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HI-STORE CIS Aircraft Crash Assessment

FOR

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Holtec Report No: HI-2188201

Holtec Project No: 5025

Sponsoring Holtec Division: NPD

Report Class : IMPORTANT TO SAFETY

HOLTEC INTERNATIONAL

DOCUMENT ISSUANCE AND REVISION STATUS[1]

DOCUMENT NAME:	HI-STORE CIS Aircraft Crash Assessment
DOCUMENT NO.:	HI-2188201
PROJECT NO.:	5025

CATEGORY: ☐ GENERIC ☑ PROJECT SPECIFIC

Rev. No.[2]	Date Approved	Author's Initials	VIR #
0	7/27/2018	B.Zwierlein	50782

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REVISION LOG

Revision 0 – Original issue.

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1.0 INTRODUCTION

The HI-STORE CIS (Consolidated Interim Storage) facility is located in South East New Mexico, Lea County, half way between the cities of Hobbs and Carlsbad. This report documents a probabilistic assessment of the likelihood of an aircraft crash at the facility. This assessment is based on the guidance provided in NUREG-0800 Section 3.5.1.6 [9], and considers all commercial, civil, and military aircraft flying in the vicinity of this site. This includes aircraft arriving at or departing from local airports, aircraft flying along nearby Federal Airways, and aircraft flying along nearby Military Training Routes (MTRs). Information used in the assessment was gathered from publicly available sources as well communications with the Air Force. Results of the assessment are then used to demonstrate that aircraft hazards need not be a design-basis concern.

1.1 BACKGROUND INFORMATION

There are several local and regional airports close by the HI-STORE site. These airports include Artesia Municipal Airport, Cavern City Air Terminal, Lea County Regional Airport, and Lea County Zip Franklin Memorial Airport and are within 50 miles of the site. Of these airports, only the Lea County Regional has a Federal Aviation Administration (FAA) funded air traffic control tower. All of the flights from these airports report to and are controlled by either the Albuquerque Air Route Traffic Control Center (ARTCC) or Fort Worth ARTCC, two of the 22 ARTCCs servicing the United States [1][7]. Also, in the general region of the CIS facility, but further away (within 100 miles) are two international airports, Midland International Air and Space Port, and Roswell International Air Center. These airports also fall under the jurisdiction of Fort Worth and Albuquerque ARTCC respectively [1].

The airspace surrounding the CIS Facility is unrestricted and at any given time there would be the potential for commercial aircraft, military aircraft, and civilian aircraft to be flying in that airspace at various altitudes and at various speeds. Commercial and civil aircraft would fly in accordance with flight plans filed with the FAA and would be controlled by the national air traffic control system [2]. Military aircraft would fly within designated Military Training Routes, which may or may not be flown under air traffic control.

Commercial aircraft flight plans would be limited to the Federal Airways that make up the en-route airspace structure of the National Airspace System. There are multiple federal airways near the CIS Facility: V83, V102, and V291 [3][4]. Victor routes are low altitude airways that make up the majority of the lower stratum of the federal en-route airspace structure. Victor routes extend from the floor of the controlled airspace up to but not including 18,000 feet above mean sea level [2]. They are defined as straight line segments between Very high frequency Omnidirectional Range (VOR) stations and are designated by the letter "V" followed by the route number. Victor routes have a width of 4 Nautical Miles (NM) on either side of the centerline when VOR stations are less than 102 NM apart, with the width increasing for VORs farther apart [2][21].

Because airspace above the United States from the surface to 10,000 feet above sea level is limited to 250 knots (indicated airspeed) by FAA regulations, any aircraft below 10,000 feet should be travelling at speeds of less than 250 knots [5]. There is a military exception to this

requirement, however. The Military Training Route Program is a joint venture by the FAA and the Department of Defense (DOD), developed for use by military aircraft to gain and maintain proficiency in tactical "low-level" flying. These low-level training routes are generally established below 10,000 feet for speeds in excess of 250 knots [26].

Department of Defense publication AP/1B controls and defines all MTRs, which are designated either IR (Instrument Route) or VR (Visual Route), with IR routes being flown under air traffic control [6]. AP/1B provides the air speed limits for the route, which are limited to at most 540 knots [6]. Additionally, no person is allowed to operate a civil aircraft in the United States in excess of Mach 1 without prior authorization from the FAA [5].

There are four designated Military Training Routes in the vicinity of the proposed CIS Facility: IR-128, IR-180, IR-192, and IR-194. However, these four designations represent only 2 mapped airways, as IR-128 and IR-180, and IR-192 and IR-194 share the same airway but represent opposite directions of travel (hereafter referred to as IR-128/180 and IR-192/194, respectively). IR-128 and IR-192 both represent the North to South direction, while IR-180 and IR-194 represent the South to North flight direction of their respective corridors [6] [3]. The routes are individually operated by an Air Force Base (AFB), which schedule and 'own' the route. IR-128/180 is "owned" by Dyess AFB while IR-192/194 is "owned" by Holloman AFB. The FAA requires the military to provide advance notice to other aircraft that the Military Training Routes will be used to allow for civilian traffic to de-conflict if needed. AP/1B defines all MTRs giving coordinates of airway fixes, or points between segments as well as the airway width at different points along the route [6].

A Military Operation Area (MOA) is "airspace established outside Class A airspace to separate or segregate certain nonhazardous military activities from IFR Traffic and to identify for VFR traffic where these activities are conducted." [8]. Examples of these activities include, but are not limited to: air combat tactics, air intercepts, aerobatics, formation training, and low-altitude tactics [26]. The nearest MOAs to the CIS facility are the Talon High East MOA, which is located north of Carlsbad, NM and the Bronco 3 MOA, which is located North of Hobbs, NM. However, the nearest edge of either of these MOAs is greater than 25 miles from the site [3].

2.0 METHODOLOGY

NUREG-0800 Section 3.5.1.6 provides guidance and acceptance criteria for aircraft hazard assessments [9]. It allows probabilistic analyses to be used to demonstrate that aircraft hazards need not be a design-basis concern. In other words, if the cumulative probability of an aircraft crash from all considered sources is below a certain threshold, then the risk of an aircraft crash can be considered negligible. Per NUREG-0800 the areas that must be considered, as briefly discussed already are:

A. Airports
B. Federal airways
C. Holding and approach patterns
D. Military airports, training routes, and training areas.

