PACIFIC GAS & ELECTRIC COMPANY

PROBABILISTIC RISK ASSESSMENT

CALCULATION FILE NO. **PRA03-14 Revision 0**

SUBJECT: Risk Assessment of Aircraft Hazard for Dry Cask/Spent Fuel Transportation and Storage for Humboldt Bay ISFSI

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NOTE: This Document contains assumptions and results that are the basis for parts of SAR Sections 2.2.1.3. Modification of this document will require evaluation under 10CFR72.48.

This file contains 14 pages

RECORD OF REVISIONS

REV. 0 Original Calculation.

INTRODUCTION

This PRA evaluation looks at the various hazards that may have an influence on the HBPP ISFSI facility and the transfer of spent fuel to that facility. This evaluation addresses the potential aircraft hazards.

Per the guidance of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Section 3.5.1.6, Aircraft Hazards to the ISFSI facility shall be evaluated for the potential of an aircraft crash affecting the site. The threshold used in this evaluation is 1E-6, which was specified in the Private Fuel Storage SER (Reference 6) for an acceptable frequency of aircraft impact into a facility from all types of aircraft. As specified in NUREG-0800, the probability of aircraft crashes is considered to be negligibly low by inspection and does not require further analysis if the three criteria specified in Item II.1 of Section 3.5.1.6 are met. In particular, Criterion 1 specifies that if the plant–to-airport distance, D, is between 5 and 10 statute miles, and the projected annual number of operations must be less than 500 D^2 or the plant–to-airport distance, D, must be greater than 10 statute miles, and the projected annual number of operations must be less than 1,000D^2. Criterion 2 specifies that the facility must be at least 5 statute miles from the edge of military training routes. Criterion 3 specifies that a facility must be at least 2 statute miles beyond the nearest edge of a federal airway, holding pattern, or approach pattern.

AIRCRAFT HAZARD DISCUSSION

To evaluate the aircraft hazard for the ISFSI three areas must be evaluated. First are the airports in the area of which there are five, Eureka Arcata, Kneeland, Rohnerville, Eureka Municipal, and Murray Field Airports. The second is military facilities and airways. There are no military facilities or airways in the area of the ISFSI that could affect the ISFSI facility. The third are federal airways, holding patterns, and approach patterns. Federal flight corridor V607, which passes approximately 9 miles northeast of the ISFSI site, is one of the main flight approach corridor into the Eureka-Arcata Airport. There are also several other approach and departure corridors for the Eureka-Arcata Airport that either fly directly over the ISFSI or would be within 2 statute miles to the nearest edge of those corridors. In addition, there are three other federal flight corridors, which fly almost directly over the ISFSI facility. These are V 27, V 195, and V 494.

ACCEPTANCE CRITERIA

Per the guidance of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Section 3.5.1.6, Aircraft Hazards the ISFSI facility shall be evaluated for the potential of an aircraft crash affecting the site. The threshold used in this evaluation is 1E-6, which was specified by the NRC staff in the

Private Fuel Storage SER, Revision 13 (Reference 6) for an acceptable frequency of aircraft impact into a facility from all types of aircraft.

BASE DATA USED

The Eureka-Arcata Airport, located adjacent to US Highway 101 approximately 20 miles to the north of the ISFSI site, is the primary airport for commercial air traffic in Humboldt County. This airport serves on average 207 flight operations per day (www.airnav.com/airport/KACV).

The Eureka Municipal Airport is located on the Samoa Peninsula at approximately 2 miles north of the ISFSI site. Direct access to this airport is via local roadways connected to the north of the airport with State Highway 255, which connects the Samoa Peninsula with US Highway 101. This airport serves on average 96 flight operations per week (www.airnav.com/airport/033).

The Murray Field Airport is located at the northern edge of Eureka immediately adjacent to US Highway 101, approximately 6 miles north of the ISFSI site. This airport serves on average 179 flight operations per day (www.airnav.com/airport/EKA).

The Kneeland Airport is located approximately 14 miles southeast of the ISFSI site. This airport serves on average 27 flight operations per day (www.airnav.com/airport/019).

The Rohnerville Airport is located 3 miles southeast of Fortuna, California and approximately 15 miles southeast of the ISFSI site. This airport serves on average 75 flight operations per week (www.airnav.com/airport/KFOT).

