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UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	Docket No. 72-22-ISFSI
	)	
PRIVATE FUEL STORAGE, LLC	)	ASLBP No. 97-732-02-ISFSI
(Independent Spent Fuel	)	
Storage Installation)	)	February 19, 2002

STATE OF UTAH'S PREFILED TESTIMONY OF COLONEL HUGH HORSTMAN (U.S.A.F. RET.) FOR CONTENTION UTAH K/CONFEDERATED TRIBES B

The State of Utah has two direct case witnesses for Contention Utah K: Lieutenant Colonel Hugh Horstman (U.S.A.F. Ret.) and Dr. Marvin Resnikoff. As directed in the Board's Prehearing Memorandum and Order dated December 26, 2001, the State has prepared Key Determinations for Contention Utah K as well as a Preface to each set of prefiled testimony. The Key Determinations and preface and prefiled testimony of Dr. Resnikoff are being filed separately but concurrently with this filing.

Filed herewith is the pre-filed testimony of Lt. Colonel Hugh Horstman, consisting of the following:

1. Preface to Prefiled Testimony of Lt. Colonel Hugh Horstman (U.S.A.F. Ret.).

3. Prefiled Testimony of Lt. Colonel Hugh Horstman (U.S.A.F. Ret.).

4. Index to Exhibits of the Prefiled Testimony of Lt. Colonel Hugh Horstman (U.S.A.F. Ret.).

Template = SECY-055

SECY-02

5. Exhibits to the Prefiled Testimony of Lt. Colonel Hugh Horstman (U.S.A.F. Ret.) consisting of State Exhibit Nos. 38[1] through 69.

DATED this 19th day of February, 2002.

Respectfully submitted,

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[1] Numbering continues from the last State exhibit number introduced at the June 2000 hearing.

CERTIFICATE OF SERVICE

I hereby certify that a copy of STATE OF UTAH'S PREFILED TESTIMONY OF COLONEL HUGH HORSTMAN (U.S.A.F. RET.) FOR CONTENTION UTAH K/CONFEDERATED TRIBES B was served on the persons listed below by electronic mail (unless otherwise noted) with conforming copies by United States mail first class, this 19th day of February, 2002:

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STATE OF UTAH'S PREFACE TO PREFILED TESTIMONY OF COLONEL HUGH HORSTMAN (U.S.A.F. RETIRED) FOR CONTENTION UTAH K

I. Qualifications of Lt. Colonel Horstman (Retired U.S.A.F.)

A. 20 years and 2,500 hours as a USAF pilot, 1,000 hours as navigator, retired June,1999.
B. Over 800 hours as F-16 pilot, 1,000 hours as F-111 pilot.
C. F-16 instructor pilot, instructor navigator, aviation instructor for AF officers.
D. Deputy Commander of 388th Operations Group, Hill AFB, Oct 1997-June, 1999.
  1. Commanded F-16 Operations Group, flying15,000 sorties per year.
  2. Managed UTTR airspace and sorties flown in the UTTR.
E. Flew over 150 F-16 training missions in the UTTR.
  1. Including air to air combat, ordnance bombing, low level, night vision goggle.
  2. Responsible for assessing pilot performance including emergency procedures.
F. Commanded first Air Expeditionary Force squadron in Europe with F-16s, F-15s.
G. Currently a commercial 737 pilot and aviation instructor for master degree candidates.

II. Flight path direction and width of airspace used by F-16s transiting Skull Valley.

A. F-16s typically fly through Skull Valley in formations of 2 or 4 aircraft, not singly.
B. In a 2 ship formation, the aircraft are spaced 1.5 to 2.0 miles "line abreast," *i.e.* width.
C. A 4 ship formation ranges in width from just over 1.5 miles to just under 4.0 miles.
D. Most F-16 flights fly through Sevier B MOA at 3,000 feet AGL, flying north to south down the middle of Skull Valley, with the formation passing over or near the PFS site.
  1. The width of the Sevier B MOA at the PFS facility latitude is 12 miles.
  2. The Stansbury mountains extend approximately 3 miles into the east side of the Sevier B MOA at 3000 feet AGL.
  3. Formations maintain a 2 mile distance from the Stansburys on the east and a 1 mile distance from the MOA/restricted airspace boundary on the west, resulting in a usable airspace width of approximately 6 miles.
  4. Formations extend towards the center of the 6 mile usable airspace resulting in most aircraft flying in a corridor of less than five miles in width.

III. Speed, altitude and missions flown in Skull Valley.

A. Typical speed through Skull Valley is 400-450 knots indicated air speed ("KIAS").
  1. Pilots practice G awareness exercises through Skull Valley at 400-450 KIAS.
  2. Speeds less that 400 KIAS are not typical, and less than 350 KIAS are unusual.
B. Altitude range is1,000 to18,000 feet AGL, most commonly flown at 3,000 feet AGL
C. F-16s fly training missions in Skull Valley that are considered high risk, including
  1.low level night training, G awareness turns, terrain masking and tactical turning.
  2.Flights may be under visual or instrument flight rules.

IV. Number of sorties flown through Skull Valley annually.

A. This table is presented in the Revised Addendum to PFS Crash Report (July 20, 2001):

FY	Sevier B MOA	Sevier D MOA	Total
FY1998	3,871 sorties	215 sorties	4,086 sorties
FY1999	4,240 sorties	336 sorties	4,576 sorties
FY2000	5,757 sorties	240 sorties	5,997 sorties

B. F-16 flights in Skull Valley include flights through Sevier B and Sevier D MOAs, and above the Sevier D MOA.
C. The most recent data presented, the FY2000 total of 5,997 sorties is not indicative of the rate for future sorties.
D. Twelve additional F-16s have been assigned to Hill AFB which will increase the sorties proportionally, resulting in a 17.4% increase, or 7,040 annual Skull Valley sorties.
E. 7,040 sorties is low - it does not account for the trend of increasing annual sorties

V. Crash rate for F-16s transiting Skull Valley.
A. Crash rates are higher at the beginning and end of the service life of a fighter aircraft.
B. The F-16, flown since 1975, will be replaced by the Joint Strike Fighter in about 2009.
C. The average F-16 crash rates for all years will best predict the crash rate for its replacement during the 40 year life of the proposed PFS facility.

VI. Lack of basis to quantify pilot's ability to avoid aircraft impact with PFS facility.
A. No statistics or studies published on pilot's ability to avoid ground site before ejecting.
B. Air Force Safety advisory in1996 notes "erroneous assumptions," "poor airmanship," and "inappropriate performance" in ejection decisions and during in-flight emergencies.
C. Four pilots who have ejected from fighters all stated they were focused on survival and that they did not consider aircraft or ordnance impact location before ejecting.
D. No factual basis for PFS's assignment of probability (95%) that pilot could locate and avoid PFS facility before ejecting in an emergency.

1. PFS did not base estimate on reported accidents where pilot took such action
2. PFS subjectively and incorrectly estimated pilot would have time to avoid facility.

VII. Impacts from ordnance.
A. F-16s transiting Skull Valley may carry two MK-84, 2,000 lb. bombs; probability of MK-84 penetrating PFS storage cask/canister determined by Air Force to be 0-50%.
B. RIA response (5/31/01), p.12-16, notes 77% decline in MK-84s carried in FY00 from FY98; FY00 is anomalous because decrease was due to training for interception/drug traffic not requiring ordnance; current training tactics require more sorties to carry ordnance than in FY00.
C. PFS's estimate of ordnance carried based on FY2000 is not realistic or conservative.

VIII. Flights on the Moser Recovery Route ("MRR").
A. Air Force Headquarters has issued a memorandum dated July 18, 2001, advising that of the total sorties in MOAs, approximately one third will be night sorties.
B. The MRR is flown at night by sorties returning from the UTTR South Area, which includes sorties transiting Skull Valley.
C. The realistic number of sorties flying the MRR could be 33% of the sorties returning from UTTR South Area.

XI. PFS Analysis of F-16 Accident Reports Inappropriately Excludes Many Factors.
In addition to inappropriately using "able to avoid," PFS incorrectly assesses the phase of flight and excludes accidents caused by midair collisions, G induced loss of consciousness, bird and lightning strikes and poor visibility.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

BEFORE THE ATOMIC SAFETY AND LICENSING BOARD

In the Matter of:	)	Docket No. 72-22-ISFSI
PRIVATE FUEL STORAGE, LLC	)	ASLBP No. 97-732-02-ISFSI
(Independent Spent Fuel Storage Installation)	)	February 19, 2002

STATE OF UTAH'S PREFILED TESTIMONY OF LIEUTENANT COLONEL HUGH HORSTMAN (U.S.A.F. RETIRED) REGARDING CONTENTION UTAH K/CONFEDERATED TRIBES B

I. BACKGROUND AND QUALIFICATIONS

Q. 1: Please state your name and residence.

A. 1. My name is Hugh Horstman. I live in Layton, Utah.

Q. 2: By whom are you employed and what is your position?

A. 2. I am currently a Boeing 737 pilot for Southwest Airlines as well as an Adjunct Professor at Embry Riddle Aeronautical University, where I instruct masters degree candidate students in aviation.

Q. 3: Please describe your professional background.

A. 3. I have more than 20 years experience as a pilot in the U.S. Air Force with over 2,500 hours as a pilot and over 1,000 hours as a navigator. I have over 1,800 hours flying F-16 and F-111 fighters. I was an instructor pilot for both the F-16 and F-111 fighter aircraft and, in addition, an instructor navigator. I also taught masters level aeronautical courses to Air Force officers for Embry Riddle Aeronautical University while I was in the Air Force. I earned a B.S. degree in business from the University of Southern California and a M.A. degree in business from Central Michigan University. A copy of my curriculum vitae is included with this testimony as State's Exhibit 38.

Q. 4: Please describe your background with respect to the Utah Test and Training Range.

A. 4. From October 1997 through June 1999, I served as Deputy Commander, 388th Operations Group, Hill Air Force Base, Utah. In this position, I commanded the F-16 Operations Group and 1,500 personnel. The Operations Group was responsible for the administration of all 388th Fighter Wing flying activity, including the sorties flown in the Utah Test and Training Range ("UTTR") airspace. The Operations Group was also responsible for managing the UTTR air space and for managing the three fighter squadrons stationed at Hill Air Force Base. In addition, I was responsible for the flight line maintenance of all 60 F-16C aircraft assigned to the 388th Fighter Wing.

From June 1993 through September 1997, I was stationed at Spangdahlem Air Base, Germany. I served as Deputy Commander of the 52nd Support Group, Chief of the 52nd Fighter Wing Readiness, and Assistant Operations Officer of the 22nd Fighter Squadron. As

Assistant Operations Officer, I was, in part, responsible for ensuring that all F-16 pilots in my fighter squadron were combat ready and fully trained. As Chief of Fighter Wing Readiness, part of my responsibility included preparing training scenarios for 100 F-16s, F-15s, and A-10s and serving as a flight instructor. As Deputy Commander of the Support Group, I served as a flight instructor in addition to my other duties.

Q. 5: Please describe your familiarity with the UTTR.

A. 5: I flew over 150 training missions in the UTTR during the twenty months I was stationed at Hill Air Force Base ("AFB") and I am intimately familiar with the UTTR land and air space, including its various military operating areas ("MOAs"). I flew an average of two training missions per week while stationed at Hill AFB. In addition, while stationed at Hill AFB I was responsible for planning training missions and instructing F-16 pilots. I flew training missions as an instructor pilot, as a flight lead, and as a mission commander. In those capacities I was responsible for assessing individual pilot performance on various tasks, including emergency procedures. I was qualified to fly and did fly all missions out of Hill AFB, including air-to-air combat missions, air-to-ground combat missions (*e.g.*, precision ordinance bombing), low level training missions, targeting pod, and night vision goggle missions.

II. PURPOSE OF TESTIMONY AND DOCUMENTS REVIEWED

Q. 6: Are you familiar with Contention Utah K and what is your understanding of the issues remaining in Utah K?

A. 6: Yes, I am familiar with Utah K. I have been assisting the State on this issue since 2000. The remaining issues in Utah K concern the probability and extent of damage from aircraft crash impact at the proposed Private Fuel Storage, L.L.C. ("PFS") facility from F-16 aircraft transiting Skull Valley, F-16 and other aircraft conducting air-to-air training exercises on the UTTR, F-16 aircraft returning to Hill AFB from the UTTR via the Moser Recovery Route ("MRR"), military aircraft flying in military airway IR-420 to and from Michael Army Airfield, and crash impacts from military ordnance.

Q. 7: What is the purpose of your testimony?

A. 7: The purpose of my testimony is to provide expert opinions and otherwise testify concerning the extent and nature of F-16 and other military flights in the UTTR and Skull Valley, and the characteristics of the F-16 aircraft and the capabilities of F16 pilots as those issues relate to the proposed PFS facility and Contention Utah K. My testimony includes matters relating to the number of flights in the vicinity of the PFS facility; the nature of the flights and their missions; the weather encountered in the area; pilot performance in emergency situations, such as ejection; the F-16 crash rate; the purpose and interpretation of mishap reports and their unreliability as future predictors of whether pilots can avoid a specific ground site; and whether assumptions and values relied on by PFS in connection with its analysis of impacts from aircraft crashes are correct and conservative.

Q. 8: Are you familiar with the PFS license application filed in this proceeding and the proposed location of the PFS facility?

A. 8: Yes. I understand that PFS plans to build a large facility to store commercial spent nuclear fuel from reactors located across the country, and to store the spent nuclear fuel in concrete storage casks located on concrete pads and exposed to view. I am generally familiar with the rough dimensions of the facility and the size and material of the storage casks. Furthermore, having flown numerous training missions over Skull Valley, I am very familiar with the proposed location of the PFS facility – the northwest corner of the Skull Valley Reservation.

Q. 9: What documents have you reviewed with respect to this contention?

A. 9: I have reviewed PFS's license application to include pertinent sections of the *Safety Analysis Report* ("SAR") and subsequent SAR revisions dealing with "Hazards From Air Crashes." I have reviewed Revision 2 dated June 6, 2000, Revision 3 dated June 17, 2000, and Revision 4 dated August 10, 2000 of PFS's *Aircraft Crash Impact Hazard Report* ("Crash Report"), and Addenda thereto (dated January 19, 2001 and July 20, 2001). I have also reviewed the applicable portions of NRC's final *Safety Evaluation Report* (September 29, 2000) and the *Supplemental Safety Evaluation Report* (November 13, 2001). I am generally familiar with NRC regulations and guidance documents relating to the calculation of aircraft hazards, including NUREG-0800. I have reviewed the U.S. Air Force Accident Investigation Reports for F-16s obtained by the State from PFS. Further, I have reviewed various data, manuals, directives, and memoranda issued by the U.S. Air Force, including F-16 crash rates, F-16 procedural manuals, and SAFECOM directives. I have also reviewed weather related data from Michael Army Airfield located at Dugway Proving Ground, Utah. Further, I have reviewed the Air Force instruction on preparing accident reports, specifically AF Instruction 51-503, *Aircraft, Missile, Nuclear, and Space Accident Investigations*.

In addition, I have reviewed the Applicant's Motion for Summary Disposition of

Utah Contention K and Confederated Tribes Contention B – Inadequate Consideration of Credible Accidents ("Utah K") filed December 20, 2000, including the Joint Declaration of James Cole, Wayne Jefferson, and Ronald Fly (Joint Declaration, State's Exhibit 39), and the declaration of Stephen A. Vigeant. I have also reviewed the deposition transcripts of State expert witness Dr. Marvin Resnikoff and PFS witnesses James Cole and Ronald Fly. I was present at the deposition of PFS witness, Ronald Fly. I have reviewed Dr. Resnikoff's pre-filed testimony in this matter and various other related documents.

III. F-16 AIRCRAFT TRANSITING SKULL VALLEY

A. The nature of the airspace and the aircraft flights above Skull Valley.

Q. 10: Please describe the UTTR air space and the military activities that occur within the air space.

A. 10: The UTTR or Utah Test and Training Range, located in Utah's west desert, is comprised of both an on-ground training range and training airspace. *See* State's Exhibit 40, map showing a portion of the UTTR. The UTTR range and the UTTR airspace are defined by different boundaries. Skull Valley is located below the UTTR airspace while the UTTR South range is defined by on-the-ground boundaries that do not include Skull Valley.

The UTTR airspace is the largest overland special use airspace in the continental United States and the largest overland safety footprint available to the U.S. Department of Defense. *See* State's Exhibit 41, UTTR Capabilities Guide excerpt at 3. The UTTR is a unique and valuable asset to the U.S. military, and its continued use as a military training and testing area is vital to military training and the national security of the United States.

The Sevier B Military Operating Area is part of the UTTR airspace over Skull Valley. *See* State's Exhibit 42, Annual Military Operating Area Usage Report for Sevier B MOA. Military low altitude training, air-to-air combat training, major exercises, and cruise missile testing are authorized and conducted in this airspace. *See also* Exh. 40, and State's Exhibit 43, Map of IFR Enroute Low Altitude - U.S., effective May 20, 1999, showing locations of Sevier B and D MOAs.

Portions of Sevier D MOA are also part of the UTTR airspace over Skull Valley. *See* State's Exhibit 44, Annual Military Operating Area Usage Report for Sevier D MOA; *see also* State's Exh. 43. Major exercises and cruise missile testing are authorized in the Sevier D MOA.

Additionally, the portions of the UTTR airspace over the UTTR range are designated "restricted airspace." *See* Map, State's Exh. 40. Airspaces designated as R-6402 and R-6406, located near the proposed PFS facility, are authorized for air-to-ground bombing, air-to-air training, and major exercise deployment in the restricted UTTR airspace. *See* State's Exhibit 45, Separate Annual Military Operating Area Usage Reports for R-6402A, R-6402B, and R6406, dated November 30, 1998.

Q. 11: Please describe the boundaries of the Sevier B MOA and their locations relative to the proposed PFS facility.

A. 11: The Sevier B MOA begins at an elevation of 100 feet above ground level and extends to 9,500 feet above mean sea level (approximately 5,000 feet above ground level). *See* State's Exh. 42. The proposed PFS facility is located under the Sevier B MOA.

Q. 12: Please describe the boundaries of the Sevier D MOA and their locations relative to the proposed PFS facility.

A. 12 The Sevier D MOA begins at an elevation of 9,500 feet mean sea level (approximately 5,000 feet above ground level) and extends to Flight Level 180 (approximately 13,750 feet above ground level). *See* State Exh. 43. The proposed PFS facility is located under the Sevier D MOA.

Q. 13: Please describe the boundaries of the UTTR restricted airspace and their locations relative to the proposed PFS facility.

A. 13: The proposed PFS facility will be located two miles from restricted airspaces R-6402 and R-6406. *See* Crash Report at 28.

Q. 14: Do you have an opinion on whether the U.S. Air Force will continue to use the UTTR airspace and if so, what is your opinion?

A. 14. Yes, it is my opinion the U.S. Air Force is likely to continue its present use or increase its use of the UTTR airspace, including the airspace over Skull Valley. *See also* State's Exhibit 46, Statement by Utah First District Congressman, Representative James V. Hansen, Limited Appearance Session, Salt Lake City, June 23, 2000, Tr. 13-17.

Q. 15: What F-16 formations are flown in Skull Valley?

A. 15: Typically, F-16s fly in two or four aircraft formations. Each formation is led by a flight leader. The positions of the aircraft vary depending upon the selected formations. In a two ship formation, the wingman would fly 1.5 to 2 miles, line abreast, from the flight leader at a position 0 to 10 degrees aft (or "abeam") of the leader's flight path.

In a four ship formation, a wingman would fly 1.5 to 2 miles line abreast from the flight leader. Those two aircraft (lead and wingman) comprise the "lead element." Two additional aircraft with similar line abreast spacing to the lead element will follow 2 to 15 miles behind the lead element. One of the aircraft in the back element will be located between the horizontal spacing of the lead element (2 to 15 miles back). The back element will be offset from the lead element to the left or right wing. Thus, a four ship formation may vary from just over 1.5 to just under 4 miles in horizontal width and over 2 to 15 miles long.

Q. 16: What is the typical flight path for F-16s transiting Skull Valley?

A. 16: Most flights are in the Sevier B MOA. Due to the flight path from Hill AFB and the physical layout of Skull Valley, a flight will enter Skull Valley heading in a southwest to south direction, and will then turn south to southeast. Thus, the natural and typical flight path of an F-16 formation is essentially down the middle of Skull Valley with part of the formation flying over or near the proposed PFS site, because the formation must maintain a safe distance from the Stansbury Mountains to the east and restricted airspace to the west.

Q. 17: Describe the width of the Sevier B MOA airspace used by F-16s at the latitude of the proposed PFS facility site.

A. 17: The Sevier B MOA is 12 miles wide at the latitude of the proposed PFS facility site, as shown by State's Exhibit 47, Figure one of the PFS Crash Report. The Stansbury Mountains encroach approximately 3 miles into the Sevier B MOA at the latitude of the PFS facility, eliminating the most easterly 3 miles of the MOA airspace. The flight leader will select a flight path to allow the furthest east aircraft in the formation to retain a sufficient distance (generally two miles) from the Stansbury Mountains. Therefore, the furthest east ship in a formation will be 5 miles from the eastern boundary of the Sevier B MOA.

The flight leader will also select a path to allow the furthest west aircraft in the formation to keep a one mile distance from the western boundary of Sevier B MOA, beyond which is restricted airspace. Therefore, the width of the Sevier B MOA airspace over the PFS facility that is actually used by F-16s extends from a point one mile east of the western boundary of the MOA to a point 5 miles west of the eastern boundary of the MOA, or a width of approximately 6 miles. Within this 6 mile width of usable airspace, F-16s fly in 2 or 4 ship formations which are from 1.5 to just under 4 miles wide. With one ship in the formation flying at either the east or west edge of the usable airspace, the remaining ships in the formation would be inward from the edges of the usable airspace. Therefore, the majority of F-16 flights in Sevier B MOA are in a corridor less than five miles wide located within the 6 mile width of usable airspace. The airspace I have described is illustrated in State's Exhibit 48 as an overlay to Figure One of the Crash Report.

Q. 18: The PFS Crash Report states that the predominant route of F-16s transiting Skull Valley is along the edge of the Stansbury Mountains "approximately 5 statute miles east of the PFS site." Is that statement consistent with your testimony that F-16s fly over the proposed PFS facility site within a corridor less than 5 miles wide?

A. 18: As I testified in my foregoing answer, the maximum width of the Sevier B MOA airspace over the PFS facility site that is actually usable is approximately 6 miles wide. The eastern edge of that usable airspace at the latitude of the PFS facility is five miles west of the eastern boundary of the Sevier B MOA, and is also 5 miles east of the PFS facility site. Therefore, the F-16 "route" described by the PFS Crash Report is approximately the same as the eastern boundary of the usable airspace that I have described. Consequently, with formations of 2 to 4 ships where the furthest east ship is flying five miles east the PFS facility site, all aircraft would be within the six mile usable airspace that I described. Also, all ships except the one furthest east in the formation would be inward from the eastern edge of that airspace. Thus, most F-16s would be in a corridor of less than five miles in width, consistent with my testimony.

However, I do not agree that F-16 formations would predominately use a flight path where the furthest east ship is approximately 5 miles east of the PFS facility site. Although such a flight path is within the 6 miles width of usable Sevier B MOA airspace, the actual flight path is dependent upon the flight training mission and flight leader. Based on my personal experience, F-16 formations are just as likely to use other portions of that usable airspace.

