FPL Energy
Seabrook Station

FPL Energy Seabrook Station
P.O. Box 300
Seabrook, NH 03874
(603) 773-7000

SEP 15 2003

Docket No. 50-443

NYN-03081

U. S. Nuclear Regulatory Commission
Attention: Document Control Desk
Washington, DC 20555-0001

Seabrook Station
Supplemental Information Pertaining to
License Amendment Requests 02-06 and 02-07

References:

1. NYN-02089, "Changes to TS 3.9.4 Containment Building Penetrations," dated October 11, 2002
2. NYN-02103, "Revision to Technical Specifications Associated With Reduction of Decay Time for Core Offload," dated October 11, 2002
3. NYN-03043, "Revision to License Amendment Request 02-07, Changes TS 3.9.4 Containment Building Penetrations," dated May 30, 2003
4. NYN-03049, "Response to Request for Information Regarding License Amendment Requests 02-06 and 02-07," dated July 16, 2003
5. NYN-03054, "Response to Request for Information Regarding License Amendment Request 02-06," dated July 17, 2003
6. NYN-03066, "Supplemental Information Regarding License Amendment Requests 02-06 and 02-07," August 18, 2003
7. NYN-03077, "Response to Request for Information Regarding License Amendment Requests 02-06 and 02-07," dated September 9, 2003

By letter dated August 18, 2003 (Reference 6), FPL Energy Seabrook, LLC (FPLE Seabrook) identified that tracer gas testing of the Control Room Envelope (CRE) would be conducted during the week of August 25, 2003. The results of this testing indicated that unfiltered inleakage to the CRE exceeds the current license basis limit.

A001

In response to Nuclear Regulatory Commission (NRC) staff reviews and questions pertaining to References 1 and 2, FPLE Seabrook commits to maintaining a program in effect to control the administration of potassium iodide (KI) to Control Room personnel during core alterations when the Primary Containment Equipment Hatch is open. This interim measure will remain in effect until the current license basis for unfiltered CRE leakage is revised. The FPLE Seabrook commitment associated with this program is identified in Enclosure 3.

By letter dated September 9, 2003 (Reference 7), FPLE Seabrook forwarded information to the NRC pertaining to the design of the Control Room Building Air (CBA) system west air intake and its compliance with the requirements of General Design Criterion 2 and 4 of Appendix A of 10 CFR 50. In a telephone conference conducted on September 11, 2003, the NRC requested FPLE Seabrook to forward two documents referenced in the response provided in Reference 7. The documents requested were YAEC Memo ESG 19/90 - "Tornado Missile Evaluation for Control Room West Air Intake Relocation," dated March 12, 1990 and YAEC Calculation SBC-367, Revision 1, "Control Room West Intake Relocation - Tornado Missiles, dated April 1990. The subject documents are provided in Enclosures 1 and 2 respectively.

Should you have any questions concerning this response, please contact Mr. James M. Peschel, Regulatory Programs Manager, at (603) 773-7194.

Very truly yours,
FPL Energy Seabrook, LLC

Mark E. Warner
Site Vice President

cc: H. J. Miller, NRC Region I Administrator
V. Nerses, NRC Project Manager, Project Directorate I-2
G. T. Dentel, NRC Senior Resident Inspector

Mr. Bruce Cheney, Director
New Hampshire Office of Emergency Management
State Office Park South
107 Pleasant Street
Concord, NH 03301

NYN-03081

Oath and Affirmation

I, Mark E. Warner, Site Vice President of FPL Energy Seabrook, LLC, hereby affirm that the information and statements contained within this document are based on facts and circumstances which are true and accurate to the best of my knowledge and belief.

Sworn and Subscribed
before me this

15th day of September, 2003

James W. Connolly
Notary Public

Mark E. Warner
Mark E. Warner
Site Vice President

JAMES W. CONNOLLY
MY COMMISSION EXPIRES SEPT. 4, 2007
NOTARY PUBLIC
NEW HAMPSHIRE

Enclosure 1 to NYN-03081

MEMORANDUM

YANKEE ATOMIC - BOLTON

To D. E. Johnson

From G. A. Harper

Subject TORNADO MISSILE EVALUATION FOR CONTROL ROOM WEST AIR INTAKE RELOCATION

Date March 12, 1990

Group # ESG 19/90

W.O. # 6124

I.M.S. # SB O 01.16.03

CLOSEOUT

EXECUTIVE SUMMARY

A probabilistic tornado missile impact evaluation was performed in support of the control room west air intake relocation. A conservative mean estimate of the annual probability of a tornado missile impacting the west air intake pipe is in the range of 2×10^{-9} to 3×10^{-7} per year. The NRC tornado missile acceptance criterion is that the probability of significant damage to a component following a tornado missile strike be less than a mean value of 10^{-6} per year. This NRC acceptance criterion is met. Hardened tornado missile protection for the relocated west air intake is not necessary due to the acceptably low missile impact probabilities.

BACKGROUND

The control room west air intake is to be relocated adjacent to the east wall of the cooling tower. The Environmental Sciences Group (ESG) performed a probabilistic analysis of tornado missile impacts on the intake pipe. The analysis is based on information from the Seabrook Station site-specific tornado missile study (Reference 1). This study was reviewed and accepted by the NRC (see Section 3.5.2 of Reference 2). The west air intake analysis is documented in Reference 3 (see attachment). This analysis is similar to one that ESG performed in 1986 for the diesel generator exhaust stacks (Reference 4), which was reviewed and accepted by the NRC (Reference 5).

DISCUSSION

The NRC tornado missile acceptance criterion is: "The probability of significant damage to structure, systems and components required to prevent a release of radioactivity in excess of 10 CFR Part 100 following a missile strike, assuming loss of offsite power, shall be less than or equal to a median value of 10^{-7} or a mean value of 10^{-6} per year" (Reference 2).

West air intake tornado missile impact probabilities were estimated by adjusting impact probabilities from specific targets modeled in Reference 1 by ratios of target areas. The west air intake tornado missile target area was defined as the surface area of the above grade pipe plus 2.5 feet of the vertical buried pipe. The length of buried pipe was included to account for ground penetration of any tornado missiles. All horizontal portions of the underground intake pipe are at a sufficient depth to preclude a tornado missile related failure. The impact probabilities that were adjusted were conservatively chosen to account for the direction the target faces, target location and the number of potential tornado missiles in the surrounding area. This analysis is similar to the tornado missile evaluation for the diesel generator exhaust stacks (Reference 4). The NRC concurred that hardened protection of the diesel generator exhaust stacks was not necessary due to the acceptably low probability of tornado missile impact (Reference 5).

The probability estimate is considered conservative for the reasons discussed in Reference 1 and the additional conservatisms applied in the calculation (Reference 3).

CLOSEOUT

RESULTS

A conservative mean estimate of the annual probability of a tornado missile impacting the relocated west air intake pipe is in the range of 2×10^{-9} to 3×10^{-7}. These probabilities are for missile impact. The probability that the pipe would be hit and sufficiently damaged to preclude performance of its intake function is lower than for impact alone.

CONCLUSION

The probability of a tornado missile impacting the relocated control room west air intake is less than the NRC acceptance criterion. Hardened tornado missile protection for the relocated west air intake is therefore not necessary due to the acceptably low tornado missile impact probabilities.

George A. Harper
Environmental Sciences Group

GAH/lmf

Attachment

cc: W/o attachment
J. G. Robinson
J. P. Jacobson
G. Tsouderos
T. M. Cizauskas
T. F. O'Hara

REFERENCES

1. Seabrook Nuclear Power Plant Tornado Missile Analysis, Applied Research Associates, Inc., Final Report C569, Revision 1, March 1984, Addendums 1 and 2, December 1984

2. NUREG-0896, Safety Evaluation Report Related to the Operation of Seabrook Station, Supplement No. 3, July 1985.

3. YAEC Calculation SBC-367, "Control Room West Intake Relocation - Tornado Missiles," February 26, 1990.

4. Memorandum from G. A. Harper to R. E. White, Subject: Diesel Generator Exhaust Stacks - Tornado Missiles, ESG 46/86, April 24, 1986.

5. NUREG-0896, Safety Evaluation Report Related to the Operation of Seabrook Station, Supplement No. 5, July 1986.

CLOSEOUT

Enclosure 2 to NYN-03081

IMS NO. SB0 01.16.03

RECORD TYPE 07.C16.004

W.O./P.O. NO. 6124

YANKEE ATOMIC ELECTRIC COMPANY

ANALYSIS/CALCULATION FOR

TITLE CONTROL ROOM WEST INTAKE RELOCATION - TORNADO MISSILES

PLANT SEABROOK STATION CYCLE -

CALCULATION NUMBER SBC-367

	PREPARED BY/DATE	REVIEWED BY/DATE	APPROVED BY/DATE
ORIGINAL	2/26/90 George A. Harper	3/2/90 Thomas E. O'Hara	3/5/90 [signature]
REVISION 1	4/10/90 George A. Harper	4/13/90 Thomas E. O'Hara	4/13/90 [signature]
REVISION 2			
REVISION 3			

KEYWORDS Tornado Missiles

Yankee Atomic Electric

SBC-367 2/13/90

Seabrook Station 2/41

Control Room West Intake

Relocation - Tornado Missiles

GAHarper gal T.O'Hara T.O'H 3/1/90

Objective

The objective of this analysis is to estimate tornado missile impact probabilities on the proposed relocation of the control room west air intake. Tornado missile impact probabilities will be based on information presented in the site-specific Seabrook Station tornado missile analysis prepared by Applied Research Associates (ARA) (Reference 1). This analysis is similar to that of Reference 2. A further objective is to show that the NRC tornado missile probability acceptance criterion outlined in Section 3.5.2 of Reference 3 is met.