There are three federal flight corridors, which fly almost directly over the ISFSI facility; these are V 27, V 195, and V 494. These corridors converge on the Fortuna transponder. Per the FAA Northwest Mountain Region (Reference 4), the estimated traffic on these corridors is 18 flights per day and the majority of the aircraft using these routes are above 10,000 feet and below 18,000 feet. In addition, there are some high altitude airways that pass over the general area with approximately 52 flights per day. These flights are almost exclusively at 33,000 feet and are classified as direct flights by the FAA.

There is also federal flight corridor V 607, which is the main flight approach corridor into the Eureka-Arcata Airport. The center of this corridor passes approximately 13 miles east of the ISFSI. The estimated traffic on this corridor is 207 flight operations per day.

There is also a military training route (VR 1251), which passes the ISFSI facility to the east at an approximate distance of 18 miles. The use of this route is limited to transport through the area, as there are no major military bases or facilities in the region within 50 miles of the ISFSI site.

There is a US Coast Guard Reservation and Lifeboat Station located at the tip of Samoa Peninsula, which is approximately 1.5 miles north of the ISFSI site, where a

Coast Guard Cutter is stationed. The station is accessible via the waters of Humboldt Bay as well as local access roadways connected with State Highway 255. The US Coast Guard Air Station is located at the Eureka-Arcata Airport, approximately 20 miles north of the ISFSI site. Training activities as well as actual events involving coastal surveillance and air-sea rescue missions along the Humboldt County coastline are conducted from both locations year round.

SCREENING EVALUTIONS

Screening Per Criterion 1

As specified in NUREG-0800, the probability of aircraft crashes is considered to be negligibly low by inspection and does not require further analysis if the three criteria specified in Item II.1 of Section 3.5.1.6 are met. In particular, Criterion 1 specifies that if the plant–to-airport distance, D, is between 5 and 10 statute miles, and the projected annual number of operations must be less than 500 D^2 or the plant–to-airport distance, D, must be greater than 10 statute miles, and the projected annual number of operations must be less than 1,000D^2. Of the five airports in the area of the ISFSI facility, the Eureka Arcata, Kneeland and Rohnerville Airports meet Criterion 1 of the NUREG-0800 as follows:

The Eureka-Arcata Airport is approximately 20 miles to the north of the ISFSI site with annual flight operations totals of approximately 75,600, which is less than $1,000(20)^2$ or 400,000.

The Kneeland Airport is approximately 14 miles southeast of the ISFSI site with annual flight operations totals of approximately 9,855, which is less than $1,000(14)^2$ or 196,000.

The Rohnerville Airport is approximately 15 miles southeast of the ISFSI site with annual flight operations totals of approximately 3,900, which is less than $1,000(15)^2$ or 225,000.

The Eureka Municipal Airport, which is located approximately 2 miles north of the ISFSI site with annual flight operations of approximately 4,992 and the Murray Field Airport, which is located approximately 6 miles north of the ISFSI site with annual flight operations totals of approximately 65,335 do not meet Criterion 1 of NUREG-0800 and require further evaluation.

Screening Per Criterion 2

Criterion 2 specifies that the facility must be at least 5 statute miles from the edge of military training routes. There is no military training route within 5 statute miles of the ISFSI facility (the edge of VR 1251 is approximately 14 miles) and further evaluation under this criterion is not required.

Screening Per Criterion 3

Criterion 3 specifies that a facility must be at least 2 statute miles beyond the nearest edge of a federal airway, holding pattern, or approach pattern. Federal flight corridor V607, which passes approximately 9 miles northeast of the ISFSI site, is one of the main flight approach corridor into the Eureka-Arcata Airport. This corridor meets Criterion 3 of NUREG-0800 and does not require further evaluation.

There are several other secondary approach and departure patterns for the Eureka-Arcata Airport that either fly directly over the ISFSI or would be within 2 statute miles to the nearest edge of those patterns. These do not meet Criterion 3 of NUREG-0800 and require further evaluation.

There are three other federal flight corridors, which fly almost directly over the ISFSI facility, which are V 27, V 195, and V 494. These three air corridors do not meet Criterion 3 of NUREG-0800 and require further evaluation.