Q. 19: Will there be any change in the flight path of F-16s through Skull Valley if the proposed PFS facility is built?

A. 19: If the PFS facility is built, F-16s will continue to fly in a corridor of less than 5 miles wide as I have described, but they will fly in greater concentration over or near the PFS facility site. This is because many pilots will use the PFS facility on clear or cloudy days as a turning or navigation point because of its finite features. A turning or navigation point is used to update the aircraft's internal navigation system. During this process a pilot essentially points the aircraft at the navigation point, in this case, the PFS facility. Pilots update their navigation equipment during each training mission before entering the UTTR.

Pilots also use turning points to map out a flight path, and pilots practice using turning points on every mission. As a result, more F-16s will fly directly over the PFS facility site if the facility is built.

Q. 20: What type of flights are flown through Skull Valley?

A. 20: F-16s originating from Hill Air Force Base regularly transit Skull Valley using the Sevier B MOA or the Sevier D MOA en route to the UTTR South Area range. F-16s conduct low altitude training in Skull Valley, and practice terrain masking using either the Stansbury Mountains to the east or the Cedar Mountains to the west. F-16s may also perform G awareness turns, clearing turns, tactical turning maneuvers, aircraft orientation, fence checks, systems calibration checks, visual navigation radar updates, or turning points while transiting Skull Valley.

Q. 21: Please describe "low altitude training" that occurs in Skull Valley.

A. 21: A pilot conducting low altitude training typically flies from 1,000 to 2,000 feet above ground level ("AGL"). Low altitude training may occur at lower altitudes. I have conducted low altitude night training ("LANTIRN") at levels of 500 to 600 feet above ground level through Skull Valley.

Q. 22: Please describe "terrain masking."

A. 22: Terrain masking is the use of a geological feature, such as mountains, to prevent radar detection of the aircraft by flying below the ridge line of the feature. The position of F-16s in Skull Valley during terrain masking is dependent upon the hypothetical location of the radar. The hypothetical location of the radar varies with each training mission and flight. I have used both the Cedar Mountains and Stansbury Mountains to conduct terrain masking exercises while transiting Skull Valley. Thus, my terrain masking flight paths through Skull Valley have occurred over the eastern, middle and western portions of the valley.

Q. 23: Please describe "G awareness turns," "tactical turning maneuvers," and "clearing turns."

A. 23: In performing a G awareness turn, a pilot would perform a 90 degree turn at approximately a four G force, roll out, then perform another 90 degree turn back to the original heading. A G awareness turn is performed to test the pilot's physical capability to encounter G forces.

A tactical turning maneuver is performed at tactical airspeeds while in a formation. Tactical turns are aggressive turns at 3 to 4 Gs, designed to be as brief as possible. In a tactical turn the wingman's position relative to the flight leader must be achieved as quickly as possible after completion of the turn. The purpose of the tactical turn is for each flight member to provide visual mutual support to other flight members for as much time as possible. Flight members that are positioned behind or directly above are not able to provide visual mutual support.

A clearing turn is a less aggressive maneuver than a tactical turn. Clearing turns may be performed in formation or by a single aircraft. A clearing turn is designed to "clear" the visual flight path of the aircraft.

Q. 24: Are the F-16 flights conducted over Skull Valley considered "low risk"?

A. 24: No. Because of the speed, altitude and nature of the missions flown in Skull Valley, they would be considered "high risk"activities, although of a lower risk than combat activities.

Q. 25: At what altitudes do F-16s fly through Skull Valley?

A. 25: F-16s most commonly fly through Skull Valley at 3,000 feet AGL in the Sevier B MOA but may fly in or above the Sevier B MOA up to 18,000 feet AGL. I often flew above the upper boundary of Sevier B MOA when transiting Skull Valley. The altitude of F-16s transiting through Skull Valley is dependent upon the decision of the flight leader and the specific training mission. Based on my personal experience, F-16s fly over Skull Valley at altitudes ranging between 500 to 18,000 feet AGL, although flights below 1,000 feet AGL are now limited.

Q. 26: Please describe the terms "visual flight rules" and "instrument flight rules"?

A. 26: For a pilot to fly under visual flight rules ("VFR"), a pilot must have at least 5 miles of visibility in front of the aircraft. In addition, the aircraft must be "clear of clouds" which means that the aircraft must be at least 1,000 feet above clouds and at least 500 feet below clouds. A pilot may fly under VFR either above or below clouds. I have flown many times above cloud cover through Skull Valley.

For a pilot to fly through Skull Valley in IFR conditions means that the pilots' visual acuity is limited by weather phenomenon to less than VFR conditions. With less visibility than VFR conditions a pilot is required to fly in instrument flight rules which requires a ground radar controller to issue instructions.

Q. 27: Are all flights above the Sevier B MOA flown under instrument flight rules?

A. 27: No. Depending upon the weather, F-16 pilots may fly above the Sevier B MOA under either visual flight rules or instrument flight rules. I have piloted an F-16 above the Sevier B MOA under visual flight rules many times.

Q. 28: Are all flights in the Sevier B MOA flown under visual flight rules?

A. 28: No. Pilots can and do fly F-16s through the Sevier B MOA under instrument flight rules as well as visual flight rules.

Q. 29: How fast do F-16s fly through Skull Valley?

A. 29: Typically, F-16s fly through Skull Valley at "tactical speed" or 400 to 450 knots indicated air speed ("KIAS"). F-16 pilots may fly faster than "tactical speed," and typically fly at 400 to 450 KIAS when performing a G awareness exercise. F-16 pilots do not normally fly through Skull Valley at speeds of less than 400 KIAS and such speeds would neither be typical nor average. A speed as low as 350 KIAS would be unusual because at that speed the aircraft is significantly less maneuverable than at 450 KIAS. A pilot would fly at 350 KIAS for only a brief period in order to gather the formation or adjust timing.

Q. 30: What is your opinion as to the annual number of flights transiting Skull Valley?

A. 30: Flights through Skull Valley include flights in the Sevier B MOA and in and above the Sevier D MOA. The number of annual sorties flown in Sevier B and D MOAs in recent years is:

FY	Sevier B MOA	Sevier D MOA	Total
FY1998	3,871 sorties	215 sorties	4,086 sorties
FY1999	4,240 sorties	336 sorties	4,576 sorties
FY2000	5,757 sorties	240 sorties	5,997 sorties

This figures are shown at page 4 of the Revised Addendum to PFS's Crash Report (July 20, 2001).

Also, twelve additional F-16 fighters have been assigned to the 388th Fighter Wing at Hill AFB, increasing the 388th total from 54 to 66 F-16s. *See* State's Exhibit 49, news report. The 419th Reserve Fighter Wing consisting of 15 F-16s continues to be stationed at Hill AFB. The total number of F-16s assigned to the 388th Fighter Wing and the 419th Reserve Fighter Wing has therefore increased from 69 to 81, or 17.4%. The additional F-16 fighters will increase the number of training sorties proportionally. *See*, Cole, et al Joint Dec. ¶ 27. It should be noted that these numbers do not account for sorties flown above both Sevier B and D MOAs in Skull Valley. As I testified, I have flown many times above both MOAs while transiting Skull Valley.

Q. 31: What is your opinion as to whether the determination of annual sorties through Skull Valley made by PFS and used in its Aircraft Crash Impact Report and SAR was correct and conservative?

A. 31: Even though the total number of sorties for Sevier B MOA has increased each year from FY1998 to FY2000, PFS states that it would be "improper" to use the number of sorties in FY2000 because of fluctuations caused in part by a deployment policy known as the Air Expeditionary Force ("AEF"). In fact, the 388th fighter wing at Hill AFB has been involved in AEF deployment since July 7, 1997, as shown on State Exhibit 69. Any actual effect on the number of Skull Valley flights due to the AEF concept is reflected in the actual flight data for FY1998 through 2000. The AEF concept provides no reason why the single year FY2000 would reflect artificially high sortie numbers and no reason has been offered by PFS.

PFS determined the annual number of sorties through Skull Valley to be 5,870, arrived at by taking the average of FY1999 and FY2000 sorties for Sevier B MOA only, increased by the proportion of additional F-16s assigned to Hill AFB, 17.4%. The lower number of sorties used by PFS has already been exceeded by the total flights in Sevier B and D MOAs for FY2000, even without considering that twelve additional F-16s have been assigned to Hill AFB. The number of sorties used by PFS will likely be exceeded over the 40 year life span of the proposed PFS facility.

The expected number of F-16 annual sorties flown through Skull Valley in the Sevier B MOA and Sevier D MOA in the future should therefore should be estimated to be a minimum of 7,040 annual sorties -- that is, a 17.4% increase to account for the additional twelve F-16s over the 5,997 sorties flown in Sevier B and D MOAs in FY2000. Even the 7,040 number is not conservative because it does not account for the trend of increasing annual sorties and does not consider sorties flown through Skull Valley above the Sevier B and D MOAs.

PFS's failure to consider the sorties flown above Skull Valley in Sevier D MOA, failure to consider the number of annual flights through Skull Valley above Sevier B and D MOAs, and failure to account for the trend of increasing annual flights through Skull Valley make PFS's determination of 5,870 annual sorties through Skull Valley neither a realistic nor conservative estimate of present or future flight activity.

B. Crash Rates for F-16 Aircraft.

Q. 32: Are you familiar with the crash rates for the F-16 aircraft?

A. 32: Yes. The Air Force publishes the F-16 crash statistics; included as State's Exhibit 50 are crash statistics through FY 2000. There are separate crash statistics for each version of the F-16 (F-16A, F-16B, F-16C, F-16D, and F-16 GLOC) and crash statistics for all versions combined.

The F-16 crash rates for FY1976 to 1993 are also contained in the *Data Development Technical Support Document for the Aircraft Crash Risk Analysis Methodology ("ACRAM") Standard*, by Chris Y. Kimura, et al, Lawrence Livermore National Laboratory, August 1, 1996, UCRL-ID-124837. The ACRAM crash rates have been separated for F-16 normal flight and special operations, as are shown on table 4.8. *See* State's Exhibit 51, excerpts from ACRAM. The manner in which the data was derived is discussed in ACRAM pages 4-1 through 4-6, State's Exh.51.

Q. 33: What factors should be considered in predicting future F-16 crash rates for use in evaluating aircraft crashes impacts to the proposed PFS facility?

A. 33: There are extreme variances in crash rates over the service life of a fighter aircraft. Fighter aircraft experience particularly high crash rates at the beginning and end of their service life. F-16s have already been in service over 25 years and will certainly be replaced by a new fighter aircraft during the 40 year operation of the proposed PFS facility. Any estimate of future crash rates must therefore approximate the entire service life of the F-16 as the best predictor of the next 40 plus years of aircraft crashes in Skull Valley.

Q. 34: Please explain the nature of the variance in crash rates over the service life of the F-16.

A. 34: Crash rates are higher when a fighter aircraft is initially put into service. During the middle of the aircraft's service life, the crash rates become lower. Near the end of an aircraft's life, the crash rates begin to rise again. This phenomena is known as the "bathtub" effect, and is particularly pronounced in the beginning years of an aircraft's service life. When I was stationed in Langley, Virginia, I became familiar with a number of Air Force studies which showed the bathtub effect. *See* State's Exhibit 52, graph showing the bathtub effect for the F-16.

F-16s have been flown for over 25 years and I expect that they will reach the end of their service life within ten years. *See also*, State's Exhibit 53, news article citing Jacques Gansler, Pentagon acquisition chief, stating that the F-16 will reach the end of its life span around 2009-2010. Based on my experience, I believe the crash rate for F-16s will trend up during its remaining years of service. It is commonly accepted by Air Force operations and maintenance personnel that crash rates begin to rise near the end of a fighter aircraft's life span. The rise in crash rates is due to fewer new replacement parts and the aircraft generally becoming more difficult to maintain as the fleet ages.

Q. 35: What aircraft do you believe will replace the F-16 at the end of its service life?

A. 35: It will likely be another single engine fighter and most probably the Joint

Strike Fighter ("JSF").[1] The United States Department of Defense has awarded a contract for System Development and Demonstration of the JSF. *See* State's Exhibit 54, Department of Defense ("DOD") October 26, 2001 News Release, *JSF Contractor Award*. DOD expects the first JSF flight to occur in "about four years." *See* State's Exhibit 55, Department of Defense ("DOD") October 26, 2001 News Transcript of live interview of Undersecretary of Defense, Edward Aldridge. It is reasonable to assume that the Air Force will initiate JSF training well within the planned life of the PFS facility and that the JSF will conduct training missions over Skull Valley.

Q. 36: What crash rate do you expect the replacement aircraft for the F-16 to experience?

A. 36: I expect that the JSF or other replacement fighter for the F-16 will experience high initial crash rates as have other fighter aircraft. Figure 2, located after page 9a of PFS's Crash Report, illustrates the high initial crash rates that various single engine fighters have experienced. It should be noted, however, that the Figure 2 chart seriously understates the high initial crash rates by not including the first 100,000 hours of flight, the period when crash rates are the highest. This distortion, in effect, eliminates the first seven years of F-16 crash experience. The entire service life of the F-16 is the best predictor of crash rates for the JSF's service life over the next 40 years. The same would be true if another replacement fighter is chosen.

Q. 37: The PFS Crash Report and SAR use the average F-16 crash rate for the ten year period FY89 to FY98 to calculate the probability of aircraft impact hazards to the proposed PFS facility. Does that ten year period provide a basis for a realistic estimate of aircraft impacts to the PFS facility?

A. 37: No. As shown in Exh. 50, the F-16 crash rates during FY89 to FY98 are the lowest for any ten year period during the F-16's flight history of over 25 years. Selecting the lowest crash rate disregards the upward trend expected at the end of the F-16's service life and disregards the high crash rates expected during the early years of the F-16's replacement aircraft. Selecting the lowest ten year period does not approximate all phases of an aircraft's service life that will be encountered in the next 40 years. Use of the ten-year FY89 to FY98 period is neither realistic nor conservative.

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[1] PFS agrees that the JSF is the planned replacement for the F-16. Crash Report, Revised Addendum (July 20, 2001) at 11.

C. Lack of basis for assuming a pilot could maneuver a crashing F-16 aircraft to avoid impact to the proposed PFS site.

Q. 38: Do you have an opinion on PFS's assumption in its Aircraft Crash Report that an F-16 pilot can maneuver a crashing F-16 aircraft to avoid impact to the proposed PFS site?

A. 38. Yes, based on my experience as an F-16 pilot and F-16 instructor and from other factors, such an assumption of "able to avoid" is unrealistic and unconservative.

Q. 39: Are you familiar with F-16 emergency procedures, and if so describe those procedures for an in flight emergency such as engine failure.

A. 39: Yes, as a former F-16 pilot and F-16 instructor, I am intimately familiar with F-16 emergency procedures. Although I have never had to eject in an emergency, I have performed emergency procedures while flying both F-16s and F-111s because of engine, hydraulic, and electrical failure.

F-16 emergency procedures are as follows:

(1) When a pilot experiences an in flight emergency, the pilot first determines whether control of the aircraft is retained. In some situations, such an engine fire, the pilot may be forced to immediately eject even if control of the aircraft is retained.

(2) If weather conditions permit, the pilot will then "zoom" the aircraft, *i.e.* climb by trading airspeed for altitude. Zooming the aircraft provides the pilot with additional time.

(3) Then, without regard to location, the pilot will jettison all stores, such as weapons and fuel tanks. The pilot's main goal is to control the aircraft and buy time, not to consider where the weapons or fuel tanks will land.

(4) Meanwhile, the pilot will communicate the emergency. Additionally, given adequate time prior to ejection, the pilot will then perform various other procedures, such as restarting the engine. If the pilot must eject, time permitting, the pilot will assess his/her ejection scenario (*e.g.*, ensuring a minimum ejection altitude of 2,000 feet above ground level, ensuring ejection

does not occur into the mountain or lake, identifying a large flat landing area, etc.). If time allows after all these procedures are completed, the pilot can only then assess whether there are any populated or built-up areas to avoid.

(5) The pilot must eject at a minimum altitude of 2,000 feet above ground level in a controlled situation. However, in an uncontrolled situation, the pilot must eject at 6,000 feet above ground level.

Q. 40: Are performing emergency procedures in an F-16 different from those in other multi-engine or multi-seat aircraft?

A. 40: Yes, performing emergency procedures in a single seat, single engine fighter jet, such as an F-16, is different and dramatically more demanding than in a multi-seat or multi-engine aircraft. In addition to losing all power when an engine malfunctions in a single engine fighter, there is no one to assist the pilot with emergency procedures. For example, during an emergency in bad weather, a single seat, single engine pilot must concentrate on flying the aircraft and has less time to implement emergency procedures or analyze and respond to the problem.

Q. 41: What are aircraft crashes and what are the causes of F-16 crashes?

A. 41: Military crashes are sometimes referred to as mishaps or accidents. A "Class A Mishap" is defined by the U.S. Air Force as an accident involving a fatality or the aircraft incurs more than $1 million in damages. The leading cause of F-16 crashes is pilot error, which account for 52% of Class A mishaps, according to Lockheed Martin, the manufacturer of the F-16. Engine related mishaps account for 36% of Class A mishaps. This data can be found in Air Force Magazine, May 1999, Vol. 82, No. 5, a copy of which is included in pertinent part as State's Exhibit 56.

Crashes are also be caused by the pilot losing consciousness, mid-air collisions with other aircraft, bird strikes, weather conditions, and various types of mechanical failures.

Q. 42: What factors determine whether a pilot could maneuver a crashing F-16 or similar aircraft to avoid impacting the proposed PFS site ?

A. 42: Many factors influence whether an F-16 pilot could or would even attempt to maneuver a crashing fighter aircraft to avoid impacting the proposed PFS site. Those factors include whether the pilot remains conscious, whether the aircraft responds to pilot control, whether the pilot forms an intention to take avoidance measures relative to the PFS facility, whether the pilot can locate the PFS facility due to weather or other conditions, whether there is time to take avoidance measures, the experience level of the pilot, and human factors which impair the pilot's decisions in emergency situations.

Q. 43: Explain G induced loss of consciousness and how it could prevent a pilot of a crashing F-16 from avoiding impact to the PFS facility.

A. 43: G induced loss of consciousness occurs when a pilot becomes unconscious because of the "G" or gravity forces imposed on the pilot. G induced loss of consciousness could occur while performing a hard turn. The Air Force defines a "hard turn" as an energy sustaining turn. This turn is typically done with military power, not afterburner. Depending upon airspeed and altitude, a hard turn could impose between 3.5 to 6 Gs on a pilot. When conducting a G awareness warmup turn, the pilot experiences approximately a 4 G force. A G awareness warmup is considered a "hard turn." Consequently, a pilot may lose consciousness when performing G awareness exercises conducted in Skull Valley. Additionally, I have observed that pilot's bodies react differently to G forces following a non-flying period. Obviously, a pilot who incurs a G induced loss of consciousness would not be able to take any action to avoid the PFS facility. The Air Force has determined that the cause of thirteen F-16 Class A mishaps were due to G induced loss of consciousness. *See* State's Exhibit 50, F-16 G induced loss of consciousness crash statistics.

Q. 44: Explain why a crashing F-16 may not respond to pilot control and how it could prevent the pilot from avoiding impact to the PFS facility.

A. 44: The aircraft may sustain impact damage or a mechanical failure of the control systems that would prevent the pilot from maneuvering the aircraft away from the PFS facility or elsewhere.

Q. 45: What factors determine whether the pilot of a crashing F-16 would make a conscious decision to take action to avoid the PFS facility.

A. 45: A pilot's first concern upon realizing the aircraft is about to crash is for the pilot's survival. Survival is dependant on ejecting from the aircraft, a dangerous procedure which can cause severe injury or death if not done appropriately. Altitude and air speed are critical factors which will be considered by the pilot in making a safe ejection. The pilot will also consider where he/she can survive a parachute landing and for that reason will steer away from mountains, forested areas and bodies of water in winter conditions.

A pilot is also trained to jettison all stores, (e.g., fuel tanks, ordnance) before ejecting to reduce the aerodynamic drag on the aircraft to aid in the pilot's control. This also prevents their detonation if they remain onboard and crash as a result of crashing with the aircraft. A pilot may have other high priority tasks, such as trying to restart a malfunctioning engine which could prevent the crash and the need to eject.

The pilot's focus on survival will limit or entirely prevent the pilot from evaluating where the aircraft will impact or trying to locate a specific site and maneuvering the crashing aircraft away from it. The only training an Air Force pilot receives with respect to avoiding ground sites, is contained in a flight manual which instructs a pilot to avoid populated or built-up areas. The PFS facility occupies an area of only 0.13 square miles and neither appears to be a populated area nor a built-up area with commercial or residential buildings. Therefore, a pilot may not even make a conscious decision to maneuver a crashing F-16 away from the PFS site.

Q. 46: Explain your basis for concluding that the pilot's focus on survival may prevent any effort to locate and steer the crashing aircraft away from a ground site such as the proposed PFS facility.

A. 46: I have discussed specific mishap circumstances with four active duty F-16 pilots who have ejected from aircraft. Three of the pilots ejected from F-16s and one pilot ejected from an F-111, a two engine fighter aircraft.[2] All four pilots said their thoughts were focused on their own survival and all of the pilots said they did not even consider where the aircraft would impact and did not consider where the jettisoned stores would impact. All four pilots stated that if they were required to eject in the future, they would again not consider where their aircraft or ordnance would impact.

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[2]The four pilots are: 1) Major Tom Smith, whose January 13, 1995 F-16 crash is the subject of an accident report reviewed in the PFS Crash Report; 2) Captain Pietrykowski, currently assigned to the 388th Fighter Wing at Hill AFB, who ejected from an F-16 on June 21, 2000, near Cold Lake, Canada; his F-16 was flying at 1,700 feet AGL at 540 KIAS on a straight and level course when it encountered a bird strike; 3) Lt. Tidgewell, currently assigned to the 388th Fighter Wing at Hill AFB, who ejected from an F-16 on October 17, 2001, at Hill AFB; his F-16 was on the runway traveling at 150 KIAS when it encountered a tire separation; and 4) Colonel Couter, currently assigned to the 388th Fighter Wing at Hill AFB, who ejected from an F-111 on September 16, 1982, in the United Kingdom; his F-111 was on a final approach flying at 150 feet AGL at 150 KIAS when it encountered hydraulic failure.

The experiences of these four pilots is consistent with experiences of pilots noted in State's Exhibit 57, ALSAFECOM 02-1996 sent out by the Air Force Chief of Safety in 1996. ALSAFECOM 02-1996 advised that 73% of ejections in the proceeding six months had occurred below the published minimum altitude of 2,000 feet AGL, and that futile attempts to restart failed engines were driving pilots to eject below the minimum altitude. A failed engine is a direct threat to the pilot's survival and causes the pilot to eject to save his life. Restarting the engine, like ejection, would also save the pilot's life, and without the dangers that accompany ejection. Attempts by pilots the restart to engine are directly related to a pilot's survival. Thus, the available information based on pilots who have actually ejected in emergency situations indicates that their attention during the emergency is riveted on their survival.

Q. 47: Describe Major Smith's emergency experience and how PFS has used it to predict a pilot's ability to avoid impact to the PFS site.

A. 47: During an orientation flight in an F-16D, Major Smith's engine caught fire and ceased operating due to a mechanical problem. Although he zoomed the aircraft to trade airspeed for altitude and time, Major Smith told me that he did not have time to think about where his jettisoned stores or aircraft would impact. Major Smith's aircraft crashed into a golf course and his stores struck a farmer's field. Major Smith was an experienced pilot with just less than 500 hours of F-16 flying time and 987.5 hours total flying time at the time of the accident.