The NRC Guidance defines criteria, which if met, considers the probability of a crash to be less than the acceptable limit by inspection. These criteria will be referred to as screening criteria. If the source of the potential aircraft doesn't meet the screening criteria (i.e. is not screened out), then a more detailed review of the source (airport, airway, MTR, etc.) is required. This detailed review collects the necessary parameters for the source necessary to calculate the probability of a crash using formula provided by NUREG-0800. The formula for each source is slightly different given the nature of the source, airways have different parameters than airports. However, all of the formulae are dependent on the crash rate of the potential aircraft, the amount of air traffic, and the effective area of the safety significant components (SSCs) of the site.

The effective area of the site is the sum of the fly-in area of the site and the skid area of the site [11], where the fly-in area is the footprint of the SSC expanded to account for the height of the SSC. While an aircraft may not crash directly onto the footprint of the SSC, the shadow area for impact of the SCC increases as the height of the SSC increases. The skid area is the additional area, outside the shadow area of the SSC, in which an aircraft could crash and then skid or slide into the SSC. These areas are dependent on the size and type of aircraft being considered. The crash rate of the potential aircraft is also dependent on its specific type. Therefore, if a detailed review is necessary, each type of aircraft that uses the applicable source must be considered.

3.0 ACCEPTANCE CRITERIA

According to NUREG-0800 Section 3.5.1.6, the NRC allows the use of probabilistic assessments to "demonstrate that aircraft hazards need not be a design basis concern" [9]. The storage of fuel at an ISFSI falls under the aircraft crash probability criterion of one in a million, which was established by The Commission in the Memorandum for Director John F Cordes [10]. Therefore:

- The risk from aircraft hazards are sufficiently low if the total probability of an aircraft crash from all nearby air traffic sources is less than an order of magnitude of 1.0×10^{-6}.

The Screening Criteria defined in NUREG-0800 [9] are as follows:

A. The site-to-airport distance D is between 5 and 10 statute miles, and the projected annual number of operations is less than $500\ D^2$, or the site-to-airport distance D is greater than 10 statute miles, and the projected annual number of operations is less than $1000\ D^2$

B. The site is at least 5 statute miles from the nearest edge of military training routes, including low-level training routes, except for those associated with usage greater than 1000 flights per year, or where activities (such as practice bombing) may create an unusual stress situation

C. The Site is at least 2 statute miles beyond the nearest edge of a federal airway, holding pattern, or approach pattern

4.0 ASSUMPTIONS

The following assumptions have been made in this aircraft crash assessment:

1. All civilian and commercial aircraft are considered to have the same crash rate of $4x10^{-10}$ [9].
2. For conservatism, Special Operations flight mode Crash Rates will be used for all military aircraft.
3. For Skid Area calculations, military aircraft will be considered either Large or Small [11].
4. The maximum height of the Cask Transfer Building (CSB) is 60 ft [27].
5. The maximum height of the Security Building is 20 ft.
6. For conservatism, to account for any version of UMAX, the closure lid is considered to be at its maximum height of 5.5 ft for all systems [23].
7. For conservatism, all flights on IR-128/180 will be considered to be performed by B-52 aircraft.

5.0 INPUT DATA

5.1 HI-STORE CIS FACILITY

The HI-STORE CIS Facility is located in Section 13, Township 20 South, Range 32 East, N.M.P.M., Lea County, New Mexico [28]. The facility's SSCs that are being considered for this analysis are listed in Table 5.1 below; dimensions of these SSCs are also listed in the table.

Table 5.1: HI-STORE SSC Dimensions

SSC	Width (ft)	Length (ft)	Height (ft)	Reference
UMAX ISFSI Area	2470	1814	5.5	[22][23][27]
Cask Transfer Building	350	100	60	[22][27]
Security Building	100	100	20	[22]

5.2 AIRPORTS

Airport operation numbers have been gathered from two sources, first is the Air Traffic Activity Data System (ATADS), which contains the official NAS (National Airspace System) air traffic operations data available for public release [18]. The other is GRC Inc.'s AirportIQ 5010, which is a compilation of FAA form 5010-5 Airport Master Records and Reports. ATADS gives data as far back as 1990, where AirportIQ gives only the past year's data. Additionally, ATADS only gives data for Airports that have an FAA certified Air traffic control tower, so data for some of the smaller airports has only been sourced from AirportIQ. If data is available from both sources, the bounding value of either the average of ATADS yearly values, or the AirportIQ value will be used. Table 5.2 below summarizes the airport operations numbers as well as distances from the CIS site. ATADS Reports can be found in Appendix A

Table 5.2: Nearby Airports – Distance and Operations

Airports	City	Distance "D" from Site (mi)	Average Annual Operations	Reference
Artesia Municipal (ATS)	Artesia, NM	47	14,050*	[12]
Cavern City (CNM)	Carlsbad, NM	34	6,900*	[13]
Lea County Regional (HOB)	Hobbs, NM	30	12,745+	Table A.1 [14]
Lea Co. Zip Franklin Mem (E06)	Lovington, NM	32	2,200*	[15]
Roswell International (ROW)	Roswell, NM	68	49,045	Table A.3 [17]
Midland Intl Air and Space Port (MAF)	Midland, TX	98	76,412	Table A.2 [16]

* Note that Airport does not have an FAA funded air traffic control tower, and therefore does not have data reported to ATADS

+ Note that operations data reported on AirportIQ does not match the data for the same time period reported on ATADS.

5.3 FEDERAL AIRWAYS AND HOLDING AREAS

The Albuquerque VFR Sectional Chart [3] was reviewed to determine Federal airways near the site. The "airway fixes", or points defining the airway, are used to plot the "centerline" of the airway. The distance from the center of the airway to the site could then be measured. The nearest Federal Airways are illustrated on Figure 5.1. Table 5.3 below, summarizes the Federal Airways and their distances to the CIS Facility. As mentioned above, the width of the airway is 4 NM on each side of center if the VOR stations are less than 102 NM apart. In this case each of the three airways has VOR stations less than 102 NM apart.