Yankee Atomic Electric

SBC - 367 2/13/90

Seabrook Station 3/41

Control Room West Intake

Relocation - Tornado Missiles

gah T.O.H

Analysis

Reference 1 is a site-specific analysis of tornado missile impact and entrance probabilities at Seabrook Station for various specified targets. Missile impact probabilities from Reference 1 will be adjusted by target area ratios to estimate tornado missile hit probabilities for the control room west air intake which is to be relocated adjacent to the east wall of the cooling tower.

The major components of this analysis include:

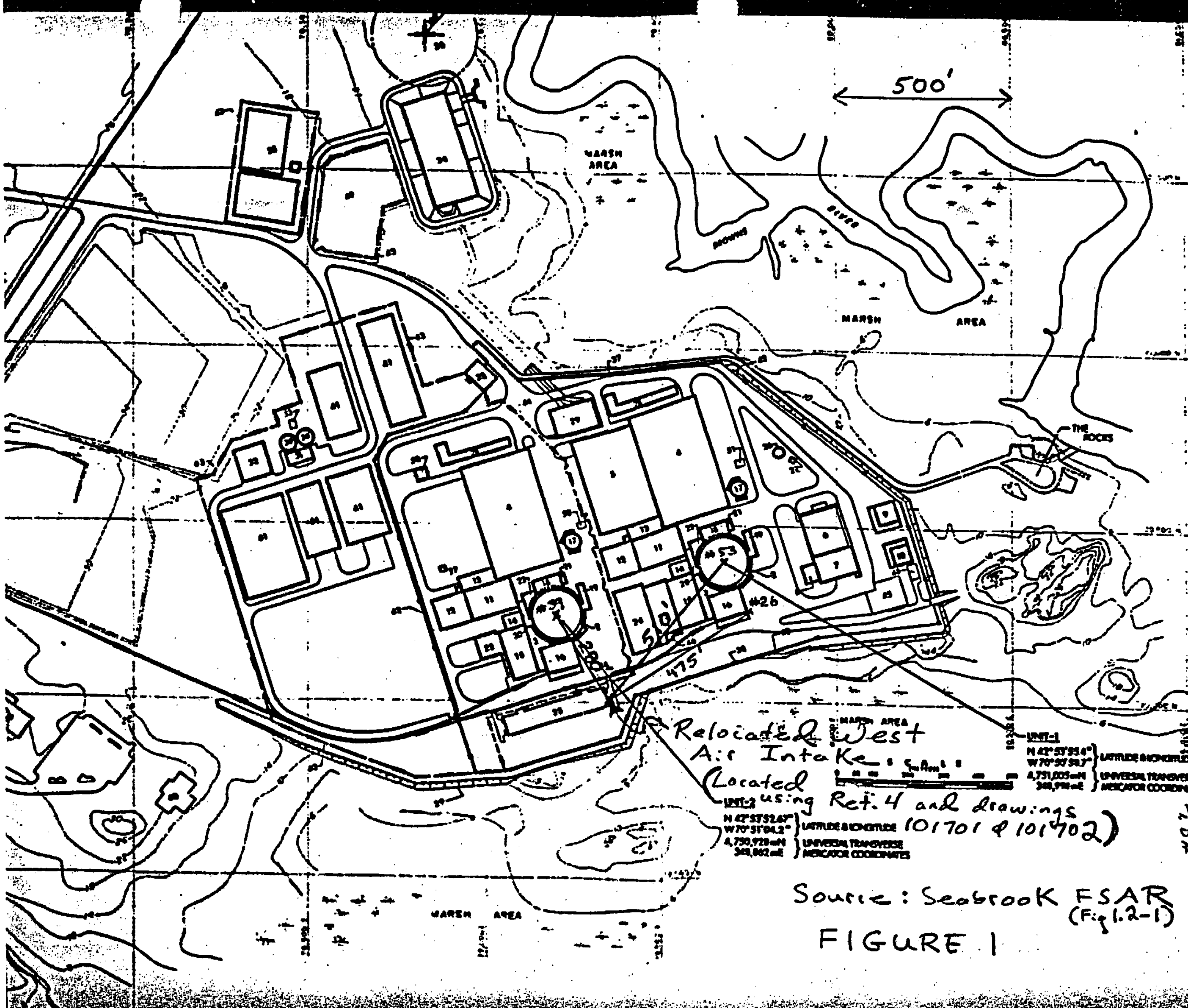
- Develop tornado missile impact probabilities applicable adjacent to the east wall of the cooling tower (annual probability per square foot of target area).
- Determine the tornado missile target area for the relocated configuration of the control room west air intake pipe.
- Combine the above two to provide a conservative estimate of the annual probability of a tornado missile impacting the intake pipe.

Yankee Atomic Electric

SBC - 367 2/16/90
4/41
Seabrook Station
Control Room West Intake
Relocation - Tornado Missiles
gah T.OH

The location of the relocated west air intake is shown on Figures 1, 2 + 3. To determine the tornado missile origin zone associated with the west intake it was located on Figure 2 as follows:

- The distances from Unit 2 containment, Unit 1 containment and the Fuel Storage Building (Reference 1 target numbers 39, 53 and 26, respectively) to the relocated west air intake were measured from Figure 1.
- Reference 1 targets numbers 39, 53 and 26 were plotted on Figure 2 using the reference point coordinates from Reference 1 Table IV-9.
- An arc was drawn from each of the three targets with a radius equal to the distances determined above. The relocated west air intake is located where the three arcs intersect. The approximate coordinates of the relocated west air intake are X = 410, Y = 260 and is located in tornado missile origin zone 13.



Source: Seabrook FSAR (Fig 1.2-1)

