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MARTIN MARIETTA

**The Annual Probability of an
Aircraft Crash on the U.S.
Department of Energy Reservation
in Oak Ridge, Tennessee**

Robert S. Seigler
Laura J. Luttrell

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**THE ANNUAL PROBABILITY OF AN AIRCRAFT CRASH
ON THE U.S. DEPARTMENT OF ENERGY RESERVATION
IN OAK RIDGE, TENNESSEE**

November 1992

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ACRONYMS AND INITIALISMS

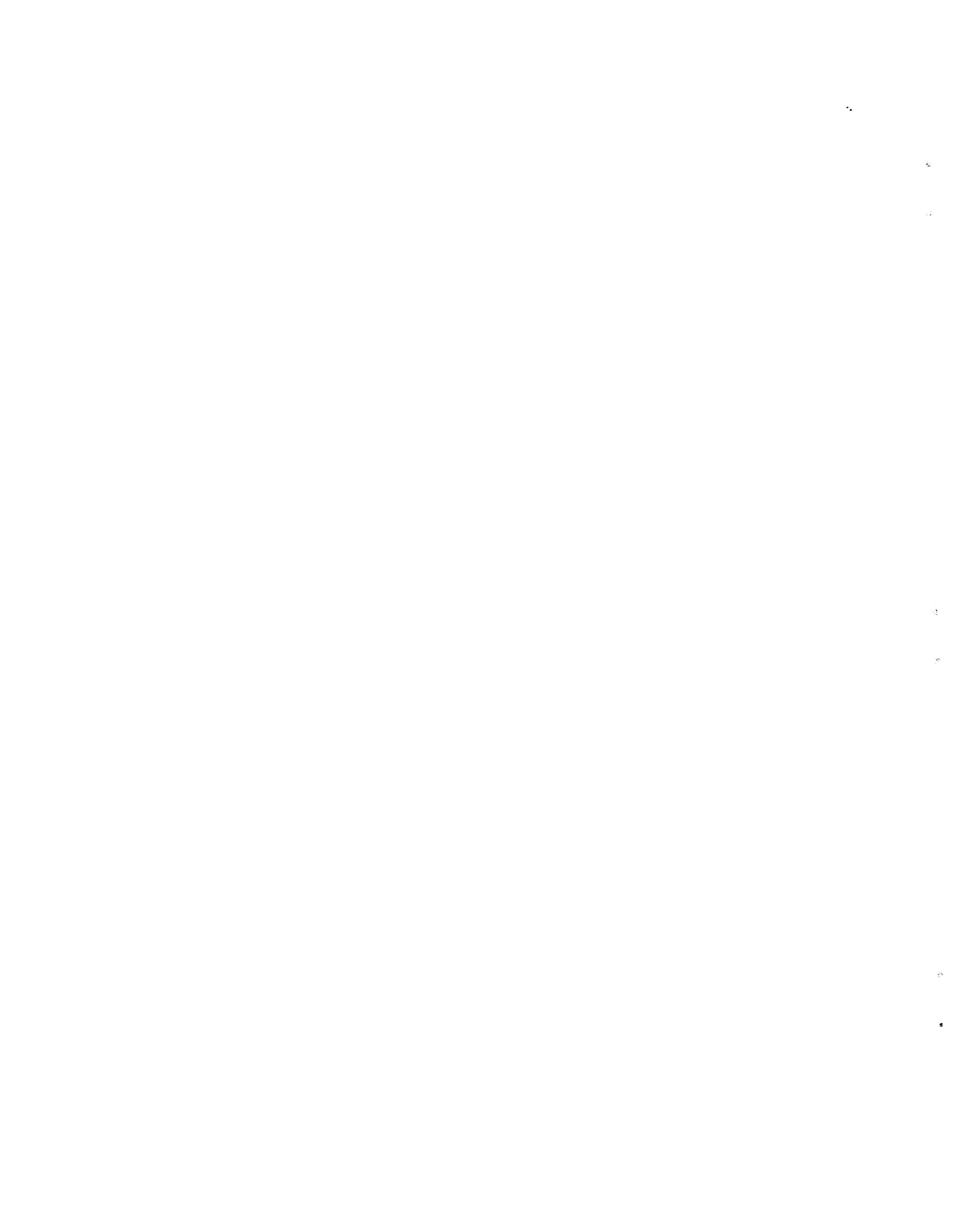
A_T	Effective Plant Area (or “effective ground surface area”)
A_S	Shadow Area
A_B	True Target Area (footprint)
ARTCC	Air Route Traffic Control Center (Atlanta)
A_K	Skid Area
CFRF	Consolidated Fuel Reprocessing Facility
CRBR	Clinch River Breeder Reactor
DOE	U.S. Department of Energy
FAA	Federal Aviation Administration
FBO	Fixed Base Operator
HFIR	High Flux Isotope Reactor
HPRR	Health Physics Research Reactor
IFR	Instrument Flight Rules
K-25	K-25 Site (formerly Oak Ridge Gaseous Diffusion Plant)
KBH	K-25 Boiler House
MOA	Military Operations Area
NRC	Nuclear Regulatory Commission
ORGDP	Oak Ridge Gaseous Diffusion Plant
ORNL	Oak Ridge National Laboratory
SRP	Standard Review Plan (U.S. Nuclear Regulatory Commission)
TSF	Tower Shielding Facility
VFR	Visual Flight Rules
X-10	Oak Ridge National Laboratory
Y-12	Oak Ridge Y-12 Plant

ABSTRACT

Aircraft hazards were evaluated to determine the total annual probability of an aircraft crash occurring at any structure located on the U.S. Department of Energy (DOE) reservation in Oak Ridge, Tennessee. This report documents the use of an accepted methodology for calculating the probability of an aircraft crash as applied to the three Oak Ridge plant sites (Oak Ridge National Laboratory, K-25 plant, and Y-12 plant) including the adjoining facilities (High Flux Isotope Reactor, Tower Shielding Facility, Health Physics Research Reactor, Consolidated Fuel Reprocessing Facility, and K-25 Boiler House). Based on the data contained herein, the evaluation concluded that the probability of an aircraft crash occurrence at a single facility is generally considered "not credible" as defined in DOE/OR-901 (probability $< 10^{-6}$). However, an evaluation similar to this should be performed on an individual basis for particular facilities.

Additionally, reevaluation of probabilities would be necessary if significant changes were made to local air traffic. The probability of an aircraft crash could increase as a result of (1) the opening of any new airport or heliport in the vicinity; (2) a greater volume of air traffic from McGhee Tyson airport in Knoxville, should the airport status change from feeder airport to hub airport; (3) the rerouting of commercial and/or military flights at the McGhee Tyson airport; and finally, (4) a change in direction or the addition of a federal airway.

At one time, DOE planned to establish a zone of prohibited airspace over the Y-12 plant; if the plans are enacted in the future, the probability of an aircraft crash at the Y-12 plant could decrease. Pilots since have been voluntarily requested not to fly below 3000 feet over the Y-12 plant. Also, the Federal Aviation Administration plans to reroute air traffic in the spring of 1993 on federal airway V16. However, the section of V16 which traverses the three plant sites and five adjoining facilities will not be altered. If this plan is implemented, the air traffic over the Oak Ridge facilities would not be affected significantly, and the probability of an aircraft crash as determined herein would be unchanged.



1. INTRODUCTION

1.1 THE SITES AND THEIR VICINITY

This report documents an evaluation of the total annual probability of an aircraft crashing into any structure located at any of the three designated plant sites on the U.S. Department of Energy (DOE) reservation in Oak Ridge, Tennessee. The reservation currently occupies approximately 37,000 acres adjacent to the city of Oak Ridge. Melton Hill Lake (Clinch River) bounds the reservation on the east, south, and west; Black Oak Ridge and the city of Oak Ridge bound the reservation on the north (Fig. 1.1). Approximately 80% of the Oak Ridge reservation lies within Roane County, Tennessee; the remaining 20% lies to the northeast in Anderson County, Tennessee.¹ The three major plants (Fig. 1.2) located on the DOE reservation in Oak Ridge are the following:

- K-25 Site (previously called the Oak Ridge Gaseous Diffusion Plant - ORGDP)
- Oak Ridge Y-12 Plant
- Oak Ridge National Laboratory (ORNL or X-10)

The K-25 site is located at lat. 35°56'00" N and long. 84°23'30" W. The Oak Ridge National Laboratory (ORNL or X-10) is located at lat. 35°55'45" N and long. 84°19'00" W. Finally, the Oak Ridge Y-12 Plant is located at lat. 35°59'20" N and long. 84°15'30" W.

The annual probabilities of an aircraft crash occurring at any of the following five adjoining facilities were also determined for this study:

- High Flux Isotope Reactor (HFIR)
- Tower Shielding Facility (TSF)
- Health Physics Research Reactor (HPRR)
- Consolidated Fuel Reprocessing Facility (CFRF)
- K-25 Boiler House (KBH)

Four of the five smaller facilities (HFIR, TSF, HPRR, and CFRF) are adjacent to the ORNL site (Fig. 1.1); the remaining facility (KBH—not shown) is adjacent to, and west of, the K-25 site.

A geographical map indicates the exact location of the three plants and five adjoining facilities and the relative locations of nearby airports and heliports within a 40-mile radius (Fig. 1.3). (All airport and heliport symbols used in Fig. 1.3 are defined in Table 1.1.)

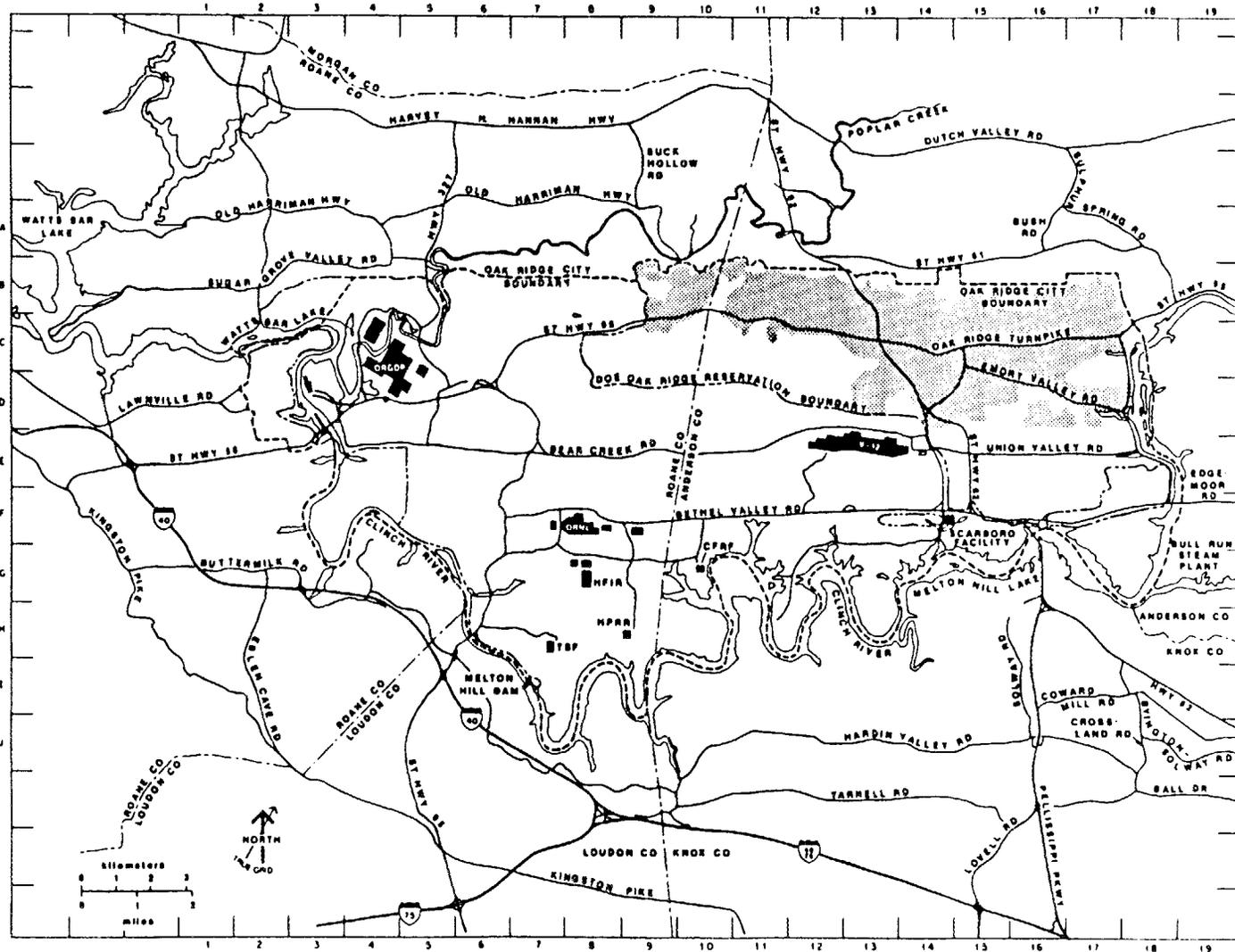


Fig. 1.1. Oak Ridge Reservation.

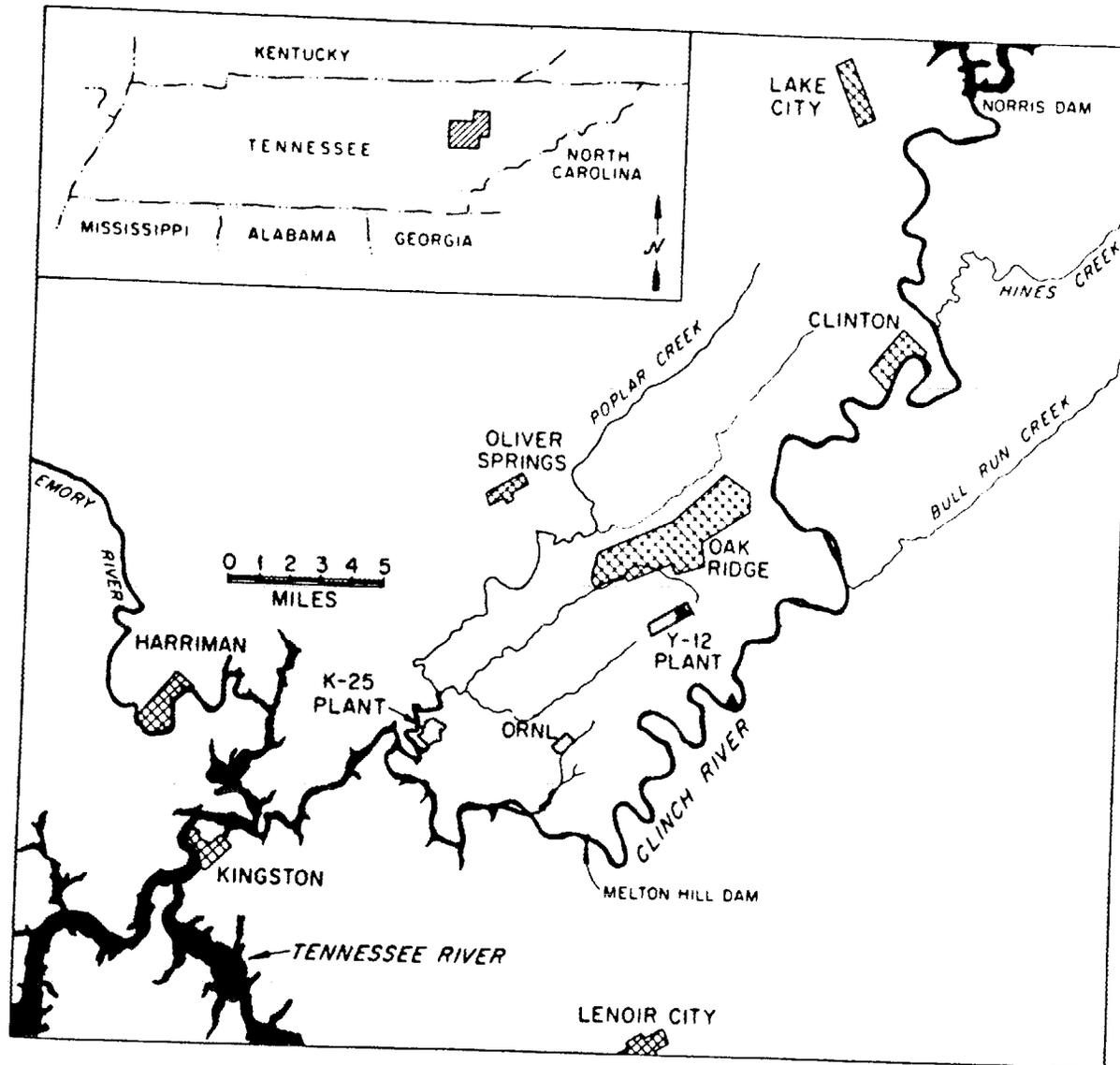


Fig. 1.2. The U.S. Department of Energy reservation in Oak Ridge, Tennessee.

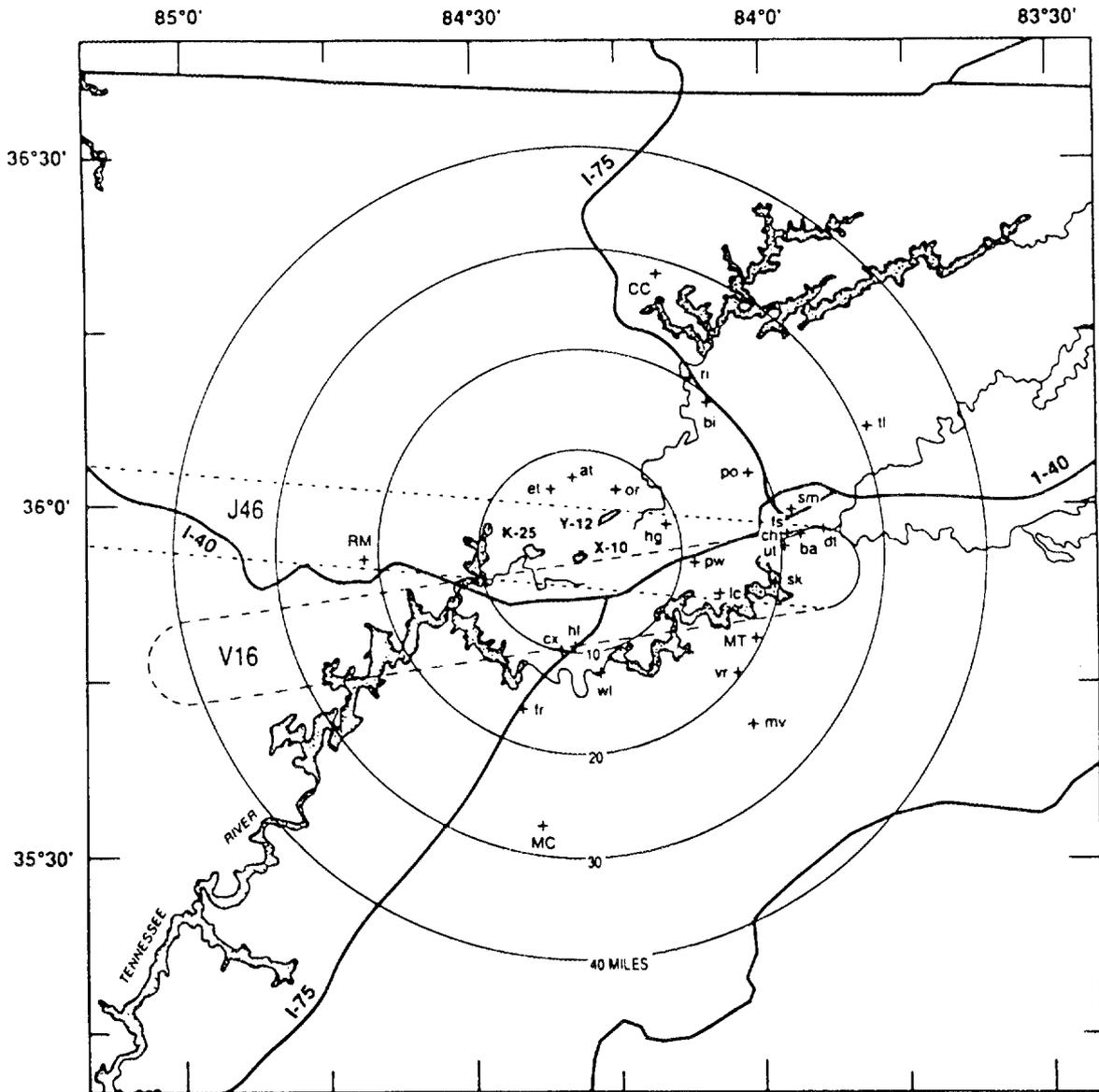


Fig. 1.3. Airports within 40 miles of Oak Ridge plant sites.

Table 1.1. Airports and their identification symbols

Airport/Heliport	Symbol ¹
<i>Private Heliports</i>	
UT Lifestar (Knoxville)	UT
Vertiflite (Maryville)	VR
Med Flight V Park West Hospital	PW
Med Flight V Children's Hospital	CH
Med Flight V St. Mary's Hospital	SM
Med Flight V Fort Sanders Hospital	FS
Med Flight V Baptist Hospital	BA
Med Flight V UT Hospital	UT
Oak Ridge Methodist Medical Center	OR
<i>Commercial Airports</i>	
Campbell County (Jacksboro)	CC
McGhee Tyson (Knoxville)	MT
Monroe County (Madisonville)	MC
Rockwood Municipal (Rockwood)	RM
<i>Private Airports</i>	
Atomic (Oliver Springs)	AT
Cox Farm (Lenoir City)	CX
Downtown Island (Knoxville)	DT
Ferguson (Philadelphia)	FR
Will Hildreath (Lenoir City)	HL
Little Creek (Knoxville)	LC
Montvale (Maryville)	MV
Powell (Powell)	PO
Riner Farms (Clinton)	RI
Sky Ranch (Knoxville)	SK
Taylor (Knoxville)	TL
<i>Closed Private Airports</i>	
Bishop Residence (Clinton)	BI
E. Tenn. Ultra Light (Oliver Springs)	ET
Higdon (Karns)	HG
Wilkerson (Lenoir City)	WL
¹ Used in Fig. 1.3	
Not shown: Athens Community Hospital, McMinn County Airport (Athens), Meadow Lake Airpark (Kingston), and Phillips & Jordan, Inc., Heliport (Knoxville).	

1.2 METHODOLOGY

Methodology established in the U.S. Nuclear Regulatory Commission (NRC) Standard Review Plan (SRP) (Appendix A) was used as a basis to determine the annual probability of an aircraft crashing into any structure within one of the three plants or five adjoining facilities. The SRP procedure was developed to estimate the annual probability of an aircraft (airplane or helicopter) crashing into a commercial nuclear power plant (Appendix A). Because this particular SRP had proven valuable, the same methodology was used to estimate the probability of aircraft crashes at the three plants and five adjoining facilities on the Oak Ridge reservation.

The procedure referenced in the SRP for predicting the annual probability of an aircraft crashing into a commercial nuclear power plant was based primarily on the distance between the site under evaluation and the various sources of aircraft hazards. These sources include but are not limited to airports; heliports; federal airways, holding patterns, and approach patterns; and military training routes. Additionally, the SRP methodology was modified to consider a military airspace specific to the Oak Ridge area.

The SRP procedure states that the probability of an aircraft crash is less than about 10^{-7} per year by inspection if the structure meets three proximity criteria; otherwise, an in-depth calculation must be performed. Therefore, the application of the SRP procedure to the three plants and five adjoining facilities contained herein is limited by the accuracy of the SRP procedure. If greater precision is required, this report should not be used.

Traditionally, DOE Oak Ridge Operations has indicated that Martin Marietta Energy Systems, Inc., safety analyses should consider as credible all those events having an annual probability greater than or equal to 10^{-6} ; events having an annual probability less than 10^{-6} should be considered non-credible. Therefore, if the annual probability of a crash is less than 10^{-6} , an airplane crash into the facility being evaluated will be considered non-credible, and the safety evaluation will not include an evaluation of the consequences that would result from a crash. However, if a crash is credible (i.e., the probability is greater than 10^{-6}), the consequences of the crash should be reported in the safety evaluation.² An evaluation of the consequence resulting from a crash as well as the uncertainty of the results obtained is beyond the scope of this report.

Information and technical data for this aircraft crash study were obtained from July 1988 through February 1989, and were verified and/or updated in September 1992.

1.3 SUPPLEMENTARY DATA

Formulas for calculating the total annual probability of an aircraft crash at any structure within a given site are provided for each site in Sects. 3.4.1 through 3.4.8.

Standard work sheets (Appendix B) are provided as guidance in determining the total annual probability of an aircraft crash on any structure within the official DOE borders of the three plants and five adjoining facilities on the Oak Ridge reservation.

Using these work sheets, the reader can determine the total annual probability of an aircraft crash on any structure at a given site, as may be required for safety reports or safety analyses.

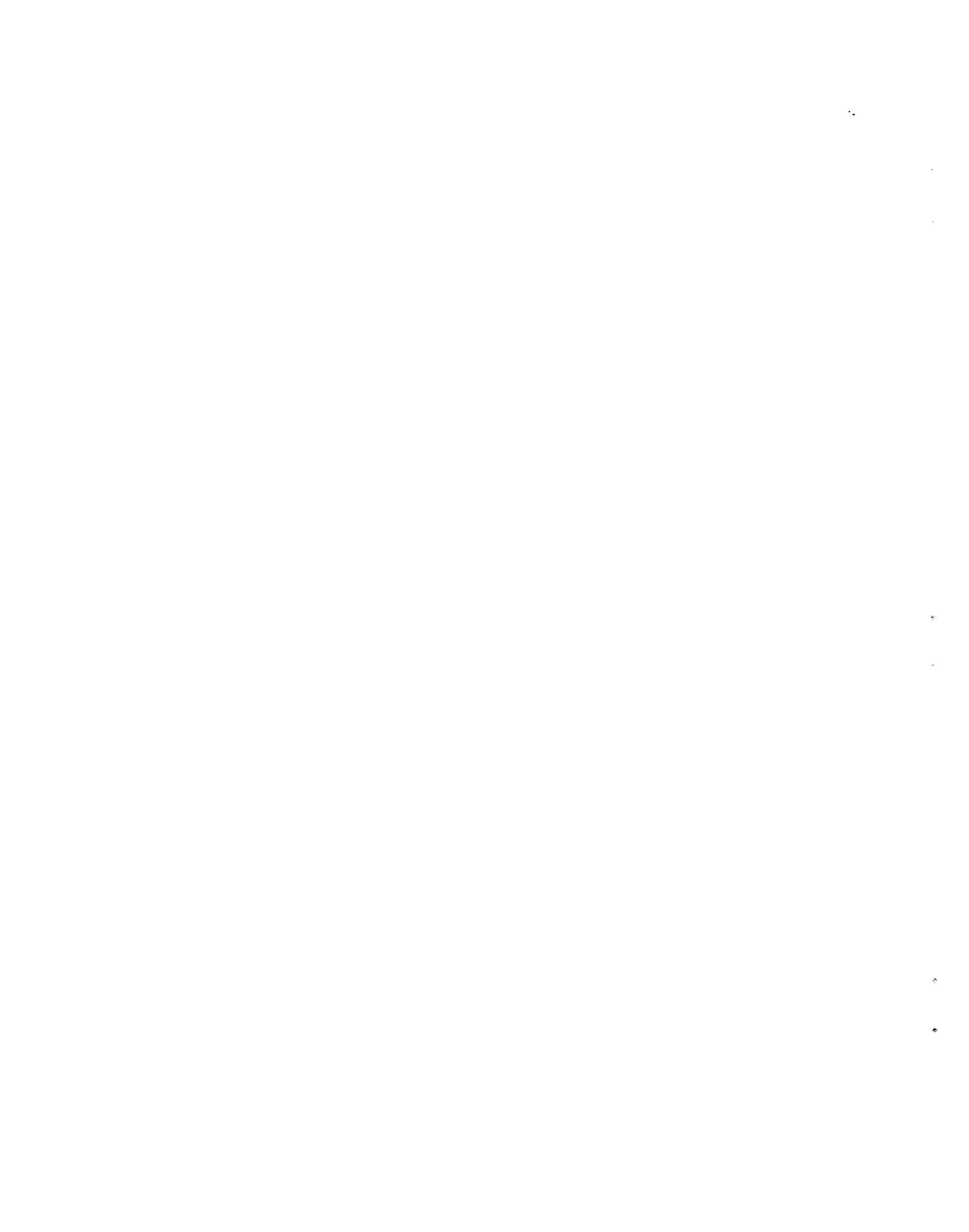
Two work sheets are provided: one for determining the total annual probability of an aircraft crash on any structure at Y-12; the other for determining the total annual probability of an aircraft crash on any structure at ORNL, K-25, HFIR, TSF, CFRF, HPRR, or KBH.

