MAY 0 1 2000

L-2000-089

FPL

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

Re: Turkey Point Units 3 and 4
Docket Nos. 50-250 and 50-251
Response to Request for Information Regarding the Potential Risk of the Proposed Civil and Government Aircraft Operations at Homestead Air Force Base on the Turkey Point Plant (TAC NOS. MA6249 and MA6250)

By letters L-98-152 dated June 15, 1998, and L-99-251 dated November 17, 1999, Florida Power and Light Company (FPL) provided the NRC an assessment of the impact on the overall risk to Turkey Point from an aircraft accident as a result of the proposed civil and government aircraft operations at Homestead Air Force Base.

The NRC staff reviewed FPL's submittal and determined that additional information is needed to complete its review. By letter dated March 8, 2000, the NRC issued the request for additional information. The attachment to this letter provides the information requested.

Should there be any questions on this submittal, please contact us.

Very truly yours,

R. J. Hovey
Vice President
Turkey Point Plant

OIH

Attachment

cc: Regional Administrator, Region II, USNRC
Senior Resident Inspector, USNRC, Turkey Point Plant
Florida Department of Health

A001

Response to Request for Additional Information

Question 1

The attachment to the FPL June 15,1998 letter response (L-98-152) on aircraft hazards presents the equation

f = N * P * A * F

as part of the Department of Energy methodology for assessing the risk of aircraft crashes to nuclear power plants. The definition of P is given as "in flight crash rate **per mile** ...". In addition, F is defined as "crash probability density over area A", without any mention of units. If F is dimensionless, then the units of f work-out to be

(Flight operation/year)*(crashes/mile)*(sq. miles)*(probability density).

This has the units of

Flight operations-crashes-miles/year

which is incompatible with the quantity f, whose units are crashes/year.

The same equation is also presented in FPL's attachment to June 24, 1994 letter response (L-94-157) on IPEEE results for aircraft. However, some of the definitions appear to be different. Specifically, on page 27, P is defined as "probability of an aircraft crash **per operation.**" With this definition the units for the equation are

(Flight operations/year)*(crashes/flight operation)*(sq. miles)*(probability density).

This works out to have the units

Crashes-sq. miles/year

which again is inappropriate for a crash frequency. It appears in this case that if the crash probability density had the units of (1/sq. miles) then the overall crash frequency would have the units of crashes/year.

Please provide a clarification of the units that were used in both analyses with respect to the crash probability and the crash probability density.

Response 1

The definitions of the variable names in the equation f = N * P * A * F are given below, supercede the definitions provided by FPL letter L-98-152, dated June 15, 1998, and are consistent with the information provided by FPL letter L-94-157, dated June 24, 1994.

f = estimated annual aircraft crash impact frequency for the facility of interest (no./y)

N = estimated annual number of site-specific aircraft operations (i.e., takeoffs, landings, and in-flights) for each applicable summation parameter (no./y)

P = aircraft crash rate (per takeoff or landing for near-airport phases and per flight for the in-flight (non-airport) phase of operation for each applicable summation parameter (dimensionless)

A = the site-specific effective area for the facility of interest that includes skid and fly-in effective areas (square miles) for each applicable summation parameter, aircraft category or subcategory, and flight phase

F = aircraft crash location conditional probability (per square mile) given a crash evaluated at the facility location for each applicable summation parameter

Question 2

With respect to the aircraft risk analyses performed for Turkey Point Units 3 and 4, please indicate how the presence of the adjacent fossil unit chimneys was taken into account when calculating the effective target area used in estimating the on-site crash frequency. Indicate the relative effect of the chimneys on the total calculated effective target area.