FIGURE 1

SBC-367 p.5/41

Source: Reference 1

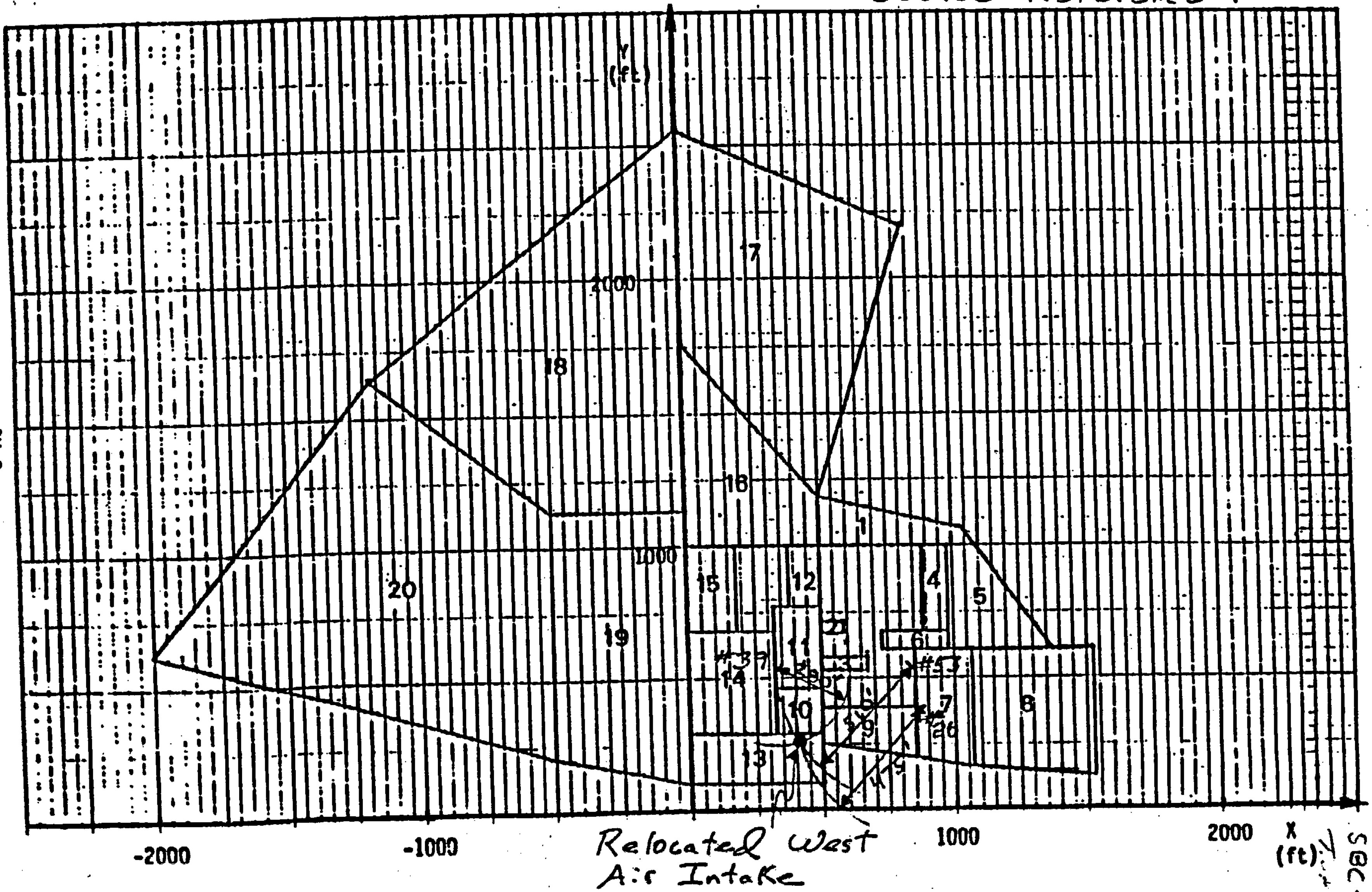


Figure IV-2. Tornado Missile Origin Zones

FIGURE 2

Source: Reference 1

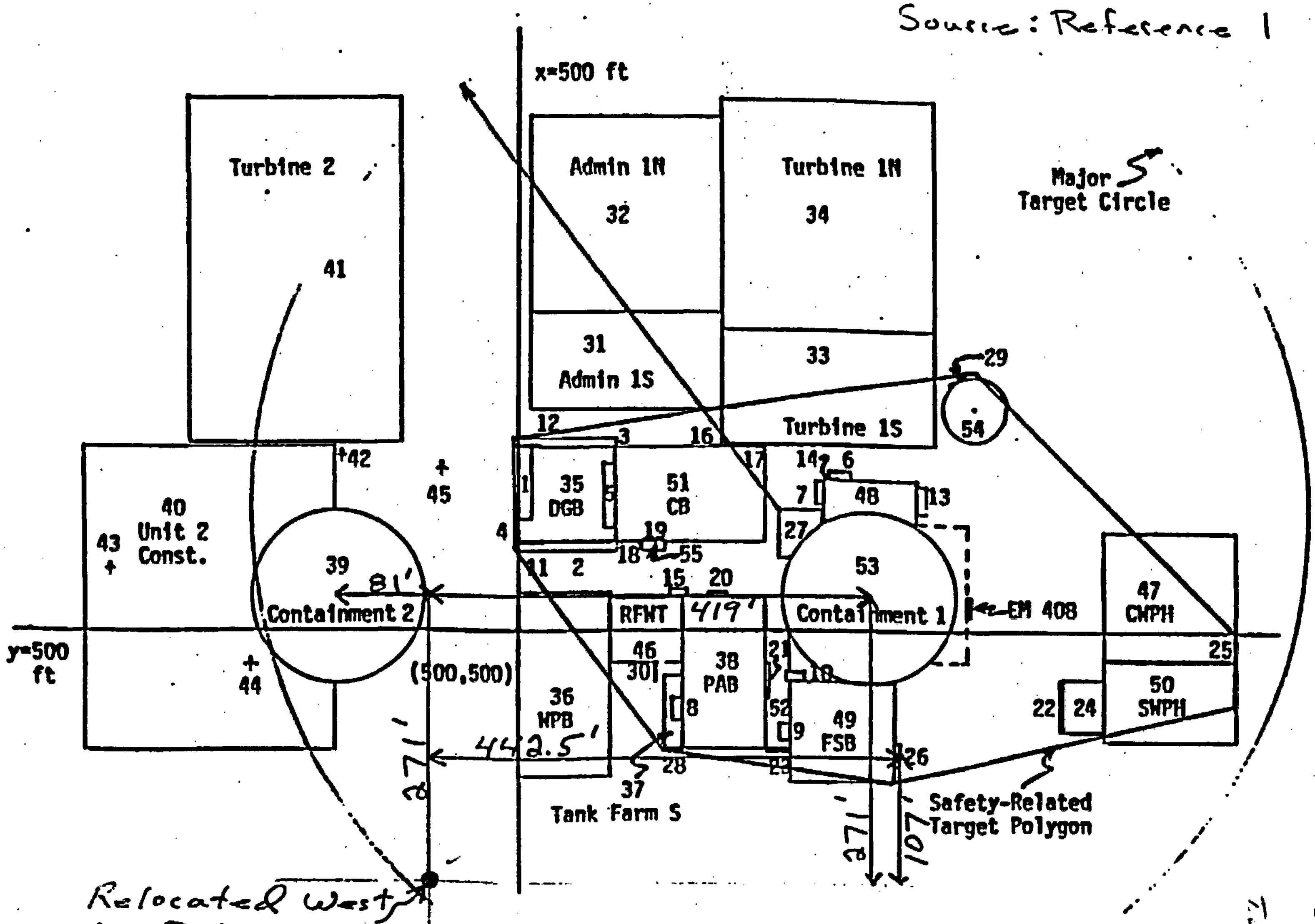


Figure IV-6. Plan View of Seabrook Plant Target Area

FIGURE 3

IV-33

SBC-367
p. 7/41

Yankee Atomic Electric

SBC-367 2/16/90

Seabrook Station 8/41

Control Room West Intake

Relocation - Tornado Missiles

[initials] T.O.H

The relocated west air intake was located on Figure 3 by X and Y offsets determined from the three target (#39, #53 and #26) reference coordinates and the coordinates of the relocated west air intake. The locations of all Reference 1 targets are shown on Figure 3. Tables V-1 through V-3 of Reference 1 present the quantity $P^N(A)$ for each of the 30 category I targets modeled. $P^N(A)$ is defined as the annual probability of a tornado missile center of mass impacting the modeled first opening and damaging a hypothetical one-inch, 100 psi concrete slab. By engineering judgement the 12" diameter intake pipe with a 0.375" wall thickness is considered at least as capable as the hypothetical concrete slab in resisting tornado missile loads. $P^N(A)$'s for the thirty modeled targets are listed in Table 1.

Also listed in Table 1 are the target areas that were modeled. These modeled target areas are associated with the $P^N(A)$ probabilities.

Yankee Atomic Electric

SBC-367 2/16/90

Seabrook Station 9/41

Control Room West Intake

Relocation - Tornado Missiles

gch T.O'H

TABLE 1

Target #	$P^N(A)$ (yr^{-1})	A (modeled) (ft^2)	P^N ($ft^{-2}\,yr^{-1}$)
2	1.2×10^{-8}	864	1.4×10^{-11}
3	2.3×10^{-7}	864	2.7×10^{-10}
4	1.3×10^{-5}	444	2.9×10^{-8}
5	2.7×10^{-5}	1440	1.9×10^{-8}
6	7.8×10^{-7}	360	2.2×10^{-9}
7	1.0×10^{-9}	270	3.7×10^{-12}
8	1.8×10^{-5}	310	5.8×10^{-8}
9	6.1×10^{-8}	524.3	1.2×10^{-10}
10	5.9×10^{-7}	382.1	1.5×10^{-9}
13	6.3×10^{-8}	225	2.8×10^{-10}
15	2.0×10^{-8}	200	1.0×10^{-10}
16	5.9×10^{-7}	350	1.7×10^{-9}
24	1.3×10^{-6}	1677	7.8×10^{-10}
11	1.4×10^{-7}	200	7.0×10^{-10}
12	4.4×10^{-7}	200	2.2×10^{-9}
17	2.1×10^{-7}	225	9.3×10^{-10}
18	2.4×10^{-8}	110	2.2×10^{-10}
19	2.3×10^{-8}	225.5	1.0×10^{-10}
20	7.2×10^{-8}	220	3.3×10^{-10}
21	3.1×10^{-8}	1664	1.9×10^{-11}
23	1.6×10^{-7}	253	6.3×10^{-10}
28	1.4×10^{-6}	216	6.5×10^{-9}
29	2.8×10^{-6}	260	1.1×10^{-8}
30	7.8×10^{-6}	540	1.4×10^{-8}
1	9.1×10^{-6}	816	1.1×10^{-8}
14	1.6×10^{-7}	300	5.3×10^{-10}
22	1.6×10^{-7}	1100	1.5×10^{-10}
25	1.5×10^{-7}	150	1.0×10^{-9}
26	1.6×10^{-9}	387	4.1×10^{-12}
27	1.2×10^{-6}	468	2.6×10^{-9}

$\Sigma = 1.65\times10^{-7}$

Mean $= 5.5\times10^{-9}$

Yankee Atomic Electric

SBC-367 2/16/90

10/41

Seabrook Station

Control Room West Intake

Relocation - Tornado Missiles

gal T.OH

As noted on page III-11 of Reference 1, tornado missile impact probabilities are approximately proportional to the area of the target. With this in mind each of the $P^N(A)$ probabilities in Table 1 was divided by the appropriate modeled target area (A) to develop a tornado missile impact probability per ft^2. These $P^N(ft^{-2}, yr^{-1})$ are also listed in Table 1.