In Appendix C, the total annual probability of an aircraft crash is calculated for eight specific structures (one at each of the three plants and one at each of the five adjoining facilities). Calculation procedures are provided with these examples.

Also included in this report are additional data used in the analysis: regional flight operations data (Appendix D), a matrix of distances from each airport or heliport to each plant site (Appendix E), and annual flight statistics for the largest airport in the vicinity (Appendix F).

To obtain information on local air traffic, standard forms were sent to airport owners, managers, and/or fixed base operators, and in some cases, city or county government offices. The returned standard forms and other responses are included in Appendix G. Also included in Appendix G is a listing of the owners, managers, fixed base operators, and/or other qualified individuals contacted to update the estimates of local air traffic from the original 1988 estimates to 1992 figures.

Most of the aviation terms used in this report are defined in a glossary provided by the Metropolitan Knoxville Airport Authority. The list was revised (Appendix H) to delete irrelevant terms and to include terms not found in the original glossary.



2. EVALUATION OF CRITERIA

Calculations to determine the probability of an aircraft crash are based solely on the air traffic levels and distances from the Oak Ridge plant sites to all sources of aircraft impact hazards. These hazards include but are not limited to airports; heliports; federal airways, holding patterns, and approach patterns; and military training routes. Each source of aircraft hazards is considered a separate contributor to the total annual probability of aircraft crashes at each plant or adjoining facility.

A plant site that meets the three acceptance criteria [1.(a), (b), and (c)] referenced in the SRP (Appendix A) is considered to have a total probability of a aircraft crash of less than 10^{-7} per year. No further probability analysis would be required for a site meeting these three criteria. However, if one or more of the acceptance criteria are not met, calculations must be performed to determine the total annual probability of an aircraft crash at the plant site in question. To determine the total annual probability of an aircraft crash for each of the three plants and five adjoining facilities in accordance with the SRP procedure, information and data were obtained on the number of annual flight operations at each airport and heliport located within a 40-mile radius of the Oak Ridge reservation. Although an actual area has not been specified by the SRP procedure, a 40-mile radius was arbitrarily chosen for the Oak Ridge reservation. This selection was made because of the density of both airports and heliports located within this sector and the small number within the next 5-10 mile interval. Air traffic information for nearby federal airways was also obtained.

To estimate air traffic on nearby federal airways, high-altitude IFR (instrument flight rules)³ and low-altitude⁴ en route maps and sectional maps^{5,6} were reviewed, and information was obtained both orally and in correspondence from the Federal Aviation Administration offices in Atlanta^{7,8} (Appendix D) and Memphis.^{9,10} A total of 21 airports and 11 heliports are located within a 40-mile radius of the DOE Oak Ridge reservation: all were analyzed for this study. (The minimum distances from each airport or heliport to all three plants and five adjoining facilities are provided in Appendix E). The locations of K-25, Y-12, and ORNL relative to each airport and heliport in the vicinity are shown in Fig. 1.3. The ORNL site is at the center of the 40-mile-radius map.

Data associated with flight operations at the largest facility, the McGhee Tyson Airport, were obtained from reports furnished by the Metropolitan Knoxville Airport Authority (Appendix F).^{11,12} The names and locations of other airports/heliports in the vicinity were obtained from the Knoxville Flight Service Station, along with the names and addresses of persons to contact for additional

information. Telephone calls and/or a standard form letter were used to request flight operations data from the airport owners, managers, and Fixed Based Operators of the remaining 20 airports and 11 heliports. In some cases, information was obtained from local government offices. (The responses received from airport personnel and local government offices are presented in Appendix G.) The Fixed Base Operator of the Powell Airport refused to participate in the flight data survey.^{13,14} Therefore, the annual number of flight activities for the Powell Airport is unavailable. Because the number of flight operations per year at the Powell Airport is not expected to exceed proximity acceptance criterion 1.(a) (as described in Sect. 2.1), the participation of the Powell Airport is not crucial for the purposes of this study.

Data for this report were originally obtained from July 1988 to February 1989 and were verified and/or updated in September 1992. In updating this report, the owner of Ferguson Flying Circus Airfield did not respond to the request for information. Because the number of flight operations from 1988 did not exceed acceptance criterion 1.(a) (as described in Section 2.1) and the number of flight operations based on 1992 activities are not expected to increase significantly in value to exceed acceptance criterion 1.(a), the estimate from 1988 is assumed to be accurate for 1992 for this airfield.

Also, two airports and two heliports within a 40-mile radius of the Oak Ridge reservation were not contacted originally in 1988, but information concerning their yearly flight statistics has been obtained either by oral or written communication. They are: Athens Community Hospital, McMinn County Airport, Meadow Lake Airpark, and Phillips & Jordan, Inc., heliport.

Tables 2.1 through 2.8 provide the distance from each plant site or facility to each airport and heliport, plus information on the flight operations for all 21 airports and 11 heliports located near the three plants and five adjoining facilities. (Tables 2.1 through 2.8 are grouped at the end of this chapter.)

2.1 PROXIMITY OF PLANT TO AIRPORT [CRITERION 1.(a)]

Acceptance criterion 1.(a) from the SRP is met provided that:

“The plant-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 plant-to-airport distance D is greater than 10 statute miles, and the projected annual number of operations is less than $1000(D^2)$.”

(Appendix A, p. 3.5.1.6-2)

2.1.1 Distance from Plant Site

The information presented in Tables 2.1 through 2.8 was used to exclude airports and heliports from further consideration based on the SRP acceptance criterion 1.(a). Criterion 1.(a) is fully met for two of the three plants (K-25 and ORNL) and for the five adjoining facilities (HFIR, TSF, HPRR, CFRF, and KBH). However, acceptance criterion 1.(a) is not fully met for the Y-12 plant, because the helicopter landing area (heliport) used by the Oak Ridge Methodist Medical Center is 1.6 miles northeast of the nearest boundary of the Y-12 plant, and the runway at the Oliver Springs Atomic Airport is 4.9 miles northwest of the nearest boundary of the Y-12 plant. Both distances are less than the 5-mile distance established in acceptance criterion 1.(a) of the SRP.

Therefore, an annual probability calculation (P_A) to determine the probability of an aircraft crash at the Y-12 site is required on the basis of the proximity of the Y-12 site to the airport (P_{1A}) and heliport (P_{2A}).

2.1.2 Number of Flight Operations

The data presented in Tables 2.1 through 2.8 indicate that the numbers of commercial and general aviation flights for all 21 airports and 11 heliports near the three plants and five adjoining facilities are well below the number of flights that correspond to $500(D^2)$ and $1000(D^2)$.

2.2 PROXIMITY OF PLANT TO MILITARY TRAINING ROUTES AND DESIGNATED AIR SPACE [CRITERION 1.(b)]

Acceptance criterion 1.(b) from the SRP is met provided that:

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

(Appendix A, p. 3.5.1.6-2)

The Military Operations Area (MOA) closest to the Oak Ridge reservation is designated “Snowbird” by the U.S. Department of Defense. Snowbird is located approximately 34 miles northwest of the nearest boundary of the Y-12 plant site.⁶ Because Snowbird is located more than 5 miles from the Y-12 plant site (the closest facility), criterion 1.(b) is fully met for all three plants (K-25, Y-12, and ORNL) and five adjoining facilities (HFIR, TSF, HPRR, CFRF, and KBH). There are no low-level military training routes (i.e., IFR or VFR) near the Oak Ridge reservation.¹⁵

Therefore, an annual probability calculation (P_M) based on the proximity of a plant site to an MOA is not required.

However, the cities of Oak Ridge, Knoxville, and Rockwood lie beneath AR-633, a volume of airspace used by the 134th Tennessee Air National Guard Air Refueling Group for practicing air refueling. Although this area is under military jurisdiction, the AR-633 flight patterns more closely resemble those of federal holding patterns or approach patterns than the flight patterns for military training routes. This volume of airspace is therefore described in further detail in Sect. 2.3.4.

2.3 PROXIMITY OF PLANT TO FEDERAL AIRWAYS, HOLDING PATTERNS, OR APPROACH PATTERNS [CRITERION 1.(c)]

Acceptance criterion 1.(c) from the SRP is met provided that:

“The plant is at least two statute miles beyond the nearest edge of a federal airway, holding pattern, or approach pattern.”

(Appendix A, p. 3.5.1.6-2)

2.3.1 Federal Airways

The proximity of the three plants and five adjoining facilities to both low- and high-level federal airways was investigated. The distances cited in Sects. 2.3.1.1 and 2.3.1.2 are the minimum distances between the plant site and the airway (measured between the two closest points).

2.3.1.1 Low-Level Airways

Two low-level federal airways (V16 and V97) traverse the vicinity of the three plants and five adjoining facilities. The western edge of V97 is approximately 13 miles east of the eastern edge of the Y-12 plant, which is the closest facility.⁴ Because the distance from V97 to the Y-12 facility is greater than the 2-statute-mile distance referenced in acceptance criterion 1.(c), further evaluation of federal airway V97 is not required for this study.

Federal airway V16 (Fig. 1.3) is 3.3 miles from the Y-12 plant, 1.0 mile from K-25, 0.2 mile from ORNL, 1.0 mile from the CFRF, and 0.6 mile from the KBH. In addition, federal airway V16 falls within the boundaries of the HFIR, HPRR, and TSF. Since two of the three plants and all five adjoining facilities (K-25, ORNL, HFIR, HPRR, CFRF, TSF, and KBH) fail the 2-statute-mile criterion referenced in the SRP, this part of acceptance criterion 1.(c) is not met.

However, the Airspace and Procedures Office of the Atlanta Air Route Traffic Control Center¹⁶ reports federal airway V16 will be rerouted in the spring of 1993. In an attempt to discourage low flying air traffic (below 12,000 feet) from flying in the vicinity of the airport located in Nashville, Tennessee, federal airway V16 will be reconfigured away from Nashville. The section of federal airway V16 between Knoxville and Hinch Mountain (near Crossville, Tennessee) which traverses part of the Oak Ridge reservation will not be affected by the change.

Therefore, an annual probability calculation (P_{FA}) is required on the basis of the proximity of a plant site to federal airway V16.

2.3.1.2 High-Level Airways

Three high-level federal airways (J22, J99, and J46) traverse the vicinity of the three plants and the five adjoining facilities. The northwest edge of J22 is approximately 15 miles from the southeast edge of the CFRF, which is the closest facility.³ The southwest edge of J99 is approximately 21 miles from the northeast edge of Y-12, the closest facility. Because the distances from J22 to the CFRF and J99 to Y-12 are both greater than the 2-statute-mile distance referenced in acceptance criterion 1.(c) of the SRP, federal airways J22 and J99 require no further evaluation for the purposes of this study.

However, all three plants (ORNL, Y-12, and K-25) and five adjoining facilities (HFIR, HPRR, CFRF, TSF, and KBH) lie *within* the 8-mile-wide corridor of federal airway J46 (Fig. 1.3) and therefore do not meet the 2-statute-mile distance referenced in the SRP.

Therefore, an annual probability calculation (P_{FA}) to determine the probability of an aircraft crash at each of the three plant sites and five adjoining facilities is required on the basis of the proximity of federal airway J46 to each of the facilities.

2.3.2 Federal Aviation Administration Holding Patterns

No FAA holding patterns are located within the vicinity of the three plants and five adjoining facilities on the Oak Ridge reservation.

2.3.3 Federal Aviation Administration Approach Patterns

No FAA approach patterns traverse the vicinity of the three plants and five adjoining facilities on the Oak Ridge reservation.

2.3.4 Military Holding Patterns and Approach Patterns

The cities of Oak Ridge, Knoxville, and Rockwood lie beneath AR-633, a volume of airspace used by the 134th Tennessee Air National Guard Air Refueling Group for practicing air refueling (Sect. 2.2). Although under military jurisdiction, this designated airspace is equivalent to an FAA holding pattern.

AR-633 has an airspace volume of approximately 97 statute miles \times 41 statute miles \times 1 statute mile in depth. Refueling operations take place within this box of airspace. Because the military has jurisdiction over this volume of airspace and operations may be considered sensitive, it is impossible to determine whether refueling operations by the 134th Air Refueling Group occur directly over the Oak Ridge reservation. The Oak Ridge reservation encompasses an area of approximately 58 sq mi; the refueling area used by the military (AR-633) encompasses 4,000 total sq mi.

Therefore, an annual probability calculation (designated P_{MIL}) is required on the basis of the proximity of the volume of airspace designated AR-633.

Table 2.1. Operations analysis of airports and heliports near the K-25 Facility

Airport (location)	Distance (D) from airport to K-25 (mi.)	No. of Operations from May '87 to May '88	No. of Operations from Aug. '91 to Aug. '92	D ≤ 10 mi. (500 D ²)	D > 10 mi. (1,000 D ²)
Private Heliports					
UT Lifestar (Knoxville)	23.9	1,500 ^a	1,000 ^a		571,000
Vertiflite (Maryville)	22.7	3,400 ^a	2,600 ^a		515,000
Med Flight V Park West	15.2	26 ^b	500 ^a		231,000
Med Flight V Children's	24.2	53 ^b	500 ^a		586,000
Med Flight V St. Mary's	25.1	35 ^b	500 ^a		630,000
Med Flight V Fort Sanders	24.3	87 ^b	500 ^a		590,000
Med Flight V Baptist	25.5	208 ^b	500 ^a		650,000
Med Flight V U.T.Hospital	23.9	141 ^b	500 ^a		571,000
Oak Ridge Methodist Medical	9.4	12 ^b	30 ^a	44,000	
Athens Community Hospital	38.0	N/A ^e	52 ^a		1,440,000
Commercial Airports					
Campbell County (Jacksboro)	29.4	5,000 ^a	3,000 ^a		864,000
McGhee Tyson (Knoxville)	22.8	159,125 ^c	146,429 ^f		520,000
McMinn County (Athens)	38.5	N/A ^e	18,250 ^a		1,480,000
Monroe County (Madisonville)	25.7	20,000 ^a	50,000 ^a		660,000
Rockwood Municipal	15.7	3,000 ^a	3,000 ^a		246,000
Private Airports					
Atomic (Oliver Springs)	7.7	1,200 ^a	1000 ^a	30,000	
Cox Farm (Lenoir City)	9.2	100 ^a	100 ^a	42,000	
Downtown Island (Knoxville)	27.8	73,000 ^a	73,000 ^a		773,000
Ferguson Flying Circus (Philadelphia)	14.3	30 ^a	N/A ^e		204,000
Will Hildreath (Lenoir City)	8.6	720 ^a	760 ^a	37,000	
Little Creek (Knoxville)	18.3	300 ^a	30 ^a		335,000
Meadow Lake (Kingston)	10.0	N/A ^e	720 ^a	50,000	
Montvale (Maryville)	26.7	600 ^a	600 ^a		713,000
Powell (Powell)	21.8	N/A ^d	N/A ^d		475,000
Riner Farms (Clinton)	22.4	100 ^a	200 ^a		502,000
Sky Ranch (Knoxville)	23.4	4,123 ^a	3,650 ^a		548,000
Taylor (Knoxville)	34.3	90 ^a	25 ^a		1,180,000
Closed Private Airports & Heliports					
Bishop Residence (Clinton)	21.7	0 ^a	0 ^a		471,000
E. Tenn. Ultra Light (Oliver Springs)	5.7	0 ^a	0 ^a	16,000	
Higdon (Karns)	12.3	0 ^a	0 ^a		151,000
Phillips & Jordan (Knoxville)	23.0	N/A ^e	0 ^a		529,000
Wilkerson (Lenoir City)	12.7	0 ^a	0 ^a		161,000
^a Estimate from airport owner, manager, and/or Fixed Base Operator (FBO), or city/county government office (Appendix G). ^b Based on best estimate of Med Flight 5 which services six hospitals in Knoxville and one in Oak Ridge (Appendix G). ^c Based on statistical data (Appendix F). ^d Not available; owner refused to participate in survey. ^e Total number of MedFlight Operations in Knoxville area. Statistics no longer available on each individual hospital. ^f Based on statistical data (Appendix F) from Jan '91 to Dec '91. ^g Not available; owner, manager and/or FBO was not contacted.					

Table 2.2. Operations analysis of airports and heliports near the Y-12 Facility

Airport (location)	Distance (D) from airport to Y-12 (mi.)	No. of Operations from May '87 to May '88	No. of Operations from Aug. '91 to Aug. '92	D ≤ 10 mi. (500 D ²)	D > 10 mi. (1,000 D ²)	
Private Heliports						
UT Lifestar (Knoxville)	16.6	1,500 ^a	1,000 ^a	41,000	276,000	
Vertiflite (Maryville)	19.5	3,400 ^a	2,600 ^a		380,000	
Med Flight V Park West	9.0	26 ^b	500 ^c		279,000	
Med Flight V Children's	16.7	53 ^b	500 ^c		292,000	
Med Flight V St. Mary's	17.1	35 ^b	500 ^c		279,000	
Med Flight V Fort Sanders	16.7	87 ^b	500 ^c		324,000	
Med Flight V Baptist	18.0	208 ^b	500 ^c		276,000	
Med Flight V U.T.Hospital	16.6	141 ^b	500 ^c		1,300	1,980,000
Oak Ridge Methodist Medical	1.6	12 ^b	30 ^a			
Athens Community Hospital	44.5	N/A ^e	52 ^a			
Commercial Airports						
Campbell County (Jacksboro)	23.4	5,000 ^a	3,000 ^a		548,000	
McGhee Tyson (Knoxville)	18.2	159,125 ^c	146,429 ^f		331,000	
McMinn County (Athens)	45.0	N/A ^e	18,250 ^a		2,030,000	
Monroe County (Madisonville)	29.5	20,000 ^a	50,000 ^a		870,000	
Rockwood Municipal	23.0	3,000 ^a	3,000 ^a		529,000	
Private Airports						
Atomic (Oliver Springs)	4.9	1,200 ^a	1,000 ^a	12,000		
Cox Farm (Lenoir City)	12.5	100 ^a	100 ^a		156,000	
Downtown Island (Knoxville)	20.1	73,000 ^a	73,000 ^a		404,000	
Ferguson Flying Circus (Philadelphia)	18.9	30 ^a	N/A ^e		357,000	
Will Hildreath (Lenoir City)	11.1	720 ^a	760 ^a		123,000	
Little Creek (Knoxville)	12.9	300 ^a	30 ^a		166,000	
Meadow Lake (Kingston)	19.5	N/A ^e	720 ^a		380,000	
Montvale (Maryville)	24.4	600 ^a	600 ^a		595,000	
Powell (Powell)	13.3	N/A ^d	N/A ^d		177,000	
Riner Farms (Clinton)	14.7	100 ^a	200 ^a		216,000	
Sky Ranch (Knoxville)	17.1	4,123 ^a	3,650 ^a		292,000	
Taylor (Knoxville)	25.8	90 ^a	25 ^a		666,000	
Closed Private Airports & Heliports						
Bishop Residence (Clinton)	13.4	0 ^a	0 ^a		180,000	
E. Tenn. Ultra Light (Oliver Springs)	5.6	0 ^a	0 ^a	16,000		
Higdon (Karns)	4.5	0 ^a	0 ^a	10,000		
Phillips & Jordan (Knoxville)	14.0	N/A ^e	0 ^a		196,000	
Wilkerson (Lenoir City)	14.2	0 ^a	0 ^a		202,000	

^aEstimate from airport owner, manager, and/or Fixed Base Operator (FBO), or city/county government office (Appendix G).

^bBased on best estimate of Med Flight 5 which services six hospitals in Knoxville and one in Oak Ridge (Appendix G).

^cBased on statistical data (Appendix F).

^dNot available; owner refused to participate in survey.

^eTotal number of MedFlight Operations in Knoxville area. Statistics no longer available on each individual hospital.

^fBased on statistical data (Appendix F) from Jan '91 to Dec '91.

^gNot available; owner, manager and/or FBO was not contacted.

Table 2.3. Operations analysis of airports and heliports near the ORNL Facility

Airport (location)	Distance (D) from airport to ORNL (mi.)	No. of Operations from May '87 to May '88	No. of Operations from Aug. '91 to Aug. '92	D ≤ 10 mi. (500 D ²)	D > 10 mi. (1,000 D ²)
Private Heliports					
UT Lifestar (Knoxville)	19.6	1,500 ^a	1,000 ^a		384,000
Vertiflite (Maryville)	18.8	3,400 ^a	2,600 ^a		353,000
Med Flight V Park West	10.8	26 ^b	500 ^c		117,000
Med Flight V Children's	19.9	53 ^b	500 ^c		396,000
Med Flight V St. Mary's	20.9	35 ^b	500 ^c		437,000
Med Flight V Fort Sanders	20.0	87 ^b	500 ^c		400,000
Med Flight V Baptist	21.2	208 ^b	500 ^c		449,000
Med Flight V U.T.Hospital	19.6	141 ^b	500 ^c		384,000
Oak Ridge Methodist Medical	6.8	12 ^b	30 ^a	23,000	
Athens Community Hospital	38.0	N/A ^g	52 ^a		1,440,000
Commercial Airports					
Campbell County (Jacksboro)	28.4	5,000 ^a	3,000 ^a		807,000
McGhee Tyson (Knoxville)	18.6	159,125 ^e	146,429 ^f		346,000
McMinn County (Athens)	38.5	N/A ^g	18,250 ^a		1,480,000
Monroe County (Madisonville)	25.8	20,000 ^a	50,000 ^a		666,000
Rockwood Municipal	20.3	3,000 ^a	3,000 ^a		412,000
Private Airports					
Atomic (Oliver Springs)	7.4	1,200 ^a	1000 ^a	27,000	
Cox Farm (Lenoir City)	8.7	100 ^a	100 ^a	38,000	
Downtown Island (Knoxville)	23.5	73,000 ^a	73,000 ^a		552,000
Ferguson Flying Circus (Philadelphia)	15.0	30 ^a	N/A ^g		225,000
Will Hildreath (Lenoir City)	7.4	720 ^a	760 ^a	27,000	
Little Creek (Knoxville)	13.9	300 ^a	30 ^a		193,000
Meadow Lake (Kingston)	13.5	N/A ^g	720 ^a		182,000
Montvale (Maryville)	23.1	600 ^a	600 ^a		534,000
Powell (Powell)	18.0	N/A ^d	N/A ^d		324,000
Riner Farms (Clinton)	20.2	100 ^a	200 ^a		408,000
Sky Ranch (Knoxville)	19.0	4,123 ^a	3,650 ^a		361,000
Taylor (Knoxville)	30.5	90 ^a	25 ^a		930,000
Closed Private Airports & Heliports					
Bishop Residence (Clinton)	19.0	0 ^a	0 ^a		361,000
E. Tenn. Ultra Light (Oliver Springs)	6.8	0 ^a	0 ^a	23,000	
Higdon (Karns)	8.3	0 ^a	0 ^a	34,000	
Phillips & Jordan (Knoxville)	18.5	N/A ^g	0 ^a		342,000
Wilkerson (Lenoir City)	10.9	0 ^a	0 ^a		119,000
^a Estimate from airport owner, manager, and/or Fixed Base Operator (FBO), or city/county government office (Appendix G). ^b Based on best estimate of Med Flight 5 which services six hospitals in Knoxville and one in Oak Ridge (Appendix G). ^c Based on statistical data (Appendix F). ^d Not available; owner refused to participate in survey. ^e Total number of MedFlight Operations in Knoxville area. Statistics no longer available on each individual hospital. ^f Based on statistical data (Appendix F) from Jan '91 to Dec '91. ^g Not available; owner, manager and/or FBO was not contacted.					

Table 2.4. Operations analysis of airports and heliports near the HFIR Facility

Airport (location)	Distance (D) from airport to HFIR (mi.)	No. of Operations from May '87 to May '88	No. of Operations from Aug. '91 to Aug. '92	D ≤ 10 mi. (500 D ²)	D > 10 mi. (1,000 D ²)
Private Heliports					
UT Lifestar (Knoxville)	20.0	1,500 ^a	1,000 ^a		400,000
Vertiflite (Maryville)	18.7	3,400 ^a	2,600 ^a		350,000
Med Flight V Park West	11.2	26 ^b	500 ^c		125,000
Med Flight V Children's	20.3	53 ^b	500 ^c		412,000
Med Flight V St. Mary's	21.4	35 ^b	500 ^c		458,000
Med Flight V Fort Sanders	20.4	87 ^b	500 ^c		416,000
Med Flight V Baptist	21.6	208 ^b	500 ^c		467,000
Med Flight V U.T. Hospital	20.0	141 ^b	500 ^c		400,000
Oak Ridge Methodist Medical	8.0	12 ^b	30 ^a	32,000	
Athens Community Hospital	38.0	N/A ^e	52 ^a		1,440,000
Commercial Airports					
Campbell County (Jacksboro)	29.3	5,000 ^a	3,000 ^a		858,000
McGhee Tyson (Knoxville)	18.6	159,125 ^c	146,429 ^f		346,000
McMinn County (Athens)	38.5	N/A ^e	18,250 ^a		1,480,000
Monroe County (Madisonville)	25.6	20,000 ^a	50,000 ^a		655,000
Rockwood Municipal	21.3	3,000 ^a	3,000 ^a		454,000
Private Airports					
Atomic (Oliver Springs)	8.3	1,200 ^a	1,000 ^a	34,000	
Cox Farm (Lenoir City)	8.6	100 ^a	100 ^a	37,000	
Downtown Island (Knoxville)	23.9	73,000 ^a	73,000 ^a		571,000
Ferguson Flying Circus (Philadelphia)	15.1	30 ^a	N/A ^e		228,000
Will Hildreath (Lenoir City)	7.2	720 ^a	760 ^a	26,000	
Little Creek (Knoxville)	14.0	300 ^a	30 ^a		196,000
Meadow Lake (Kingston)	13.5	N/A ^e	720 ^a		182,000
Montvale (Maryville)	22.9	600 ^a	600 ^a		524,000
Powell (Powell)	18.6	N/A ^d	N/A ^d		346,000
Riner Farms (Clinton)	21.0	100 ^a	200 ^a		441,000
Sky Ranch (Knoxville)	19.2	4,123 ^a	3,650 ^a		369,000
Taylor (Knoxville)	31.1	90 ^a	25 ^a		967,000
Closed Private Airports & Heliports					
Bishop Residence (Clinton)	19.8	0 ^a	0 ^a		392,000
E. Tenn. Ultra Light (Oliver Springs)	7.8	0 ^a	0 ^a	30,000	
Higdon (Karns)	8.9	0 ^a	0 ^a	40,000	
Phillips & Jordan (Knoxville)	19.0	N/A ^e	0 ^a		361,000
Wilkerson (Lenoir City)	10.6	0 ^a	0 ^a		112,000

^aEstimate from airport owner, manager, and/or Fixed Base Operator (FBO), or city/county government office (Appendix G).

^bBased on best estimate of Med Flight 5 which services six hospitals in Knoxville and one in Oak Ridge (Appendix G).

^cBased on statistical data (Appendix F).

^dNot available; owner refused to participate in survey.

^eTotal number of MedFlight Operations in Knoxville area. Statistics no longer available on each individual hospital.

^fBased on statistical data (Appendix F) from Jan '91 to Dec '91.

^gNot available; owner, manager and/or FBO was not contacted.

