UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION
BOARD REPORT

F-16C BLOCK 40 E, T/N 89-002023

555th FIGHTER SQUADRON (555 FS)
31st FIGHTER WING (31 FW)
AVIANO AIR BASE, ITALY

LOCATION: Undisclosed Location in Southwest Asia

DATE OF ACCIDENT: 17 November 2023

BOARD PRESIDENT: Colonel Robert B. Blake

Conducted IAW Air Force Instruction 51-307

DEPARTMENT OF THE AIR FORCE
UNITED STATES AIR FORCES IN EUROPE
UNITED STATES AIR FORCES AFRICA

17 AUG 24

MEMORANDUM FOR COLONEL ROBERT B. BLAKE (BOARD PRESIDENT)

FROM: USAFE-AFAFRICA/CD

SUBJECT: Approval of Accident Investigation Board Report

1. I have reviewed the Accident Investigation Board report that investigated the 17 November 2023 mishap involving F-16C Block 40 E, T/N 89-002023, assigned to the 555th Fighter Squadron, 31st Fighter Wing, Aviano Air Base, Italy.

2. The report of the Accident Investigation Board, conducted under the provisions of AFI 51-307, substantially complies with the applicable statutory and regulatory provisions.

3. The report is approved as written.

JOHN D. LAMONTAGNE
Lieutenant General, USAF
Deputy Commander

EXECUTIVE SUMMARY
UNITED STATES AIR FORCE
AIRCRAFT ACCIDENT INVESTIGATION

F-16C Block 40 E, T/N 89-002023
Undisclosed Location in Southwest Asia
17 November 2023

On 17 November 2023, the mishap aircraft (MA), an F-16 with tail number (T/N) 89-002023, assigned to 555th Fighter Squadron, 31st Operational Group, 31st Fighter Wing, Aviano Air Base, Italy, was operating out of a deployed, undisclosed location (UL) in Southwest Asia. At all times relevant to the mishap, the MA was parked, unmanned, and unarmed, on a ramp at the UL approximately 60 feet from an F-15E where a team of weapons loaders were working to remove munitions. The team of weapons loaders included a team chief (MXLC1), a weapons loader (MXLC2), and the weapons loader driver (MXLC3), who were using a MJ-1 weapons loader, also known as a "jammer" or bomb lift. At approximately 2200 local time (L) and while beginning efforts to load munitions onto the F-15E, MXLC2 started operating the mishap jammer (MMJ-1). After getting on MMJ-1 and placing it in reverse in a direction toward the F-15E, MXLC2 believed he was unable to stop the jammer. While continuing to travel in reverse, the MMJ-1 hit the sniper pod, and MXLC2 hit his head and scraped his back on the bomb rack unit (BRU) of the F-15, pinning him to the dashboard of the jammer. MMJ-1 proceeded to hit the landing gear tire of the F-15E, which changed its course of direction towards the MA. MMJ-1 then turned under the left fuel tank of the F-15E and MXLC2 was thrown off MMJ-1. The jammer then hit a nearby toolbox and proceeded to travel unmanned in a direction toward the MA. MMJ-1 hit the MA on the right fuel tank, causing a fuel leak. Shortly afterwards, a spark from the MMJ-1 ignited a fire, engulfing the MMJ-1 and the right front side of the MA. This mishap caused an estimated $30,241,892.00 in damage to government equipment and an estimated $4,954.00 in environmental clean-up costs.

The Accident Investigation Board (AIB) President found by a preponderance of evidence the cause of the mishap was MXLC2's loss of situational awareness and confusion as to the model of MJ-1 he was operating as well as the distance to the F-15E aircraft when first began operating MMJ-1. This led to MXLC2 panicking and mistakenly engaging the accelerator pedal when he thought he was engaging the brake pedal and failing to properly apply emergency shutdown procedures on MMJ-1. The combination of these errors led to MMJ-1 impacting the F-15E's landing gear at a high rate of speed, resulting in the failure of MMJ-1's hydrostatic drive pump and inability of the centering mechanism to retract the pump's control lever to the neutral position and bring MMJ-1 to a stop. The Board President further found that lack of proper documentation for the assigned MJ-1 fleet at the UL and a loose culture of adherence to Air Force standards and technical procedures by maintainers at the UL were contributing factors in this mishap.

ACRONYMS AND ABBREVIATIONS

A1C	Airman First Class
AEW	Air Expeditionary Wing
AFAFRICA	Air Forces Africa
AFCENT	Air Forces Central Europe
AFB	Air Force Base
AFE	Aircrew Flight Equipment
AFFF	Aqueous Film Foaming Foam
AFI	Air Force Instruction
AFMAN	Air Force Manual
AFRL	Air Force Research Laboratory
AFSC	Air Force Specialty Code
AFSEC	Air Force Safety Center
AFTO	Air Force Technical Order
AGE	Aerospace Ground Equipment
AIB	Accident Investigation Board
AMOPS	Airfield Management Operations
AMXS	Aircraft Maintenance Squadron
AOR	Area of Responsibility
APG	Airframe, Powerplant General
ARF	Aircraft Rescue and Fire
ATC	Air Traffic Control
ATOP	Air Transport Operations
ATP	Advanced Targeting Pod
BRU	Bomb Rack Unit
CANN	Cannibalization
CFT	Conformal Fuel Tank
CMA	Controlled Movement Area
Col	Colonel
CTK	Consolidated Tool Kit
DAFI	Department of the Air Force Instruction
DOD	Department of Defense
DOT	Department of Transportation
DSN	Defense Switched Relay
DSU	Delayed Sensing Unit
ECC	Entry Control Center
EFGS	Expeditionary Fighter Generation Squadron
EMXS	Expeditionary Maintenance Squadron
EOR	End of Runway Crew
EOD	Explosive Ordinance Disposal
FGS	Fighter Generation Squadron
FOD	Foreign Object Debris
FS	Fighter Squadron
FW	Fighter Wing
GB	Guided Bomb
GBU	Guided Bomb Unit
GPS	Global Positioning System
HFACS	Human Factors Analysis and Classification System
IMDS	Integrated Maintenance Data System
ISB	Interim Safety Board
LIMFAC	Limiting Factor
LNO	Liaison Officer
LOTI	Local One Time Inspection
LMR	Land Mobile Radio
LSA	Life Support Area
Lt Col	Lieutenant Colonel
MA	Mishap Aircraft
Maj	Major
MED	Medical
MFR	Memorandum for Record
MHU	Munitions Handling Unit
MIL-PRF	Military Performance Standards
MJ-1	Aerial Stores Lift Truck
MMJ-1	Mishap Aerial Stores Lift Truck
MPH	Miles Per Hour
MUNS	Munitions
NATO	North Atlantic Treaty Organization
PA	Public Affairs
PPE	Personal Protective Equipment
PRP	Personnel Reliability Program
RAF	Royal Air Force
RAFL	Royal Air Force Lakenheath
RIV	Rapid Intervention Vehicle
RPM	Revolutions Per Minute
RTV	Red Tail Village
SABC	Self-Aid Buddy Care

SAE	Society Of Automotive Engineers
SAR	Search and Rescue
SCL	Standard Combat Load
SIB	Safety Investigation Board
SMSgt	Senior Master Sergeant
SN	Serial Number
SSgt	Staff Sergeant
SrA	Senior Airman
SWP	Subordinate Work Package
T/N	Tail Number
TCTO	Time Compliance
TSgt	Technical Sergeant
WP	Work Package
WPNS	Weapons
TO	Technical Order
US	United States
USC	United States Code
UL	Undisclosed Location
USAF	United States Air Force
USAFE	United States Air Forces Europe
USAFRICOM	United States Africa Command
USCENTCOM	United States Central Command
USEUCOM	United States European Command

SUMMARY OF FACTS

1. AUTHORITY AND PURPOSE

a. Authority

On 18 December 2023, Lieutenant General John D. Lamontagne, the Deputy Commander of United States Air Forces in Europe and United States Air Forces Africa, appointed Colonel Robert B. Blake to conduct an aircraft accident investigation of the 17 November 2023 mishap of a F-16 aircraft that occurred at an undisclosed location (UL) in Southwest Asia. (Tab Y-3). On 26 February 2023, the Accident Investigation Board (AIB) convened at Ramstein Air Base, Germany. A Medical Member (Lieutenant Colonel), Legal Advisor (Major), Pilot Member (Captain), Maintenance Member (Master Sergeant), and a Recorder (Staff Sergeant) were also appointed to the board. (Tab Y-3). A Subject Matter Expert (Technical Sergeant) in MJ-1 weapons loaders, also known as "jammers," was also appointed. (Tab Y-5). The AIB was conducted in accordance with Air Force Instruction (AFI) 51-307, *Aerospace and Ground Accident Investigations*, dated 18 March 2019, and AFI 51-307, United States Air Forces in Europe-Air Forces Africa Supplement, *Aerospace and Ground Accident Investigations*, dated 14 October 2020.

b. Purpose

In accordance with AFI 51-307, *Aerospace and Ground Accident Investigations*, this AIB 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 17 November 2023, the mishap aircraft (MA), an F-16 with tail number (T/N) 89-002023, assigned to 555th Fighter Squadron, 31st Operational Group, 31st Fighter Wing, Aviano Air Base, Italy, was operating out of a deployed, undisclosed location (UL) in Southwest Asia. (Tabs D-11, D-22 to D-23, O-4, O-44). At all times relevant to the mishap, the MA was unmanned, unarmed, and parked on a ramp at the UL approximately 60 feet from an F-15E from which a team of weapons loaders were working to remove munitions from. (Tabs A-9 to A-10, R-26 to R-29, R-66 to R-69, T-3 to T-9). The team of weapons loaders included a crew chief (MXLC1), a weapons loader (MXLC2), and the driver (MXLC3) of a MJ-1 weapons loader, also known as a "jammer." (Tab R-26 to R-29, R-66 to R-69). All weapons loaders were assigned to the 332d Expeditionary Maintenance Squadron (332 EMXS). At approximately 2200 local time (L), and while beginning efforts to load new munitions on the F-15E, MXLC2 started operating the mishap jammer (MMJ-1) at the request of MXLC1. (Tabs O-4, R-26 to R-29, R-66 to R-69, R-84, V-2.4). Prior to operating MMJ-1, it was parked approximately 12 feet from the nose of the F-15E and was facing munitions that had recently been removed from that same F-15E. (Tabs R-44, T-3 to T-10, V-1.17). After getting on MMJ-1 and placing it in reverse in a direction toward the F-15E, MXLC2 indicated he was unable to stop the jammer. (Tab R-26 to R-29, R-67 to R-69). While continuing to travel in reverse, MMJ-1 hit the sniper pod and MXLC2 hit his head and scraped his back on the bomb rack unit (BRU) of the F-15, which pinned him to the jammer dashboard. (Tab R-26 to R-29, R-67 to R-69). MMJ-1 then hit the landing gear tire of the F-15E, changing its course of direction and throwing MXLC2 off, and it then proceeded to travel under the F-15E's left fuel tank. (Tabs R-26 to R-29, R-44 to R-46, R-67 to R-69, T-3 to T-8). It then hit a toolbox and continued to travel unmanned in a direction toward the MA, hitting the aircraft on the right fuel tank and causing a fuel leak. (Tabs R-26 to R-29, R-44 to R-45, R-67 to R-69, T-3 to T-8). A spark from the MMJ-1 quickly ignited a fire, which engulfed the right front side of the MA. (Tabs R-26 to R-29, R-44, R-67 to R-69). The mishap caused an estimated $30,241,892.00 in damage to government equipment and an estimated $4,954.00 in environmental clean-up costs. (Tab A-3 to A-4).