Table 5.3: Nearby Federal Airways – Width and Distances

Airways	Federal/MTR	Travel Direction	Distance to Centerline (mi)	Width left of Center (mi)	Width Right of center (m)]	Site Side	Distance to nearest edge (mi)
V102	Federal	Either	6.8	4.60	4.60	N/A	2.2
V291	Federal	Either	12.0	4.60	4.60	N/A	7.4
V83	Federal	Either	34.8	4.60	4.60	N/A	30.2

Review of Jeppesen Instrument Approach charts, as well as those provided on AirNav.com for the nearby airports reveals two holding or approach patterns that come near the HI-STORE site. The holding pattern for Cavern City Air Terminal runway RNAV (GPS) RWY 21 begins at KEREY airway fix, just under 14 miles North East of the airport and is 6 NM long [19][1]. Matching this pattern is the missed approach pattern for Cavern City runway RNAV (GPS) RWY 3 [1]. The missed approach holding pattern for Lea County Regional runway LOC RWY 3 begins at DYETT airway fix, approximately 19 miles South West of the airport and is 6 NM long [20][1]. Also matching this pattern are the missed approach patterns for Lea County

Regional runways LOC BC RWY 21 and VOR or TACAN RWY 2 [1]. Both of these patterns were plotted using associated airport fixes so that the distance to the site could be measured. Both patterns are located on Figure 5.1. Table 5.4 below summarizes these approach/holding patterns and their distances from the CIS facility. Additional approach or holding patterns for other runways at either of these airports are farther from the site than those described above. Approach or holding patterns for other nearby airports are also farther from the site than those described above.

Table 5.4: Nearby Approach and Holding Patterns

Holding/Approach Pattern	Distance to Centerline (mi)	Width left of Center (mi)	Width Right of center (mi)	Site Side	Distance to nearest edge (mi)
CNM Holding Pattern	16.5	4.60	4.60	N/A	11.9
HOB Missed Approach Pattern	7.8	4.60	4.60	N/A	3.2

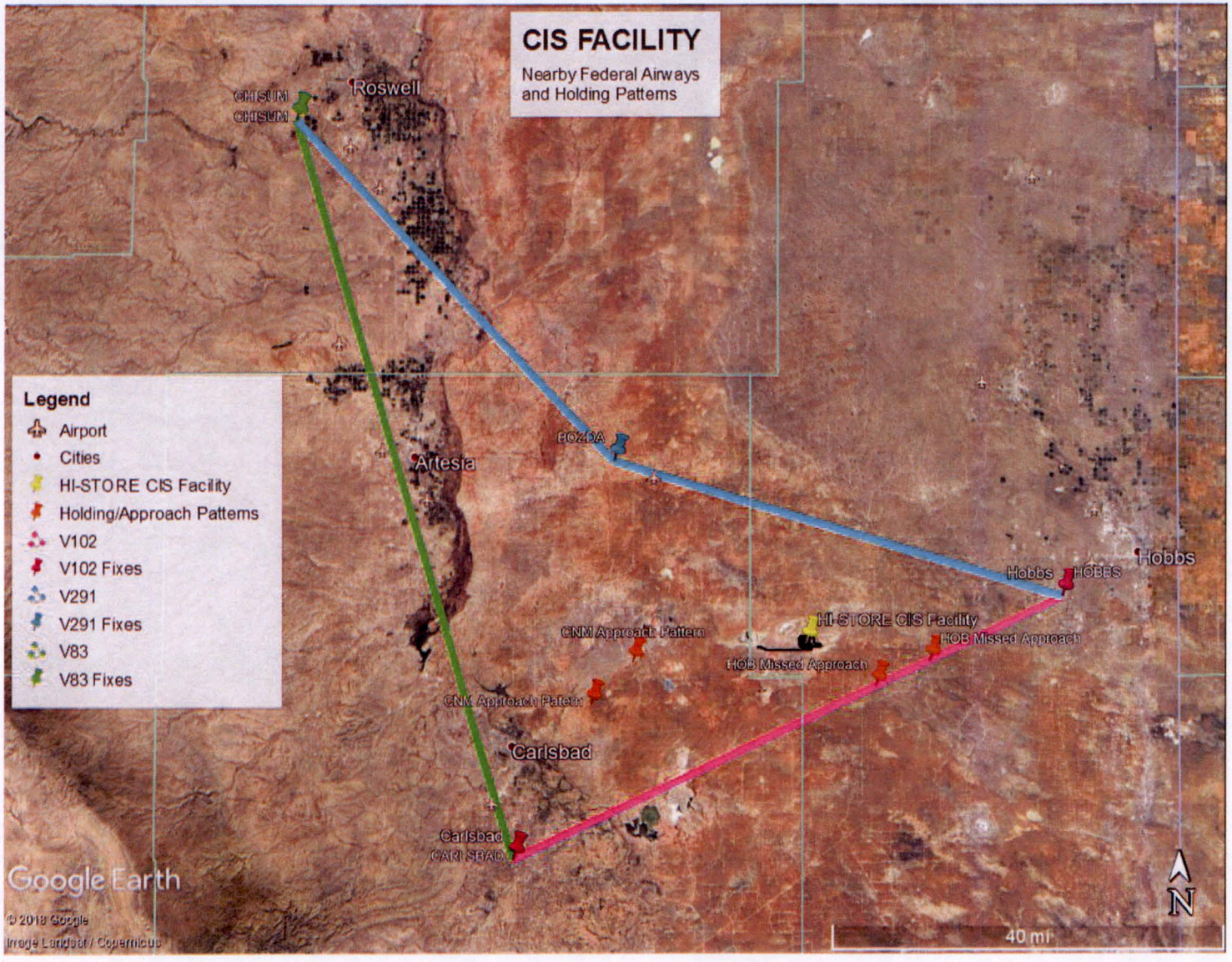

Figure 5.1: Nearby Federal Airways and Holding Patterns

5.4 MILITARY TRAINING ROUTES

Again, the Albuquerque VFR Sectional Chart [3] was reviewed to determine MTRs near the facility. Department of Defense Publication AP/1B [6] provided the route fixes for each MTR as well as the width of the route between the fixes. The width of the MTR can vary along its length, and while the "centerline" is considered the straight lines between fixes, the route can have different widths on each side of "center". The direction of travel along the route is used to determine which side of the route (left or right) the facility is on. The plotted fixes are used to determine the distance to the centerline from the site. Table 5.5 below summarizes the distance from the site and the widths of the nearby MTRs. Figure 5.2 Illustrates these MTRs.