Table 2.5. Operations analysis of airports and heliports near the TSF Facility

Airport (location)	Distance (D) from airport to TSF (mi.)	No. of Operations from May '87 to May '88	No. of Operations from Aug. '91 to Aug. '92	D ≤ 10 mi. (500 D ²)	D > 10 mi. (1,000 D ²)
Private Heliports					
UT Lifestar (Knoxville)	20.0	1,500 ^a	1,000 ^a		400,000
Vertiflite (Maryville)	17.9	3,400 ^a	2,600 ^a		320,000
Med Flight V Park West	11.2	26 ^b	500 ^c		125,000
Med Flight V Children's	20.5	53 ^b	500 ^c		420,000
Med Flight V St. Mary's	21.7	35 ^b	500 ^c		471,000
Med Flight V Fort Sanders	20.5	87 ^b	500 ^c		420,000
Med Flight V Baptist	21.8	208 ^b	500 ^c		475,000
Med Flight V U.T. Hospital	20.0	141 ^b	500 ^c		400,000
Oak Ridge Methodist Medical	8.9	12 ^b	30 ^a	40,000	
Athens Community Hospital	36.5	N/A ^e	52 ^a		1,330,000
Commercial Airports					
Campbell County (Jacksboro)	30.7	5,000 ^a	3,000 ^a		942,000
McGhee Tyson (Knoxville)	18.1	159,125 ^c	146,429 ^f		328,000
McMinn County (Athens)	37.0	N/A ^e	18,250 ^a		1,370,000
Monroe County (Madisonville)	24.4	20,000 ^a	50,000 ^a		595,000
Rockwood Municipal	21.5	3,000 ^a	3,000 ^a		462,000
Private Airports					
Atomic (Oliver Springs)	9.8	1,200 ^a	1,000 ^a	48,000	
Cox Farm (Lenoir City)	7.4	100 ^a	100 ^a	27,000	
Downtown Island (Knoxville)	24.0	73,000 ^a	73,000 ^a		576,000
Ferguson Flying Circus (Philadelphia)	14.0	30 ^a	N/A ^e		196,000
Will Hildreath (Lenoir City)	6.0	720 ^a	760 ^a	18,000	
Little Creek (Knoxville)	13.8	300 ^a	30 ^a		190,000
Meadow Lake (Kingston)	13.5	N/A ^e	720 ^a		182,000
Montvale (Maryville)	22.0	600 ^a	600 ^a		484,000
Powell (Powell)	19.2	N/A ^d	N/A ^d		369,000
Riner Farms (Clinton)	22.1	100 ^a	200 ^a		488,000
Sky Ranch (Knoxville)	19.1	4,123 ^a	3,650 ^a		365,000
Taylor (Knoxville)	31.7	90 ^a	25 ^a		1,000,000
Closed Private Airports & Heliports					
Bishop Residence (Clinton)	20.8	0 ^a	0 ^a		433,000
E. Tenn. Ultra Light (Oliver Springs)	9.2	0 ^a	0 ^a	42,000	
Higdon (Karns)	9.5	0 ^a	0 ^a	45,000	
Phillips & Jordan (Knoxville)	19.5	N/A ^e	0 ^a		380,000
Wilkerson (Lenoir City)	9.3	0 ^a	0 ^a	43,000	

^aEstimate from airport owner, manager, and/or Fixed Base Operator (FBO), or city/county government office (Appendix G).

^bBased on best estimate of Med Flight 5 which services six hospitals in Knoxville and one in Oak Ridge (Appendix G).

^cBased on statistical data (Appendix F).

^dNot available; owner refused to participate in survey.

^eTotal number of MedFlight Operations in Knoxville area. Statistics no longer available on each individual hospital.

^fBased on statistical data (Appendix F) from Jan '91 to Dec '91.

^gNot available; owner, manager and/or FBO was not contacted.

Table 2.6. Operations analysis of airports and heliports near the HPRR Facility

Airport (location)	Distance (D) from airport to HPRR (mi.)	No. of Operations from May '87 to May '88	No. of Operations from Aug. '91 to Aug. '92	D ≤ 10 mi. (500 D ²)	D > 10 mi. (1,000 D ²)
Private Heliports					
UT Lifestar (Knoxville)	19.0	1,500 ^a	1,000 ^a		361,000
Vertiflite (Maryville)	17.7	3,400 ^a	2,600 ^a		313,000
Med Flight V Park West	10.2	26 ^b	500 ^c		104,000
Med Flight V Children's	19.4	53 ^b	500 ^c		376,000
Med Flight V St. Mary's	20.6	35 ^b	500 ^c		424,000
Med Flight V Fort Sanders	19.5	87 ^b	500 ^c		380,000
Med Flight V Baptist	20.7	208 ^b	500 ^c		428,000
Med Flight V U.T.Hospital	19.0	141 ^b	500 ^c		361,000
Oak Ridge Methodist Medical	7.7	12 ^b	30 ^c	30,000	
Athens Community Hospital	38.0	N/A ^e	52 ^a		1,440,000
Commercial Airports					
Campbell County (Jacksboro)	29.6	5,000 ^a	3,000 ^a		876,000
McGhee Tyson (Knoxville)	17.6	159,125 ^a	146,429 ^f		310,000
McMinn County (Athens)	38.5	N/A ^g	18,250 ^a		1,480,000
Monroe County (Madisonville)	25.5	20,000 ^a	50,000 ^a		650,000
Rockwood Municipal	22.4	3,000 ^a	3,000 ^a		502,000
Private Airports					
Atomic (Oliver Springs)	9.0	1,200 ^a	1000 ^a	41,000	
Cox Farm (Lenoir City)	8.6	100 ^a	100 ^a	37,000	
Downtown Island (Knoxville)	23.0	73,000 ^a	73,000 ^a		529,000
Ferguson Flying Circus (Philadelphia)	15.2	30 ^a	N/A ^g		231,000
Will Hildreath (Lenoir City)	7.1	720 ^a	760 ^a	25,000	
Little Creek (Knoxville)	13.0	300 ^a	30 ^a		169,000
Meadow Lake (Kingston)	14.5	N/A ^g	720 ^a		210,000
Montvale (Maryville)	22.0	600 ^a	600 ^a		484,000
Powell (Powell)	18.0	N/A ^d	N/A ^d		324,000
Riner Farms (Clinton)	20.9	100 ^a	200 ^a		437,000
Sky Ranch (Knoxville)	18.2	4,123 ^a	3,650 ^a		331,000
Taylor (Knoxville)	30.4	90 ^a	25 ^a		924,000
Closed Private Airports & Heliports					
Bishop Residence (Clinton)	19.5	0 ^a	0 ^a		380,000
E. Tenn. Ultra Light (Oliver Springs)	8.7	0 ^a	0 ^a	38,000	
Higdon (Karns)	8.2	0 ^a	0 ^a	34,000	
Phillips & Jordan (Knoxville)	18.5	N/A ^g	0 ^a		342,000
Wilkerson (Lenoir City)	10.2	0 ^a	0 ^a		104,000

^aEstimate from airport owner, manager, and/or Fixed Base Operator (FBO), or city/county government office (Appendix G).

^bBased on best estimate of Med Flight 5 which services six hospitals in Knoxville and one in Oak Ridge (Appendix G).

^cBased on statistical data (Appendix F).

^dNot available; owner refused to participate in survey.

^eTotal number of MedFlight Operations in Knoxville area. Statistics no longer available on each individual hospital.

^fBased on statistical data (Appendix F) from Jan '91 to Dec '91.

^gNot available; owner, manager and/or FBO was not contacted.

Table 2.7. Operations analysis of airports and heliports near the CFRF Facility

Airport (location)	Distance (D) from airport to CFRF (mi.)	No. of Operations from May '87 to May '88	No. of Operations from Aug. '91 to Aug. '92	D \leq 10 mi. (500 D ²)	D > 10 mi. (1,000 D ²)
Private Heliports					
UT Lifestar (Knoxville)	18.4	1,500 ^a	1,000 ^a	47,000	339,000
Vertiflite (Maryville)	18.3	3,400 ^a	2,600 ^a		335,000
Med Flight V Park West	9.7	26 ^b	500 ^c		350,000
Med Flight V Children's	18.7	53 ^b	500 ^c		384,000
Med Flight V St. Mary's	19.6	35 ^b	500 ^c		350,000
Med Flight V Fort Sanders	18.7	87 ^b	500 ^c		400,000
Med Flight V Baptist	20.0	208 ^b	500 ^c		339,000
Med Flight V U.T.Hospital	18.4	141 ^b	500 ^c		1,560,000
Oak Ridge Methodist Medical	6.0	12 ^b	30 ^a		18,000
Athens Community Hospital	39.5	N/A ^e	52 ^a		
Commercial Airports					
Campbell County (Jacksboro)	27.7	5,000 ^a	3,000 ^a		767,000
McGhee Tyson (Knoxville)	17.8	159,125 ^c	146,429 ^f		317,000
McMinn County (Athens)	40.0	N/A ^e	18,250 ^a		1,600,000
Monroe County (Madisonville)	27.3	20,000 ^a	50,000 ^a		745,000
Rockwood Municipal	22.9	3,000 ^a	3,000 ^a		524,000
Private Airports					
Atomic (Oliver Springs)	7.5	1,200 ^a	1,000 ^a	28,000	
Cox Farm (Lenoir City)	10.3	100 ^a	100 ^a		106,000
Downtown Island (Knoxville)	22.2	73,000 ^a	73,000 ^a		493,000
Ferguson Flying Circus (Philadelphia)	16.9	30 ^a	N/A ^e		286,000
Will Hildreath (Lenoir City)	8.9	720 ^a	760 ^a	40,000	
Little Creek (Knoxville)	12.9	300 ^a	30 ^a		166,000
Meadow Lake (Kingston)	14.5	N/A ^e	720 ^a		210,000
Montvale (Maryville)	22.8	600 ^a	600 ^a		520,000
Powell (Powell)	16.6	N/A ^d	N/A ^d		276,000
Riner Farms (Clinton)	19.1	100 ^a	200 ^a		365,000
Sky Ranch (Knoxville)	17.9	4,123 ^a	3,650 ^a		320,000
Taylor (Knoxville)	29.2	90 ^a	25 ^a		853,000
Closed Private Airports & Heliports					
Bishop Residence (Clinton)	17.8	0 ^a	0 ^a		317,000
E. Tenn. Ultra Light (Oliver Springs)	7.5	0 ^a	0 ^a	28,000	
Higdon (Karns)	7.0	0 ^a	0 ^a	25,000	
Phillips & Jordan (Knoxville)	17.0	N/A ^e	0 ^a		289,000
Wilkerson (Lenoir City)	11.9	0 ^a	0 ^a		142,000

^aEstimate from airport owner, manager, and/or Fixed Base Operator (FBO), or city/county government office (Appendix G).

^bBased on best estimate of Med Flight 5 which services six hospitals in Knoxville and one in Oak Ridge (Appendix G).

^cBased on statistical data (Appendix F).

^dNot available; owner refused to participate in survey.

^eTotal number of MedFlight Operations in Knoxville area. Statistics no longer available on each individual hospital.

^fBased on statistical data (Appendix F) from Jan '91 to Dec '91.

^gNot available; owner, manager and/or FBO was not contacted.

Table 2.8. Operations analysis of airports and heliports near the KBH Facility

Airport (location)	Distance (D) from airport to KBH (mi.)	No. of Operations from May '87 to May '88	No. of Operations from Aug. '91 to Aug. '92	D ≤ 10 mi. (500 D ²)	D > 10 mi. (1,000 D ²)
Private Heliports					
UT Lifestar (Knoxville)	25.8	1,500 ^a	1,000 ^a		666,000
Vertiflite (Maryville)	23.7	3,400 ^a	2,600 ^a		562,000
Med Flight V Park West	17.0	26 ^b	500 ^c		289,000
Med Flight V Children's	26.2	53 ^b	500 ^c		686,000
Med Flight V St. Mary's	27.2	35 ^b	500 ^c		740,000
Med Flight V Fort Sanders	26.2	87 ^b	500 ^c		686,000
Med Flight V Baptist	27.5	208 ^b	500 ^c		756,000
Med Flight V U.T.Hospital	25.8	141 ^b	500 ^c		666,000
Oak Ridge Methodist Medical	12.0	12 ^b	30 ^a		144,000
Athens Community Hospital	37.5	N/A ^e	52 ^a		1,410,000
Commercial Airports					
Campbell County (Jacksboro)	31.5	5,000 ^a	3,000 ^a		992,000
McGhee Tyson (Knoxville)	24.1	159,125 ^c	146,429 ^f		581,000
McMinn County (Athens)	38.0	N/A ^e	18,250 ^a		1,440,000
Monroe County (Madisonville)	25.3	20,000 ^a	50,000 ^a		640,000
Rockwood Municipal	15.3	3,000 ^a	3,000 ^a		234,000
Private Airports					
Atomic (Oliver Springs)	9.7	1,200 ^a	1,000 ^a	47,000	
Cox Farm (Lenoir City)	9.0	100 ^a	100 ^a	41,000	
Downtown Island (Knoxville)	29.7	73,000 ^a	73,000 ^a		882,000
Ferguson Flying Circus (Philadelphia)	13.7	30 ^a	N/A ^e		188,000
Will Hildreath (Lenoir City)	8.7	720 ^a	760 ^a	38,000	
Little Creek (Knoxville)	19.8	300 ^a	30 ^a		392,000
Meadow Lake (Kingston)	10.0	N/A ^e	720 ^a	50,000	
Montvale (Maryville)	27.5	600 ^a	600 ^a		756,000
Powell (Powell)	24.0	N/A ^d	N/A ^d		576,000
Riner Farms (Clinton)	24.7	100 ^a	200 ^a		610,000
Sky Ranch (Knoxville)	25.1	4,123 ^a	3,650 ^a		630,000
Taylor (Knoxville)	36.5	90 ^a	25 ^a		1,330,000
Closed Private Airports & Heliports					
Bishop Residence (Clinton)	23.9	0 ^a	0 ^a		571,000
E. Tenn. Ultra Light (Oliver Springs)	7.8	0 ^a	0 ^a	30,000	
Higdon (Karns)	14.4	0 ^a	0 ^a		207,000
Phillips & Jordan (Knoxville)	24.5	N/A ^e	0 ^a		600,000
Wilkerson (Lenoir City)	12.8	0 ^a	0 ^a		164,000

^aEstimate from airport owner, manager, and/or Fixed Base Operator (FBO), or city/county government office (Appendix G).

^bBased on best estimate of Med Flight 5 which services six hospitals in Knoxville and one in Oak Ridge (Appendix G).

^cBased on statistical data (Appendix F).

^dNot available; owner refused to participate in survey.

^eTotal number of MedFlight Operations in Knoxville area. Statistics no longer available on each individual hospital.

^fBased on statistical data (Appendix F) from Jan '91 to Dec '91.

^gNot available; owner, manager and/or FBO was not contacted.

3. AIRCRAFT CRASH PROBABILITY FOR ALL THREE PLANTS AND FIVE ADJOINING FACILITIES

3.1 COMPLIANCE WITH ACCEPTANCE CRITERIA IN THE SRP

Calculations must be made to determine the annual probability of an aircraft crash that would impact the Y-12 plant, because the site does not satisfy acceptance criterion 1.(a) of the SRP (Appendix A). The Y-12 plant is located within 4.9 miles of the Atomic Airport and within 1.6 miles of the heliport used by the Oak Ridge Methodist Medical Center. Both distances are less than the required 5-mile distance from plant to airport referenced in acceptance criterion 1.(a) of the SRP (Appendix A).

The SRP indicates that the annual probability of an aircraft crash resulting from air traffic on military training routes or military planes landing at the various airports is negligible: all three plants and five adjoining facilities on the Oak Ridge reservation satisfy acceptance criterion 1.(b) of the SRP (Appendix A).

None of the three plants or five adjoining facilities satisfies acceptance criterion 1.(c) of the SRP (Appendix A). Additional calculations are required for plant sites not located at least 2 miles beyond the nearest edge of a federal airway, holding pattern, or approach pattern (Appendix A). Federal airway J46 lies directly over all three plants and all five adjoining facilities. Federal airway V16 lies directly over all the plant sites except Y-12. Therefore, calculations must be made to determine the annual probability of an aircraft crash resulting from air traffic on federal airways V16 and J46.

3.2 PROBABILITY CALCULATIONS BASED ON SRP CRITERIA AND OTHERS

3.2.1 SRP Criteria

3.2.1.1 Proximity to Airports and Heliports [Criterion 1.(a)]

The probability of an aircraft crash need not be considered if (1) the plant-to-airport distance (D) is between 5 and 10 statute miles and the projected annual number of flight operations is less than the equation $500(D^2)$, or (2) the projected annual number of flight operations is less than the equation $1000(D^2)$ (Appendix A, p. 3.5.1.6-2).

The annual probability of an aircraft crash resulting from airports and heliports located within 5 miles of a plant is calculated as follows (Appendix A, p. 3.5.1.6-4):

$$P_A = C_A \times N_A \times A_T \quad (1)$$

where

- P_A = the annual probability of an aircraft crash at a plant site as a result of the flight operations of airports and heliports near the facility being evaluated,
- C_A = the annual probability per square mile of an aircraft crash per aircraft movement in the vicinity of the plant site,
- N_A = number of aircraft movements per year along a particular flight path,
- A_T = the effective ground surface area of the plant site being evaluated (square miles); also referred to as "total effective plant area."

Two of the three plants (ORNL and K-25) and all five adjoining facilities (HFIR, HPRR, CFRF, TSF, and KBH) meet the requirements of SRP acceptance criterion 1.(a) and need no further analysis; however, both the helicopter landing area used by the Oak Ridge Methodist Medical Center and the runway at the Atomic Airport are closer to the Y-12 plant site than the 5-statute-mile distance established in the SRP.

3.2.1.2 Proximity to Military Training Routes [Criterion 1.(b)]

The probability of an aircraft crash need not be considered if the plant is at least 5 statute miles from the edge of military training routes, including low-level training routes, except for those having more than 1000 flights per year, or where activities (such as practice bombing) may create an unusual stress situation (Appendix A, p. 3.5.1.6-2).

The annual probability of an aircraft crash resulting from military flight operations near a plant is calculated as follows (Appendix A, p. 3.5.1.6-2):

$$P_M = C_M \times A_T \quad (2)$$

where

- P_M = the annual probability of a potentially damaging aircraft crash at a plant site as a result of military flight operations near the facility being evaluated,
- C_M = the total annual probability per square mile of an aircraft crash per aircraft movement in the vicinity of the plant site,
- A_T = the total effective plant area of the plant site being evaluated (square miles).

Because all three plants and five adjoining facilities on the Oak Ridge reservation satisfy acceptance criterion 1.(b), additional calculations are not required for the purposes of this study.

3.2.1.3 Proximity to Federal Airways, Holding Patterns, or Approach Patterns [Criterion 1.(c)]

Federal airways located more than 2 statute miles from the plant site need not be considered in evaluating the annual probability of an aircraft crash resulting from air traffic on a federal airway (Appendix A, p. 3.5.1.6-2).

The annual probability of an aircraft crash resulting from air traffic on a federal airway or aviation corridor within 2 statute miles of a plant site is calculated as follows (Appendix A, p. 3.5.1.6-3):

$$P_{FA} = C_{FA} \times N_{FA} \times (A_T/W) \quad (3)$$

where

- P_{FA} = the probability of an aircraft crashing into a plant structure as a result of air traffic on a federal airway (crashes/year),
- C_{FA} = the in-flight number of crashes per aircraft-mile for aircraft using a federal airway,
- N_{FA} = the annual number of flights along that segment of the federal airway (aircraft/year),
- A_T = the total effective plant area of the site being evaluated (square miles),
- W = the width of the federal airway (miles).

None of the three plants or five adjoining facilities meet the requirements of SRP Criterion 1.(c). Therefore, additional calculations are required as a result of the proximity of federal airways V16 and J46.

3.2.2 Proximity to Military Holding Patterns

This criterion is not specified by the NRC in the SRP, but it was concluded after review of aircraft crash articles and reports that the probability of an aircraft crash resulting from air refueling operations in the area must be considered. Because this area is under military jurisdiction, the probability of an aircraft crash resulting from refueling operations within the airspace of AR-633 must be estimated on the basis of relevant assumptions. The probability formula for federal airways, P_{FA} , when applied to military flights in AR-633, provides the basis for a conservative approach for determining the probability of an aircraft crash resulting from refueling operations.

The annual probability of an aircraft crash resulting from air traffic in a military air refueling zone is calculated as follows:

$$P_{MIL} = C_{MIL} \times N_{MIL} \times (A_T/W) \quad (4)$$

where

P_{MIL} = the probability of military aircraft crashing into a plant structure as a result of military air traffic in AR-633 (crashes/year),

C_{MIL} = the in-flight number of crashes per aircraft mile for aircraft using a military airway,

N_{MIL} = the annual number of flights within AR-633 (aircraft/year),

A_T = the total effective plant area of the site being evaluated (square miles),

W = the width of the military airway within AR-633 (miles).

Since all three plants and five adjoining facilities lie beneath the military air refueling zone AR-633, additional calculations are required to determine the probability of an aircraft crash due to military flight operations in this volume of airspace. The P_{MIL} formula was developed specifically for this aircraft crash study.

3.2.3 Proximity to Multiple Sources of Aircraft Hazards (Combined Criteria)

To determine the total annual probability (P_T) of an aircraft crash at any of the three plants or one of the five adjoining facilities, the SRP requires that the probabilities for the following criteria be combined: acceptance criterion 1.(a) [Eq. (1), P_A , proximity to airports and heliports]; acceptance criterion 1.(b) [Eq. (2), P_M , proximity to military training routes], and acceptance criterion 1.(c) [Eq. (3), P_{FA} , proximity to federal airways, holding patterns, or approach patterns]. An additional factor, the probability of an aircraft crash based on proximity to military holding patterns [Eq. (4), P_{MIL}], was also included in Eq. (5), the calculation of the total annual probability (P_T).

$$P_T = P_A + P_M + P_{FA} + P_{MIL} \quad (5)$$

Because the probability of an aircraft crash resulting from military flight operations [acceptance criterion 1.(b)] is negligible for all three plants and five adjoining facilities [i.e., $P_M = 0$, Eq. (2)], the calculations in the following sections deal primarily with acceptance criterion 1.(a), acceptance criterion 1.(c), and the probability of an aircraft crash based on proximity to military holding patterns (i.e., P_{MIL}), Eqs. (1), (3), and (4), respectively.

3.3 DETERMINATION OF VALUES FOR VARIABLES C, N, A_T, AND W

To determine the annual probability of an aircraft crashing on any structure located on the Oak Ridge reservation, the values for the variables C, N, A_T, and W must be determined as required for each equation. The following sections contain suggested values for each variable. If more precise data are known or more conservative results are required, additional effort should be spent determining the unknown variables for that specific case.

3.3.1 In-Flight Number of Crashes per Aircraft-Mile (Variable C)

The values for the variable C used in Eqs. (1) and (3) are given in the SRP (Appendix A). Values for C_A in Eq. (1) (Appendix A, p. 3.5.1.6-4) for airport runways and heliports located less than 5 miles from the plant site being evaluated are based on statistical data reported in the SRP. For the Oak Ridge Methodist Medical Center, C_A = 15.0(10⁻⁶) crashes per square mile; for the Atomic Airport, C_A = 1.2(10⁻⁵) crashes per square mile. The SRP recommends using C_{FA} = 4.0(10⁻¹⁰) crashes per aircraft-mile in Eq. (3) for federal airways having fewer than 100 flights per day. For federal airways having more than 100 flights per day, a more in-depth analysis must be performed (Appendix A).

For Eq. (4), the value for C was determined on the basis of the military aircraft crash rate during noncombat missions being equivalent to the civilian air carrier crash rate.¹⁷ Using data for a 10-year period, 1967-1976, Kot et al. estimated an air carrier accident rate of 3.0(10⁻⁹) per aircraft-mile.¹⁷ This value was selected for C_{MIL} over the SRP-recommended value of 4.0(10⁻¹⁰) per aircraft-mile, because at least two planes are used in the refueling operation of the 134th Air Refueling Group and apparent danger is involved. In the absence of additional information, an aircraft-mile is assumed to be a "statute" aircraft-mile as defined in the variables C_{FA} and C_{MIL}.

3.3.2 Number of Flights per Year (Variable N)

The values for the variable N used in Eqs. (1) and (3) were determined by examining IFR en route high-altitude,³ en route low-altitude,⁴ and sectional charts.^{5,6} In various cases, personal communications including telephone conversations and site visits were needed to gather data. When

difficulty was encountered in obtaining information and flight operations data, the appropriate city, county, state, and federal agencies were contacted.

The value for the variable N used in Eq. (4) was determined by information obtained from the 134th Air Refueling Group of the Tennessee Air National Guard.^{18,19}

3.3.2.1 Number of Aircraft Movements Along a Particular Path (N_A and N_{FA})

Information on the number of flight operations for the airport and heliport within the five-mile radius of the Y-12 Plant was obtained from the owners and managers. The Oak Ridge Methodist Medical Center heliport estimates 30 flights per year, and the Atomic Airport in Oliver Springs estimates 1,000 flights per year.

Information on the total number of aircraft operating on federal airways J46 and V16 was obtained from the Atlanta Federal Aviation Administration--Air Route Traffic Control Center (FAA-ARTCC).^{7,8} The Atlanta FAA-ARTCC retains data on the number of aircraft operating on federal airways in the Atlanta sectional area, of which the Oak Ridge area is a part, for a maximum of 15 days. Based on data from June 1988, the Atlanta FAA-ARTCC estimates that an average of 336 aircraft per week use IFR on federal airway J46 and 220 aircraft per week use IFR on federal airway V16 while flying from Knoxville, Tennessee, to points west of Knoxville (Appendix D).

However, while updating this study in 1992, it was discovered that there has been a significant decrease in the number of airplanes reporting flight on federal airways routes. Inertial Navigational Systems have increased in use and in availability over the past four years. With this instrumentation, pilots can input the latitudinal and longitudinal coordinates of the origination and destination of the flight, and the instrumentation will give information on direct routes between the two points. In such a case, the pilot no longer follows federal airways routes. In compiling the 1992 update, it was not feasible to count the number of airplanes reporting usage on federal airways J46 and V16. However, an individual with the FAA-ARTCC did pore over the flight progress strips for a typical 24-hour period.⁹ On September 23, 1992, 14 airplanes were reported on federal airway V16 from Knoxville to points west of Knoxville and 11 airplanes were reported on federal airway J46 for the same area. The FAA-ARTCC suggested tripling the number of flights on the two federal airways to arrive at estimates of the true number of flight operations occurring over the Oak Ridge reservation since aircraft flying direct routes (using auto-navigational instrumentation) do not report the flight path. Therefore, a more accurate estimate is 42 flights per day in the vicinity of federal airways V16 and 33 flights per day in the vicinity of federal airways J46.

The number of general aviation flights has decreased considerably since the U.S. Department of Transportation dismissed approximately 11,000 air traffic controllers in August of 1981. A comparison between the flight operations data obtained for the 1983 *Clinch River Breeder Reactor Plant Probabilistic Risk Assessment*²⁰ and the flight operations data obtained for this aircraft crash report (1988 & 1992) verifies that general aviation air traffic has decreased considerably in 9 years.

For the probabilistic risk assessment of the Clinch River Breeder Reactor (CRBR)²⁰ generated in 1983, it was conservatively assumed that the number of aircraft using Visual Flight Rules (VFR) and operating on federal airway V16 near the CRBR was twice the number of aircraft using Instrument Flight Rules (IFR).²⁰ This conservative estimate was made because no established FAA method exists for accurately determining the number of aircraft using VFR on federal airways.

Estimating the VFR air traffic on federal airways is important, because the total annual probability value is dependent on the total air traffic on the federal airway. The primary users of VFR are general aviation aircraft, and VFR air traffic has been in a virtual decline since 1983. Therefore, the conservative estimate applied in 1983 (that VFR air traffic is twice the amount of IFR air traffic) can also be used conservatively today (1992). However, the jet routes (such as J46) are designed to serve aircraft operating above 18,000 feet mean sea level in what is called the "Positive Control Area."²¹ There should be no VFR flights within the positive control area and, therefore, operating on the high-altitude federal airway J46.^{3,16} In determining the annual amount of aircraft flights operating on both federal airways V16 and J46, the following calculations were performed:

IFR estimated number of flights on federal airway:

V16: 42 flights/day x 365 days/yr \approx 15,330 flights/year

VFR estimated number of flights on federal airway:

V16: 2(15,330 flights/year) \approx 30,660 flights/year

IFR estimated number of flights on federal airway:

J46: 33 flights/day \times 365 days/year \approx 12,045 flights/year

VFR estimated number of flights on federal airway:

J46: 0 flights/year

The total number of flights per year for aircraft using IFR and VFR on federal airway V16 is conservatively estimated at 45,990 aircraft per year. The total air traffic for aircraft using IFR and VFR on federal airway J46 is conservatively estimated at 12,045 aircraft per year.