In Table V-3 of Reference 1 it is noted that tornado missile impact probabilities for target "EM 408" were extrapolated from target 26. Among the reasons why this approach is appropriate is that both targets are east facing and shielded from the west by adjacent structures.

Similar arguments can be raised for using target 26 probabilities to estimate probabilities for the relocated control room west air intake. They include:

- both face east.
- both are immediately adjacent and shielded by reinforced concrete structures to the west.
- both are along the southern

perimeter of the plant adjacent to the marsh.

- missile zone 13 (location of relocated west air intake) has a low number of potential missiles as does zone 7 (location of target 26) (see Attachment 1).

From Table 1 the tornado missile impact probability, P^N (ft^{-2}, yr^{-1}) is 4.1×10^{-12} ford target 26. For conservatism this annual impact probability per ft^2 will be increased by a factor of 10 and be used as one estimate for the relocated west air intake location ($4.1 \times 10^{-11} ft^{-2}, yr^{-1}$).

Another estimate of the annual impact probability per ft^2 will be the average of the 30 modeled targets. This estimate is 5.5×10^{-9} ft^{-2}, yr^{-1} (see Table 1). This mean estimate is considered to be very conservative for the following reasons:

- Tornado missile density is low in zone 13 compared to other zones (see Attachment 1, Table A-5).

- Tornado missile impact probabilities (ft^{-2}, yr^{-1}) for east facing, shielded targets tend to

be lower than for targets facing other directions (see Table 1, targets 13, 21 and 26). Note the relocated control room west intake is an east facing target, shielded to the west by the cooling tower.

Two tornado missile impact probabilities, P^N (ft^{-2}, yr^{-1}), have been developed for the area where the west air intake is to be relocated. For reasons developed above both are considered conservative. They are 4.1×10^{-11} ft^{-2}, yr^{-1} and 5.5×10^{-9} ft^{-2}, yr^{-1}.

These impact probabilities are per ft^2 of target area. The next step is to estimate the target area for the relocated west intake. Since the pipe is not protected below grade, an estimate of the length of buried pipe that could be impacted by a credible ground penetrating missile will be included in the target area estimate.

Attachment 2 shows a portion of the Reference 4 drawing of the above grade intake pipe.

Yankee Atomic Electric

SBC-367 2/21/90

13/41

Seabrook Station

Control Room West Intake

Relocation - Tornado Missiles

gah T.D.H.

As shown on Attachment 2, grade elevation where the intake exits the ground at the cooling tower is 20.0'. The pipe drops down vertically to a 90° elbow with bottom of pipe (B.O.P.) at elevation 17.0'. Since the pipe is a 12" line (O.D.≈12.75") top of pipe for the horizontal section after the elbow is about 18.1'. Therefore the top of the horizontal pipe is about 1.9' below grade.

Seabrook Stations site-specific tornado missile set is presented in Table IV-4 of Reference 1 (see Attachment 7). This missile set also contains the seven tornado missiles presented in Table 3.5-11 of the Seabrook FSAR (see Attachment 3).

For tornado missile ground penetration the missiles vertical velocity is of interest. Vertical missile velocities will be determined from information presented in Reference 8. Penetration will be determined for the Attachment 3 missiles.

Tornado missile ground penetration will be estimated using a procedure outlined in Reference 5. Reference 5 presents the following equations for the prediction of earth penetration distance:

Yankee Atomic Electric

SBC-367 2/22/90

Seabrook Station 14/41

Control Room West Intake

Relocation - Tornado Missiles

gal T.O.H 4/13/90

$$Z = 0.53\, S N \left(\frac{W}{A}\right)^{1/2} \ln\left(1 + 2V^2/10^5\right), \quad V < 200 \text{ fps}$$

[Eqn. 1]

$$Z = 0.00031\, S N \left(\frac{W}{A}\right)^{1/2} (V - 100), \quad V \geq 200 \text{ fps}$$

[Eqn. 2]

where

Z = penetration depth or distance in feet

S = soil constant

N = nose performance coefficient

W = projectile (missile) weight in lb

A = cross sectional area in sq in.

V = impact velocity in ft per second

The soil constant, S, is obtained from Table 3 of Reference 5 (see Attachment 4). Backfill over and around the buried intake pipe will be a controlled compacted engineered backfill. Per review of Table 3, S of 5.2 was chosen as representative of the backfill material.

Yankee Atomic Electric

SBC-367 2/22/90
15/41

Seabrook Station
Control Room West Intake
Relocation - Tornado Missiles

geh T. OH 4/13/90

The nose coefficient, N, is obtained from Table 2 of Reference 5 (see Attachment 5). All of the tornado missiles will be characterized as flat nosed and N will be taken as 0.56.

W and A will be taken from Attachment 3.

Information on tornado missiles maximum vertical velocities is presented in Table IV-17 of Reference 8 (see Attachment 8) for the seven missiles listed in Attachment 3. Three vertical velocity values are provided: the mean, the 90% quantile and the extreme. For conservatism the extreme value will be used for maximum vertical missile velocity at ground impact. Since the site-specific Seabrook study (Ref. 1) is based on the Reference 8 methodology, the Reference 8 missile velocity characteristics are applicable for Seabrook.

The vertical missile velocities used from Attachment 8 are for the 300 mph tornado.

Per ANSI (Reference 6), the 10^{-7} annual probability tornado windspeed for the Seabrook Station area is 250 mph.

Yankee Atomic Electric

SBC-367 4/9/90

16/41

Seabrook Station

Control Room West Intake

Relocation - Tornado Missiles

gah T.J.H. 4/13/89

The 10^{-7} annual probability is significant since it satisfies the NRC tornado missile acceptance criterion (page 3-2 of Reference 3). Therefore use of vertical tornado missile ground impact velocities based on a 300 mph tornado is conservative given that its probability is less than 10^{-7} per year.

Vertical missile velocities at ground impact are listed in Table 2.

TABLE 2

Tornado Missiles - Vertical Velocities

Missile	Maximum Vertical Velocity Extreme Value mph	fps
Wood Plank	140.9	207
3" Steel Pipe	91.3	134
1" Steel Rod	96.1	141
6" Steel Pipe	83.3	122
12" Steel Pipe	78.4	115
Utility Pole	35.1	51
Automobile	43.6	64

Yankee Atomic Electric

SBC-367

Seabrook Station — 2/23/90

Control Room West Intake — 17/41

Relocation - Tornado Missiles

gah — TJOH 4/13/90

Using Eqn. 1 or 2 depending on V, penetration depth for each tornado missile can be calculated.

- Wood Plank

$$z = 0.0031(5.2)(.56)\left(\frac{200}{48}\right)^{1/2}(207-100) = 2.0\ ft.$$

- 3" Steel Pipe

$$z = 0.53(5.2)(.56)\left(\frac{78}{7.1}\right)^{1/2} \ln\left(1+\frac{2(134)^2}{10^5}\right) = 1.6\ ft.$$

- 1" Steel Rod

$$z = 0.53(5.2)(.56)\left(\frac{8}{0.8}\right)^{1/2} \ln\left(1+\frac{2(141)^2}{10^5}\right) = 1.6\ ft.$$

- 6" Steel Pipe

$$z = 0.53(5.2)(.56)\left(\frac{285}{28.3}\right)^{1/2} \ln\left(1+\frac{2(122)^2}{10^5}\right) = 1.3\ ft.$$

- 12" Steel Pipe

$$z = 0.53(5.2)(.56)\left(\frac{743}{113}\right)^{1/2} \ln\left(1+\frac{2(115)^2}{10^5}\right) = 0.9\ ft.$$

- Utility Pole

$$z = 0.53(5.2)(.56)\left(\frac{1490}{143}\right)^{1/2} \ln\left(1+\frac{2(51)^2}{10^5}\right) = 0.3\ ft.$$

- Automobile

$$z = 0.53(5.2)(.56)\left(\frac{4000}{20(144)^2}\right)^{1/2} \ln\left(1+\frac{2(64)^2}{10^5}\right) = 0.1\ ft.$$

Yankee Atomic Electric

SBC-367 4/10/90

Seabrook Station 13/41

Control Room West Intake

Relocation - Tornado Missiles

gph T.O.H. 4/13/90

Maximum vertical tornado missile
penetration is 2.0 feet for the wood
plank. Vertical ground penetration is
1.6 feet or less for the other six
missiles. As previously noted the
elevation of top of pipe for the
buried horizontal section after the 90°
elbow is about 1.9 feet below grade.
Therefore the soil cover about the
pipe is just less than the predicted
maximum missile penetration based
on the extreme maximum vertical
missile ground impact velocity.

An additional ground penetration
calculation will be performed for
the wood plank.

As previously noted, Table IV-17 of
Reference 8 (see Attachment 8) also
lists the 90% quantile maximum
vertical missile velocity. This means
that in 90% of the 500 missile
simulations, the wood planks' maximum
vertical velocity was less than 102.4 mph.
From this it can be concluded that
the conditional probability of the
missiles' maximum vertical velocity
exceeding 102.4 mph* given that it is
a missile in a 300 mph tornado is
0.1.