Table 5.5: Military Training Routes – Widths, Distances, and Operations

Airways	Federal/MTR	Travel Direction	Distance to Centerline (mi)	Width left of Center (mi)	Width Right of center (mi)	Site Side	Distance to nearest edge (mi)
IR-192/ IR-194	MTR	N to S	13.0	3.45	8.06	Left	9.5
		S to N	13.0	8.06	3.45	Right	
IR-128/ IR-180	MTR	N to S	1.8	3.45	4.60	Right	Over Site
		S to N	1.8	4.60	3.45	Left	

A stipulation of the NUREG-0800 Screening Criteria for MTRs is that routes with usage greater than 1000 flights per year cannot be screened out by inspection. The number of annual flight operations for IR-192/194 are presented in a U.S. Air Force Environmental Assessment [24], however, the data for IR-128/180 is less readily available. The U.S. Air Force provided usage data for the past 2 years for IR-180 and the past 3 years for IR-128. Email correspondence from the U.S. Airforce has been attached to this report, and the data tables for the routes have been included as Appendix B. Table 5.6 summarizes the number of flight operations. The highest value from the data given is taken as the annual number of flight operations.

Table 5.6: Military Training Route Annual Flight Operations

Airways	Travel Direction	Number of Annual Flight Operations	Reference
IR-192/ IR-194	N to S	97	[24]
	S to N	81	
IR-128/ IR-180	N to S	155	Appendix B Attachment 1
	S to N	6	

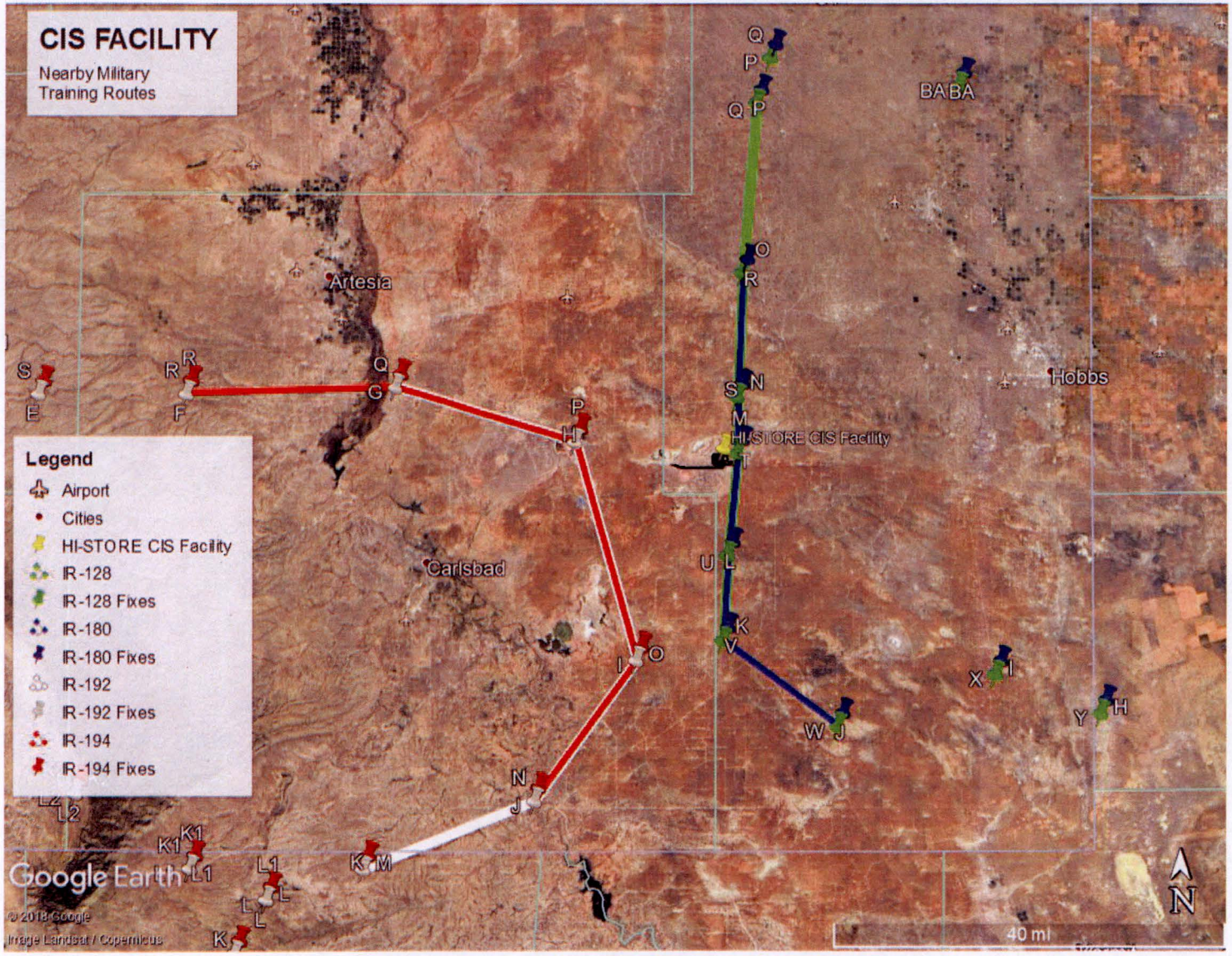

Figure 5.2: Nearby Military Training Routes

6.0 ANALYSIS AND RESULTS

6.1 SCREENING CRITERIA CHECK

As mentioned above, screening criteria is provided by NUREG-0800 [9]. If an aircraft source (e.g. airport, airway, MTR, etc.) passes the screening criteria, the probability of an aircraft crash from that source is considered sufficiently low. Therefore, further investigation is not necessary, and the source is not a credible hazard. If the source does not pass the screening criteria, further investigation is needed to determine the crash probability. Tables 6.1, 6.2, and 6.3 below present the screening criteria check for the nearby aircraft sources.