To determine the estimated number of flights operating on both federal airways V16 and J46, the IFR and VFR were combined (15,330 + 30,660 + 12,045 + 0) to yield 58,035 flights/year.

Therefore, the value for N is 45,990, 12,045 or 58,035 annual flights, depending on which federal airway or airways are in the vicinity of the plant site under evaluation.

3.3.2.2 Number of Flights within AR-633 (N_{MIL})

Information on the number of flight operations within AR-633 was obtained from the Tennessee Air National Guard.^{18,19} From the period of October 1, 1991 to September 30, 1992, the 134th Air Refueling Group flew 243 missions. These 243 aircraft refueled 465 other military unit's aircraft for a total of 708 aircraft operations within AR-633. However, each refueling mission may not have linked up with the air refueling tanker the first time. To provide a conservative estimate, the number of missions was multiplied by three to account for any missed fly-bys. Therefore, there are approximately 2,124 air movements associated with the 134th Air Refueling Group usage of Air Refueling Anchor 633. In addition, other military aircraft not associated with the 134th Air Refueling Group use the 633 refueling area. Although the 134th Air Refueling Group does not keep track of outside usage of AR-633, they estimated 34 military aircraft used AR-633 for a 30 day period for about 408 additional missions per year. If this value is also multiplied by three to account for missed fly-bys (assuming other groups are participating in similar activities as the 134th Air Refueling Group), there could be approximately 1,224 other missions within AR-633. Finally, if the two values are summed together, there would be approximately 3,348 air movements within AR-633 per year.

3.3.3 Total Effective Plant Area of the Site (Variable A_p)

Determining the value for the variable A used in both Eqs. (1), (3) and (4) is much more complicated and requires additional analysis. The following pages describe one of several ways that the total effective plant area can be calculated. The technique was selected for this specific evaluation

only and may not apply to significantly different situations. The technique is merely a suggestion and should not be construed as the only method available or as the most conservative.

It should be noted that the terminology "total effective plant area" consistent with the SRP procedure refers to the structure of interest and should not be confused with the three Oak Ridge "plants" (ORNL, Y-12, or K-25).

To calculate the total effective plant area for a plant site being evaluated (A_T), aircraft crashes that could potentially damage structures on the Oak Ridge reservation must be evaluated. The extent of damage likely to result from an aircraft crash determines the total effective plant area.

According to most analyses, the total effective plant area for a structure (A_T) is the sum of the aircraft shadow area (A_S), skid area (A_K), and true target area (A_B).¹⁷ The true target area is also referred to as the footprint area of the structure.

Therefore, the total effective plant area for a structure (A_T) affected by an aircraft crash is:

$$A_T = A_S + A_K + A_B . \quad (6)$$

A probability work sheet (Appendix B) was developed to determine the effective plant area, the true target area, the shadow area, and the skid area of structures located at any of the three plants and the five adjoining facilities on the Oak Ridge reservation; the procedures used are explained in the following paragraphs. An example provided in Sect. 3.3.3.4 demonstrates how the effective plant area is determined.

3.3.3.1 Shadow Area (A_S)

The shadow area is dependent on the height of the structure and on the aircraft angle of attack (Fig. 3.1). Aircraft angles of attack used in several similar studies of aircraft crash scenarios were between 10° and 90°. Cravero and Lucenet concluded from their study of international aviation that vertical dives (aircraft angle of attack equal to 90°) occurred in more than half of 34 accidents from 1962 to 1966.²² In the remainder of the 34 accidents, the angle of attack was greater than 45°.²² Joerissen and Zuend assumed an average value of 45° for the aircraft angle of attack in their study.²³ To simplify calculations and to ensure a conservative probability estimate, an aircraft angle of attack of 45° was assumed in determining the shadow area for this study.

A_S is defined as the shadow area (Fig. 3.1) of the structure, $[a \times R]$ or $[a \times Z]$.

$$\tan \phi = Z \div R$$

where

Z is the height of structure, and

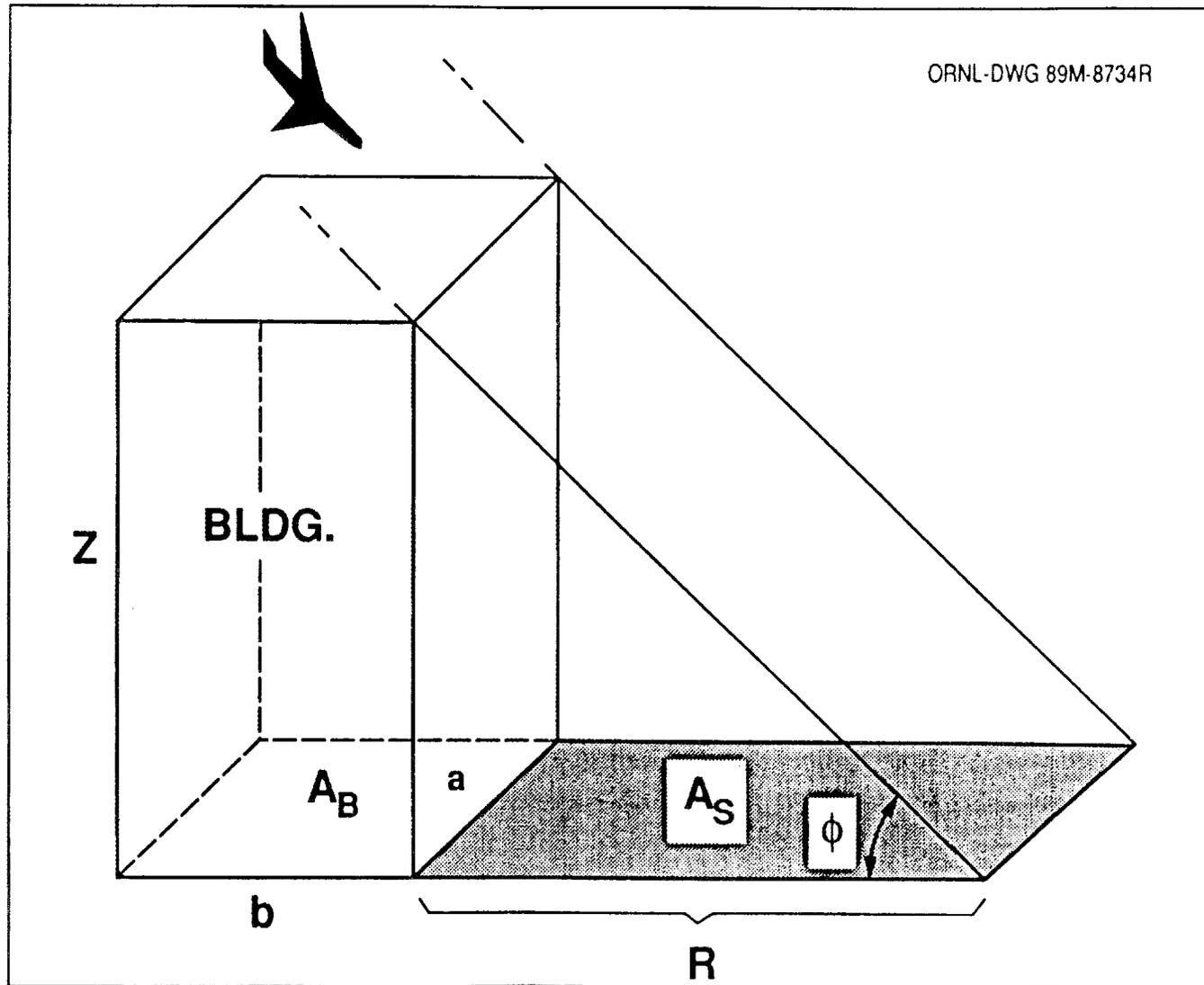


Fig. 3.1. Shadow area of a plant structure.

R is the length of the shadow in the direction of the aircraft line of attack.

When

$$\phi = 45^\circ, \text{ Tan } 45^\circ = 1.0, \text{ and } Z = R.$$

3.3.3.2 Skid Area (A_k)

The skid area varies proportionally with the square of the initial horizontal velocity of the aircraft and inversely with a friction factor dependent on the ground terrain.²⁴ Solomon's review of accident reports and other studies lists skid distances for various types of aircraft.²⁴ For high velocity military aircraft, the skid distance is 0.6 mile; for air carriers, 0.3 mile; and for general aviation aircraft, 0.06 mile.²⁴ If precise information is available on the type of aircraft involved in an evaluation of an aircraft crash hazard, the appropriate skid distance should be used; or, if additional conservatism is required, the maximum skid distance of 0.6 mile (for military aircraft) should be used in the SRP recommended equations. However, for this evaluation the precise data were not available on the breakdown of individual aircraft type.

In many analyses, skid area is not factored into estimations of total effective plant area (A_T), probably because of the corresponding decrease in the impact kinetic energy of the aircraft as the skid distance increases. However, Solomon notes that the skid area tends to dominate the evaluation of total effective plant area (A_T) more than the choice of ϕ and is therefore important.²⁴

A_k is the distance an aircraft would skid upon impact multiplied by the greatest dimension (length or width) of the impacted structure. The calculations in the following paragraphs indicate the factors used to determine the skid area for this evaluation.

Federal Airway

1. Federal airway V16 air traffic: 42 IFR flights/day and 84 VFR flights/day
2. Federal airway J46 air traffic: 33 IFR flights/day and 0 VFR flights/day
3. Federal airways (V16 and J46) combined air traffic: 75 IFR flights/day and 84 VFR flights/day

Skid Length (l_k)

Skid length (l_k) is a function of the type of aircraft. Most aircraft flying federal airways V16 and J46 are general aviation and air carriers. Skid lengths for these aircraft and the skid length for military aircraft are provided in Solomon²⁵:

1. General Aviation Aircraft: 0.06 mile
2. Air Carrier Aircraft: 0.30 mile
3. Military Aviation: 0.60 mile

Skid length varies depending on whether the facility being analyzed falls within the bounds of federal airway V16, J46, or both V16 and J46. However, to simplify calculations and provide a conservative estimate, it was assumed that all three major sites (ORNL, K-25, and Y-12) fall within the bounds of both federal airways (V16 and J46). Since a breakdown of individual aircraft type was not available for this specific evaluation it was assumed that the number of general aviation flights would be approximated as the number of flights using VFR on airways V16 and J46 (although general aviation aircraft also fly using IFR); the number of air carrier flights would be approximated as the number of flights using IFR on airways V16 and J46 (individual company policy almost always requires air carriers and air taxis to use IFR); and the number of military aviation flights would be approximated as the number of flights using airspace AR-633 (although military aircraft in general may follow the federal airways).

Calculations determining the skid length specifically for this aircraft crash study are based on the following weighted average formula:

$$l_k = f_1 l_{1k} + f_2 l_{2k} + f_3 l_{3k} / (f_1 + f_2 + f_3) \quad (7)$$

where

f = number of flights

l_k = skid length

1. For general aviation:

f_1 = 84 flights/day

l_{1k} = 0.06 mile

2. For air carriers:

f_2 = 75 flights/day

l_{2k} = 0.30 mile

3. For military aviation:

f_3 = 9 flights/day

l_{3k} = 0.6 mile

Skid length for general aviation, air carrier, and military aviation aircraft combined is:

$$\sum \frac{(f_1 l_{1K} + f_2 l_{2K} + f_3 l_{3K})}{(f_1 + f_2 + f_3)} = \frac{(84)(0.06) + (75)(0.30) + (9)(0.60)}{(84 + 75 + 9)} = 0.196 \text{ mile.}$$

Skid Width (w_K)

The skid width (w_K) is the greatest dimension (length or width) of the impacted structure.

Skid Area (A_K) Calculation

The skid area (A_K) is calculated as follows:

$$\begin{aligned} A_K &= \text{skid length} \times \text{skid width} = l_K \times w_K \\ &= 0.196 \text{ mile} \times \text{greatest dimension of structure in feet.} \end{aligned} \quad (8)$$

To convert square feet to square miles:

$$A_K = 0.196 \text{ mile} \times \text{greatest dimension of structure in feet} \times 1 \text{ mile}/5,280 \text{ ft.}$$

3.3.3.3 True Target Area (A_B)

The true target area is the total amount of land occupied by the structure (i.e., the base area of the target).²³ For example, a cylindrical building of radius r (postulated to have been impacted by an aircraft of point dimension) has a true target area of A_B where:

$$A_B = \pi r^2.$$

For a building of rectangular shape, true target area A_B is defined as the actual footprint area [$a \times b$] of the structure or actual length of the structure multiplied by its actual width (Fig. 3.1). For an "L-shaped", "H-shaped", or "E-shaped" building, for example, the true target area is the area of the base (or footprint) of the structure determined by breaking the footprint into rectangles and summing up the individual areas.

3.3.3.4 Effective Plant Area (A_T) Calculation — Example

Therefore, the total effective plant area (A_T) affected by an aircraft crash is determined by the summation formula:

$$A_T = A_S + A_K + A_B. \quad (6)$$

The following problem is given as an example for determining the total effective plant area (A_T).

Example:

The rectangular structure being analyzed has a height of five stories above ground level (or 100 ft) and a footprint area of 420,000 sq ft (width of 600 ft and length of 700 ft). Determine the effective plant area of the structure.

Solution:

$$A_T = A_S + A_K + A_B . \quad (6)$$

$$A_S = [a \times R] \text{ or } [a \times Z]$$

where

the height of the structure, Z , is 100 ft, which also equals R . Thus, $[a \times R]$ equals $600 \text{ ft} \times 100 \text{ ft}$, which equals $60,000 \text{ sq ft}$ or 0.0022 sq mi .

$$A_K = (0.196 \text{ mile})[(700 \text{ ft}) \times (1 \text{ mile}/5,280 \text{ ft})] = 0.0260 \text{ sq mi} .$$

$$A_B = [a \times b]$$

where

$$a = 600 \text{ ft} ,$$

$$b = 700 \text{ ft} ;$$

therefore,

$$A_B = 420,000 \text{ sq ft or } 0.0151 \text{ sq mi} .$$

The total effective plant area (A_T) is:

$$A_T = A_S + A_K + A_B . \quad (6)$$

Therefore,

$$\begin{aligned} A_T &= 0.0022 + 0.0260 + 0.0151 \\ &= 0.0433 \text{ sq mi} . \end{aligned}$$

3.3.4 Width of Federal Airway (Variable W)

Determining the value for the variable W used in Eqs. (3) and (4) is much more complicated and requires additional analysis.

The value for the width of a federal airway (W) is a function of the distance from the plant to the centerline of the federal airway. The SRP suggests using the width of the federal airway for the value of W when the site being evaluated lies under the federal airway (Appendix A). For a site that

does not lie under the federal airway, the SRP suggests using for the value of W the width of the federal airway plus twice the distance from the closest edge of the airway to the site (Appendix A).

The Federal Aviation Administration has set the minimum width of a low-altitude federal airway such as V16 at 8 nautical miles.^{7,9,10} High-altitude federal airways such as J46 have no set width, primarily because aircraft flying high-altitude jet routes, such as J46, use IFR instead of VFR.¹⁰ Finally, the military air traffic in airspace AR-633 has no set widths or patterns to fly within the airspace. They only are confined to the 4,000 square mile refueling area (of which the Oak Ridge reservation encompasses 58 square miles). To simplify calculations for the value of W for each plant site on the Oak Ridge reservation and to ensure a conservative estimate, the widths of both J46 and V16 as well as flight patterns within air space AR-633 were assumed to be 8 nautical miles for this study. However, the variables in the probability equations are in terms of statute miles. Therefore, the value of W is 9.21 statute miles (1 nautical mile = 1.1516 statute mile).

3.4 PROBABILITY CALCULATIONS FOR THE THREE PLANT SITES AND THE FIVE ADJOINING FACILITIES ON THE OAK RIDGE RESERVATION

In Sects. 3.4.1 through 3.4.8, the total annual probability (P_T) is calculated as a function of area for each of the three plants and the five adjoining facilities located on the Oak Ridge reservation. Probability work sheets for calculating the total annual probability (P_T) for any structure are provided in Appendix B. Complete calculations for eight specific structures (one structure at each of the three plants and each of the five adjoining facilities) are presented in Appendix C.

3.4.1 Total Annual Probability of an Aircraft Crash at Y-12

The Y-12 plant is located near the Atomic Airport (P_{IA}) and the Oak Ridge Methodist Medical Center heliport (P_{2A}) and falls within the corridor of federal airway J46 (P_{FA}). No military training routes fall within the vicinity of the Y-12 plant site; therefore, $P_M = 0$. However, a military air refueling track does exist in the area (P_{MIL}). The total annual probability (P_T) of an aircraft crash on any structure contained within the official DOE borders is determined by:

$$P_T = P_{FA} + P_{IA} + P_{2A} + P_M + P_{MIL}$$

where

$$P_{FA} = (12,045 \text{ flights/year})[4.0(10^{-10}) \text{ crashes/aircraft-mile}](A_T \text{ sq. miles})/9.21 \text{ miles}$$

$$\begin{aligned}
 &= 5.23(10^{-7})A_T, \\
 P_{1A} &= (1,000 \text{ flights/year})[1.2(10^{-8}) \text{ crashes/sq mi—movement}](A_T \text{ sq. miles}) \\
 &= 1.20(10^{-5})A_T, \\
 P_{2A} &= (30 \text{ flights/year})[15.0(10^{-8}) \text{ crashes/sq mi—movement}](A_T \text{ sq. miles}) = 4.50(10^{-6})A_T, \\
 P_M &= 0 \\
 P_{MIL} &= (3,348 \text{ flights/year})[3.0(10^{-9}) \text{ crashes/aircraft-mile}](A_T \text{ sq. miles})/9.21 \text{ miles} \\
 &= 1.09(10^{-6})A_T;
 \end{aligned}$$

therefore,

$$P_T = 1.81(10^{-5})A_T.$$

Remember that

$$A_T = A_S + A_K + A_B$$

where

- A_T = total effective plant area of the plant site being evaluated,
- A_S = shadow area,
- A_K = skid area,
- A_B = footprint area of structure.

DOE has indicated that Martin Marietta Energy Systems, Inc., safety analysis should consider as credible all those events having an annual probability greater than or equal to 10^{-6} ; events having an annual probability less than 10^{-6} should be considered non-credible.²

If an airplane crash is non-credible, the safety evaluation will not include an evaluation of the consequences that would result from a crash. However, if a crash is credible, the consequences of the crash must be reported in the safety evaluation. An evaluation of the consequence resulting from a crash is beyond the scope of this report.

3.4.2 Total Annual Probability of an Aircraft Crash at K-25

The K-25 plant falls within the corridor of federal airways V16 and J46 (P_{FA}). No airports and/or heliports or military training routes fall within the vicinity of the K-25 site; therefore, $P_A = 0$ and $P_M = 0$, respectively. However, a military air refueling track does exist in the area (P_{MIL}). The total annual probability (P_T) of an aircraft crash on any structure contained within the official DOE borders is determined by:

$$P_T = P_{FA} + P_A + P_M + P_{MIL}$$

where

$$P_{FA} = (58,035 \text{ flights/year})[4.0(10^{-10}) \text{ crashes/aircraft-mile}](A_T \text{ sq. miles})/9.21 \text{ miles}$$

$$= 2.52(10^{-6})A_T ,$$

$$P_A = 0 ,$$

$$P_M = 0 ,$$

$$P_{ML} = (3,348 \text{ flights/year})[3.0(10^{-9}) \text{ crashes/aircraft-mile}](A_T \text{ sq. miles})/9.21 \text{ miles}$$

$$= 1.09(10^{-6})A_T ;$$

therefore,

$$P_T = 3.61(10^{-6})A_T .$$

Remember that

$$A_T = A_S + A_K + A_B$$

where

A_T = total effective plant area of the plant site being evaluated,

A_S = shadow area,

A_K = skid area,

A_B = footprint of the structure.

DOE has indicated that Martin Marietta Energy Systems, Inc., safety analysis should consider as credible all those events having an annual probability greater than or equal to 10^{-6} ; events having an annual probability less than 10^{-6} should be considered non-credible.²

If an airplane crash is non-credible, the safety evaluation will not include an evaluation of the consequences that would result from a crash. However, if a crash is credible, the consequences of the crash must be reported in the safety evaluation. An evaluation of the consequence resulting from a crash is beyond the scope of this report.

3.4.3 Total Annual Probability of an Aircraft Crash at ORNL

The Oak Ridge National Laboratory falls within the corridor of federal airways V16 and J46 (P_{FA}). No airports and/or heliports or military training routes fall within the vicinity of the ORNL site; therefore, $P_A = 0$ and $P_M = 0$, respectively. However, a military air refueling track does exist in the area (P_{ML}). The total annual probability (P_T) of an aircraft crash on any structure contained within the official DOE borders is determined by:

$$P_T = P_{FA} + P_A + P_M + P_{ML}$$

where

$$\begin{aligned} P_{FA} &= (58,035 \text{ flights/year})[4.0(10^{-10}) \text{ crashes/aircraft-mile}](A_T \text{ sq. miles})/9.21 \text{ miles} \\ &= 2.52(10^{-6})A_T, \end{aligned}$$

$$P_A = 0,$$

$$P_M = 0,$$

$$\begin{aligned} P_{MIL} &= (3,348 \text{ flights/year})[3.0(10^{-9}) \text{ crashes/aircraft-mile}](A_T \text{ sq. miles})/9.21 \text{ miles} \\ &= 1.09(10^{-6})A_T, \end{aligned}$$

therefore,

$$P_T = 3.61(10^{-6})A_T.$$

Remember that

$$A_T = A_S + A_K + A_B$$

where

A_T = total effective plant area of the plant site being evaluated,

A_S = shadow area,

A_K = skid area,

A_B = footprint of the structure.

DOE has indicated that Martin Marietta Energy Systems, Inc., safety analysis should consider as credible all those events having an annual probability greater than or equal to 10^{-6} ; events having an annual probability less than 10^{-6} should be considered non-credible.²

If an airplane crash is non-credible, the safety evaluation will not include an evaluation of the consequences that would result from a crash. However, if a crash is credible, the consequences of the crash must be reported in the safety evaluation. An evaluation of the consequence resulting from a crash is beyond the scope of this report.

3.4.4 Total Annual Probability of an Aircraft Crash at HFIR

The High Flux Isotope Reactor falls within the corridor of federal airways V16 and J46 (P_{FA}). No airports and/or heliports or military training routes fall within the vicinity of the HFIR site; therefore, $P_A = 0$ and $P_M = 0$, respectively. However, a military air refueling track does exist in the area (P_{MIL}). The total annual probability (P_T) of an aircraft crash on any structure contained within the official DOE borders is determined by:

$$P_T = P_{FA} + P_A + P_M + P_{MIL}$$

where

$$\begin{aligned} P_{FA} &= (58,035 \text{ flights/year})[4.0(10^{-10}) \text{ crashes/aircraft-mile}](A_T \text{ sq. miles})/9.21 \text{ miles} \\ &= 2.52(10^{-6})A_T, \end{aligned}$$

$$P_A = 0,$$

$$P_M = 0,$$

$$\begin{aligned} P_{ML} &= (3,348 \text{ flights/year})[3.0(10^{-9}) \text{ crashes/aircraft-mile}](A_T \text{ sq. miles})/9.21 \text{ miles} \\ &= 1.09(10^{-6})A_T, \end{aligned}$$

therefore,

$$P_T = 3.61(10^{-6})A_T.$$

Remember that

$$A_T = A_S + A_K + A_B$$

where

A_T = total effective plant area of the plant site being evaluated,

A_S = shadow area,

A_K = skid area,

A_B = footprint of the structure.

DOE has indicated that Martin Marietta Energy Systems, Inc., safety analysis should consider as credible all those events having an annual probability greater than or equal to 10^{-6} ; events having an annual probability less than 10^{-6} should be considered non-credible.²

If an airplane crash is non-credible, the safety evaluation will not include an evaluation of the consequences that would result from a crash. However, if a crash is credible, the consequences of the crash must be reported in the safety evaluation. An evaluation of the consequence resulting from a crash is beyond the scope of this report.

3.4.5 Total Annual Probability of an Aircraft Crash at TSF

The Tower Shielding Facility falls within the corridor of federal airways V16 and J46 (P_{FA}). No airports and/or heliports or military training routes fall within the vicinity of the TSF site; therefore, $P_A = 0$ and $P_M = 0$, respectively. However, a military air refueling track does exist in the area (P_{ML}). The total annual probability (P_T) of an aircraft crash on any structure contained within the official DOE borders is determined by:

$$P_T = P_{FA} + P_A + P_M + P_{ML}$$

where

$$P_{FA} = (58,035 \text{ flights/year})[4.0(10^{-10}) \text{ crashes/aircraft-mile}](A_T \text{ sq. miles})/9.21 \text{ miles}$$

$$= 2.52(10^{-6})A_T,$$

$$P_A = 0,$$

$$P_M = 0,$$

$$P_{MIL} = (3,348 \text{ flights/year})[3.0(10^{-9}) \text{ crashes/aircraft-mile}](A_T \text{ sq. miles})/9.21 \text{ miles}$$

$$= 1.09(10^{-6})A_T;$$

therefore,

$$P_T = 3.61(10^{-6})A_T.$$

Remember that

$$A_T = A_s + A_k + A_B$$

where

A_T = total effective plant area of the plant site being evaluated,

A_s = shadow area,

A_k = skid area,

A_B = footprint of the structure.

DOE has indicated that Martin Marietta Energy Systems, Inc., safety analysis should consider as credible all those events having an annual probability greater than or equal to 10^{-6} ; events having an annual probability less than 10^{-6} should be considered non-credible.²

If an airplane crash is non-credible, the safety evaluation will not include an evaluation of the consequences that would result from a crash. However, if a crash is credible, the consequences of the crash must be reported in the safety evaluation. An evaluation of the consequence resulting from a crash is beyond the scope of this report.

3.4.6 Total Annual Probability of an Aircraft Crash at HPRR

The Health Physics Research Reactor falls within the corridor of federal airways V16 and J46 (P_{FA}). No airports and/or heliports or military training routes fall within the vicinity of the HPRR site; therefore, $P_A = 0$ and $P_M = 0$, respectively. However, a military air refueling track does exist in the area (P_{MIL}). The total annual probability (P_T) of an aircraft crash on any structure contained within the official DOE borders is determined by:

$$P_T = P_{FA} + P_A + P_M + P_{MIL}$$

where

$$P_{FA} = (58,035 \text{ flights/year})[4.0(10^{-10}) \text{ crashes/aircraft-mile}](A_T \text{ sq. miles})/9.21 \text{ miles} \\ = 2.52(10^{-6})A_T ,$$

$$P_A = 0 ,$$

$$P_M = 0 ,$$

$$P_{ML} = (3,348 \text{ flights/year})[3.0(10^{-9}) \text{ crashes/aircraft-mile}](A_T \text{ sq. miles})/9.21 \text{ miles} \\ = 1.09(10^{-6})A_T ,$$

therefore,

$$P_T = 3.61(10^{-6})A_T .$$

Remember that

$$A_T = A_S + A_K + A_B$$

where

A_T = total effective plant area of the plant site being evaluated,

A_S = shadow area,

A_K = skid area,

A_B = footprint of the structure.

DOE has indicated that Martin Marietta Energy Systems, Inc., safety analysis should consider as credible all those events having an annual probability greater than or equal to 10^{-6} ; events having an annual probability less than 10^{-6} should be considered non-credible.²

If an airplane crash is non-credible, the safety evaluation will not include an evaluation of the consequences that would result from a crash. However, if a crash is credible, the consequences of the crash must be reported in the safety evaluation. An evaluation of the consequence resulting from a crash is beyond the scope of this report.