* 102.4 mph = 150 fps

Yankee Atomic Electric

SBC - 367 4/10/90

Seabrook Station 19/41

Control Room West Intake

Relocation - Tornado Missiles

gch T.D.H 4/13/90

Recalculating the penetration depth for the wood plank using Equation 1 for a maximum vertical velocity of 150 fps:

$$z = 0.53(5.2)(.56)\left(\frac{200}{48}\right)^{1/2} \ln\left(1 + \frac{2(150)^2}{10^5}\right) = 1.2 \text{ ft.}$$

Combining the annual probability of a 300 mph tornado (less than 10^{-7}) with the conditional probability that the maximum vertical velocity of the missile would be greater than 102.4 mph (cond. prob = 0.1) yields a probability of the combined event of $< 10^{-8}$ per year. Since this meets the Reference 3 NRC probabilistic tornado missile criteria, the wood plank impacting the buried horizontal pipe is not of concern.

Based on the above calculations, it is concluded that the horizontal buried portion of the intake pipe has adequate soil cover (about 1.9 feet or more) to preclude failure due to impact from a ground penetrating tornado missile.

The target area of the intake pipe can be estimated using the same approach as in Reference 2. The entire vertical section of intake pipe below grade at the intake will be included in the target area calculation.

Yankee Atomic Electric

SBC - 367 2/23/90

Seabrook Station 20/41

Control Room West Intake

Relocation - Tornado Missiles

gak T.O.H. 4/13/90

The tornado missile target area of the intake pipe is defined as the outside surface cylindrical surface area of the intake pipe over the full length of the vertical riser section plus the cross sectional area of the intake opening itself.

Total length of target area intake pipe is (see Attachment 2):

1.9' (vertical buried portion)
7.8' (vertical above grade portion)
6.3' (outside length of 180° bend)

Σ = 16.0' (total target length)

Target area, T.A., is

T.A. = cylindrical surface area + intake opening area

$$T.A. = \pi (\text{pipe diam.})(\text{length}) + \frac{\pi (\text{pipe diam})^2}{4}$$

$$= \pi \left(12.75 \text{ inches}\right)\left(\frac{ft}{12 \text{ in}}\right)\left(16.0 \text{ ft}\right) + \frac{\pi}{4}\left(12.75 \text{ inches}\right)^2\left(\frac{ft^2}{144 \text{ in}^2}\right)$$

$$T.A. = 53.4 \text{ ft}^2 + 0.9 \text{ ft}^2$$

$$T.A. = 54.3 \text{ ft}^2$$

Yankee Atomic Electric

SBC - 367 2/26/90

21/41

Seabrook Station

Control Room West Intake

Relocation - Tornado Missiles

gah TOH

4/13/9-

The tornado missile impact probabilities per ft^2 per year can now be combined with the west intake pipe target area. The product of these terms is defined as the annual probability of any tornado missile impacting the pipe. The conditional probability of rendering the intake useless will not be explicitly estimated. The mechanism of system failure would be to hit the pipe and cause it to crimp closed or almost closed. The annual probability of this event is less than that of the tornado missile impact alone.

The two previously developed tornado missile impact probabilities, $P^N (ft^{-2}, yr^{-1})$, for the west intake relocation area are $4.1 \times 10^{-11}\ ft^{-2}, yr^{-1}$ and $5.5 \times 10^{-9}\ ft^{-2}, yr^{-1}$. West intake target area is $54.3\ ft^2$. The two estimates of the annual probability of a tornado missile impacting the target west intake pipe are:

$$P1 = (4.1 \times 10^{-11}\ ft^{-2}, yr^{-1})(54.3\ ft^2) = 2.2 \times 10^{-9}\ yr^{-1}$$

$$P2 = (5.5 \times 10^{-9}\ ft^{-2}, yr^{-1})(54.3\ ft^2) = 3.0 \times 10^{-7}\ yr^{-1}$$

As noted in Reference 1 (pages

Yankee Atomic Electric

SBC-367 2/26/90
Seabrook Station 22/41
Control Room West Intake
Relocation - Tornado Missiles
gak T.J.H. 4/13/90

V-8 and V-9) these probabilities are mean value estimates.

In NUREG-0896 (Reference 3, page 3-1), the NRC tornado missile acceptance criterion is defined as: "The probability of significant damage to structure, systems and components required to prevent a release of radioactivity in excess of 10 CFR Part 100 following a missile strike, assuming loss of offsite power, shall be less than or equal to a median value of 10^{-7} or a mean value of 10^{-6} per year."

Risk #13

The two estimates of the annual mean probability of a tornado missile impacting the unprotected west intake pipe developed in this calculation are 2.2×10^{-9} and 3.0×10^{-7}. As noted in this calculation both of these probabilities are conservatively extrapolated from information presented in Reference 1. Further conservatisms are built into these estimates for the same reasons as discussed in the site-specific study (Reference 1).

Furthermore, tornado missile impact on the west intake pipe does not necessarily imply failure of the intake pipe's intake capability. The 12" diameter, 0.375" wall steel pipe has

Yankee Atomic Electric

SBC-367 2/26/90

23/41

Seabrook Station
Control Room West Intake
Relocation - Tornado Missiles

gah TDM 4/11/90

an inherent ability to resist some impact loads. Also the redundancy of the control room intake air system, i.e. independent, physically separate east air intake, is a conservative feature of the overall intake system. Both of the points would tend to further reduce the probability of complete intake system failure to below those presented for tornado missile impact.

In conclusion the two estimates of the annual mean probability of a tornado missile impacting the unprotected west intake pipe are conservatively 2.2×10^{-8} and 3.0×10^{-7}. These estimates are likewise very conservative estimates of system failure. Since these estimates are below the NRC criterion of 10^{-6} mean estimate, the NRC acceptance criterion is met. Therefore hardened tornado missile protection for the relocated west air intake (configured as modeled herein) is not necessary due to the acceptably low failure probabilities.

Refer to Section 9.5.8 of Reference 7 for precedent.

Attachment 6 is WE-103-1 Review Form.

Yankee Atomic Electric

SBC-367 2/26/90

Seabrook Station 24/41

Control Room West Intake

Relocation - Tornado Missiles

gwh T.O.M. 4/13/90

Summary of Results

Based on the site-specific tornado missile analysis for Seabrook (Reference 1), two conservative estimates of the annual probability of a tornado missile impacting the relocated control room west air intake were developed. The two estimates are 2.2×10^{-9} and 3.0×10^{-7}. These estimates are mean values. These estimates are conservative for reasons stated in this calculation and those given in Reference 1.

Conclusions

The annual probability of significant damage to the control room air intake system following a tornado missile strike on the unprotected portion of the west air intake pipe (defined as the target area in this calculation) is sufficiently less than a mean value of 10^{-6} per year. Therefore hardened tornado missle protection of the west air intake pipe at the cooling tower location is not necessary.

Yankee Atomic Electric

SBC-367 2/26/90

Seabrook Station 25/41

Control Room West Intake

Relocation - Tornado Missiles

gah T.O'T

This conclusion is consistent with information presented in References 3 (Section 3.5.2) and 7 (Section 9.5.8). The NRC Standard Review Plan Guidelines for tornado missile failure probability are satisfied.

The objectives of this calculation have been met.

Yankee Atomic Electric

SBC-367 2/13/90
26/41

Seabrook Station
Control Room West Intake
Relocation - Tornado Missiles
gah T.O.H

References

1. Seabrook Nuclear Power Plant Tornado Missile Analysis prepared by Applied Research Associates, Inc., Final Report C569, Revision 1, March 1984 with Addendum No. 1 dated December 1984 and Addendum No. 2 dated December 1984.

2. Yankee Atomic Electric Calculation SBC-145, Diesel Generator Exhaust Stacks - Tornado Missiles, 4/23/86.

3. U.S.N.R.C. NUREG-0896, Safety Evaluation Report related to the operation of Seabrook Station, Supplement 3, July 1985.

4. New Hampshire Yankee drawing: Control Room West Intake Relocation, DCR No. 890080, SK No. SKD-890080-2001, dated 3/29/90.

5 Depth Prediction for Earth-Penetrating Projectiles by C. Wayne Young, Journal of the Soil Mechanics and Foundations Division, A.S.C.E., SM3, May 1969.

Yankee Atomic Electric

SBC-367 2/22/90

Seabrook Station 27/41

Control Room West Intake

Relocation - Tornado Missiles

gak TJH

References (continued)

6. ANSI/ANS-2.3-1983, American National Standard for Estimating Tornado and Extreme Wind Characteristics at Nuclear Power Sites, October 1983.

7. NUREG-0896, Safety Evaluation Report related to the Operation of Seabrook Station, Supplement 5, July 1986.

8. EPRI NP-2005, Tornado Missile Simulation and Design Methodology, Volume 1: Simulation Methodology, Design Applications, and TORMIS Computer Code, Research Triangle Institute, August 1981.

Yankee Atomic Electric

SBC-367 2/21/90

Seabrook Station 28/41

Control Room West Intake

Relocation - Tornado Missiles

gmh TDH

ATTACHMENT 1

Tornado Missile Densities

Tornado missile densities for selected missile origin zones are determined in this attachment. The missile densities are determined from information presented in Reference 1 (see main calculation).