Table 6.1: Screening Criteria Check for Airports

Airports	Distance "D" from Site (mi)	Average Annual Operations	Screening Criteria: $5 \le D \le 10$: $500*D^2$ Operations $D \ge 10$: $1000*D^2$ Operations	Pass/Fail
Artesia municipal (ATS)	47	14,050*	2,209,000	Pass
Cavern City (CNM)	34	6,900*	1,156,000	Pass
Lea County Regional (HOB)	30	12,745	900,000	Pass
Lea Co. Zip Franklin Mem (E06)	32	2,200*	1,024,000	Pass
Roswell International (ROW)	68	49,045	4,624,000	Pass
Midland Intl Air and Space Port (MAF)	98	76,412	9,604,000	Pass

Table 6.2: Screening Criteria Check for Airways and Approach Patterns

Airways	Type	Distance to nearest edge (mi)	Screening Criteria	Pass/Fail
V-102	Federal Airway	2.2	> 2 mile	Pass
V-291	Federal Airway	7.4	> 2 mile	Pass
V-83	Federal Airway	30.2	> 2 mile	Pass
CNM	Holding Pattern	11.9	>2 mile	Pass
HOB	Missed Approach Pattern	3.2	>2 mile	Pass

Table 6.3: Screening Criteria Check for MTRs

Airways	Type	Distance to nearest edge (mi)	Number of Annual Flight Operations	Screening Criteria	Pass/Fail
IR-192/ IR-194	MTR	9.5	97 81	D > 5 mile N < 1000	Pass
IR-128/ IR-180	MTR	Over Site	155 6	D > 5 mile N < 1000	Fail

As can be seen in the tables above, all airports, federal airways, and approach/holding patterns in the area of the HI-STORE CIS Facility pass the screening criteria. Of the two sets of reciprocal Military Training Routes, IR-192/194 passes the screening criteria while IR-128/180 does not. Each of the sources that pass the screening criteria are therefore not considered credible hazards. IR-128/180 requires additional investigation.

6.2 IR-128/180 ADDITIONAL INVESTIGATION

6.2.1 Equations

For sources that aren't screened out by inspection, NUREG-0800 Section 3.5.1.6 [9] provides formulae for determining the aircraft crash probability. For airways, the probability equation is:

$$P = C * N * {}^{A}/_{w}$$

Where:

C = in-flight Crash Rate per mile for aircraft using the airway
N = Number of flights per year along the airway
A = effective Area of the facility in square miles
w = Width of the airway in miles

According to the DOE report "Accident Analysis of Aircraft into Hazardous Facilities" the effective area of the facility is the sum of the fly-in area (shadow area + footprint) and the skid area [11]. The report provides equations for the calculation of the shadow and skid areas:

$$A_{eff} = A_f + A_s$$

Where:

$$A_f = (WS + R) * H \cot\varphi + \frac{2 * L * W * WS}{R} + L * W$$

$$A_s = (WS + R) * S$$

Where:

A_f = effective Fly-in Area
A_s = effective Skid Area
WS = aircraft Wing Span
L = Length of facility
W = Width of facility
H = Height of facility
R = length of the diagonal of the facility = $(L^2 + W^2)^{0.5}$
cotφ = mean of the cotangent of the aircraft impact angle
S = Aircraft Skid distance

6.2.2 Additional Inputs

As discussed in Section 2.0, the probability of an aircraft crash for a source, in this case an MTR airway, must account for each type of aircraft that uses the airway. The crash rate as well as the effective area are dependent on the aircraft. As can be seen in Appendix B, four different types of aircraft have been flown on IR-128/180 in the past three years. The DOE report, that provided the effective area calculations also provides values for cotφ and S for different aircraft [11]. A separate report created under the auspices of the DOE "Data Development Technical Support Document of the Aircraft Crash Risk Analysis Methodology (ACRAM) Standard" provides crash rates and wing spans for different military aircraft [25]. Table 6.4 below summarizes the aircraft, and their related parameters.

Table 6.4: IR-128/180 Aircraft Inputs

Aircraft Info						
Airframe	Large/ Small	Wingspan (ft)	Crash Rate normal	Crash Rate spec ops	cot(ϕ) ϕ = impact angle	Skid Length (ft)
Appendix B	[25]	[25]	[25]	[25]	[11]	[11]
B-1B	Large	137	4.00E-09	1.20E-08	7.4	780
B-52	Large	185	4.00E-09	1.20E-08	7.4	780
C-130J	Large	133	2.67E-09	6.67E-09	7.4	780
KC-135	Large	131	9.09E-10	9.09E-10	7.4	780

Note that for military aircraft, there are both normal flight mode crash rates as well as special operations crash rates depending on the type operations the aircraft are performing.

6.2.3 Probability Determination

As can be seen in Appendix B, the usage data provided by the Air Force, for the 2 most recent years, does not distinguish how many operations (sorties) each type of aircraft performed. It provides the types of aircraft and the sum of all sorties resulting in a yearly total only. Therefore, to be conservative, it will be assumed that all flights are performed by B-52 aircraft. B-52s have the highest crash rates and largest wing span. All other parameters are the same for each of the aircraft types. Additionally, for conservatism, all flights will be assumed to be in special operations mode.

The DOE report "Accident Analysis of Aircraft into Hazardous Facilities" states that, "In calculating an effective area, the analyst must be cognizant of the 'critical areas' of the facility" [11]. Critical areas must be considered to eliminate unnecessary conservatism, which would be introduced if the facilities overall dimensions were used blindly [11]. In this case, the total effective area of the facility shall be the sum of the effective areas of each SSC considered: the UMAX ISFSI area, the CTB, and the security building. Tables 6.5 and 6.6 below calculate the effective areas and the aircraft crash probability for IR-128 and IR-180.