3.4.7 Total Annual Probability of an Aircraft Crash at CFRF

The Consolidated Fuel Reprocessing Facility falls within the corridor of federal airways V16 and J46 (P_{FA}). No airports and/or heliports or military training routes fall within the vicinity of the CFRF site; therefore, $P_A = 0$ and $P_M = 0$, respectively. However, a military air refueling track does exist in the area (P_{ML}). The total annual probability (P_T) of an aircraft crash on any structure contained within the official DOE borders is determined by:

$$P_T = P_{FA} + P_A + P_M + P_{ML}$$

where

$$\begin{aligned} P_{FA} &= (58,035 \text{ flights/year})[4.0(10^{-10}) \text{ crashes/aircraft-mile}](A_T \text{ sq. miles})/9.21 \text{ miles} \\ &= 2.52(10^{-6})A_T, \end{aligned}$$

$$P_A = 0,$$

$$P_M = 0,$$

$$\begin{aligned} P_{MIL} &= (3,348 \text{ flights/year})[3.0(10^{-9}) \text{ crashes/aircraft-mile}](A_T \text{ sq. miles})/9.21 \text{ miles} \\ &= 1.09(10^{-6})A_T, \end{aligned}$$

therefore,

$$P_T = 3.61(10^{-6})A_T.$$

Remember that

$$A_T = A_S + A_K + A_B$$

where

A_T = total effective plant area of the plant site being evaluated,

A_S = shadow area,

A_K = skid area,

A_B = footprint of the structure.

DOE has indicated that Martin Marietta Energy Systems, Inc., safety analysis should consider as credible all those events having an annual probability greater than or equal to 10^{-6} ; events having an annual probability less than 10^{-6} should be considered non-credible.

If an airplane crash is non-credible, the safety evaluation will not include an evaluation of the consequences that would result from a crash. However, if a crash is credible, the consequences of the crash must be reported in the safety evaluation. An evaluation of the consequence resulting from a crash is beyond the scope of this report.

3.4.8 Total Annual Probability of an Aircraft Crash at KBH

The K-25 Boiler House falls within the corridor of federal airways V16 and J46 (P_{FA}). No airports and/or heliports or military training routes fall within the vicinity of the KBH site; therefore, $P_A = 0$ and $P_M = 0$, respectively. However, a military air refueling track does exist in the area (P_{MIL}). The total annual probability (P_T) of an aircraft crash on any structure contained within the official DOE borders is determined by:

$$P_T = P_{FA} + P_A + P_M + P_{MIL}$$

where

$$\begin{aligned} P_{FA} &= (58,035 \text{ flights/year})[4.0(10^{-10}) \text{ crashes/aircraft-mile}](A_T \text{ sq. miles})/9.21 \text{ miles} \\ &= 2.52(10^{-6})A_T, \end{aligned}$$

$$P_A = 0,$$

$$P_M = 0,$$

$$\begin{aligned} P_{ML} &= (3,348 \text{ flights/year})[3.0(10^{-9}) \text{ crashes/aircraft-mile}](A_T \text{ sq. miles})/9.21 \text{ miles} \\ &= 1.09(10^{-6})A_T, \end{aligned}$$

therefore,

$$P_T = 3.61(10^{-6})A_T.$$

Remember that

$$A_T = A_S + A_K + A_B$$

where

A_T = total effective plant area of the plant site being evaluated,

A_S = shadow area,

A_K = skid area,

A_B = footprint of the structure.

DOE has indicated that Martin Marietta Energy Systems, Inc., safety analysis should consider as credible all those events having an annual probability greater than or equal to 10^{-6} ; events having an annual probability less than 10^{-6} should be considered non-credible.²

If an airplane crash is non-credible, the safety evaluation will not include an evaluation of the consequences that would result from a crash. However, if a crash is credible, the consequences of the crash must be reported in the safety evaluation. An evaluation of the consequence resulting from a crash is beyond the scope of this report.

4. CONCLUSION

4.1 ANALYSIS RESULTS

The analysis indicates that the total annual probability (P_T) of an aircraft crash is less than 10^{-6} for any structure located on the ORNL, K-25, HFIR, TSF, CFRF, HPRR, and KBH sites, provided that the total effective plant area of the structure is not greater than about 0.25 sq mi. The total annual probability (P_T) of an aircraft crash is less than 10^{-6} for any structure on the Y-12 plant site, provided that the total effective plant area of the structure is not greater than about 0.05 sq mi. However, if the total effective plant area of the structure is such that a P_T equal to or greater than 10^{-6} would result, a more detailed analysis (not covered by this report) would have to be performed.

Because the total annual probability calculated for this study indicates that an aircraft crash for a facility at any of the three plants or five adjoining facilities is not credible, a more detailed modeling of aircraft hazard effects need not be performed. An aircraft crash having an estimated annual probability less than 10^{-6} events per year is not considered a significant contribution to risk and need not be considered.² Therefore, the safety analysis of the three plant sites and five adjoining facilities on the DOE reservation in Oak Ridge does not require a consequence evaluation.

4.2 NEED FOR PERIODIC REEVALUATION

Aviation activities statistics gathered from the Metropolitan Knoxville Airport Authority (Appendix F) indicate that air traffic at the McGhee Tyson Airport increased approximately 13% from December 1986 to December 1987 and approximately 23% from 1983 to 1988. In contrast, aviation statistics gathered from the FAA indicate that IFR air traffic operating on federal airway V16 decreased 74% during the same period from 1983 to 1988. Updated aviation statistics from the Metropolitan Knoxville Airport Authority indicate air traffic has decreased approximately 8.3% from December 1987 to December 1991, and appears to be declining steadily in the months of January through June, 1992, as compared to the same monthly totals for January through June, 1991. Most data and information referenced in this report were obtained from July 1988 through February 1989 and updated in September 1992.

This study accurately reflects all aircraft crash hazards at present (September 1992), but future air traffic patterns or the addition or subtraction of various aircraft crash hazards cannot be predicted.

Therefore, the report should be updated periodically. The data obtained for this report could eventually be invalidated by aircraft crash hazards resulting from the opening of any new airport or heliport within 5 miles of the Oak Ridge plant sites. The report would warrant immediate update if for instance, (1) a new municipal airport should open in the City of Oak Ridge, (2) the status of Knoxville's McGhee Tyson Airport should change from feeder airport to hub airport, (3) the amount of VFR and IFR traffic should increase or (4) there should be a change in direction or the addition of a federal airway.

The probability of an aircraft crash could also decrease. Secretary of Energy James D. Watkins announced in March 1990 that DOE plans to establish a zone of prohibited airspace over nine DOE nuclear facilities as part of an ongoing security program.^{26,27} One of the facilities included in the DOE proposal is the Y-12 plant in Oak Ridge.²⁸ On March 20, 1990, DOE and FAA jointly conducted a public meeting concerning the proposed airspace restrictions over the Y-12 plant.^{29,30} Enactment of airspace restrictions over the Y-12 plant could decrease the probability of an aircraft crash at the Y-12 plant. It should be noted that this probability may already be decreased by a statement on the Atlanta Sectional Aeronautical Chart. The Atlanta chart indicates the Y-12 plant is a National Security Area with the following note: "Notice - For reasons of national security pilots are requested to avoid flight below 3000' MSL [mean sea level] in this area."⁵

Finally, the FAA plans to reroute air traffic in the Spring of 1993 on federal airway V16. If these plans are carried out as proposed, air traffic over the Oak Ridge reservation should not be affected significantly; therefore, this evaluation would require no modification based on the rerouting of federal airway V16.

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APPENDIX A

NUREG-0800

U.S. Nuclear Regulatory Commission

Standard Review Plan 3.5.1.6



U.S. NUCLEAR REGULATORY COMMISSION
STANDARD REVIEW PLAN
OFFICE OF NUCLEAR REACTOR REGULATION

3.5.1.6 AIRCRAFT HAZARDS

REVIEW RESPONSIBILITIES

Primary - Siting Analysis Branch (SAB)

Secondary - None

I. AREAS OF REVIEW

The staff reviews the applicant's assessment of aircraft hazards. The purpose of the review is to assure that the risks due to aircraft hazards are sufficiently low. Probabilistic considerations may be used to demonstrate that aircraft hazards need not be a design basis concern. Otherwise, design basis aircraft identification is made and the applicant's plant design is evaluated to assure that it is protected against the potential effects of aircraft impacts and fires.

The SAB reviews the applicant's assessment of aircraft hazards to the plant and determines whether or not they should be incorporated into the plant design basis. If the aircraft hazards are incorporated into the plant design basis, the SAB identifies and describes the design basis aircraft in terms of aircraft weight, speed, and other appropriate characteristics.

On request by SAB, the following branches with primary review responsibility will review specific aspects of aircraft hazards:

1. The Structural Engineering Branch (SEB), in the area of missile effects (SRP Section 3.5.3), with respect to aircraft impacts,
2. The Chemical Engineering Branch (CMEB), in the area of fire protection (SRP Section 9.5.1), with respect to aircraft fires, and
3. The Auxiliary Systems Branch (ASB), in the area of structures, systems, and components (SSC) important to safety (SRP Section 3.5.2), with respect to protection requirements against aircraft crashes.

Rev. 2 - July 1981

USNRC STANDARD REVIEW PLAN

Standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for the review of applications to construct and operate nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The standard review plan sections are keyed to the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. Not all sections of the Standard Format have a corresponding review plan.

Published standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20540.

4. For those areas of review identified above as being part of the primary responsibility of other branches, the acceptance criteria necessary for the review and the methods of their application are contained in the referenced SRP sections of the corresponding primary branches.
5. The Applied Statistics Branch (ASB/MPA) will provide technical review support with respect to aircraft accident statistics.

II. ACCEPTANCE CRITERIA

SAB acceptance criteria are based on meeting the relevant requirements of one of the following sets of regulations:

1. 10 CFR Part 100, §100.10 as it relates to indicating that the site location, in conjunction with other considerations (such as plant design, construction, and operation), should insure a low risk of public exposure. This requirement is met if the probability of aircraft accidents resulting in radiological consequences greater than 10 CFR Part 100 exposure guidelines is less than about 10^{-7} per year (see SRP Section 2.2.3). The probability is considered to be less than about 10^{-7} per year by inspection if the distances from the plant meet all the requirements listed below:
 - (a) The plant-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 plant-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 plant is at least 5 statute miles from the edge of military training routes, including low-level training routes, except for those associated with a usage greater than 1000 flights per year, or where activities (such as practice bombing) may create an unusual stress situation,
 - (c) The plant is at least 2 statute miles beyond the nearest edge of a federal airway, holding pattern, or approach pattern.

If the above proximity criteria are not met, or if sufficiently hazardous military activities are identified (see item b above), a detailed review of aircraft hazards must be performed. Aircraft accidents which could lead to radiological consequences in excess of the exposure guidelines of 10 CFR Part 100 with a probability of occurrence greater than about 10^{-7} per year should be considered in the design of the plant. If the results of the review do not support a finding that the risk due to aircraft activities is acceptably low, then the design basis acceptance criteria outlined in Item II.2 below applies.

2. General Design Criterion (GDC) 4 of 10 CFR Part 50 (Ref. 13), Appendix A, requires that structures, systems, and components (SSC) important to safety be appropriately protected against the effects of missiles that may result from events and conditions outside the nuclear power unit. GDC 3 of 10 CFR Part 50, Appendix A, requires that SSC important to safety be appropriately protected against the effects of fires. The plant meets the relevant requirements of GDC 3 and GDC 4, and is considered appropriately protected against design basis aircraft impacts (Ref. 6) and fires (Ref. 3) if the SSC important to safety are capable of withstanding the effects of the

postulated aircraft impacts and fires without loss of safe shutdown capability, and without causing a release of radioactivity which would exceed 10 CFR Part 100 dose guidelines.

The safety-related SSC to be considered with respect to the above acceptance criteria include those described in the Appendix to Regulatory Guide 1.117, "Structures, Systems, and Components of Light-Water-Cooled Reactors to be Protected Against Tornadoes." Other safety-related SSC, which may not be included in Regulatory Guide 1.117, will be considered on a case-by-case basis in accordance with the acceptance criteria of the appropriate branches having primary responsibility for their protection.

III. REVIEW PROCEDURES

The reviewer selects and emphasizes aspects of the areas covered by this SRP section as may be appropriate for a particular case. The judgment on areas to be given attention and emphasis in the review is based on a inspection of the material presented to see whether it is similar to that recently reviewed on other plants and whether items of special safety significant are involved.

The staff's review of the aircraft hazard assessment consists of the following steps:

1. Aviation Uses. Data describing aviation uses in the airspace near the proposed site, including airports and their approach paths, federal airways, Federal Aviation Administration (FAA) restricted areas, and military uses is obtained from Section 2.2.1-2.2.2 of the SAR. For many cases, no detailed analysis need be made as the probability can be judged adequately low based on a comparison with analyses previously performed (Refs. 5, 7, 8, 9 and 10). In general, civilian and military maps should be examined to verify that all aviation facilities of interest have been considered. In the process, the reviewer should develop an independent assessment of the aircraft hazards. Communications with agencies responsible for aircraft operations and the evaluation of aircraft operational data may be utilized.
2. Airways. For situations where federal airways or aviation corridors pass through the vicinity of the site, the probability per year of an aircraft crashing into the plant (P_{FA}) should be estimated. This probability will depend on a number of factors such as the altitude and frequency of the flights, the width of the corridor, and the corresponding distribution of past accidents.

One way of calculating P_{FA} is by using the following expression:

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

where:

C = inflight 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 the airway, and
 A = effective area of plant in square miles.

This gives a conservative upper bound on aircraft impact probability if care is taken in using values for the individual factors that are meaningful and conservative. For commercial aircraft a value of $C = 4 \times 10^{-10}$ (Ref. 11) per aircraft mile has been used. For heavily traveled corridors (greater than 100 flights per day), a more detailed analysis may be required to obtain a proper value for this factor.

3. Civilian and Military Airports and Heli-Ports (Refs. 2, 4, and 14). The probability of an aircraft crashing into the site should be estimated for cases where one or more of the conditions in Item II.1 of the Acceptance Criteria are not met.

The probability per year of an aircraft crashing into the site for these cases (P_A) may be calculated by using the following expression:

$$P_A = \sum_{i=1}^L \cdot \sum_{j=1}^M C_j N_{ij} A_j$$

where:

M = number of different types of aircraft using the airport,
 L = number of flight trajectories affecting the site,
 C_j = probability per square mile of a crash per aircraft movement, for the jth aircraft,
 N_{ij} = number (per year) of movements by the jth aircraft along the ith flight path, and
 A_j = effective plant area (in square miles) for the jth aircraft.

The manner of interpreting the individual factors in the above equation may vary on a case-by-case basis because of the specific conditions of each case or because of changes in aircraft accident statistics.

Values for C_j currently being used are taken from the data summarized in the following table:

Distance From End of Runway (miles)	Probability ($\times 10^8$) of a Fatal Crash per Square Mile per Aircraft Movement			
	U.S. Air Carrier ¹	General Aviation ²	USN/USMC ¹	USAF ¹
0-1	16.7	84	8.3	5.7
1-2	4.0	15	1.1	2.3
2-3	0.96	6.2	0.33	1.1
3-4	0.68	3.8	0.31	0.42
4-5	0.27	1.2	0.20	0.40
5-6	0	NA ³	NA	NA
6-7	0	NA	NA	NA
7-8	0	NA	NA	NA
8-9	0.14	NA	NA	NA
9-10	0.12	NA	NA	NA

Reference 2.

Reference 4.

NA indicates that data was not available for this distance.

4. Designated Airspaces. For designated airspaces involving military or civilian usage, a detailed quantitative modeling of all operations should be verified. The results of the model should be the total probability (C) of an aircraft crash per unit area and time in the vicinity of the proposed site.

The probability per year of a potentially damaging crash at the site due to operations at the facility under consideration (P_M) is then given for this case by the following expression:

$$P_M = C \times A$$

where:

- C = total probability of an aircraft crash per square mile per year in the vicinity of the site due to the airports being considered, and
- A = effective area of one unit of the plant in square miles.

Where estimated risks due to military aircraft activity are found to be unacceptably high, suitable airspace or airway relocation should be implemented. Past experience has been that military authorities have been responsive to modification of military operations and relocation of training routes in close proximity to nuclear power plant sites. (Ref. 12)

5. Holding Patterns. Holding patterns are race track shaped courses at specified altitudes, associated with one or more radio-navigational facilities, where aircraft can "circle" while awaiting clearance to execute an approach to a landing at an airport or to continue along an airway. Holding patterns which are sufficiently distant from the plant need not be considered (See subsection II above). Otherwise, traffic in the holding pattern should be converted into equivalent aircraft passages taking into account the characteristics, including orientation with respect to the plant, of the holding pattern. The information in Item III.2 above should be used in this evaluation.
6. The total aircraft hazard probability at the site equals the sum of the individual probabilities obtained in the preceding steps.
7. The effective plant areas used in the calculations should include the following:
- A shadow area of the plant elevation upon the horizontal plane based on the assumed crash angle for the different kinds of aircraft and failure modes.
 - A skid area around the plant as determined by the characteristics of the aircraft under consideration. Artificial berms or any other man-made and natural barriers should be taken into account in calculating this area.
 - The areas of those safety-related SSC which are susceptible to impact or fire damage as a result of aircraft crashes.

IV. EVALUATION FINDINGS

The reviewer drafts an introductory paragraph for the evaluation findings describing the procedure used in evaluating the aircraft hazards with respect to the safety-related SSC. The reviewer verifies that the site location is acceptable and meets the requirements of 10 CFR Part 100, §100.10.

The basis for the above findings may be strictly in terms of the probabilities associated with potential aircraft crashes onsite. If the aircraft crash statistics applicable to the onsite facilities are such that SRP Section 2.2.3 criteria are met without explicit consideration of plant design features, then conclusions of the following type should be included in the staff's safety evaluation report:

The staff concludes that the operation of the _____ plant in the vicinity of _____ does not present an undue risk to the health and safety of the public and meets the relevant requirements of 10 CFR Part 100, §100.10. This conclusion is based on the staff's independent verification of the applicant's assessment of aircraft hazards at the site that resulted in a probability less than about 10^{-7} per year for an accident having radiological consequences worse than the exposure guidelines of 10 CFR Part 100.

In addition, plant sites reviewed in the past which had equivalent aircraft traffic in equal or closer proximity were, after careful examination, found to present no undue risk to the safe operation of those plants. Based upon this experience, in the staff's judgment, no undue risk is present from aircraft hazard at the plant site now under consideration.

In the event that the staff evaluation of the aircraft hazards does not support the above basis, i.e., if SRP Section 2.2.3 criteria are not met, then the basis for acceptance is derived from applying GDC 3 and GDC 4 criteria. If the protection against aircraft impacts and fires is such that the plant safety-related SSC meet GDC 3 and GDC 4 criteria, then 10 CFR Part 100 requirements are considered to be met and conclusion of the following type may be included in the staff's safety evaluation report:

The staff concludes that the operation of the _____ plant in the vicinity of _____ does not present an undue risk to the health and safety of the public due to aircraft hazards and meets the relevant requirements of General Design Criteria 3 and 4. This conclusion is based on the staff having independently verified the applicant's assessment of aircraft hazards, including aircraft fires and impacts, at the site and that if the appropriate safety-related structures, systems, and components are designed to withstand the aircraft selected as the design basis aircraft, the probability of an aircraft strike causing radiological consequences in excess of the exposure guidelines of 10 CFR Part 100 is less than about 10^{-7} per year.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, and method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced regulatory guides and NUREG.

VI. REFERENCES

1. 10 CFR Part 100, "Reactor Site Criteria."
2. D. G. Eisenhut, "Reactor Siting in the Vicinity of Airfields." Paper presented at the American Nuclear Society Annual Meeting, June 1973.
3. I. I. Pinkel, "Appraisal of Fire Effects from Aircraft Crash at Zion Power Reactor Facility," July 17, 1972 (Docket No. 50-295).
4. D. G. Eisenhut, "Testimony on Zion/Waukegan Airport Interaction" (Docket No. 50-295).
5. USAEC Regulatory Staff, "Safety Evaluation Report," Appendix A, "Probability of an Aircraft Crash at the Shoreham Site" (Docket No. 50-322).
6. "Addendum to the Safety Evaluation by the Division of Reactor Licensing, USAEC, in the Matter of Metropolitan Edison Company (Three Mile Island Nuclear Station Unit 1, Dauphin County, Pennsylvania)," April 26, 1968 (Docket No. 50-289).
7. Letter to Honorable J. R. Schlesinger from S. H. Bush, Chairman, Advisory Committee on Reactor Safeguards, "Report on Rome Point Nuclear Generating Station," November 18, 1971 (Project No. 455).
8. Letter to Mr. Joseph L. Williams, Portland General Electric Company, from R. C. DeYoung (in reference to Mr. Williams' letter of May 7, 1973), November 23, 1973 (Project No. 485).
9. "Aircraft Considerations-Preapplication Site Review by the Directorate of Liensing, USAEC, in the Matter of Portland General Electric Company, Boardman Nuclear Plant, Boardman, Oregon," October 12, 1973 (Project No. 485).
10. Letter to Mr. J. H. Campbell, Consumers Power Company, from Col. James M. Campbell, Dep. Chief, Strategic Division, Directorate of Operations, U.S. Air Force, May 19, 1971 (Docket No. 50-155).
11. H. E. P. Krug, "Testimony on Aircraft Operations in Response to a Question from the Board" (Docket Nos. 50-275 and 50-323).
12. Letter to Mr. J. H. Campbell, Consumers Power Company, from Col. James M. Campbell, Dep. Chief, Strategic Division, Directorate of Operations, U.S. Air Force, May 19, 1971 (Docket No. 50-155).
13. 10 CFR Part 50, "Domestic Licensing of Production and Utilization Facilities."
14. NUREG-0533, "Aircraft Impact Risk Assessment Data Base for Assessment of Fixed Wing Air Carrier Impact Risk in the Vicinity of Airports."

APPENDIX B

**Standard Work Sheets for Determining
Total Annual Probability of an Aircraft Crash
at the Three Plants and Five Adjoining Facilities
on the U.S. Department of Energy Reservation
in Oak Ridge, Tennessee**

NOTE:

1. The facilities in these example work sheets are rectangular in shape. Equation (1) should be modified to determine the actual amount of land occupied by the structure depending on its particular shape.
2. The skid length used in these example work sheets is based on a weighted average approach defined by the specific air traffic data given for the Oak Ridge area. As stated in the text (Section 3.3.3.2), skid length should be determined on an individual basis depending on the precision of the data available and/or the level of conservatism required.

STRUCTURES AT THE Y-12 PLANT SITE

Building No. _____ Building Name _____

To determine the P_T of an aircraft crashing into a structure, the following procedure should be followed:

1. Determine the footprint area of the structure of rectangular shape:

$$A_B = \text{structure length} \times \text{structure width} .$$

$$A_B = \text{_____ ft} \times \text{_____ ft} .$$

Convert A_B into square miles by dividing by $27.8784(10^6)$:

$$A_B = \text{_____ sq mi} . \quad (\text{A})$$

2. Determine the height of the structure being analyzed:

$$H = \text{height} = \text{_____ ft} . \quad (\text{B})$$

3. Use skid area:

$$A_K = \text{skid length} \times \text{greatest dimension of structure} , \quad (\text{C})$$

$$A_K = 0.196 \text{ mi.} \times \text{_____ ft} \times 1 \text{ mile}/5,280 \text{ ft} = \text{_____ sq mi} .$$

4. The SRP requires a calculation for shadow area A_S :

$$A_S = \text{height} \times \text{greatest dimension of structure} .$$

$$A_S = \text{_____ ft} \times \text{_____ ft} .$$

Convert A_S into square miles by dividing by $27.8784(10^6)$:

$$A_S = \text{_____ sq mi} . \quad (\text{D})$$

5. The total effective plant area A_T equals the sum of A_B , A_K , and A_S .

$$A_T = A_B + A_K + A_S .$$

$$A_T = \text{_____} + \text{_____} + \text{_____} \text{ sq mi} . \quad (\text{E})$$

6. Substituting A_T into the total annual probability (P_T) formula that corresponds to the plant site yields the P_T of an aircraft crash. Therefore,

$$P_T = A_T \times 1.81(10^{-5}) = \text{_____} \times 1.81(10^{-5}) = \text{_____} .$$

If P_T is less than 10^{-6} , the procedure established in the SRP suffices and no further analysis is required.

STRUCTURES AT THE ORNL AND K-25 PLANT SITES

Building No. _____ Building Name _____

To determine the P_T of an aircraft crashing into a structure, the following procedure should be followed:

1. Determine the footprint area of the structure of rectangular shape:

$$A_B = \text{structure length} \times \text{structure width} .$$

$$A_B = \text{_____ ft} \times \text{_____ ft} .$$

Convert A_B into square miles by dividing by 27.8784(10^6):

$$A_B = \text{_____ sq mi} . \quad (\text{A})$$

2. Determine the height of the structure being analyzed:

$$H = \text{height} = \text{_____ ft} . \quad (\text{B})$$

3. Use skid area:

$$A_K = \text{skid length} \times \text{greatest dimension of structure} , \quad (\text{C})$$

$$A_K = 0.196 \text{ mi.} \times \text{_____ ft} \times 1 \text{ mile}/5,280 \text{ ft} = \text{_____ sq mi} .$$

4. The SRP requires a calculation for shadow area (A_S):

$$A_S = \text{height} \times \text{greatest dimension of structure} .$$

$$A_S = \text{_____ ft} \times \text{_____ ft} .$$

Convert A_S into square miles by dividing by 27.8784(10^6):

$$A_S = \text{_____ sq mi} . \quad (\text{D})$$

5. The total effective plant area A_T equals the sum of A_B , A_K , and A_S .

$$A_T = A_B + A_K + A_S .$$

$$A_T = \text{_____} + \text{_____} + \text{_____ sq mi} . \quad (\text{E})$$

6. Substituting (A_T) into the total annual probability (P_T) formula that corresponds to the plant site in question yields the P_T of an aircraft crash. Therefore,

$$P_T = A_T \times 3.61(10^{-6}) = \text{_____} \times 3.61(10^{-6}) = \text{_____} .$$

If P_T is less than 10^{-6} , the procedure established in the SRP suffices and no further analysis is required.

APPENDIX C

Total Annual Probability

of an Aircraft Crash at Eight Specific Structures

(One at Each of the Three Plants and Five Adjoining Facilities)

on the U.S. Department of Energy Reservation in Oak Ridge, Tennessee

Y-12 Production Building 9212

To determine the P_T of an aircraft crashing into Y-12 Production Building 9212, the footprint of the building, A_B , including its height must be determined:

$$A_B = \text{building length} \times \text{building width} .$$

$$A_B = 370 \text{ ft} \times 490 \text{ ft} = 181,300 \text{ sq ft} .$$

$$A_B = 181,300 \text{ sq ft} \div 27.8784(10^6) \text{ sq ft/sq mi} = 0.0065 \text{ sq mi} .$$

$$H = \text{building height} = 52 \text{ ft} .$$

The SRP requires that both a skid area and shadow area be added to the footprint of the building. The skid area is equal to the skid length multiplied by the skid width, which conservatively is the greatest width of the impacted structure. Therefore, the skid area, A_K , of Y-12 Production Building 9212 is:

$$A_K = \text{skid length} \times \text{skid width} .$$

$$A_K = 0.196 \text{ mile} \times 490 \text{ ft} \times 1 \text{ mile}/5,280 \text{ ft} = 0.018189 \text{ sq mi} .$$

To calculate the shadow area, the height of the building is multiplied by the length of the building. Therefore, the shadow area of Y-12 Production Building 9212 is:

$$A_S = \text{building height} \times \text{building length} .$$

$$A_S = 52 \text{ ft} \times 490 \text{ ft} = 25,480 \text{ sq ft} .$$

$$A_S = 25,480 \text{ sq ft} \div 27.8784(10^6) \text{ sq ft/sq mi} = 0.00091 \text{ sq mi} .$$

Therefore, the effective plant area (A_T) equals the sum of the footprint of the building, skid area, and shadow area:

$$A_T = A_S + A_K + A_B .$$

$$A_T = 0.006503 + 0.018189 + 0.000914 = 0.025606 \text{ sq mi} .$$

Substituting $A_T = 0.025606 \text{ sq mi}$ into Eq. (1) yields the P_T of an aircraft crashing into Y-12 Production Building 9212:

$$P_T = A_T \times 1.81(10^{-5}) . \tag{1}$$

$$P_T = 0.025606 \text{ sq mi} \times 1.81(10^{-5}) = 4.63(10^{-7}) .$$

Since $4.63(10^{-7})$ is less than 10^{-6} , the procedure established in the SRP suffices and no further analysis is required.