3. BACKGROUND

a. United States Central Command (USCENTCOM)

USCENTCOM, headquartered at McDill Air Force Base, Florida, directs and enables all military operations and activities with allies and partners to increase regional security and stability in support of enduring U.S. interests in the area of the globe located between the European, Africa and Indo-Pacific Commands. (Tab CC-5).

b. United States Air Forces in Europe – Air Forces Africa (USAFE-AFAFRICA)

USAFE-AFAFRICA, headquartered at Ramstein Air Base, Germany, is a major command of the U.S. Air Force. It is the air component for two Department of Defense combatant commands – United States European Command (USEUCOM) and United States Africa Command (USAFRICOM). As the air component for both USEUCOM and USAFRICOM, USAFE-AFAFRICA executes missions with forward-based airpower and infrastructure to conduct and enable theater and global operations. USAFE-AFAFRICA directs air operations in a theater spanning three continents, covering more than 15 million square miles, containing 104 independent states, possessing more than one-fifth of the world's population, and more than a quarter of the world's gross domestic product. (Tab CC-3).

c. 31st Fighter Wing (31 FW)

The 31 FW, Aviano Air Base, Italy, delivers combat power across the globe in support of US and North Atlantic Treaty Organization (NATO) objectives. The 31 FW maintains two F-16CM fighter squadrons, the 510 FS and the 555 FS, capable of conducting offensive and defensive air combat operations. The 31 FW prepares for its combat role by maintaining aircraft and personnel in a high state of readiness. (Tab CC-8).

d. 48th Fighter Wing (48 FW)

The 48th FW, RAF Lakenheath, United Kingdom, is the U.S. Air Forces in Europe's only fourth and fifth-generation fighter wing, bringing unique air combat capabilities to the fight, such as the most advanced Joint Direct Attack Munitions used by the F-35A & F-15E. The 48 FW provides all-weather, day or night air superiority, air-to-ground precision combat capability, and multi-staged improvement program avionics. (Tab CC-9).

e. 332d Air Expeditionary Wing (332d AEW)

The 332 AEW operates out of an undisclosed location (UL) and generates, executes and sustains combat air power in support of CENTCOM missions. The wing is equipped to host a wide array of airpower capabilities, including precision strike, aerial refueling, intelligence, surveillance, reconnaissance, space, and combat search and rescue missions. (Tab CC-10).

f. 555th Fighter Squadron (555 FS)

The 555 FS, Aviano Air Base, Italy, provides combat airpower on demand to US and NATO Combatant Commanders, as well as the National Command Authority in order to meet National Security objectives. It also performs air and space control and force application roles of counterair, strategic attack and counterland, including interdiction and close-air support, with F-16CMs employing state of the art munitions in support of the joint, NATO, and combined operations. (Tab CC-12).

g. 494th Fighter Squadron (494 FS)

The 494 FS is a combat-ready, worldwide deployable F-15E Strike Eagle squadron capable of executing strategic attack, interdiction, close air support and counter-air missions in support of war plans and contingency operations for USEUCOM, USAFRICOM, and NATO. The 494 FS employs the full array of air superiority and surface attack munitions, to include the most advanced USAF precision-guided weapons. (Tab CC-14).

h. 494th Fighter Generation Squadron (494 FGS)

The 494 FGS is a worldwide deployable unit which conducts the inspection, generation and organizational maintenance of F-15E aircraft. In this role, the fighter squadron supports USAFE, USEUCOM and NATO taskings and commitments. It ensures consistent application of quality maintenance practices, equitable distribution of resources, and successful training programs. (Tab CC-14 to CC-15).

i. F-16C Fighting Falcon

The F-16 Fighting Falcon is a compact, multi-role fighter aircraft. It is highly maneuverable and has proven itself in air-to-air combat and air-to-surface attack. It provides a relatively low-cost, high-performance weapon system for the US and allied nations. (Tab CC-16).

j. F-15E Strike Eagle

The F-15E Strike Eagle uses two crew members, a pilot and a weapon systems officer. It is a dual-role fighter designed to perform air-to-air and air-to-ground missions. An array of avionics and electronics systems gives the F-15E the capability to fight at low altitude, day or night and in all weather. (Tab CC-18).

k. MJ-1 Aerial Stores Lift Truck

The MJ-1, also known as a "jammer," is a standard lift truck used to transport, load, and unload a wide variety of munitions and equipment to a wide variety of United States Air Force aircraft. Controls at the rear of the lift truck allow the load crew to make small adjustments for precise positioning during loading and unloading of munitions. (Tab CC-21).

The MJ-1B/C lift-truck looks nearly identical to the MJ-1C lift truck at first glance but many of the components in the MJ-1C model have been upgraded. The differences between the B/C and C model are overall minor but include components in the braking system, fuel system, steering system, electrical and wheel paneling area. For the braking system, the MJ-1C model has an upgraded foot brake, which is in a differing location than on the older MJ-1B/C model. For the fuel system, the MJ-1C model no longer has a clear bowl to help identify the presence of water in fuel but otherwise is the same. The steering system in the MJ-1C model also has a minor difference, including the removal of the steering manifold beneath the operator's seat cushion, but it otherwise has the same steering pump as the B/C version. Lastly, the front wheel fenders on the MJ-1C model have incorporated slip-resistant steps, as opposed to the conforming style fenders on the previous B/C model. (Tab CC-21).

l. Maintenance Skill Levels

AFMAN 36-2100, *Military Utilization and Classification*, dated 7 April 2021, defines maintenance skill levels. The 3-skill level (3-Level), or apprentice, identifies enlisted personnel who have obtained basic knowledge within an Air Force Specialty Code (AFSC) through completion of an initial skills training. Apprentices gain duty position experience and, upon completion, enter a structured apprenticeship program to gain qualification and experience required of a 5-skill level (5-Level), or journeyman. The 5-skill level identifies enlisted personnel who, through experience and training, have demonstrated skilled proficiency in their AFSC. The 7-skill level (7-Level), or craftsman, identifies enlisted personnel who have gained a high degree of technical knowledge in their AFSC and who have additionally acquired supervision capability through training and experience.

4. SEQUENCE OF EVENTS

a. Mission

The MA was not flying at the time of the mishap. It was parked on a ramp at the UL, unmanned and unarmed. (Tabs D-22, O-4, T-3 to T-8).

b. Planning

The MA was not flying at the time of the mishap. It was parked on a ramp at the UL, unmanned and unarmed. (Tabs S-6 to S-8, T-3 to T-8).

c. Preflight

The MA was not flying at the time of the mishap. It was parked on a ramp at the UL, unmanned and unarmed. (Tabs S-6 to S-8, T-3 to T-8).

d. Summary of Accident

On 17 November 2023, the MA, an F-16 with tail number (T/N) 89-002023, assigned to 555th FS from 31 FW was operating out of a deployed, undisclosed airfield in Southwest Asia. (Tabs D-11, D-22 to D-23, O-4, O-44). At all times relevant to the mishap, the MA was parked, unmanned, and unarmed, on a ramp at the UL. (Tabs S-6 to S-8, T-3 to T-8). It was parked approximately 60 feet from an F-15E with T/N 91-0335 from the 48 FW which was also operating out of the UL. (*Figure 1*) (Tabs S-6 to S-8, T-9).

Immediately preceding the mishap, a team of weapons loaders were working to remove munitions from the F-15E due to new mission requirements. (Tabs R-54 to R-55, R-78 to R-80, R-84, V-2.4). The team of weapons loaders included a crew chief (MXLC1), a weapons loader (MXLC2), and the driver (MXLC3) of a MJ-1 B/C weapons loader, also known as a “jammer” or bomb lift. (Tab R-26 to R-29, R-67 to R-69). Immediately prior to the mishap, MXLC3 had finished removing several munitions from the F-15E and parked the mishap jammer (MMJ-1) facing those munitions and approximately 12 feet from the nose of the F-15E. (*Figure 1)* (Tabs R-26 to R-29, R-67 to R-69, R-78 to R-80, R-84, T-9 to T-10, V-1.17). At approximately 2200L, MXLC1 requested that MXLC2 move MMJ-1 to save time as the load crew began efforts to load new munitions on the F-15E. (Tabs O-4, R-55, V-2.4).

After getting on MMJ-1, MCLC2 hit the ignition switch, pulled up on the throttle to increase the rotations per minute of the engine, placed it in reverse and then disengaged the parking brake. (Tab V-3.16). MMJ-1 then proceeded in reverse in a direction toward the F-15E and MXLC2 indicated he traveled approximately five feet when he realized he was not able to stop the jammer. (Tabs R-26, R-41 to R-42, R-55, R-67, V-2.4, V-2.23, V-3.2, V-3.5, V-3.15). MXLC1 observed MXLC2 on MMJ-1 and watched MXLC2 trying to stop MMJ-1, to include pumping the brake, but it “accelerated backwards,” in a “violent way,” and MXLC2 “panicked.” (Tabs R-55, V-2.4, V-3.2).

MXLC2 stated that after he realized the brake pedal was not stopping MMJ-1, he “panicked and tried to set the emergency brake like three or four times, still hitting the brake at the same time.” (Tab V-3.2). He also attempted to switch on or engage the parking brake. (Tabs R-49, V-3.5). MXLC2 could not recall which model of MJ-1 jammer he was operating at the time of the mishap. (Tab V-3.15). Other than stating he took his foot off the ignition, engaging the brake pedal, and engaging the parking brake several times, MXLC2 did not attempt any other procedures to shut down or stop MMJ-1. (Tabs R-49, V-3.5 to V-3.6). The parking brake is only designed to keep the brake pedal engaged and is not designed to bring a moving jammer to a stop. When interviewed, MXLC2 did not recall the placement of the brake pedal on MMJ-1, specifically if the brake pedal was right next to the accelerator pedal or inches away. (Tab V-3.26).

While continuing to travel in reverse, MMJ-1 hit the sniper pod (*Figure 1, item 1*) and MXLC2 hit his head and scraped his back on the bomb rack unit (BRU) of the F-15E, pinning him to the steering wheel and dashboard of MMJ-1. (Tabs R-26 to R-27, R-41 to R-42, R-55, R-67, V-2.4). MXLC2 reported going "unconscious" near this time. (Tabs R-27, V-3.6). MMJ-1 continued in reverse, hitting the left main landing gear tire (*Figure 1, item 2*) on the F-15E. (Tabs R-26 to R-27, R-41 to R-42, S-5). This impact significantly changed the direction of MMJ-1's travel, sending it under the F-15E's external fuel tank and also threw MXLC2 from the jammer. (*Figure 1)* (Tabs R-26 to R-27, R-67, T-9, V-2.4). MMJ-1 then hit a toolbox (*Figure 1, item 3*) and proceeded to travel unmanned in a direction toward the MA. (*Figure 1*) (Tabs R-26 to R-27, R-67, T-9, V-2.4 to V-2.5). It hit MA on the right fuel tank and caused a fuel leak. (Tabs R-18, R-57, R-69, V-2.5). A spark from the MMJ-1 ignited a fire, which engulfed the MMJ-1 and the right front side of the MA. (*Figure 1, item 4*) (Tabs R-18, R-69, V-2.5).