Table 6.5: Probability Calculation for IR-128

SSC	Effective Area									Probability IR-128		
	W (ft)	L (ft)	R (ft)	H (ft)	A_f		A_s		A_{eff} (mi^2)	Number of Flights per Year	Width of IR-128/180 (mi)	Probability
					(ft^2)	(mi^2)	(ft^2)	(mi^2)				
-	Table 5.1	Table 5.1	$(L^2+W^2)^{0.5}$	Table 5.1	Paragraph 6.2.1		Paragraph 6.2.1		$A_f + A_s$	Table 5.6	Table 5.5	-
UMAX Area	2470	1814	3064.55478	5.5	5153801	0.184867	2534653	0.090918	0.275785	155	8.06	6.37E-08
CTB	350	100	364.005494	60	314334.8	0.011275	428224.3	0.01536	0.026636	155	8.06	6.15E-09
Security Building	100	100	141.421356	20	84473.31	0.00303	254608.7	0.009133	0.012163	155	8.06	2.81E-09
								Total:	0.314584			**7.26E-08**

Table 6.6: Probability Calculation for IR-180

SSC	Effective Area									Probability IR-180		
	W (ft)	L (ft)	R (ft)	H (ft)	A_f		A_s		A_{eff} (mi^2)	Number of Flights per Year	Width of IR-128/180 (mi)	Probability
					(ft^2)	(mi^2)	(ft^2)	(mi^2)				
-	Table 5.1	Table 5.1	$(L^2+W^2)^{0.5}$	Table 5.1-	Paragraph 6.2.1		Paragraph 6.2.1		$A_f + A_s$	Table 5.6	Table 5.5	-
UMAX Area	2470	1814	3064.55478	5.5	5153801	0.184867	2534653	0.090918	0.275785	6	8.06	2.46E-09
CTB	350	100	364.005494	60	314334.8	0.011275	428224.3	0.01536	0.026636	6	8.06	2.38E-10
Security Building	100	100	141.421356	20	84473.31	0.00303	254608.7	0.009133	0.012163	6	8.06	1.09E-10
								Total:	0.314584			**2.81E-09**

The total probability of an aircraft crash at the HI-STORE CIS Facility is the sum of the probabilities from each source. As all other sources screened out, the aircraft crash probability for the site will be the sum of the IR-128 and IR-180 probabilities:

$$P_{CIS} = 7.26X10^{-8} + 2.81X10^{-9}$$

$$\boldsymbol{P_{CIS} = 7.54X10^{-8} < 1X10^{-6}}$$

7.0 CONCLUSIONS

The probabilities of an aircraft crash for each of the airports near the HI-STORE CIS facility, Atresia Municipal, Cavern City, Lea County Regional, Zip Franklin Memorial, Roswell International, and Midland International are considered to be sufficiently low by inspection. Therefore, they are not credible hazards to the site. The aircraft crash probabilities for nearby holding and approach patterns, Cavern City Approach Pattern, and Lea County Regional Missed Approach Holding Pattern, are sufficiently low by inspection. Therefore, they are not credible hazards to the site. For Federal Airways near the site, V-102, V-291, and V-83, their aircraft crash probabilities are considered sufficiently low by inspection and are therefore not credible hazards to the site. Reciprocal Military Training Route IR-192/194, which is one of two sets of MTRs near the CIS facility, is not a credible hazard as its aircraft crash probability is considered sufficiently low by inspection.

The other reciprocal MTR near the site, IR-128/180 has an Aircraft crash probability of

$P = 7.54X10^{-8}$

As all other aircraft sources are not credible hazards to the site, the aircraft crash probability for the whole facility is

$P = 7.54X10^{-8}$

This value is less than an order of magnitude of 10^{-6} and is therefore sufficiently low. There are no credible aircraft crash hazards to the HI-STORE CIS Facility, and aircraft hazards need not be a design-basis threat.

8.0 REFERENCES

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9.0 LIST OF APPENDICES AND ATTACHMENTS

Appendix A – ATADS Search Results

Appendix B – IR-128/180 Usage Tables

Attachment 1 – Email Correspondence from Lt. Col. Rudy Cancino USAF

Attachment 2 – Email Summary of Telephone Conversation between Mr. Ed Mayer, Holtec International and Mr. Alan Shafer, Headquarters Air Force (A-3), 11:30 am, June 26th, 2018

APPENDIX A – ATADS SEARCH RESULTS

Table A.1: ATADS Standard Report for LEA County Regional Airport 2003-2017

Calendar Year	State	Facility	Itinerant					Local			Total Operations
			Air Carrier	Air Taxi	General Aviation	Military	Total	Civil	Military	Total	
2003	NM	HOB	0	3,047	8,676	167	11,890	6,138	468	6,606	18,496
2004	NM	HOB	0	3,002	6,850	200	10,052	5,224	344	5,568	15,620
2005	NM	HOB	0	2,277	5,082	77	7,436	3,660	166	3,826	11,262
2006	NM	HOB	0	2,195	4,574	72	6,841	3,694	155	3,849	10,690
2007	NM	HOB	0	2,237	5,468	62	7,767	4,006	82	4,088	13,810
2008	NM	HOB	0	2,388	5,165	85	7,638	5,240	188	5,428	17,366
2009	NM	HOB	0	2,136	10,327	171	12,634	6,884	390	7,274	19,908
2010	NM	HOB	4	2,190	9,806	280	12,280	3,991	366	4,357	16,637
2011	NM	HOB	2	1,944	6,332	137	8,415	2,011	326	2,337	10,752
2012	NM	HOB	0	2,264	5,817	157	8,238	856	176	1,032	9,270
2013	NM	HOB	2	2,341	5,622	100	8,065	738	90	828	8,893
2014	NM	HOB	0	2,358	5,153	257	7,768	511	244	755	8,523
2015	NM	HOB	0	1,979	5,336	399	7,714	1,196	304	1,500	9,214
2016	NM	HOB	0	2,115	5,351	374	7,840	818	226	1,044	8,884
2017	NM	HOB	0	1,870	5,049	157	7,076	1,097	16	1,113	8,189
Sub-Total for HOB			8	34,343	94,608	2,695	131,654	46,064	3,541	49,605	187,514
Sub-Total for NM			8	34,343	94,608	2,695	131,654	46,064	3,541	49,605	187,514
Total:			**8**	**34,343**	**94,608**	**2,695**	**131,654**	**46,064**	**3,541**	**49,605**	**187,514**
										15yr AVG	**12,501**

Table A.2: ATADS Standard Report for Midland International Air and Space Port 2003-2017