Contrary to Major Smith's statements, PFS has classified Major Smith's accident as "able to avoid" and used it to support the conclusion that a pilot in an emergency situation would locate and avoid impact with the PFS site. *See Crash Report* at Tab H, Table 1.

Q. 48: Explain why a pilot of a crashing F-16 may not have time to maneuver the aircraft to avoid impact to the PFS facility prior to ejecting.

A. 48: U.S. Air Force procedures and training require the pilot to perform other emergency procedures prior to even considering whether to attempt to steer the aircraft away from a populated or built-up area. There is often only seconds or no time remaining after required emergency procedures and before ejection to assess and carry out measures that would avoid impact to the PFS facility site.

Q. 49: Explain how the experience level of a pilot of a crashing F-16 would

influence the pilot's ability to avoid the aircraft impacting the PFS facility.

A. 49: During an emergency situation an inexperienced pilot may take longer to perform tasks or not be capable of performing them at all. In particular, an inexperienced pilot would have more difficulty performing adequately in a low altitude flight emergency. For example, an inexperienced pilot is more likely to focus on a particular aspect of the emergency procedures, such as restarting an engine or ejecting, and may not be capable of identifying the proposed PFS site and steering the aircraft away. As a qualified flight instructor, I have flown with and evaluated the performance of a number of pilots who, because of their lack of experience, would not in my opinion have the situational awareness to select where they were going to eject and would be unable to take appropriate action to avoid a facility such as the proposed PFS facility.

Q. 50: Describe the range of experience of pilots likely to fly in Skull Valley.

A. 50: Similar to all fighter wings, the 388th and 419th Fighter Wings stationed at Hill Air Force Base are comprised of both experienced and inexperienced pilots and therefore both inexperienced and experienced pilots will be flying in Skull Valley. Depending upon actual flying time and experience in other fighter aircraft, a pilot is generally classified as "experienced" by the U.S. Air Force after flying F-16s for 3 years.

The ratio of experienced to inexperienced F-16 pilots is going down due the downsizing of the military over the last decade. In FY2000, approximately sixty percent of the 388th Fighter Wing pilots could be classified as experienced and forty percent as inexperienced. However, as of February 2002, only about forty-eight percent of 388th Fighter Wing pilots could be classified as experienced. Over the last two years the ratio of experience pilots to inexperienced pilots at the 388th Fighter Wing has dramatically dropped.

Q. 51: Explain how human factors would influence the ability of the pilot of a crashing F-16 to avoid the aircraft impacting the PFS facility.

A. 51: Pilots are under great physical and emotional stress during in-flight emergency situations, which causes their performance to deteriorate. They are more likely to take inappropriate actions under the stress of an emergency. Pilot error causes 52% of Class A F-16 accidents, according to F-16 manufacturer, Lockheed Martin.

Q. 52: Has the U.S. Air Force recognized that stress induced by in-flight emergencies causes pilots to perform poorly?

A. 52: Yes. The Air Force Chief of Safety sends out messages known as ALSAFECOMs to distribute critical safety information. During 1996, the Air Force Chief of Safety sent out ALSAFECOM 02-1996, one of only four ALSAFECOMs sent out that year. It advised that 73% of ejections in the proceeding six months had occurred below the published minimum altitude of 2,000 feet AGL. It also advised that incorrect assessment of airborne situations and timely ejections had become a problem. It also noted that erroneous assumptions and poor airmanship flourished in IFE situations. It concluded that "Human factors specialists indicate that crew members, when confronted with IFE induced stress, may need external or interpersonal intervention to alter their inappropriate performance/actions." *See* ALSAFECOM 02-1996, State's Exh. 57.

Q. 53: Explain why a pilot may not be able to locate the PFS facility due to weather conditions and how weather conditions could prevent the pilot from avoiding a crash into the PFS facility.

A. 53: Cloud cover in Skull Valley may prevent the pilot from seeing the PFS facility and therefore prevent the pilot from being able to steer away from the facility. A cloud ceiling is defined as 50 percent cloud cover and would obstruct the pilot's view of the PFS facility. A pilot cannot penetrate cloud cover without an instrument flight rules clearance provided by Clover Control. If cloud cover is "scattered," 25 percent of the sky is covered. In many cases a scattered cloud cover may obstruct a pilot's view of a structure such as the PFS facility.

If an F-16 flying below cloud cover experiences engine failure, the pilot would not zoom (trade speed for altitude) into the clouds, but would remain at the lower altitude and may be forced to eject immediately due to low altitude. In this situation, the pilot may not have time for any emergency procedures, including locating and steering the aircraft away from the proposed PFS facility. Additionally, if a pilot is flying in, or above, a cloud deck, then the pilot would not be able to visually locate the PFS facility.

Q. 54: In its Crash Report, PFS claims that pilots fly through Skull Valley only under visual flight rules, do you agree?

A. 54: No. While flying through Skull Valley, weather may require pilots to fly instrument flight rule. Instrument flight rule conditions in Skull Valley do not rule out training over the UTTR range. Visual flight rule conditions may not be present in Skull Valley yet the weather over the UTTR may be adequate to perform some or all of the specific planned training mission. Additionally, some pilots may be forced to train in less than optimum weather due to their need for actual flight training hours and to retain their qualifications. For example, the 419th is an Air Force Reserve Fighter Wing. The 419th pilots only have the opportunity to fly approximately five days a month. Reserve pilots who must fly to stay qualified may not have the luxury to reschedule and do fly on cloudy days.

Q. 55: Would visual flight rule conditions ensure that cloud cover would not impair the ability of a pilot of a crashing F-16 to see and avoid the proposed PFS facility?

A. 55: No. A pilot may still not be able to see the proposed facility if flying under visual flight rules. In order to fly under visual flight rules in the Sevier B MOA, a pilot must have at least 5 miles of visibility in front of the aircraft. In addition, the aircraft must be clear of clouds, which means a distance of 1,000 feet above clouds and 500 feet below clouds. However, a pilot may fly under visual flight rules but fly either above or below clouds. I have flown many times above cloud cover through Skull Valley.

Thus, even if the weather is clear under visual flight rules, and a pilot is flying 1,000 feet beneath a cloud ceiling at 7,000 feet mean sea level (approximately 2,500 feet AGL), then the pilot would only have seconds before he/she had to eject at the minimum altitude of 2,000 feet AGL. The cloud ceiling would not allow the pilot to zoom the aircraft (trade speed for altitude) to gain additional time.

Q. 56: Do F-16 pilots flying in Skull Valley encounter cloud cover and if so, how frequently?

A. 56: Yes. Michael Army Airfield is located approximately 17.25 miles southwest from the proposed PFS facility. This is confirmed by the PFS Crash Report at page 56. Because of the close proximity, Michael Army Air Field weather data is representative of the weather in Skull Valley. *See also*, State's Exhibit 58, Deposition Transcript of Donald E. Fly (Dec. 12, 2000) at 85. Annual data from Michael Army Airfield show there is cloud cover (greater than 50 percent) 46 percent of the time at or below 12,000 feet above ground level. *See* State's Exhibit 59, International Station Meteorological Climate Summary, dated 12/9/00.

Q. 57: Is data obtained from the National Weather Service more accurate than the cloud ceiling data from Michael Army Airport?

A. 57: No. The National Weather Service data is not data certified by the Federal Aviation Administration ("FAA") or used by pilots. For example, in contrast to the FAA's definition of a cloud ceiling, the National Weather Service defines a cloud ceiling at 60 percent cloud cover. Exh. 39 at 43, n.33. The FAA defines a cloud ceiling as 50 percent cloud cover. Thus, cloud cover according to the National Weather Service is meaningless for pilots. For example, without instrument flight rules, a pilot could not penetrate clouds described as free of cloud cover by the National Weather Service if there is 50 percent cloud cover. Moreover, 60 percent cloud cover does not mean pilots could see the proposed PFS site.

Q. 58: Does UTTR have weather 96 percent of the time of at least a 3,000 foot ceiling and three miles of visibility and how would such weather affect the ability of a pilot to see and avoid the PFS facility in a crash situation?

A. 58: If 96 percent of the time the UTTR has weather of at least a 3,000 foot ceiling and three miles of visibility as suggested in Exh. 39 ¶ 104, that simply means that 96 percent of the time the cloud cover would be located at 3,000 feet or higher. A pilot flying above the cloud cover could not see the proposed site and therefore, could not avoid it. Essentially a ceiling of at least 3,000 feet 96 percent of the time only ensures that a pilot flying under 3,000 feet above ground level would not encounter cloud cover four percent of the time. However, if the pilot flew below 3,000 feet above ground level, then depending upon the actual ceiling altitude, the pilot may not be able to zoom the aircraft to gain additional time and may be forced to eject immediately. Pilots will not zoom the aircraft into clouds. It is unlikely that pilots flying below 3,000 feet AGL who are prevented from zooming due to cloud cover would have time to steer the aircraft away from the PFS facility before ejecting.

Q. 59: Will pilots always fly beneath the weather in Skull Valley?

A. 59: No. Pilots fly above the weather in many cases. If there were clouds in Skull Valley, I intentionally flew above the weather. If there is a solid cloud ceiling at say 9,000 feet mean sea level (approximately 4,500 feet AGL) and I was flying below the weather, at some point I would have to climb above the weather to continue my mission because just south of Skull Valley, Clover Control cannot see aircraft below 10,000 feet above ground level on its radar due to line of sight limitations. Thus, in order to penetrate the cloud deck (or fly through), the pilot must have clearance from the radar control agency, Clover Control. Because Clover Control could not locate the aircraft, it would be unable to provide the required clearance. Then I would be prohibited from climbing above the weather without instrument flight rule clearance in the Sevier B MOA. Therefore, I would enter Skull Valley above 10,000 feet mean sea level with an instrument flight rule clearance. If a pilot flew below the cloud deck, Clover Control could not provide assistance to penetrate the cloud deck because it cannot identify low level aircraft flying in Skull Valley.

Q. 60: Is cloud cover the only weather factor that would affect the ability of a pilot to avoid to PFS facility in a crash situation?

A. 60: No. A pilot may not be able to see the PFS facility due to ground fog. Utah often experiences severe ground fog in the winter. Although flying conditions may otherwise be clear, a pilot may not be able to see the PFS facility because it is concealed by ground fog.

Q. 61: Are there factors other than weather that could prevent a pilot from locating the proposed PFS site?

A. 61: Yes. If accident circumstances do not require an immediate ejection, a pilot will lift the nose of the aircraft during an emergency procedure which limits the pilot's visibility. Depending on the degree to which the nose is lifted, the pilot's view of the ground could be blocked for the entire distance that the aircraft could glide.

Q. 62: In its Crash Report, PFS states that if the proposed PFS site is not visible, the pilot would use navigation instruments or radio to locate the site. Is that correct?

A. 62: No. Contrary to PFS's claims, a pilot cannot rely on his instruments to locate the PFS facility during an emergency. If the engine fails, the precision in the navigation system is reduced. The instruments work on and off for short periods of time as the electrical systems switch to backup systems; so a pilot cannot rely on them. In addition, a pilot would not call Clover Control to locate the proposed PFS facility when time is critical in an emergency. Moreover, during an emergency, Clover Control may be able to direct a pilot away from a large area such as Salt Lake City but would not be able to direct a pilot away from an area as small as the proposed PFS facility.

Q. 63: Could an F-16 pilot use the Stansbury or Cedar Mountains as reference points in steering the aircraft away from the PFS facility in an emergency even if a pilot could not see the facility?

A. 63: Using the Stansbury or Cedar Mountains as reference points is unlikely to provide assistance in avoiding the PFS facility. These mountains merely indicate Skull Valley and the PFS facility is located between them. The pilot's primary focus is to eject safely and if possible to save the aircraft. A pilot would not attempt to avoid the PFS facility by heading toward the mountains because they are not a safe place to eject. It is highly improbable that a pilot could determine the location of the 0.13 square mile PFS facility in Skull Valley by reference to surrounding mountain ranges. Even if an initial estimate could be made, its location relative to the aircraft will continually change, requiring the pilot to track the distance and direction the aircraft travels following the estimate, which requires the pilot to estimate the speed of the aircraft as it continues to decrease following loss of power or other emergency event. The pilot would have to accomplish this while under the stress of performing emergency procedures, without being able to rely on the accuracy of the navigation systems, and while contemplating imminent ejection. It is completely unreasonable to assume a pilot could rely on reference points such as the Stansbury and Cedar Mountains to locate and avoid the PFS facility. Further, if the PFS facility is not visible due to clouds, the pilot may not be able to see the mountains for the same reason.

Q. 64: Does the Air Force keep statistics showing the success rate of pilots of crashing F-16s or other fighters in identifying a specific ground site and maneuvering the aircraft to avoid impact with it?

A. 64: No. I am not aware of any statistics kept or studies that have been done by any military or other organization which address the success rate of pilots in identifying or avoiding specific ground sites in a crash situation. Further, I am not aware of any data available on which to base such a study. The accident reports kept by the Air Force, such as those reviewed by PFS, rarely mention whether the pilot attempted any avoidance maneuver. In the few instances that mention the pilot taking general action such as pointing the aircraft away from a populated area, there is no further detail given. It would be unknown if the pilot took action based on the general awareness of a large location such as a city or bailout area, or whether the pilot visually located one or more specific sites of smaller size and successfully chose and avoided a specific small site like the PFS site.

Q. 65: Are you aware of any published authorities or articles in military or industry journals that suggest that the success rate of F-16 pilots in avoiding aircraft crash impacts to a specific site can be predicted or quantified?

A. 65: No. I am not aware of any published work or authority that has attempted to quantify or predict the probability that a pilot in a crash situation would successfully avoid impact with a specific ground site. To my knowledge, no methodology to calculate such a probability has ever been used, subjected to peer review, or even proposed by any authority or in any published work.

Q. 66: When does the Air Force issue accident reports and what is their purpose?

A. 66: The Air Force is required to investigate all class A mishaps and accidents with high public interest, and to issue a report of the investigation in accordance with AF Instruction 51-503, State's Exhibit 60. AF Instruction 51-503 sets forth the required method of conducting an accident investigation and the information that the accident report must contain. The purpose of accident investigations is to provide a publicly releasable report of the facts and circumstances surrounding the accident including a statement of opinion on the cause of the accident, and to preserve evidence for claims or litigation.

Q. 67: What experience do you have with conducting an accident report for the Air Force?

A. 67: I served as the interim president of a Safety Investigation Board convened to investigate an F-16 crash.

Q. 68: Does AF Instruction 51-503 require accident investigators to establish the extent of populated or built-up areas existing in the vicinity of the crash?

A. 68: No. Identifying populated or built up areas in the vicinity of the crash is not mentioned in AF Instruction 51-503. I am not aware of any Air Force accident report that purports to identify all significant populated areas or other ground sites in the crash vicinity.

Q. 69: Does AF Instruction 51-503 require an investigation into what actions, if any, the pilot took to avoid crashing into populated or built up areas?

A. 69: No. A F Instruction 51-503 does not make any reference to investigating what actions, if any, were taken by the pilot to avoid populated or other ground sites.

Q. 70: Does AF Instruction 51-503 require an opinion or other statement as to whether the action or inaction of the pilot with respect to avoiding impact with a ground site was done properly or successfully?

A. 70: No. AF Instruction 51-503 does not require the accident report to include an opinion or other statement as to whether the pilot acted properly in any action or inaction with respect to avoiding impact with a ground site. Furthermore, I have never seen an accident report that included such an opinion or statement. Neither does AF 51-503 require the accident report to include an opinion or statement as to whether a pilot's efforts, if any, were successful in avoiding impact with a particular ground site.

Q. 71: Do the Air Force accident reports reviewed by PFS provide a basis to predict whether pilots of crashing F-16s would successfully avoid an impact to the PFS facility?

A. 71: No. In its Crash Report, PFS classified various accident reports from FY 1989 through 1998 as "able to avoid" based on PFS's estimate that the pilot had control of the aircraft and time to steer the aircraft away from a facility, such as the PFS facility, before ejecting. PFS then concluded that the percentage of "able to avoid" accidents was also the probability that a pilot would in fact take successful actions to locate and avoid impact to the PFS site.

However, the accidents classified as "able to avoid" by PFS are not accidents where the pilot identified a site similar to the proposed PFS facility and successfully maneuvered the aircraft to avoid impact with it before ejecting. In fact, none of the 126 reports over the 10 year period reviewed by PFS discloses a situation where a pilot located a specific ground feature, such as the PFS facility, and took action to avoid impacting it. Only a few reports even mention an effort by the pilot to point the aircraft in a general direction, such as away from populated areas. Therefore, the reports identified by PFS as "able to void" are neither evidence that pilots have in the past located and avoided a specific ground site, nor do they offer a basis to predict that pilots would in the future, locate and avoid the PFS facility.

IV. POTENTIAL FOR ORDNANCE TO IMPACT THE PFS FACILITY.

Q. 72: Do F-16s carry ordnance while flying through Skull Valley?

A. 72: Yes. F-16s transiting Skull Valley may carry between zero and six ordnance per flight. An F-16 may carry two MK-84s (2,000 lb. bombs) per flight. *See also* State's Exhibit 61, Memorandum from Colonel Ronald G. Oholendt, U.S. Air Force (October 26, 1999)[3].

[3] Note: Colonel Oholendt provides the number or ordnance "normally" carried on a 388th Fighter Wing aircraft during FY98. However, the number of ordnance identified does not bound the number of ordnance per aircraft.

Q. 73: In the event of an F-16 emergency, what happens to the ordnance?

A. 73: After a pilot zooms the aircraft, the pilot will release the bombs and fuel tanks from the aircraft, known as "jettison all stores." A pilot typically will take no action to select where the ordnance will impact. This is because immediate jettison of all stores may be necessary to retain control of the aircraft, and also because the pilot's attention in an emergency will be focused on tasks relating to the pilot's survival, such as restarting a failed engine and safely ejecting.

Q. 74: Could jettisoned ordnance strike and penetrate the proposed PFS storage casks?

A. 74: Yes. Live and inert ordnance may potentially strike and penetrate the proposed PFS storage casks and canisters. Using PC effects model[4], the U.S. Air Force determined that the GBU-24 A/B and the GBU-10 with the BLU-109 warhead could penetrate the proposed PFS storage cask and canister (HI-STORM 100). Attached is State's Exhibit 62, USAF letter from Colonel Lee C. Bauer; and State's Exhibit 63, USAF letter from Denise L. King. The Air Force also estimated the maximum probability that the MK-84 warhead configured as a GBU-10, GBU-24, or free-fall unguided ordnance would penetrate the cask and canister to be 0 to 50 percent. *See* King letter, Exh. 63. The Air Force estimate did not consider the possibility that the cask or canister may buckle or crack. Also, the Air Force assumed only inert weapons in its estimates and did not account for any potential weakening of steel due to an explosion.

Q. 75: Describe the ordnance path after jettison.

A. 75: Once a pilot jettisons the ordnance, the bombs will fly in a predetermined parabola and impact the earth according to that parabola. The parameters for the parabola are speed at jettison, altitude at jettison, pitch of aircraft at jettison with respect to the horizon, and aerodynamic drag of the bombs.

Q. 76: How does the 388th Fighter Wing determine how many aircraft will carry ordnance and what type?

A. 76: That decision is based on the current tactics of the Air Force and budget. The actual number of ordnance used each year could vary dramatically.

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[4] Joint Munitions Effective Manual Air to Surface Weaponeering Systems. *See* Oholendt letter, Exh. 61.

Q. 77: Explain whether or not PFS has used a realistic number of ordnance carried annually in calculating the probability of ordnance impact to the proposed PFS facility?

A. 77: As shown in the July 20, 2001 Revised Addendum its Crash Report, p.30 and the May 31, 2001 Response to RAI at p.12-16, PFS has reduced the probability it had previously calculated for impact from ordnance, by using FY00 data rather than the higher FY98 data. However, the more recent FY00 data is an anomaly and not indicative of usual training. On February 1, 2001 I was advised by 388th Fighter Wing Operations Group Commander Colonel Couter, that the 388th Fighter Wing's training tactics changed in FY00 due to real world deployments. Squadrons from the 388th were deployed to the Caribbean to aid in the interdiction of drug smuggling aircraft. Hence, the 388th's training concentrated not on ordnance carrying missions such as bombing runs but on low level, low speed training. However, because of the current Air Force needs in Kosovo and Afghanistan, the 388th's current training tactics require more sorties to carry ordnance than in FY00. PFS's reliance on a fiscal year where ordnance training is an anomaly is not realistic to estimate the risks from ordnance carried by F-16s through Skull Valley over the next 40 plus years. No reason has been offered by PFS as to why the FY98 annual ordnance data will not be repeated in the future, and therefore no less than FY98 data should be used, increased by the increase in sorties since FY98.

V. AIRCRAFT USING THE MOSER RECOVERY ROUTE.

Q. 78: Does PFS use realistic values in calculating the impact probability to the PFS facility site from aircraft on the Moser Recovery Route?

A. 78: No. In addition to incorrectly assuming that pilots will in fact avoid the PFS facility site in an emergency, PFS has used neither a realistic crash rate nor realistic annual sortie data, as I have mentioned elsewhere in this testimony. Also, PFS has incorrectly assumed that only 5% of flights returning from the UTTR South Area would use the Moser Recovery Route ("MRR").

PFS states that undisclosed "air traffic controllers" provided the 5% estimate, which was used by PFS in its August 13, 1999 submission.[5] The use of the MRR has increased since the estimate relied on by PFS.

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[5]Crash Report, p.49, n.57A.

The Moser Recovery Route is flown during inclement weather conditions or during night training missions. The Moser Recovery Route has been used more frequently since 1999 because the 388th Fighter Wing and the 419th Fighter Wing fly night vision goggle ("NVG") training missions. These missions were in the initial stages of being implemented during the latter part of 1999. The 5% estimate relied on by PFS was made before NVG training was implemented for all pilots. In calendar year 1999, when I was stationed at Hill AFB, I flew at least four night missions in seven months.

The Memorandum dated July 18, 2001 from Air Force Headquarters, shown in State's Exhibit 64, states that NVG training will increase and that of the total sorties flown in MOAs, "approximately one third will be night sorties." A realistic number of flights using the MRR could be as high as 33% of the sorties returning from the UTTR South Area.

VI. THE PFS ANALYSIS OF F-16 ACCIDENT REPORTS.

Q. 79: Is the PFS analysis of F-16 accident reports found at Tab H of the Crash Report useful in determining the risk of impact to the proposed PFS facility from aircraft?

A. 79: No. The stated objective of the analysis is limited to determining the percentage of flights where the pilot "would remain in control of the aircraft and have time to avoid the PFSF." Therefore, the analysis is designed only to identify accidents where the F-16 remained flyable and the pilot had some increment of time before ejecting. Even if the analysis correctly identified those accidents with an increment of time available to the pilot, that time would most likely be used on tasks related to the pilot's survival, not on attempting to locate and avoid the PFS facility site. Therefore, the fact that a pilot may have had some available time before ejecting is not useful in determining the risk of impact to the PFS facility, and classifying such accidents as "able to avoid" is not an accurate characterization and is, in fact, misleading.

Q. 80: Does the PFS analysis at tab H of the Crash Report correctly determine the probability of crashes in Skull Valley where the pilot "would remain in control of the aircraft and have time to avoid the PFS facility"?

A. 80: No. There are several reasons why the analysis does not correctly determine the probability of crashes in Skull Valley where the pilot would remain in control of the aircraft and have time to avoid the PFS facility.

