group (58 OG)

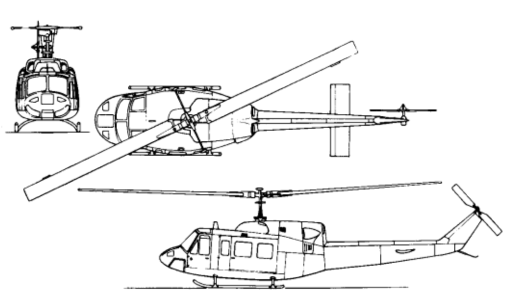
The 58 OG trains mission-ready special operations, CSAR and airlift aircrews in the UH-1H/N, HH-60G, HC-130N/P, MC-130P, MC-130H, CV-22 and corresponding simulators. The group also provides Specialized Undergraduate Pilot Training-Helicopter, conducts special operations and CSAR intelligence training, and responds to contingencies and humanitarian missions. (Tabs CC-21 through CC-23)

e. 512th Rescue Squadron (512 RQS)

The 512 RQS's mission is to provide mission-ready UH-1N and HH-60 crewmembers to helicopter units worldwide. The 512 RQS also participates in Special Operations contingencies, exercises, and humanitarian rescue helicopter training. (Tabs CC-15 through CC-16)

f. The Bell UH-1N Iroquois "Huey" (UH-1N)

The UH-1N is a light-lift utility helicopter used to support varied uses. Its primary mission includes airlift of emergency security and disaster response forces, emergency evacuation of key government officials, support for school training and testing, and airlift for distinguished visitors and missile support personnel. Other uses include airborne cable inspections, security surveillance of off-base nuclear weapons convoys, response to search and rescue operations, and medical evacuation and transport.



The UH-1N is capable of flight in instrument and nighttime conditions. The crew complement is normally three (pilot, co-pilot and flight engineer), but may be flown single-pilot depending on weather and mission requirements. When configured for passengers, the UH-1N can seat up to 13 people, but actual passenger loads are dependent on fuel loads and atmospheric conditions.

The UH-1N entered the Air Force inventory in 1970 to provide search and rescue capabilities. Manufactured by Bell Helicopter/Textron Inc., the UH-1N is the military version of the Bell 212, one of the more than 15 variants of the original "Huey" first designed and flown in 1956. (Tabs CC-19 through CC-20)

4. SEQUENCE OF EVENTS

a. Mission

The objective for the mishap sortie (MS) on 27 April 2011 was to conduct an initial instructor checkride for a flight engineer (FE). (Tabs K-17, V-10.4) The MS would encompass a sampling of events to include formation, remote operations, alternate insertion and extraction (AIE), and emergency procedures (EPs). (Tab V-7.6) The mishap crew (MC) was comprised of two pilots (MP1 and MP2), one evaluator flight engineer (MF1), and one instructor candidate flight engineer (MF2). (Tab K-19) The Assistant Director of Operations for the 512 RQS authorized the flight. (Tab K-3)

b. Planning

Mission planning was adequate for the sortie. MP1, MP2, and MF1 were assigned to the 512 RQS, while MF2 was on temporary duty from the 54th Helicopter Squadron at Minot AFB, North Dakota. (Tabs V-7.1, V-8.1, V-9.2, V-10.1) The first event of the mission was a planned formation takeoff at Kirtland AFB departing to the south. (Tab K-23) The formation consisted of the MA and another formation aircraft (FA). The sortie included 30 minutes of navigation enroute to Site 37. (Tab K-23) For training purposes, the 58 SOW utilizes pre-surveyed remote sites to conduct flight training. (Tab K-25) At Site 37, the two aircraft planned to split up after completing all formation training requirements. (Tab V-8.5) The MC would proceed to Site 15 for remote operations before continuing to the Auxiliary (Aux) Field for EPs. (Tabs K-23, V-8.5) Site 15 is 14.3 nautical miles (NM) from Site 37, and approximately 27 NM from Kirtland AFB. (Tabs K-23, AA-5) The Site 15 survey was updated on 7 March 2011 and the survey was valid until 3 September 2011. (Tab K-25) The Aux Field is 24.6 NM from Site 15. (Tabs K-23) At the completion of all training requirements, the MC would return to Kirtland AFB. (Tab K-23)

MF2 arrived at the squadron around 0600L. (Tab DD-3 through DD-30) MP2 arrived at around 0645L, MF1 at around 0650L, and MP1 just before 0700L. (Tabs V-7.3, V-8.3, V-10.3) The 512 RQS Operations Supervisor conducted a standup brief at 0700L to notify all flying crews of any pertinent information for that day’s flights, to include weather and Notices to Airmen (NOTAMs). (Tab V-1.2) MP1 led the aircrew brief starting at approximately 0745L for the entire formation, including the MC and the formation aircraft crew (FC). (Tab V-10.4) The brief was conducted in accordance with applicable directives. (Tabs K-11 through K-16, O-3 through O-14) Items briefed included a risk assessment, mission and route planning, and crew duties. (Tabs K-11 through K-16) The risk assessment worksheet calculates risk based on the mission profile, crew composition, weather, and human factors. The major areas of increased risk for the MS were crew fatigue, wind, turbulence, and conducting a checkride. The overall risk assessment came out as 19 (low), but only one point below moderate. (Tab K-7)

Additional briefings for AIE and EPs were conducted after the aircrew brief. (Tab K-16) The FC conducted the AIE brief. (Tabs V-7.7, V-8.7, V-9.7, V-10.5) AIE items briefed included devices to be used, hover height, power requirements, communications, hazards, and emergency procedures. (Tab K-16) Per standard practice, emergency cable cut authority was transferred to the flight engineers. (Tabs V-7.7, V-8.22, V-9.25) EP items briefed included the area to be used, traffic pattern, transition and EP maneuvers. (Tab K-16) MF1 was absent and in the restroom during the AIE brief, and the formation co-pilot (FP2) was absent for the AIE and EP briefs. (Tabs V-7.7, V-11.3) The MC had no concerns regarding the briefs. (Tabs V-7.6, V-8.5, V-9.6, V-10.4) Squadron supervisory personnel did not attend the briefing. (Tabs V-7.5, V-9.5)

c. Preflight

MP1 was the Aircraft Commander. MP1 and MP2 were both qualified as instructor pilots (IPs). Neither pilot was acting as an instructor or student during the MS, though flight orders were created listing MP1 as an IP and MP2 as a mission pilot (MP). MP1 changed his status from IP to MP before the flight. (Tab K-3)

The NOTAMs were standard for Albuquerque airspace. (Tabs K-9 through K-10, V-10.3) MF2 completed the weight and balance worksheet for the MA with no discrepancies. (Tab K-31) The locally developed 512 RQS combined flight plan and pre-step checklist completed by MP1 indicated that all required actions for flight were completed. (Tab K-5) MP1 received a final Go/No Go briefing from the Operations Supervisor, confirming that all members of the aircrew were clear to fly. (Tabs K-21, V-1.3)

MF1 and MF2 preflighted the hoist and the right side of the MA while MP1 preflighted the remaining areas. (Tabs V-7.12, V-8.9, V-9.10) MP1, MF1, and MF2 checked the MA and hoist forms, finding no discrepancies affecting mission accomplishment. (Tabs V-9.9 through V-9.10, V-10.7) MP2 stepped to the MA after the rest of the crew and did a final walkaround. (Tab V-8.9) The MA start was normal. (Tab V-10.8)

d. MA Configuration

The MA was configured with a Lucas rescue hoist installed on the right side of the MA's main cabin. (Tabs K-19, O-14) The hoist can be selected to operate at a high or low speed. At the high rate setting, the hoist can lift loads up to 300 pounds and retract the cable at a rate of 0 to 250 feet per minute. At the low speed setting, the hoist can lift up to 600 pounds at 0 to 125 feet per minute. (Tab BB-56) For the MS, the hoist was selected to the low speed setting. (Tab V-7.33)

The hoist is controlled by either a hoist operator's pendant or by a four position rescue hoist switch located on the pilot's cyclic. The pilot's control has priority over the hoist operator's pendant. The pendant can operate the hoist at variable speeds, whereas the pilot's control is limited to full speed operation as selected by the speed mode switch. In the event of an emergency, cable cut ability is provided by an electrically initiated, ballistically actuated cable cutter in the head of the hoist. There are two cable cut switches: one for the pilots located on the center console and one for the hoist operator located on the back of the rescue hoist control panel. (Tab BB-56)

