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Project DWPF	Calculation Number S-CLC-S-00038	Project Number N/A
Title Airplane Crash Frequency for DWPF Structures (u)	Functional Classification NS Discipline Safety	Sheet 1 of 4

Preliminary O Committed O Confirmed ⊗

Computer Program No. (s) NA	Version/Release No. 0

Purpose and Objective

The purpose of this calc-note is to document calculations that estimate the expected frequency of airplane crashes into the Vitrification Bldg. (221-S), Glass Waste Storage (250-S), Low Point Pump Pit (511-S), Water & Chemical Waste Treatment (980-S), Cold Feed Storage Bldg. (422-S), and Organic Waste Storage Tank (430-S) at DWPF.

Summary of Conclusion

The largest (and therefore, most likely to be crashed into) building at DWPF is the vitrification building. The expected frequency of an airplane crashing into the vitrification building is 3.1×10^{-7} per year.

Revisions

Rev. No.	Revision Description
0	Original Issue

Sign Off

Rev No.	Originator (Print) Sign / Date	Verification / Checking Method	Verifier / Checker Sign / Date	Manager (Print) Sign / Date
0	AG Sarrack [redacted]	Checking	Ray Lux [redacted] 3/9	DA Sharp [redacted] 3/

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Summary of Assumptions

Military planes have the same crash probability as commercial planes.

Planes that are going to crash approach the area on a 15° decent.

The angle of approach is directly at the broad side of each structure (maximizes effective target area).

Calculation

The frequency of an airplane crash into a building is related to the effective target area of the building and the frequency of flights over that building, as described by the following equation:

$$F_{crash} = A_{target} \times [(F_1 \times P_1) + (F_2 \times P_2)]$$

Where F_{crash} is the frequency of an aircraft crashing into a building,

A_{target} is the effective target area of that building,

F_1 is the frequency of commercial aircraft flights over the area,

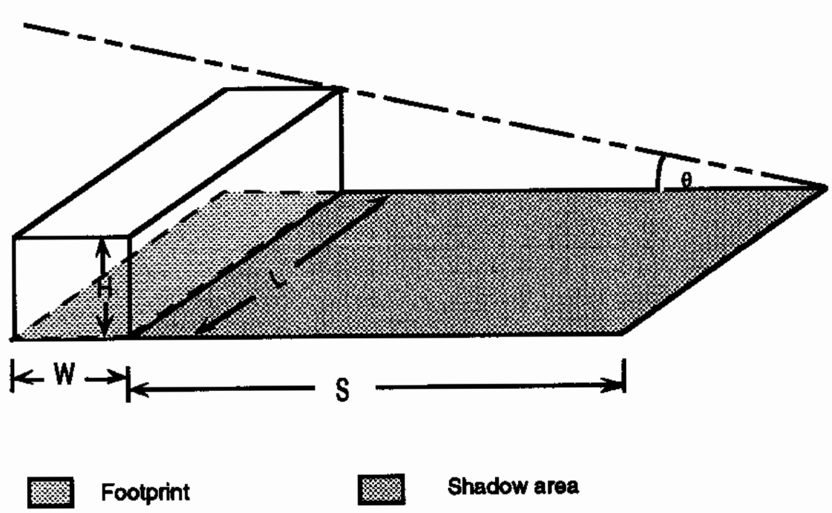
P_1 is the probability that a commercial aircraft will crash per unit area,

F_2 is the frequency of general use aircraft flights over the area, and

P_2 is the probability that a general use aircraft will crash per unit area.

Effective target area of building

The effective target area of each building is calculated by adding the building footprint $A_{footprint}$ (the area of land under the building) and the 15° shadow area, A_{shadow} (the area of land blocked by the building, as viewed from an aircraft approaching the broad side of the building, from a 15° angle with respect to the ground). This angle was chosen because it is approximately the angle of approach for landing an airplane. (The lower the angle is, the larger the effective target area is.) The following sketch and equations describe the areas of interest.



$$A_{footprint} = L \times W$$

Where $A_{footprint}$ is the footprint of the building,

L is the Length of the building, and

W is the Width of the building.

$$A_{shadow} = L \times [H + Tan(\theta)]$$

Where A_{shadow} is the "shadow area" cast by the building,

L is the length of the building,

H is the height of the building, and

θ is the angle of approach (assumed to be 15°).

The effective target area is equal to the sum of the footprint and the shadow. Site maps and drawings were reviewed to estimate DWPF building dimensions. The table on page 4 summarizes effective target area calculations for the six structures which contain radioactive material or hazardous chemicals at DWPF.

<u>Probability of crash per unit area</u>

The probability that an airplane will crash in a given area depends on the type of aircraft. Commercial flights and general use aircraft crash probabilities per unit area (P_1 and P_2) given that they fly over the area, are documented in Reference 2.

<u>Frequency of flights over the area</u>

Although statistical information on the number of flights which traverse the site outside the airway is lacking, conversations with Atlanta FAA personnel (Ref. 1) indicate that there are approximately 38 flights in a 24 hour period which cross SRS. These flights consist of approximately 20 commercial, 8 military, and 10 small aircraft. This amounts to 10,220 commercial / military and 3,650 general aviation flights per year across SRS. For the purposes of this calculation, military planes are assumed to have the same crash probability as commercial planes.

The aircraft crash frequency per unit area is defined by the following equation:

$$F_{total} = (F_1 \times P_1) + (F_2 \times P_2)$$

where F_{total} is the total aircraft crash frequency per unit area,

F_1 is the frequency of commercial aircraft flights over the area,

P_1 is the probability that a commercial aircraft will crash per unit area,

F_2 is the frequency of general use aircraft flights over the area, and

P_2 is the probability that a general use aircraft will crash per unit area.

Putting the frequencies of commercial and general aviation flights and probabilities from Reference 2 into the previous equation gives:

$$F_{total} = (10{,}220 \times 1.2 \times 10^{-9}) + (3{,}650 \times 1.2 \times 10^{-8})$$

$$= 5.6 \times 10^{-5} \text{ (aircraft crashes / year / square mile)}$$

The following table summarizes approximate building dimensions, effective target area, and the resulting frequency that an airplane crash into that facility can be expected.

Structure	Approximate Dimensions (L x W x H) (ft)	Footprint Area (ft^2)	Shadow Area (ft^2)	Effective Target Area (ft^2)	Airplane Crash Frequency (per year)
Vitrification Building (221-S)	360 x 117 x 82	42,120	110,170	152,290	**3.1×10^{-7}**
Glass Waste Storage (250-S)	205 x 184 x 0 (Below Grade)	37,720	NA	37,720	**7.6×10^{-8}**
Low Point Pump Pit (511-S)	115 x 65 x 0 (Below Grade)	7,475	NA	7,475	**1.5×10^{-8}**
Water & Chemical Waste Treatment (980-S)	114 x 92 x 18	10,488	7,658	18,146	**3.6×10^{-8}**
Cold Feed Storage Building (422-S)	150 x 60 x 28	9,000	15,675	24,675	**5.0×10^{-8}**
Organic Waste Storage Tank (430-S)	42 ft Diameter x 24 ft High	1,385	3,762	5,147	**1.0×10^{-8}**

<u>References</u>

1. Letter from Don Cass, Manager of the System Management Branch, FAA Southern Regional Office, Atlanta, GA. to C. R. Lux, Dated April 7, 1993.

2. *U.S. Nuclear Regulatory Commission Standard Review Plan*, NUREG-0800, Washington, D. C. (July 1981).