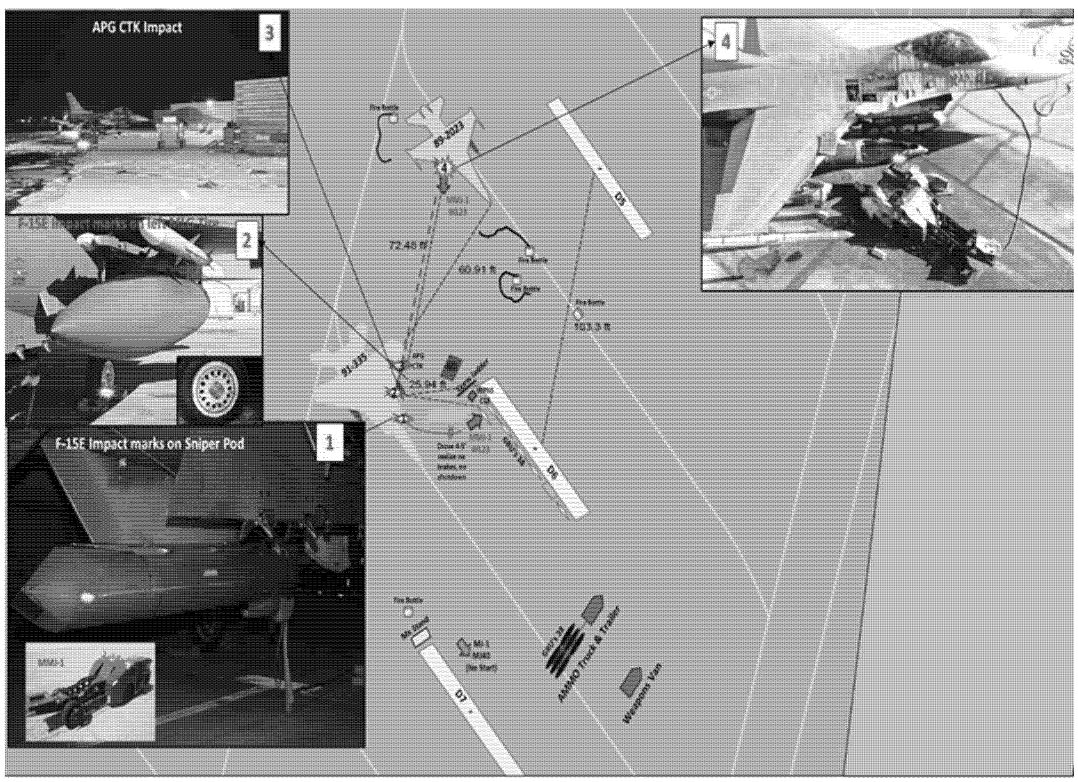

FIGURE 1

e. Impact

The MA was not flying at the time of the mishap. It was parked on a ramp at the UL, unmanned and unarmed. (Tabs S-6 to S-8, T-3 to T-10).

f. Egress and Aircrew Flight Equipment (AFE)

The MA was not flying at the time of the mishap. It was parked on a ramp at the UL, unmanned and unarmed. (Tabs S-6 to S-8, T-3 to T-10).

g. Search and Rescue (SAR)

Not applicable.

h. Recovery of Remains

Not applicable.

i. Weapons Load Crew Operations Pre-Mishap

At around 1835L on the day of the mishap, maintenance personnel were informed the F-15E with T/N 91-0335, which was originally scheduled for a 2300L takeoff time, was rescheduled for a 0030L takeoff time, and had a new munitions load requirement. (EE-4, EE-14). There was some miscommunication to the weapons load crew, however, because some of them erroneously believed the F-15E would be departing earlier than the 2300L takeoff time. (Tabs R-63, R-79, R-84 to R-85, EE-4, EE-14). However, based on this new takeoff time, the time the aircrew planned to proceed, or "step," to the aircraft changed to 2330L. (EE-4, EE-14). The F-15E was parked approximately 60 feet away from the MA. (Tab T-9).

At approximately 2100L, the mishap weapons load crew began removing the munitions on the F-15E. (Tab V-1.2 to V-1.4). Prior to doing so, MXLC3 attempted to use an MJ-1 jammer with serial number (SN) MJ-40, located in between barriers D6 and D7 (*Figure 1*), but quickly realized this unit would not start. (Tabs R-84, T-6, T-9, S-9, V-1.4 to V-1.5). MXLC3 then found another MJ-1 jammer (SN unknown) near the D5 barrier and was able to successfully remove several munitions off the F-15E. (Tabs R-78, R-84, R-86, V-1.3 to V-1.5). While removing these munitions, MXLC3 encountered some abnormal gear shifting issues with that second MJ-1 and decided to find another MJ-1 jammer. (Tabs R-84, R-86). MXLC3 drove the second jammer to another part of the flightline to obtain a replacement. (Tabs R-78, R-84, R-86, V-1.6). MXLC3 proceeded to exchange that second jammer with MMJ-1 (SN 23), which had recently been used by another load crew to upload 2 pylons to another aircraft (tail number unknown). (Tabs R-78 to R-79, R-84 to R-85, R-86, V-1.6 to V-1.7).

MXLC3 returned to the F-15E with MMJ-1 and proceeded to finish removing the remaining munitions from the F-15E. (Tab R-78 to R-79, R-84 to R-85, R-86). After concluding, MXLC3 parked the jammer facing the recently removed munitions. (*Figure 1)* (Tab T-6). MXLC3 reported no mechanical issues while operating MMJ-1 prior to the mishap. (Tabs R-84, Tab V-1.7, V-1.17). MXLC3 then proceeded to join MXLC1 and ammunition personnel to help prepare the new munitions located on the weapons trailer at the front entrance between barrier D6 and D7. (*Figure 1*) (Tabs R-84 to R-85, V-1.3 to V-1.5). At approximately 2200L, MXLC1 directed MXLC2 to reposition the MMJ-1 closer to the weapons trailer in order to help speed the uploading munitions operation, which started the mishap sequence. (*See Figure 1*) (Tabs R-55, V-2.4).

5. MAINTENANCE

a. Maintenance Documentation

There were four possible locations for maintenance documentation to be stored or maintained for the mishap jammer, MMJ-1. First, the Air Force Technical Order Form 244 (AFTO Form 244) is designed and used to document recent mechanical issues and servicing of all equipment and is physically kept in a compartment on every jammer. However, the active Form 244 for MMJ-1 was destroyed during the fire that resulted from the mishap and therefore the data on any recent mechanical servicing was not recoverable. (Tab S-7).

Second, historical Form 244s for MJ-1s are kept in a filing system at 332 EMXS's Air Ground Equipment (AGE) Flight. A review of the historical Form 244 filing system within the AGE Flight was conducted and a single Form 244 was found for MMJ-1. (Tab EE-17 to EE-18). This Form 244 was created 26 November 2022 and covered a period through 13 February 2023. (Tab EE-17 to EE-18). This Form 244 did not reveal anything relevant to the investigation, but likely indicates the Form 244 for the period covering the mishap was also created on 13 February 2023 when it replaced the previous form. No other AFTO Form 244's for MMJ-1 were discovered in the AGE Flight's historical filing system.

Third, maintenance documentation regarding MMJ-1 was located within the Integrated Maintenance Data Documentation System (IMDS), an Air Force-wide maintenance management information system for all aircraft or ground equipment. IMDS stores all recorded maintenance on a piece of equipment and is searchable by part number, serial number combination, or an equipment identification number. All maintenance that is documented using the IMDS system will be time stamped via Julian date. IMDS showed that an acceptance inspection was accomplished on MMJ-1 on 2021092 (2 April 2021), which is the date it was inspected when it was assigned to the 332 EMXS AGE Flight. (Tab D-12). IMDS also showed the special, annual, and corrosion inspections were accomplished on MMJ-1 on 2023064 (5 Mar 2023) in accordance with Technical Order 35D3-2-16-16WC-1, work cards 1-001 thru work cards 1-006 (annual), and 35D3-2-16-16WC-1 work cards 2-001 thru work cards 2-002 (special). A special inspection was also accomplished on 19 September 23. No other documentation for MMJ-1 was available in IMDS after 19 September 23. (Tab D-12).

Fourth, jammer maintenance at 332 AEW was documented in emails that are sent from outgoing shifts to the oncoming shift workers and essentially functions as turnover logs. (Tab EE-3). However, there was no relevant maintenance recorded for MMJ-1, indicating that it was either never brought in for maintenance at the AGE maintenance shop, or such maintenance was not documented. (Tab EE-3).

Ultimately, documentation at the UL was not maintained in accordance with published guidance and thus it is unknown whether MMJ-1 suffered from mechanical problems prior to or during the mishap. During the course of the investigation into this mishap, five maintenance members failed to document known discrepancies on the MJ-1 fleet at the UL. (Tab D-8 to D-10). Each member assumed, but did not document, known mechanical issues on Air Force Forms 244 or properly report those issues to the UL's Aerospace Ground Equipment (AGE) Flight for repair. (Tab D-8). For example, on the first of three jammers that MXLC3 used prior to the mishap sequence, no action was taken to document a known discrepancy in the AFTO From 244 despite it failing to start. (Tab D-8 to D-10). In addition, for the second jammer that MXLC2 used prior to the mishap sequence, no action or discrepancy was documented for the forward to reverse mechanical discrepancy. (Tab D-8 to D-10). Lastly, weapons load crew members reported bringing MJ-1 jammers to the AGE flight, though these same MJ-1's would be returned to the flightline as serviceable with no corrective maintenance actions taken on those reported discrepancies. (Tab D-8 to D-10).

b. Inspections

MJ-1 B/C jammers require four serviceability inspections in accordance with Air Force Technical Order 35D3-2-16-16WC-1 and 35D3-3-8-36WC-1. (Tabs D-3, D-6). The four inspections are: periodic, special, annual and serviceability. AGE flight chiefs may increase the frequency due to operational requirements, but all inspections must be documented. Inspections can only be deferred during contingency operations or wartime conditions with the approval of a group commander or equivalent. However, certain inspections cannot be deferred, to include hydraulic servicing and other servicing requirements based on operational demands, without higher level approval. (Tab D-3, Tab D-6).

Records show the lubrication inspection for the MMJ-1's centering mechanism, to include the operational checkout of the jammer, was conducted as a part of the annual inspection on 5 March 2023. (Tab D-12). At the time, TO 35D3-2-16-16WC-1 work card number 3-001, step G, stated that the centering mechanism should be filled with hydraulic fluid MIL-PRF-83282 or equivalent. (Tab D-3). While it was not possible to determine whether the MMJ-1's centering mechanism was filled during the 5 March 2023 annual inspection, MXAGE1 stated AGE technicians were not routinely opening the fill cap to observe fluid level during that portion of the inspection. (Tab V-7.3 to Tab V-7.5). Unless the centering mechanisms were leaking or not working, AGE technicians are generally not required to open the cap on the centering mechanism to assess fluid level during routine scheduled maintenance. (Tab V-7.3 to Tab V-7.5).

The operational checkout of the centering mechanism itself is done by operating the machine under power and verifying the unit does not move, or "creep," while in the neutral position. During this step, AGE technicians often conduct the operational checkout by physically driving the unit out of the maintenance area and taking it back to the AGE "ready line," during which time they observe whether any issues are present. (Tab V-7.4 to V-7.6). The inspection work cards did not require isolating the centering mechanism's ability to quickly stop the machine when un-commanded, such as would be possible were the unit placed on jacks and operationally checked. The only time placing the jammer on jacks is mandated for an operation checkout is when the centering mechanism is removed and re-installed. (Tab D-6). On this step, AGE technicians are to place the machine on jacks to isolate any movement, or creep, and adjust as needed.

In additional to the required annual and special inspections, MMJ-1 was part of a Time Compliance Technical Order (TCTO) regarding the integrity of the centering mechanism. (Tab D-5). Two TCTO's – 35D3-2-25-541 (MJ-1) and 35D3-3-8-558 (MHU-83 D/E) (Tab D-7) – were issued in April of 2019 due to intermittent failure of centering mechanism parts. TCTO 35D3-2-25-541 is for the MJ-1 model weapons loader and TCTO 35D3-3-8-558 is for the larger MHU-83 model weapons loader. These TCTO's required a re-design and replacement of the centering mechanism, lever arm assembly, bracket, ball-joint, and the installation of two new safety wire bolts in order to eliminate and mitigate the possibility of centering mechanism failures. (Tab D-5, D-7).

Not all assigned bomb lifts at the UL had step jj of TCTO 35D3-2-25-541 or -558 completed. (Tab D-8 to D-10). Step jj on both TCTO's involves applying safety wire to the new bolts using .32-gauge safety wire. Of the assigned, or permanent, MJ-1 fleet at the UL (six total machines), it was observed that only MMJ-1 was properly safety wired. In conjunction with the safety wire, each unit should have been stamped with "TCTO #541/558 C/W," showing that the TCTO was accomplished. Out of the nine machines, eight were observed with no stamp placed on the data plate, indicating the TCTO was not properly documented. (Tab D-8 to D-10). MMJ-1 had step jj of TCTO 35D3-2-25-541 accomplished more than likely between 1 April 2019 and 1 October 2021, as it was not documented in IMDS after 1 October 2021. (Tab D-5).