As noted on p. IV-1 (Reference 1) all safety-related targets for Unit 1 are east of zones 10 and 11, south of zone 1 and north of zone 9. Figure A-1 shows the tornado missile origin zones. Table A-1 lists the zone definition coordinates. Table A-2 lists the X and Y coordinates for each coordinate number.

In Table A-3 the zone areas are calculated for all zones in the vicinity of Unit 1 including the cooling tower. Table A-4 lists the number of tornado missiles by zone.

Using this information the tornado missile densities (# missiles per ft.^{2}) were determined. These are listed in Table A-5.

Source: Reference 1

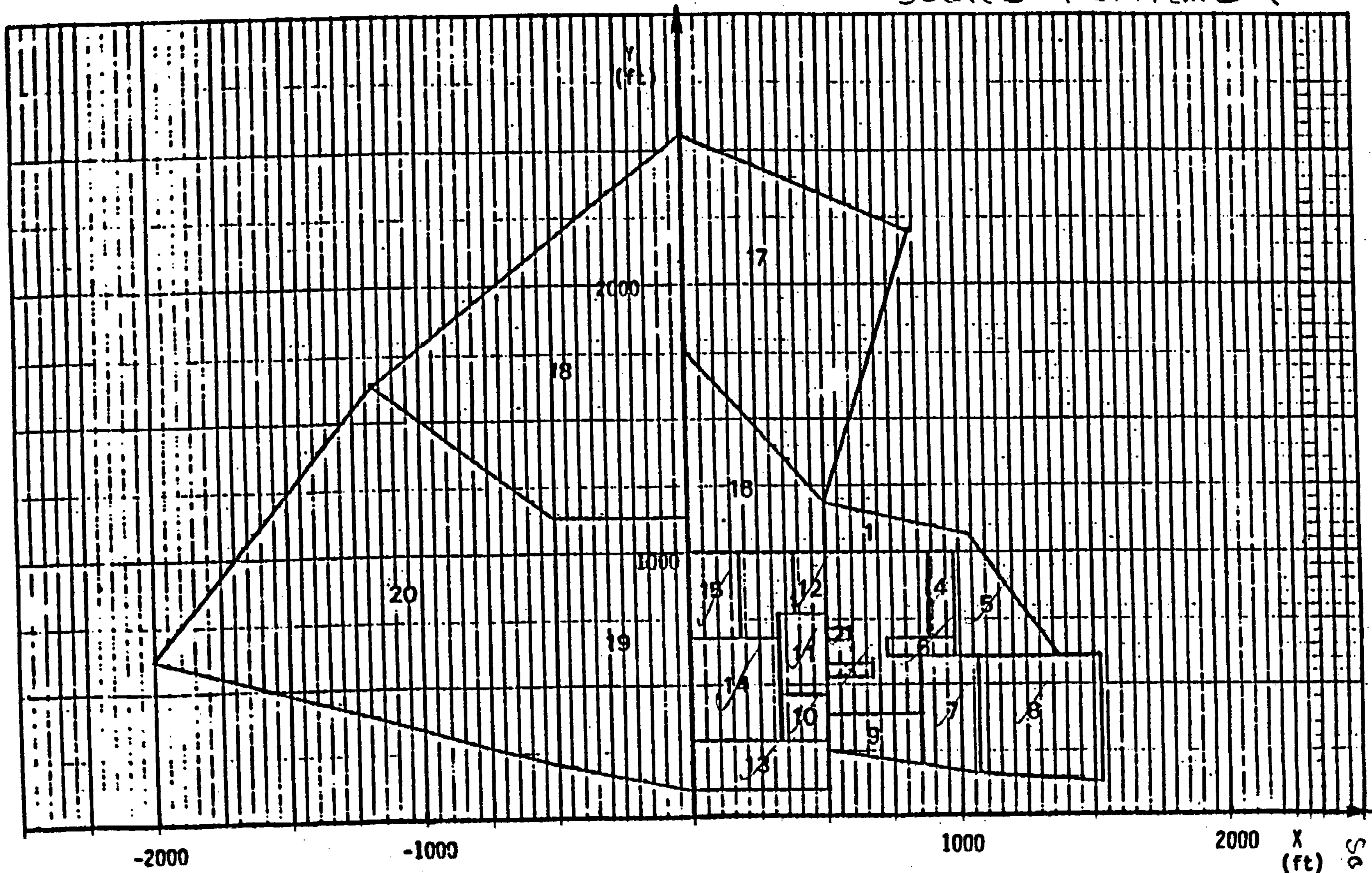


Figure IV-2. Tornado Missile Origin Zones

Figure A-1

IV-3

p. 29/41
SAC-367
7.0

p. 30/41
SBC-367

TABLE A-1

T.-H

TABLE IV-2. ZONE DEFINITIONS

Zone	Coordinate Numbers	Zone	Coordinate Numbers
1	17-33-44-45-17	11	11-12-14-13-11
2	25-24-23-22-25	12	15-14-17-16-15
3	21-20-19-18-21	13	1- 2- 3- 4- 1
4	30-27-32-31-30	14	4- 7- 6- 5- 4
5	28-34-33-32-28	15	5-10- 9- 8- 5
6	29-28-27-26-29	16	8-17-45-48- 8
7	39-36-35-40-39	17	48-45-46-47-48
8	36-37-38-35-36	18	52-50-49-47-52
9	41-39-43-42-41	19	51- 1-49-50-51
10	7- 3-12-11- 7	20	53-51-50-52-53

Source:
Reference 1

p. 31/41
SBC-367
T. J. M

TABLE A-2

TABLE IV-1. SEABROOK STATION TORNADO MISSILE ZONE COORDINATES

Coordinate Number	X (ft)	Y (ft)	Coordinate Number	X (ft)	Y (ft)
1	0	100	28	992	611
2	500	100	29	731	611
3	500	293	30	892	675
4	0	293	31	892	1000
5	0	675	32	992	1000
6	329	675	33	1092	1000
7	329	293	34	1367	611
8	0	1000	35	1074	611
9	191	1000	36	1074	161
10	191	675	37	1524	136
11	329	463	38	1524	611
12	500	463	39	852	199
13	329	769	40	852	611
14	500	769	41	500	250
15	392	769	42	500	386
16	392	1000	43	852	386
17	500	1000	44	1038	1063
18	500	581	45	500	1188
19	675	581	46	844	2220
20	675	531	47	0	2550
21	500	531	48	0	1750
22	500	709	49	0	1130
23	590	709	50	-500	1130
24	590	671	51	-500	200
25	500	671	52	-1174	1640
26	731	675	53	-2000	620
27	992	675			

Source:
Reference 1

Yankee Atomic Electric

SBC-367 2/21/90

Seabrook Station 32/41

Control Room West Intake

Relocation - Tornado Missiles

gah T.OH

SRT CHECK

Table A-3

Missile Zone

15	Area = 191' × 325'	=	62,075 ft^2
14	Area = 329' × 382'	=	125,678 ft^2
13	Area = 500' × 193'	=	96,500 ft^2
10	Area = 171' × 170'	=	29,070 ft^2
11	Area = 171' × 306'	=	52,326 ft^2
12	Area = 108' × 231	=	24,948 ft^2
2	Area = 90' × 38'	=	3,420 ft^2
3	Area = 175' × 50'	=	8,750 ft^2
4	Area = 100' × 325'	=	32,500 ft^2
5	Area = $\frac{1}{2}$(375' + 100') × 389'	=	92,388 ft^2
6	Area = 261' × 64'	=	16,704 ft^2
7	Area = $\frac{1}{2}$(412' + 450) × 222'	=	95,682 ft^2
8	Area = $\frac{1}{2}$(450' + 475) × 450'	=	208,125 ft^2
9	Area = $\frac{1}{2}$(136 + 187') × 352'	=	56,848 ft^2

TABLE A-4

TABLE IV-5. MISSILE DISTRIBUTION BY ZONE

Final Missile Set	Description	Missile Origin Zone 1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	Total
1	Rebar				100				700		100	500			1,000	1,000	200			2,000	500	6,100
2	Gas Cylinder		25	72	15		5	10	160			20	8		20	50	20		6	100	25	536
3	Drum, Tank	20	25			10	5	10	40	20	20	50	10	10		30	15		22	1,010	120	1,417
4	Utility Pole					10			10								10	10	8	10	10	68
5	Cable Reel								10			400			50	20			5			485
6	3-in Pipe	25						100	300		27	200			500			10		4,100	1,600	6,862
7	6-in Pipe											100			500		150			800	20	1,570
8	12-in Pipe				10				50				20		100		50	30	14	400	38	712
9	Eqpt., Bin			1	3			10	28			44		11	36	54	4	16	10	320	22	559
10	Dumpster	2				2				11	35	4	20		4	2	4		6	24	8	122
11	Wood Tie								30				8			40		60	251	2,400	4,500	7,289
12	Wood Beam				20	80		200	220	10	500	150	300	40	[illegible]60	40	380	270	380	400	2,110	5,930
13	Wood Plank				10	40			30				60	10	240		160	110	170	200	450	1,480
14	Metal Siding								300								300	5	230		100	935
15	Plywood Sheet				10	40			50		20		73	10	240		185	110	210	200	1,600	2,748
16	Wide Flange	80			4				150			100		15	230	10	160	22	131	200	70	1,172
17	Angle Section	100							150			200				80		8	5	6,000	3,000	9,543
18	Channel Section				10	40		30	100		15	250	60	10	240		10	150	170	1,200	2,850	5,135
19	Small Eqpt.			4			5	10		5				10	20						20	74
20	Large Eqpt.	77							10													87
21	Pipe Frame								30			200				20				5,000	1	5,251
22	Grating	6										100		8	16					320		450
23	Rect. Frame								10			5							30	200	1,200	1,445
24	Crane Sections																					0
25	Wood Frame												10		100			1			1,000	1,111
26	Vehicle	5	1	1	3	2	1	5	10	5	2	1	1	1	10	10	200	35	2,514	90	183	3,080
	Totals	315	51	78	185	224	16	375	2,368	51	719	2,324	570	125	3,086	1,356	1,848	787	4,182	24,974	19,427	63,861

