RS-002, "PROCESSING APPLICATIONS FOR EARLY SITE PERMITS"

ATTACHMENT 2

3.5.1.6 AIRCRAFT HAZARDS

REVIEW RESPONSIBILITIES

Primary - Probabilistic Safety Assessment Branch (SPSB)

Secondary - None

I. AREAS OF REVIEW

For this section of an early site permit application, the staff reviews the applicant's assessment of aircraft hazards. The purpose of the review is to ensure 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, a design basis aircraft event, involving potential effects of aircraft impacts and fires, is identified for consideration with respect to a nuclear power plant or plants of specified type that might be constructed and operated on the proposed site.

The SPSB reviews the applicant's assessment of aircraft activities in the vicinity of the proposed site and determines whether or not the hazards associated with these activities should be identified as design basis events for a plant or plants that might be constructed on the site. In such cases, the SPSB identifies and describes the design basis aircraft in terms of aircraft weight, speed, and other appropriate characteristics.

II. ACCEPTANCE CRITERIA

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

1. 10 CFR 100.20 as it relates to the requirement that site characteristics be evaluated to determine whether individual and societal risk of potential plant accidents is low. This requirement is met if the probability of aircraft accidents having the potential for radiological consequences greater than 10 CFR Part 100 exposure guidelines is less than about 10^{-7} per year. (See Section 2.2.3 of this review standard.) The probability is considered to be less than about 10^{-7} per year by inspection if the distances from the site meet all the requirements listed below:

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

    b. The site is at least 5 statute miles from the 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, and

c. The site 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 a plant or plants that might be constructed and operated on the site. If the results of the review do not support a finding that the risk due to aircraft activities is acceptably low, then a determination of acceptability with respect to protection against aircraft impacts and fires will need to be made for the specific plant design at the combined license (COL) stage in accordance with the review procedures of NUREG-0800 section 3.5.1.6.

III. REVIEW PROCEDURES

The reviewer selects and emphasizes aspects of the areas covered by this section of this review standard 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 for other plants and/or sites and whether items of special safety significance 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 the site description section of the safety assessment . 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 crash on the site (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 = site area 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. The use of the site area, in particular, is conservative, since typically plant area is significantly smaller than the site area. In the event that this leads to the identification of an aircraft hazard as a design basis event, the site may still be acceptable if the use of a proposed plant area reduces the crash probability to within the acceptance criteria. 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:

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

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 site 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 (x 10^8) of a Fatal Crash per Square Mile per Aircraft Movement			
	U.S. Air Carrier[1]	General Aviation[2]	USN/USM[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

[1]Reference 2.
[2]Reference 4.
[3]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 = site area of in square miles.

Where estimated risks due to military aircraft activity are found to be unacceptably high, the site may still be acceptable if suitable airspace or airway relocation is 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 site 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 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 site area used in the calculations may exclude those portions of the site which clearly would not be part of a plant area (e.g., significant bodies of water or other topological features which would preclude the location of plant structures). The applicant also may use an estimated effective plant area in place of the site area (as described in this section of this review standard). However, site acceptability would include the requirement that a proposed plant effective area would not exceed this area. Otherwise, the actual plant effective area would need to be evaluated in estimating the aircraft crash probability.

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 probability of a crash on the site. The reviewer verifies that the site location is acceptable and meets the requirements of 10 CFR Parts 52 and 100.

The basis for the above findings may be strictly in terms of the probabilities associated with potential aircraft crashes onsite. If the estimated aircraft crash probability is such that criteria of Section 2.2.3 of this review standard are met , then conclusions of the following type should be included in the staff's safety evaluation report:

> As set forth above, the staff has independently verified 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 the potential for 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 these considerations , in the staff's judgment, no undue risk to the health and safety of the public is present from aircraft hazard at the plant site now under consideration. Therefore, the staff concludes that the proposed site is acceptable for siting a plant of type specified by the applicant and meets the relevant requirements of 10 CFR Parts 52 and 100.

In the event that the staff evaluation of the aircraft hazards does not support the above basis, i.e., if criteria of Section 2.2.3 of this review standard are not met, then the basis for acceptance is addressed at the COL stage with respect to plant design, as well as site characteristics. Specifically, the criteria of 10 CFR Part 50, Appendix A, General Design Criteria 3 and 4 are applied to a specific plant design to be sited on the proposed site. In such cases, a determination of acceptability with respect to protection against aircraft impacts and fires is

made for the specific plant design in accordance with the review procedures of NUREG-0800 Section 3.5.1.6.

V. IMPLEMENTATION

The following provides guidance to applicants and licensees regarding the NRC staff's plan for using this section of this review standard.

This section will be used by the staff when performing safety evaluations of early site permit applications submitted by applicants pursuant to 10 CFR Part 52. Except in those cases in which the applicant proposes an acceptable alternate method for complying with specified portions of the Commission's regulations, the 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 Committe 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."