Maintenance of the hydrostatic assembly, to include the hydrostatic drive, pump, and steering pump, is only conducted if it is determined to be inoperable. (Tab FF-29). This would include leaking, failing to engage in the forward or reverse position, un-commanded vehicle movements, or steering issues. (Tab FF-29). Internal disassembly or inspections of the hydrostatic assembly is not conducted at the field level. When any maintenance is accomplished, or in the event of a hydraulic fluid leak, any missing hydraulic fluid is replaced by filing the main reservoir. (Tab FF-29). There is no requirement that the hydraulic fluid be drained or flushed for contamination. During annual jammer maintenance, the filters associated with the hydrostatic system are removed and inspected. If no debris is found, or it is within limits, the unit is returned to service and the reservoir topped off. (Tab FF-29).

c. Maintenance Procedures

The permanently assigned (local) fleet of MJ-1s at the UL originally belonged to other bases within theater and were retrograded to the UL as those bases were operationally closed. As units leave the UL, the permanently assigned bomb lifts stay behind and custodial responsibility was signed over via the *Defense Property Accountability System Custodian Inventory Report* to the 332 EMXS. (Tab EE-5 to EE-9). This digital report provides a complete inventory of all assigned AGE equipment for the 332 EMXS AGE Flight. As units conduct turnover, they conduct a "floor-to-book/book-to-floor" equipment inventory. This is a physical inventory of all equipment as shown on the aforementioned report. An inventory was conducted during the transition of 494 EFGS into the UL for a total of six total bomb lifts – four MJ-1 B/Cs and two MHU-83s. The average age of the local fleet of bomb lifts assigned to the UL is 9.8 years with the oldest being 13 years old. (Tab D-10).

There appeared to be a marked distinction in the proper care and maintenance of the locally assigned bomb lifts in comparison to those temporarily brought into the area of responsibility but owned by other units. (Tab D-8 to D-10). Though the bomb lifts at the UL had not accomplished TCTO 35D3-2-25-541 or -558 properly, as described above, weapons loaders owned by other units showed full compliance with these TCTOs. Additionally, the locally assigned fleet of both MJ-1 and MHU-83 weapons loaders were visually neglected for corrosion control, despite the corrosion inspections being documented as completed in accordance with 35D3-2-16-16WC-1, work card 2-001, as part of the special inspection, step 2. (Tab D-3, D-8 to D-10). Additionally, witness interviews of personnel uncovered eight instances where maintenance members reported a general lack of care and attention to detail on routine maintenance practice towards the MJ-1 fleet at the UL. (Tab D-8 to D-10). Additionally, the UL does not have a local written policy to ensure MJ-1's are returned to the AGE shop for proper preventative maintenance based on environmental conditions and high operational use. (Tab D-8 to D-10).

d. Maintenance Personnel and Supervision

All the individuals directly involved in the mishap were trained and qualified for the roles they were performing at the time of the mishap. (Tabs G-3, G-4, G-19 to G-55, G-57 to G-98, G-99 to G-135). On a weapon's loading crew, there are three positions: the team chief (position 1), weapons loader (position 2), and weapons loader driver (position 3). The weapons loader driver is usually the lowest ranking member on the team, but the most proficient at driving the weapons loaders because it is their sole responsibility in loading operations. Once a member is promoted out of the weapons loader driver position, they will progress to weapons loader, and they will usually stop operating the weapons loader on a regular basis. (Tab R-41).

Information below is current as of the day of the mishap:

(1) MXLC1: 7-Level F15E Weapons Load Crew Team Chief (Tab G-57 to G-98)
Time in service: Approximately 6 years
Time at RAFL: Approximately 1 year
Part in mishap: Load Team Chief responsible for actions and movements of MXLC2 and MXLC3 on the day of the mishap
Training Status: Fully qualified on all tasks performed

(2) MXLC2: 5-Level F15E Weapons Load Crew Team Member (Tabs G-3, G-4, G-19 to G-55)
Time in service: Approximately 3 years
Time at RAFL: Approximately 2 years
Part in mishap: Driving/operating MMJ-1 at time of mishap
Training status: Fully qualified on all tasks performed

At the time of the mishap, although fully qualified, MXLC2 was not proficient at operating an MJ-1 B/C model bomb lift within the prescribed and confined space of a live loading operation. (Tabs G-3, G-4, G-19 to G-55). Additionally, MXLC2 was not aware of all steps of the emergency shut down procedures associated with a malfunctioning MJ-1 B/C bomb lift. (Tabs D-8 to D-10, V-

3.18). Emergency Procedures can be found in TO 35D3-2-25-11 work package 006 00, step 9 page 17. (Tab D-4).

(3) MXLC3: 3-Level F15E Weapons Load Crew Team Member (Tab G-99 to G-135)
Time in service: Approximately 1 year
Time at RAFL: Approximately 6 months
Part in mishap: Drove MMJ-1 prior to mishap and prior to its operation by MXLC2
Training status: Fully qualified on all tasks performed (Tab G-99 to G-135)

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

Fuel from the MA was collected on 17 November 2023 and sent to the fuels laboratory at Ramstein Air Base Germany. There is no evidence the MA fuel was contaminated or a contributing factor to the mishap. (Tab D-61).

Oil was pulled from the MA and tested at the local Nondestructive Inspection Lab (NDI) at the mishap location. There is no evidence the MA oil was contaminated or a contributing factor to the mishap. (Tab D-63).

Hydraulic fluid was pulled from MMJ-1's hydrostatic pump assembly and the hydraulic reservoir on 7 March 2024 and sent to the Science and Engineering Laboratory at Hill Air Force Base. The analysis showed an extremely high particle count, indicative of significant corrosion. (Tab FF-21 to FF-22, FF-26).

f. Unscheduled Maintenance

Not applicable.

6. AIRFRAME, MISSILE, OR SPACE VEHICLE SYSTEMS

a. Structures and Systems

(1) F-16C (T/N 89-002023)

The General Dynamics F-16 Fighting Falcon is a one-engine multirole combat aircraft. It was originally designed and built by General Dynamics, which is now owned by Lockheed Martin. The MA is a Block 40E F-16C aircraft first delivered to the USAF on 30 July 1990. It was assigned to the 555 FS located at Aviano Air Base, Italy on 30 September 2000 and remained at all times permanently assigned to that squadron. On 17 November 2023, it was involved in a mishap at the UL while temporarily deployed to the 332 AEW. The aircraft last flew on 10 November 2023 and was configured to fly a return flight back to Aviano Air Base, with no scheduled flight date. (Tab D-22). The aircraft was configured with two 370-gallon external fuel tanks, a AN/ALQ-131 electronic countermeasure pod, two MXU-648-EA travel pods, a AN/AAQ-33 Sniper Advanced Targeting Pod (ATP) and two Inert AIM-120B Captive Air Training Missiles. The post flight inspection from the last fly day was completed on 10 November 2023 and its most recent inspection was a walk-around-inspection dated 14 November 2023. (Tab D-22). The MA had a fuel load of 11,700lbs, consistent with a standard full fuel load for the aforementioned configuration. (Tab D-23).

Damage sustained to the MA was extensive, but contained to the right, front side of the aircraft. The impact point from the MMJ-1 was to the right external 370-gallon fuel tank's forward section. This impact resulted in an immediate fire with extensive aircraft panel, bulkhead, and internal line damage. (Tab S-7).

(2) F-16 Wing Tank (370 Gallon)

The external fuel tank sub-subsystem offers additional fuel storage capability for extended flight and consists of right and left-wing tanks. These tanks hold 370 gallons (2,000lb) each and are attached to a non-jettisonable fuel pylon mounted on an F-16's underwing hardpoints. The external fuel tank transfers fuel to the wings upon demand. The right-side fuel tank was full at the time of the mishap with approximately 370 gallons of jet fuel. The right-side tank was damaged from the impact of MMJ-1 and destroyed in the subsequent fire. The front top portion of the tank was melted off during the fire and was non-recoverable. (Tab S-7).

(3) F-15E Wing Tank (610 Gallon)

The external fuel tank of the F-15E (T/N 91-0335) is an external mounted drop tank. A drop tank is expendable and often capable of being jettisoned. Each external, under-wing tank can carry 610 gallons (4,092lbs) of jet fuel. The tank involved in the incident was mounted on the underside of the left wing on the station 2 hardpoint. The MMJ-1 traveled underneath the tank and the only contact to the tank was made by MXLC2's body. No damage to the fuel tank was sustained. (Tab R-26, R-55).

(4) F-15E Sniper Pod

The Lockheed Martin Sniper Pod is a targeting pod for military aircraft that provides positive target identification, autonomous tracking, GPS coordinate generation, and precise weapons guidance from extended standoff ranges. The system has been designated by the U.S. military as the Sniper Advanced Targeting Pod (ATP), AN/AAQ-33. The Sniper Pod (S/N 10691) involved in the mishap was mounted on the F-15E's (S/N 91-0335) left engine intake hardpoint. Due to impact from MMJ-1, it sustained an external scratch traveling the length of the Sniper Pod on the outboard left side surface. The damage came from the table assembly on the MMJ-1 as it traveled underneath the F-15E (T/N 91-0335). (Tab S-4).

(5) F-15E Tire and Wheel Assembly

The main landing gear wheel assembly on the F-15E is a Goodyear tire mounted on a single web, ring retained flange, forged aluminum wheel. MMJ-1 struck the main part of the tire in the reverse position leaving a scuff on the black rubber portion of the tire, but no serious damage. (Tab S-5).

(6) MJ-1 B/C

The MJ-1 B/C Aerial Stores Lift Truck "jammer," "weapons loader," or "bomb lift," manufactured by Hydraulics International, Inc., in Chatsworth, California, is a lift truck used to transport, lift, and attach bombs, fuel tanks, pylons, and aerial stores weighing up to 3000 lbs. The mishap MJ-1 B/C (MMJ-1) failed to stop moving in reverse and collided with the MA, resulting in a fire and subsequent damage and destruction of the entire jammer. (Tab Z-6 to Z-8). Though the MJ-1 B/C model and MJ-1C model jammers are very similar, there are some major differences between them, including a different location of the brake pedal. (*Figure 2*, item 2). The distance between the brake pedal and the accelerator pedal in the MJ-1B/C model is 11 inches. The distance between the brake pedal and accelerator pedal in the MJ-1C model is 1 inch. (Tab EE-16).

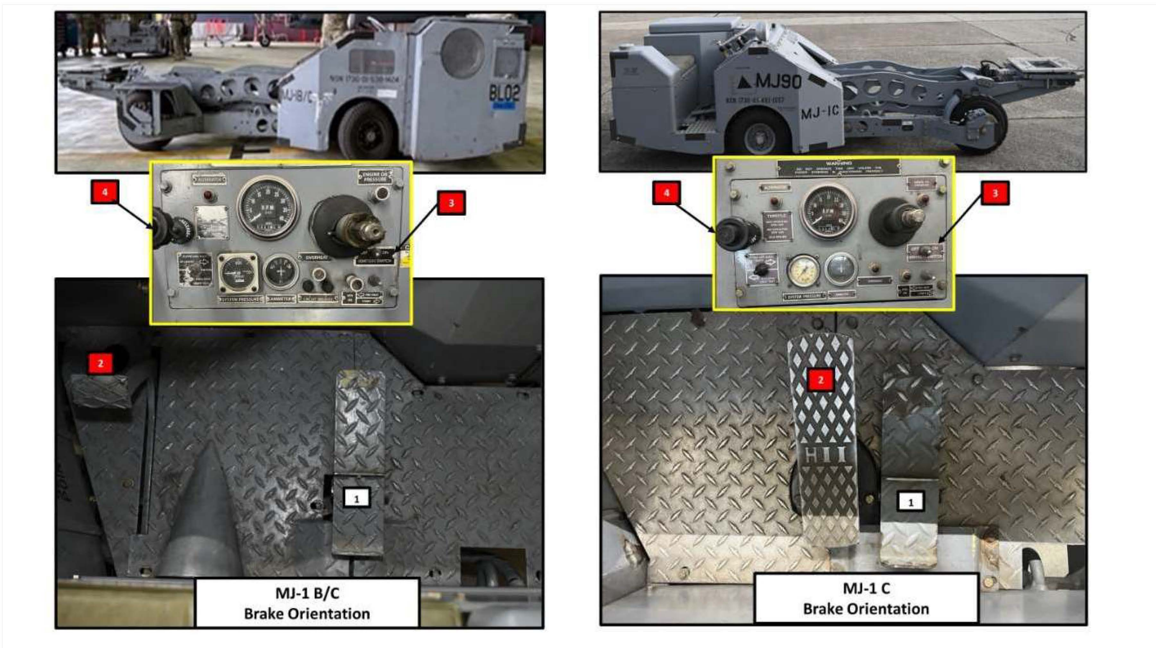

FIGURE 2
1. Accelerator Pedal 2. Brake Pedal 3. Ignition Switch 4. Throttle

(7) MJ-1B/C Centering Mechanism

The MJ-1B/C utilizes a hydrostatic drive (*Figure 3*, item 1) for propulsion. An accelerator pedal (*Figure 3*, item 9) moves linkages (*Figure 3*, item 8) connected to the swash plate of a hydrostatic pump. (*Figure 3*, item 5). When the pedal is pressed, the swash plate is articulated to provide hydraulic flow to a hydraulic motor connected via drive shaft to the rear wheels. (Tab J-7). A spring-loaded device known as the centering mechanism, part number 201219025-01, is designed to move the swash plate back to a neutral position when the operator removes his or her foot from the accelerator pedal. (Tab J-7). The internal reservoir of the centering mechanism is filled with MIL-PRF-83282, or equivalent, hydraulic fluid and is self-contained. The exterior of MMJ-1's centering mechanism was completely burnt, as were the inner parts after they were removed from the centering mechanism body. The mishap centering mechanism did not contain any MIL-PRF-83282, which would have been burned off from the fire. (Tab J-36).