Response 2

The fossil unit chimneys were not factored into the calculation of the effective area in the analysis. The DOE Standard 3014-96, which was used as guidance for the Homestead analysis, contains only the following reference to this effect (see Appendix B, Section B.4, pp. B-29, 30), "In addition, there may exist conditions and physical attributes that could affect the evaluation of the effective target areas. For example, there could be nearby barriers that have sufficient structural integrity to resist impact from the categories (or subcategories) of aircraft under investigation. Examples of barriers are robust structures (e.g., munition storage bunkers and seismically qualified process and storage buildings), extremely rocky terrain, soft soil, dense forests, ravines, and canyons. These special conditions could permit the analyst to reconsider the angle of impact and the skid length for the aircraft of interest. If, for example, the nearby robust structure is tall with respect to the facility, the angle of impact might be considerably larger than the mean value recommended, resulting in a substantially smaller effective target area. The higher angle of impact may result in a reduced or negligible skid length, which could also reduce the effective target area. In addition, if the facility is surrounded by other buildings, the skid distance will not be greater than the largest distance between these buildings and the facility." The Standard Review Plan, in Section 3.5.1.6, III.7 (a), says, when referring to the calculation of the effective plant area, simply, "Artificial berms or any other man-made and natural barriers should be taken into account in calculating this area." While it is recognized that the chimneys could conceivably deflect a crashing aircraft, which would normally miss the nuclear site, causing the aircraft to crash into one of the nuclear site buildings, it is also recognized that the chimneys could serve as a barrier deflecting some crashing aircraft, which, if otherwise unobstructed, would hit the nuclear site, such that they would not hit any of the nuclear buildings. This "barrier function" is implied in both the DOE Standard and the Standard Review Plan reference above.

Question 3

The on-site crash frequency was estimated using parameters that are dependent on aircraft type and flight phase. Specifically, this applies to the parameters N, P, A, and F in the equation

$$f = N * P * A * F .$$

That is, the equation is really of the form

$$f = \sum_i \sum_j N_{ij} P_{ij} A_{ij} F_{ij}$$

where i is the ith type of aircraft and j is the jth flight phase. Please provide a sample of representative values (e.g., for a commercial air carrier and a large military aircraft) that were used in the analyses for each of these parameters. Please indicate the source of the information used to evaluate each parameter.

Response 3

A listing of the data parameters and their sources is given below.

Parameter	Source
Wingspan of Aircraft Class/Subcategory	DOE-STD-3014-96, Appendix B (Table B-16)
Skid Distance	DOE-STD-3014-96, Appendix B (Table B-18)
Length	Plant-specific drawings
Width	Plant-specific drawings
Diameter	Plant-specific drawings
Height of Target	Plant-specific drawings
Cot ø	DOE-STD-3014-96, Appendix B (Table B-17)
Aircraft Crash Rates	DOE-STD-3014-96, Appendix B (Table B-1); Generic crash rates for each aircraft category and subcategory were calculated based on a review of accident reports published by FAA and/or the National Transportation Safety Board (NTSB) for civilian aircraft, and by the United States military for military aircraft. The evaluation techniques used to estimate specific crash rates for each aircraft category or subcategory are documented in "Data Development Technical Support Document for the Aircraft Crash Risk Analysis Methodology (ACRAM) Standard," UCRL-ID-124837, LLNL, 1996.

Parameter	Source
Crash Location Probabilities	DOE-STD-3014-96, Appendix B (Tables B-2 to 15); Crash location probabilities per square mile in the vicinity of a runway were calculated based on a review of accident reports published by FAA and/or NTSB for civilian aircraft, and by the United States Air Force for military aircraft. The data and calculations used to determine the probability values are provided in "Data Development Technical Support Document for the Aircraft Crash Risk Analysis Methodology (ACRAM) Standard," UCRL-ID-124837, LLNL, 1996.

The target building data is given below.