Source: Reference 1

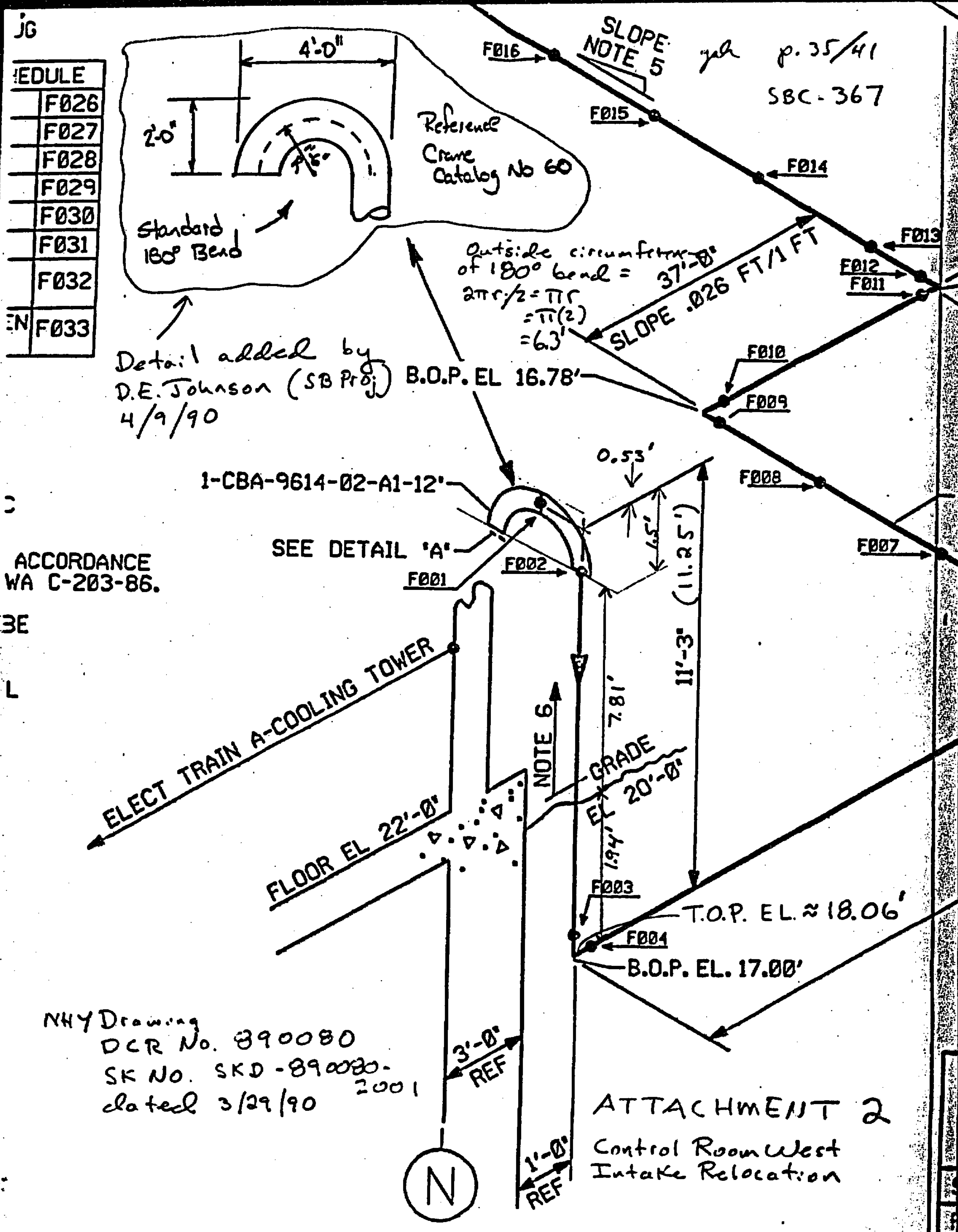
p. 33/41
SBC-367

Yankee Atomic Electric

SBC-367 2/21/90
34/41
Seabrook Station
Control Room West Intake
Relocation - Tornado Missiles
jeh TJSH

TABLE A-5

Missile Zone	# missiles	Area (ft^2)	(#/ft^2) Missile/Area
15	1356	62075	0.022 ✓
14	3886	125678	0.031 ✓
13	125	96500	0.001 ✓
10	719	29070	0.025
11	2324	52326	0.044 ✓
12	570	24948	0.023
2	51	3420	0.015 ✓
3	78	8750	0.009 ✓
4	185	32500	0.006 ✓
5	224	92388	0.002
6	16	16704	0.001
7	375	95682	0.004 ✓
8	2388	208125	0.011 ✓
9	51	56848	0.001 ✓



jG
EDULE
F026
F027
F028
F029
F030
F031
F032
EN F033
4'-0"
2'-0"
R 2'
Standard 180° Bend
Reference Crane Catalog No 60
Detail added by D.E. Johnson (SB Proj) 4/9/90
F016
SLOPE NOTE 5
jah p. 35/41
SBC-367
F015
F014
F013
F012
F011
Outside circumference of 180° bend = 2πr/2 = πr = π(2) = 6.3'
37'-0"
SLOPE .026 FT/1 FT
F010
F009
B.O.P. EL 16.78'
0.53'
1-CBA-9614-02-A1-12"
F008
SEE DETAIL 'A'
1.5'
(11.25')
F007
F002
F001
ACCORDANCE WA C-203-86.
BE
L
ELECT TRAIN A-COOLING TOWER
NOTE 6
7.81'
11'-3"
GRADE EL 20'-0"
FLOOR EL 22'-0"
1.94'
F003
T.O.P. EL. ≈ 18.06'
F004
B.O.P. EL. 17.00'
NHY Drawing DCR No. 890080 SK No. SKD-890080-2001 dated 3/29/90
3'-0" REF
1'-0" REF
N
ATTACHMENT 2
Control Room West Intake Relocation

SB 1 & 2
FSAR

p. 36/41
SBC-367
T.277

ATTACHMENT 3

TABLE 3.5-11

TORNADO-GENERATED MISSILES AND VELOCITIES

	MISSILE, DESCRIPTION	FRACTION OF TOTAL TORNADO VELOCITY[1]	HORIZONTAL VELOCITY IN REGION I (fps)
A.	Wood plank, 4 in. x 12 in. x 12 ft. weight 200 lb.	0.8	422
B.	Steel pipe, 3 in. diameter, schedule 40 10 ft. long, weight 78 lb.	0.4	211
C.	Steel rod, 1 in. diameter x 3 ft. long weight 8 lb.	0.6	317
D.	Steel pipe, 6 in. diameter, schedule 40 15 ft. long, weight 285 lb.	0.4	211
E.	Steel pipe, 12 in. diameter, schedule 40 15 ft. long, weight 743 lb.	0.4	211
F.	Utility pole, 13-½ in. diameter, 35 ft. long, weight 1490 lb.	0.4	211
G.	Automobile, frontal area 20 ft.[2] weight 4000 lb.	0.2	106

[1]The maximum wind speed in Region is 360 MPH (528 fps) per Regulatory Guide 1.76, Design Basis Tornado for Nuclear Power Plants.

ATTACHMENT 4

p. 37/41
SBC-367
T.S.R

$$f_2(A) = \left(\frac{1}{A}\right)^{1/2} = (A)^{-1/2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (12)$$

$$f_3(W) = (W)^{1/2} \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots \quad (13)$$

The Velocity Effect, $f_4(V)$.—Since most soils considered in this analysis are vertically homogeneous for only the top few feet, it is not practical to hold the soil function constant over the complete range of velocities. The approach is to determine the velocity effect for the low-velocity range, during which the soil function may be assumed constant, and then separately determine the velocity effect for the high-velocity range.