ORNL Administration Building 4500-N and 4500-S

To determine the P_T of an aircraft crashing into ORNL Administration Building 4500-N and 4500-S, the footprint of the building, A_B , including its height must be determined:

$$A_B = \text{building length} \times \text{building width} .$$

$$A_B = 750 \text{ ft} \times 650 \text{ ft} = 487,500 \text{ sq ft} .$$

$$A_B = 487,500 \text{ sq ft} \div 27.8784(10^6) \text{ sq ft/sq mi} = 0.0175 \text{ sq mi} .$$

$$H = \text{building height} = 50 \text{ ft} .$$

The SRP requires that both a skid area and shadow area be added to the footprint of the building. The skid area is equal to the skid length multiplied by the skid width, which conservatively is the greatest width of the impacted structure. Therefore, the skid area, A_K , of ORNL Administration Building 4500-N and 4500-S is:

$$A_K = \text{skid length} \times \text{skid width} .$$

$$A_K = 0.196 \text{ mile} \times 750 \text{ ft} \times 1 \text{ mile}/5,280 \text{ ft} = 0.027841 \text{ sq mi} .$$

To calculate the shadow area, the height of the building is multiplied by the length of the building. Therefore, the shadow area of ORNL Administration Building 4500-N and 4500-S is:

$$A_S = \text{building height} \times \text{building length} .$$

$$A_S = 50 \text{ ft} \times 750 \text{ ft} = 37,500 \text{ sq ft} .$$

$$A_S = 37,500 \text{ sq ft} \div 27.8784(10^6) \text{ sq ft/sq mi} = 0.001345 \text{ sq mi} .$$

Therefore, the effective plant area (A_T) equals the sum of the footprint of the building, skid area, and shadow area:

$$A_T = A_S + A_K + A_B .$$

$$A_T = 0.017487 + 0.027841 + 0.001345 = 0.046673 \text{ sq mi} .$$

Substituting $A_T = 0.046673 \text{ sq mi}$ into Eq. (1) yields the P_T of an aircraft crashing into ORNL Administration Building 4500-N and 4500-S:

$$P_T = A_T \times 3.61(10^{-6}) . \tag{1}$$

$$P_T = 0.046673 \text{ sq mi} \times 3.61(10^{-6}) = 1.68(10^{-7}) .$$

Since $1.68(10^{-7})$ is less than 10^{-6} , the procedure established in the SRP suffices and no further analysis is required.

K-25 Process Buildings K-303-1 Through K-312-3

To determine the P_T of an aircraft crashing into K-25 Process Buildings K-303-1 through K-312-3, the footprint of the building, A_B , including its height must be determined:

$$A_B = \text{building length} \times \text{building width} .$$

$$A_B = 2,300 \text{ ft} \times 1,000 \text{ ft} = 2.3(10^6) \text{ sq ft} .$$

$$A_B = 2.3(10^6) \text{ sq ft} \div 27.8784(10^6) \text{ sq ft/sq mi} = 0.0825 \text{ sq mi} .$$

$$H = \text{building height} = 70 \text{ ft} .$$

The SRP requires that both a skid area and shadow area be added to the footprint of the building. The skid area is equal to the skid length multiplied by the skid width, which conservatively is the greatest width of the impacted structure. Therefore, the skid area, A_K , of K-25 Process Buildings K-303-1 through K-312-3 is:

$$A_K = \text{skid length} \times \text{skid width} .$$

$$A_K = 0.196 \text{ mile} \times 2,300 \text{ ft} \times 1 \text{ mile}/5,280 \text{ ft} = 0.085379 \text{ sq mi} .$$

To calculate the shadow area, the height of the building is multiplied by the length of the building. Therefore, the shadow area of K-25 Process Buildings K-303-1 through K-312-3 is:

$$A_S = \text{building height} \times \text{building length} .$$

$$A_S = 70 \text{ ft} \times 2,300 \text{ ft} = 161,000 \text{ sq ft} .$$

$$A_S = 161,000 \text{ sq ft} \div 27.8784(10^6) \text{ sq ft/sq mi} = 0.0058 \text{ sq mi} .$$

Therefore, the effective plant area (A_T) equals the sum of the footprint of the building, skid area, and shadow area:

$$A_T = A_S + A_K + A_B .$$

$$A_T = 0.082501 + 0.085379 + 0.005775 = 0.173655 \text{ sq mi} .$$

Substituting $A_T = 0.173655 \text{ sq mi}$ into Eq. (1) yields the P_T of an aircraft crashing into K-25 Process Buildings K-303-1 through K-312-3:

$$P_T = A_T \times 3.61(10^6) . \tag{1}$$

$$P_T = 0.173655 \text{ sq mi} \times 3.61(10^6) = 6.27(10^7) .$$

Since $6.27(10^7)$ is less than 10^6 , the procedure established in the SRP suffices and no further analysis is required.

HFIR Building 7900

To determine the P_T of an aircraft crashing into HFIR Building 7900, the footprint of the building, A_B , including its height must be determined:

$$A_B = \text{building length} \times \text{building width} .$$

$$A_B = 400 \text{ ft} \times 300 \text{ ft} = 120,000 \text{ sq ft} .$$

$$A_B = 120,000 \text{ sq ft} \div 27.8784(10^6) \text{ sq ft/sq mi} = 0.0043 \text{ sq mi} .$$

$$H = \text{building height} = 80 \text{ ft} .$$

The SRP requires that both a skid area and shadow area be added to the footprint of the building. The skid area is equal to the skid length multiplied by the skid width, which conservatively is the greatest width of the impacted structure. Therefore, the skid area, A_K , of HFIR Building 7900 is:

$$A_K = \text{skid length} \times \text{skid width} .$$

$$A_K = 0.196 \text{ mile} \times 400 \text{ ft} \times 1 \text{ mile}/5,280 \text{ ft} = 0.014848 \text{ sq mi} .$$

To calculate the shadow area, the height of the building is multiplied by the length of the building. Therefore, the shadow area of HFIR Building 7900 is:

$$A_S = \text{building height} \times \text{building length} .$$

$$A_S = 80 \text{ ft} \times 400 \text{ ft} = 32,000 \text{ sq ft} .$$

$$A_S = 32,000 \text{ sq ft} \div 27.8784(10^6) \text{ sq ft/sq mi} = 0.0011 \text{ sq mi} .$$

Therefore, the effective plant area (A_T) equals the sum of the footprint of the building, skid area, and shadow area:

$$A_T = A_S + A_K + A_B .$$

$$A_T = 0.004304 + 0.014848 + 0.001148 = 0.020300 \text{ sq mi} .$$

Substituting $A_T = 0.020300 \text{ sq mi}$ into Eq. (1) yields the P_T of an aircraft crashing into HFIR Building 7900:

$$P_T = A_T \times 3.61(10^{-6}) . \tag{1}$$

$$P_T = 0.020300 \text{ sq mi} \times 3.61(10^{-6}) = 7.33(10^{-8}) .$$

Since $7.33(10^{-8})$ is less than 10^{-6} , the procedure established in the SRP suffices and no further analysis is required.

CFRF Building 7600

To determine the P_T of an aircraft crashing into CFRF Building 7600, the footprint of the building, A_B , including its height must be determined (the footprint of the CFRF building is circular):

$$A_B = (\pi/4) \times (\text{building diameter})^2 .$$

$$A_B = (3.1416 \div 4) \times (125 \text{ sq ft})^2 = 12,272 \text{ sq ft} .$$

$$A_B = 12,272 \text{ sq ft} \div 27.8784(10^6) \text{ sq ft/sq mi} = 0.00044 \text{ sq mi} .$$

$$H = \text{building height} = 150 \text{ ft} .$$

The SRP requires that both a skid area and shadow area be added to the footprint of the building. The skid area is equal to the skid length multiplied by the skid width, which conservatively is the greatest width of the impacted structure. Therefore, the skid area, A_X , of CFRF Building 7600 is:

$$A_X = \text{skid length} \times \text{skid width} .$$

$$A_X = 0.196 \text{ mile} \times 125 \text{ ft} \times 1 \text{ mile}/5,280 \text{ ft} = 0.004640 \text{ sq mi} .$$

To calculate the shadow area, the height of the building is multiplied by the length of the building. Therefore, the shadow area of CFRF Building 7600 is:

$$A_S = \text{building height} \times \text{building length} .$$

$$A_S = 150 \text{ ft} \times 125 \text{ ft} = 18,750 \text{ sq ft} .$$

$$A_S = 18,750 \text{ sq ft} \div 27.8784(10^6) \text{ sq ft/sq mi} = 0.0007 \text{ sq mi} .$$

Therefore, the effective plant area (A_T) equals the sum of the footprint of the building, skid area, and shadow area:

$$A_T = A_S + A_X + A_B .$$

$$A_T = 0.000440 + 0.004640 + 0.000673 = 0.005753 \text{ sq mi} .$$

Substituting $A_T = 0.005753 \text{ sq mi}$ into Eq. (1) yields the P_T of an aircraft crashing into CFRF Building 7600:

$$P_T = A_T \times 3.61(10^{-6}) . \tag{1}$$

$$P_T = 0.005753 \text{ sq mi} \times 3.61(10^{-6}) = 2.08(10^{-8}) .$$

Since $2.08(10^{-8})$ is less than 10^{-6} , the procedure established in the SRP suffices and no further analysis is required.

KBH Building K701

To determine the P_T of an aircraft crashing into KBH Building K701, the footprint of the building, A_B , including its height must be determined:

$$A_B = \text{building length} \times \text{building width} .$$

$$A_B = 300 \text{ ft} \times 600 \text{ ft} = 180,000 \text{ sq ft} .$$

$$A_B = 180,000 \text{ sq ft} \div 27.8784(10^6) \text{ sq ft/sq mi} = 0.0065 \text{ sq mi} .$$

$$H = \text{building height} = 100 \text{ ft} .$$

The SRP requires that both a skid area and shadow area be added to the footprint of the building. The skid area is equal to the skid length multiplied by the skid width, which conservatively is the greatest width of the impacted structure. Therefore, the skid area, A_K , of KBH Building K701 is:

$$A_K = \text{skid length} \times \text{skid width} .$$

$$A_K = 0.196 \text{ mile} \times 600 \text{ ft} \times 1 \text{ mile}/5,280 \text{ ft} = 0.022273 \text{ sq mi} .$$

To calculate the shadow area, the height of the building is multiplied by the length of the building. Therefore, the shadow area of KBH Building K701 is:

$$A_S = \text{building height} \times \text{building length} .$$

$$A_S = 100 \text{ ft} \times 600 \text{ ft} = 60,000 \text{ sq ft} .$$

$$A_S = 60,000 \text{ sq ft} \div 27.8784(10^6) \text{ sq ft/sq mi} = 0.0022 \text{ sq mi} .$$

Therefore, the effective plant area (A_T) equals the sum of the footprint of the building, skid area, and shadow area:

$$A_T = A_S + A_K + A_B .$$

$$A_T = 0.006457 + 0.022273 + 0.002152 = 0.030882 \text{ sq mi} .$$

Substituting $A_T = 0.030882 \text{ sq mi}$ into Eq. (1) yields the P_T of an aircraft crashing into KBH Building K701:

$$P_T = A_T \times 3.61(10^{-6}) . \tag{1}$$

$$P_T = 0.030882 \text{ sq mi} \times 3.61(10^{-6}) = 1.11(10^{-7}) .$$

Since $1.11(10^{-7})$ is less than 10^{-6} , the procedure established in the SRP suffices and no further analysis is required.

TSF Building 7700

To determine the P_T of an aircraft crashing into TSF Building 7700, the footprint of the building, A_B , including its height must be determined:

$$A_B = \text{building length} \times \text{building width} .$$

$$A_B = 100 \text{ ft} \times 200 \text{ ft} = 20,000 \text{ sq ft} .$$

$$A_B = 20,000 \text{ sq ft} \div 27.8784(10^6) \text{ sq ft/sq mi} = 0.00072 \text{ sq mi} .$$

$$H = \text{building height} = 324 \text{ ft} .$$

The SRP requires that both a skid area and shadow area be added to the footprint of the building. The skid area is equal to the skid length multiplied by the skid width, which conservatively is the greatest width of the impacted structure. Therefore, the skid area, A_K , of TSF Building 7700 is:

$$A_K = \text{skid length} \times \text{skid width} .$$

$$A_K = 0.196 \text{ mile} \times 200 \text{ ft} \times 1 \text{ mile}/5,280 \text{ ft} = 0.007424 \text{ sq mi} .$$

To calculate the shadow area, the height of the building is multiplied by the length of the building. Therefore, the shadow area of TSF Building 7700 is:

$$A_S = \text{building height} \times \text{building length} .$$

$$A_S = 324 \text{ ft} \times 200 \text{ ft} = 64,800 \text{ sq ft} .$$

$$A_S = 64,800 \text{ sq ft} \div 27.8784(10^6) \text{ sq ft/sq mi} = 0.00232 \text{ sq mi} .$$

Therefore, the effective plant area (A_T) equals the sum of the footprint of the building, skid area, and shadow area:

$$A_T = A_S + A_K + A_B .$$

$$A_T = 0.000717 + 0.007424 + 0.002324 = 0.010465 \text{ sq mi} .$$

Substituting $A_T = 0.010465 \text{ sq mi}$ into Eq. (1) yields the P_T of an aircraft crashing into TSF Building 7700:

$$P_T = A_T \times 3.61(10^{-6}) . \tag{1}$$

$$P_T = 0.010465 \text{ sq mi} \times 3.61(10^{-6}) = 3.78(10^{-8}) .$$

Since $3.78(10^{-8})$ is less than 10^{-6} , the procedure established in the SRP suffices and no further analysis is required.

HPRR Building 7709

To determine the P_T of an aircraft crashing into HPRR Building 7709, the footprint of the building, A_B , including its height must be determined:

$$A_B = \text{building length} \times \text{building width} .$$

$$A_B = 40 \text{ ft} \times 80 \text{ ft} = 3.2(10^3) \text{ sq ft} .$$

$$A_B = 3,200 \text{ sq ft} \div 27.8784(10^6) \text{ sq ft/sq mi} = 0.00011 \text{ sq mi} .$$

$$H = \text{building height} = 55 \text{ ft} .$$

The SRP requires that both a skid area and shadow area be added to the footprint of the building. The skid area is equal to the skid length multiplied by the skid width, which conservatively is the greatest width of the impacted structure. Therefore, the skid area, A_K , of HPRR Building 7709 is:

$$A_K = \text{skid length} \times \text{skid width} .$$

$$A_K = 0.196 \text{ mile} \times 80 \text{ ft} \times 1 \text{ mile}/5,280 \text{ ft} = 0.002970 \text{ sq mi} .$$

To calculate the shadow area, the height of the building is multiplied by the length of the building. Therefore, the shadow area of HPRR Building 7709 is:

$$A_S = \text{building height} \times \text{building length} .$$

$$A_S = 55 \text{ ft} \times 80 \text{ ft} = 4,400 \text{ sq ft} .$$

$$A_S = 4,400 \text{ sq ft} \div 27.8784(10^6) \text{ sq ft/sq mi} = 0.00016 \text{ sq mi} .$$

Therefore, the effective plant area (A_T) equals the sum of the footprint of the building, skid area, and shadow area:

$$A_T = A_S + A_K + A_B .$$

$$A_T = 0.000115 + 0.002970 + 0.000158 = 0.003243 \text{ sq mi} .$$

Substituting $A_T = 0.003243 \text{ sq mi}$ into Eq. (1) yields the P_T of an aircraft crashing into HPRR Building 7709:

$$P_T = A_T \times 3.61(10^{-6}) . \tag{1}$$

$$P_T = 0.003243 \text{ sq mi} \times 3.61(10^{-6}) = 1.17(10^{-8}) .$$

Since $1.17(10^{-8})$ is less than 10^{-6} , the procedure established in the SRP suffices and no further analysis is required.

APPENDIX D

Data from the Atlanta Federal Aviation Administration

Concerning the Volume of Flight Operations

on Federal Airways J46 and V16

1992 and 1988 Estimates

D-1

1988 Estimates

Date	V16	J46 FL180-FL230	J46 FL240-FL330	J46 FL350 & Above	Totals
6-25-88	34	16	25	9	84
6-26-88	29	4	22	4	59
6-27-88	17	9	26	11	63
6-28-88	42	16	23	7	88
6-29-88	33	9	30	9	81
6-30-88	42	13	41	9	105
7-01-88	23	10	37	6	76
Totals	220	77	204	55	556

FL, as in FL180, stands for Flight Level. These are the altitude levels used from 18,000 ft on up. It is based on a constant altimeter setting of 29.92 so that FL180 is 18,000 ft above sea level when the barometric pressure is 29.92.

1992 Estimates

Date	V16	J46	Totals
9-23-92	14	11	25
Totals	14	11	25

APPENDIX E

**Distances Between Airports and the Three Plants
and Five Adjoining Facilities
on the U.S. Department of Energy Reservation
in Oak Ridge, Tennessee**

Distances between airports and the three plants
and five adjoining facilities
on the U.S. Department of Energy Reservation
in Oak Ridge, Tennessee

From:	To:	ORNL	Y-12	K-25	TSF	HPRR	CFRF	HFIR	KBH
McGhee Tyson ^a		18.6	18.2	22.8	18.2	17.6	17.8	18.6	24.1
Ultra Light ^a		6.8	5.6	5.7	9.2	8.7	7.5	7.8	7.8
Atomic ^a		7.4	4.9	7.7	9.8	9.0	7.5	8.3	9.7
Hildreath ^a		7.4	11.1	8.6	6.0	7.1	8.9	7.2	8.7
Cox Farm ^a		8.7	12.5	9.2	7.4	8.6	10.3	8.6	9.0
Bishop ^a		19.0	13.4	21.7	20.8	19.5	17.8	19.8	23.9
Campbell Co. ^a		28.4	23.4	29.4	30.7	29.6	27.7	29.3	31.5
Wilkerson ^a		10.9	14.2	12.7	9.3	10.2	11.9	10.6	12.8
Riner Farms ^a		20.2	14.7	22.4	22.1	20.9	19.1	21.0	24.7
Powell ^a		18.0	13.3	21.8	19.2	18.0	16.6	18.6	24.0
Downtown Is. ^a		23.5	20.1	27.8	24.0	23.0	22.2	23.9	29.7
Little Creek ^a		13.9	12.9	18.3	13.8	13.0	12.9	14.0	19.8
Higdon ^a		8.3	4.5	12.3	9.5	8.2	7.0	8.9	14.4
Montvale ^a		23.1	24.4	26.7	22.0	22.0	22.8	22.9	27.5
Ferguson ^a		15.0	18.9	14.3	14.0	15.2	16.9	15.1	13.7
Taylor ^a		30.5	25.8	34.3	31.7	30.4	29.2	31.1	36.5
Monroe Co. ^a		25.8	29.5	25.7	24.4	25.5	27.3	25.6	25.3
Rockwood Muni. ^a		20.3	23.0	15.7	21.5	22.4	22.9	21.3	15.3
Sky Ranch ^a		19.0	17.1	23.4	19.1	18.2	17.9	19.2	25.1
Park West Hosp. ^a		10.8	9.0	15.2	11.2	10.2	9.7	11.2	17.0
Children's Hosp. ^a		19.9	16.7	24.2	20.5	19.4	18.7	20.3	26.2
St. Mary's Hosp. ^a		20.9	17.1	25.1	21.7	20.6	19.6	21.4	27.2
Ft. Sanders Hosp. ^a		20.0	16.7	24.3	20.5	19.5	18.7	20.4	26.2
Baptist Hosp. ^a		21.2	18.0	25.5	21.8	20.7	20.0	21.6	27.5
Oak Ridge Hosp. ^a		6.8	1.6	9.4	8.9	7.7	5.9	7.7	11.7
UT LifeStar ^a		19.6	16.6	23.9	20.0	19.0	18.4	20.0	25.8
Vertiflite ^a		18.8	19.5	22.7	17.9	17.7	18.3	18.7	23.7
UT Hospital ^a		19.6	16.6	23.9	20.0	19.0	18.4	20.0	25.8
Phillips & Jordan ^b		18.5	14	23	19.5	18.5	17	19	24.5
Athens Community Hosp. ^b		38	44.5	38	36.5	38	39.5	38	37.5
McMinn County ^b		38.5	45	38.5	37	38.5	40	38.5	38
Meadow Lake ^b		13.5	19.5	10	13.5	14.5	14.5	13.5	10

^aDistances determined from latitudinal and longitudinal coordinates

^bDistances determined from "Atlanta Sectional Aeronautical Chart," 49th ed., and are rounded to the nearest half-mile.

APPENDIX F

McGhee Tyson Municipal Airport

Annual Flight Data Sheets

**From December 1991 through June 1992
(F-1 to F-7)**

and

**From May 1987 through May 1988
(F-8 to F-20)**

McGHEE TYSON AIRPORT
ACTIVITY REPORT
DECEMBER 1991

Terry Igoe, Executive Director

MAJOR	PASSENGERS		
	ENPLANED	DEPLANED	TOTAL
Delta	275,666	273,690	549,356
Northwest	51,371	50,191	101,562
USAir	97,427	98,359	195,786
United	49,749	46,419	96,168
TOTAL MAJOR	474,213	468,659	942,872
REGIONAL/COMMUTER			
Comair	20,437	21,229	41,666
WestAir	15,868	16,079	31,947
Metro Express	701	711	1,412
Nashville Eagle	34,727	34,626	69,353
CC Air	15,543	15,570	31,113
Trans World Exp.	10,030	9,679	19,709
Jetstream	4,815	5,509	10,324
TOTAL REGIONAL/COMMUTER	102,121	103,403	205,524

MOVEMENTS (Per Tower Report)	YEAR TO DATE		1991
	1991	1990	
Air Carrier	21,035	22,407	-6.12%
Air Taxi	25,379	30,186	-15.92%
General Aviation	80,122	90,811	-11.77%
Military	19,893	23,501	-15.35%
TOTAL	146,429	166,905	-12.27%

YEAR TO DATE TOTALS			
JANUARY-DECEMBER 1991	576,334	572,062	1,148,396
JANUARY-DECEMBER 1990	584,406	579,764	1,164,170
1991 TO 1990	-1.38%	-1.33%	-1.35%

Compiled by Metropolitan Knoxville Airport Authority

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McGHEE TYSON AIRPORT
ACTIVITY REPORT
JANUARY 1992

Terry Igoe, Executive Director

MOVEMENTS (Per Tower Report)	MONTH OF JANUARY		YEAR TO DATE	
	1992	1991	1992	1991
Air Carrier	1,725	1,806	1,725	1,806
Air Taxi	1,890	2,404	1,890	2,404
General Aviation	5,276	6,534	5,276	6,534
Military	1,551	1,526	1,551	1,526
TOTAL	10,442	12,270	10,442	12,270

MAJOR	TOTAL FLIGHTS IN & OUT	PASSENGERS		
		ENPLANED	DEPLANED	TOTAL
Delta	724	20,066	20,580	40,646
Northwest	180	3,274	3,255	6,529
USAir	386	6,242	6,205	12,447
United	176	3,136	2,947	6,083
TOTAL MAJOR		32,718	32,987	65,705
REGIONAL/COMMUTER				
Comair	385	1,395	1,813	3,208
Atlantic Coast	198	1,016	1,136	2,152
Flagship	490	2,296	2,030	4,326
CCAir	230	1,252	1,370	2,622
Trans World Exp.	165	718	749	1,467
TOTAL REGIONAL/COMMUTER		6,677	7,098	13,775

MONTHLY TOTALS			
JANUARY 1992	39,395	40,085	79,480
JANUARY 1991	39,499	39,183	78,682
1992 TO 1991	-0.26%	2.30%	1.01%

YEAR TO DATE TOTALS			
JANUARY 1992	39,395	40,085	79,480
JANUARY 1991	39,499	39,183	78,682
1992 TO 1991	-0.26%	2.30%	1.01%

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McGHEE TYSON AIRPORT
ACTIVITY REPORT
FEBRUARY 1992

Terry Igoe, Executive Director

MOVEMENTS (Per Tower Report)	MONTH OF FEBRUARY		YEAR TO DATE	
	1992	1991	1992	1991
Air Carrier	1,611	1,610	3,336	3,416
Air Taxi	1,653	1,961	3,543	4,365
General Aviation	5,375	6,639	10,651	13,173
Military	1,393	1,226	2,944	2,752
TOTAL	10,032	11,436	20,474	23,706

MAJOR	TOTAL FLIGHTS IN & OUT	PASSENGERS		
		ENPLANED	DEPLANED	TOTAL
Delta	685	19,662	19,415	39,077
Northwest	170	3,492	3,284	6,776
USAir	366	6,208	6,381	12,589
United	172	2,967	2,598	5,565
TOTAL MAJOR		32,329	31,678	64,007

REGIONAL/COMMUTER		ENPLANED	DEPLANED	TOTAL
Comair	259	1,405	1,512	2,917
Atlantic Coast	192	982	1,029	2,011
Flagship	445	2,354	2,242	4,596
CCAir	212	1,212	1,279	2,491
Trans World Exp.	154	620	654	1,274
TOTAL REGIONAL/COMMUTER		6,573	6,716	13,289

% Major	83.10%	82.51%	82.81%
& Regional	16.90%	17.49%	17.19%

MONTHLY TOTALS			
FEBRUARY 1992	38,902	38,394	77,296
FEBRUARY 1991	36,967	36,528	73,495
1992 TO 1991	5.23%	5.11%	5.17%

YEAR TO DATE TOTALS			
FEBRUARY 1992	78,297	78,479	156,776
FEBRUARY 1991	76,466	75,711	152,177
1992 TO 1991	2.39%	3.66%	3.02%

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McGHEE TYSON AIRPORT
ACTIVITY REPORT
MARCH 1992

Terry Igoe, Executive Director

MOVEMENTS (Per Tower Report)	MONTH OF MARCH		YEAR TO DATE	
	1992	1991	1992	1991
Air Carrier	1,670	1,672	5,006	5,088
Air Taxi	1,655	2,104	5,198	6,469
General Aviation	5,744	7,589	16,395	20,762
Military	1,605	1,539	4,549	4,291
TOTAL	10,674	12,904	31,148	36,610

MAJOR	TOTAL FLIGHTS IN & OUT	PASSENGERS		
		ENPLANED	DEPLANED	TOTAL
Delta	738	22,854	22,821	45,675
Northwest	182	4,157	4,074	8,231
USAir	400	7,198	7,606	14,804
United	174	3,560	3,724	7,284
TOTAL MAJOR		37,769	38,225	75,994

REGIONAL/COMMUTER		ENPLANED	DEPLANED	TOTAL
Comair	278	1,694	1,812	3,506
Atlantic Coast	156	939	1,129	2,068
Flagship	472	2,586	2,503	5,089
CCAir	226	1,310	1,482	2,792
Trans World Exp.	171	856	860	1,716
TOTAL REGIONAL/COMMUTER		7,385	7,786	15,171

% Major & Regional	83.64%	83.08%	83.36%
	16.36%	16.92%	16.64%

MONTHLY TOTALS			
MARCH 1992	45,154	46,011	91,165
MARCH 1991	42,812	44,225	87,037
1992 TO 1991	5.47%	4.04%	4.74%

YEAR TO DATE TOTALS			
MARCH 1992	123,451	124,490	247,941
MARCH 1991	119,278	119,936	239,214
1992 TO 1991	3.50%	3.80%	3.65%

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McGHEE TYSON AIRPORT
ACTIVITY REPORT
APRIL 1992