Structure	Length (ft.)	Width (ft.)	Diameter (ft.)	Height (ft.)	Comments
Unit 3 Containment	126	126	126	168	
Unit 4 Containment	126	126	126	168	
Control Building	63	73	N.A.	40	No skid-in area considered because of protection of surrounding buildings.
Unit 3 and 4 Turbine Building	100	447	N.A.	24	
Unit 3 and 4 Auxiliary Building	197	274	N.A.	16	
Unit 3 Spent Fuel Building	66	63	N.A.	66	
Unit 4 Spent Fuel Building	66	63	N.A.	66	No skid-in area considered because of protection of surrounding buildings.
Unit 3 EDG Building	49	43	N.A.	19	
Unit 4 EDG Building	104	56	N.A.	43	
Intake Structure	65	112	N.A.	0	
Unit 2 Smokestack	30	30	30	400	

A sample from the spreadsheet used for the calculations is given below.

Sample of Excel Worksheet for Aircraft Risk Analysis
Unit 3 Containment Building

L (ft.)	W (ft.)	D (ft.)	H (ft.)	R R (ft.)	AC Class	Aircraft Subcategories	Flt. Phase	WS (ft.)	Skid Distance S (ft.)	Cot ø	Shadow Area (ft^2)	Direct Hit Area (ft^2)	Fly-In Area (ft^2)	Skid-In Area (ft^2)	Total Area (ft^2)	Total Area (mi^2)	MUOR AC Total Ops.	Operations by Flt. Phase	Crash Rate by Flt. Phase	Crash Location	Crash Hit Frequency
126	126	126	168	178	A	Air Carriers	TO	100	1440	10.2	476,708	33,695	510,403	400,595	910,998	0.0327	154679	77339.5	2.86E-07	3.39E-06	2.45E-09
126	126	126	168	178	A	Air Carriers	Land	100	1440	10.2	476,708	33,695	510,403	400,595	910,998	0.0327		77339.5	3.65E-07	1.56E-17	1.44E-20
126	126	126	168	178	A	Large Military	TO	223	780	7.4	498,761	55,613	554,373	312,929	867,302	0.0311	1624	812	5.72E-07	4.20E-06	6.07E-11
126	126	126	168	178	A	Large Military	Land	223	368	9.7	653,781	55,613	709,393	147,638	857,032	0.0307		812	1.60E-06	1.00E-03	3.99E-08

Question 4

According to the draft SEIS for the proposed disposal of some of the former Homestead Air Force Base, bird strikes can cause aircraft mishaps. Hence, some portion of the overall crash rate for a given aircraft and flight phase may be attributable to bird strikes. To what extent has the possibility of bird strikes been incorporated in the aircraft risk assessment for Turkey Point Units 3 and 4? If the Turkey Point aircraft risk analyses are based on nationally averaged aircraft crash rates, please indicate how representative are these rates of the projected Homestead air operations with respect to the bird strike contribution?

Response 4

The FPL Turkey Point aircraft risk analyses are indeed based on nationally averaged aircraft crash rates. In order to estimate the effect of bird strikes on the analyses, the following analysis was performed.

The U.S. DOT FAA report, "Wildlife Strikes to Civil Aircraft in the United States 1990-1998" reports 19 accidents involving a wildlife strike where the aircraft sustained enough damage to make it "inadvisable to restore the aircraft to an airworthy condition." Of these 19 accidents, 12 were caused by a deer or a cow, and seven were due to bird strikes. Of the seven bird-strike accidents, five involved small single-engine general-aviation aircraft, which pose little threat to a nuclear plant. Of the two remaining accidents, one involved a helicopter (Bell 128), and the other a medium-sized twin-engine commuter aircraft (C-441 Conquest). The first of these poses little threat to a nuclear plant due to its relatively small size. The second is the only accident which might marginally meet the criteria of posing a threat to a nuclear plant. However, in this accident, the pilot was still able to make a forced landing after he mistakenly shut down the good engine. Note that none of the incidents involved large air carriers.