PFS has only evaluated accident reports over a ten year period, not for the entire accident history of the F-16. Additionally, PFS has not obtained and reviewed accident reports for 18 of the 139 (13%) F-16s that were destroyed in this period.

Of the accident reports that were reviewed, many were excluded from consideration by incorrectly assessing the flight phase, incorrectly concluding that the accident could not happen in Skull Valley, and incorrectly concluding that the accident occurred under conditions that are not similar to those experienced in Skull Valley within the Sevier B MOA. Additionally, excluding accidents on the basis that they do not match Sevier B MOA conditions improperly excludes those accidents that happen under conditions experienced in other air above the Sevier B MOA which is also used to transit Skull Valley.

Q. 81: Explain how PFS excluded F-16 accident reports by incorrectly assessing the phase of flight.

A. 81: Many times, PFS discounted an accident report because it classified the accident as special flight or take off or landing when in fact the aircraft was performing essentially normal flight at the time of the accident. I discussed these incorrect classifications in my declaration dated January 30, 2001, State's Exhibit 65. For example, PFS incorrectly classified a July 31, 1992 accident report as "takeoff" when the aircraft was at an altitude of 5,719 feet above ground when it was struck by lightning. After the accident aircraft performed takeoff, three additional F-16s also performed takeoff and were above 4,500 feet AGL at the time of the accident. The accident aircraft was essentially in normal flight when the accident occurred.

Q. 82: Explain how PFS excluded F-16 accident reports by incorrectly assessing Skull Valley Type Events and Sevier B MOA Conditions.

A. 82: PFS incorrectly excluded accidents that occurred at altitudes higher than 5,000 feet AGL and accidents while under instrument flight rules, both of which commonly occur in the Skull Valley. PFS also incorrectly excluded accidents caused by midair collisions, G induced loss of consciousness, bird strikes, lightning strikes, and poor visibility due to cloud cover, all of which could occur in Skull Valley.

Q. 83: Explain why midair collisions could occur in Skull Valley.

A. 83: During a September 16, 1997, F-16 accident, there was a midair collision when the back element (2^{nd}) pilot in the formation lost situational awareness and hit the lead element aircraft. This accident occurred after take off and while the pilots were preparing for their night goggle training mission at 13,760 feet above ground level. Although one aircraft successfully landed, the other aircraft was out of control and would have not been capable of avoiding the PFS facility or other site. Pilots conduct night vision goggle training in Skull Valley and a midair collision similar to this accident could occur in Skull Valley.

Q. 84: Explain why G induced loss of consciousness could occur in Skull Valley.

A. 84: Pilots may conduct G awareness turns in Skull Valley, which apply 3 to 4 G on a pilot. If a pilot has not flown for a period of time due to leave, injury, or another assignment, a pilot may not be physically capable of sustaining a G awareness turn and could lose consciousness. I have personally experienced this lack of ability to sustain G forces after a period of not flying, and it is a common experience among pilots.

Such an accident is described in the May 25, 1990 accident reviewed by PFS, where a pilot suffered G induced loss of consciousness on his first flight following return from leave. The accident occurred at 6,000 feet above ground level when the pilot turned to enter a low-level training route. During the descent to enter the low-level route, the mishap pilot suffered G induced loss of consciousness and crashed into the ground. This pilot was well qualified and experienced, but had just returned from a period of non-flying. The circumstances of this accident could occur in Skull Valley. G induced loss of consciousness accidents were improperly excluded by PFS.

Q. 85: Explain why bird strikes could occur in Skull Valley.

A. 85: The Air Force's report of the July 6, 1998 aircraft accident reviewed by PFS states that the accident was caused by birds impacting the aircraft. The report shows that the F-16 canopy is designed to withstand a bird strike of 4 pounds at 350 knots. *See* State's Exhibit 66, excerpt from AFI 51-503 Aircraft Accident Investigation Report. Pilots typically fly 400 to 450 knots through Skull Valley. While flying F-16s through Skull Valley I have frequently encountered birds that I estimate to exceed 4 pounds in weight.

According to the Handbook of North American Birds, State's Exhibit 67, American White Pelicans, Canada Geese, Great Blue Herons, Bald Eagles, and Golden Eagles all have weights ranging from 5 to 30 pounds and can fly at altitudes exceeding 1,000 feet above ground. These species have been identified at the Timpie Springs Waterfowl Management Area, located north of Skull Valley near the shoreline of the Great Salt Lake. The documentation of theses species known to frequent the area is shown in the letter and attached surveys from the director of the Utah Division of Wildlife Services, shown in State's Exhibit 68. The presence of these species in Skull Valley can be expected as they fly to or from wetlands including Timpie Springs and the Great Salt Lake.

Q. 86: Explain why PFS incorrectly excluded from its analysis F-16 accidents caused by lightning strikes.

A. 86: Although pilots will generally not fly in known and predicted lightning storms, lightning is not always predictable. It is reasonably foreseeable that a pilot will at some time fly in the presence of lightning as verified by the reports of accidents caused by lightning. I have personally flown in lightning and it cannot be disregarded as a hazard in Skull Valley.

In the Matter of: PRIVATE FUEL STORAGE, LLC
(Independent Spent Fuel Storage Installation)
Docket No. 72-22-ISFSI; ASLBP No. 97-732-02-ISFSI

State of Utah List of Hearing Exhibits - Contention Utah K/Confederated Tribes B for the Prefiled Testimony of Lt. Col. Hugh L. Horstman (USAF, Ret.)

State Exhibit Number	Description	Witness	Contention
38	Resume of Lt. Col. Hugh L. Horstman (USAF Ret.)	Horstman	K
39	Joint Declaration of James L. Cole, Jr., Wayne O. Jefferson, Jr., and Ronald E. Fly (December 30, 2000), attached to the Applicant's Motion for Summary Disposition of Utah Contention K and Confederated Tribes B (December 30, 2000)	Horstman	K
40	Map showing portion of Utah Test and Training Range (UTTR)	Horstman	K
41	Excerpt from UTTR Capabilities Guide [UT-45673, 45677]	Horstman	K
42	Annual Military Operating Area Usage Report for Sevier B MOA dated November 30, 1998	Horstman	K
43	Portion of IFR Enroute Low Altitude - U.S., dated May 20, 1999, showing locations of Sevier B and D MOAs.	Horstman	K
44	Annual Military Operating Area Usage Report for Sevier D MOA dated November 30, 1998	Horstman	K
45	Separate Annual Military Operating Area Usage Reports for R-6402A, R-6402B, R6406, dated November 30, 1998	Horstman	K
46	Statement by Utah First District Congressman, Representative James V. Hansen, Limited Appearance Session, Salt Lake City, June 23, 2000, Tr. 13-19	Horstman	K
47	Figure 1 of the PFS Crash Report	Horstman	K
48	Overlay to Figure 1 of the PFS Crash Report	Horstman	K
49	Undated news report stating that an additional twelve F-16 fighters have been assigned to the 388th Fighter Wing at Hill AFB	Hortsman	K
50	U.S. Air Force F-16 Crash Statistics for all F-16s, F-16A, F-16B, F-16C, F-16D, and F-16GLOC	Horstman	K

State Exhibit Number	Description	Witness	Conten-tion
51	Kimura, et al, *Data Development Technical Support Document for the Aircraft Crash Risk Analysis Methodology (ACRAM) Standard*, UCRL-ID-124837 (August 1, 1996), Lawrence Livermore National Laboratory, pages 4-1 to 4-6, Table 4.8	Horstman	K
52	F-16 Crash History Graph	Horstman	K
53	News article from Federation of American Scientists website, titled *Cohen: Joint Strike Fighter program must stay on schedule* (June 24, 2000)	Horstman	K
54	News Release from the United States Department of Defense, *JSF Contractor Award*, dated October 26, 2001 [UT-48538 to -48539]	Horstman	K
55	News Transcript from the United States Department of Defense, Live Interview of Edward Aldridge, dated October 26, 2001.	Horstman	K
56	Portions of Air Force Magazine, May 1999, Vol. 82, No. 5	Horstman	K
57	AF document ALSAFECOM 002-1996 (March 1996) [UT-48483 to -48486]	Horstman	K
58	Deposition transcript of Ronald E. Fly, December 12, 2000	Horstman	K
59	International Station Meteorological Climate Summary for Dugway Proving Ground (12/9/00), from Hill Air Force Base website	Horstman	K
60	AF Instruction 51-503, *Aircraft, Missile, Nuclear, and Space Accident Investigations* (April 5, 2000)	Horstman	K
61	Memorandum from Colonel Ronald G. Oholendt, USAF, for 75 CS/SCSRF (FOIA), dated October 26, 1999 [59803]	Horstman	K
62	Letter from Colonel Lee C. Bauer, USAF, dated December 28, 2000 [UT-45794 to -45795]	Horstman	K
63	Letter from Denise L. King, USAF, dated January 18, 2001	Horstman	K
64	Memorandum from AF Headquarters (July 18, 2001)	Horstman	K

State Exhibit Number	Description	Witness	Conten-tion
65	Declaration of Lt. Colonel Hugh L. Horstman, Air Force (Retired) in Support of the State of Utah's Response to PFS's Motion for Summary Disposition of Contention Utah K and Confederated Tribes B (January 30, 2001)	Horstman	K
66	Excerpt from AFI 51-503 Aircraft Accident Investigation Report [58809, 58811]	Horstman	K
67	Excerpt from *Handbook of North American Birds*, Vols. 1 and 2, Yale University Press, 1962	Horstman	K
68	Letter from J. Kimball, Director, Utah Division of Wildlife Resources, attaching recent Waterbird Survey data in the vicinity of Timpie Springs Waterfowl Management Area (January 26, 2001)	Horstman	K
69	Notice from Air Force News website, *First no-notice AEF deployment underway* (July 8, 1997)	Horstman	K

Resume

Lt. Col. Hugh L. Horstman
(U.S. Air Force, ret.)

June 1999 – Present: Pilot, Southwest Airlines.
Pilots a Boeing 737 aircraft for Southwest Airlines. Responsible for the safe air travel of over 6,000 people per month throughout the United States.

1996 - Present: Adjunct Professor, Embry Riddle Aeronautical University.
Instructor of master's degree candidate students in aviation.

October 1997 – June 1999: Deputy Commander, 388th Operations Group, Hill AFB UT.
Commanded the F-16 Operations Group and 1,500 personnel. Responsible for all flying and maintenance of 60 F-16C aircraft and resources valued at $4 billion, flying over 15,000 sorties per year. F-16 Instructor Pilot.
Accomplishments: Rated the number one Lieutenant Colonel in the entire Fighter Wing. Achieved the highest aircraft readiness rates in Air Combat Command at 21% less cost than any other wing. Directed 12 major aircraft deployments to Bosnia, Kosovo, and Iraq.

June 1996 – September 1997: Deputy Commander, 52nd Support Group, Spangdahlem AB, Germany.
Commanded the Support Group and over 2,000 personnel. Responsible for maintaining the entire base infrastructure and environment, including facilities, security forces, communications capabilities, disaster response, housing, fire fighting and rescue, retail sales and personnel services.
Accomplishments: Rated more productive than any other Lieutenant Colonel in the wing. Controlled and directed allocation of a $75 million operations and maintenance budget for the base and provided oversight for $240 million worth of ongoing projects resulting in the base winning the USAF 1997 Installation of the year award. Commanded the United States Air Forces in Europe first Air Expeditionary Squadron with both F-16 and F-15 aircraft.

June 1995 – June 1996: Chief, 52nd Fighter Wing Readiness, Spangdahlem AB, Germany.
Designed and evaluated all base level exercises in preparation for real world contingencies, NATO Tactical Evaluations, Operational Readiness Inspections, Nuclear Surety Inspections. Conducted routine natural disaster and emergency response exercises. F-16 instructor pilot.

Accomplishments: Rated in the top 1% of the Air Force. Orchestrated an evaluation of 25 squadrons, 5,000 personnel, 72 aircraft for NATO, resulting in the first ever "Outstanding" grade given by NATO for mobilization, preparation and combat employment. Personally selected to lead an operational inspection of Operation Provide Comfort after the US friendly fire helicopter shootdown.

June 1993 - June 1995: Assistant operations Officer, 52 Fighter Wing, Spangdahlem Air base Germany
Description: Maintained readiness of a combat fighter squadron. Planned, organized and managed the squadrons utilization of 4800 sorties and 6,000 flying hours per year. F-16C instructor pilot and wing supervisor of flying (mission was both conventional and nuclear weapons employment).

May 1991 - May 1992: Executive Officer to the Chief of Staff of Plans, Headquarters Air Combat Command, Langley AFB, VA.
Managed the administrative process for headquarters directorate - responsible for all long range strategic planning for Air Combat Command.

August 1989 - May 1991: Aircraft program manager, Headquarters Tactical Air Command, Langley AFB, VA.
Developed relocation plans consistent with base closures and procured funding for all aircraft modifications.

September 1985 - August 1989: Flight Commander, 20th Fighter Wing, RAF Upper Heyford United Kingdom.
Responsible for leadership and training 14 of combat crews (pilots and navigators), F-111 instructor pilot (mission was both conventional and nuclear weapons employment).

Flying History

B-52: Over 1,000 hours (1979 – 1983) Navigator and Instructor Navigator
F-111: Over 1,000 hours (1985 – 1989) Instructor Pilot
F-16: Over 800 hours (1992 – 1999) Instructor Pilot
Miscellaneous aircraft: 700 hours as pilot in command

Education

August 1992 - June 1993, Air Command and Staff College, Montgomery, Alabama (diploma earned). Field of study: military history, leadership and management.

1982, Master of Arts, business, Central Michigan University.

1978, Bachelor of Science, business finance, University of Southern California.

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

Before the Atomic Safety and Licensing Board

In the Matter of	)	
	)	
PRIVATE FUEL STORAGE L.L.C.	)	Docket No. 72-22
	)	
(Private Fuel Storage Facility)	)	

DECLARATION OF JAMES L. COLE, JR., WAYNE O. JEFFERSON, JR., AND RONALD E. FLY

James L. Cole, Jr., Wayne O. Jefferson, Jr., and Ronald E. Fly state as follows under penalties of perjury:

I. WITNESSES

A. James L. Cole, Jr.

1. I am Senior Director, Safety of the Air Transport Association and an associate with Burdeshaw Associates, Ltd. Burdeshaw Associates is a consulting firm in the Washington, D.C. area that provides services to clients in the areas of aviation, transportation, military operations, and government affairs. In 1994 I retired from the United States Air Force with the rank of Brigadier General. I am providing this declaration in support of a motion for summary disposition of Contention Utah K in the above captioned proceeding to indicate the risk of aircraft or air-delivered ordnance accidents impacting the proposed Private Fuel Storage Facility (PFSF) for the storage of spent nuclear fuel in Skull Valley, Utah.

2. My professional and educational experience is summarized in the curriculum vitae attached as Exhibit 1 to this declaration. I have extensive experience in and

State's
Exhibit 39

knowledge of aircraft operations and aviation safety. From 1991 to 1994, I served as Chief of Safety of the United States Air Force and directed the entire USAF safety program. I was responsible for accident prevention and investigation in all aspects of ground and air operations. I was also commander of the 89th Airlift Wing (which transports the President of the United States) and vice commander of a C-141 wing. I have 6,500 total flying hours with 3,000 flying hours in heavy jet aircraft. I was also an instructor pilot and flight examiner (check pilot) in the C-141 aircraft.

3. I was responsible for PFS's assessment of the risk to the PFSF posed by aircraft crashes and ordnance impacts, with respect to, generally speaking, overall aviation safety, data and information concerning military and civilian air traffic in the region of the PFSF and aircraft accident rates, and all aspects of civilian aviation. I also reviewed in depth the Air Force's mishap reports for the F-16 for the ten year period from FY1989 through FY1998. During over three years as USAF Chief of Safety, I personally reviewed and approved every Air Force Accident Safety Investigation report for all types of aircraft. On all relevant aspects of the assessment I provided my judgment regarding pilot actions and responses to emergencies.

B. Wayne O. Jefferson, Jr.

4. I am an associate with Burdeshaw Associates, Ltd. In 1989 I retired from the United States Air Force with the rank of Major General. I am providing this declaration in support of a motion for summary disposition of Contention Utah K in the above captioned proceeding to indicate the risk of aircraft or air-delivered ordnance accidents impacting the proposed PFSF for the storage of spent nuclear fuel in Skull Valley, Utah.

5. My professional and educational experience is summarized in the curriculum vitae attached as Exhibit 2 to this declaration. I have extensive experience in and knowledge of U.S. Air Force aircraft operations and weapons testing and training operations. I served in the Air Force for over 30 years, including service with the Strategic Air Command as a B-52 wing commander. I have 4,450 flying hours in 9 different aircraft

types. My experience also includes service in senior positions on the Air Staff, Joint Staff and on the faculty of the U.S. Air Force Academy. Since I retired from the Air Force I have been a consultant in management, management training, and quantitative probabilistic analysis. My education includes a master's degree in operations research and a master's in business administration.

6. I was responsible for PFS's assessment of the risk to the PFSF posed by aircraft crashes and ordnance impacts, with respect to, generally speaking, the quantitative calculations PFS performed concerning the probability that a crashing aircraft would impact the PFSF. I also reviewed in depth the Air Force's mishap reports for the F-16 for the ten year period from FY1989 through FY1998. On all relevant aspects of the assessment I provided my judgment regarding pilot actions and responses to emergencies.

C. Ronald. E. Fly

7. I am an associate with Burdeshaw Associates, Ltd. In 1998 I retired from the United States Air Force with the rank of Colonel. I am providing this declaration in support of a motion for summary disposition of Contention Utah K in the above captioned proceeding to indicate the risk of aircraft or air-delivered weapon accidents impacting the proposed PFSF for the storage of spent nuclear fuel in Skull Valley, Utah.

8. My professional and educational experience is summarized in the curriculum vitae attached as Exhibit 3 to this declaration. I have extensive experience in and knowledge of U.S. Air Force aircraft operations and training operations. I served in the Air Force for 24 years as an F-16 pilot, instructor, and wing commander. I have approximately 1,200 flying hours in the F-16 as a pilot and instructor. From 1997 to 1998 I served as Commander of the 388th Fighter Wing at Hill Air Force Base, Utah, during which time I flew F-16s on the UTTR. I was also Commander of the UTTR beginning Oct. 1, 1997 when the range was transferred to the 388th FW from Air Force Material Command. In addition to my flight operations and training operations experience, I also have experience in strategic planning, operational analysis, international affairs, space

operations, and logistical support. Furthermore, I am specifically knowledgeable about the operations of military and civilian aircraft that fly in and around Skull Valley, Utah, including the military aircraft that fly from Hill Air Force Base and on or around the UTTR and Dugway.

9. I was responsible for PFS's assessment of the risk to the PFSF posed by aircraft crashes and ordnance impacts, with respect to, generally speaking, military aircraft operations on and around the UTTR and F-16 emergency procedures. I reviewed in depth the Air Force's mishap reports for the F-16 for the ten year period from FY1989 through FY1998. On all relevant aspects of the assessment I also provided my judgment regarding pilot actions and responses to emergencies.

II. BACKGROUND

10. In the bases for Contention Utah K, as admitted by the Licensing Board, the State asserts in part that Applicant Private Fuel Storage (PFS) inadequately considered the hazard to the PFSF of credible accidents involving materials or activities at or emanating from Salt Lake City International Airport, Hill Air Force Base, the UTTR, and Dugway (which is the location of Michael Army Airfield). We have reviewed information and data concerning the potential hazard to the PFSF from aircraft crashes and the use of air-delivered weapons in testing and training at these facilities and have determined that they pose no credible or significant hazard to the PFSF. Our assessment is set forth in a formal report attached as Exhibit 4, entitled, "Private Fuel Storage, Aircraft Crash Impact Hazard at the Private Fuel Storage Facility," Revision 4 (August 10, 2000) ("Aircraft Report"). Our analysis and the conclusions from the report are summarized in Part III below.

11. As part of our assessment, we reviewed all of the available Air Force F-16 Class A Mishap Aircraft Accident Investigation Reports from the period fiscal year 1989

through fiscal year 1998.[1] Those reports are prepared under Air Force Instruction 51-503 after each aircraft mishap to determine the cause of the accident for the purposes of preserving all available evidence and providing a complete factual summary for use in claims, litigation, disciplinary actions, adverse administrative proceedings, and other purposes in accordance with AFI 51-503. The reports follow a set format which sets forth the details of the circumstances surrounding the accident, including: a summary of the history of the flight, the flight mission, preflight activities and planning, the actual flight activity, crash impact information, the functioning of the emergency escape mechanism, rescue activity, maintenance and mechanical factors, supervisory factors, pilot qualifications and performance, navigational aids and facilities, weather, and pertinent directives and publications. Each report may conclude with a statement of opinion by the investigating officer as to the cause of the accident. The flight activity section in particular gives the relevant information as to pilot actions after the emergency begins, including efforts to avoid populated areas and built up structures on the ground. By obtaining these reports, PFS has been able to determine the causes of F-16 accidents likely to occur in Skull Valley and on the UTTR. In total, we reviewed 126 accident reports, covering mishaps in which 121 F-16s were destroyed.

12. In recent responses to PFS discovery requests, the State of Utah has taken issue with some aspects of our assessment. In Part IV of this declaration we respond to the State's specific challenges.

III. SUMMARY OF AIRCRAFT CRASH IMPACT HAZARD ASSESSMENT

A. Aviation Activity in the Vicinity of the PFSF in Skull Valley

13. The PFSF site is located in Skull Valley, Utah, approximately 50 miles southwest of Salt Lake City. Aviation activity in the vicinity of the site consists of mili-

[1] A Class A mishap is one in which there is a fatality, the aircraft is destroyed, or the aircraft suffers $1 million in damage or more.

tary operations, associated with the UTTR and Michael Army Airfield, and civilian commercial and potentially general aviation. The UTTR is an Air Force training and testing range. The airspace over the UTTR extends somewhat beyond the range's land boundaries and is divided into restricted areas, over which the airspace is restricted to military operations, and military operating areas (MOAs). The MOAs on the UTTR are located on the edges of the range, adjacent to the restricted areas. A MOA constitutes airspace of defined dimensions allocated to the military to separate or segregate certain military activities from other flight operations.

14. The UTTR airspace is shown on the map attached as Exhibit 5. It is divided into a North Area, located on the western shore of the Great Salt Lake, north of Interstate 80, and a South Area, located to the west of the Stansbury Mountains, south of Interstate 80. The area covered by the airspace of the UTTR South Area is roughly 148 miles long (at its longest point) by 102 miles wide (at its widest point). The PFSF site is located over 18 statute miles east of the eastern land boundary of the UTTR South Area and 8.5 statute miles northeast of the northeastern boundary of Dugway Proving Ground. The site lies within the Sevier B MOA, two statute miles to the east of the edge of UTTR restricted airspace. As shown on Exhibit 5, the area covered by the airspace of the Sevier B MOA is roughly 145 miles long and, in the vicinity of the PFSF site, is roughly 12 miles wide.

15. Military air operations in the vicinity of Skull Valley consist of the following:

- U.S. Air Force F-16 fighter aircraft transiting Skull Valley en route from Hill AFB to the UTTR South Area. Some F-16 flights carry military ordnance.
- F-16s from Hill and other military aircraft of various types conducting training exercises on the UTTR.
- F-16s from Hill occasionally returning from the UTTR South Area to Hill via the Moser Recovery Route, which runs to the northeast, 2-3 miles north of the PFSF site.

- Military aircraft, comprising mostly large transport aircraft, flying on military airway IR-420, to and from Michael Army Airfield, located on DPG, about 17 miles southwest of the PFSF.