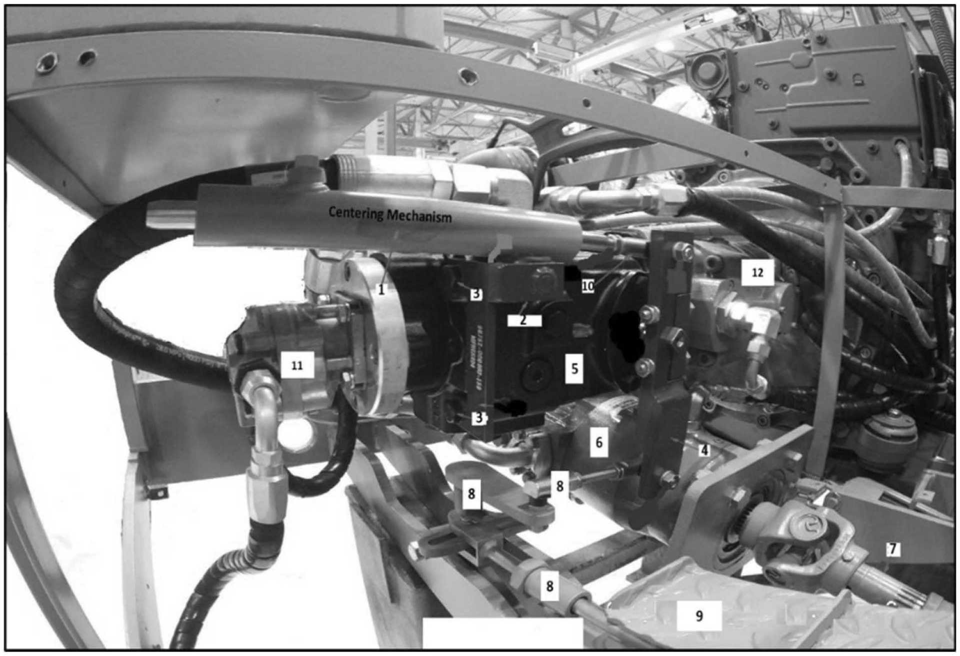

FIGURE 3
1. Centering Mechanism 2. Bracket-Centering Mechanism 3. Bracket Bolts w/safety wire holes 4. Lever- Centering Mechanism 5. Hydrostatic Pump 6. Hydrostatic Drive 7. Driveshaft 8. Linkage 9. Accelerator Control 10. Ball Joint 11. Steering Pump 12. Piston Pump

(8) MJ-1 B/C Hydro Static Assembly

The drive system of the bomb lift consists of the diesel engine, hydrostatic pump, hydrostatic motor, and an automotive-type steering mechanism. Power from the engine is transmitted to drive the rear wheels by means of a hydrostatic drive system. This consists of a fluid coupling between the engine and differential. A variable displacement hydrostatic pump is connected to the engine, and a fixed displacement hydrostatic motor is connected to the differential. The hydrostatic pump draws fluid from the hydraulic reservoir tank and directs the fluid at high pressure to the hydrostatic motor which is coupled to the differential by a conventional drive shaft. The amount of fluid delivered from the pump to the motor controls how fast the bomb lift moves. The flow rate of the pump can be varied by changing the engine speed with the throttle control and with the accelerator pedal, which changes the stroke (displacement) of the pistons within the pump. Forward and reverse directions are controlled by the driver by actuation of the directional control lever to the right of the instrument panel. A mechanical linkage between the hydrostatic pump and the operator's directional control varies the position of the pump's swashplate to direct the fluid going to the hydrostatic motor to cause the lift truck to move forward, reverse, or stay in neutral. When the drive control on the instrument panel is pushed forward and the accelerator pedal is fully depressed, the stroke of the pistons within the pump are at their maximum stroke output, and the bomb lift will travel at its maximum speed. When the drive control is centered, there is no stroke of the pistons within the pump and the lift truck does not move regardless of engine speed. When the drive control is pulled back, the direction of fluid flow is reversed, and the lift truck moves in reverse. By combination of engine speed and displacement control, the lift truck is capable of a speed of approximately 15 miles per hour in forward or reverse. Generally, the normal operating speed of the engine should be adjusted between 1500 and 1800 RPM with the throttle, and lift truck speed controlled by the accelerator pedal. (Tab FF-23).

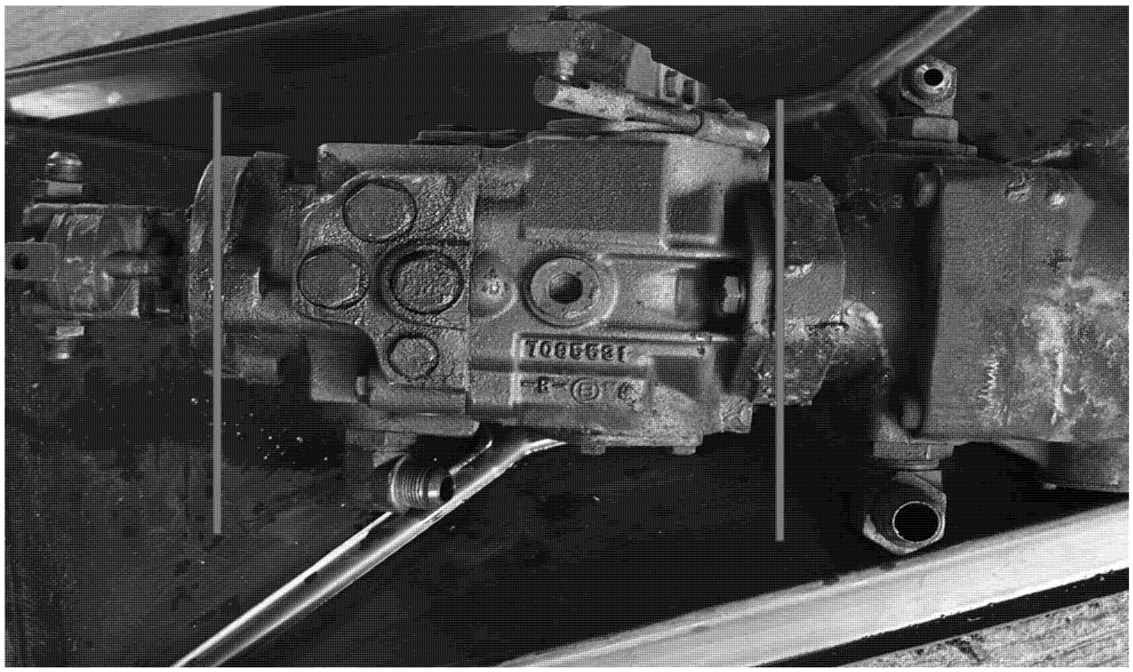

FIGURE 4
Hydrostatic Pump

(9) Toolbox

Aerospace Propulsion General (APG) Consolidated Toolkit (CTK) is a multi-use, moveable flightline toolbox. The APG CTK is manufactured by Snap-On Tools International LTD. The APG CTK involved in the mishap was in service with the 494th EFGS and was fully functional and structurally sound. This APG CTK was positioned off the left wingtip of the F-15E (T/N 91-0335) and was struck by MMJ-1 before it proceeded to hit the MA, but it did not sustain any damage. (Tab R-55, S-10 to S-11, T-9).

b. Evaluation and Analysis

(1) Analysis of Centering Mechanism and Brake Cylinder

The MMJ-1's centering mechanism and brake master cylinder were analyzed by the Accelerated Materials and Processing Solutions Branch (AFRL/RXNS) Materials and Manufacturing Directorate, located at Wright-Patterson Air Force Base, Ohio. The centering mechanism and brake master cylinder were cut open to reveal their internal condition using an end mill without coolant. The position of the centering mechanism at the time of the mishap corresponds to the reverse direction. At the time of the mishap, the centering mechanism was determined to be at least three quarters full of a hydrocarbon-based fluid with a phosphorus bearing compound, such as MIL-PRF-83282 (hydraulic fluid). Transferred copper-zinc material on the steep shaft indicated adhesive wear between the split collars and the shaft that could lead to binding, and thus a failure of the centering mechanism to return the MMJ-1 to neutral when the accelerator pedal was not engaged. Some other minor discrepancies were noted with the centering mechanism unit, but they were not determined to have contributed to the mishap. (Tab J-3 to J-13).

The analysis of MMJ-1's master brake cylinder revealed that the cylinder had rust-colored deposits on most of the internal surfaces, which suggests it may not have had sufficient hydraulic fluid in it at the time of the fire. However, a functional brake check, such as the one required by TO 35D3-2-25-11 WP 006 for normal operations, would readily identify low fluid levels in the brake cylinder. Debris consistent with the environment was also found within the brake cylinder, though the analysis did not determine this debris contributed to the mishap. Computed tomography and pressure testing of the brake cylinder revealed the brake cylinder was not otherwise compromised. (Tab J-10 to J-13).

Hydraulics International, Inc. also evaluated the centering mechanism for potential causes of binding. This analysis determined that lack of lubrication and/or environmental deterioration, or a combination of the two, could potentially cause the centering mechanism to fail during driving operations and cause an "un-commanded movement situation." (Tab J-34 to J-38).

(2) Analysis of Hydrostatic Drive Pump

The MMJ-1's hydrostatic drive pump was analyzed by the Science and Engineering Laboratory, Materials Engineering Flight, at Hill AFB, Utah. The laboratory observed the control lever of the hydrostatic drive pump was severely restricted in movement, which was determined to be the result of heavy corrosion related to debris buildup inside the pump and more particularly in the piston assembly. (Tab FF-10 to FF-22). Gritty debris observed in the cylinder block and on the pistons was also determined to have restricted piston movement. The analysis suggested that corrosion had been going on for quite some time in MMJ-1's hydrostatic drive pump, and water in the lubricating fluid was a common cause of the observed corrosion. (Tab FF-21). Ultimately, the laboratory determined malfunctions in the hydrostatic drive pump were attributed to water in the hydraulic fluid, which resulted in severe corrosion of several internal components. As corrosion progressed, particles flaked off and resulted in a buildup of gritty debris in some areas of the pump which hindered movement, fluid flow, and could have significantly impeded swashplate rotation. (Tab FF-21). Despite severely restricted movement in the control lever and heavy corrosion, there was no obvious damage detected which would have indisputably halted movement of the swashplate control lever. (Tab FF-21).

However, the laboratory analysis did find that a check-ball within the drive pump's rear spacer had impacted the inner surface of the rear adapter flange, leaving a noticeable indent on the surface.

(Tab FF-7). (*Figure 5*). This check-ball is free floating and designed to relieve pressure inside of the drive pump. (Tab FF-28). An inspection of a new, unused hydrostatic drive pump by AIB members found the surface of the rear adapter flange to be smooth and without indent. (Tab FF-28). The indent to the adapter flange in MMJ-1's hydrostatic drive pump was determined to face to the right, rear of the jammer. (Tab FF-28). The maximum pressure inside of the drive pump is 1800 pounds per square inch, which would not be sufficient to cause the indent in MMJ-1's adapter flange mating surface. (Tab FF-28).