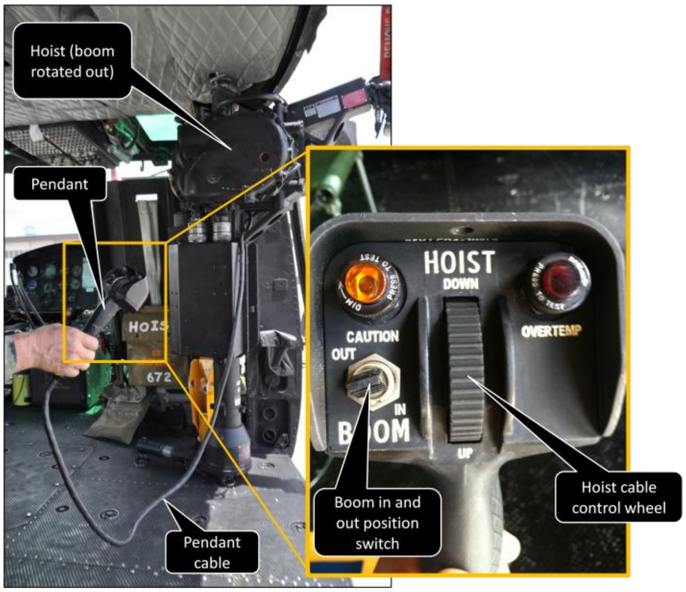


Figure 1. Hoist and Pendant Controls

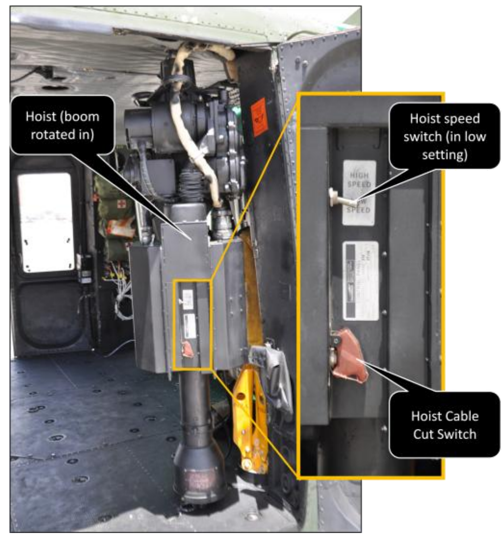


Figure 2. Hoist Speed and Cable Cut Switches

During hoist operation, the FE operating the hoist will switch to "hot mic," meaning that all his communications are continuously broadcast to all crewmembers. (Tab V-7.12) When lowering the hoist cable, the FE also provides commentary on the status of the hoist operation as well as directing the pilot's hover. (Tabs V-8.14, V-9.11)

The forest penetrator is a rescue device designed to penetrate through dense foliage to reach personnel on the ground or in water. Three retractable seat paddles (or blades) and accompanying straps secure personnel as the hoist is raised. The penetrator attaches to the end of the hoist cable, and is lowered with raised seat paddles and stowed straps to prevent entanglement. (Tab BB-52)

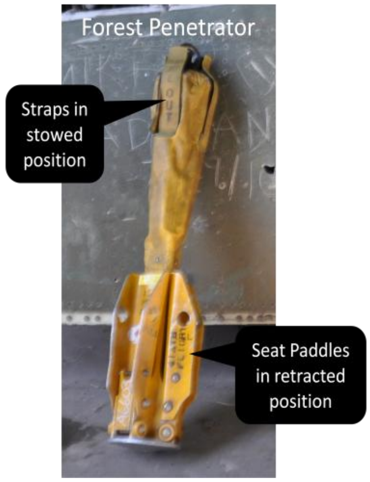


Figure 3. Forest Penetrator With Retracted Seat Paddles

MP1 sat in the left pilot seat and MP2 sat in the right pilot seat. (Tabs V-8.8, V-10.8) MF1 and MF2 were in the main cabin and changed positions throughout the MS based on mission requirements. (Tabs V-7.10, V-9.8)

e. Pilot Controls

The UH-1N has three main separate flight control inputs. These are the cyclic, the collective, and the tail rotor control pedals.

The pilot uses the cyclic to control forward, backward and lateral movement of the helicopter. The cyclic changes the plane of rotation of the main rotor, producing lift in the corresponding direction. The pilot utilizes the collective to increase or decrease overall lift. The collective alters the angle of attack for all blades by equal amounts at the same time resulting in ascents, descents, acceleration and deceleration. Tail rotor control pedals alter the pitch of the tail rotor blades, providing directional control. (Tab BB-65 through BB-66)

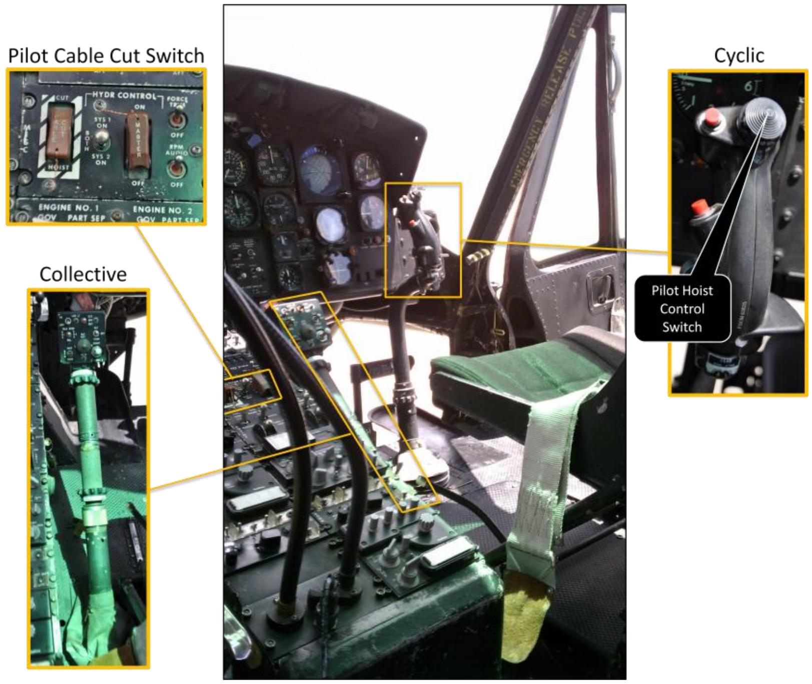


Figure 4. Pilot Controls

f. Flight Engineer Checkride

Initial instructor FE checkrides are conducted to evaluate an instructor candidate's ability to instruct, provide performance analysis, and effectively demonstrate maneuvers. (Tabs O-44 through O-45) The evaluator will often play the role of a student in order to simulate common errors made by inexperienced FEs in order to assess the instructor candidate's ability to correct and critique the student's performance. (Tab V-7.10) The instructor candidate will also be assessed on his ability to communicate his knowledge of aircraft systems and maneuvers through demonstrations provided to the evaluator. (Tab V-9.8)

g. Summary of Accident

The MC and FC started the mission as a formation. (Tab V-10.8) Startup, taxi, and takeoff occurred without incident. (Tab V-10.8) The formation took off 12 minutes early at 0948L. (Tab AA-3) The formation departed via the South Departure and proceeded to Site 37. (Tab K-23) While enroute to Site 37, the formation descended below 300 feet above ground level (AGL) to conduct tactical low-level operations, including two practice evasive maneuvers. (Tabs V-8.11, BB-13) The formation did three approaches at Site 37 with one go-around called by MF2. (Tabs V-8.11, V-9.11) Upon completion of training objectives for the formation portion of the sortie, MC and FC disbanded the formation per the mission plan. (Tabs V-7.5, V-8.11)