FURTHER DETAILED EVALUATIONS

To determine the probability of an aircraft crashing into the site per year an evaluation of the various airways, landing and departure patterns, and air traffic in the vicinity of the ISFSI was performed. This evaluation was performed based the guidance and acceptability criteria in NUREG-0800.

For Airways and Corridors

For situations where federal airways or aviation corridors pass through the vicinity of the ISFSI site, the probability per year of an aircraft crashing into the site (P_{fa}) is estimated in accordance with NUREG-0800. The probability depends on factors such as altitude, frequency, and width of the corridor and corresponding distribution of past accidents. Per NUREG-0800, the following expression is used to calculate the probability:

Equation 1

$$P_{fa} = C \times N \times A/w$$

Where:

C = In-flight crash rate per mile for aircraft using airway

w = Width of airway (plus twice the distance from the airway edge to the site when the site is outside the airway) in miles

N = Number of flights per year along airway

A = Effective area of the site in square miles

Determining Effective Crash Area

The following analysis was completed per DOE-STD 3014-96 (Reference 3) to determine effective crash area. In this analysis conservative factors have been used for maximum skid distance and maximum wingspan. Based on the available information on aircraft type, size, and the location of the site these factors are very conservative.

Equation 2

In DOE-STD-3014-96:

The effective crash area is: $A = A_f + A_s$

where:

$A_f = (WS + R)(H\cot\Phi) + (2)(L)(W)(WS)/R + (L)(W)$

and

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

where:

A_f	=	effective fly-in area;
A_s	=	effective skid area;
WS	=	aircraft wingspan; (reference Table B-16 of DOE-STD 3014-96)
R	=	length of diagonal of the facility, = $(L^2+W^2)^{0.5}$
H	=	facility height;
$\cot\Phi$	=	mean on the cotangent of the aircraft impact angle; (reference Table B-17 of DOE-STD 3014-96)
L	=	length of facility;
W	=	width of facility;
S	=	aircraft skid distance; (reference Table B-18 of DOE-STD 3014-96)

Determining the effective crash area for commercial aircraft at the ISFSI site:

where:

WS	=	aircraft wingspan is 98 feet; (Reference Table B-16 of DOE-STD 3014-96)
R	=	length of diagonal of the facility is 76.16 feet,
H	=	facility height is 1.5 feet;
$\cot\Phi$	=	mean on the cotangent of the aircraft impact angle is 10.2; (Reference Table B-17 of DOE-STD 3014-96)
L	=	length of facility is 70 feet;
W	=	width of facility is 30 feet;
S	=	aircraft skid distance is 1440 feet;

(Reference Table B-18 of DOE-STD 3014-96)

$A_f = (WS + R)(H\cot\Phi) + (2)(L)(W)(WS)/R + (L)(W)$

$A_f = (98 + 76.16)(1.5)(10.2) + (2)(70)(30)(98)/76.16 + (70)(30)$
$A_f = 10{,}169\ ft^2/(5{,}280\ ft/mile)^2 = 0.000365$ sq miles

and

$A_s = (WS + R)(S) = (98 + 76.16)(1440) = 250{,}790\ ft^2/(5{,}280\ ft/mile)^2 = 0.009$ sq miles

Total Effective Crash Area for commercial aircraft:

$A = A_f + A_s = 0.000365 + 0.009 = 0.009365$ sq miles

Determining the effective crash area for general aviation aircraft at the ISFSI site:

where:

WS	=	aircraft wingspan is 73 feet; (Reference Table B-16 of DOE-STD 3014-96)
R	=	length of diagonal of the facility is 76.16 feet,
H	=	facility height is 1.5 feet;
$\cot\Phi$	=	mean on the cotangent of the aircraft impact angle is 8.2; (Reference Table B-17 of DOE-STD 3014-96)
L	=	length of facility is 70 feet;
W	=	width of facility is 30 feet;
S	=	aircraft skid distance is 60 feet; (Reference Table B-18 of DOE-STD 3014-96)

$A_f = (73 + 76.16)(1.5)(8.2) + (2)(70)(30)(73)/76.16 + (70)(30)$
$A_f = 7{,}960\ ft^2/(5{,}280\ ft/mile)^2 = 0.000286$ sq miles

and

$A_s = (WS + R)(S) = (73 + 76.16)(60) = 8950\ ft^2/(5{,}280\ ft/mile)^2 = 0.00032$ sq miles