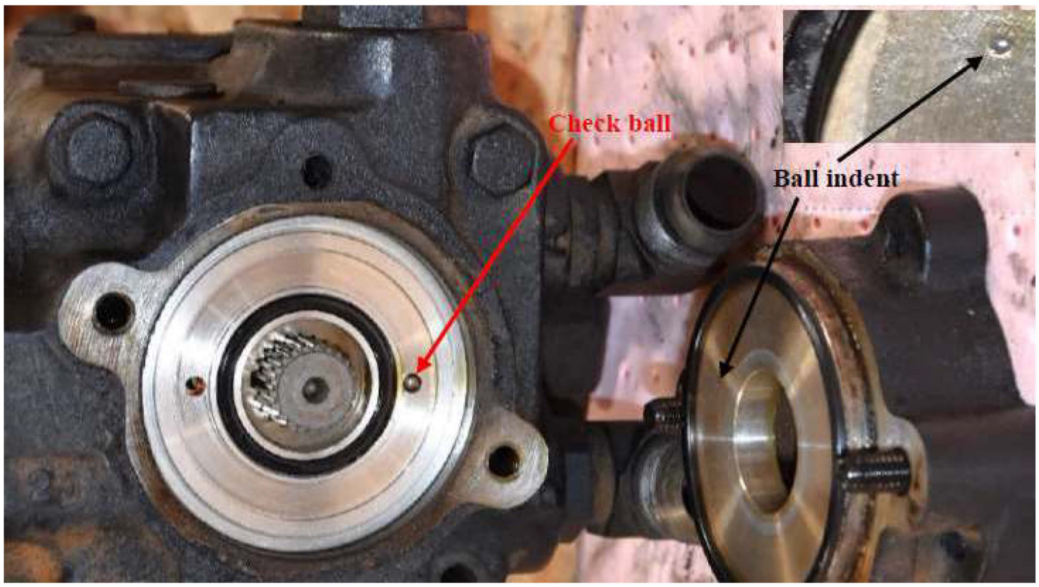

FIGURE 5
Rear Spacer Rear Adapter Flange

The main control lever on a new, unused hydrostatic drive pump was also moveable with minimal pressure. (Tab FF-28 to FF-29). It could be moved by hand between forward, neutral, and reverse smoothly and with only a small amount of force. (Tab FF-28 to FF-29). The pistons of the new, unused hydrostatic drive pump also moved within the cylinder block housing smoothly and with extreme precision, indicating an exact engineering fit. (*Figure 6*). The same hydraulic fluid that was present throughout the hydrostatic drive pump was found to lubricate the pistons and their movement in the cylinder block. (Tab FF-29).

FIGURE 6
Pistons in Cylinder Block (New Unit) **Pistons after Cylinder Block Removed (MMJ-1)**

(3) Analysis of Hydraulic Oil

The MMJ-1's hydraulic fluid was analyzed by the Science and Engineering Laboratory, Materials Engineering Flight, at Hill AFB, Utah. The analysis showed extremely elevated levels of particulate and contamination in MMJ-1's hydraulic fluid. The particle count per 100 milliliters of MMJ-1's hydraulic fluid was analyzed to fall within the most contaminated, or dirtiest, measurement level represented in the Society of Automotive Engineers' standard for classification of particle contamination in oils and fluids. (Tab FF-26 to FF-27). Specifically, for particles smaller than 100 µm, the laboratory analysis showed that MMJ-1's hydraulic fluid registered at a class 12. (Tab FF-26). For particles larger than 100 µm, the laboratory analysis showed that MMJ-1's hydraulic fluid registered at a class 9. (Tab FF-26). Such corrosion, caused by water within the hydraulic system, was found to cause malfunctions within the hydrostatic pump drive, hindering movements and fluid flow. (Tab FF-22).

7. WEATHER

a. Forecast Weather

The weather conditions at the time of the mishap (2200L-2300L) were forecasted to be 14° Celsius (57° Fahrenheit) with winds variable at 6 knots. Skies were forecasted to be clear with 7 statute miles of visibility and no significant weather conditions. (Tab F-5).

b. Observed Weather

The observed weather at 2155L was 18° Celsius (64° Fahrenheit) with winds variable at 6 knots. Skies were clear with smoke or ash present in the air with 9000 meters (5.6 miles) of visibility and no other significant weather. (Tab F-7 to F-8).

c. Space Environment

Not applicable.

d. Operations

The MA was not flying at the time of the mishap. It was parked on a ramp at the UL, unmanned and unarmed. (Tab T-3 to T-10). All ground operations were conducted within the prescribed operational weather limitations. (Tab F-5 to F-7). Weather had no relevant impact on operations or the mishap.

8. CREW QUALIFICATIONS

a. Mishap Pilot

The MA was not flying at the time of the mishap. It was parked on a ramp at the UL, unmanned and unarmed. (Tabs S-8, T-3 to T-10).

9. MEDICAL

a. Qualifications

All members of the weapons load crew were Personnel Reliability Program (PRP) certified and medically qualified to perform their responsibilities. MXLC2 was PRP certified on 01 April 2021. MXLC1 was PRP certified on 01 June 2022. MXLC3 was PRP certified on 30 November 2022. (Tab DD-4).

b. Health

At the time of the mishap, the operator of MMJ-1, MXLC2, suffered small abrasions to both legs, left arm, occiput of head, and larger abrasions to left back. (Tab DD-3). Blood and urine toxicology analysis were negative for illegal drugs or substances in MXLC2's system at the time of the mishap. (Tab G-56). MXLC2's medical history was negative for any conditions or diagnoses contributory to the mishap. (Tab DD-3). A review of the medical histories for both MXLC1 and MXLC3 were also negative for any conditions or diagnoses contributory to the mishap. (Tab DD-5).

c. Pathology

Not applicable to this mishap.

d. Lifestyle

There is no evidence to suggest lifestyle factors were a factor in the mishap.

e. Crew Rest and Crew Duty Time

MXLC1, MXLC2, and MXLCL3 worked as a crew and at the time of the mishap were on day 4 of a 4-day rotation work shift. All three worked 12-hour shifts. MXLC2 reported adequate rest during proceeding days to the mishap. (Tab G-10 to G-17).

10. OPERATIONS AND SUPERVISION

a. Operations

At around 1835L on the day of the mishap, 17 November 2023, maintenance personnel were informed an F-15E (T/N 91-0335), which was originally scheduled for a 2300L takeoff time, was rescheduled for a 0030L takeoff time and had a new munitions load requirement. (Tabs R-63, R-79, R-84 to R-85, EE-4, EE-14). Based on this new takeoff time, the time the aircrew planned to proceed, or "step," to the aircraft changed to 2330L. At approximately 2100L, the mishap weapons load crew began downloading munitions on the F-15E. (Tabs R-63, R-78 to R-79, R-84 to R-85). Prior to downloading operations, MXLC3 attempted to use an MJ-1 jammer with serial number MJ-40, located between barriers D6 and D7 (*Figure 1*), but quickly realized this unit would not start. (Tabs R-84, T-6, T-9, S-9, V-1.4). MXLC3 then found another MJ-1 jammer (SN unknown) nearby and was able to successfully download several munitions off the F-15E. (Tabs R-78, R-84, R-86, V-1.4 to V-1.5). During removal of these munitions from the F-15E, MXLC3 encountered some abnormal gear shifting issues with the second MJ-1 and decided to find another MJ-1 jammer. (Tabs R-78, R-84 to R-86, V-1.4 to V-1.7). MXLC3 drove the second jammer to another part of the flightline and replaced it with MMJ-1 (SN 23), which had recently been used by another load crew to upload 2 pylons to another aircraft. (Tabs R-78 to R-79, R-84 to R-86, V-1.5).

MXLC3 returned with MMJ-1 to the F-15E and proceeded to finish removing the remaining several munitions from the F-15E. (Tabs R-78 to R-79, R-84 to R-86, V-1.4 to V-1.7). When completed, MXLC3 parked MMJ-1 facing the recently removed munitions and approximately 12 feet away from the nose of the F-15E. (*Figure 1*) (Tabs T-10, V-1.18). MXLC3 reported no mechanical issues with MMJ-1 while driving MMJ-1 or removing several munitions from the F-15E. (Tabs R-84, V-1.16 to V-1.17). MXLC3 then proceeded to join MXLC1 and ammunition personnel at a trailer carrying new munitions that was parked nearby between barrier D6 and D7 (*Figure 1*). (Tabs R-84 to R-85, V-1.8 to V-1.9, T-6). At approximately 2200L, MXLC1 directed MXLC2 to reposition the MMJ-1 closer to the trailer in order to help speed the loading of the new munitions. (Tabs O-4, R-55, V-2.4). MXLC2 started the MMJ-1 without issue, placed MMJ-1 in reverse, and initiated a reverse turn towards the F-15E in order to make room to then drive MMJ-1 forward. (Tabs R-26, R-41 to R-42, R-55, R-67). Approximately 5 feet into the reverse turn, MXLC2 determined the MMJ-1 would not stop despite attempting to apply the brakes. (Tabs R-26, R-41 to R-42, R-55, R-67). As a result, MMJ-1 drove under the F-15E's left side intake, impacting the sniper pod, and hitting his back and head on the bomb rack unit (BRU) of the F-

15E. (*Figure 1*) (Tabs R-26 to R-27, R-41 to R-41, R-55, R-67, V-2.4). This impact to the BRU resulted in MXLC2 being pinned face forward on the MMJ-1's dash. (Tab R-26 to R-27). MMJ-1 then impacted the left main landing gear tire, where it changed directions went under the left external wing, striking a toolbox and ejecting MXLC2 from the MMJ-1 seat. (Tabs R-26 to R-27, R-67, T-9, V-2.4 to V-2.5). MMJ-1 then proceeded to travel approximately 71 feet unmanned, ultimately striking the MA. (*Figure 1*) (Tabs R-57, R-69, T-9, V-2.4 to V-2.5).

Despite the belief by all members of the load crew that the replacement of munitions on the F-15E was required earlier than originally anticipated, the mishap load crew had approximately 4 hours to complete the reconfiguration prior to aircrew "stepping" to the F-15E. (Tabs EE-4, EE-14). Regardless, the load crew reported that operations tempo was not a factor in this mishap. (Tab R-62 to R-63).

b. Supervision

Despite four hours to complete the reconfiguration on the F-15E, MXLC1 fostered an environment in which the entire load crew felt they needed to complete the aircraft reconfiguration sooner than anticipated. (Tab R-26, R-63). This desire to speed up the load operations led to MXLC1 directing MXLC2 to operate the MMJ-1, even though driving jammers was not his role on the weapons load crew team, and he was not proficient. (Tab R-41 to R-42, R-63, V-2.22 to V-2.24).

11. HUMAN FACTORS ANALYSIS

a. Introduction

The Department of Defense Human Factors Analysis and Classification System 7.0 (DoD HFACS 7.0) lists potential human factors that can play a role in aircraft mishaps and identifies potential areas of assessment during an accident investigation. (Tab BB-3). Having this systematic approach enables investigation boards to better classify variables that could affect human performance. The taxonomy classifies potential factors into either active failures or latent failures. Active failures are actions (or inactions) by the individual that are causative or contributory to the mishap. Latent failures are conditions that exist within a supervisory or organizational level. The three identified factors listed below represent human factors that contributed to the mishap. (Tab BB-3). The following human factors were identified as relevant to the mishap:

b. AE102 Checklist Not Followed Correctly

HFACS code AE102 is applicable when the individual, either through an act of commission or omission, makes a checklist error or fails to run an appropriate checklist. (Tab BB-8).

MXLC2 failed to properly follow the emergency shutdown procedures of the mishap jammer. (Tab R-49).

c. PC 104 Confusion

HFACS code PC104 is applicable when the individual is unable to maintain a cohesive and orderly awareness of events and required actions, and they experienced a state characterized by a lack of understanding, clear thinking or a misperception of the situation, which resulted in the hazardous condition or unsafe act. (Tab BB-11 to BB-12).

MXLC2 failed to maintain orderly awareness as he operated MMJ-1 in close proximity to the F-15 and lacked clear thinking after he realized MMJ-1 was not stopping as expected. (Tabs R-55, V-2.4).

d. SI008 Selected Individual with Lack of Current or Limited Experience

HFACS code SI008 is applicable when a supervisor or leader inadvertently tasks an individual whose fluency or expertise did not match skills required for safe execution of the task, system, or mission; or whose familiarity with a task or process was either not current or limited by infrequent or rare performance and resulted in hazardous conditions or unsafe acts. (Tab BB-24).