The MC flew to Site 15 to conduct remote operations. (Tab V-10.8) Site 15 is located in a bowl-shaped depression along a series of ridgelines at an elevation of 5382 feet mean sea level (MSL). (Tab S-6) The surveyed landing area is surrounded by rising terrain on the northeast and southwest sides. Due to terrain, the best approach and escape headings are 110 or 290 degrees. (Tab K-27) The landing area is 263 feet long and 160 feet wide. (Tab K-27) An F-111 capsule was located on a downward slope approximately 145 feet northwest of and 12 feet lower in elevation than the landing area. (Tabs K-27, S-6, S-9, AA-6) The F-111 capsule is an entire cockpit pod from an F-111 usually resulting from an ejection. The capsule on Site 15 weighed 2,060 pounds and was missing multiple window coverings. (See Figure 7 and Tabs S-9, U-3)

The MC arrived at Site 15 at approximately 1055L. MP2 accomplished a site evaluation and landed in the surveyed landing area. (Tab V-8.13) While on the ground, the MC took a five minute restroom break. (Tabs V-8.14, V-9.13) MP1 took off, orbited, and came back around for a 50 foot AIE near the F-111 capsule. (Tab V-10.10) For the first AIE, MF1 assumed the role of the student and took control of hoist operations in order for MF2 to act as an instructor. (Tabs V-7.23, V-9.13) The approach was performed into the wind with a northwest heading. MF1 directed the aircraft to hover 10 to 20 feet south of the F-111 capsule. (Tabs V-7.23, V-9.13) During the hover, MF1 purposefully made minor mistakes to simulate being a student, and MF2 corrected those mistakes as the instructor candidate. (Tab V-7.24) The MC concluded the first AIE without incident.

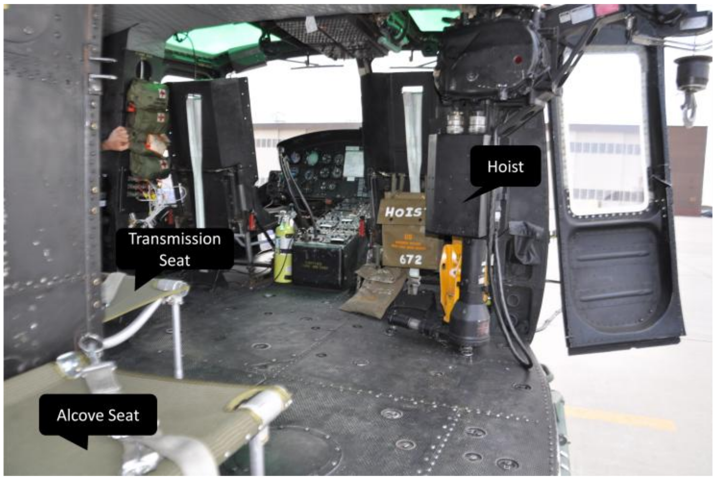


Figure 5. Hoist Position in MA

MF1 expressed that he wanted to see MF2 operate the hoist, so the MFs switched positions. MP2 assumed control of the MA and performed the next approach. (Tabs V-8.15, V-10.11) MP2 performed an approach to the same spot as the first AIE and settled into a stable hover. (Tab V-10.15) MP2 held the hover between 44 and 48 feet, utilizing approximately 80 percent power. (Tabs V-8.16, V-8.20, V-10.13) MF2 demonstrated operating the hoist, providing instruction to MF1 as he would to a student. (Tab V-9.16) MF2 lowered the cable and set the forest penetrator on the ground at the intended target, approximately 10 to 15 feet south of the F-111 capsule. (Tabs V-7.27, V-9.14, V-9.16)

As MF2 was lowering the cable, MF1 leaned over MF2 and induced a simulated hoist malfunction by holding the up limit switch to the full up position. The up limit switch is designed to stop cable retraction once the cable fully retracts. (Tab V-7.8) Holding the up limit switch up prevented the hoist from retracting the cable but allowed it to extend. (Tab V-7.26) In accordance with procedure, MF2 attempted to retract the hoist cable by using his pendant. MF2 noticed that the hoist was not retracting. (Tab V-9.17) MF2 began trouble-shooting the hoist malfunction in accordance with the 512th Standard Operating Procedures. (Tab O-13)

MF2 announced to the MC that the cable was not coming up and asked the MPs if the hoist power was on. (Tab V-9.18) The MPs confirmed that it was on. (Tabs V-8.17 through V-8.18, V-9.18) MF2 then asked the MPs if they could double check their circuit breakers, and it was confirmed that the circuit breakers were in. (Tab V-9.18) MF2 again checked his pendant. (Tab V-9.18) MF2 then misdiagnosed the simulated malfunction as a pendant failure. He then asked MP2 to raise the hoist cable by using the pilot hoist control switch on the pilot's cyclic. (Tab V-9.19) MP2 responded in the affirmative that he was using the pilot's hoist control switch to attempt to retract the cable. (Tabs V-7.28, V-9.19, V-10.14) MF2 announced that "nothing was happening." (Tabs V-7.28, V-9.19)

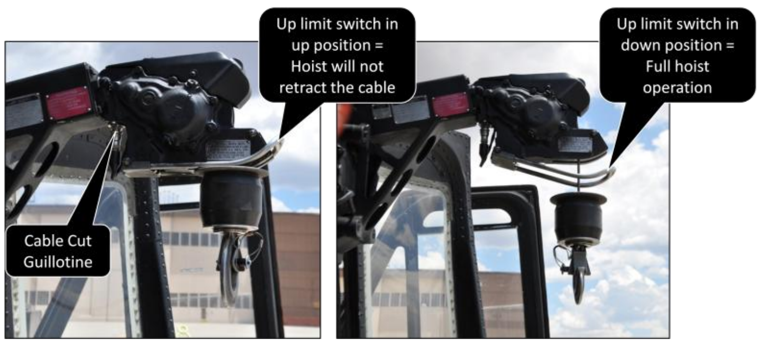


Figure 6. Hoist Up Limit Switch and Hook

Upon seeing that MF2 had not yet correctly identified the simulated malfunction, MF1 interjected and queried MF2 on the cause. (Tab V-7.27) MF2 then looked at the hoist, noticed that MF1 was holding the up limit switch, and promptly identified and corrected the simulated malfunction by swiping MF1's hand from the switch. (Tabs V-7.27, V-9.19) Since the up limit switch was no longer activated, the cable immediately began retracting at full rate in the low speed setting (125 feet per minute). MF2 did not immediately notice the retraction. (Tabs V-7.28, V-9.19, V-9.23 through V-9.24, V-10.14) MF1 sat down in the transmission seat in the middle of the cabin to observe MF2. (Tab V-7.27)

While MF2 was focused on the malfunction inside the cabin, the MA had an undetected drift forward and left, positioning the MA 5 to 10 feet west of the capsule. (Tab V-9.21) Upon clearing the simulated malfunction, MF2 looked back outside and noticed that the forest penetrator was already off the ground and swinging. (Tab V-9.20) Within approximately 2 seconds, MF2 saw the penetrator snag in the front left F-111 capsule window. He noticed the cable becoming taut and immediately called "stop up, stop up." (Tabs V-7.28 through 7.29, V-9.23) Neither MP1 nor MP2 heard this call. (Tabs V-8.23, V-10.21)

Due to the snag, the MA experienced a violent jerk, creating a right roll and right yaw. (Tab V-10.15) Based on the unexpected aircraft movement and abnormal control feel, MP2 instinctively pulled up on the collective, which would normally move the MA away from the ground. MP2 glanced inside and noticed the torque showing 100 percent or maximum power available. (Tab V-8.19) Simultaneously, MP1 placed his hand to the right of the cyclic to ensure that control inputs were not causing the right bank. (Tab V-10.19) MP1 noticed that the right bank was not being caused by the cyclic and decided to mirror the controls because of the MA's erratic behavior. (Tab V-10.15)

Figure 7. F-111 Capsule With Snag Point and Forest Penetrator

The MA started a descending right turn which prompted MF1 to call for cable cut. (Tab 7.31) MF2 reached for the cable cut switch on the back side of the hoist. With the hoist swung out for operations, the cable cut switch faced the inside of the cabin. MF1 initially saw both MPs on the flight controls, and attempted to reach the cable cut switch on the center console, but was unable to due to his restraining device. (Tab V-7.35) MP1 also reached for the center console to activate the cable cut switch. (Tab V-10.20) MP2 remained on the controls attempting to recover the MA. (Tab V-8.21)