Total effective crash area for general aviation:

$A = A_f + A_s = 0.000286 + 0.00032 = 0.000606$ sq miles

Determining the effective crash area for military aircraft at the ISFSI site:

where:

WS	=	aircraft wingspan is 110 feet; (Reference Table B-16 of DOE-STD 3014-96)

R = length of diagonal of the facility is 76.16 feet,
H = facility height is 1.5 feet;
cotΦ = mean on the cotangent of the aircraft impact angle is 10.4; (Reference Table B-17 of DOE-STD 3014-96)
L = length of facility is 70 feet;
W = width of facility is 30 feet;
S = aircraft skid distance is 780 feet; (Reference Table B-18 of DOE-STD 3014-96)

$A_f = (WS + R)(H\cot\Phi) + (2)(L)(W)(WS)/R + (L)(W)$

$A_f = (110 + 76.16)(1.5)(10.4) + (2)(70)(30)(110)/76.16 + (70)(30)$
$A_f = 11{,}070\ ft^2/(5{,}280\ ft/mile)^2 = 0.0004$ sq miles

and

$A_s = (WS + R)(S) = (110 + 76.16)(780) = 145{,}204.8\ ft^2/(5{,}280\ ft/mile)^2 = 0.0052$ sq miles

Total effective crash area for military aircraft:

$A = A_f + A_s = 0.0004 + 0.0052 = 0.0056$ sq miles

Determining the effective crash area for Military Helicopters at the ISFSI site:

where:

WS = aircraft wingspan is 50 feet; (Reference Table B-16 of DOE-STD 3014-96)
R = length of diagonal of the facility is 76.16 feet,
H = facility height is 1.5 feet;
cotΦ = mean on the cotangent of the aircraft impact angle is 0.58; (Reference Table B-17 of DOE-STD 3014-96)
L = length of facility is 70 feet;
W = width of facility is 30 feet;
S = aircraft skid distance is 0.0 feet; (Reference Table B-18 of DOE-STD 3014-96)

$A_f = (WS + R)(H\cot\Phi) + (2)(L)(W)(WS)/R + (L)(W)$

$A_f = (50 + 76.16)(1.5)(0.58) + (2)(70)(30)(50)/76.16 + (70)(30)$
$A_f = 4{,}967\ ft^2/(5{,}280\ ft/mile)^2 = 0.00018$ sq miles

and

$A_s = (WS + R)(S) = (50 + 76.16)(0) = 0.0\ ft^2 = 0.0$ sq miles

Total effective crash area for military helicopters;

$$A = A_f + A_s = 0.00018 + 0.0 = 0.00018 \text{ sq miles}$$

Note: In the above calculations the skid distance (A_s) is based on the layout of the facility which is a vault that is below the ground with the exception of the top of the vault which extends approximately 18 inches above the surface. The top of the ISFSI vault sits on a hill, which is the highest point of land in the immediate area. Although being on this hill might have an affect on the skid distance, for this calculation no topographical elements around the site were considered to provide additional protection from a crash. As such, the skid distances used in the above calculations are 1,440 feet for commercial aircraft, 60 feet for general aviation, and 780 feet for military aircraft per Table B-18 of DOE-STD 3014-96 (Reference 3).

Evaluation of Airways and Routs for Local traffic at the Eureka-Arcata

The Eureka-Arcata Airport has a control tower and the traffic patterns are very controlled and precise. The distance to the airport is over 20 miles and the distance to the edge of normal approach and departure route (V607) for this airport is more than 14 miles away, which per NUREG-0800 criteria would not require further review for the ISFSI. However, a few secondary approaches and departure patterns potentially either pass directly over the ISFSI or very close to it. In considering these secondary patterns, based on the configuration of the airport runways and the area prevailing winds, it is conservatively assumed that 95 percent of the aircraft approaching or departing this airport follow the normal (V607) route and would not be considered a threat to the ISFSI. As a result, only 5 percent of the traffic in and out of this airport is considered to potentially fly over the ISFSI site

Based on the above assumptions (P_{fa}) for the air traffic at Eureka-Arcata Airport was calculated using Equation 1, as follows:

In calculating (P_{fa}) we consider the three main types of traffic at an airport. This includes commercial, general aviation, and military operations. As a result, there are three components to $(P_{fa}) = P_{\text{commercial}} + P_{\text{general aviation}} + P_{\text{military}}$.