The DOT FAA 1998 Annual Report "Aviation System Indicators" gives the following accident statistics for the different aircraft classifications for the years 1992-1998. An "aircraft accident" is defined by the National Transportation Safety Board (NTSB) as "an occurrence associated with the operation of an aircraft that takes place between the time any person boards the aircraft with the intention of flight and all such persons have disembarked, and in which any person suffers death or serious injury, or in which the aircraft receives substantial damage."

	Large Air Carrier	Commuter Air Carrier	Air Taxi	General Aviation
Calendar Year	No. of Accidents	No. of Accidents	No. of Accidents	No. of Accidents
1992	18	23	76	2,073
1993	23	16	69	2,039
1994	23	10	85	1,995
1995	36	12	75	2,053
1996	38	11	90	1,907
1997	49	17	82	1,858
1998	48	8	79	1,907
Total	235	97	556	13,832

The total number of accidents for the 1992-1998 period for large air carriers, commuter air carriers, and air taxi operators is 235+97+556 = 888. Adjusting this number to represent a nine-year period in order to compare it to the nine-year statistics in the U.S. DOT FAA report, "Wildlife Strikes to Civil Aircraft in the United States 1990-1998," yields a total of (9/7)(888) = 1,142. If we include the general aviation accidents, the total is 18,926.

Of the bird strike incidents where the aircraft sustained enough damage to make it "inadvisable to restore the aircraft to an airworthy condition," only two were determined to possibly pose any threat to a nuclear plant, and neither of these involved a large air carrier. Dividing this number by the total number of accidents for the 1992-1998 period for large air carriers, commuter air carriers, and air taxi operators adjusted to represent a nine-year period, a rough estimate of the fraction of aircraft accidents caused by bird strikes can be calculated: 2/1,142 = .00175, or 0.175%. If we include the five bird-strike accidents involving small single-engine general-aviation aircraft, which pose little threat to a nuclear plant, to make a total of seven bird-strike accidents, and divide by the total number of accidents for the 1992-1998 period for large air carriers, commuter air carriers, air taxi operators, AND general aviation aircraft adjusted to represent a nine-year period (18,296), a rough estimate of the fraction of aircraft accidents caused by bird strikes (including general aviation aircraft) can be calculated: 7/18,296 = .00038, or 0.038%.

There have been 23 Class A mishaps due to bird strikes involving USAF aircraft for the period 1/85 through 2/98, according to the draft Homestead SEIS. A Class A mishap is a mishap in which there was a fatality or more than $1 million damage to the aircraft. For the years 1985 through 1997 inclusive, there was a total of 546 Class A mishaps due to any cause involving USAF aircraft. This translates to 23/546 = .041, or 4.1% of all Class A mishaps occurring due to bird strikes.

There were a total of 21,257 bird strikes involving civil aircraft in the U.S. during the years 1990-1998. About 10% of these (2,056 to be exact) occurred in Florida. If the bird strikes were evenly distributed by state (regardless of size and population), Florida would be the site of 2% of the bird strikes. Florida has five times this amount. If we take the percentage of civil aircraft accidents caused by bird strikes, 0.175%, and multiply it by five, we get 0.875%, or about 1%. If we take the percentage of military aircraft accidents caused by bird strikes, 4.1%, and multiply it by five, we get 20.5%. Therefore, if we multiply the calculated risk to the nuclear plant from an aircraft strike in the FPL submittal by 20.5%, this should be a bounding estimate of the impact of the increased likelihood of bird strikes in the state of Florida.

Question 5

The draft SEIS (pp. 2.2-9 to 2.2-11), in discussing the projected air traffic for the proposed Homestead airport conversion, indicates that more than 80% of the traffic is estimated to be in connection with flights from Latin America, the Caribbean, or other international locations. The aircraft crash rates presented in NUREG -0800, SRP 3.5.1.6, are based on data for U.S. Carriers, General Aviation, and military aviation. Hence, the data may not be representative of the air traffic mix being projected for the Homestead airport.