The MA turned to a northeastern heading, positioning itself into a direct crosswind from the northwest. At that point, the forest penetrator ripped free from the F-111 capsule. The MA departed from its radial path and slid left and forward towards the rising terrain. (Tabs V-10.15 through V-10.17) Just prior to impact, MP1 returned to mirroring the flight controls. (Tab V-10.18) Both MP1 and MP2 realized that they could not recover the MA and applied aft cyclic to level the skids with the rising terrain. (Tabs V-8.2, V-10.19) Approximately 3 to 5 seconds passed between the cable snagging and the MA impacting the terrain. (Tabs V-8.23, V-9.24, V-10.20) The cable was sheared by the hoist cable cut mechanism close to impact. (Tab J-45)

Figure 8. Approximate Mishap Terrain Vertical Reference

h. Impact

The MA impacted rising terrain with an approximate 15 degree nose up attitude and a forward left drift. (Tabs J-49, V-10.21) Effort was made to impact with the skids as level as possible in order to increase the chance of occupant survivability. (Tabs V-8.22, V-10.20) Upon initial impact, the main rotor blades came in contact with the higher terrain to the northeast. (Tabs V-8.24, V-10.17) This caused the nose of the aircraft to spin right and the fuselage to roll left. (Tabs V-7.39, V-8.24, V-10.22) The MA came to rest on its left side. (Tabs V-7.41, V-10.23) Even though MF1 and MF2 were wearing restraining devices, the impact and left roll tossed both of them onto the left side of the cabin (Tabs V-7.39, V-9.27) MP1 and MP2 remained restrained in their seats throughout the impact. (Tabs V-8.25, V-10.23)

The MA impacted at approximately 1115L at 34° 45’ 24.8N / 107° 0’ 19.9W and an elevation of 5392 feet MSL. (Tabs J-39, S-6) The MA impacted approximately 100 feet northeast and uphill of the F-111 capsule. (Tab J-50) The MA came to rest on a westward facing slope 20 feet below the peak of the hill. (Tab J-39) The forest penetrator lay approximately 35 feet to the west and downhill of the MA and was attached to 39 feet of cable that terminated near the MA. (Tab J-50) The final heading of the aircraft was 120 degrees magnetic. (Tab J-40)

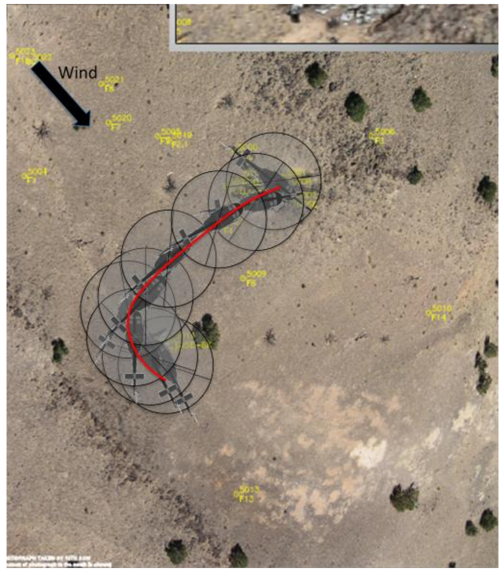


Figure 9. Approximate MA Flight Path

i. Egress and Aircrew Flight Equipment

In order to shut the engines off after the MA came to rest, MP1 actuated the idle stop switch and rolled the throttles to off. He then pulled the number one engine fire pull handle primarily to cut fuel to the engine. (Tab V-10.22) MP2 applied the rotor break and pulled the number two engine fire pull handle. (Tab V-8.25) MF1 attempted to roll the right pilot seat throttles off and turn the main fuel switches off from the back, but found them already in the off positions. (Tab V-7.41) The battery switch was not turned off. (Tab V-10.22) The MC egressed through the right cabin door in the following order: MF2, MF1, MP1, MP2. (Tab V-7.41) Due to the MA's left roll, the MC had to climb up the cabin floor of the MA to egress. (Tabs V-7.41, V-8.25, V-9.27, V-10.23) Time from impact to egress was less than one minute. (Tabs V-7.41, V-8.26,V-10.23)

The MC regrouped at a safe distance down the hill away from the MA. (Tab V-10.23) The MC was ambulatory with no major injuries. (Tabs V-7.40, V-9.29) Soon after egress, the MC noticed smoke emanating from the MA, and decided to move further south. (Tabs V-9.29, V-10.24) All survival equipment was current on inspections and in good working condition. (Tabs H-10 through H-11, V-9.25)

j. Search and Rescue (SAR)

After moving away from the MA, MF1 utilized two smoke flares in an attempt to attract the attention of a large truck. (Tab V-7.44) MF1 also attempted to contact a light civilian aircraft with a signaling mirror. (Tabs V-7.44, V-9.28) MF2 prepped his gyro jet flares but did not employ them. (Tabs V-7.45, V-9.28) Meanwhile, MP1 unsuccessfully tried to make contact via combat survivor evader locator (CSEL) radio. (Tabs V-7.43, V-9.28, V-10.24) MP2 was eventually able to contact the 512 RQS operations desk via cell phone approximately 15 minutes after egress. (Tabs V-8.26, V-9.29)

The 512 RQS operations supervisor re-tasked the FC to pick up the MC. The FC departed the Aux Field for Site 15 and arrived 20 minutes later. (Tabs V-5.4, V-6.3) The FC conducted a remote and landed to the southwest of Site 15. (Tab V-6.4) At that point, the MA was engulfed in flames except for the tail boom. (Tabs V-2.5, V-6.5) The FC picked up the MC and departed the crash site at approximately 1205L, arriving at Kirtland at approximately 1225L. (Tab EE-3) The MC was immediately treated by paramedics, followed by a flight surgeon. No major injuries were reported. (Tab V-4.3)

k. Recovery of Remains

Not applicable.

5. MAINTENANCE

a. General Definitions

Air Force Technical Order (AFTO) 781 series forms and the Core Automated Maintenance System (CAMS) database document Air Force aircraft maintenance and inspection histories. In addition to scheduling and documenting routine maintenance actions, these tools allow aircrews to report aircraft discrepancies and maintenance personnel to document the actions taken to resolve reported issues. Furthermore, the forms and CAMS provide a tool to research past aircraft problems to more effectively troubleshoot and solve new maintenance discrepancies.

Active forms consist of the AFTO 781 series forms currently in use by maintenance personnel to record aircraft condition and repairs. Inactive forms are retained for historical purposes after all uncleared discrepancies are carried forward.

The red symbols established for use on maintenance documents make important notations instantly apparent. They indicate the condition, fitness for flight or operation, servicing, inspection, and maintenance status of the aircraft. A “red X” annotates that an aircraft is considered unsafe or in an unserviceable condition. The unsatisfactory condition must be corrected and the symbol cleared before flying the aircraft. A “red dash” indicates an unknown condition of the equipment. A more serious condition may exist, but the aircraft is still flyable. The “red diagonal” indicates a discrepancy exists on equipment, but is not sufficiently urgent or dangerous to warrant the aircraft’s grounding or discontinued use. (Tabs BB-61 through BB-62)

b. Forms Documentation

The MA’s active AFTO Form 781 series forms were destroyed in the post-mishap fire. New forms were electronically generated on 2 May 11. All existing aircraft AFTO 781 series forms and the complete aircraft historical file, to include Time Compliance Technical Order (TCTO) status, AFTO Forms 95, major inspection packages, and archived data within CAMS were thoroughly reviewed for accuracy and completeness dating six months prior to the mishap. Only minor documentation discrepancies were noted. The total airframe time prior to the accident was

12,242.2 hours. The number one engine time was 5062.3 hours and the number two engine time was 5144.4 hours. (Tabs D-3 through D-24)

c. Inspections

Pilot and/or maintenance personnel reported the following discrepancies during pre-flight (PR) and basic post-flight (BPO) inspections for the MA from 9 to 26 April 2011. There were two open discrepancies in the MA AF Form 781A on the day of the mishap. It was noted that the right cabin door did not line up with the hinge panel door and the latch receptacle was on order. It was also noted that a Joint Oil Analysis Program (JOAP) sample was due at 12,250.7 aircraft hours. (Tabs D-3 through D-24)