For $P_{\text{commercial}}$ (C) is specified by NUREG-0800 for commercial aircraft to be 4E-10 crashes per mile. The number of flights per year, N, is taken conservatively from the local flight schedules at approximately 34 flight/day. Per the assumptions only 5 percent of these flights would pass near the site. As a result N = (0.05)(34 fights/day)(365days/year) = 621 flights/year. Since the aircraft are being considered to fly directly over the ISFSI the width of the airway is conservatively set at 1 mile. From above the effective crash area A = 0.009365 sq miles for commercial. Based on these values, $P_{\text{commercial}} = (C)(N)(A/w) = (4E\text{-}10)(621)(9.365E\text{-}3/1) = 2.326E\text{-}9$.

For $P_{\text{general aviation}}$, Table 3.33 of the ACRAM (Reference 5) specifies a (C) value of 1.510×10^{-7} per mile, which is used in this analysis. The number of flights per year, (N), is taken conservatively from the local flight schedules at approximately (0.05)(145 flights/day)(365days/year) = 2646 flights/year. Since the aircraft are being considered to fly directly over the ISFSI the width of the airway is conservatively set at 1 mile.

From above the effective crash area A = 0.000606 sq miles for general aviation. Based on these values, $P_{general\ aviation}$ = (C)(N)(A/w) = (1.51E-7)(2646)(6.06E-4/1) = 2.42E-7.

For $P_{military}$, there are two types of aircraft listed as using this airport, helicopters and air taxi. Conservatively all of these aircraft are assumed to be turbine powered helicopters in this calculation. Table 3.35 of the ACRAM (Reference 5), specifies a (C) value of 1.788E-7 per mile which was used in this analysis. The number of flights per year, (N), is taken conservatively from the local flight schedules at approximately (0.05)(87 flights/day)(365 days/year) =1588 flights/year. Since the aircraft are being considered to fly directly over the ISFSI the width of the airway is conservatively set at 1 mile. From above the effective crash area A = 0.00018 sq miles for military aircraft. Based on these values, $P_{military}$ = (C)(N)(A/w) = (1.788E-7)(1588)(1.8E-4/1) = 5.11E-8.

The total probability (P_{fa}) for the Eureka-Arcata Airport is:

2.326E-9 + 2.42E-7 + 5.11E-8 =2.93E-7.

Evaluation of Federal Air Route Non-Local Traffic

The above probability evaluations take into consideration all local traffic on the federal air routes including V-27, V-195 and V-494. However, per a FAA traffic review dated 04/25/03, (Reference 4) the total non-local traffic on these airways per day includes 15 commercial and 3 general aviation operations. These operations pass through the area at between 10,000 ft and 18,000 ft. Per NUREG-0800 Equation 1 is used to determine probability per year of an aircraft crashing into the site (P_{fa}).

For the commercial flights:

NUREG-0800 for specifies (C) for commercial aircraft as 4E-10 crashes per mile. Since the flights are considered to be over the ISFSI the width of the airway is taken as 1 mile. From the above calculations, the effective crash area A = 0.009365 sq miles for commercial traffic.

$P_{commercial}$ = CxNxA/w = (4 E-10 crashes/mile)(15 flights/day)(365 days/year)(9.365E-3 sq miles)/(1 mile) = 2.5E-8

For general aviation flights:

Table 3.33 of the ACRAM (Reference 5) specifies a (C) value for general aviation of 1.510E-7 crashes per mile. Since the flights are considered to be over the ISFSI the width of the airway is taken as 1 mile. From above calculations, the effective crash area A = 0.000606 sq miles for general aviation traffic.

$P_{general\ aviation}$ =(C)(N)(A/w)= (1.510E-7 crashes/mile)(3 flights/day)(365 days/year)(0.000606 sq miles/1mile) = 1.00E-7.