By directing MXLC2 to move MMJ-1, MXLC1 selected an individual with limited and non-current experience. MXLC2 had not operated a MJ-1 weapons loader for at least 3 months prior to the mishap and driving weapons loaders was not his primary duty. (Tab R-41).

12. GOVERNING DIRECTIVES AND PUBLICATIONS

a. Publicly Available Directives and Publications Relevant to the Mishap

(1) AFI 51-307, *Aerospace and Ground Accident Investigations*, dated 18 March 2019
(2) AFI 51-307 USAFE-AFAFRICA Supplement, *Aerospace and Ground Accident Investigations*, dated 14 October 2020
(3) AFI 21-101, USAFE-AFAFRICA Supplement, *Aircraft and Equipment Maintenance Management*, 25 August 2020
(4) AFMAN 36-2100, *Military Utilization and Classification*, dated 7 April 2021

NOTICE: All directives and publications listed above are available digitally on the Air Force Departmental Publishing Office website at: https://www.e-publishing.af.mil.

b. Other Directives and Publications Relevant to the Mishap

(1) TO 35D3-2-25-11, *Operation & Maintenance Instructions with Illustrated Parts Breakdown*, dated 16 February 2020 (incorporating change 13 dated 4 December 2023)
(2) TO 35D3-2-16-16WC-1, *Periodic Inspections Work Cards*, dated 8 July 2021
(3) TO 35D3-3-8-36WC-1, *Service Inspection Work Cards*, dated 9 July 2017, (incorporating change 5 dated 25 January 2023)
(4) TO 35D3-2-25-4, *Illustrated Parts Breakdown*, dated 2 November 2023

(5) TO 00-20-1, *Aerospace Equipment Maintenance Inspections, Documentation, Policies, and Procedures*, dated 11 July 2016
(6) LOTI 332-L332301, *One-Time Inspection of Truck, Lift, Aerial Stores Transmission Control Mechanism Assembly and Accelerator Mechanism*, dated 19 November 2023

c. Known or Suspected Deviations from Directives or Publications

(1) TO 35D3-2-25-11, Procedural Task WP 006 00, *Emergency Shutdown Procedures*, Step 9. This technical order provides the emergency shutdown procedures for a weapons loader and states during an emergency an operator must 1) depress brake pedal, 2) push the throttle cable all the way in, and 3) place the ignition switch in the off position. MXLC2 did not attempt to push the throttle cable in or place ignition switch to the off position prior to hitting the F-15E or being thrown off MMJ-1. (Tab D-4).

(2) TO 00-20-1, Procedural Task 7.5, *Support Equipment Document Administration*, AFTO Form 244. This technical order requires maintainers to properly document the status, condition, and any discrepancies that are discovered on a piece of equipment on the AFTO 244. On several occasions, maintenance members at the mishap location did not document known discrepancies on the AFTO Form 224 or within IMDS, and instead used a running email to document critical discrepancies on their jammer fleet (Tab EE-3, EE-17 to EE-18).

(3) TO 35D3-3-16-16WC-1, Procedural Task, all known or suspected deviations are addressed in Opinion Summary, paragraph 3, item a. (Tab D-3). All assigned jammers at the UL had severe corrosion issues, despite all assigned jammer's annual corrosion inspections being signed off as complete in IMDS. (Tab D-10).

(4) DAFI 21-101 "*Aircraft Equipment and Maintenance Management*" paragraph 4.5.4.5.1. The AGE flight at the UL did not properly maintain records, including on AF Form 244 or in IMDS. In some, but not all cases, maintenance issues were documented in a turnover email log left between shifts. (Tab EE-3, EE-17 to EE-18).

16 JULY 2024

ROBERT B. BLAKE, Colonel, USAF
President, Accident Investigation Board

STATEMENT OF OPINION

F-16C, T/N 89-002023
UNDISCLOSED LOCATION
17 November 2023

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 17 November 2023, at approximately 2200 local time (L), a weapons loader (MXLC2) got on the mishap MJ-1 B/C weapons loader (MMJ-1), also known as a "jammer" or bomb lift, to reposition it so his weapons load crew could begin uploading munitions to a nearby F-15E fighter aircraft (T/N 91-0335). At the time MXLC2 started MMJ-1, it was parked approximately 12 feet from the F-15E and facing towards munitions that had recently been removed from the F-15E. (*See Figure 1*). After starting MMJ-1, MXLC2 placed it in reverse and drove the MMJ-1 to the left towards the F-15E. This was in an effort to allow room to then drive MMJ-1 forward towards a trailer carrying new munitions. MXLC2 was moving MMJ-1 at the request of his team chief (MXLC1) so it could be used to upload new munitions to the F-15E aircraft. After traveling approximately 5 feet backwards, MXLC2 reported not being able to stop the MMJ-1 from moving in reverse.

MMJ-1 proceeded to hit the F-15E's sniper pod (*Figure 1, item 2*) and left center main landing gear tire (*Figure 1, item 1*). After impacting the landing gear, the MMJ-1 changed its course of direction, hit a toolbox (*Figure 1, item 3*), and MXLC2 was thrown from MMJ-1. MMJ-1 continued to travel without a driver at a high rate of speed towards the parked Mishap Aircraft (MA), F-16C, S/N 89-002023. MMJ-1 impacted the MA on the right external fuel wing tank, causing the tank to rupture and leak fuel onto the still running MMJ-1 (*Figure 1, item 4*). The MA's external wing fuel tank and MMJ-1 tank quickly caught fire resulting in total damage of the MMJ-1 and significant damage to the MA.

I find by a preponderance of the evidence that the cause of the mishap was MXLC2's loss of situational awareness and failure to properly apply emergency shutdown procedures. The impact of MMJ-1 to the F-15E's landing gear then more likely than not caused the hydrostatic drive pump to fail and stick in the reverse position, thus forcing the MMJ-1 to continue traveling even after MXLC2 was thrown off MMJ-1. This failure of the hydrostatic drive pump prevented the centering mechanism, which itself was compromised by corrosion, from pulling the control lever on the hydrostatic pump back to neutral. This failure was more likely than not caused by the significant force from the impact of MMJ-1 to the F-15E's landing gear tire, combined with the degraded condition of both the centering mechanism and hydrostatic drive pump.

I also find by preponderance of the evidence two additional factors substantially contributed to the mishap. First, inadequate maintenance documentation at the undisclosed location (UL) for the assigned MJ-1 fleet contributed to a failure to identify and remedy problems with the centering mechanism or hydrostatic drive assembly prior to this mishap. Second, failure to ensure routine servicing maintenance of the MJ-1 fleet at the UL led to a premature failure of components in the hydrostatic drive pump and centering mechanism, despite the impact of MMJ-1 to the F-15E's landing gear.

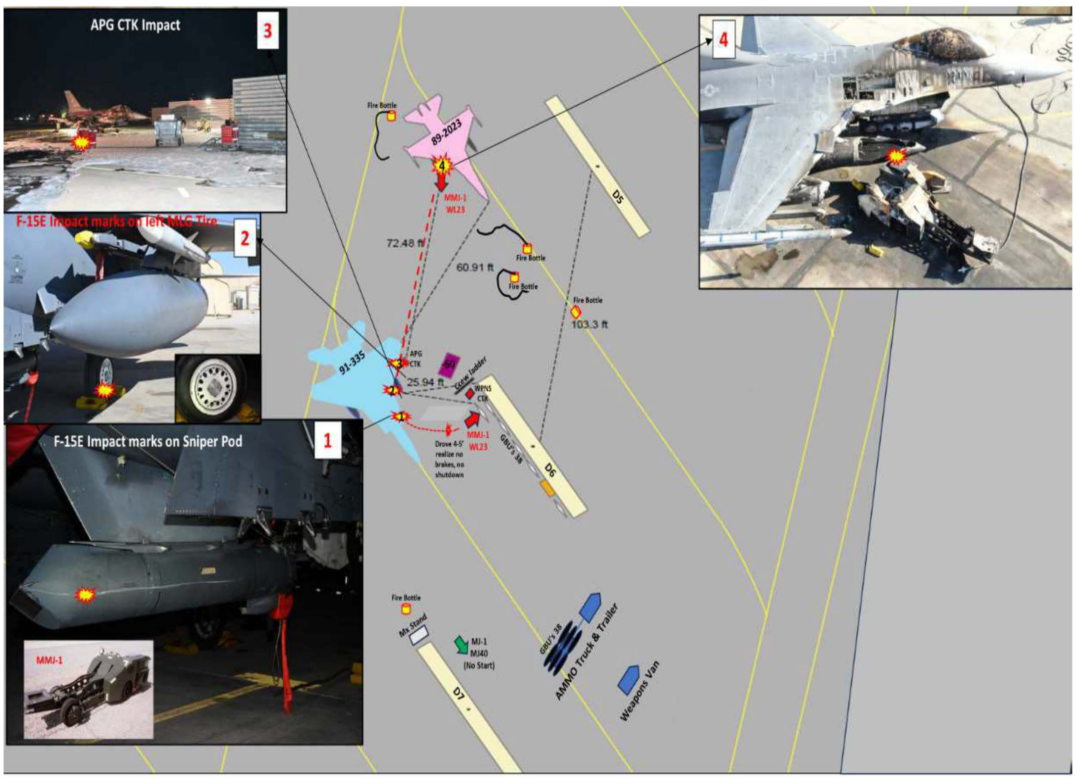

FIGURE 1

I developed my opinion by carefully considering the standard of proof for a preponderance of the evidence. I analyzed the wreckage of MMJ-1, all available maintenance records, photographs, videos, technical and engineering reports, training records, weather records, witness testimony, Air Force Technical Orders (TO), Air Force Instructions and other applicable guidance.

2. CAUSE

I find by the preponderance of the evidence the cause of the mishap was MXLC2's loss of situational awareness and failure to properly apply emergency shutdown procedures of MMJ-1. The evidence also shows MMJ-1 impacted the F-15E's left main landing gear tire at a high rate of speed, which resulted in the hydrostatic drive pump failing or sticking in the reverse position. This resulted from substantial corrosion and debris within the hydrostatic assembly, to include the pistons, cylinder block, bearings, swashplate, and hydraulic fluid. This malfunction resulted in the centering mechanism (*Figure 2, item 1*) being unable to return the control lever of the hydrostatic pump (*Figure 2, item 4*) to the neutral position, as designed, which would have stopped MMJ-1. This meant the hydrostatic pump swashplate continued to direct hydraulic fluid to the hydrostatic drive in the reverse operating position, even though MMJ-1 was unmanned and un-commanded. As a result, MMJ-1 continued driving in reverse for over 70 feet and into the MA. At the time of the mishap and the resulting fire, the MMJ-1's hydrostatic pump transmission lever (*Figure 2, item 4*) was in the reverse position and not in the neutral position as it should have been after MXLC2 was thrown from the jammer.