Aircraft Report at 1.

16. Civilian aircraft flying in the vicinity of Skull Valley consist of the following:

- Aircraft flying on Federal airway J-56, which runs east-northeast and west-southwest about 12 miles north of the PFSF site.[2]
- Aircraft flying on airway V-257, which runs north and south about 20 miles east of the site.
- General aviation activity, which has not been reported but conceivably may occur in the area.

Aircraft Report at 1.

17. We have grouped the aircraft flying in and around Skull Valley that could potentially pose a hazard to the PFSF in the event of an accident as above. We have calculated the annual crash impact probabilities for the PFSF for each group of aircraft and the probability that ordnance carried on a military aircraft (separate from the aircraft itself) would impact the PFSF. The annual crash impact probability that we have calculated is less than 1 E-6/year.

B. F-16 Aircraft Transiting Skull Valley

1. Aircraft Crash Hazard

18. F-16 fighter aircraft fly north to south down Skull Valley, within Sevier B MOA, en route from Hill AFB to the UTTR South Area. The F-16s use the eastern side of Skull Valley as their predominant route of travel and typically pass approximately five miles to the east of the PFSF site. The U.S. Air Force has indicated that the F-16s typi-

[2] Commercial air traffic to and from Salt Lake City International Airport, including business jets, flying through the region around the PFSF is included in the traffic on J-56 and V-257.

cally fly between 3,000 and 4,000 ft. above ground level (AGL), with a minimum altitude of 1,000 ft AGL at approximately 350 to 400 knots indicated airspeed (KIAS). In Fiscal Year 1998, 3,871 such flights passed through Skull Valley. Aircraft Report at 5-6.

19. It is not credible that a crashing F-16 would impact the PFSF. F-16s use the airspace above Skull Valley primarily as a transition corridor to the UTTR. Typically F-16s will start a descent into the low altitude arena (below 5,000 ft. above ground level (AGL)) and spread out in a tactical formation which may be 2-3 nautical miles across. Formations vary depending on the number of aircraft in the flight, meteorological conditions, mission objectives, etc. In addition, the F-16s may accelerate to above 400 KIAS and perform two 90° G-awareness turns. Typical maneuvering in Skull Valley is in the administrative and routine categories, both of which are low risk phases of flight (compared to aggressive maneuvering in restricted areas, which is higher risk) . Furthermore, by far the most likely cause of an accident in Skull Valley would be an engine failure, which would leave the pilot in control of the aircraft. Air Force pilots are instructed to avoid ground facilities in the event of a mishap in which the pilot retains control of the direction of the aircraft. Thus, the pilot of an F-16 that had suffered an engine failure would be able to direct the aircraft away from the PFSF before ejecting. Nevertheless, we calculated the probability that an F-16 transiting Skull Valley would crash and impact the PFSF.

20. We calculated the probability that an F-16 transiting Skull Valley would crash and impact the PFSF using the following equation:

$P = C \times N \times A / w$, where

P = probability per year of an aircraft crashing into the PFSF
C = in-flight crash rate per mile
N = number of flights per year along the airway
A = effective area of the PFSF in square miles
w = width of airway in miles

Aircraft Crash Report at 6-8.

21. To calculate the F-16 impact probability, the Sevier B MOA airspace in the vicinity of the PFSF was treated as an airway with a width of 10 statute miles. Id. at 16. Given the flight characteristics of the F-16, the region within PFSF where the storage casks are located has an effective area of 0.1337 sq. mi., assuming a facility at full capacity with 4,000 spent fuel storage casks on site. Id. at 13-16. The number of normal flights through the valley was taken to be 3,871 per year. Id. at 8. The crash rate for the F-16 flight was calculated from Air Force data to be 2.736 E-8 per mile. Id. at 8-13. We also determined, from an extensive review of Air Force F-16 accident investigation reports over a 10-year period, that over 90 percent of the F-16 crashes that would result from accident-initiating events that could occur in Skull Valley would leave the pilot in control of the aircraft after the event. Id. at 16-18, Tab H.

22. Furthermore, because of the training Air Force pilots receive in responding to such in-flight events, the flight characteristics of the F-16, the absence of other built up areas in Skull Valley, and the small effort required for the pilot to avoid the PFSF site in the event of a crash caused by an accident-initiating event leaving him in control of the aircraft, the pilot would be able to direct the aircraft away from the PFSF at least 95 percent of the time in which such an event caused a crash in Skull Valley. Id. at 18-23. Review of the F-16 accident reports showed a number of instances in which pilots maneuvered their aircraft to avoid sites on the ground after an accident-initiating event. The accident reports showed no cases, however, in which the pilot had control of the aircraft and time but failed to guide his aircraft so as to minimize damage to a facility or populated area on the ground. Therefore, based on this data, the assumption that pilots would fail to avoid the PFSF 5 percent of the time is a very conservative upper bound; the data would support assigning a percentage of near zero. Id. Tab H at 28 n.22.

23. Accordingly, conservatively, 85.5 percent (90% x 95%) of the crashing F-16s would be able to avoid the PFSF. Hence the calculated crash impact hazard to the PFSF would be reduced by this fraction. See id. at 23a-24.

24. Based on the above, the annual crash impact probability for F-16s transiting Skull Valley (assuming a fully loaded facility) was calculated in the Aircraft Report to be 2.05 E-7 based on the 3,871 flights F-16 in Fiscal Year 1998. Id. at 24-25. PFS, however, recently requested and has just received data from Hill AFB on the number of F-16s transiting Skull Valley en route to the south part of the UTTR for Fiscal Years 1999 and 2000. For Fiscal Year 1999, 4,250 F-16s transited Skull Valley and for Fiscal Year 2000, 5,757 F-16s transited Skull Valley.

25. The change in the number of F-16 sorties represents in part normal fluctuations in the number of sorties flown annually as well as certain changes in Air Force operations. In 1998, the Air Force announced a new policy for overseas and other deployments of Air Force units away from their home bases, implemented through the Air Expeditionary Force (AEF) concept. Under the AEF concept, portions of various Air Force squadrons are assigned to an AEF on a regular basis for overseas or other deployment as needed. Under the AEF concept, units are on call for deployment for 90 days over a 15-month period. The purpose is to make more equal and regular the deployment of Air Force units from their home base of operations. The goal is to provide a more stable and predictable operating cycle and control and reduce the amount of time spent away from the home base of operations.

26. Therefore, based on this new data it is appropriate to increase the number of F-16 sorties transiting Skull Valley on an annual basis. The three year average for Fiscal Years 1998-2000 is 4,626 sorties per year. This number may, however, understate the ongoing impact of the AEF concept, introduced in 1998. By the same token, it would not be appropriate to use the Fiscal Year 2000 number by itself. As stated, the AEF is on a 15-month rotation so there will be fluctuations from year to year on this basis alone. Overseas deployments would reduce sortie rates, as fewer aircraft would be at Hill AFB. For example, in 1999 the Air Force deployed a significant number of aircraft to the conflict in Kosovo. In addition, even if the 388^{th} Fighter Wing were not deployed overseas, some of its aircraft might be temporarily deployed to other locations in the United States

to replace units that were sent overseas. The United States was not involved in an international crisis like the Kosovo conflict in FY2000. UTTR sortie rates in future years, in which there was such a crisis, would therefore be expected to be lower than those in FY2000. In these circumstances, we believe that taking into account the recent increases in sorties, an appropriate and reasonable number of F-16 sorties to assume on an annual basis transiting Skull Valley would be an average of the FY1999 and FY2000 numbers, or approximately 5,000.[3]

27. In addition to the F-16s at Hill AFB flying more sorties, in its recent discovery responses, the State claimed that additional F-16s are to be stationed at Hill. The number of authorized F-16s for the 388th Fighter Wing at Hill AFB has been 54 and we have been advised that this number is scheduled to increase by 12 to 66. Further, the 419th reserve wing consisting of 15 authorized F-16s are still stationed, as previously, at Hill AFB. It would be reasonable to assume a proportional increase in the number of sorties resulting from the additional authorization. The total number of authorized aircraft at the base will increase from 69 (54 + 15) to 81 (66 + 15), which is a 17.4% increase.

28. Therefore, the annual number of sorties would increase by 17.4%, from 5,000 to 5,870 to account for the increase in the number of F-16s stationed at Hill AFB. Accordingly "N" in the equation set forth in paragraph 20 above would become 5,870 instead of 3,871. This in turn would increase the annual crash impact probability for F-16s transiting Skull Valley (assuming a fully loaded 4,000 cask facility) to 3.11 E-7. While F-16 sortie rates were higher in FY1999 and FY2000 than they were in FY1998 and FY1999, the Federal Aviation Administration has projected that the number of military flights in the United States overall would not increase in the period from 1998 to

[3] This includes the last year in which there was a significant military operation overseas and the most recent year without one.

2025.[4] Therefore, we would not expect the sortie rate at Hill AFB or on the UTTR to increase significantly beyond the FY1999 and FY2000 rate.[5]

2. Jettisoned Ordnance Hazard

a. Direct Impact

29. The U.S. Air Force has specifically stated that "no aircraft flying over Skull Valley are allowed to have their armament switches in a release capable mode. All switches are "SAFE" until inside DOD land boundaries." Aircraft Report at 77. The Air Force has also stated that "the UTTR has not experienced an unanticipated munitions release outside of designated launch/drop/shoot boxes" Id. During FY 1998 there were 13,367 total sorties in the UTTR with 5,083 in the North and 8,284 in the South; in earlier years, during the Cold War, the sortie rate was higher; e.g., 27,000 sorties were flown on the UTTR in FY1988. Id. All were accomplished with obviously no inadvertent munitions releases outside of designated launch/drop/shoot boxes. Consequently, the likelihood or probability of an inadvertent weapons release from F-16s flying over Skull Valley impacting or affecting the PFSF is as a practical matter zero.

30. We did calculate, however, a probability for ordnance jettisoned from a crashing F-16 in Skull Valley that could potentially impact the PFSF. Aircraft Report at 79-83. Some of the F-16 flights through Skull Valley carry ordnance (live or inert). In the event of an incident leading to a crash in which the pilot would have time to respond before ejecting from the aircraft (e.g., an engine failure), one of the pilot's first actions would be to jettison any ordnance carried by the aircraft. Id. at 79. We used an approach

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[4] Federal Aviation Administration, Office of Aviation Policy and Plans, FAA Long-Range Forecasts, Fiscal Years 2015, 2020, and 2025, FAA-APO-99-5 (June 1999).

[5] As an excursion, PFShas examined the use of the FY2000 count of 5757 F-16 sorties in Skull Valley as the norm and adjusted it upward by 17.4% to 6759 sorties as the new steady state rate. While we do not believe this rate is likely to be the steady state rate, using it increases the Skull Valley F-16 impact probability from 3.11×10^{-7} to 3.58×10^{-7}, and the Jettisoned Military Ordnance probability from 1.49×10^{-7} to 1.71×10^{-7}. Adjusting the Moser Recovery probability by its same factor brings it upfront 2.00×10^{-8} to 2.30×10^{-8}. This is not significant in the total calculation.

similar to the approach described above for calculating the aircraft impact probability to calculate the probability that jettisoned ordnance would impact the PFSF. See id. at 79-82. Specifically, we calculated the probability, P, that the ordnance would impact the PFSF using the equation $P = N \times C \times e \times A/w$, as described in the paragraph below. Id.

31. The fraction of the 3,871 F-16s transiting Skull Valley per year that would be carrying ordnance that could be jettisoned was determined from data provided by Hill AFB to be 11.8 percent. Id. at 82. Thus the number of aircraft carrying live or inert ordnance through Skull Valley per year, N in the equation above, would be 457. See id. The crash rate for the F-16s, C, was taken to be 2.736 E-8 per mile, as above. Id. None-theless, the pilot was assumed to jettison ordnance in only 90 percent of all crashes, the fraction of the crashes, e, assumed to be attributable to engine failure or some other event leaving him in control of the aircraft (in crashes attributable to other causes it was assumed that the pilot would eject quickly and would not jettison ordnance). Id. Skull Valley was treated as an airway with a width, w, of 10 statute miles.

32. As with the calculation for F-16s transiting Skull Valley, we conservatively assumed that the F-16s are uniformly distributed across the 10 miles, despite the fact that their predominant route of flight is down the eastern side of the valley. The area of the PFSF, from the perspective of ordnance jettisoned from an aircraft flying from north to south over the site, A, was taken to be the product of the width and the depth of the cask storage area (assuming a full facility with 4,000 casks) plus the product of the width and depth of the canister transfer building, in that pieces of ordnance are small relative to an aircraft and impact the ground at a steep angle. Id. at 80 & n.82, 82. Thus, the area of the PFSF was calculated to be 0.08763 sq. mi. Id. at 82. Therefore, using the equation $P = N \times C \times e \times A/w$, the probability that jettisoned ordnance would impact the PFSF is calculated as follows:

$$P = 457 \times 2.736\text{ E-8} \times 0.90 \times 0.08763 / 10 = 9.85\text{ E-8}$$

Id. at 82-83.

33. If we assume that the number of sorties carrying ordnance through Skull Valley would increase in proportion to the total increase in sorties due to greater usage of the UTTR and an increase in the number of aircraft at Hill AFB, then this probability would increase by a factor of 5,870/3,871, or 1.516. Therefore, the new probability would be 1.49 E-7.

b. Near Impact and Explosion

34. In addition to the potential hazard posed by direct impacts of crashing aircraft and jettisoned ordnance, we also calculated the hazard to the PFSF posed by jettisoned live ordnance that might land near the facility and explode on impact, as well as the hazard posed by a potential explosion of live ordnance carried aboard a crashing aircraft that might impact the ground near the PFSF. Aircraft Report at 83a-83l. At the outset, as stated above, Air Force pilots do not arm the live ordnance they are carrying while transiting Skull Valley near the PFSF. Id. at 83a. Furthermore, the U.S. Air Force has indicated that the likelihood that unarmed live ordnance would explode when impacting the ground after being jettisoned is "remote" and the Air Force has no records of such incidents in the last 10 years. Id. at 83b, Tab Q. Thus, it is highly unlikely that jettisoned live ordnance or live ordnance carried aboard a crashing aircraft that did not directly impact the PFSF would damage the facility.

35. Nevertheless, to calculate a numerical hazard to the facility, we assumed that such ordnance would have a 1 percent chance of exploding and assessed that damage to the PFSF that would result if an explosion occurred close enough so that the blast overpressure would damage a storage cask or the Canister Transfer Building, without hitting either one. Id. at 83g-83i. The explosive overpressure limit for a storage cask was taken to be 10 psi. Id. at 83b-83c. The limit for the Canister Transfer Building was taken to be 1.5 psi. Id. at 83c. We assumed that the ordnance in question was a 2,000 lb. bomb, the largest single piece of ordnance carried by the F-16s that transit Skull Valley. Id. at 81, 83j. Based on information provided by Hill AFB, approximately 193 F-16s transited Skull Valley in 1998 with live ordnance. Id. at 83h. We calculated the prob-

ability that an F-16 carrying live ordnance would jettison the ordnance so as to impact near the PFSF, or crash near the PFSF without jettisoning the ordnance, following the same method we used to calculate the probability that an F-16 would crash and impact the facility. The results of our final calculation showed that the annual probability that a storage cask or the Canister Transfer Building would be damaged by an explosion of live ordnance jettisoned from a crashing aircraft or carried aboard a crashing aircraft that impacted the ground near the PFSF was equal to 2.43 E-10. Id. at 83k-83l. This is exceedingly low and is insignificant relative to the other aircraft crash and jettisoned ordnance impact hazards calculated for the PFSF. Even if the probability is increased to reflect additional sorties transiting Skull Valley, it remains negligible.

C. Aircraft Conducting Training on the UTTR

36. According to the Air Force, 8,284 sorties were flown over the UTTR South Area in 1998. Aircraft Report at 28. Those aircraft conducted a variety of activities, including air-to-air combat training, air-to-ground attack training, air-refueling training, and transportation to and from Michael Army Airfield (which is located beneath UTTR airspace). Id. at 29. Hazards posed by aircraft flying to and from Michael Army Airfield on Dugway are addressed separately below.

1. Potential Aircraft Impacts

37. Aircraft conducting air-to-ground attack training do so over targets that are located more than 20 miles from the PFSF site and aircraft conducting air refueling training do so on the far western side of the UTTR, over 50 miles from the site. Id. at 29-32. Thus, by virtue of their distance from the PFSF, such aircraft do not pose a crash impact hazard to the facility. Id. Fighter aircraft conducting air to air combat training conduct their aggressive, higher risk maneuvering toward the center of the restricted areas on the UTTR, well over 10 miles from the PFSF. Thus, as a practical matter, those aircraft also do not pose a crash impact hazard to the facility. Nevertheless, we calculated a conservative upper bound probability that fighter aircraft conducting air to air combat training on the UTTR would crash and impact the PFSF.

38. The Air Force indicated 6,360 fighter sorties were flown on the UTTR South Area in 1998 and one-third, or approximately 2,120, involved fighter aircraft conducting air-to-air training. Aircraft Report at 34.

39. The crash impact probability for fighter aircraft conducting air-to-air training on the UTTR was calculated as follows:

$P = C_a \times A_c \times A/A_p \times R$, where

P = annual crash impact probability
C_a = total air-to-air training crash rate per square mile on the UTTR
A_c = the area of the UTTR from which aircraft could credibly impact the PFSF in the event of a crash
A = effective area of the PFSF in square miles
A_p = the footprint area, in which a disabled aircraft could possibly hit the ground in the event of a crash
R = the probability that the pilot of a crashing aircraft would be able to take action to avoid hitting the PFSF

Aircraft Report at 32-33.

40. The total air-to-air training crash rate per square mile on the UTTR, C_a, was calculated from the total number of hours flown in air-to-air training on the UTTR South Area (2,468), the crash rate per hour for fighter aircraft (the F-16) in combat training (3.96 E-5), the distribution of air operations over the sectors of the UTTR nearest the PFSF, and the ground areas of those sectors. Aircraft Report at 34a-37d. As with the F-16s transiting Skull Valley, 95 percent of the crashes on the UTTR attributable to engine failure or some other cause leaving the pilot in control of the aircraft were determined not to pose a hazard to the PFSF, in that the pilot would retain control of the aircraft and would be able to avoid the site. Id. at 42-43. Based on Air Force data, 45 percent of all F-16 crashes occurring during combat training are attributable to engine failure; thus the factor R in the equation above was calculated to be 1-(45% x 95%), or 0.573. Id.

41. The area from which an aircraft could credibly impact the PFSF in the event of a crash, A_c, was taken to be the portion of the UTTR within 10 miles of the PFSF and outside a three-mile buffer zone assumed to exist on the edge of the UTTR restricted

areas. Id. at 37d-39c. A crashing aircraft more than 10 miles from the PFSF would have to be under control of the pilot in order to glide and reach the site, and the pilot would guide any such aircraft away from the site, which is outside the land boundaries and the restricted airspace of the UTTR. Id. at 37d-39. The buffer zone represents the fact that aircraft rarely fly within three miles of the edges of the restricted areas while conducting training on the UTTR. Id. at 37c-37d, 39. For the purposes of calculation, potential aircraft crashes during air to air combat training were assumed to be evenly distributed over the restricted areas in which the training takes place, outside the buffer zone. This is conservative, in that the aggressive maneuvering, that leads to most mishaps and by far the most mishaps in which the pilot does not retain control of the aircraft, occurs toward the center of the restricted areas, not toward the edges. Hence, most UTTR accidents that would theoretically pose an impact hazard to the PFSF would actually occur too far away for the aircraft to reach the facility. See id. Tab Y.

42. The site effective area, A, was determined as above for a facility at a full capacity of 4,000 storage casks. Id. at 40. The footprint area, A_p, was calculated by assuming that a crashing aircraft could glide in any direction up to a distance equal to the product of its starting altitude above ground and its glide ratio. Id. Accordingly, the aircraft conducting air-to-air training over the UTTR were divided into altitude bands and an impact probability calculated for each band. Id. at 39-42. Aircraft too low to glide to the PFSF in the event of a mishap were calculated not to contribute to the crash impact hazard, in that they would have no chance of reaching the site. Id. at 39a-39b.

43. The maximum annual air crash impact probability for aircraft conducting air-to-air training on the UTTR South Area was calculated from the sum of impact probabilities of the altitude bands to be 7.35 E-8. Id. at 43-43a. If we assume that the total number of fighter sorties on the UTTR would increase in proportion to the increase in F-16 sorties flown from Hill AFB (which is conservative, since not all fighter aircraft that fly on the UTTR are F-16s based at Hill), then this probability would increase by a factor of 1.516, to a probability of 1.11 E-7.

44. Nevertheless, as discussed above, this result is highly conservative, in that the crashes on the UTTR that would leave the pilot without control of the aircraft and the ability to avoid the PFSF would occur toward the center of the restricted area ranges, far from the site. Moreover, while it might be possible for an aircraft to glide 10 miles after an in-flight mishap, it is highly unlikely that a pilot experiencing such a mishap that far from the PFSF would fail to turn his aircraft away from it before ejecting. As the Aircraft Report shows, if it is assumed that a crashing aircraft from the UTTR would glide no more than five miles toward the PFSF, then the hazard posed to the PFSF by UTTR operations would be zero. Id. at 44. Therefore, as a practical matter, the risk to the PFSF from aircraft conducting training on the UTTR is negligible. Indeed, State of Utah witness Lt. Col. Horstman agreed that "if an airplane has a problem up there [on the UTTR], it's not going to make it to Skull Valley, it's going to go to Michael [Army Airfield] or it's going to crash before it gets there, it's that simple." Horstman Dep. at 218.[6]

2. Weapons Use on the UTTR

45. Military aircraft conduct air-to-ground attack training and weapons testing using air-delivered ordnance on the UTTR South Area. Nevertheless, the use of air-delivered ordnance on the UTTR does not pose a potential hazard to the PFSF. See Aircraft Report at 30-32, 76-77. The PFSF site is located to the east of the easternmost land boundary of the range and over 20 miles from the nearest target for air-delivered ordnance on the UTTR. Id. at 28, 30. Weapons use on the UTTR is strictly controlled and, as stated above, the UTTR has never experienced an unanticipated munitions release outside of designated launch/release areas. Id. at 77. Master Arm switches are not actually armed until the aircraft are on the ranges within the UTTR where the bombs are to be dropped. Id. All armament switches are on "safe" until the aircraft are inside DOD land boundaries. Id. Furthermore, the targets on the UTTR are all over 20 miles from the PFSF site and there are no run-in headings for weapons delivery over the Skull Valley

[6] Lt. Col. Hugh Horstman, USAF (Ret.) was named by the State as an expert witness on Contention Utah K.

area. Id. at 30, 76-77. Therefore, weapons use on the UTTR does not pose a hazard to the PFSF.

D. Aircraft Flying on the Moser Recovery

46. Most of the F-16s returning to Hill AFB from the UTTR South Area exit the northern edge of the range (away from the PFSF) in coordination with air traffic control. However, some aircraft returning to Hill from the UTTR South Area may use the Moser recovery route, which runs from the southwest to the northeast, approximately two miles from the PFSF site. Aircraft Report at 48. The Moser route is only used during marginal weather conditions or at night under specific wind conditions which require the use of Runway 32 at Hill AFB. Id. at 48-48a. Based on information from local air traffic controllers, conservatively estimated, the Moser recovery is used by less than five percent of the aircraft returning to Hill. Id. at 48a-49. Indeed, Lt. Col. Horstman stated that Moser was not used at all in 1998. Horstman Dep. at 189-90. He knew of only four flights that used Moser in 1999. Id. at 189. According to the Air Force, 5,726 F-16 sorties were flown on the UTTR South Area in FY98, almost all of which flew from Hill AFB (not all aircraft transit Skull Valley en route to the South Area). Thus, at the very most, fewer than 286 aircraft per year (5% x 5,726) would use the Moser recovery on their return flights. Id. at 49.