Total non local aircraft crash potential:

$P_{fa} = P_{a\ commercial} + P_{a\ general\ aviation} = 2.5E\text{-}8 + 1.00E\text{-}7 = 1.25E\text{-}7.$

Evaluation of Local traffic at the Eureka Municipal and the Murray Field Airports

To determine the probability of a crash involving air traffic in or out of these three airports several assumptions were made. In the case of the Eureka Municipal and Murray Field Airports there are no control towers and the traffic is less precise for approaches and departures. Although the exact number of flights into or out of the Eureka Municipal or Murray Field Airports which will pass over the ISFSI is not known, based on the configurations of the runways and prevailing winds, it was conservatively assumed that approximately 15 percent of all arrivals and departures for Murray Fields Airport and approximately 50 percent for Eureka Municipal Airport fly directly over the ISFSI.

For the air traffic at the Eureka Municipal and Murray Field Airports, the following equation from NUREG-0800 Section II.3 was used The NUREG provides this equation for civilian and military airports and heli-ports to determine the probability per year of an aircraft crashing into the site (P_a) is:

Equation 3

$P_a = (L)(M)(C)(N)(A)$

Where

M = Number of different types of aircraft using the airport,
L = Number of flight trajectories affecting the site,
C = Probability per square mile of a crash per aircraft movement,
N = Number per year of movements
A = Effective plant area in square miles.

The (P_a) for the air traffic at Murray Field Airport was calculated as follows:

In calculating (P_a) we consider the three main types of traffic at an airport. This includes air taxi, general aviation, and military operations. As a result, there are three components to (P_a) = $P_{air\ taxi} + P_{general\ aviation} + P_{military}$. Conservatively in this calculation the air taxi operations have been included in the general aviation data. The number of types of aircraft (M) for each sub-calculation is taken conservatively as 1. This is conservative based on the crash rates used in the calculations being composites of the general type of aircraft. In addition, (L) the numbers of flight trajectories affecting the site are also taken as 1. This is conservative because it assumes that all of the flight trajectories included in the calculation fly directly over the ISFSI site.

The distance to the end of the runway at this airport is approximately 6 miles. For $P_{general\ aviation}$, (C) is specified by NUREG-0800 at 5 miles to be 1.2E-8 crashes per sq mile, which is conservatively used in this analysis. Due to the configuration on the runways at this airport, the normal approach and departure from this airport is along an axis that runs from approximately 135 degrees to 315 degree. This path would put the majority

of the airport traffic either northwest of the site or southeast of the site. Conservatively 15 percent of the total traffic is being considered to pass over the ISFSI site and (N) is taken conservatively from the local flight schedules at approximately (0.15)(178 flights/day)(365 days/year) = 9,746 flights/year. From above the effective crash area A= 0.000606 sq miles. Based on these values, $P_{\text{general aviation}}$ = (L)(M)(C)(N)(A) = (1)(1)(1.2E-8)(9,746)(6.06E-4) = 7.32E-8.

For P_{military}, (C) is specified by NUREG-0800 at 5 miles at 4.0E-9 crashes per sq mile, which is conservatively used in this analysis. The number of flights per year, N, is taken conservatively from the local flight schedules at approximately (0.15)(1 flight/day)(365 days/year) = 55 flights/year. From above the effective crash area A = 0.00018 sq miles. Based on these values, P_{military} = (L)(M)(C)(N)(A) = (1)(1)(4.0E-9)(55)(1.8E-4) = 4.0E-11.

Total probability (P_a) for the Murray Field Airport is:

7.32E-8 + 4.0E-11 =7.32E-8

The (P_a) for the Eureka Municipal Airport was calculated as follows:

In calculating (P_a) we considered all of the traffic to be general aviation operations. As a result, there is only one component to ($P_{\text{general aviation}}$). The number of types of aircraft (M) for each sub-calculation is taken conservatively as 1. This is conservative based on the crash rates used in the calculations being composites of the general type of aircraft. In addition, (L) the numbers of flight trajectories affecting the site are also taken as 1. This is conservative because it assumes that all of the flight trajectories included in the calculation fly directly over the ISFSI site.

The distance to the runway is taken at 2 miles. For $P_{\text{general aviation}}$, (C) is specified by NUREG-0800 at 2 miles at 1.5E-7 crashes per sq mile, which is used in this analysis. Conservatively 15 percent of the traffic at this airport is considered to pass over the site and (N) is taken conservatively from the local flight schedules at approximately (0.5)(96 flights/week)(52 weeks/year) = 2,496 flights/year. From above the effective crash area A = 0.000606 sq miles. Based on these values, $P_{\text{general aviation}}$ = (L)(M)(C)(N)(A) = (1)(1)(1.5E-7)(2,496)(6.06E-4) = 2.27E-7.