There were four open discrepancies in AFTO Form 781K. These included a mislabeled battery switch position, the flight data recorder (FDR) fail light came on in flight and remained on, an overhaul of the main rotor hub assembly was due at 12,529.8 aircraft hours, and the combining gearbox (CGB) oil filler hose was not anchored. (Tabs D-3 through D-24)

d. Maintenance Procedures

Aircraft phase inspections for the UH-1N are completed on a 400-hour cycle. The last phase (#4) for the MA was 31.4 flight hours prior to mishap. The next scheduled phase inspection was due in 369.6 hours. (Tab D-25)

e. Maintenance Personnel and Supervision

A thorough review of the MA forms and maintenance members' training records was performed. All maintenance members were fully qualified and appropriate maintenance actions were being performed with proper technical data. (Tab U-4)

f. Fuel, Hydraulic, and Oil Inspection Analysis

Oil samples taken from the MA tail rotor gear boxes after the mishap were found to be within normal limits. No further oil, fuel or hydraulic samples could be retrieved from the MA due to the post mishap fire. All fuel, oil, and hydraulic samples taken from ground support equipment were also found to be within normal limits. (Tabs D-3 and D-27)

g. Unscheduled Maintenance

A thorough review of all maintenance activities on the MA from 29 September 2010 to 27 April 2011 was performed. The aircraft flew 136 sorties, totaling 289.1 flight hours from November 2010 through 27 April 2011. A thorough review of the aircraft vibration signature analysis was conducted. The last vibration signature analysis was conducted on 8 April 2011 at 12220.8 aircraft hours, and was within standards. (Tab D-3)

h. Lucas Rescue Hoist

The Lucas rescue hoist (serial number 0024, identification number GRH-024) was installed on the forward right side of the MA on 6 April 2011. The active equipment documentation, AFTO Form 244, was destroyed during the post-mishap fire. A thorough review of the hoist history and CAMS documentation was conducted with no discrepancies noted. (Tab D-27)

i. Summary

There was no evidence of maintenance discrepancies or deficiencies in maintenance practices, training, and supervision.

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

a. Structure and Systems

Figure 10. UH-1N Major Components

(1) **Impact Information**

The at-rest heading of the helicopter was approximately 120 degrees magnetic. Main and tail rotor ground scars were not present due to the hard, rocky terrain. During the mishap sequence, the left main skid broke off and survived the post mishap fire. The main cabin was destroyed by fire forward of the engine nacelles with only a portion of the engine cowling and gearbox housing remaining. The main rotor blades disintegrated upon impact and the main transmission housing was consumed by the post mishap fire. The post mishap fire burned away the mounting points and caused the tailboom and attaching hardware to separate from the main fuselage. (Tab J-39 and J-40)

(2) **Airframe Damage**

A thorough inspection and evaluation of all the MA’s systems was conducted. All aircraft systems, to include the hoist, performed normally up to the time of impact. Most of the airframe forward of the tailboom and all aircraft recording devices were consumed by the post mishap fire. The tail rotor and synchronized elevator systems were relatively undamaged except for the crumpling of the left elevator upon impact. (Tabs J-40 and S-7 through S-15)

Figures 11 and 12. Post Mishap Wreckage

Figure 13. Crumpled Left Synchronized Elevator

The right landing skid was consumed by post mishap fire with the exception of the steel shoe that was found under the aircraft. The left skid was found down the hill to the right of the aircraft and was mostly intact. Only a small section of one of the two skid crossover tubes was located, and was too damaged to determine if it was from the front or rear. (Tab J-40) The post-mishap fire damaged the fuselage from the front of the MA to just in front of the engine exhaust. (Tabs S-11 through S-15) The AN/ARN-89 Automatic Direction Finder (ADF) antenna housing and the lower cable guide from the wire strike protection system were both found approximately 16 feet west (downhill) from the main wreckage, and were not burned. The location and condition of these two items indicate that they contacted the ground and broke free early in the impact sequence (Tab J-40)

The tailboom attachment fittings and hardware at all four locations were still intact with no evidence of tailboom separation from the impact. The tailboom separated from the aircraft during post impact fire. (Tabs J-39 through J-43)

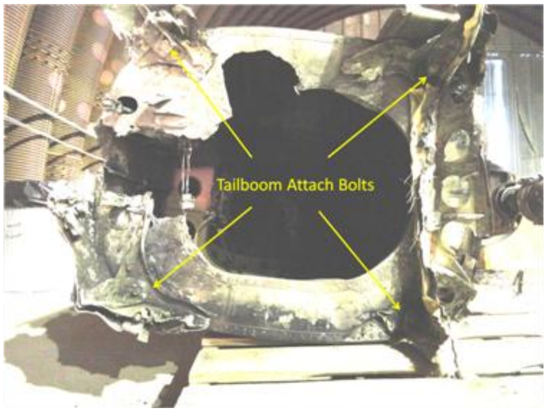


Figure 14. Tailboom Cross-Section

b. Engineering Evaluations and Analyses

(1) **Tail Rotor Control Inspection and Testing**

All tail rotor controls and control tubes forward of the tailboom were consumed by the post mishap fire and were not available for analysis. Manipulation of the remaining section of the tail rotor control tube still changed blade pitch. (Tab J-43)

(2) **Tail Rotor Drive System Inspection and Testing**

The tail rotor driveshaft was torsionally sheared, indicating the tail rotor was rotating when the main rotors contacted the ground. When the main rotors contacted the ground, they stopped rotation of the main drive gearbox and transmission. Oil samples from both the 42 and 90 degree tail rotor gear boxes were taken and showed no discrepancies. The tail rotor blades and attachment points were visually inspected for damage and proper hardware installation, with no discrepancies. The tail rotor blades did not contact the ground. (Tab J-42)

Figure 15. Tail Rotor Drive Shaft

(3) **Main Rotor System**

UH-1N main and tail rotor blades are labeled with red or white markers. The steel leading edge strips and lower surfaces showed significant scoring consistent with ground impact. Dirt and vegetation was present on the leading edge strip and nose block extrusion. All damage is consistent with ground contact at high rotational energy.

Upon ground contact, the red main rotor blade sustained 2 feet of outboard damage, the white main rotor blade sustained 4 feet of outboard damage, and the drive tube disintegrated. Each blade struck the ground only once. As a result of the damage, there was a loss of drive to the rotor system, causing insufficient rotational energy for a second strike. The damage to the main rotor head is consistent with sudden stoppage of the main rotor from ground contact. The main rotor gear box housing was consumed in the post crash fire. Visual examination of the internal gear faces revealed no obvious distress or mechanical failure. (Tab J-40)

Figure 16. Main Rotor Gearbox

(4) **Flight Control System Performance**

The majority of the flight control linkages in the cockpit and cabin area were consumed in the post mishap fire. The surviving flight control systems were still properly attached and operating correctly. (Tab J-42)

(5) **Engine Nacelles**

The engine nacelles were fairly intact but suffered significant fire damage. Significant mechanical damage, including tearing and shredding, was found in the nacelle firewalls located between the two engine bays. These firewalls house the main drive shaft running from the combining gear box to the transmission. Damage to the engine nacelle tunnel walls is aligned with the forward and aft drive shaft couplings. It is characterized by torn and shredded metal, numerous distinct dents in the outboard direction, and several sharp cuts. (Tab J-42)

(6) **Engines**

During engine teardown, a portion of the main drive shaft aft coupling was found in the power turbine exhaust duct assembly of the number one engine. This caused internal damage to the power turbine blades, the combustion chamber, and outer engine turbine case. The number two engine appears to have shut down due to fuel starvation and showed no evidence of internal damage. (Tab J-43)

(7) **Engine Fuel Controls**

The majority of the engine control linkages in the cockpit and cabin area were consumed in the post mishap fire. Some components from the transmission pylon and engine nacelle areas were recovered and evaluated. The number one engine fuel control was recovered with significant fire damage. The control tube was still attached and had mechanical impact damage on the inboard side, presumably from the drive shaft coupling failure. The number two engine fuel control was consumed in the post mishap fire. The control tube was recovered, and had mechanical damage most likely caused by the MA settling during the fire. (Tab J-43)