47. The average annual crash impact probability for aircraft flying the Moser recovery was calculated using the same method used for calculating the hazard from F-16 flights through Skull Valley. Aircraft Report at 49. The Moser recovery is defined as an airway with a width, *w*, of 10 nautical miles (11.5 statute miles) (equal to the width of military airway IR-420). Id. The number of aircraft, *N*, is very conservatively taken to be 286; the crash probability, *C*, is equal to 2.736 E-8 per mile; the effective area of the site is 0.1337 mi^2; and it is calculated that 85.5 percent of all crashes would be attributable to events leaving the pilot in control of the aircraft, in which the pilot could direct the aircraft away from the PFSF. Id. at 49-49b. Thus, the annual crash impact probability is conservatively estimated to be 1.32 E-8. Id. at 49. If this probability is increased to

reflect the additional sorties flown by F-16s from Hill AFB, it would increase by a factor of 1.516 to 2.00 E-8. But as discussed, PFS's estimate of the number of flights on the Moser recovery was very conservative to begin with.

E. Aircraft Flying to and from Michael AAF on IR-420

48. Michael Army Airfield is located on Dugway Proving Ground, 17 statute miles south-southwest of the PFSF. Aircraft Report at 56. This military airfield has a 13,125 foot runway, and can accommodate all operative aircraft in the Department of Defense inventory, although the majority of the aircraft flying to and from Michael AAF are large cargo aircraft such as the C-5, C-17, and C-141. Id. at 51. The airspace over the Dugway Proving Ground is restricted. Military airway IR-420 terminates north of the PFSF site; aircraft using IR-420 and flying to and from Michael AAF pass in proximity to the site. Id. at 51. The same method used to calculate the hazard to the PFSF from F-16s transiting Skull Valley was used to estimate the probability of an aircraft impacting the PFSF from this airway. Id.

49. NUREG-0800 provides an in-flight crash rate of 4 E-10 per mile for large commercial aircraft, which is appropriate to apply to the types of aircraft flying to and from Michael AAF. Aircraft Report at 51-53. Information provided to PFS by Dugway Proving Ground in 1997 stated that there are approximately 414 flights annually at this airfield. Id. at 55. The effective area of the PFSF is 0.2116 mi^2, calculated for the types of aircraft flying to and from Michael AAF, using the same method as was used to calculate the effective area of the PFSF for an F-16 above. Id. at 53a-54. The width of the airway is 10 nautical miles (nm), or 11.5 statute miles. Id. at 55. The probability of an aircraft impacting the PFSF is therefore 3.0 E-9 per year. Id. Takeoff and landing operations at Michael AAF would pose a negligible hazard to the PFSF because the airfield is over 17 miles from the PFSF. Id. at 56-60. This probability would not increase because of the additional F-16 sorties from Hill AFB, in that the aircraft flying to and from Michael in the direction of IR-420 are not F-16s from Hill.

F. Civilian Aircraft on Airways J-56 and V-257 Including Aircraft Flying to and from Salt Lake City International Airport

50. Airway J-56 runs west-southwest and east-northeast 11.5 statute miles north of the PFSF. Aircraft Report at 62. Airway V-257 runs north and south 19.5 statue miles east of the PFSF. Id. at 66. Traffic on J-56 and V-257 consists of commercial airliners and private business jets, including the traffic to and from Salt Lake City International Airport. Id. at 62, 66. The same method used to calculate the hazard to the PFSF from F-16s transiting Skull Valley was used to estimate the probability of an aircraft impacting the PFSF from both of these airways. Id. at 62, 66.

51. NUREG-0800 provides an in-flight crash rate of 4 E-10 per mile for large commercial aircraft, which is appropriate to apply to the types of aircraft flying on the airways. Aircraft Report at 65. Regional air traffic controllers have stated that fewer than 12 aircraft per day transit each airway. Id. at 62, 66. The effective area of the PFSF is 0.2116 mi^2, calculated for large commercial airliners, using the same method as was used to calculate the effective area of the PFSF for an F-16 above. Id. at 62-65. J-56 is eight nautical miles wide; V-257 is 12 nautical miles wide. Id. at 62, 66. The total probability that an aircraft flying on J-56 or V-257 would crash and impact the PFSF is therefore 3.1 E-8 per year. Id. at 65-66.

52. Takeoff and landing operations at Salt Lake City airport, which is approximately 50 miles from the PFSF, would pose no hazard to the facility. First, takeoff and landing hazards at a commercial airport generally extend out to no more than 10 miles from the end of the runway in question. See Aircraft Report at 56-60 (similar analysis for Michael Army Airfield). Second, using the method of NUREG-0800 to determine the magnitude of takeoff and landing hazards on the basis of distance from the airport and the annual number of operations there, we have shown that the risk to the PFSF is negligible. The risk posed by takeoffs and landings at an airport is insignificant and need not be considered if the number of takeoffs and landings per year is less than 1,000 x D^2, where D is the distance from the airport to the facility in question in miles.

NUREG-0800 § 3.5.1.6. In 1998, there were 365,000 takeoffs and landings at Salt Lake City airport.[7] To pose a significant hazard to the PFSF, there would have to be 2,500,000 takeoffs and landings at Salt Lake City (1,000 x 50^2). Therefore, the hazard to the PFSF posed by takeoffs and landings at Salt Lake City is insignificant. Furthermore, the FAA anticipates that the annual number of takeoffs and landings at Salt Lake City will increase by 53.1 percent, to 558,500, from fiscal year 1999 to fiscal year 2013.[8] If that is extrapolated for another 14 years, to FY2027, beyond the 20-year license term of the PFSF, the number of takeoffs and landings at Salt Lake City would be 855,000, still far less than 2,500,000. Thus, the hazard to the PFSF would remain insignificant.

G. General Aviation

53. The general aviation traffic over Skull Valley is negligible and thus general aviation would not pose a significant hazard to the PFSF. Aircraft Report at 67-73. There are no civilian airports within 25 miles of the PFSF. Id. at 70. The PFSF is located in a sparsely populated area, inside a military operating area (MOA) in which IFR flight by civilian aircraft is restricted while the MOA is being used by the Air Force (and which is avoided by general aviation pilots because of the military operations being conducted within the MOA). Id. at 67. Thus, the general aviation traffic over Skull Valley is negligible; in fact F-16 pilots who have flown from Hill AFB through Skull Valley, including Col. Fly, indicate never having seen general aviation traffic there. Id. at 67-68. Indeed, State of Utah witness Lt. Col. Hugh Horstman, who also flew F-16s over Skull Valley agreed that the general aviation traffic there was "minimal." Horstman Dep. at 220-21.[9] Therefore, it is highly unlikely that a general aviation aircraft would crash into the PFSF.

54. Nevertheless, we calculated a highly conservative upper bound on the crash impact probability for general aviation aircraft using National Transportation Safety

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[7] Federal Aviation Administration, FAA Administrator's Handbook (Mar. 1999) at 12.

[8] Federal Aviation Administration, 1999 Aviation Capacity Enhancement Plan (2000) at A-8.

[9] Deposition of Lt. Col. Hugh Horstman (Dec. 11, 2000) ("Horstman Dep.").

Board (NTSB) crash data and the population of general aviation aircraft in the state of Utah. See Aircraft Report at 69-73. The crash impact probability is equal to C_a x A, where C_a is the crash rate per square mile and A is the effective area of the PFSF. Id. at 70a-71. In 1995, the 182,600 general aviation aircraft in the United States suffered 412 fatal accidents. Id. at 69-70. There are 1,218 general aviation aircraft in the state of Utah, which covers an area of 84,094 mi^2. Id. at 69. FAA crash data indicate, however, that only 15 percent of all general aviation crashes occur during the cruise mode of flight, which, because there are no airports nearby, is the mode in which general aviation aircraft would be flying near the PFSF. Id. at 70. Furthermore, business jets experience 7.85 percent of all general aviation fatal crashes and they can be excluded from this calculation, in that they fly mostly on federal airways. Id. The effective area of the PFSF with respect to general aviation aircraft crashes is 0.1173 mi^2 (assuming a fully loaded facility with 4,000 casks). Id. at 68-69. Accordingly, the average annual crash impact probability for general aviation aircraft is 5.25 E-7. Id. at 71.

55. Despite the calculated impact probability, however, the crash impact hazard to the PFSF from general aviation is, as a practical matter, zero because the spent fuel storage casks would be able to withstand the crash impact of the general aviation aircraft that might be found in Skull Valley. First, fifty-five percent of all general aviation aircraft are single-engine piston types weighing less than 3,500 lbs. Id. at 71. Such aircraft typically fly at speeds under 130 knots (150 mph). During a power off glide during a forced landing, which would be the most likely crash scenario at the PFSF, the airspeed is normally well below 100 knots (114 mph). See id. at 71a-72. Therefore, the impact of such aircraft at the PFSF would be bounded by the design basis tornado missile impact for the PFSF, an automobile weighing 1800 kg (3,968 lbs.) moving at a speed of 126 mph. PFSF SAR at 8.2-17. Thus, the impact of such light general aviation aircraft would not cause a radioactive release from a storage cask. Therefore, the calculated general aviation crash impact hazard to the PFSF can be reduced by 55 percent to 2.36 E-7. Id. at 72. As stated above, however, even this probability is highly conservative given PFS's

use of a state-wide average crash rate when the level of general aviation traffic in Skull Valley is negligible.

56. Second, a more detailed assessment of the ability of a crashing general aviation aircraft to penetrate the storage casks that would be used at the PFSF shows that such aircraft would not penetrate the casks and thus would not cause a release of radioactive material from the PFSF. See Declaration of Jeffrey R. Johns (Dec. 27, 2000). In that calculation, PFS shows that a crash of a general aviation aircraft with a weight of 12,500 lbs. or less (which would be those aircraft other than jets, which as noted above, would fly on federal airways rather than through the Sevier B MOA and Skull Valley) would not penetrate a storage cask. The calculation is based on the penetration capability of the aircraft engine with the greatest kinetic energy at impact. The calculation conservatively assumes, moreover, that an engine weighing 800 lbs. (the heaviest engine) could have a diameter as small as 12 inches. In fact, based on discussions with the General Aviation Manufacturers Association, a general aviation aircraft engine weighing 800 lbs. would have a rough diameter of approximately 35 inches. Thus, the penetration calculation is very conservative. Because the calculation shows that a crashing general aviation aircraft would not penetrate a storage cask at the PFSF (in addition to the traffic level being negligible), the hazard to the PFSF from general aviation aircraft accidents may be taken to be zero.[10]

H. Cumulative Hazard to the PFSF from Aircraft Accidents

57. Summing the aircraft impact probabilities from the potential aviation accidents assessed above, including potential impacts of jettisoned ordnance, the cumulative hazard to the PFSF is 6.25 E-7/year, which is below the applicable risk standard. Therefore, potential aircraft accidents do not pose an unacceptable hazard to the PFSF.

58. The results of our assessment are tabulated below.

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[10] This calculation was performed after the publication of the Aircraft Report and this was not included in it.

Calculated Aircraft Crash Impact Probabilities	
Aircraft	**Annual Probability**
Skull Valley F-16s	3.11×10^{-7}
UTTR Aircraft	1.11×10^{-7}
Aircraft Using the Moser Recovery	2.00×10^{-8}
Aircraft on Airway IR-420	3.0×10^{-9}
Aircraft on Airway J-56	1.9×10^{-8}
Aircraft on Airway V-257	1.2×10^{-8}
General Aviation Aircraft	0
Cumulative Crash Probability	4.76×10^{-7}
Jettisoned Military Ordnance	1.49×10^{-7}
Cumulative Hazard	6.25×10^{-7}

IV. RESPONSES TO CRITICISMS OF THE STATE OF UTAH

59. In recent responses to PFS discovery requests, the State of Utah asserted that PFS's assessment of the probability that an aircraft would crash and impact the PFSF was deficient in some respects.[11] Specifically, the State claimed that first, additional F-16 aircraft will be stationed at Hill AFB and hence the number of sorties flown over Skull Valley and on the UTTR will be higher than what PFS assumed. Second, PFS assertedly used a crash rate that was too low for Skull Valley and UTTR military flight operations, in that 1) the F-16 will begin to experience a higher crash rate in the future as it gets older, due to an asserted "bathtub effect" in aircraft crash rates and 2) the F-16 will be replaced by a new aircraft sometime in the next 40 years and new aircraft typically have high crash rates. Third, the State claims that PFS incorrectly assumes a random distribu-

[11] State of Utah's Supplemental Response to Applicant's First Set of Discovery Requests for Contention Utah K (Dec. 5, 2000); see also Memorandum from Matt Lamb and Marvin Resnikoff to Hugh Horstman (Dec. 5, 2000) ("Lamb/Resnikoff Memo"), attached as Exhibit 9.

tion of flights through Skull Valley, in that if the PFSF is built, F-16 pilots will aim at the facility in order to calibrate their instruments before entering the restricted areas on the UTTR. Fourth, the State asserts that PFS overestimates a pilot's ability to avoid the PFSF in the event of a mishap leaving the pilot in control of the aircraft, in that 1) PFS does not account for variations in pilot experience and 2) bad weather may obscure the PFSF from the view of the pilot and hence impede his ability to guide his aircraft away from the site before ejecting. PFS responds to all of the State's claims here.

A. Additional F-16 Aircraft and Sorties

60. PFS has addressed the additional aircraft that will be stationed at Hill AFB above, in the section in which PFS describes its calculation of the aircraft crash hazard to the PFSF. PFS has also addressed the additional sorties that the F-16s currently stationed at Hill flew in FY99 and FY00. PFS assumed that the total sorties (adjusted to reflect FY99 and FY00 operational levels) would increase proportionally to the increase in the number of F-16s at the base. The effect of this are included in 58 above.

B. Skull Valley and UTTR Crash Rates

1. F-16 Crash Rates and the "Bathtub Effect"

61. The State of Utah asserts that a "bathtub effect" is exhibited by aircraft accident statistics that show that in the life cycle of an aircraft model (e.g., F-16), high accident rates are seen as the aircraft is introduced. Horstman Dep. at 75-77. As pilot and maintenance experience are gained and problems are fixed, the accident rate decreases for most of the life of the aircraft model, then increases again as the aircraft reaches the end of its life cycle because of mechanical fatigue and aging. This argument is allegedly buttressed by the observation that the F-16 accident rate for FY-99 increased. Purportedly, this presages increased accident rates in the future for the F-16.

62. This assertion, insofar at least as the F-16 is concerned, is without basis for the following reasons. First, the F-16 Class A mishap accident rate for FY-2000 has

actually decreased to 2.63 per 100,000 flight hours[12] compared to a rate of 5.11 per 100,000 hours for FY-99. It is also significantly (28%) below the FY-99 10 year average rate of 3.67 per 100,000 hours.[13] Therefore, taking the one-year FY-99 numbers as a trend would be seriously misleading. The best way to understand these accident statistics is to take a multi-year average. Three-year, 5-year and 10-year averages progressively dampen single year fluctuations. The shorter the average, the more variability there is and the more likely one is to mistake a short term aberration for a trend. As discussed in the Aircraft Crash Report (p. 11), a 5 or 10-year rate is most useful. Both the 5-year and 10-year averages show a level or steadily decreasing accident rate over the life of the F-16, even with the FY-99 figures. A graph of those averages is attached as Exhibit 8. Adding the FY-00 numbers would bring the averages down more.

63. Second, accident rates are decreasing for the total Air Force aircraft inventory as well as for the F-16 because of better maintenance, parts control, improved inspections, built-in tests and fault reporting, better pilot training and other improvements. Air Force commanders are focused on safety and will routinely reallocate resources to reduce and manage risk. According to the Air Force Chief of Safety, the Air Force experienced its lowest accident rate ever in FY2000.[14] The broad trend is illustrated by Figure 2 in the Aircraft Crash Report (behind p. 9), which shows that accident rates for Air Force single engine fighter aircraft have decreased greatly over the past 50 years. There is no reason to believe that the trend will not continue into the future.

64. Third, a study of aircraft accident rates on other fighter aircraft that have been phased out of the inventory within the last 20 years does not show a rise at the end of their lives. There are some anomalies in rates towards the very end of the life cycle of

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[12] Curt Lewis, American Airlines Flight Safety, www.aasafety.com. Flight Safety Information (03NOV00-254), attached as Exhibit 6. American Airlines distributes articles in the press concerning aviation safety to the aviation industry.

[13] Air Force Safety Center F-16 statistics, as of January 10, 2000. Exhibit 7.

[14] Secretary of the Air Force, Public Affairs, News Release (Oct. 3, 2000).

some aircraft, where a single Class A mishap causes a large spike in the rate. This is because the number of flying hours has decreased drastically from the norm because of the sharply decreased number of aircraft remaining in the inventory. This causes a large rate change based on a single accident. This does not mean that aircraft are falling out of the sky everywhere. It only means that there are only a few aircraft of that model still flying. The risk to a facility on the ground is actually decreasing since the total number of aircraft flying, the number of sorties, the number of flight hours and the number of accidents are all decreasing.

65. The aircraft that have been phased out of the active inventory most recently are the F-111 (FY98); the F-106 (FY97); and the F-4. The F-4 is still flying a small number of hours (4,306 in FY99) but is essentially phased out. All of these aircraft exhibit the trends of decreasing or level accident rates relative to the mid-life rates except when flying hours are very low. The F-106 (Exhibit 10) is a good example of the effect of an accident when there are only a few aircraft flying and flying hours are low. The F-106 began phase-out in 1984 and most were gone by 1988. Rates (but not accidents) for that aircraft skyrocketed in its last years after 1990, but it was flying less than 100 hours in each of those years. In several cases for the F-106, e.g., in FY1992 and FY1995, the rolling average rates rose even when there were no accidents, because of the fewer number of hours being added to the denominator of the moving average equation to replace larger numbers from earlier years. Exhibits 9 through 11 show the number of flight hours and the 5-year and 10-year average crash rates for the F-111, the F-106, and the F-4, respectively.

66. Looking specifically at flying hour and accident statistics for the F-16A model, the first model of the F-16 introduced to the Air Force and therefore the oldest of the F-16s, it is apparent that most of them have been retired. As may be seen on the charts attached as Exhibit 12, flying hours were at a peak of about 170,000 hours per year in the FY 1984 to FY 1988 time frame, then have steadily decreased to about 20,000 hours in FY 1999. This indicates about a 90% decrease in the inventory of F-16A aircraft

as they are being phased out. Despite this, the accident rate has steadily gone down. Therefore, there is no reason to expect F-16 accident rates to increase in the future.

67. This observation is confirmed by statistics for the F-15A, which was also the first model of the F-15. It is the oldest of the F-15s and like the F-16A, is being phased out of the inventory. As shown in the charts attached as Exhibit 13, the F-15A flew in the neighborhood of 65,000 to 75,000 hours per year between 1980 and 1992, but it has now dropped to about 20,000 hours per year for the last 5 years, indicating about a 70% drop in the inventory of F-15A aircraft. Despite this, the number of destroyed aircraft has been 0 or 1 each year since 1987, and the accident rates show a commensurate decrease from the earlier mid-life years. (Again, the 5 year rate is showing a gradual increase, even in years when there were no accidents, because of the small number phenomenon explained in Para 65 above. The 10 year rate continued its general decrease or leveling off from the mid-life rates.)

68. For all of the above reasons, the 10-year average accurately represents what one should expect the rates to be in the future. Therefore, PFS does not need to change the accident rates for the F-16 used in its assessment.

2. Replacement of the F-16

69. The State of Utah also asserts that the introduction of a new fighter aircraft is always accompanied by a high accident rate as the aircraft comes into the inventory and is only decreased as the bugs are worked out of the system and the pilots learn its characteristics.. State Dec. 5 Disc. at 4; Lamb/Resnikoff Memo at 2. Thus, the State claims that the new F-22 will be a greater hazard to the PFSF than the F-16 if it is assigned to Hill AFB as a replacement for the F-16 in the future.

70. Relatively higher fighter accident rates upon introduction to initial service were the case in the past, even with the F-16, which was first delivered to the active inventory in 1978. However, it should be emphasized that the actual initial accident rates have been generally declining. As demonstrated by Figure 2 in the Aircraft Crash Re-

port, behind page 9, initial accident rates (first spikes) have decreased significantly since the F-86 was introduced in 1950. Other aircraft introduced into the inventory in the last 30 years are the F-15 (FY74) and the A-10 (FY75). If plotted on the same Figure 2, the F-15 rate would be 10.14 and the A-10 rate would be 9.27, both below the initial F-16 rate. All of these aircraft were introduced over 20 years ago, with design technology which is now 25 to 30 years old. A further reduction in introduction accident rates is to be expected due to increased skill in designing aircraft with computer modeling and to large scale use of high fidelity simulator training for pilots so that they already know the characteristics of the aircraft before they fly. As well, the aircraft control systems and instrumentation have also improved markedly over the recent years with advances in electronics and computer power. (The F-117 stealth fighter was introduced into the inventory in 1982 but accident data on its early years is still classified and unavailable).

71. There is therefore no reason to expect that the newest computer designed aircraft, the F-22, would not be safer than the F-16 during its introduction and throughout its total life cycle, continuing a trend in fighter aircraft. Moreover, the F-22 is a twin-engine aircraft. As such, because engine failure is a significant cause of aircraft accidents, the F-22 accident rate will likely be even lower than what would be suggested by the use of modern technology in its design and construction, discussed above. Indeed, a comparison of F-16 (single engine) and F-15 (twin engine) accident rates shows that over the last 10 years, the F-15 rate has been only 50.3 percent of the F-16 rate. See Horstman Dep. at 85.

72. Finally, it is unclear that the F-22 would be a replacement for the F-16 or that it would be stationed at Hill AFB. The F-22 is specifically intended to be an air superiority fighter that would replace the F-15 and there are no F-15s stationed at Hill AFB. Horstman Dep. at 84. Moreover, the Air Force has not yet decided how many F-

22's to buy nor where to station them.[15] One informed source (Air Force Magazine, Journal of the Air Force Association, May 2000) states that Langley AFB, Virginia is the preferred F-22 unit location. The October 2000 issue states that the Air Force F-22 training will be accomplished at Tyndall AFB, Florida with 2 F-22 squadrons. So any argument about the F-22, or some other future aircraft (e.g., the Joint Strike Fighter) coming to Hill AFB and experiencing higher crash rates is highly speculative at this point.[16]

C. Distribution of F-16 Flights in Skull Valley

73. The State has raised an attractive nuisance argument concerning the proposed PFS facility. The State argues that F-16 pilots transiting Skull Valley will all point at the PFSF site sometime during their transit through the valley to update their sensors,[17] use it as a navigation turn point or maintain their prescribed position relative to other aircraft in their flight[18]. Because the F-16 pilots will point at the PFSF at some point in time, the State claims, the risk to the facility from a crash will increase. The State essentially asserts that if the facility is built, the predominant flight paths and activities which currently take place in Skull Valley will be fundamentally changed and therefore the PFS analysis no longer accurately reflects the potential risk proposed by military aviation.