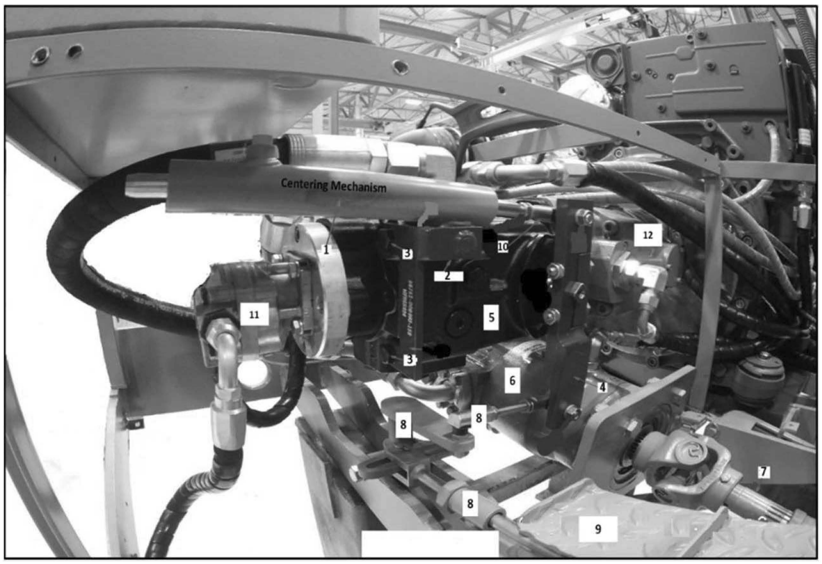

FIGURE 2

1. Centering Mechanism 2. Bracket-Centering Mechanism 3. Bracket Bolts w/safety wire holes 4. Lever- Centering Mechanism 5. Hydrostatic Pump 6. Hydrostatic Drive 7. Driveshaft 8. Linkage 9. Accelerator Control 10. Ball Joint 11. Steering Pump 12. Piston Pump

The preponderance of the evidence demonstrations that MXLC2 lost situational awareness when he began to operate MMJ-1 in close proximity to the F-15E. When MXLC2 began to move MMJ-1 in reverse toward the F-15E, it was parked at most 12 feet away from the F-15E. (*Figure 3*) When MXLC2 reported an inability to stop the jammer, MMJ-1 was at most 8-12 feet from the F-15E's sniper pod, the point of first impact to the F-15E. (*Figure 3*) Based on the likely speed of MMJ-1 at this point in time, MXLC2 had approximately 3 to 5 seconds with which to react and initiate emergency shutdown procedures before he was pinned under the bomb rack unit of the F-15E and became further disoriented. (*Figure 3*). The sole eyewitness stated that MXLC2 panicked, and MXLC2 also acknowledged this to be the case.

Immediately prior to MXLC2's operation of the jammer, MMJ-1 has been previously used without mechanical issue by another member of the load crew to download munitions from the F-15E. MMJ-1 had also been used, without issue, by a different load crew to successfully load pylons to another aircraft shortly before the mishap. Technical analysis of MMJ-1's centering mechanism and hydrostatic pump did not reveal evidence of an immediate or unprompted catastrophic failure. Technical analysis of the braking system also revealed no evidence of failure.

MXLC2's loss of situation awareness more than likely included misjudging the distance to the F-15E and mistaking the model of MJ-1 jammer he was operating. The brake and the accelerator pedal are 11 inches apart on the MJ-1B/C model, meaning the brake pedal would normally only be engaged by the left foot. On an MJ-1C model, the brake and accelerator pedal are only 1 inch apart and both pedals are engaged by the right foot. It is more likely that MXLC2 mistook the placement of the brake pedal on the model of jammer he was operating than that MMJ-1 had a sudden catastrophic failure of brakes, centering mechanism, and hydrostatic drive pump. This means it is more likely than not that MXLC2 was engaging the accelerator pedal when he thought he was engaging the brake pedal. This is supported by eyewitness testimony that MMJ-1 "jerked back" and accelerated backwards. This is also supported by the fact that at the time of the mishap, MXLC2 had not operated a MJ-1 jammer for three months, and it was not his primary role on the weapons load crew. MXLC2 also could not remember which model of MJ-1 he was operating at the time of the mishap. Though he was properly trained to operate the B/C and C model of the MMJ-1, he was not proficient. Witnesses also confirmed that the weapons load crew was attempting to change the munitions configuration on the F-15E under quicker than anticipated time constraints.

Additionally, MXLC2 failed to properly apply emergency shutdown procedures when he realized MMJ-1 was not stopping as expected. Despite the short timeline between believing the brakes were not working and his body impacting the F-15E bomb rack unit, MXLC2 did not follow proper procedures to implement an emergency shutdown in accordance with Technical Order 35D3-2-25-11 WP 006 00, page 17. These procedures require operators faced with an emergency, such as when the accelerator pedal is non-responsive to commands or fails to return to the neutral position, to: (a) depress the brake pedal; (b) push the throttle cable all the way in, effectively killing the output of the hydrostatic pump and drive, and (c) place the ignition in the off position. I find by a preponderance of the evidence that each of these steps would have prevented MMJ-1 from continuing to travel in the reverse direction and eventually impacting the MA.

After recognizing he could not stop MMJ-1, rather than follow the correct emergency shutdown procedures, MXLC2 attempted to engage the MMJ-1's parking brake, which would not stop MMJ-1 without the brake pedal also being properly engaged. In the 3 to 5 seconds that MXLC2 had to react, rather than push the throttle cable all the way in or hit the ignition switch, it is more likely than not that MXLC2 continued to unwittingly press on the accelerator pedal when he thought he was depressing the brake. The preponderance of the evidence discovered demonstrates that had MXLC2 properly engaged any of the three emergency shutdown options, MMJ-1 would have stopped prior to MXLC2 being thrown from the jammer and impacting the MA.

I further find by a preponderance of the evidence that the impact of MMJ-1 to the F-15E's landing gear more likely than not caused the hydrostatic drive pump to stick and fail in the reverse position, thus propelling MMJ-1 toward the MA without a driver. This is supported by the indentation found from the check ball to the hydrostatic pump's rear adapter flange mating surface, indicating significant impact to the unit. The extreme rigidity of MMJ-1's hydrostatic drive pump control lever also indicates that significant and extensive corrosion caused the pistons, cylinder block, bearings, and swashplate to lock up and fail in the reverse operating position after the impact.

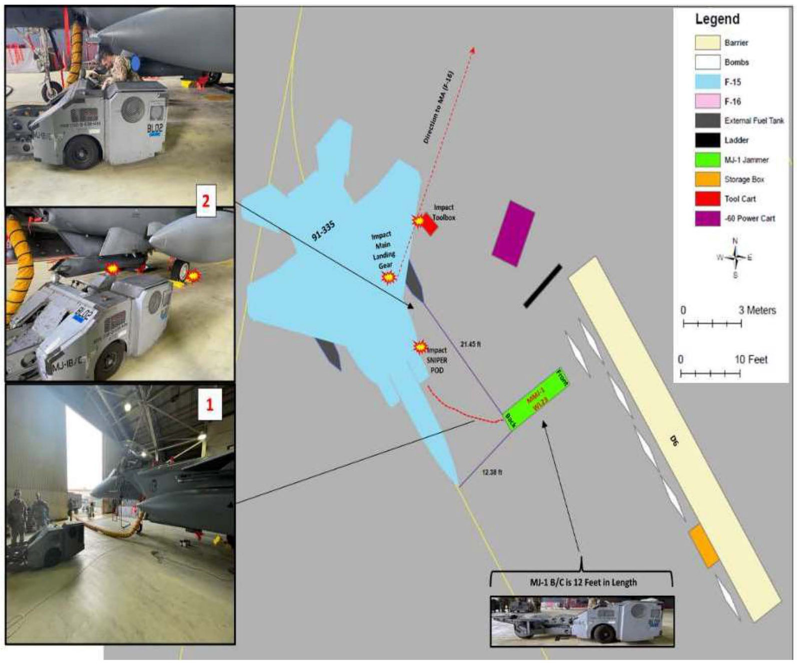

FIGURE 3

3. SUBSTANTIALLY CONTRIBUTING FACTORS

I find by a preponderance of the evidence that two factors substantially contributed to the mishap: (a) lack of proper documentation for the assigned MJ-1 fleet at the UL; and (b) a loose culture of adherence to Air Force standards and technical procedures by maintainers at the UL.

a. Lack of Documentation for Assigned MJ-1 Fleet

I find by a preponderance of the evidence that failures to properly document reported discrepancies on the MJ-1 fleet assigned at the UL contributed to a failure to identify and remedy problems with the centering mechanism or hydrostatic pump prior to this mishap. This lack of proper documentation made it impossible to conclusively determine what, if any, maintenance discrepancies MMJ-1 had prior to the mishap. At the same time, it also removed the ability for weapons loaders, including MXLC3, to know about such discrepancies prior to operating MMJ-1, or for such discrepancies to be properly remedied prior to the mishap. On the first of three jammers MXLC3 used prior to the mishap sequence, no action was taken to document a known discrepancy on the AFTO From 244. Also, no action was taken to document a known forward-to-reverse mechanical discrepancy on the second jammer used by MXLC3 prior to the mishap. During the investigation, five maintenance members interviewed failed to document known discrepancies on the MJ-1 fleet, as each assumed these were being documented by others on the Air Force Form 244 or being reported to the Aerospace Ground Equipment (AGE) Flight for repair.

During my investigation, it was clear the filing system and proper use of AFTO Form 244's was inadequate and indicative of a breakdown in DAFI 21-101, *Aircraft Equipment and Maintenance Management*, paragraph 4.5.4.5.1. Ultimately, no digital records exist on MMJ-1 and evidence shows that MJ-1 jammers that arrived at the UL's maintenance work area were not properly documented within IMDS or via turnover email log. I find the preponderance of the evidence shows inadequate maintenance documentation and a lack of local written policy to ensure MJ-1's are returned to the AGE shop for proper preventative maintenance, which may have contributed to an inability to remedy mechanical problems with the centering mechanism and hydrostatic pump on the MMJ-1.

b. Loose Culture of Adherence to Air Force Standards and Technical Procedures

Similarly, I believe a loose culture of adherence to Air Force standards and technical procedures also played a role in this mishap. Multiple instances were discovered of improper maintenance procedures, uncompleted TCTOs, and a willingness to pass equipment from inspections despite readily apparent deficiencies. Four jammers were discovered without safety wire installed on the centering mechanism bracket assembly in accordance with published TCTO 35D3-2-25-541 and TCTO 35D3-3-8-558. This was despite those jammers undergoing 332 EMXS's post-mishap Local One Time Inspection (LOTI) on 21 November 2023 to verify the proper operation of the acceleration pedal by performing a centering mechanism adjustment check. Each jammer passed inspection with no defects noted and were marked serviceable.

Furthermore, TO 35D3-2-16-16WC-1 and TO 35D3-3-8-36WC-1 contain several steps and checks to identify corrosion issues, loose hardware, linkages, and filters, as well as to perform operational checks to ensure MJ-1's are serviced with proper fluids and functioning properly. However, it was very evident all assigned jammers at the UL had severe corrosion issues, despite all assigned jammer's annual corrosion inspections being signed off as complete in IMDS with very little attempt to mitigate or properly document corrosion related discrepancies. Loose adherence to technical procedures is further supported by laboratory analysis of the master brake cylinder and centering mechanism showing signs of environmental debris in the hydraulic component's inner diameter walls as well as their check valves showing signs of insufficient fluid at the time of the fire. The laboratory analysis of MMJ-1's hydraulic fluid and hydrostatic pump also showed extremely high levels of contamination and corrosion within the hydrostatic assembly. Though not a primary cause of this mishap, these oversights contributed to the premature failure of the hydrostatic drive pump and centering mechanism, even after MMJ-1's impact to the F-15E. Specifically, it is more likely than not the presence of water and debris in the hydraulic system caused premature degradation in the hydrostatic drive pump assembly, and contributed to MMJ-1 continuing in the reverse position after it impacted the F-15E's left main landing gear.

Failure to ensure routine servicing maintenance of the MJ-1 fleet at the UL would lead to premature failure of components or shorten the life expectancy of these critical components, especially in an austere environment. At the same time, routine and proper servicing actions would have helped increase the reliability and durability of the centering mechanism and hydrostatic pump. As such, I find by a preponderance of the evidence the lack of adherence to Air Force standards and technical procedures played an important role that contributed to this mishap.

4. CONCLUSION

After a comprehensive investigation into this mishap, I find by a preponderance of the evidence the cause of the mishap was loss of situational awareness and confusion by MXLC2, who misjudged the model of MJ-1 he was operating and the distance to the F-15E aircraft behind him. This led to MXLC2 panicking and mistakenly engaging the accelerator pedal when he thought he was engaging the brake pedal. MXLC2 also failed to properly apply emergency shutdown procedures on the MMJ-1. The combination of these errors led to MMJ-1 impacting the F-15E's left main landing gear tire at a high rate of speed. This impact resulted in the failure of MMJ-1's hydrostatic drive pump and made the centering mechanism unable to retract the pump's control lever to the neutral position and thus bring MMJ-1 to a stop. As a result, the hydrostatic pump continued to propel MMJ-1 in reverse even though unmanned. This ultimately caused MMJ-1 to impact the MA, resulting a fuel leak and subsequent fire.

16 JULY 2024

ROBERT B. BLAKE, Colonel, USAF
President, Accident Investigation Board

INDEX OF TABS