Terry Igoe, Executive Director

MOVEMENTS (Per Tower Report)	MONTH OF APRIL		YEAR TO DATE	
	1992	1991	1992	1991
Air Carrier	1,661	1,873	6,667	6,961
Air Taxi	1,839	2,111	7,037	8,580
General Aviation	5,967	8,852	22,362	29,614
Military	1,717	1,679	6,266	5,970
TOTAL	11,184	14,515	42,332	51,125

MAJOR	TOTAL FLIGHTS IN & OUT	PASSENGERS		
		ENPLANED	DEPLANED	TOTAL
Delta	712	21,835	21,550	43,385
Northwest	172	4,249	4,075	8,324
USAir	384	7,555	7,690	15,245
United	178	3,749	3,435	7,184
TOTAL MAJOR		37,388	36,750	74,138

REGIONAL/COMMUTER		ENPLANED	DEPLANED	TOTAL
Comair	276			
Atlantic Coast	162	1,243	1,308	2,551
Flagship	465	2,821	2,679	5,500
CCAir	218	1,230	1,343	2,573
Trans World Exp.	166	841	857	1,698
TOTAL REGIONAL/COMMUTER		7,752	7,998	15,750

% Major	82.83%	82.13%	82.48%
& Regional	17.17%	17.87%	17.52%

MONTHLY TOTALS			
APRIL 1992	45,140	44,748	89,888
APRIL 1991	46,373	46,143	92,516
1992 TO 1991	-2.66%	-3.02%	-2.84%

YEAR TO DATE TOTALS			
APRIL 1992	168,591	169,238	337,829
APRIL 1991	165,651	166,079	331,730
1992 TO 1991	1.77%	1.90%	1.84%

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McGHEE TYSON AIRPORT
ACTIVITY REPORT
MAY 1992

Terry Igoe, Executive Director

MOVEMENTS (Per Tower Report)	MONTH OF MAY		YEAR TO DATE	
	1992	1991	1992	1991
Air Carrier	2,168	1,788	8,835	8,749
Air Taxi	1,824	2,304	8,861	10,884
General Aviation	5,318	8,244	27,680	37,858
Military	1,902	1,662	8,168	7,632
TOTAL	11,212	13,998	53,544	65,123

MAJOR	TOTAL FLIGHTS IN & OUT	PASSENGERS		
		ENPLANED	DEPLANED	TOTAL
Delta	724	24,769	24,253	49,022
Northwest	174	4,412	4,362	8,774
USAir	384	8,232	8,475	16,707
United	182	4,748	4,457	9,205
TOTAL MAJOR		42,161	41,547	83,708

REGIONAL/COMMUTER				
Comair	269	1,943	1,986	3,929
Atlantic Coast	162	1,456	1,421	2,877
Flagship	681	3,376	3,532	6,908
CCAir	228	1,470	1,379	2,849
Trans World Exp.	161	1,105	990	2,095
TOTAL REGIONAL/COMMUTER		9,350	9,308	18,658

% Major	81.85%	81.70%	81.77%
& Regional	18.15%	18.30%	18.23%

MONTHLY TOTALS			
MAY 1992	51,511	50,855	102,366
MAY 1991	52,091	50,978	103,069
1992 TO 1991	-1.11%	-0.24%	-0.68%

YEAR TO DATE TOTALS			
MAY 1992	202,102	220,093	440,195
MAY 1991	217,742	217,057	434,799
1992 TO 1991	1.08%	1.40%	1.24%

Compiled by Metropolitan Knoxville Airport Authority

P. O. Box 15600, Knoxville, TN 37902 615-970-2773

McGHEE TYSON AIRPORT
ACTIVITY REPORT
JUNE 1992

Terry Igoe, Executive Director

MOVEMENTS (Per Tower Report)	MONTH OF JUNE		YEAR TO DATE	
	1992	1991	1992	1991
Air Carrier	1,791	1,730	10,626	10,479
Air Taxi	1,863	2,121	10,724	13,005
General Aviation	5,281	6,177	32,961	44,035
Military	2,135	1,902	10,303	9,534
TOTAL	11,070	11,930	64,614	77,053

MAJOR	TOTAL FLIGHTS IN & OUT	PASSENGERS		
		ENPLANED	DEPLANED	TOTAL
Delta	712	30,928	29,875	60,803
Northwest	170	5,768	5,428	11,196
USAir	386	10,033	10,362	20,395
United	178	5,971	6,277	12,248
TOTAL MAJOR		52,700	51,942	104,642

REGIONAL/COMMUTER		ENPLANED	DEPLANED	TOTAL
Comair	220	1,708	2,129	3,837
Atlantic Coast	216	1,396	1,480	2,876
Flagship	640	4,672	4,721	9,393
CCAair	218	1,399	1,402	2,801
Trans World Exp.	164	1,173	1,165	2,338
TOTAL REGIONAL/COMMUTER		10,348	10,897	21,245

% Major	83.59%	82.66%	83.12%
& Regional	16.41%	17.34%	16.88%

MONTHLY TOTALS			
JUNE 1992	63,048	62,839	125,887
JUNE 1991	50,916	50,137	101,083
1992 TO 1991	23.83%	25.26%	24.54%

YEAR TO DATE TOTALS			
JUNE 1992	283,150	282,932	566,082
JUNE 1991	268,658	267,224	535,882
1992 TO 1991	5.39%	5.88%	5.64%

Compiled by Metropolitan Knoxville Airport Authority¹

P. O. Box 15600, Knoxville, TN 37902 615-970-2773

**METROPOLITAN KNOXVILLE AIRPORT AUTHORITY
AVIATION ACTIVITIES STATISTICS
MONTH OF MAY 1987**

OPERATIONS:	1987	1986	# Inc. (Dec.)	% Inc. (Dec.)	YEAR-TO-DATE		% Inc. (Dec.)
					1987	1986	
Air Carrier	1,773	1,806	-33	-1.83	8,701	9,250	-5.94
Air Taxi	2,521	2,290	231	10.09	11,142	8,758	27.22
General Aviation	8,167	6,724	1,443	21.46	35,342	32,750	7.91
Military	2,169	1,368	801	58.55	9,450	6,412	47.38
TOTAL	14,630	12,188	2,442	20.04	64,635	57,170	13.06
PASSENGERS:							
Enplaned	56,339	46,834	9,505	20.30	248,646	199,731	24.49
Deplaned	55,563	46,131	9,432	20.45	244,609	197,941	23.58
TOTAL	111,902	92,965	18,937	20.37	493,255	397,672	24.04
FREIGHT:							
Enplaned	678,560	406,960	271,600	66.74	2,837,450	2,783,031	1.96
Deplaned	997,601	732,359	265,242	36.22	4,126,880	5,640,019	-26.83
TOTAL	1,676,161	1,139,319	536,842	47.12	6,964,330	8,423,050	-17.32
MAIL:							
Enplaned	233,784	212,481	21,303	10.03	1,159,818	1,035,671	11.99
Deplaned	71,915	78,849	-6,934	-8.79	380,694	355,578	7.06
TOTAL	305,699	291,330	14,369	4.93	1,540,512	1,391,249	10.73

METROPOLITAN KNOXVILLE AIRPORT AUTHORITY
AVIATION ACTIVITIES STATISTICS
MONTH OF JUNE 1987

OPERATIONS:	1987	1986	# Inc. (Dec.)	% Inc. (Dec.)	YEAR-TO-DATE		% Inc. (Dec.)
					1987	1986	
Air Carrier	1,912	1,705	207	12.14	10,613	10,955	-3.12
Air Taxi	2,531	2,246	285	12.69	13,673	11,004	24.25
General Aviation	6,875	6,399	476	7.44	42,217	39,149	7.84
Military	1,838	1,214	624	51.40	11,288	7,626	48.02
TOTAL	13,156	11,564	1,592	13.77	77,791	68,734	13.18
PASSENGERS:							
Enplaned	57,904	47,989	9,915	20.66	306,550	247,720	23.75
Deplaned	55,654	47,375	8,279	17.48	300,263	245,316	22.40
TOTAL	113,558	95,364	18,194	19.08	606,813	493,036	23.08
FREIGHT:							
Enplaned	567,157	470,522	96,635	20.54	3,404,607	3,253,553	4.64
Deplaned	873,340	683,407	189,933	27.79	5,000,220	6,323,426	-20.93
TOTAL	1,440,497	1,153,929	286,568	24.83	8,404,827	9,576,979	-12.24
MAIL:							
Enplaned	239,064	192,323	46,741	24.30	1,398,882	1,227,994	13.92
Deplaned	71,487	67,594	3,893	5.76	452,183	423,172	6.86
TOTAL	310,551	259,917	50,634	19.48	1,851,065	1,651,166	12.11

**METROPOLITAN KNOXVILLE AIRPORT AUTHORITY
AVIATION ACTIVITIES STATISTICS
MONTH OF JULY 1987**

OPERATIONS:	1987	1986	# Inc. (Dec.)	% Inc. (Dec.)	YEAR-TO-DATE		% Inc. (Dec.)
					1987	1986	
Air Carrier	2,018	1,697	321	18.92	12,631	[sic]	
Air Taxi	2,652	2,156	496	23.01	16,325		
General Aviation	7,371	6,641	730	10.99	49,588		
Military	1,467	1,201	266	22.15	12,755		
TOTAL	13,508	11,695	1,813	15.50	91,299		
PASSENGERS:							
Enplaned	57,593	50,220	7,373	14.68	364,143		
Deplaned	56,987	49,130	7,857	15.99	357,250		
TOTAL	114,580	99,350	15,230	15.33	721,393		
FREIGHT:							
Enplaned	924,204	477,867	446,337	93.40	4,328,811		
Deplaned	1,195,982	732,435	463,547	63.29	6,196,202		
TOTAL	2,120,186	1,210,302	909,884	75.18	10,525,013		
MAIL:							
Enplaned	259,232	206,261	52,971	25.68	1,658,114		
Deplaned	116,125	65,125	51,000	78.31	568,308		
TOTAL	375,357	271,386	103,971	38.31	2,226,422		

[Editors note: Shown as received. Two columns of data were not provided.]

**METROPOLITAN KNOXVILLE AIRPORT AUTHORITY
AVIATION ACTIVITIES STATISTICS
MONTH OF AUGUST 1987**

OPERATIONS:	1987	1986	# Inc. (Dec.)	% Inc. (Dec.)	YEAR-TO-DATE		% Inc. (Dec.)
					1987	1986	
Air Carrier	1,984	1,772	212	11.96	14,614	14,424	1.32
Air Taxi	2,611	2,253	358	15.89	18,936	15,413	22.86
General Aviation	6,899	7,135	-236	-3.31	56,487	52,925	6.73
Military	1,759	1,264	495	39.16	14,514	10,091	43.83
TOTAL	13,253	12,424	829	6.67	104,551	92,853	12.60
PASSENGERS:							
Enplaned	55,740	49,208	6,532	13.27	419,883	347,148	20.95
Deplaned	54,776	48,872	5,904	12.08	412,026	343,318	20.01
TOTAL	110,516	98,080	12,436	12.68	831,909	690,466	20.49
FREIGHT:							
Enplaned	833,206	563,381	269,825	47.89	5,162,017	4,294,801	20.19
Deplaned	1,151,712	799,013	352,699	44.14	7,347,914	7,854,874	-6.45
TOTAL	1,984,918	1,362,394	622,524	45.69	12,509,931	12,149,675	2.97
MAIL:							
Enplaned	266,557	215,770	50,787	23.54	1,924,671	1,650,025	16.64
Deplaned	153,672	71,528	82,144	114.84	269,797	721,980	-62.63
TOTAL	420,229	287,298	132,931	46.27	2,194,468	2,372,005	-7.48

**METROPOLITAN KNOXVILLE AIRPORT AUTHORITY
AVIATION ACTIVITIES STATISTICS
MONTH OF SEPTEMBER 1987**

OPERATIONS:	1987	1986	# Inc. (Dec.)	% Inc. (Dec.)	YEAR-TO-DATE		% Inc. (Dec.)
					1987	1986	
Air Carrier	1,872	1,760	112	6.36	16,486	16,184	1.87
Air Taxi	2,799	2,085	714	34.24	21,735	17,498	24.21
General Aviation	7,406	6,447	959	14.88	63,893	59,372	7.61
Military	2,385	1,830	555	30.33	16,899	11,921	41.76
TOTAL	14,462	12,122	2,340	19.30	119,013	104,975	13.37
PASSENGERS:							
Enplaned	47,942	44,571	3,371	7.56	467,825	391,665	19.45
Deplaned	48,682	44,917	3,765	8.38	460,708	388,235	18.67
TOTAL	96,624	89,488	7,136	7.97	928,533	779,900	19.06
FREIGHT:							
Enplaned	817,653	531,568	286,085	53.82	5,979,670	4,826,369	23.90
Deplaned	1,170,779	760,541	410,238	53.94	8,518,693	8,615,415	-1.12
TOTAL	1,988,432	1,292,109	696,323	53.89	14,498,363	13,441,784	7.86
MAIL:							
Enplaned	274,151	393,978	-119,827	-30.41	2,198,822	2,044,003	7.57
Deplaned	151,144	71,791	79,353	110.53	873,122	631,616	38.24
TOTAL	425,295	465,769	-40,474	-8.69	3,071,944	2,675,619	14.81

**METROPOLITAN KNOXVILLE AIRPORT AUTHORITY
AVIATION ACTIVITIES STATISTICS
MONTH OF OCTOBER 1987**

OPERATIONS:	1987	1986	# Inc. (Dec.)	% Inc. (Dec.)	YEAR-TO-DATE		% Inc. (Dec.)
					1987	1986	
Air Carrier	2,029	1,741	288	16.54	18,515	17,925	3.29
Air Taxi	2,861	2,301	560	24.34	24,596	19,799	24.23
General Aviation	8,976	7,572	1,404	18.54	72,869	66,944	8.85
Military	1,826	1,671	155	9.28	18,725	13,592	37.76
TOTAL	15,692	13,285	2,407	18.12	134,705	118,260	13.91
PASSENGERS:							
Enplaned	54,635	52,715	1,920	3.64	522,460	444,376	17.57
Deplaned	53,581	51,567	2,014	3.91	514,289	440,074	16.86
TOTAL	108,216	104,282	3,934	3.77	1,036,749	884,450	17.22
FREIGHT:							
Enplaned	1,098,458	614,298	484,160	78.82	7,078,128	5,440,667	30.10
Deplaned	1,444,466	901,226	543,240	60.28	9,963,159	9,516,641	4.69
TOTAL	2,542,924	1,515,524	1,027,400	67.79	17,041,287	14,957,308	13.93
MAIL:							
Enplaned	311,664	233,371	78,293	33.55	2,510,486	2,277,374	10.24
Deplaned	205,238	86,448	118,790	137.41	1,078,360	718,064	50.18
TOTAL	516,902	319,819	197,083	61.62	3,588,846	2,995,438	19.81

**METROPOLITAN KNOXVILLE AIRPORT AUTHORITY
AVIATION ACTIVITIES STATISTICS
MONTH OF NOVEMBER 1987**

OPERATIONS:	1987	1986	# Inc. (Dec.)	% Inc. (Dec.)	YEAR-TO-DATE		% Inc. (Dec.)
					1987	1986	
Air Carrier	2,276	1,652	624	37.77	20,791	19,577	6.20
Air Taxi	2,106	2,026	80	3.95	26,702	21,825	22.35
General Aviation	6,752	5,703	1,049	18.39	79,621	72,647	9.60
Military	1,807	1,182	625	52.88	20,530	14,774	38.96
TOTAL	12,941	10,563	2,378	22.51	147,644	128,823	14.61
PASSENGERS:							
Enplaned	48,973	44,464	4,509	10.14	571,433	488,840	16.90
Deplaned	49,351	44,953	4,398	9.78	563,640	485,027	16.21
TOTAL	98,324	89,417	8,907	9.96	1,135,073	973,867	16.55
FREIGHT:							
Enplaned	846,307	457,233	389,074	85.09	7,924,435	5,897,900	34.36
Deplaned	1,244,059	723,221	520,838	72.02	11,207,218	10,239,862	9.45
TOTAL	2,090,366	1,180,454	909,912	77.08	19,131,653	16,137,762	18.55
MAIL:							
Enplaned	279,717	207,665	72,052	34.70	2,781,203	2,485,039	11.92
Deplaned	220,849	70,211	150,638	214.55	1,299,209	788,275	64.82
TOTAL	500,566	277,876	222,690	80.14	4,080,412	3,273,314	24.66

**METROPOLITAN KNOXVILLE AIRPORT AUTHORITY
AVIATION ACTIVITIES STATISTICS
MONTH OF DECEMBER 1987**

OPERATIONS:	1987	1986	# Inc. (Dec.)	% Inc. (Dec.)	YEAR-TO-DATE		% Inc. (Dec.)
					1987	1986	
Air Carrier	2,396	1,752	644	36.76	23,187	21,329	8.71
Air Taxi	2,336	2,173	163	7.50	29,038	23,998	21.00
General Aviation	5,588	6,162	-574	-9.32	85,209	78,809	8.12
Military	1,647	1,566	81	5.17	22,177	16,340	35.72
TOTAL	11,967	11,653	314	2.69	159,611	140,476	13.62
PASSENGERS:							
Enplaned	47,064	44,972	2,092	4.65	618,497	534,024	15.82
Deplaned	46,310	44,478	1,832	4.12	609,950	529,449	15.20
TOTAL	93,374	89,450	3,924	4.39	1,228,447	1,063,473	15.51
FREIGHT:							
Enplaned	1,040,728	657,615	383,113	58.26	8,965,163	6,555,515	36.76
Deplaned	1,469,991	711,016	758,975	106.75	12,677,209	10,950,878	15.76
TOTAL	2,510,719	1,368,631	1,142,088	83.45	21,642,372	17,506,393	23.63
MAIL:							
Enplaned	459,028	313,394	145,634	46.47	3,240,231	2,798,433	15.79
Deplaned	433,186	100,900	332,286	329.32	1,732,395	889,175	94.83
TOTAL	892,214	414,294	477,920	115.36	4,972,626	3,687,608	34.85

METROPOLITAN KNOXVILLE AIRPORT AUTHORITY
AVIATION ACTIVITIES STATISTICS
MONTH OF JANUARY 1988

OPERATIONS:	1988	1987	# Inc. (Dec.)	% Inc. (Dec.)	YEAR-TO-DATE		% Inc. (Dec.)
					1988	1987	
Air Carrier	2,261	1,765	496	28.10	2,261	1,765	28.10
Air Taxi	2,069	2,099	-30	-1.43	2,069	2,099	-1.43
General Aviation	5,644	5,370	274	5.10	5,644	5,370	5.10
Military	1,659	1,656	3	0.18	1,659	1,656	0.18
TOTAL	11,633	10,890	743	6.82	11,633	10,890	6.82
PASSENGERS:							
Enplaned	41,402	38,992	2,410	6.18	41,402	38,992	6.18
Deplaned	39,416	37,366	2,050	5.49	39,416	37,366	5.49
TOTAL	80,818	76,358	4,460	5.84	80,818	76,358	5.84
FREIGHT:							
Enplaned	878,439	498,424	380,015	76.24	878,439	498,424	76.24
Deplaned	1,119,729	786,439	333,290	42.38	1,119,729	786,439	42.38
TOTAL	1,998,168	1,284,863	713,305	55.52	1,998,168	1,284,863	55.52
MAIL:							
Enplaned	278,677	233,493	45,184	19.35	278,677	233,493	19.35
Deplaned	262,406	87,975	174,431	198.27	262,406	87,975	198.27
TOTAL	541,083	321,468	219,615	68.32	541,083	321,468	68.32

**METROPOLITAN KNOXVILLE AIRPORT AUTHORITY
AVIATION ACTIVITIES STATISTICS
MONTH OF FEBRUARY 1988**

OPERATIONS:	1988	1987	# Inc. (Dec.)	% Inc. (Dec.)	YEAR-TO-DATE		% Inc (Dec.)
					1988	1987	
Air Carrier	2,121	1,694	427	25.21	4,382	3,459	26.68
Air Taxi	2,033	1,909	124	6.50	4,102	4,008	2.35
General Aviation	6,650	5,284	1,366	25.85	12,294	10,654	15.39
Military	2,060	1,623	437	26.93	3,719	3,279	13.42
TOTAL	12,864	10,510	2,354	22.40	24,497	21,400	14.47
PASSENGERS:							
Enplaned	42,541	42,753	-212	-0.50	83,943	81,739	2.70
Deplaned	42,082	41,861	221	0.53	81,498	80,165	1.66
TOTAL	84,623	84,614	9	0.01	165,441	161,904	2.18
FREIGHT:							
Enplaned	952,292	570,459	381,833	66.93	1,830,731	1,068,883	71.28
Deplaned	1,286,592	743,052	543,540	73.15	2,406,321	1,529,491	57.33
TOTAL	2,238,884	1,313,511	925,373	70.45	4,237,052	2,598,374	63.07
MAIL:							
Enplaned	272,640	228,342	44,298	19.40	551,317	461,835	19.38
Deplaned	261,590	70,613	190,977	270.46	523,996	158,588	230.41
TOTAL	534,230	298,955	235,275	78.70	1,075,313	620,423	73.32

**METROPOLITAN KNOXVILLE AIRPORT AUTHORITY
AVIATION ACTIVITIES STATISTICS
MONTH OF MARCH 1988**

OPERATIONS:	1988	1987	# Inc. (Dec.)	% Inc. (Dec.)	YEAR-TO-DATE		% Inc. (Dec.)
					1988	1987	
Air Carrier	2,346	1,777	569	32.02	6,728	5,236	28.50
Air Taxi	2,325	2,257	68	3.01	6,427	6,265	2.59
General Aviation	7,160	8,352	-1,192	-14.27	19,454	19,495	-0.21
Military	1,986	2,306	-320	-13.88	5,705	5,585	2.15
TOTAL	13,817	14,692	-875	-5.96	38,314	36,581	4.74
PASSENGERS:							
Enplaned	50,904	54,291	-3,387	-6.24	134,847	136,030	-0.87
Deplaned	49,975	53,875	-3,900	-7.24	131,473	134,040	-1.92
TOTAL	100,879	108,166	-7,287	-6.74	266,320	270,070	-1.39
FREIGHT:							
Enplaned	1,071,034	572,761	498,273	86.99	2,901,765	1,641,644	76.76
Deplaned	1,414,550	817,869	596,681	72.96	3,820,871	2,347,360	62.77
TOTAL	2,485,584	1,390,630	1,094,954	78.74	6,722,636	3,989,004	68.53
MAIL:							
Enplaned	291,951	231,450	60,501	26.14	843,268	693,285	21.63
Deplaned	274,458	76,750	197,708	257.60	798,454	235,338	239.28
TOTAL	566,409	308,200	258,209	83.78	1,641,722	928,623	76.79

METROPOLITAN KNOXVILLE AIRPORT AUTHORITY
AVIATION ACTIVITIES STATISTICS
MONTH OF APRIL 1988

OPERATIONS:	1988	1987	# Inc. (Dec.)	% Inc. (Dec.)	YEAR-TO-DATE		% Inc. (Dec.)
					1988	1987	
Air Carrier	2,259	1,692	567	33.51	8,987	6,928	29.72
Air Taxi	2,189	2,356	-167	-7.09	8,616	8,621	-0.06
General Aviation	8,047	7,680	367	4.78	27,501	27,175	1.20
Military	1,868	1,696	172	10.14	7,573	7,281	4.01
TOTAL	14,363	13,424	939	6.99	52,677	50,005	5.34
PASSENGERS:							
Enplaned	49,281	56,277	-6,996	-12.43	184,128	192,307	-4.25
Deplaned	49,707	55,006	-5,299	-9.63	181,180	189,046	-4.16
TOTAL	98,988	111,283	-12,295	-11.05	365,308	381,353	-4.21
FREIGHT:							
Enplaned	1,251,975	517,246	734,729	142.05	4,153,740	2,158,890	92.40
Deplaned	1,520,875	781,919	738,956	94.51	5,341,746	3,129,279	70.70
TOTAL	2,772,850	1,299,165	1,473,685	113.43	9,495,486	5,288,169	79.56
MAIL:							
Enplaned	252,117	232,749	19,368	8.32	1,095,385	926,034	18.29
Deplaned	275,054	73,441	201,613	274.52	1,073,508	308,779	247.66
TOTAL	527,171	306,190	220,981	72.17	2,168,893	1,234,813	75.65

**METROPOLITAN KNOXVILLE AIRPORT AUTHORITY
AVIATION ACTIVITIES STATISTICS
MONTH OF MAY 1988**

OPERATIONS:	1988	1987	# Inc. (Dec.)	% Inc. (Dec.)	YEAR-TO-DATE		%Inc. (Dec.)
					1988	1987	
Air Carrier	2,169	1,773	396	22.34	11,156	8,701	28.22
Air Taxi	2,397	2,521	-124	-4.92	11,013	11,142	-1.16
General Aviation	8,126	8,167	-41	-0.50	35,627	35,342	0.81
Military	1,776	2,169	-393	-18.12	9,349	9,450	-1.07
TOTAL	14,468	14,630	-162	-1.11	67,145	64,635	3.88
PASSENGERS:							
Enplaned	53,330	56,339	-3,009	-5.34	237,458	248,646	-4.50
Deplaned	52,576	55,563	-2,987	-5.38	233,756	244,609	-4.44
TOTAL	105,906	111,902	-5,996	-5.36	471,214	493,255	-4.47
FREIGHT:							
Enplaned	1,128,370	678,560	449,810	66.29	5,290,388	2,837,450	86.45
Deplaned	1,374,798	997,601	377,197	37.81	6,720,408	4,126,880	62.84
TOTAL	2,503,168	1,676,161	827,007	49.34	12,010,796	6,964,330	72.46
MAIL:							
Enplaned	237,176	233,784	3,392	1.45	1,332,561	1,159,818	14.89
Deplaned	267,635	71,915	195,720	272.15	1,341,143	380,694	252.29
TOTAL	504,811	305,699	199,112	65.13	2,673,704	1,540,512	73.56

APPENDIX G

**Returned Standard Forms and Other Responses
from Airport/Heliport Owners, Managers, and Fixed Base Operators
and City and County Government Offices**



**Qualified Individuals Contacted to Update Estimates of Local Air Traffic
September 1992**

Airport/Heliport	Contact	Estimate
<i>Private Heliports</i>		
Athens Community Hospital	Darryl Carden Hospital Engineer	52
UT Lifestar	Walter Idle Paramedic	1,000
Vertiflite	Bob Bailey	2,600
Med Flight V	Linda Doughty	500
Oak Ridge Methodist Medical Center	Joe Deal	30
<i>Commercial Airports</i>		
Campbell County	Bert Loupe Campbell County Aviation	3,000
McGhee Tyson	Carol Graves Airport Authority	146,429
McMinn County Airport	Nancy Daily	18,250
Monroe County	Diana Parks Parks Aeromotive Service	50,000
Rockwood Municipal	Bill Dietz	3,000
<i>Private Airports</i>		
Atomic Airport	Boyd King	1,000
Cox Farm	David Cox	100
Downtown Island Airport	Bill Marrison Airport Authority	73,000
Ferguson Flying Circus	David Ferguson	No response
Will Hildreath	Will Hildreath First National Bank	760
Little Creek	Leonard Smith Little Creek Academy	30
Meadow Lake Airpark	Ken Splawn	720
Montvale Airpark	Jack Small	600
Powell	Norman Mayes	N/A
Riner Farms	Gary Riner	200
Sky Ranch	Gary Hagan East TN Pilots Club	3,650
Taylor Airfield	Jimmy Taylor	25
<i>Closed Private Airports</i>		
Bishop Residence Landing Strip	Frank Sewell Planning and Zoning Anderson County	0
East Tennessee Ultra Light Airpark	Ken Veach City Administrator City of Oliver Springs	0
Phillips & Jordan, Inc.	Bonnie Adams	0
Higdon Airfield	Bert Loupe Campbell County Aviation	0
Wilkerson Airfield	Lenoir City Chamber of Commerce	0



HEADQUARTERS
134TH AIR REFUELING GROUP
MCGHEE TYSON ANG BASE TN

134ARG/DOTO
102 Briscoe Drive
McGhee Tyson ANGB, TN 37777-6203

26 October 1992

Oak Ridge National Laboratory
Attn: Laura Luttrell
P.O. Box 2008
Bldg 1000/MS-6333
Oak Ridge, TN 37931-6333

Dear Laura

Regarding our discussion of military overflight of the Oak Ridge complex, we determined this occurs primarily during usage of Air Refueling Anchor 633. Our records indicate for the 12-month period, 1 Oct 91 to 30 Sep 92, the 134ARG flew 243 missions in area 633. These 243 aircraft of ours refueled 465 other military unit's aircraft for a total of 708 aircraft using the area associated with 134ARG missions.