74. The State fails to recognize key points in the PFS analysis. First, although the Air Force has indicated that the predominate route used by F-16 pilots favors the eastern portion of Skull Valley[19], the analysis assumed a random, even distribution of F-

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[15] See, e.g., Greg Schneider and Thomas E. Ricks, Fighter Jet Faces New Scrutiny, Budget Crunch, Changing World Threaten $200 Billion Project, Wash. Post, December 28, 2000 at E1 (the Joint Strike Fighter, a potential replacement for the F-16, may be cancelled to pay for higher priority defense projects).

[16] Ibid.

[17] Resnikoff, paragraph 4. Decreased Effective Flight Area in Skull Valley.

[18] Horstman Dep. at 229-230.

[19] Aircraft Crash Report at 5.

16 flights over Skull Valley,[20] thereby effectively overstating the risk associated with current F-16 operations. This risk is certainly overstated when considering the proposed location for the PFS site, its proximity to restricted airspace to the west and to the south, and the routes of flight available to the pilots which will reasonably keep the pilots within the lateral confines of the MOA.[21] The geometry of the MOA induces a natural funneling effect on flights proceeding south through the narrow "neck" of the MOA east of Dugway Village, which makes the eastern side of Skull Valley (away from the proposed site) the preferred route of flight.

75. Pilots routinely perform a number of administrative tasks while transiting Skull Valley. These include: operations (ops) checks, where pilots will check the operating status of the airplane, fuel quantity and distribution, and oxygen system operation; G-awareness maneuvers where the pilot accelerates and then performs two 90° turns to check his ability to withstand G-forces and proper operation of the anti-G suit; and a "fence" check where the pilot positions certain cockpit switches as though he were preparing to cross into hostile territory. There is no prescribed order in which to do these different series of checks and pilots have different habit patterns regarding when and how they accomplish the checks. It is reasonable to assume that pilots will continue to do these routine tasks while transiting Skull Valley whether or not the PFS facility is built.

76. The State infers that pilots will use the proposed PFS site as the primary navigation point in Skull Valley.[22] Nevertheless, the State fails to give adequate consideration to the prominent mountain ranges on both sides of Skull Valley that provide excellent visual references for maintaining positional awareness and that obviate the need for a specific turn point while performing the other tasks pilots routinely perform during this phase of flight. In addition, there are other cultural features, such as ranches that can

[20] Id., at 6.

[21] Id., Tab A.

[22] Horstman Dep. at 121, 124, 126.

be used for turn points if desired. Many of these are located east of the proposed PFS site which will allow pilots to fly more directly toward the narrow "neck" of the MOA at the southern end of Skull Valley.

77. The State contends that the proposed PFS site will become a magnet for pilots and result in a significant redistribution of F-16 flights through Skull Valley.[23] The State's argument is based in part upon the lack of significant sensor signal returns from cultural (i.e., man-made) objects upon which to align the aircraft sensors, as well as for navigation as previously discussed. The State admits, however, that there are no requirements to update the sensors or to update them on any particular point,[24] that pilots update their sensors at different times,[25] and that even if a pilot chooses to update his sensors he may turn anywhere from 10 miles short of the navigation point on which he updates his sensors to where he is directly above the navigation point.[26]

78. We understand that the proposed site will be a prominent feature in Skull Valley and that some pilots may use it as a reference point for navigation, sensor alignment, or both. However, the State overestimates the impact of building the proposed facility and we do not agree that it will result in a significant change to the flight distribution pattern described in the original report.

79. First, as noted previously, the current practice is for F-16s to fly toward the eastern side of the MOA for airspace considerations and to practice terrain masking. The PFS site is located toward the western side of the MOA away from the narrow "neck" at the southern portion of Skull Valley. Pilots must still contend with the airspace limitations regardless of whether or not the PFS facility is built.

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[23] Id. at 229-230.

[24] Id. at 159.

[25] Id. at 123, 160.

[26] Id. at 229-230.

80. Second, pilots will still be required to do those routine functions and checks discussed previously in 75. Skull Valley will remain a good location to complete these checks.

81. Third, there are other points more favorably aligned with the narrow "neck" of the MOA that can be used for navigation and sensor alignment if desired. The PFS access road which will connect the proposed facility with Skull Valley Road approximately two miles to the east will be an additional such point that can be used although it will lack the vertical build up of the PFS facilities.

82. Fourth, the State assumes a pilot must be pointed directly at the facility to update the sensors; this is not necessarily required. While as a practical matter most pilots will have the object fairly close to the nose of the airplane, to update using references on the pilot's Head Up Display (HUD), the point only needs to be within the HUD field of view (approximately 20° either side of the aircraft nose and not more than approximately 10° below the horizon). To update using the radar, a 15° angle minimum away from the nose of the aircraft provides a much more precise radar picture for the pilot. To align the targeting pod on the F-16, pilots are normally at medium altitude (15,000 to 17,000 ft MSL for Skull Valley, although they could be higher if airspace restrictions were not a factor), since the targeting pod is normally employed in the medium altitude environment. To align the targeting pod, the reference point should be within the HUD field of view, which would put the airplane at least 11.3 miles at 15,000 MSL (10,500 AGL with a 10° look down angle) away from the sensor point. This represents the closest distance at which the pilot would be able to align the targeting pod with the HUD.

83. Fifth, the State is in essence stipulating that the proposed PFS facility will be well known to all pilots since they will use it regularly as a primary visual reference point. This makes the conservative allowances built into the original PFS calculations regarding a pilot's ability to see and avoid the PFSF in the event of a mishap unnecessary, which decrease the original probabilities calculated. As discussed elsewhere, PFS

assumed that 5 percent of the time a pilot would fail to avoid the PFSF in the event of a mishap that left him in control of the aircraft, even though PFS's review of F-16 mishap reports over the last 10 years revealed no case where a pilot failed to avoid a site on the ground when he had the time and opportunity to see and avoid it.

84. The State seeks to find a higher risk to the PFSF site by changing the distribution of the flights within the Sevier B MOA based on the visibility of the site to the pilot without taking into account concomitant changes to the other parameters of the risk equation, namely the percentage of pilots who could now avoid crashing into the site because of their perfect situational awareness of its location and the elimination of any weather effect from site obscuration.

85. Finally, the State is using a specific observation that the site will be plainly visible and speculating that it will significantly change overall F-16 flight patterns without providing any supporting analysis that addresses the airspace limitations and other factors, discussed above, which impact and help shape the current operations and flight distribution pattern.

86. The conservative assumptions used in the original calculations adequately allow for any redistribution of F-16 flight operations should they occur as a result of building the proposed PFS facility. As noted, the State's argument is speculative in nature and not supported by empirical data or analysis.

D. Avoidance of the PFSF in the Event of a Mishap

1. Pilot Experience

87. During his December 11, 2000 deposition, State witness Lt. Col. Horstman asserted that when PFS determined that an F-16 pilot would be able to guide his aircraft away from the PFSF in 95 percent of the mishaps in which the pilot was left in control of the aircraft, PFS did not account for variations in pilot experience. Horstman Dep. at 173. Lt. Col. Horstman agreed that all pilots in such circumstances would intend to avoid the PFSF. Horstman Dep. at 172-73. He stated that the probability that a pilot

would succeed would be higher for more experienced pilots. Id. at 173. He then stated that only 60 percent of the Air Force's F-16 pilots are "experienced" in terms of the number of flying hours they have in the aircraft. Id. at 173-77. Lt. Col. Horstman then asserted his belief that PFS's assumption that pilots would be able to avoid the PFSF 95 percent of the time was too high because of the potential for inexperienced pilots to be involved in mishaps, but he did not know what the actual percentage should be. Id. at 175-77, 181, 185.

88. In assessing the Lt. Col. Horstman's assertion, it is important to note that during Lt. Col. Horstman's deposition and the December 12, 2000 deposition of Col. Fly,[27] the word "experienced" was used in two different contexts as it relates to pilots. The first context is commonly understood and is relevant to a pilot's ability to avoid the PFSF; the second context stems from an Air Force management tool used to maintain a balance between more junior and senior pilots it its fighter wings. Col. Horstman's reference to 60 percent of F-16 pilots being "experienced" is concerned with the latter, and not the former. See Horstman Dep. at 173-74.

89. One usage of the term "experienced" is the commonly understood noun "practical knowledge, skill, or practice derived from direct observation of or participation in events or in a particular activity[28]". In this context, a typical pilot who completes pilot training, initial F-16 training, and is then assigned to an operational fighter wing, would be considered "experienced" in terms of practical knowledge, skill or practice derived from direct participation in a particular activity, flying an F-16. Admittedly, a pilot who has been flying the F-16 for ten years is more experienced than one who has been flying it for two years. However, the basic purpose of pilot training, F-16 initial training and the mission ready training after arriving at the operational wing is to provide a sufficient level of experience to proficiently operate the F-16 under routine and emergency condi-

[27] Deposition of Col. Ronald Fly (Dec. 12, 2000) ("Fly Dep.").

[28] Merriam-Webster Collegiate Dictionary, electronic on-line version definition 2.a.

tions at home station and successfully conduct combat sorties when deployed for contingency operations.

90. The other usage of the term "experienced" is a management tool used by the Air Force related to specific pilot flying time. It is a quantitative definition used to distinguish those pilots with more flying hours in the F-16 ("experienced" pilots) from those with fewer hours ("inexperienced" pilots). There is no qualitative assessment of an individual pilot associated with this quantitative categorization. A typical pilot who completes pilot training, initial F-16 training and is then assigned to an operational fighter wing, is considered "experienced" only after he has 500 hours of flying time in the F-16.[29] This reclassification is automatic when the pilot completes the requisite number of hours. There is no prescribed level of performance or any specific evaluation associated with a pilot moving from the "inexperienced" into the "experienced" category. It is worth noting that many "inexperienced" pilots fully participated in the Persian Gulf War and combat operations in Bosnia and Kosovo.

91. Rather, the Air Force uses the "inexperienced" and "experienced" categories primarily as a management tool. The general guidelines are to have a 40/60 split of inexperienced/experienced pilots in an operational fighter wing. This ensures there is adequate intake of new pilots into the force structure to maintain a viable fighter force over time. The AF must ensure there are adequate accessions to provide a pool of individuals available to meet the demands for "experienced" fighter pilots to fill positions such as: undergraduate pilot training instructors, non-flying headquarters staff positions, etc., as well as those needed to fly the F-16. In addition, there is constant movement out of the AF by "experienced" pilots who either retire or elect to transition to civilian life prior to retirement.

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[29] Pilots with different backgrounds who have transitioned into the F-16 after flying some other USAF aircraft do not require 500 hours in the F-16. If they have flown another fighter, they may be "experienced" with as few as 100 hours in the F-16.

92. During our review of the 126 F-16 accident reports, there was nothing to indicate, in those cases in which a pilot took actions following an engine failure or other emergency in which he was able to control the airplane, that the pilot's limited experience would have caused him to fail to turn to avoid an inhabited area. As explained above and stated in the report (Aircraft Crash Report, Tab H at 28 n.22), in all of those cases where inhabited areas were indicated as a consideration, pilots did in fact turn to avoid them. This is in accordance with the standard training provided to new pilots. Aircraft Report at 19-19a.

93. Further, there are three factors that mitigate any concerns of pilot experience raised by the State. First, those accidents that were assessed as accidents which could have happened in Skull Valley were randomly distributed across the pilot population. As stated in the original report, mechanical engine failures constituted the vast majority of these accidents. These engine failures would be independent of pilot experience. Therefore, in assessing the ten years of accident reports, there was a reasonable distribution of these events over the spectrum of pilot experience. As a result, the initial report indirectly considered pilot experience in its analysis. Second, the report used a lower bound limit of 90% for the fraction of Skull Valley type accidents that would leave the pilot in a position from which he could maintain control of the aircraft after the initiating event for the emergency, as opposed to the 97% that is supported by consideration of the data in the F-16 mishap reports (see Aircraft Crash Report, Tab H at 13-20). Use of the lower bound 90% fraction increases the calculated probability that an F-16 experiencing a mishap in Skull Valley would not be able to avoid the PFSF. Third, in determining the fraction of pilots with control of their aircraft after a mishap who would fail to avoid the PFSF, PFS used a 5% allowance factor as a conservatism even though the analysis did not indicate such a conservatism was warranted. As discussed above, the F-16 mishap data support an assumption that in 100% of the cases in which a pilot remained in control of his aircraft after a mishap he would be able to avoid a site on the ground like the PFSF (i.e., according to the data, PFS's allowance factor for the failure to avoid the PFSF could be set at zero).

94. Therefore, adequate allowance was made for pilot experience in PFS's original assessment. No change in PFS's assumption that pilots would be able to avoid the PFSF in 95 percent of the mishaps that left the pilot in control of the aircraft is warranted.

2. Weather Effects

95. The State of Utah asserts that cloud cover in Skull Valley will increase the risk of an F-16 impacting the proposed PFS site. The state claims that Skull Valley has at least 5/10 (five-tenths) cloud cover 46.3 percent of the time in a given year and further asserts that consequently 46.3 percent of the time, F-16 pilots would be unable to see and avoid the PFSF in the event of an engine failure or other emergency. Lamb/Resnikoff Memo at 1, 3-4.

96. The State of Utah incorrectly interprets its cloud data and therefore incorrectly applies the effect of cloud cover on the probability of an F-16 impacting the proposed PFS site. In a memorandum to Hugh Horstman dated December 5, 2000, Matt Lamb and Marvin Resnikoff assert that cloud cover will prevent a pilot in control of a crashing aircraft (e.g. after an engine failure) from directing the aircraft away from the Private Fuel Storage Facility (PFSF) 45% of the time. Id. The basis for their assumption was assertedly a statement by Lt. Col. Horstman that 45% of the time annually, clouds obscure 50% of the sky at elevations below 10,000 ft (note: AGL or MSL unspecified). In his deposition on December 11, 2000, Lt. Col. Horstman stated that the basis for the statement he made to Mr. Lamb and Dr. Resnikoff was the International Station Meteorological Climate Summary for Dugway Proving Ground ("Climate Summary").[30] Horstman Dep. at 131-32.

97. The Climate Summary, submitted by the State, indicates there is cloud coverage greater than 5/10 (five tenths) 46.3% of the time on an annual basis. The State

[30] The Climate Summary is available at https://www.airfield-ops.hill.af.mil/osw/climo/kdpg.htm.

further claims this data is the sum of the cumulative cloud coverage up to an altitude of 12,000' Above Ground Level (AGL). See id. This is incorrect and results from the erroneous assumption that the chart is based on data collected by the Automated Surface Observing System (ASOS) which has a maximum cloud measurement capability of 12,000' AGL. The Climate Survey provided by the State is based upon the compilation of manual weather observations indicated on the report as "HOURLY OBS FOR: 6005-7012, 7301-7606, 8401-9004"[31]. This corresponds to May 1960 - December 1970, January 1973 – June 1976 and January 1984 – April 1990, all of which predates the use of ASOS in 1992. These sky cover observations were made on the basis of total sky coverage (expressed in tenths) without respect to cloud altitude. Thus all that can be determined is that cumulative sky coverage was observed to be greater than 5/10 (five tenths) 46.3% of the time with no basis for determining the altitude of the sky cover. Two tenths of cloud coverage at 1,000' AGL would be reported the same as two tenths at 30,000'. The Climate Summary, therefore, does not provide any useful data on the altitude of the various cloud layers nor of a pilot's ability to operate under visual flight rules (VFR), see the ground, or maintain general positional awareness using outside references. To have a better appreciation of the potential impact on flight operations in Skull Valley, it is necessary to have more information concerning the actual weather[32] and how it could affect the pilots actions. Specifically, as shown below the Climate Summary does not mean that the PFSF would be invisible to F-16 pilots transiting Skull Valley 46% of the time.

98. For example, there could be a solid deck of clouds at 11,000 ft. AGL with nothing below that. The Climate Summary reports at least 5/10 coverage. However, it would be possible for the pilot to operate VFR under the cloud deck without any restric-

[31] Telephone call between Mr. Steve Vigeant, Certified Consulting Meteorologist, and Mr. Al Wallis of the National Climatic Data Center, Asheville, NC.

[32] A more detailed weather database is attached. See also Declaration of Stephen Vigeant (Dec. 28, 2000). Portions of the historic ceiling and visibility conditions are summarized in Tables 1, 2 and 3. They will be discussed below.

tions. This would include all of the Sevier B airspace and approximately 6,000 ft. above it. If the pilot elected to operate VFR over the clouds, he would not be able to see the ground or any other features. In this situation, the pilot would use his Inertial Navigation System (INS) aided by the Global Positioning System (GPS) for navigation and positional awareness. Due to the narrowing of the Sevier B MOA near the area to the east of Michael Army Air Field, it would be reasonable for pilots to select a ground track that pointed them toward the center of the "neck" where the MOA narrows. This ground track would keep pilots away from the eastern boundary of the UTTR restricted airspace that slants toward the southeast in the southern portion of Skull Valley. This ground track would also tend to keep pilots away from the proposed PFS location as well. Pilots maintain their positional awareness by monitoring their bearing and distance to their selected INS steer point and cross referencing their map.

99. In a second example, the total cloud coverage could be reported as 5/10 by the Climate Summary, with a 1/10 layer at 3,000 AGL, a 2/10 layer at 5,000 AGL, and a 2/10 layer at 7,000 AGL. The sum of these is 5/10 cloud coverage. When looking at the distribution of the coverage however, it is reasonable to assume that F-16's could fly VFR at any altitude up to 12,000' AGL, the maximum altitude for cloud coverage contained in the Climate Survey. If they choose to fly at 3,000'AGL, 5,000'AGL or 7,000'AGL, they might have to adjust portions of their route of flight depending on where the actual clouds were, but they could operate at any of those altitudes. If the pilots elected to fly above the highest layer of clouds, it is reasonable to assume that they could maintain their positional awareness with ground references such as mountain ranges, major roads, cultural features, etc. Because of the cumulative cloud coverage however, there will be specific points or features that might not be visible. The pilot would still have awareness of the general location of those points and features.

100. In a third example, the area could be 8/10 covered by low altitude clouds at 1,000 ft. AGL. This would preclude VFR operations below the weather. In addition, it would preclude direct identification of most ground features in the relatively flat plain

areas in and around Skull Valley. However, pilots could easily operate VFR over the clouds. In Skull Valley they would be able to maintain positional awareness using the portions of the Stansbury and Cedar Mountains that rise above the clouds and that portion of the ground which is still visible. In addition, their INS would assist them with navigation as well.

101. There are innumerable variations to this theme, but they can conclusively show that in many possible circumstances where there is cloud coverage a pilot flying through Skull Valley would still be able to see the PFSF and his ability to avoid the site in case of an in-flight mishap would not be compromised by the clouds.

102. A more detailed investigation of the cloud cover in Skull Valley below, shows that the original, conservative analysis adequately allows for the effects of cloud cover and that no further adjustments to the probability of an F-16 impacting the proposed PFS site are required.

Michael Army Air Field

Local Standard Time	Ceiling > 2,500' & Visibility > 3NM[1]	Ceiling > 6,000' & Visibility > 3NM	Ceiling > 10,000' & Visibility > 3NM
1600	353.6[2]	313.3	276.0
2200	354.5	324.3	290.7
0400	352.6	320.2	300.3
1000	350.3	321.4	294.0
Average	352.8	319.8	290.3

Table 1

[1] Based upon a 13 year average of data collected by the National Weather Service.

[2] Average number of days per year the observed weather was greater than ceiling and visibility stated at the top of the column.

Salt Lake City Airport

Local Standard Time	Ceiling > 2,500' & Visibility > 3NM	Ceiling > 6,000' & Visibility > 3NM	Ceiling > 10,000 & Visibility > 3NM
1700	346.5	323.0	283.0
2300	344.3	317.4	280.2
0500	339.3	310.6	271.7
1100	338.2	309.4	274.1
Average	342.1	315.1	277.3

Table 2

Hill AFB

Local Standard Time	Ceiling > 2,500' & Visibility > 3NM	Ceiling > 6,000' & Visibility > 3NM	Ceiling > 10,000 & Visibility > 3NM
1700	343.7	305.4	267.7
2300	345.0	312.0	274.0
0500	344.3	307.6	269.0
1100	339.8	298.3	266.8
Average	343.2	305.8	269.4

Table 3

103. Tables 1, 2, and 3 show a more detailed breakout of actual ceiling[33] and visibility for Michael Army Air Field, Salt Lake City Airport, and Hill AFB respectively. Although they do not give a detailed breakout of cloud coverage in 1,000' increments, they do provide 3 different ceilings that might affect the pilots ability to fly VFR in Skull Valley and maintain positional awareness using visual references. The data for Michael Army Air Field (AAF) is considered the most like that in Skull Valley due to its proxim-

[33] A ceiling is cumulative cloud coverage of 6/10 (six tenths) or greater.

ity and location. This is supported by the Salt Lake City Airport data which is similar in elevation but closer to the Rocky Mountains to the east.

104. First, as shown in Table 1, Column 2 an average of approximately 353 days a year (96.6%) Michael AAF has a ceiling greater than 2,500 ft. and visibility greater than 3 miles. This is supported by the Air Force brochure describing the UTTR attached as Exhibit 13. The brochure states that the range has weather of at least a 3,000 ft. ceiling and 3 miles visibility 96% of the time. Further, on page 5 it states that the visibility is 10 miles or greater 95% of the time. With a 3000 ft. ceiling, an F-16 pilot can easily and safely transit Skull Valley at 2000 ft. AGL, i.e., 1000 ft. below the clouds, and maintain situational and positional awareness with respect to the location of the PFS site, particularly when the visibility is 10 miles greater. Thus pilots can operate in Skull Valley at low altitude with little to no impact from the weather. Maintaining positional awareness using outside references would not be a problem under these circumstances. Thus, a pilot would be able to avoid the PFSF in the event of an in-flight mishap.

105. Second, the 6,000 ft. ceiling listed in Table 1, Column 3 (Ceiling > 6,000' & Visibility > 3 Mi) includes all the vertical airspace in the Sevier B MOA.[34] It clearly indicates that pilots could fly through Skull Valley and the entire Sevier B MOA, using visual reference to the ground, mountains and cultural features approximately 88% of the time (320 days per year). By comparing the data in Table 1, Columns 2 and 3, it can be seen that only 7% of the time (95%-88%) would there be a ceiling between 2,500' and 6,000' in Skull Valley.

106. Although cumulative cloud coverage could mask some specific points or features, the pilots would still have a general awareness of their location. In addition, Deseret Peak at 11,031 ft. MSL provides an excellent and very specific reference for F-16's transiting Skull Valley.

[34] Sevier B MOA extends up to 9,500 ft. MSL or approximately 5,300 ft. AGL.

107. Third, as indicated in Table 1 Column 3, the ceiling is higher than 10,000 ft. AGL (14,200 ft. MSL) approximately 79% of the time (290 days per year). The 10,000 ft. AGL airspace includes all the airspace in the Sevier B MOA, 5,500' above the MOA and approximately 71% of all the airspace above Skull Valley below the Positive Control Airspace (PCA[35]). Thus pilots could maintain positional awareness at least 79% of the time in 71% of the VFR airspace over Skull Valley, including all of the Sevier B MOA. As discussed above, in most of the remaining time a pilot could fly VFR by staying beneath the cloud ceiling in Sevier B MOA if clouds above 10,000' were a factor.

108. In the event that an F-16 pilot transits Skull Valley above a ceiling or cloud deck high enough to obscure the Stansbury Mountains (which would be at least 6,500 ft. AGL), situational and positional awareness with respect to the proposed PFS site can be readily maintained using navigation systems such as GPS and INS. Ground references, such as major roads and cultural features, when visible through breaks in the undercast, are also helpful in checking position.