			Itinerant					Local			
Calendar Year	State	Facility	Air Carrier	Air Taxi	General Aviation	Military	Total	Civil	Military	Total	Total Operations
2003	TX	MAF	9,612	14,111	23,557	17,704	64,984	4,703	22,745	27,448	92,432
2004	TX	MAF	9,603	12,264	25,137	16,555	63,559	4,149	18,401	22,550	86,109
2005	TX	MAF	9,560	13,783	24,571	16,220	64,134	4,696	18,060	22,756	86,890
2006	TX	MAF	10,309	15,615	26,352	16,197	68,473	4,463	16,563	21,026	89,499
2007	TX	MAF	9,408	14,055	17,745	13,015	54,223	4,172	16,442	20,614	84,302
2008	TX	MAF	8,613	13,827	12,608	7,747	42,795	4,129	16,369	20,498	84,037
2009	TX	MAF	8,574	12,574	18,070	10,447	49,665	2,629	9,547	12,176	61,841
2010	TX	MAF	8,196	14,935	22,290	10,587	56,008	2,792	11,766	14,558	70,566
2011	TX	MAF	8,336	12,479	23,490	12,777	57,082	2,823	14,991	17,814	74,896
2012	TX	MAF	7,903	13,850	25,202	9,972	56,927	2,466	10,345	12,811	69,738
2013	TX	MAF	7,099	16,433	25,111	10,531	59,174	2,402	10,988	13,390	72,564
2014	TX	MAF	8,987	15,464	27,562	10,181	62,194	3,390	11,093	14,483	76,677
2015	TX	MAF	11,478	11,648	22,745	10,379	56,250	4,175	9,960	14,135	70,385
2016	TX	MAF	11,033	9,370	21,423	9,878	51,704	5,471	6,733	12,204	63,908
2017	TX	MAF	11,757	8,715	23,029	6,835	50,336	5,230	6,777	12,007	62,343
Sub-Total for MAF			140,468	199,123	338,892	179,025	857,508	57,690	200,780	258,470	1,146,187
Sub-Total for TX			140,468	199,123	338,892	179,025	857,508	57,690	200,780	258,470	1,146,187
Total:			**140,468**	**199,123**	**338,892**	**179,025**	**857,508**	**57,690**	**200,780**	**258,470**	**1,146,187**
										15yr AVG	**76,412**

Table A.3: ATADS Standard Report for Roswell International Air Center 2003-2017

Calendar Year	State	Facility	Itinerant					Local			Total Operations
			Air Carrier	Air Taxi	General Aviation	Military	Total	Civil	Military	Total	
2003	NM	ROW	398	8,579	13,861	13,394	36,232	9,741	12,181	21,922	58,154
2004	NM	ROW	94	9,418	18,547	13,495	41,554	12,800	13,032	25,832	67,386
2005	NM	ROW	222	9,379	16,714	12,433	38,748	7,802	13,233	21,035	59,783
2006	NM	ROW	218	8,590	19,998	15,359	44,165	7,408	15,695	23,103	67,268
2007	NM	ROW	225	8,559	14,855	11,284	34,923	6,094	18,324	24,418	66,890
2008	NM	ROW	301	6,953	8,735	5,580	21,569	4,396	9,532	13,928	50,108
2009	NM	ROW	337	6,360	12,020	11,178	29,895	6,005	12,826	18,831	48,726
2010	NM	ROW	116	6,405	9,468	10,242	26,231	4,774	20,953	25,727	51,958
2011	NM	ROW	268	6,999	8,922	7,496	23,685	4,064	7,924	11,988	35,673
2012	NM	ROW	603	6,168	7,232	8,309	22,312	4,373	7,986	12,359	34,671
2013	NM	ROW	519	6,006	6,498	13,329	26,352	2,339	24,384	26,723	53,075
2014	NM	ROW	518	6,551	7,384	12,371	26,824	3,127	16,979	20,106	46,930
2015	NM	ROW	260	5,412	6,522	8,573	20,767	2,382	12,081	14,463	35,230
2016	NM	ROW	285	6,116	6,317	8,771	21,489	1,630	11,161	12,791	34,280
2017	NM	ROW	1,652	4,718	6,593	5,252	18,215	2,301	5,030	7,331	25,546
Sub-Total for ROW			6,016	106,213	163,666	157,066	432,961	79,236	201,321	280,557	735,678
Sub-Total for NM			6,016	106,213	163,666	157,066	432,961	79,236	201,321	280,557	735,678
Total:			**6,016**	**106,213**	**163,666**	**157,066**	**432,961**	**79,236**	**201,321**	**280,557**	**735,678**
										15yr AVG	**49,045**

APPENDIX B – IR-128/180 USAGE TABLES

Table B.1: IR-128 Annual Flight Operations (Sorties) 1/1/2016 to 12/31/2016

Operating Space	Site	Requested Minutes	Utilized Minutes	Aircraft	Unit	Unit Location	Agency	MAJCOM	Sorties
IR128	Dyess	1305	915	**B-1B**	28 BS	Dyess AFB, TX	Air Force	ACC	**12**
IR128	Dyess	6135	6135	**B-1B**	9 BS	Dyess AFB, TX	Air Force	AFGSC	**70**
IR128	Dyess	150	150	**KC-135R**	28 BS	Dyess AFB, TX	Air Force	ACC	**1**

Table B.2: IR-128/180 Annual Flight Operations (Sorties) 6/18/2016 to 6/18/2017

Airspace	MsnReqHours	MsnScheduled Hours	MsnUtilized Hours	Airspace Scheduled	Airspace Utilized	Airspace Activated	Days Sched	Days Utilized	Sortie Count	Units	Aircraft
IR128	217.5	211	211	205	205	205	70	70	**119**	28 BS, 9 BS	**B-1B, KC-135R**
IR180	5.5	5.5	5.5	5.5	5.5	5.5	2	2	**2**	20 BS	**B-52H**

Table B.3: IR-128/180 Annual Flight Operations (Sorties) 6/18/2017 to 6/18/2018

Airspace	Msn Req Hours	Msn Scheduled Hours	Msn Utilized Hours	Airspace Scheduled	Airspace Utilized	Airspace Activated	Days Sched	Days Utilized	Sortie Count	Units	Aircraft
IR128	313.25	295.75	286.37	291.5	278.33	278.33	109	99	**155**	28 BS, 337 TES, 345 BS, 507 ARW, 77 WPS, 9 BS, 9 SOS, 931 ARW, 97 AMW	**B-1B, C-130J, KC-135R**
IR180	8.75	8.75	8.75	8.75	8.75	8.75	4	4	**6**	9 BS	**B-1B**

Ben Zwierlein

From: Cancino, Rodolfo G Jr Lt Col USAF AF-A3 (US) <rodolfo.g.cancino.mil@mail.mil>
Sent: Monday, June 18, 2018 3:21 PM
To: Ben Zwierlein
Cc: Ed Mayer; Shafer, Alan L CIV USAF AF-A3 (US); Sanders, Elliott J III CIV USAF ACC A3 (US); Bumpers, Donald O CIV USAF ACC CC (US); Eibe, Eric E CTR USAF AF-A3 (US)
Subject: RE: [Non-DoD Source] Dyess AFB Contact
Attachments: 18Jun16_18Jun17.xls; 18Jun17_18Jun18.xls; FW: [Non-DoD Source] Facility locations in Eddy and Lea Counties New Mexico (860 KB)
Signed By: rodolfo.cancino@us.af.mil

Ben, attached is our utilization report for the last two years for these two IRs. The use may have declined even more this calendar year. I will check with ACC/Airspace to acknowledge Dwight's analysis of use.