For example, in an item presented by the National Center for Policy Analysis,* reference is made to an 80-page report of the Commercial Aviation Safety Strategy Team in which the U.S. accident rate from 1987 to 1996 is described to be on the average of 0.5 major accidents per

*(http://www.ncpa.org/pd/regulat/pdreg/regfeb98e.html)

million departures, compared to 0.7 for Western Europe, 4.8 for Eastern Europe and the old Soviet Union, 5.7 for Latin America and 13 for Africa. This suggests that the accident rate could be significantly affected by the mix of air traffic that is being projected. Indicate if this has been taken into account in the FPL aircraft analyses to-date and if not, to what extent would this affect the previously estimated aircraft risks for Turkey Point Units 3 and 4.

Response 5

The effect of having more than 80% of the traffic estimated to be in connection with flights from Latin America, the Caribbean, or other international locations was not taken into account in the FPL aircraft analyses. A sensitivity analysis was performed where the aircraft crash frequencies for commercial air carriers were increased by a factor of 10 to approximate the effect of having more than 80% of the traffic estimated to be in connection with flights from Latin America, the Caribbean, or other international locations. The calculation was performed for the Maximum Use One Runway (MUOR) case as a representative example. The original 10 CFR 100 exceedance frequency for MUOR was 3.63E-07 per year. The 10 CFR 100 exceedance frequency for MUOR adjusted for higher crash rates for commercial air carriers is 3.82E-07 per year, approximately a 5% increase. The reason for the relatively small increase is the fact that the 10 CFR 100 exceedance frequency for Homestead airport is dominated by military air traffic.

Structure	Original Calculation				Adjusted for Higher Crash Rates			
	MUOR Aircraft Hit Freq.	CCDP	CCFP	MUOR 10 CFR 100 Exceed. Freq.	MUOR Aircraft Hit Freq.	CCDP	CCFP	MUOR 10 CFR 100 Exceed. Freq.
Containment Unit 3	3.61E-07	0.1	1	3.61E-08	3.83E-07	0.1	1	3.83E-08
Containment Unit 4	3.61E-07	0.1	1	3.61E-08	3.83E-07	0.1	1	3.83E-08
Control Building	5.34E-08	0.5	0.1	2.67E-09	5.57E-08	0.5	0.1	2.79E-09
Turbine Bldg Unit 3 and 4	1.71E-06	0.1	0.1	1.71E-08	1.73E-06	0.1	0.1	1.73E-08
Auxiliary Bldg Unit 3 and 4	2.08E-07	1	0.25	5.20E-08	2.27E-07	1	0.25	5.68E-08
Spent Fuel Bldg Unit 3	1.25E-07	0.5	1	6.25E-08	1.35E-07	0.5	1	6.75E-08
Spent Fuel Bldg Unit 4	7.96E-08	0.5	1	3.98E-08	8.30E-08	0.5	1	4.15E-08
EDG Bldg Unit 3	3.04E-07	0.1	0.5	1.52E-08	3.11E-07	0.1	0.5	1.56E-08
EDG Bldg Unit 4	7.50E-07	0.1	0.5	3.75E-08	7.60E-07	0.1	0.5	3.80E-08
Intake Structure	2.58E-07	0.5	0.5	6.45E-08	2.66E-07	0.5	0.5	6.65E-08
Total	4.21E-06			3.63E-07	4.33E-06			3.82E-07

Additional Information

Subsequent to the issuance of the RAI dated March 8, 2000, the NRC Staff requested that FPL provide an estimate of the distance from the Turkey Point site to the Homestead airport runway. Accessing satellite photos available on the website http://terraserver.microsoft.com, this distance was estimated using two different methods: 1) using the scale accompanying the satellite photo, and 2) using the known length of the runway at the Homestead Air Force Base to calculate a separate scale. Using each method above, the estimated distance from the Turkey Point site (Units 1, 2, 3 and 4) to the Homestead Air Force Base runway is 4.9 miles, with an estimated uncertainty of ±0.2 miles.