109. For example, there could be a solid deck of clouds from 8,000' to 10,000' AGL. In this situation, the pilot flying above this deck would use his Inertial Navigation System (INS) aided by the Global Positioning System (GPS) for navigation and positional awareness. Due to the narrowing of the Sevier B MOA near the area to the east of Michael Army Air Field, it would be reasonable for pilots to select a ground track that pointed them toward the center of the "neck" where the MOA narrows. This ground track would tend to keep pilots away from the eastern boundary of the UTTR restricted airspace that slants toward the southeast in the southern portion of Skull Valley. This ground track would also tend to keep pilots away from the proposed PFSF location as well. Pilots maintain their positional awareness by monitoring their bearing and distance to their selected INS steer point and cross referencing their map

[35] The PCA starts at 18,000 ft. MSL. To operate in the PCA, pilots must have an approved instrument flight plan and follow Air Traffic Control instructions. VFR flights are not allowed in the PCA. Pilots do not normally fly in the PCA airspace en route from Hill AFB to the UTTR.

110. In the event that a major weather system with extensive cloud cover moves into the area and makes the UTTR unworkable for combat training due to cloud coverage and visibility, the 388th Fighter Wing would cancel or reduce their sorties because of the weather. They would also cancel their sorties if Hill AFB weather went below takeoff and landing minimums. In either or both cases, there would be no F-16s in Skull Valley. Such cases would include part or all of the time that Skull Valley experienced weather that would result in ceilings below 3,000 ft. and/or visibility less than 3 miles.

111. In summary, the more detailed USAF Air Weather Service data demonstrates that the weather in Skull Valley clearly supports VFR flight operations. Further, the weather data shows that when cloud coverage is a factor, pilots will normally be able to conduct their training below the clouds rather than above them. The 46.3% cloud coverage greater than 5/10 relied on by the State is clearly not an accurate representation of the amount of time a pilot will be able to maintain positional awareness using visual references. In addition, it does not account for pilots' general positional awareness using navigation systems when operating above an undercast that completely obscures the ground. Also, it does not allow for probable ground tracks pilots would select to keep them from violating restricted airspace when operating over an undercast or the fact that those ground tracks would tend to keep pilots away from the proposed PFS site. Finally, it does not account for the cancellation of flight operations in Skull Valley due to poor weather.

112. In addition to the weather analysis above, PFS conducted a detailed analysis of every F-16 Class A Flight mishap from FY 1989 through FY 1998. In its Report, PFS gives particular attention to aircraft destroyed (actual ground impact/crashes), engine failures, and ability to avoid a structure like the PFSF in the event of an engine failure or other emergency. One hundred and twenty-six Class A Flight mishaps were examined.

113. PFS re-examined all 126 F-16 Class A Flight mishaps and specifically assessed the impact and effect of weather and cloud conditions at the time of each mishap.

Focus was placed on determining if the weather and cloud conditions influenced the pilot's behavior and performance in a way that would have prevented avoiding a structure like the PFSF. PFS identified only eight mishaps where the weather and cloud conditions could have affected the actions taken by the pilot during the emergency and which might have impeded the ability to avoid a structure like the PFSF in a setting similar to Skull Valley. Notably, in only one instance did the pilot eject above an undercast, the scenario envisioned by the State that would cause a pilot to be unable to avoid the PFSF. This occurred in Europe where the pilot had been operating above an undercast at low altitude and zoomed higher after experiencing engine problems, but could not see the ground. In two other accidents in which pilots experienced engine failures above or in weather that prevented them from seeing the ground, the pilots specifically asked for vectors from ground controllers to avoid inhabited areas. In another case, the pilot descended below the clouds to clear the area before ejecting. In one other accident occurring below a low overcast, the pilot elected to reduce his zoom and stay below the clouds. This enabled him to keep sight of the ground and avoid hitting ground structures.

114. In summary, the 5/10 cloud coverage 46.3 percent of the time during the year presumed by the State neither accurately depicts the operational or meteorological environment for F-16's transiting Skull Valley nor realistically influences the potential risk to a proposed PFSF site. The reality of at least 3,000 ft. ceilings with at least 3 miles visibility 96 percent of the time does not pose a hazard regarding the ability to avoid the proposed PFS site, particularly when the visibility is 10 miles or greater 95 percent of the time. Moreover, even if a pilot were to experience a mishap while transiting Skull Valley above an undercast, actual mishap data shows that it would still be possible for the pilot to avoid a site on the ground like the PFSF. The real weather and cloud conditions, coupled with the detailed examination of ten years worth of F-16 Class A Flight mishaps indicate that neither the weather nor the clouds would have any significant effect on the risk to the PFSF.

115. Based upon the detailed data provided, the subsequent analysis, and the conservatisms built into the analysis, the PFS Aircraft Crash Impact Hazard adequately considers the impact of weather on the probability of an F-16 impacting the proposed PFS site. No adjustments to the analysis are required because of weather.

E. Miscellaneous

116. The State of Utah claims that aircraft jettisoning multiple pieces of ordnance would increase the effective area of the PFSF, in that there would be a slight delay between the release of the first piece and the release of the second. The State asserts that the distance the aircraft travels during the delay should be added to both ends of the effective area of the facility, north to south.

117. The 1/3-second delay at 471.8 miles per hour is equivalent to 231 feet. This would be added to the front of the area only in calculating effective area. On the back side, if the first weapon released hit the very back edge of the facility, it would not matter for the probability calculation that another hit 231 feet beyond the site. Since the depth of the cask storage area is 1,590 ft., the effect of the delay would be to increase the site area by 231/1590 or 14.5 percent.

F. Conservatism Remaining in PFS's Assessment

118. Even if the State's challenges to PFS's assessment had some merit, PFS's calculated hazard to the PFSF retains sufficient conservatism to render the State's claims immaterial. First, with respect to the F-16s transiting Skull Valley and flying on the Moser recovery, PFS used a crash rate that included not only destroyed aircraft, but also Class A and B mishaps in which no aircraft was destroyed. Aircraft Report at 25; id. Tab H at 4 n.8. Since in the 10 years of FY-89 to FY-98, there were 162 Class A and Class B mishaps but only 139 destroyed aircraft, the crash rate is overstated by 16.5%, which probably applies to both the Normal and Special Operations accident rates used in the analysis. In other terms, for this conservatism alone, the correct calculated Impact Probabilities in Paragraph 58 above are about 86% of those shown.

119. Second, and more significantly, PFS assumed that any crashing F-16 that impacted the site could potentially cause a release of radioactive material. In fact, those F-16s that impacted the site after a mishap that left the pilot in control of the aircraft would hit at a velocity of roughly 170 to 210 knots. Aircraft Report at 21. This would be low enough not to penetrate a spent fuel storage cask. Id. Chap. XI. PFS has determined that at least 90 percent of all mishaps that would otherwise result in an impact at the PFSF would leave the pilot in control, and in no more than 5 percent of those the pilot would fail to avoid the PFSF. Accordingly, in .90 x .05 = .045 or 4.5% of the total accidents, the plane could impact the site at these relatively low speeds. The other 10 percent of the mishaps would not leave the pilot in control and could simply result in an impact at higher speeds, depending on the location of the aircraft when the mishap took place. Thus, at least approximately 30 percent of all potential impacts (.045 / (0.45 + .10)) would hit at a velocity insufficient to penetrate a cask and hence the F-16 crash hazard to the PFSF from Skull Valley transits and the Moser recovery could be reduced by 30 percent.

120. In addition, as we discussed above, crashing aircraft on the UTTR would simply be too far away, as a practical matter, to fly to and impact the PFSF. PFS's calculation conservatively assumed that a crashing aircraft could glide 10 miles before impacting the site. If potential aircraft impact locations are considered more realistically, then, as even the State of Utah's witness agrees, the hazard from the UTTR can be taken to be zero. See ¶ 44, supra.

121. PFS's calculated hazard from jettisoned ordnance is also conservative in a number of respects. First, the calculation does not take into account the fact that over half of cask storage area at the PFSF will consist of open space where ordnance could impact and do no damage. Aircraft Report at 83. Second, the State of Utah has recently produced discovery in the form of a letter from the Air Force stating that none of the inert

munitions tested would penetrate the lid of a storage cask if they struck it.[36] Those weapons tested included the Mark 82, Mark 84 and CBU-87 which make up most of the jettisonable ordnance carried by F-16s on the UTTR. Most of these are inert. Aircraft Report at 81. The Mark 84 (2000 lb. bomb) could penetrate the outside wall of the structure, but it is unclear from the Col. Bauer letter if it would then penetrate the inner shell or fuel canister shell. Since Mark 84s make up only 13% of the jettisonable ordnance, in any event the actual risk from jettisoned ordnance is probably well below the figure of 1.49×10^{-7} given in the table in Paragraph 58, and is probably on the order of 2.0×10^{-8}.

122. Finally, all of PFS's calculations assume a fully loaded site with 4,000 spent fuel storage casks. In fact, the PFSF would contain 4,000 casks for only one year during its lifetime. If PFS considered a time-weighted average size for the cask storage area, the effective area of the site would be only 55 percent of the area of the site at full capacity. Thus, the average aircraft crash impact hazard for the PFSF is only 55 percent of the peak hazard. Aircraft Report at 25-27. Since effective area is integral to all calculations of risk, the total risk could likely be reduced by a factor of approximately 45% for an average risk value.

V. CONCLUSION REGARDING THE HAZARDS OF AIRCRAFT CRASHES AND AIR-DELIVERED WEAPONS USE

123. The calculated aircraft crash impact risk to the PFSF as a whole, assuming a fully loaded facility with 4,000 storage casks, is 4.87×10^{-7} per year. If the probability of jettisoned military ordnance impacting the PFSF is added to that total, the cumulative probability of an air crash or military ordnance impact at the PFSF is 6.25×10^{-7}. Be-

[36] Letter from Col. Lee Bauer, USAF, Deputy Associate Director for Ranges and Airspace, to Connie Nakahara, Utah Department of Environmental Quality (Dec. 28, 2000).

cause of the distance from the PFSF site at which weapons use on the UTTR takes place, the likelihood that a weapon used on the UTTR would impact the PFSF is insignificant. Therefore, the cumulative hazard to the PFSF from aircraft crashes and air-delivered ordnance is insignificant.

We declare under penalties of perjury that, to the best of our knowledge, the foregoing is true and correct.

Executed on December 30, 2000.

James L. Cole, Jr.

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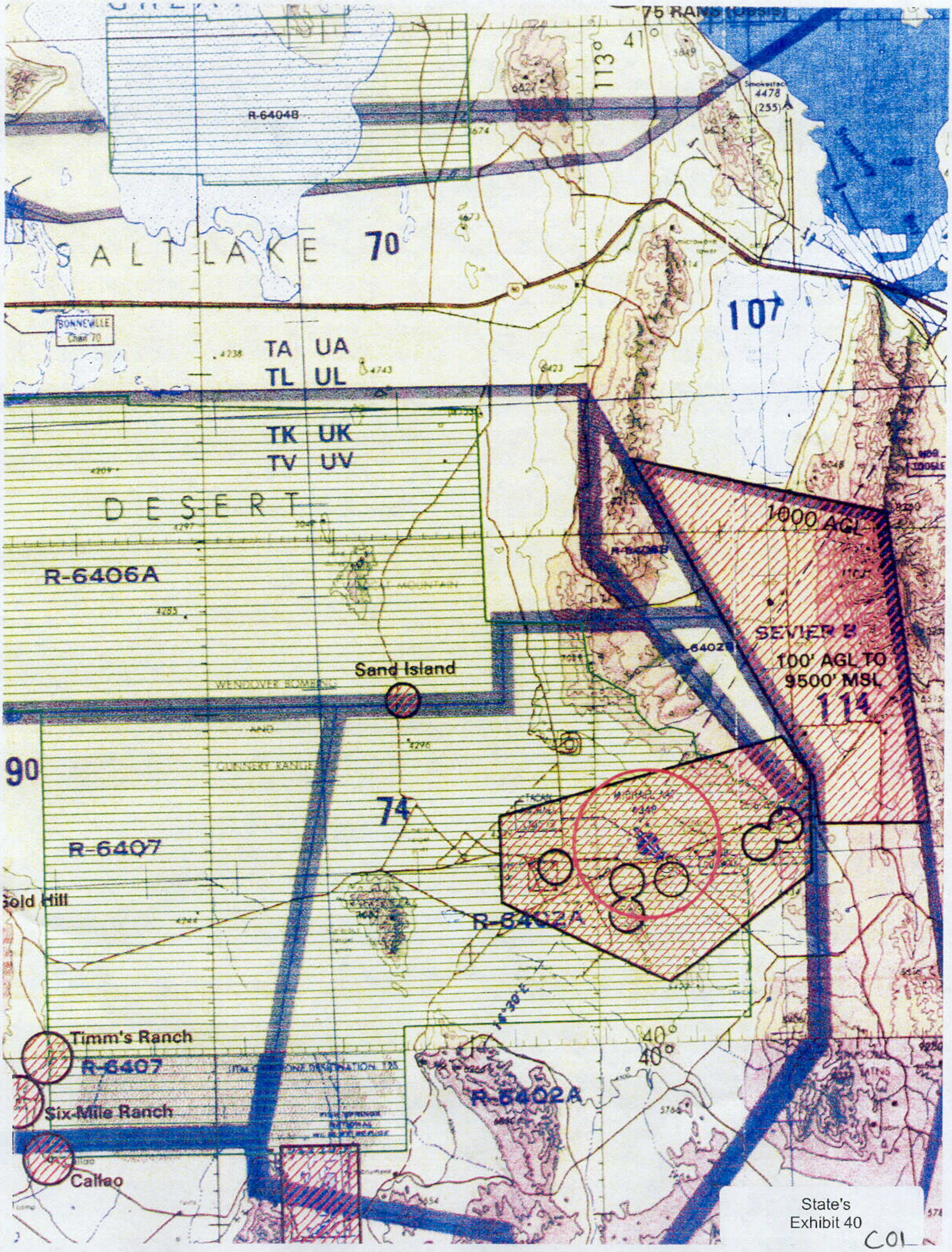
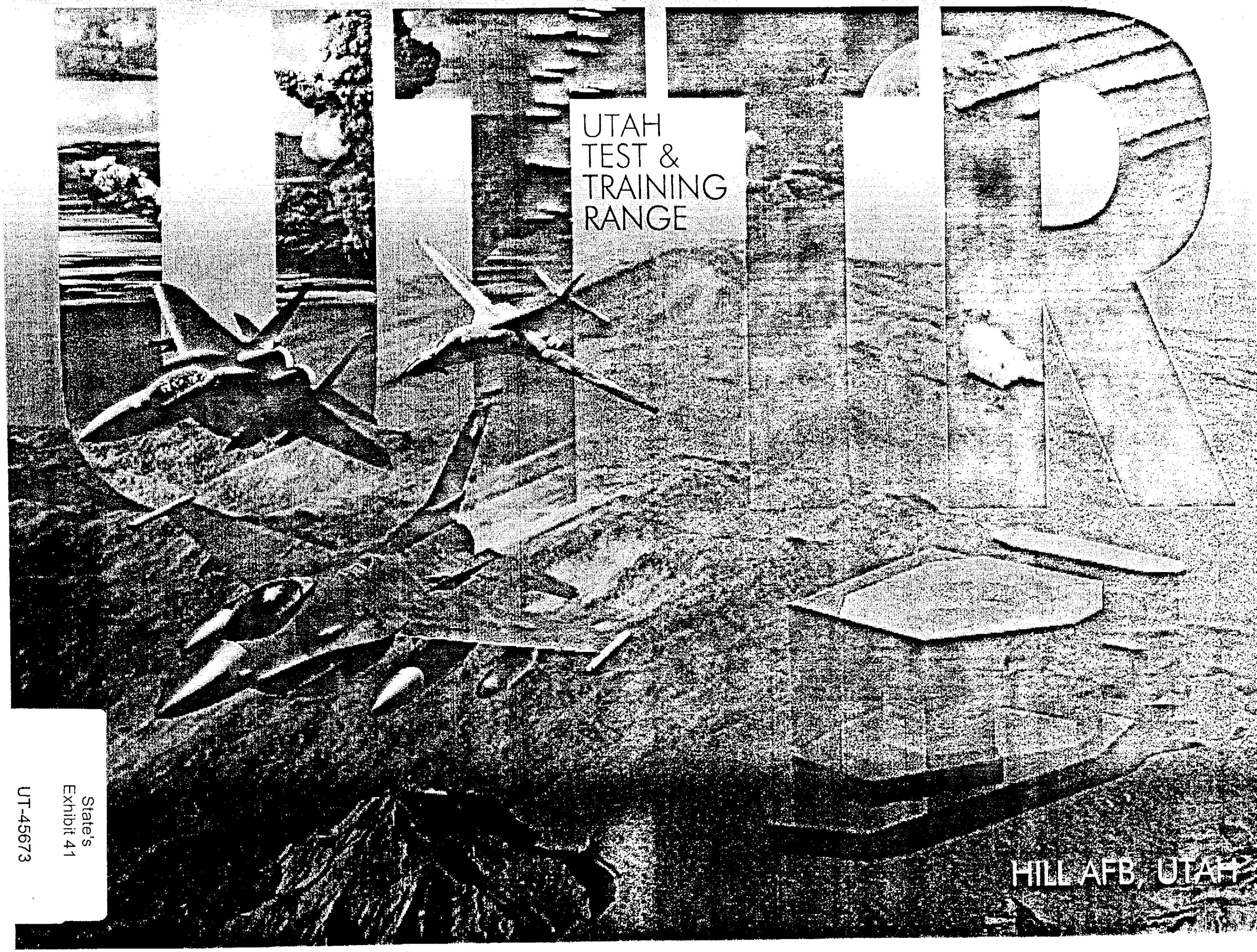


State's
Exhibit 40
C01


UTTR
UTAH
TEST &
TRAINING
RANGE
HILL AFB, UTAH

MISSION

The 388th Range Squadron operates and maintains the UTTR. We provide responsive open-air training and test services that support day-to-day training, large force training exercises, and large footprint weapons testing, thus guaranteeing superiority for America's war fighters and their weapons systems. The 388th Range Squadron provides key functions and capabilities required for range support of Air Force operational test and training programs. This includes range infrastructure systems, equipment, software, targets, facilities, data processing and display, land and airspace control, environmental management, supply, security, and safety.

The UTTR provides the largest overland safety footprint available in the Department of Defense (DoD) for aircrew training and weapons testing. It supports training customers with capabilities for air-to-ground, air-to-air, and ground force exercises. Operations include weapons and weapons platform testing as well as operational training missions. These range from two-ship basic fighter maneuvers and basic surface attacks to large joint composite force missions. Missions may include air-to-air, air-to-ground, both day and night, low and high altitude. Customers may also use the full range of supersonic airspace, tactical targets, electronic warfare facilities, and Air Combat Maneuvering Instrumentation (ACMI).

LOCATION & GEOGRAPHY

The UTTR is located in north-western Utah and eastern Nevada. It is contained within the Great Salt Lake Desert, approximately 70 miles west of Salt Lake City. Mission Control facilities are located off-range at Hill Air Force Base (AFB). The UTTR is characterized by variable desert terrain that includes undulating sand dunes, mountains rising abruptly from the desert floor, and rolling hills building up to mountain ranges. The range is surrounded by mountains generally running north and south rising from 8,000 to 12,000 feet, separated by valleys with elevations of approximately 4,500 feet Mean Sea Level (MSL). UTTR has the largest overland special use airspace measured from the surface or near surface, within the continental United States (207 by 92 nautical miles). Of the total 12,574 square nautical miles comprising this area, 6,010 are restricted airspace and 6,564 are Military Operating Areas (MOAs). The UTTR also has the largest overland contiguous block of supersonic authorized restricted air space in the continental United States. Chaff and flares are authorized over much of this area. The airspace is situated over 2,624 square miles of DoD land, of which 1,490 square miles are Air Force owned. The remainder is owned and managed by the US Army at Dugway Proving Ground. Airspace boundaries do not necessarily coincide with the boundaries of the DoD land beneath this airspace. The UTTR is primarily surrounded by public domain land and is not likely to be encroached upon in the foreseeable future. Much of the UTTR airspace is over Bureau of Land Management (BLM) land, and some Air Force equipment is located on BLM land. Ground operations on BLM land are coordinated and approved by BLM prior to the program commencement.

Restricted airspace is divided into "working sectors" to permit efficient scheduling and safe use of different parts of the range at the same time. These divisions were made in cooperation with the principal range users and were designed to meet their needs while permitting more extensive use of the range. Whenever possible, sector boundaries coincide with natural features readily distinguishable from the air.

Air refueling track locations and procedures for use are available in UTTR Supplements 1 and 2 (Test and Training) to AFI 13-212. Range users needing aerial refueling are required to make their own arrangements with refueling units.

30 November 1998

MEMORANDUM FOR AIR FORCE REPRESENTATIVE (ANM-900)
FAA Northwest Mountain Region
1601 Lind Avenue, S.W.
Renton WA 98055-4056

FROM: 388 RANS/AM
6067 Boxelder Lane
Hill AFB UT 84056-5811

SUBJECT: Annual Military Operating Area Usage Report

1. Sevier B Military Operating Area

2. Period of Report: 1 October 1997 through 30 September 1998

3. Published Hours of Operation: 1200 ZULU to 0300 ZULU, Mon-Sat, other times by NOTAM

4. Published Altitude: 100 feet AGL to 9,500 feet MSL.

5. Activities

a. Aircraft Operations

(1) Aircraft Type: F15, F16, F111, F4, B52, B1, A10, KC135, EC135, RC135, C130, C141, A4, F18, F117A, A6, A4, H1, C117, and B2

(2) Maximum Altitude/Flight Level: 9,500 feet MSL

(3) Activities Conducted: Air-to-air training LOWAT training, cruise missile testing, major exercises.

(4) Supersonic operations are not authorized.

b. Artillery/Mortar/Missile

(1) Type: Cruise missile, advanced cruise missile, unmanned vehicles

(2) Purpose/Mission: Test, evaluation, and training.

6. Area Coverage Available:

a. Communications (Frequencies Available): 118.45, 121.5, 122.9, 134.1, 138.05, 139.6, 142.3, 225.3, 226.0, 229.2, 233.4, 238.9, 243.0, 254.4, 266.3, 271.1, 271.35, 275.9, 279.9, 282.7, 286.25, 287.0, 295.8, 297.1, 298.0, 298.6, 301.7, 308.65, 311.3, 315.9, 319.6, 324.7, 325.7, 325.9, 327.6, 339.0, 344.9, 349.3, 351.0, 354.4, 359.2, 361.4, 375.9, 381.3, 383.0, 383.2, 384.7, 388.1, 389.8, 398.1.

b. Radar Type: Long Range FAA radar from Battle Mountain NV, Cedar City UT, and Francis Peak UT; Gap Filler Air Force Radar from Cedar Mountain UT, Trout Creek UT, and Bovine Mountain UT.

c. ATC Services: Clover Control Air Traffic Control Facility.

7. Utilization:

a. Air Operations: 3,878

b. Total number of days area was

Scheduled: 325
Activated: 325
Utilized: 325

c. Total number of hours area was:

Scheduled: 4585
Activated: 4585
Utilized: 4562

8. Released to Controlling Agency for Public Use:

a. Total hours released: 4199

b. Number of weekdays area was not activated: 10

c. Number of weekend/holiday days are was not activated: 27

9. Current chart is applicable.

JET TRAINOR
388 FW Airspace Manager