Let me know if this helps. I will get more words to you asap.

v/r
rc

Rudy Cancino, Lt Col, USAF
Airspace Analyst
AF/A3TI Pentagon 5D756
(703) 692-7752 DSN: 222-7752

From: Ben Zwierlein [mailto:B.Zwierlein@holtec.com]
Sent: Monday, June 18, 2018 3:08 PM
To: Cancino, Rodolfo G Jr Lt Col USAF AF-A3 (US) <rodolfo.g.cancino.mil@mail.mil>
Cc: Ed Mayer <E.Mayer@holtec.com>
Subject: [Non-DoD Source] Dyess AFB Contact

Rudy,

We had previously spoken to Dwight Williams at Dyess AFB. I've attached an email chain which in which he stated that they do not use either IR-128 or IR-180 near our site.

IR-128 and IR-180 are reciprocal MTRs. The portion of each route that passes above our site are:

IR-128 – Points S, T, and U
IR-180 – Points L, M, and N

If this is the case, that would be great news for us, we would just need an official statement. If not, we would need to know the types of aircraft that do fly those portions of the MTRs, and their number of flights per year.

Please let me know if you need any additional information. Thank you again for your help.

Thanks,

Ben Zwierlein
Civil Engineer – Plant Design Services
P: 856.797.0900, Ext. 3954 |**F:** 856.797.0909
b.zwierlein@holtec.com < Caution-mailto:b.zwierlein@holtec.com >

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Ben Zwierlein

From: Cancino, Rodolfo G Jr Lt Col USAF AF-A3 (US) <rodolfo.g.cancino.mil@mail.mil>
Sent: Tuesday, June 26, 2018 10:48 AM
To: Ben Zwierlein
Cc: Shafer, Alan L CIV USAF AF-A3 (US); Ed Mayer; Paul Angelucci; Paul Thomas
Subject: RE: [Non-DoD Source] Additional Questions in regards to IR-128/180
Attachments: IR128_IR180_.pdf; 1Jan16_31Dec16 Dyess.xls
Signed By: rodolfo.cancino@us.af.mil

Ben,
We are able to provide CY2016 utilization data. IR-128 was scheduled a few times (IR 180 was not).
Portions of the MTRs outside of the MOAs are generally used only for transit. Their MTR utilization is defined within the legal description.
Live ordinance/munitions could be carried on the MTR. As you can see, both IR128/180 lead to Melrose Range.

Let me know if you have any other questions.

Thank you,
rc

Rudy Cancino, Lt Col, USAF
Airspace Analyst
AF/A3TI Pentagon 5D756
(703) 692-7752 DSN: 222-7752

From: Ben Zwierlein [mailto:B.Zwierlein@holtec.com]
Sent: Wednesday, June 20, 2018 3:49 PM
To: Cancino, Rodolfo G Jr Lt Col USAF AF-A3 (US) <rodolfo.g.cancino.mil@mail.mil>
Cc: Shafer, Alan L CIV USAF AF-A3 (US) <alan.l.shafer.civ@mail.mil>; Ed Mayer <E.Mayer@holtec.com>; Paul Angelucci <P.Angelucci@holtec.com>; Paul Thomas <P.Thomas@holtec.com>
Subject: [Non-DoD Source] Additional Questions in regards to IR-128/180

Rudy,

As we just discussed on the phone, here is a follow up with our questions in writing.

We had our meeting with the NRC yesterday to discuss our aircraft crash assessment. The meeting went well however it became apparent that the NRC is looking for a little bit more information.

First, is there any more utilization data for IR-128/180? The NRC may want more than 2 years to determine an average annual usage. If not, we can certainly use the data you have provided.

Secondly, would the portions of the MTR which are outside of and MOA be used for anything other than transit? i.e. would rations occur outside of an MOA or would it strictly be Normal Flight modes?

Third, would live ordinance or munitions be carried on the portions of the MTR that fall outside of an MOA?

The reason we ask the second and third question is to demine if activities on IR-128/180 near our site could "create an unusual stress situation". That language is used in the acceptance criteria for the Aircraft crash assessment portion of NUREG 0800 (section 3.5.1.6).

As for a timeline, we are trying to put together our responses by the end of next week (June 29, 2018) please let me know if that is enough time. Again, we appreciate your help.

Thank you,

Ben Zwierlein
Civil Engineer – Plant Design Services
P: 856.797.0900, Ext. 3954 | **F:** 856.797.0909
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Ben Zwierlein

From: Ed Mayer
Sent: Tuesday, June 26, 2018 1:56 PM
To: Ben Zwierlein
Cc: Stefan Anton; Kimberly Manzione; Joyce Tomlinson; Paul Thomas; Paul Angelucci
Subject: Aircraft Munitions Data

Reference:
Telephone Conversation between Mr. Ed Mayer, Holtec International and Mr. Alan Shafer, Headquarters Air Force (A-3), 11:30 am, June 26th, 2018.

Munitions aboard outbound aircraft from Dyess, AFB:
50% No munitions
25% Inert munitions
20% Live 500# Precision Bomb
3% Live 250# Precision Bomb
2% Live 2000# Precision Bomb

Also, Mr. Shaffer placed a formal request to Dyess, AFB for aircraft to stay at least 1500 ft in altitude above or 2 miles horizontally around the facility. This is the same buffer used at nuclear power plants.

Ed Mayer
Program Director:
-HI-STORE: A Holtec International UMAX Facility for Consolidated Interim Storage
-Spent Fuel Dry Storage Project, Angra dos Reis, Brazil
-Krishna P. Singh Technology Campus

(856) 797-0900 Ext. 3671
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