Total probability (P_a) for the Eureka Municipal Airport is:

2.27E-7

Evaluation of High Altitude Traffic

There is also some additional traffic in the area that takes place almost exclusively at altitudes greater that 33,000 ft. This altitude precludes them from being a credible threat to the ISFSI and therefore are not considered in these calculation.

Evaluation Holding Patterns

There are no holding patterns in the area that would require evaluation per NUREG-0800 with the exception of one instrument approach occasionally used to the Eureka-Arcata Airport. It has a one-minute holding pattern over the vicinity of the ISFSI site. Traffic on this pattern is included in the estimated traffic for that airport in the total probability provided above.

CONCLUSION

Total Probability for a Aircraft Crash at the ISFSI

The total probability of aircraft crashes in the ISFSI site area, (P_{fa}), is the sum of each of the probabilities from each airport and each airway evaluation. Based on the above calculations, (P) = (P_{fa} for Eureka-Arcata Airport) + (P_a for the Murray Field Airport) + (P_a for the Eureka Municipal Airport) + (P_{fa} for non local aircraft crash potential) = (2.93E-7) + (7.32E-8) + (2.27E-7) + (1.25E-7) = 7.18E-7, which is less than the threshold of 1E-6 specified in the Private Fuel Storage SER (Reference 6) for acceptable frequency of aircraft impact into a facility from all types of aircraft.

FUTURE AIRCRAFT GROWTH PREDICTION

The following are PG&E estimates of projected growth of civilian flights based on Federal Aviation Administration (FAA) long-range forecast (FAA, 1999).

Commercial aircraft operations, include air carriers and commuter/air taxi takeoff and landings at all US towered and non-towered airports, are projected to increase from 28.6 million in 1998 to 47.6 million in 2025. That results in a projected increase of 66 percent by 2025.

The annual number of general aviation operations at all towered and non-towered airports in the US is projected by the FAA to increase from 87.4 million in 1998 to 99.2 million in 2025. That results in a projected increase of 14 percent by 2025.

The FAA also predicts that the military traffic will not increase appreciably, if at all, in the foreseeable future.

Based on the above potential increases in traffic, the following are the projected potential crash probabilities by 2025:

For the Eureka-Arcata Airport is (2.326E-9)(1.65) + (2.42E-7)(1.14) + (5.11E-8)(1) = 3.38E-9 + 2.76E-7 + 5.11E-8 = 3.309E-7

For the Murray Field Airport is (7.32E-8)(1.14) + (4.0E-11)(1) = 8.34E-8 + 4.0E-11 = 8.35E-8

For the Eureka Municipal Airport is (2.27E-7)(1.14) = 2.59E-7

For non-local aircraft crash potential is (2.5E-8)(1.65)+ (1.00E-7)(1.14) = 4.125E-8 + 1.14E-7 = 1.55E-7.

Based on the above calculations and FAA projections, the cumulative aircraft probabilities increased to (P) = (P_{fa} for Eureka-Arcata Airport) + (P_a for the Murray Field Airport) + (P_a for the Eureka Municipal Airport) + (P_{fa} for non local aircraft crash potential) = (3.309E-7) + (8.35E-8) + (2.59E-7) + (1.55E-7) = 8.287E-7. This increase remains below threshold of 1E-6 specified in the Private Fuel Storage SER (Reference 6) for acceptable frequency of aircraft impact into a facility from all types of aircraft.

REFERENCES

1. Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants, USNRC, NUREG-0800, July 1981. Section 3.5.1.6, Aircraft Hazards

2. 10 CFR 72, Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste.

3. DOE-STD-3014-96 Accident Analysis for Aircraft Crash Into Hazardous Facilities, Appendix B, page B-26, US Department of Energy, October 1996.

4. FAA Speed Memo dated 04/25/03 from Michael Rae Cooke, FOIA Officer ANM-505.4, subject: FOIA 2003-073-3, 2003-005018NM; federal airways.

5. NTIS, Data Development Technical Support Document For Aircraft Crash Risk Analysis Methodology (ACRAM) Standard, US Department of Commerce, August 1996

6. Private Fuel Storage LLC. Safety Evaluation Report, Revision 13