(8) **Fire Extinguishing System**

The engine fire extinguishing system controls from the cockpit were consumed in the post mishap fire. Most of the fire extinguishing system from the left and right engine bays was recovered. The main and reserve extinguisher bottles were discharged. The main extinguisher bottle's outlet disc was ruptured. It could not be determined if the main extinguisher bottle was discharged by electrical actuation or the post mishap fire. The reserve extinguisher bottle outlet disc was intact and not discharged by electrical actuation. (Tab J-44)

(9) **Hoist, Cable and Forest Penetrator**

The hoist was found in the wreckage with significant fire damage. Clean mechanical cuts on mating ends of the hoist cable indicate the cable was sheared. All but 39 feet of the cable was found on the hoist. The remaining 39 feet of hoist cable led downhill from the MA wreckage to the forest penetrator, which was approximately 35 feet southwest of the MA. The forest penetrator had two seat paddles extended, with the third in the retracted position. The F-111 capsule, located approximately 70 feet to the south of the forest penetrator, had dents and yellow paint transfer on the internal edges of the forward left windshield frame. The yellow paint matched the forest penetrator's paint. (Tabs J-44 and S-15)

Figure 17. View of Forest Penetrator and MA

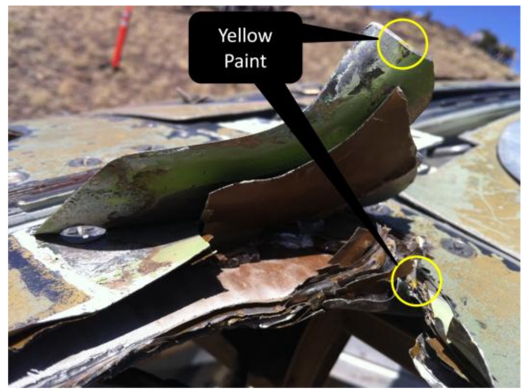


Figure 18. View of F-111 Capsule Snag Point

(10) **Recording Systems**

The Integrated Data Acquisition Recorder (IDAR), Cockpit Voice Recorder (CVR), and the structural data recorder were destroyed by the post mishap fire. Data was unable to be extracted from these devices. (Tab J-45)

(11) **Summary**

There was no evidence of maintenance discrepancies or mechanical failure in this mishap.

7. WEATHER

a. Forecast Weather

Forecast weather for the MS was clear skies and unlimited visibility, with winds from 330 degrees at 12 knots gusting to 20 knots. During the scheduled flight time from 1000L to 1248L, the temperature was 9 degrees Celsius rising to 12 degrees Celsius. The altimeter setting and pressure altitude for Kirtland AFB were forecasted to remain 30.08 and 5190 feet respectively. (Tab F-3)

b. Observed Weather

The weather was consistent with the morning forecast. Both pilots from the MC experienced moderate winds from the northwest when conducting approaches to Site 15. (Tabs V-10.10, V-8.13) The MC had no issues with the winds while conducting operations within Site 15. (Tabs V-10.10, V-8.18) When the FC arrived to pick up the MC, the winds were moderate from the northwest. (Tabs V-6.2, V-11.4)

c. Space Environment

Not applicable.

d. Operations

Based on both the forecasted and observed readings, weather was in limits for conducting operations. (Tab BB-15)

8. CREW QUALIFICATIONS

a. Mishap Pilot 1

MP1 was a current and qualified Instructor Pilot with a total of 1303.6 hours, 1056.7 of which was in the UH-1N. (Tab G-3) MP1 had 182.3 instructor hours and 15.2 hours as an evaluator in the UH-1N. (Tab G-3) MP1 completed instructor upgrade training at Kirtland AFB in September 2009. (Tab G-52)

Recent flight time is as follows (Tab G-4):

	Hours	Sorties
30 days	16.7	7
60 days	40.6	18
90 days	49.0	22

b. Mishap Pilot 2

MP2 was a current and qualified Instructor Pilot with a grand total of 1754.8 hours, 1324.3 of which was in the UH-1N (Tab G-15). MP2 had 313.0 instructor hours in the UH-1N. (Tab G-15) MP2 completed instructor upgrade training at Kirtland AFB in November 2007. (Tab G-76) MP2 re-qualified in the UH-1N upon his return from a deployment in January 2010. (Tab G-75)

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

	Hours	Sorties
30 days	14.9	6
60 days	14.9	6
90 days	24.3	11

c. Mishap Flight Engineer 1

MF1 was a current and qualified Evaluator Flight Engineer with a total of 4103.5 hours, 990.1 of which was in the UH-1N. (Tab G-27) MF1 had 166.1 instructor hours and 10.9 hours as an evaluator in the UH-1N. (Tab G-27) MF1 completed instructor upgrade training at Kirtland AFB in 2007. MF1 re-qualified in the UH-1N upon his return from a deployment in June 2010. (Tab G-120)

Recent flight time is as follows (Tab G-28):

	Hours	Sorties
30 days	23.8	10
60 days	48.9	22
90 days	82.2	33

d. Mishap Flight Engineer 2

MF2 was a current and qualified Mission Flight Engineer with a grand total of 523.4 hours, all of which in the UH-1N. (Tab G-39) MF2 became a qualified UH-1N flight engineer at Kirtland AFB in April 2009. (Tab G-163)

MF2 was on the Commander's Awareness Program after a low score on a recent sortie. (Tabs G-189, K-7) On the subsequent sortie, he met all course training standards and was recommended for the FE initial instructor checkride. (Tab G-191) His checkride was scheduled for 27 April 2011. (Tabs K-17, V-9.7)

Recent flight time is as follows: (Tabs T-3 through T-4)

	Hours	Sorties
30 days	14.7	6
60 days	24.7	12
90 days	30.0	16

9. MEDICAL

a. Qualifications

All four crew members involved in the mishap had current AF Forms 1042 stating they were medically qualified to fly. All periodic health assessments (PHAs) were up to date. No crewmembers had medical conditions requiring waivers and all were world-wide qualified. (Tab X-3)

b. Health

Prior to the MS, the MC was in good health and did not have any performance-limiting illnesses. (Tabs V-7.3, V-8.3, V-9.3, V-10.2, X-3) During the mishap, MF2 sustained a superficial abrasion to his calf. (Tabs V-9.27, X-3) MF1 complained of neck and back soreness afterward. He sustained a bruise on his knee and mild knee swelling as a result of the accident. MP2 complained of neck and shoulder soreness. All injuries are explained by the hard landing and the position of the aircraft during egress. However, none of the MC was able to pinpoint when these minor injuries occurred. (Tabs V-9.29, X-3)

c. Pathology

Not Applicable.

d. Lifestyle

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

e. Crew Rest and Crew Duty Time

Each crewmember was allowed sufficient crew rest in accordance with AFI 11-202, Vol. 3, paragraph 9.8. (Tabs BB-9 through BB-10) No duty time requirements were breached. (Tabs V-7.4, V-8.4, V-9.4, V-10.3, DD-3 through DD-34)

10. OPERATIONS AND SUPERVISION

a. Operations

The squadron's operations tempo was moderate, with each member flying 3 to 5 times a week. (Tabs V-7.2, V-8.2, V-10.2) The experience level of all members of the MC was high. Both pilots were qualified instructors. (Tabs V-8.2, V-10.2) MF1 was a qualified evaluator and MF2 was in the process of upgrading to instructor. (Tabs V-7.1, V-9.7)

b. Supervision

Squadron supervision was adequate for the mission. All squadron briefings were conducted in accordance with regulations. The MC was appropriately briefed on weather conditions and pertinent information. The MC was also briefed by the operations supervisor before stepping to the MA. (Tab V-1.3)

11. HUMAN FACTORS ANALYSIS

The Department of Defense Human Factors Analysis and Classification System (DoD-HFACS) is a systematic and comprehensive tool that is comprised of a list of potential human factors that can be contributory or causal to a mishap. The DoD-HFACS classification taxonomy describes four main tiers of human factors including Acts, Pre-Conditions, Supervision, and Organizational Influences, which are briefly described below: (Tabs BB-16 through BB-37)

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-17)

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-20)

Supervision is a factor in a mishap if the methods, decisions, or policies of the supervisory chain of command directly affect practices, conditions, or actions of individuals and this result in human error or an unsafe situation. (Tab BB-33)