The 134ARG is the scheduling agency for all military users of 633 refueling area. The above data is only for missions in which the 134ARG was a participant. I cannot provide real data for missions flown that did not include a 134ARG aircraft as we do not archive this information. However, in reviewing the record for the past 30 days, it appears there were 34 military aircraft using area 633 not associated with 134ARG missions.

I hope this information will prove helpful in completing your aircraft crash study report.

Sincerely

KENNETH C. FOSTER, Lt Col, TN ANG
Current Operations Officer

MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

October 14, 1992

RECEIVED
ENGINEERING
DATE 10/16/92 TIME _____

Mr. Joe Deal
Methodist Medical Center
Box 529
Oak Ridge, Tennessee 37830

Methodist Medical Center Helicopter Field

Dear Mr. Deal:

I wish to take this opportunity to thank you for your cooperation in helping Martin Marietta Energy Systems, Inc., update a study that evaluates the annual probability of an aircraft crash on the U.S. Department of Energy Reservation in Oak Ridge, Tennessee. Such information is required by the Department of Energy in our safety analysis reports.

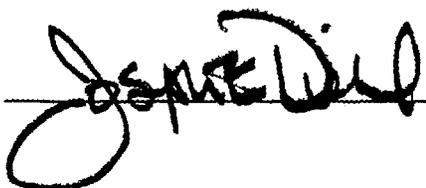
However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of September 17, 1992. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line, and sign and date this letter.

It should be pointed out that signing and dating this letter in no way makes you responsible for the analysis or conclusions contained in our analysis report. As I pointed out in our telephone conversation, it is only your best estimate that I seek, since no Federal Aviation Administration rule or regulation requires owners, managers, and/or Fixed Base Operators to keep written records.

Estimated number of Flight Operations in a year 30

Corrected number of Flight Operations in a year 30

Signature



Date

10/16/92

ARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 23, 1992

Mr. Boyd King
P. O. Box 351
Oliver Springs, Tennessee 37840

Dear Mr. King:

Atomic Airport

Martin Marietta Energy Systems, Inc., is in the process of updating a study performed in 1988 that evaluated the annual probability of an aircraft crash on the U.S. Department of Energy Reservation in Oak Ridge, Tennessee. Such information is required by the Department of Energy in our safety analysis reports.

In the 1988 study, you provided an estimate of the number of flight operations originating from the Atomic Airport, located in Oliver Springs, Tennessee. To revise our aircraft crash study we need an updated estimate of yearly flight operations for the August 1991, to August 1992, time frame. If you would, please write in your best estimate of the number of flight operations and sign and date this letter or contact me by phone with this information. I apologize for not discussing this request with you in person, but I have been unable to reach you over the telephone.

It should be pointed out that signing and dating this letter in no way makes you responsible for the analysis or conclusions contained in our analysis report. As before, it is only your best estimate that we seek, since no Federal Aviation Administration rule or regulation requires owners, managers, and/or Fixed Base Operators to keep written records.

Estimated number of Flight Operations in a year (1988) 1,200.

Updated number of Flight Operations in a year (1992) 1,000.

Signature Boyd King Date 11-2-92

If you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-7538. Once again, thank you for your time and friendly cooperation.

Sincerely,

Laura Luttrell

Laura J. Luttrell

LJL:phs

MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

November 10, 1992

Mr. Darryl Carden
Athens Community Hospital
P.O. Box 250
Athens, Tennessee 37303

Athens Community Hospital

Dear Mr. Carden:

I wish to take this opportunity to thank you for your cooperation in helping Martin Marietta Energy Systems, Inc., update a study that evaluates the annual probability of an aircraft crash on the U.S. Department of Energy Reservation in Oak Ridge, Tennessee. Such information is required by the Department of Energy in our safety analysis reports.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of October 29, 1992. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line, and sign and date this letter.

It should be pointed out that signing and dating this letter in no way makes you responsible for the analysis or conclusions contained in our analysis report. As I pointed out in our telephone conversation, it is only your best estimate that I seek, since no Federal Aviation Administration rule or regulation requires owners, managers, and/or Fixed Base Operators to keep written records.

Estimated number of Flight Operations in a year 52.

Corrected number of Flight Operations in a year _____.

Signature Douglas Pauli Date 11-13-92

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-7538. Once again, thank you for your time and friendly cooperation.

Sincerely,

Laura J. Luttrell
Laura J. Luttrell

LJL:phs

Enc.

MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

October 14, 1992

Mr. Ken Splawn
Meadow Lake Airpark
P.O. Box 566
Kingston, Tennessee 37763

Meadow Lake Airpark

Dear Mr. Splawn:

I wish to take this opportunity to thank you for your cooperation in helping Martin Marietta Energy Systems, Inc., update a study that evaluates the annual probability of an aircraft crash on the U.S. Department of Energy Reservation in Oak Ridge, Tennessee. Such information is required by the Department of Energy in our safety analysis reports.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of October 13, 1992. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line, and sign and date this letter.

It should be pointed out that signing and dating this letter in no way makes you responsible for the analysis or conclusions contained in our analysis report. As I pointed out in our telephone conversation, it is only your best estimate that I seek, since no Federal Aviation Administration rule or regulation requires owners, managers, and/or Fixed Base Operators to keep written records.

Estimated number of Flight Operations in a year 720.

Corrected number of Flight Operations in a year _____.

Signature Ken Splawn Date 19 OCT 92



HEADQUARTERS
134TH AIR REFUELING GROUP
TENNESSEE AIR NATIONAL GUARD
MCGHEE TYSON AIRPORT
KNOXVILLE, TENNESSEE 37950-5000

10 August 1989

Oak Ridge National Laboratory
Attn: Mr. Bob Seigler
P.O. Box 2008
Bldg 1000/MS-6333
Oak Ridge, TN 37931-6333

Dear Bob,

Regarding our discussion of military overflight of the Oak Ridge complex; we determined this occurs primarily during usage of Air Refueling Anchor 633. Our records indicate for the period April thru July 89 a total of 60 refueling missions were flown in area 633.

As the 134AREFG is the scheduling agency for using Air Refueling Anchor 633, this figure includes all missions scheduled into area 633. Each of these missions would typically have included either a KC-135 or KC-10 (jet tanker aircraft) joining to air refuel receiver flights consisting of one to four aircraft.

I most sincerely hope our discussion and this information will prove helpful in completing your aircraft crash study report.

Respectfully Yours,

KENNETH C. FOSTER, Lt Col, TN ANG
Current Operations Officer

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

SEP 23 12:44

September 6, 1988

Mr. Boyd King
P. O. Box 351
Oliver Springs, Tennessee 37840

Dear Mr. King:

Atomic Airport

I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of July 7, 1988. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line and sign and date this letter.

It should be pointed out that signing and dating this letter in no way makes you responsible for the analysis or conclusions contained in our analysis report. As I pointed out in our telephone conversation, it is only your best estimate that I seek, since no Federal Aviation Administration rule or regulation requires owners, managers, and/or Fixed Based Operators to keep written records.

Estimated Number of Flight Operations in a year 1,200 .

Corrected Number of Flight Operations in a year Est 1200 .

Signature Boyd King Secretary Date 9-20-88

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,

Robert S. Seigler
Robert S. Seigler

RSS/pkh

Enclosure

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 6, 1988

Mr. Leon Waters, Director
Planning and Zoning for
Anderson County
100 N. Main Street
Clinton, Tennessee 37716

Dear Mr. Waters:

Bishop Residence

I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of July 22, 1988. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line and sign and date this letter.

It should be pointed out that signing and dating this letter in no way makes you responsible for the analysis or conclusions contained in our analysis report. As I pointed out in our telephone conversation, it is only your best estimate that I seek, since no Federal Aviation Administration rule or regulation requires owners, managers, and/or Fixed Based Operators to keep written records.

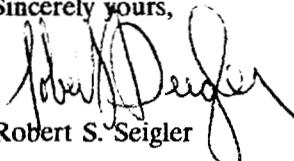
Estimated Number of Flight Operations in a year 0 (Zero) .

Corrected Number of Flight Operations in a year _____ .

Signature Leon Waters Date 9-9-88

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,


Robert S. Seigler

RSS/pkh

Enclosure

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 6, 1988

Mr. Bert Loupe
Campbell County Aviation
P. O. Box 194
Jacksboro, Tennessee 37757

Dear Mr. Loupe:

Campbell County Airport

I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of July 8, 1988. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line and sign and date this letter.

It should be pointed out that signing and dating this letter in no way makes you responsible for the analysis or conclusions contained in our analysis report. As I pointed out in our telephone conversation, it is only your best estimate that I seek, since no Federal Aviation Administration rule or regulation requires owners, managers, and/or Fixed Based Operators to keep written records.

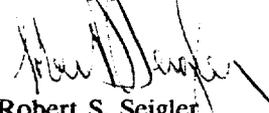
Estimated Number of Flight Operations in a year 5,000 .

Corrected Number of Flight Operations in a year _____ .

Signature Ellert H. Loupe Date 9-8-88

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,


Robert S. Seigler

RSS/pkh

Enclosure

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 6, 1988

Mr. David Cox
P. O. Box 11665
Knoxville, Tennessee 37930

Dear Mr. Cox:

Cox Farm Airfield

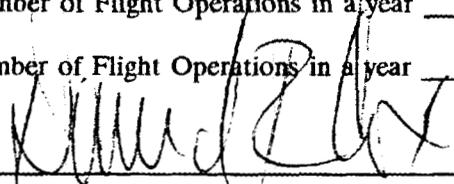
I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of July 18, 1988. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line and sign and date this letter.

It should be pointed out that signing and dating this letter in no way makes you responsible for the analysis or conclusions contained in our analysis report. As I pointed out in our telephone conversation, it is only your best estimate that I seek, since no Federal Aviation Administration rule or regulation requires owners, managers, and/or Fixed Based Operators to keep written records.

Estimated Number of Flight Operations in a year 100 .

Corrected Number of Flight Operations in a year _____ .

Signature  Date 9-12-88

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,


Robert S. Seigler

RSS/pkh

Enclosure

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 6, 1988

Mr. Barry Robinson
Steven's Aviation
Box 2664
Knoxville, Tennessee 37901

Dear Mr. Robinson:

Downtown Island Airport

I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of July 8, 1988. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line and sign and date this letter.

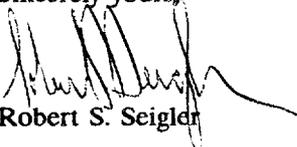
It should be pointed out that signing and dating this letter in no way makes you responsible for the analysis or conclusions contained in our analysis report. As I pointed out in our telephone conversation, it is only your best estimate that I seek, since no Federal Aviation Administration rule or regulation requires owners, managers, and/or Fixed Based Operators to keep written records.

Estimated Number of Flight Operations in a year 73,000

Corrected Number of Flight Operations in a year *CORRECT 175 5/10/88*

Signature *B. Robinson* Date *9/15/88*

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,

Robert S. Seigler

RSS/pkh

Enclosure

Stanley E. Justice, Jr.
Mayor

Joseph Van Hook
Judge/Recorder

Virginia Crisp
Treasurer

The Town of Oliver Springs

P.O. Box 303
Oliver Springs, Tennessee 37840
(615) 435-7722

August 29, 1988

ALDERMEN

Chuck Alcorn
J.C. Davis
Sam Davis
Ed Kelley
Cebert Mitchell
Ralph Wilson

Mr. Robert Seigler
Oak Ridge National Laboratory
Bldg. #1000, Mail Stop #6333
P. O. Box 2008
Oak Ridge, TN 37831-6333

In Re: EAST TENNESSEE ULTRA FLIGHT AIR PARK

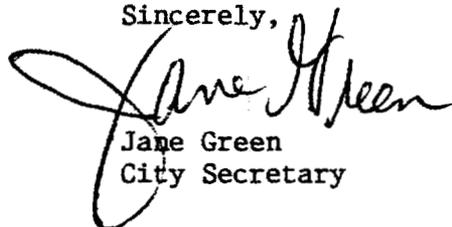
Dear Mr. Seigler:

Per our telephone conversation this morning, and due to the absence of Mr. Elliott, the Town Administrator I am forwarding this letter to you with the following information,

The above reference Air Park is closed and has zero flights.

I hope this is helpful information and sorry for any inconvenience the inquiry has caused you.

Sincerely,



Jane Green
City Secretary

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 12, 1988

Mr. David Ferguson
Route 1, Airport
Loudon, Tennessee 37774

Dear Mr. Ferguson:

Ferguson's Flying Circus Airfield

I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of July 8, 1988. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line and sign and date this letter.

It should be pointed out that signing and dating this letter in no way makes you responsible for the analysis or conclusions contained in our analysis report. As I pointed out in our telephone conversation, it is only your best estimate that I seek, since no Federal Aviation Administration rule or regulation requires owners, managers, and/or Fixed Based Operators to keep written records.

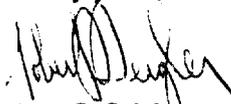
Estimated Number of Flight Operations in a year 30 .

Corrected Number of Flight Operations in a year 30 .

Signature David Ferguson Date 9-20-88

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,


Robert S. Seigler

RSS/pkh

Enclosure

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 6, 1988

Mr. Bert Loupe
Campbell County Aviation
P. O. Box 194
Jacksboro, Tennessee 37757

Dear Mr. Loupe:

Higdon Airfield

I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of July 28, 1988. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line and sign and date this letter.

It should be pointed out that signing and dating this letter in no way makes you responsible for the analysis or conclusions contained in our analysis report. As I pointed out in our telephone conversation, it is only your best estimate that I seek, since no Federal Aviation Administration rule or regulation requires owners, managers, and/or Fixed Based Operators to keep written records.

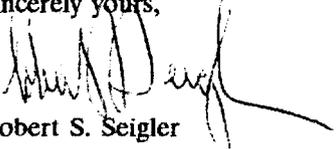
Estimated Number of Flight Operations in a year 0 (Zero) .

Corrected Number of Flight Operations in a year _____ .

Signature Elliot H. Loupe Date 9-8-88

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,


Robert S. Seigler

RSS/pkh

Enclosure

OAK RIDGE NATIONAL LABORATORY
OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 6, 1988

Mr. William Hildreath
P. O. Box 63
Lenoir City, Tennessee 37771

Dear Mr. Hildreath:

Hildreath Airport

I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of July 18, 1988. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line and sign and date this letter.

It should be pointed out that signing and dating this letter in no way makes you responsible for the analysis or conclusions contained in our analysis report. As I pointed out in our telephone conversation, it is only your best estimate that I seek, since no Federal Aviation Administration rule or regulation requires owners, managers, and/or Fixed Based Operators to keep written records.

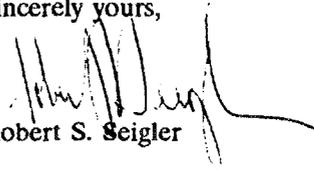
Estimated Number of Flight Operations in a year 720 .

Corrected Number of Flight Operations in a year _____ .

Signature William Hildreath Date 9-8-88

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,


Robert S. Seigler

RSS/pkh

Enclosure

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 6, 1988

Dr. Robert Lash, Director
University of Tennessee Lifestar Helicopter
1916 Alcoa Highway
Knoxville, Tennessee 37920

Dear Dr. Lash:

Lifestar Helicopter

I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of August 11, 1988. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line and sign and date this letter.

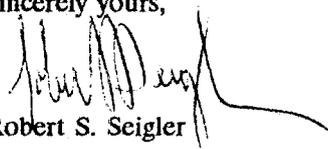
It should be pointed out that signing and dating this letter in no way makes you responsible for the analysis or conclusions contained in our analysis report. As I pointed out in our telephone conversation, it is only your best estimate that I seek, since no Federal Aviation Administration rule or regulation requires owners, managers, and/or Fixed Based Operators to keep written records.

Estimated Number of Flight Operations in a year 1,500 .

Corrected Number of Flight Operations in a year _____ .

Signature Robert Lash Date 9.6.88

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,

Robert S. Seigler

RSS/pkh
Enclosure

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 6, 1988

Mr. Kenneth Straw
c/o Rogene Goodge
1810 Little Creek Lane
Knoxville, Tennessee 37922

Dear Mr. Straw:

Little Creek

I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of July 8, 1988. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line and sign and date this letter.

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Estimated Number of Flight Operations in a year ~~120~~ .

X Corrected Number of Flight Operations in a year 150 .

Signature *Kenneth Straw* Date 12 Sept 1988

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,

Robert S. Seigler
Robert S. Seigler

RSS/pkh

Enclosure

* NOTE: Last year, aircraft were used 147 times. Some of these were flight training with take-off + landings being the primary lesson activity. If you want each take off + landing to be a flight operation, the number of operations would be larger.

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 6, 1988

Mr. Dan Hicks, III
Public Relations Personnel Director
Med Flight 5
P. O. Box 524
Knoxville, Tennessee 37901

Dear Mr. Hicks:

Med Flight 5 Helicopter

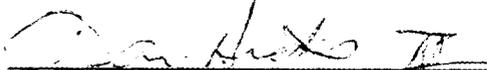
I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

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Estimated Number of Flight Operations in a year 1,500 .

Corrected Number of Flight Operations in a year _____ .

Signature  Date 9-13-88

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,


Robert S. Seigler

RSS/pkh

Enclosure

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 6, 1988

Mr. Marshall Whisnant, President
Methodist Medical Center of Oak Ridge
Box 529
Oak Ridge, Tennessee 37830-0529

Dear Mr. Whisnant:

Methodist Medical Center Helicopter Field

I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of August 11, 1988. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line and sign and date this letter.

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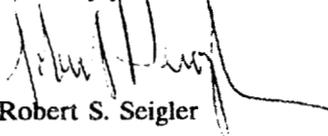
Estimated Number of Flight Operations in a year 12 :

Corrected Number of Flight Operations in a year 412 .

Signature Marshall Whisnant Date Sept. 9, 1988

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,


Robert S. Seigler

RSS/pkh

Enclosure

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 6, 1988

Mrs. Diana Parks
Parks Aeromotive Service
P. O. Box 394
Madisonville, Tennessee 37354

Dear Mrs. Parks:

Monroe County Airport

I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of July 7, 1988. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line and sign and date this letter.

It should be pointed out that signing and dating this letter in no way makes you responsible for the analysis or conclusions contained in our analysis report. As I pointed out in our telephone conversation, it is only your best estimate that I seek, since no Federal Aviation Administration rule or regulation requires owners, managers, and/or Fixed Based Operators to keep written records.

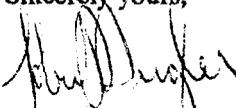
Estimated Number of Flight Operations in a year ~~30,000~~ .

Corrected Number of Flight Operations in a year 20,000 .

Signature  Date 

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,


Robert S. Seigler

RSS/pkh

Enclosure

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 6, 1988

Mr. Jack Small
1751 N. Ramsay Street
Alcoa, Tennessee 37701

Dear Mr. Small:

Montvale Airpark

I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of July 18, 1988. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line and sign and date this letter.

It should be pointed out that signing and dating this letter in no way makes you responsible for the analysis or conclusions contained in our analysis report. As I pointed out in our telephone conversation, it is only your best estimate that I seek, since no Federal Aviation Administration rule or regulation requires owners, managers, and/or Fixed Based Operators to keep written records.

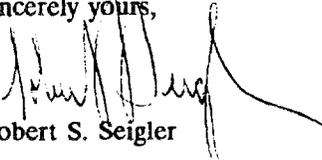
Estimated Number of Flight Operations in a year 1,250 .

Corrected Number of Flight Operations in a year 600 .

Signature Jack Small Date 9-8-88

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,


Robert S. Seigler

RSS/pkh

Enclosure

MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

November 10, 1992

Ms. Bonnie Adams
Phillips and Jordon, Inc.
6621 Wilbanks Road
Knoxville, Tennessee 37912

Phillips and Jordon, Inc.

Dear Ms. Adams:

I wish to take this opportunity to thank you for your cooperation in helping Martin Marietta Energy Systems, Inc., update a study that evaluates the annual probability of an aircraft crash on the U.S. Department of Energy Reservation in Oak Ridge, Tennessee. Such information is required by the Department of Energy in our safety analysis reports.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of October 29, 1992. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line, and sign and date this letter.

It should be pointed out that signing and dating this letter in no way makes you responsible for the analysis or conclusions contained in our analysis report. As I pointed out in our telephone conversation, it is only your best estimate that I seek, since no Federal Aviation Administration rule or regulation requires owners, managers, and/or Fixed Base Operators to keep written records.

Estimated number of Flight Operations in a year 0.

Corrected number of Flight Operations in a year _____.

Signature Bonnie Adams Date 11/19/92

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-7538. Once again, thank you for your time and friendly cooperation.

Sincerely,

Laura J. Luttrell
Laura J. Luttrell

LJL:phs

Enc.

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 6, 1988

Mr. Gary Riner
Route 1, Box 173-B
Clinton, Tennessee 37716

Dear Mr. Riner:

Riner Farms Airfield

I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

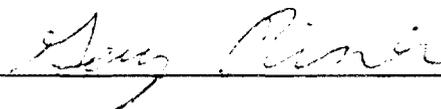
However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of July 19, 1988. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line and sign and date this letter.

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Estimated Number of Flight Operations in a year 100 .

Corrected Number of Flight Operations in a year _____ .

Signature

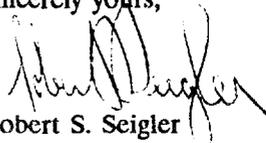


Date

9-9-88

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,



Robert S. Seigler

RSS/pkh

Enclosure

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 6, 1988

Mr. Bill Dietz
Rockwood Municipal Airport
P. O. Box 4
Rockwood, Tennessee 37854

Dear Mr. Dietz:

Rockwood Municipal Airport

I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of July 8, 1988. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line and sign and date this letter.

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Estimated Number of Flight Operations in a year 3,000 .

Corrected Number of Flight Operations in a year _____ .

Signature William J. Dietz Date 9-27-88

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,


Robert S. Seigler

RSS/pkh

Enclosure

Internal Correspondence

MARTIN MARIETTA ENERGY SYSTEMS, INC.

February 21, 1989

Mr. Gary F. Hagan, Official Representative
Board of Directors
East Tennessee Pilots Club
P. O. Box 1501
Maryville, TN 37802

Dear Mr. Hagan:

I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone previous conversation. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line and sign and date this letter.

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Estimated Number of Flight Operations in a year 4123 .

Corrected Number of Flight Operations in a year _____ .

Signature Gary F. Hagan Date Feb 23, 1989 .

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Robert S. Seigler, 1000, MS-6333, ORNL (4-5880)

RSS/pkh

Enclosure

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 6, 1988

Mr. Jimmy Taylor
8205 Shelton Road
Corryton, Tennessee 37721

Dear Mr. Taylor:

Taylor Airfield

I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

However, in keeping with Department of Energy official policy, it is necessary for me to have documented confirmation of the estimated number of flight operations quoted in our telephone conversation of July 19, 1988. If the estimated number is correct, please sign and date this letter on the appropriate line. If the number is incorrect, please cross out the incorrect number, write in the correct number on the succeeding line and sign and date this letter.

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Estimated Number of Flight Operations in a year 90 .

Corrected Number of Flight Operations in a year _____ .

Signature Jimmy R. Taylor Date 9/9/88

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,


Robert S. Seigler

RSS/pkh

Enclosure

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 6, 1988

Mr. Robert Bailey
Vertiflite Helicopters
Route 2, Box 91
Maryville, Tennessee 37801

Dear Mr. Bailey:

Vertiflite Helicopters

I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

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Estimated Number of Flight Operations in a year 3,400 .

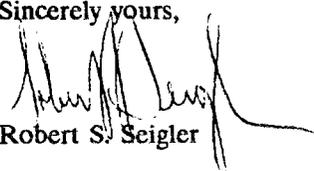
Corrected Number of Flight Operations in a year _____ .

Signature _____

Date 9-13-88

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,


Robert S. Seigler

RSS/pkh

Enclosure

OAK RIDGE NATIONAL LABORATORY

OPERATED BY MARTIN MARIETTA ENERGY SYSTEMS, INC.

POST OFFICE BOX 2008
OAK RIDGE, TENNESSEE 37831

September 6, 1988

Mr. and Mrs. Arthur Wilkerson
Route 3, Box 289
Lenoir City, Tennessee 37771

Dear Mr. and Mrs. Wilkerson:

Wilkerson Airfield

I wish to take this opportunity to thank you for your professional attitude and cooperation in helping me to prepare my "Aircraft Crash Analysis Report" for the various Department of Energy facilities operated by Martin Marietta Energy Systems, Inc. and located in Oak Ridge, Tennessee. This report could not have been attempted nor completed were it not for your active and highly professional participation.

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Estimated Number of Flight Operations in a year 0 (Zero) .

Corrected Number of Flight Operations in a year _____ .

Signature Mrs. Arthur Wilkerson Date 9-9-88

Enclosed is a self addressed stamped envelope for your convenience. Also, if you have any questions, please do not under any circumstances hesitate to call me (collect) at (615) 574-5880. Once again, thank you for your time and friendly cooperation.

Sincerely yours,


Robert S. Seigler

RSS/pkh

Enclosure

APPENDIX H

Air Carriers — the commercial system of air transportation consisting of the certificated route air carriers, air taxis (including commuters), supplemental air carriers, commercial operators of large aircraft, and air travel clubs.

Airport — an area of land or water that is used or intended to be used for the landing and takeoff of aircraft, including any buildings and facilities.

Airport Traffic Control Tower (ATCT) — a central operations facility in the terminal air traffic control system, which consists of a tower cab structure, including an associated IFR room if radar equipped, and uses air/ground communications, radar, visual signaling, and other devices to provide safe and expeditious movement of terminal air traffic.

Air Route Traffic Control Center (ARTCC) — a facility established to provide air traffic control service to aircraft operating on IFR flight plans within controlled airspace, principally during the en route phase of flight.

Controlled Airspace — airspace control area designated as a continental control area, control zone, terminal control area, or transition area, within which some or all aircraft may be subject to air traffic control.

Effective Plant Area (A_T) — the equivalent ground surface area such that a crash probability computed on the basis of (A_T) accounts for all crashes that could affect susceptible targets (structures) at the plant site for each parameter grouping.

Flight Service Station (FSS) — Air Traffic Service facilities within the National Airspace System (NAS) which provide preflight pilot briefings and en route communications with VFR flights; assist lost IFR/VFR aircraft; assist aircraft having emergencies; relay Air Traffic Control clearances; originate, classify, and disseminate notices to airmen; broadcast aviation weather and NAS information; receive the close flight plans; monitor radio NAVAIDS; notify search and rescue units of missing VFR aircraft; and operate the national weather teletypewriter system. In addition, at selected locations, FSSs monitor the weather, issue airport advisories, administer written examinations to airmen, and advise Customs and Immigration of across-the-border flights.

Footprint — a plan view area or ground surface area utilized by a building or structure. Typically the actual length of a building or structure multiplied by its actual width.

Instrument Flight Rules (IFR) — rules governing the procedures for conducting instrument flight. Also a term used by pilots and controllers to indicate type of flight plan.

Jet Route — a route designed to serve aircraft operations from 18,000 ft to 45,000 ft.

Shadow Area (A_S) — that area that is dependent upon the height of the target (structure) and the angle of the crash.

Skid Area (A_M) — that area that varies proportionally with the square of the initial horizontal velocity of the aircraft and inversely with friction dependent upon the terrain.

True Target Area (A_B) — the actual footprint area of the structure.

VFR Flight — flight conducted in accordance with Visual Flight Rules.

VORTAC — a navigation aid providing azimuth and distance measuring equipment at one site.

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