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-34)

A total of seven human factors were identified and described below for this mishap:

a. SP007 Authorized Unnecessary Hazard

Authorized Unnecessary Hazard is a factor when supervision authorizes a mission or mission element that is unnecessarily hazardous without sufficient cause or need. This includes intentionally scheduling personnel for missions or operations that they are not qualified to perform. (Tab BB-47)

The F-111 capsule had been on Site 15 for over a decade. (Tab V-1.8) At one point aluminum sheeting covered all the openings, but several panel coverings were missing at the time of the mishap. (Tab S-10) Without these panels, the capsule was an entanglement hazard. (Tab S-10) Previous site surveys noted the F-111 capsule's presence. (Tab K-27) Multiple members in the 512 RQS verified that the capsule was a frequently-used reference point for AIE operations. (Tabs V-8.21, V-10.9, V-10.11) MF1 selected an aim point for the hoist approximately 10 to 15 feet from the capsule. (Tabs V-7.27, V-9.13)

b. PC102 Channelized Attention

Channelized Attention is a factor when the individual is focusing all conscious attention on a limited number of environmental cues to the exclusion of others of a subjectively equal or higher or more immediate priority, leading to an unsafe situation. This may be described as a tight focus of attention that leads to the exclusion of comprehensive situational information. (Tab BB-34)

The FE is responsible for clearing the aircraft of obstacles on the side and rear, directing the pilots' inputs for aircraft position and altitude, and monitoring the hoist during its operation. (Tabs V-2.2, V-8.14, V-9.11,) MF2 channelized his attention on troubleshooting the hoist malfunction. (Tab V-9.21) MF1 was focused on his student's actions. (Tab V-7.27) Due to MF1 and MF2's channelized attentions, neither initially noticed the aircraft drifting or the hoist cable retracting and lifting the penetrator. (Tabs V-9.19, V-9.20, V-9.21)

c. PP102 Cross-Monitoring Performance

Cross-Monitoring Performance is a factor when crew or team members failed to monitor, assist or back-up each other's actions and decisions. (Tab BB-42)

All instructors and evaluators are tasked to immediately correct breaches of flight safety. (Tabs BB-4 through BB-5) MF1 stated he was able to monitor students' abilities and the situation by observing their body language, head movements, and verbalizations. (Tabs V-7.27, V-7.31) After MF2 cleared the hoist malfunction, MF1 sat and observed MF2 raise the hoist cable. Since MF1 was sitting and no longer standing over MF2, he was unable to visually monitor the forest penetrator. This placed him in a position where he could not quickly recognize and correct the impending unsafe situation. (Tabs V-7.27, V-7.31)

d. PP112 Miscommunication

Miscommunication is a factor when correctly communicated information is misunderstood, misinterpreted or disregarded. (Tab BB-43)

Both FEs state a "stop up" call was clearly communicated by MF2. (Tabs V-9.21, V-7.28) MP1 and MP2 did not hear a stop up call. (Tabs V-10.21, V-8.31) This discrepancy displays a communication issue. MF2 may have made the statement and it may have been unintentionally disregarded by the pilots.

e. AE101 Inadvertent Operation

Inadvertent Operation is a factor when individual's movements inadvertently activate or deactivate equipment, controls or switches when there is no intent to operate the control or device. This action may be noticed or unnoticed by the individual. (Tab BB-29)

MF1 controlled the up-limit switch on the hoist and simulated a malfunction. MF2 eventually identified the simulated malfunction and swiped MF1's hand away from the switch, releasing the hold on the cable retraction. MF1 and MF2 failed to ensure that MP2 was not activating the pilot's hoist control switch when the up limit switch was released. As a result, the hoist cable retracted inadvertently. (Tabs V-7.34, V-9.24, V-9.19)

f. PP110 Mission Briefing

Mission Briefing is a factor when information and instructions provided to individuals, crews, or teams were insufficient, or participants failed to discuss contingencies and strategies to cope with contingencies. (Tab BB-43)

The AIE portion of the brief was conducted without MF1 present, and he was not back-briefed. (Tabs V-7.7, V-7.8) This part of the brief covered AIE contingencies, including transfer of cable cut authority. (Tab V-7.7) MF1 had attended multiple AIE briefs in the past and even though he was fully aware of how to cope with those contingencies, his attendance at that brief was expected and required. (Tabs V-10.6, BB-8)

g. PP205 Inadequate Rest

Inadequate Rest is a factor when the opportunity for rest was provided but the individual failed to take the opportunity to rest. (Tab BB-43)

All crewmembers were afforded sufficient time for crew rest. (Tabs V-1.6, V-7.4, V-8.4, V-10.3) MF2 was on a night schedule two days prior to the MS. (Tabs DD-27 through DD-31) Per squadron policy, he was given one day prior to the day MS to shift his sleep cycle. MF2 did not change his sleep schedule on his day off and only slept for 5 hours the night prior to the MS. (Tabs V-9.30, DD-27 through DD-31)

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Primary Operations Directives and Publications

(1) AFI 11-202, Volume 2, *Aircrew Standardization/Evaluation Program,* 13 September 2010
(2) AFI 11-202, Volume 3, *General Flight Rules*, 22 October 2010
(3) AFI 11-2UH-1N, Volume 1, *UH-1N Helicopter Aircrew Training*, 6 June 2011
(4) AFI 11-2UH-1N, Volume 2, *UH-1N Aircrew Evaluation Criteria*, 11 February 2008
(5) AFI 11-2UH-1N, Volume 3, *UH-1N Helicopter Operations Procedures*, 27 December 2006
(6) AFI 11-2UH-1N, Volume 3, *UH-1N Helicopter Operations Procedures*, AETC Supplement, 29 June 2009
(7) AFI 11-301, Volume 1, *Aircrew Flight Equipment Program,* 25 February 2009
(8) AFI 13-217, *Drop Zone and Landing Zone Operations*, 10 May 2007
(9) AFI 51-503, *Aerospace Accident Investigations*, 26 May 2010
(10) AFI 90-901, *Operational Risk Management*, 1 April 2000
(11) AFI 91-204, *Safety Investigations and Reports*, 24 September 2008
(12) TO 1H-1(U)N-1, *UH-1N Helicopter*, 17 July 2009

b. Maintenance Directives and Publications

(1) TO 00-20-1, *Aerospace Equipment Maintenance Inspection, Documentation, Policies and Procedures,* 15 June 2011
(2) TO 14S6-3-1, *Forest Penetrator Rescue Seat Assembly,* 30 August 1995

NOTICE: The AFIs listed above are available digitally on the AF Departmental Publishing Office Internet site at http://e-publishing.af.mil.

c. Known or Suspected Deviations from Directives or Publications

AFI 11-202, Volume 3, *General Flight Rules*, 22 October 2010

13. ADDITIONAL AREAS OF CONCERN

Not applicable.

29 July 2011

CHRISTOPHER E. PLAMP, Colonel, USAF
President, Accident Investigation Board

STATEMENT OF OPINION

UH-1N, T/N 69-6603 ACCIDENT
27 April 2011

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

1. OPINION SUMMARY

I find by clear and convincing evidence that the cause of the mishap was a combination of four actions by the mishap crew (MC), including three by the mishap flight engineers (MF1 and MF2) and one by the mishap pilot (MP2). These actions included (1) MF2's troubleshooting sequence, (2) MF1's checkride supervision, (3) MF2's channelized attention, and (4) MP2's control inputs. In addition, I find by a preponderance of the evidence that the use of an old F-111 capsule as a training target during hoist operations and miscommunication between the crew substantially contributed to the incident.

MF2's troubleshooting sequence during a simulated hoist malfunction and MF1's supervision of him resulted in an unanticipated full rate hoist cable retraction. MF2's channelized attention resulted in an undetected aircraft drift. The combination of these results allowed the rescue device, in this case a forest penetrator, to rise from the ground and snag the old F-111 capsule. This caused the mishap aircraft (MA) to bank violently to the right. A combination of the right bank and abnormal control feel led MP2 to instinctively increase the collective. This resulted in the aircraft yawing to the right, pitching forward, and entering a descending right turn towards the ground.

On 27 Apr 2011 the mishap crew (MC) flew a UH-1N, T/N 69-6603 on a flight engineer (FE) initial instructor checkride. MF1 was conducting a checkride for MF2. MF2 lowered the forest penetrator approximately 10 feet from an old F-111 capsule, which was commonly used in the 512 RQS as a hoist reference point. The MA hovered between 44 and 48 feet above the ground. While MF2 was lowering the forest penetrator, MF1 induced a simulated hoist up limit switch failure. This allowed MF2 to lower but not raise the hoist cable.

MF2 attempted to raise the cable with the hoist pendant control. When the hoist failed to respond, MF2 started troubleshooting and misidentified the simulated malfunction as a pendant failure. While troubleshooting for pendent failure, he asked MP2, who was flying the MA, to move the pilot hoist control switch to the cable up position.

At this moment, MF1 queried MF2 on what malfunction he actually had. MF2 then looked at the hoist, correctly identified the malfunction, and removed MF1's hand from the switch. This deactivated the up limit switch. MP2 had not yet released the pilot hoist control switch.

This sequence of actions caused an unanticipated full rate cable retraction and raised the forest penetrator off the ground.

MF2 channelized his attention on correcting the simulated hoist malfunction and did not notice that the MA had drifted forward and left approximately ten feet. The forest penetrator swung, hit, and wedged into one of the uncovered windows of the F-111 capsule. This snagging coupled with the tightened cable caused the aircraft to violently bank right and created unusual control feel. MF2 made a "stop up, stop up" call attempting to either stop the pilot from raising the cable or the collective. Neither MP1 nor MP2 heard the stop up call.

Based on the unstable aircraft and unusual control feel, MP2 instinctively moved the controls, including increasing the collective. MP2 increased the torque from 80 to 100 percent, or maximum power available. This, combined with the right forward location of the hoist, exacerbated the unbalanced nature of the tethered aircraft causing right roll, forward pitch, and right yaw. MF1 called for the cable to be cut. MF2 and MP1 reached for their respective cable cut switches. The MA was in a sharp right descending turn, but prior to ground impact, the forest penetrator ripped free of the F-111 capsule. This allowed MP2 to straighten the flight path though the current altitude, sink rate, and rising terrain in front of the MA made a hard landing inevitable.

MP2 pulled back on the cyclic in an attempt to level the skids with the rising terrain before impact. The cable was cut just prior to impact, having no effect since the forest penetrator was already free. The aircraft struck the earth approximately five seconds after the forest penetrator snagged on the F-111 capsule. The MA impacted on the forward left skid. As the main rotors struck the ground, the tail rotated left. The MA then rolled to the left and came to a stop. The MC unsuccessfully attempted to shut down the engines and all crew members egressed the MA through the right cabin door with no significant injuries. A fire started near the engines and consumed the MA forward of the tail section.

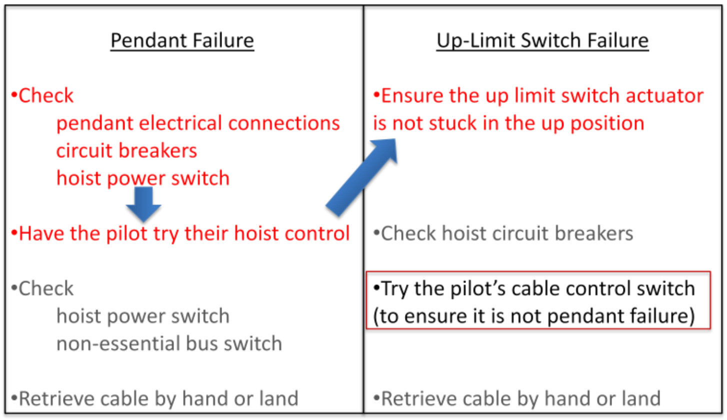
I developed my opinion by analyzing factual data, tangible evidence, Air Force directives and guidance, engineering analysis, and witness testimony. Little physical evidence was available due to the post mishap fire. In particular, both the Integrated Data Acquisition Recorder (IDAR) and Cockpit Voice Recorder (CVR) were damaged and no data could be obtained from them.

2. DISCUSSION OF OPINION

a. Causes

(1) MF2's Troubleshooting Sequence

The normal trouble shooting sequence for up-limit switch failure has the pilot try his hoist control switch two steps after the FE has already ensured the up limit switch actuator is not in the up position. MF2 executed the first steps of the pendant failure troubleshooting sequence followed by the first step for up limit switch failure. MF2 did not confirm that MP2 had released the pilot's hoist control switch before clearing the simulated malfunction. This sequence resulted in an unanticipated full rate cable retraction.



Hoist Troubleshooting Steps

(2) **Supervision**

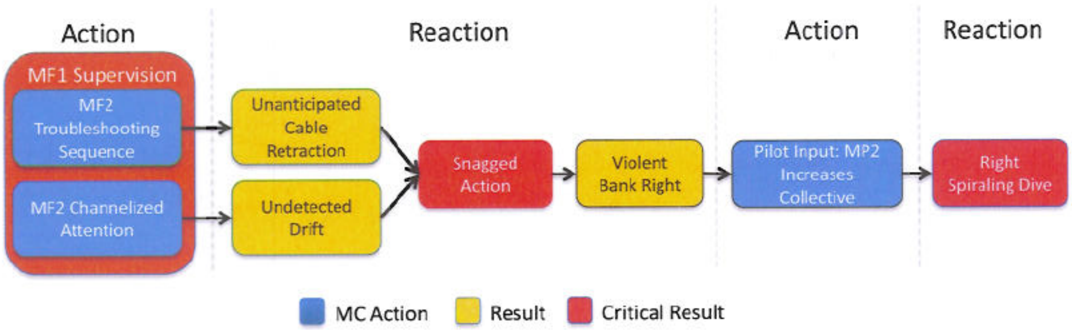
As the evaluator, MF1 had a responsibility to ensure safe operations during the flight evaluation. Since MF1 simulated the testing conditions, he had a responsibility to ensure his inputs did not cause an unsafe situation. In this mishap, MF1 failed to ensure safe conduct of hoist operations by his student. Specifically, MF1 did not ensure both the pendant and pilot hoist control switches were off prior to releasing the simulated malfunction.

(3) **Channelized Attention**

MF2 channelized his attention on the simulated hoist malfunction, which drew his attention away from the MA's hover position. Ordinarily, MF2 would correct the hover before cable retraction. When the cable unexpectedly retracted, the MA was not over the forest penetrator. The forest penetrator subsequently swung like a pendulum and lodged into the F-111 capsule.

(4) **Pilot Input (Increasing Collective)**

MP2's action of increasing the collective while tethered to the F-111 capsule exacerbated the already imbalanced flight characteristics. This caused the MA to increase right yaw, right bank, and forward pitch, resulting in a right spiraling descent until the forest penetrator separated from the F-111 capsule.



Mishap Sequence

None of the aforementioned actions independently caused the mishap. Three actions by two crewmembers created results that caused the improbable snag, which led to the bank, which led to MP2's input, which led to impact. This unique synergistic combination caused the mishap.

b. Contributing Factors

(1) Training Aid

The F-111 capsule was utilized routinely as an aide for both search training and alternate insertion and extraction (AIE) events. The capsule's deterioration increased the likelihood that a rescue device could entangle with the capsule. Though increasing the realism of the training, the routine use of the capsule as an AIE reference and training target unnecessarily increased risk.

(2) Miscommunication

MF2 made a "stop up, stop up" call after the forest penetrator hit and lodged into the F-111 capsule. This call was not successfully communicated to the MPs. Successful communication of this critical information might have reversed the pilot's actions on the collective and mitigated the ensuing rapid descent.

3. CONCLUSION

I find by clear and convincing evidence that the cause of the mishap was a combination of four actions by the mishap crew (MC), including three by the mishap flight engineers (MF1 and MF2) and one by the mishap pilot (MP2). These actions included (1) MF2's troubleshooting sequence, (2) MF1's checkride supervision, (3) MF2's channelized attention, and (4) MP2's control inputs. In addition, I find by a preponderance of the evidence that the use of an old F-111 capsule as a training target during hoist operations and miscommunication between the crew substantially contributed to the incident.

29 July 2011

CHRISTOPHER E. PLAMP, Colonel, USAF
President, Accident Investigation Board