TABLE 3.—TARGET DESCRIPTION AND SOIL CONSTANTS

Target (1)	Test site (2)	Soil description (3)	Depth, in feet (4)	Soil constant (5)	
I	Main Dry Lake, Tonopah test	Clayey silt, silty ...y, dense, hard, dry	0 to 8	5.2	Too clayey
		Sand, silty, very dense, dry, well cemented	8 to 25	2.5	✓
		Sand, silty, clayey, dense, dry to damp	25 to at least 90	5.2	✓
II	Salt target WSMR, N.M.	Clay, silty, soft, wet brown	0 to 1.6	40	✗
		Clay, silty, very stiff, tan with traces of sand, highly montmorillonitic	1.6 to at least 8	6.5	✗
III	Great Salt Lake Desert, Utah	Clay, soft, wet, grey, varved, medium to high plasticity	0 to at least 15	50	✗
IV	Northrup Strip WSMR	Gypsite, selenite, hard, moist, very homogeneous	0 to at least 20	2.5	✗
V	Gulkana Glacier, Alas.	Ice glacier	0 to at least 20	4.35	✗
VI	Eielson AFB, Alas.	Silt, clayey, frozen (permafrost)	0 to at least 30	3.5	✗ Sea Spook
VII	Eglin AFB, Fla.	Sand, loose to medium, moist	0 to at least 70	7.0	Backfill not loose
VIII	Tonopah test range and Nevada test site	Rock, highly welded, fine-grained agglomerate	0 to at least 10	1.07	
IX	Grants, N.M.	Sandstone, tres hermanos	0 to at least 30	1.3	
X	Skaggs Island, Calif.	Clay, silty, wet (bay mud)	0 to at least 80	40	✗
XI	Tonopah test range	Sand, silty, clayey, dense (desert alluvium)	0 to at least 100	4.4	✓
XII	Bryan AFB, Tex.	Clay, moist, stiff	8 to at least 15	10.5	✗

Fig. 4 shows a plot of velocity versus depth over the low-velocity range. The curve to best fit the data appears to be $f_4(V) = C_1 \ln(1 + 2V^2 10^{-5})$, for an impact velocity of less than 200 fps. The constant C_1 is completely arbitrary.

The main Dry Lake at Tonopah Test Range, Nevada, is a layered material. Thus far in the analysis only the top 10 ft of the dry lake playa have been considered. To determine the high-velocity effect, a preliminary set of soil constants was calculated and used to normalize the data to that used in the low-velocity part of the velocity effect function. Fig. 5 shows the normalized data and the curve representing the best data fit. In the final iteration the high-velocity function appears to be $C_2(V - 100)$. The constant C_2 must be determined

Source: Reference 5

ATTACHMENT 5 p. 38/41

normalized (V, W/A, and soil), any deviation in penetration performance when various nose shapes are used is an indication of nose performance. The 6.0 Caliber-Radius-Head (CRH) tangent ogive nose was selected as the standard on which penetration performance was based. The nose-shape effect, f_1 (N), is best described by a nose-performance coefficient which indicates relative nose efficiency.

The nose-performance coefficients were determined from Fig. 1 for the tangent ogive nose shapes and for the flat noses. Additional nose-performance coefficients were determined from a series of tests during which all parameters were held constant except nose shape. Any variation in penetration performance (over an average of several tests) was then attributed to the nose effect, and again using the 6.0 CRH tangent ogive as the standard, nose-

TABLE 2.—NOSE-PERFORMANCE COEFFICIENTS

Nose Shape (1)	Nose-performance coefficient, N (2)
Flat nose	0.56
Tangent ogive, 2.2 Caliber Radius Head (CRH)	0.82
Tangent ogive, 6.0 CRH	1.00[a]
Tangent ogive, 9.25 CRH	1.11
Tangent ogive, 12.5 CRH	1.22
Cone, L/D = 2, where L is length and D is diameter	1.08
Cone, L/D = 3	1.32
Conic step[b]	1.28
Biconic[c]	1.31
Short inverse ogive, L/D = 2	1.03
Long inverse ogive, L/D = 3	1.32

[a]Arbitrarily chosen as N = 1.0.
[b]Cone, plus cylinder, plus cone; with an over-all L/D = 3.
[c]Slender conic nose tip, with a more abrupt conic base; with an over-all L/D = 3.

performance coefficients were calculated. The nose-performance coefficients obtained from Fig. 1 and from the additional tests are presented in Table 2.

Weight and Area Effect, f_2 (A) and f_3 (W).—The No. 279 series of tests (Table 1) was conducted under closely controlled conditions, including similar soil conditions. It appears that sufficient data are available from this test series to justify combining f_2 (A) and f_3 (W) into a single function, f_6 (W/A). For example, Fig. 2 is a plot of impact velocity versus penetration distance, with the soil and the ratio of weight-to-area held constant (the vehicle weight and area are varied in the same ratio.) It appears from the data fit that it is reasonable to study the ratio of weight to area as a single function, and the crucial justification for f_6 (W/A) is in the fit of the test data to the final equation.

Source: Reference 5

ATTACHMENT 6

FORM WE-103-1
Revision 2

REVIEW FORM

CALCULATION NO. SBC-367 Seabrook Station

TITLE: Control Room West Intake Relocation - Tornado Missiles

To be checked by originator:

	Yes	No
Is this a structural or mechanical analysis?		✓
If yes, was Table 1 check list used?		
Was a computer code used?		✓
If yes, was the code approved per WE-108?		
Was the code appropriate?		
Were outstanding SPRs evaluated?		

REVIEWER COMMENTS	RESOLUTION
Pg 17 z for automobile should be 0.122	✓ ✓
Pg 19 Intake opening area should be 70.8 ft²	✓ Should be 51.3 ft²
Pg 20 TA should be 5-4.8 T-OH	
Pg 33 missile/area for zone 10 should be .025	✓ gah 3/2/90

T. Ottaviani 3/1/90
Reviewer / Date

Ted Ottaviani 4/13/90

ATTACHMENT 7

SBC-367
p. 40/41

TABLE IV-4. SITE-SPECIFIC MISSILE SET CHARACTERISTICS

Final Missile Set	Aero Set	Description (Typical)	Depth (in)	A_{min} (in^2)	Weight per Unit Length (lb/ft)	Length/Depth Minimum	Length/Depth Maximum
1*	1 a	Rebar	1.00	0.79	2.67	36.0	36.0
2	1 c	Gas Cylinder	10.02	9.45	38.64	4.0	10.0
3	1 d	Drum, Tank	19.98	311.60	23.55	2.3	6.0
4*	2 b	Utility Pole	13.50	143.10	32.06	31.1	31.1
5	2 c	Cable Reel	42.21	126.60	140.70	0.5	0.6
6*	3 b	3" Pipe	3.50	2.20	7.58	34.3	34.3
7*	3 c	6" Pipe	6.63	5.60	18.90	27.2	27.2
8*	3 d	12" Pipe	12.75	14.60	49.60	14.1	14.1
9	5 b	Eqpt., Bin	38.40	40.50	112.50	1.0	11.4
10	5 c	Dumpster	94.81	386.70	452.20	1.0	3.6
11	6 b	Wood Tie	10.36	107.34	29.81	6.0	36.0
12*	9 a	Wood Beam	12.00	48.00	9.50	12.0	12.0
13	11 a	Wood Plank	12.00	12.00	3.30	8.0	12.0
14	12 a	Metal Siding	48.00	24.00	25.00	2.0	4.0
15	13 a	Plywood Sheet	48.00	50.74	15.02	2.0	2.0
16	14 b	Wide Flange	11.29	8.16	27.87	8.0	60.0
17	15 a	Angle Section	5.27	2.38	7.98	0.4	108.0
18	16 a	Channel Section	5.11	3.49	11.88	9.0	80.0
19	18 a	Small Eqpt.	46.48	4.63	44.02	1.2	13.3
20	19 a	Large Eqpt.	67.07	15.70	88.67	0.3	18.8
21	21 a	Pipe Frame	53.69	1.61	13.95	1.1	6.0
22	22 a	Grating	43.31	2.22	12.37	1.0	7.5
23	22 b	Rect. Frame	97.41	11.00	47.23	1.0	5.0
24	22 c	Crane Section	98.00	400.00	168.30	1.0	10.0
25	23 a	Wood Frame	168.00	240.00	35.35	1.0	2.5
26*	25 a	Vehicle	66.00	2574.00	250.00	2.9	2.9

* Denotes membership in NRC standard spectrum of missiles [5]: Set 1 = 1-in rebar; Set 4 = utility pole; Set 6 = 3-in steel pipe; Set 7 = 6-in steel pipe; Set 8 = 12-in steel pipe; Set 12 = wood beam; Set 26 = vehicle.

Source: Reference 1

TABLE IV-17. PARAMETERS AND SAMPLE STATISTICS OF MAXIMUM VELOCITY CHARACTERISTICS

Parameter Set	Missile	Injection Height z_i (ft)	Max Windspeed[1] U_{max} (mph)	Maximum Velocity (mph)[2] Mean	Maximum Velocity (mph)[2] 90% Quantile	Maximum Velocity (mph)[2] Extreme	Maximum Hor. Velocity (mph)[2] Mean	Maximum Hor. Velocity (mph)[2] 90% Quantile	Maximum Hor. Velocity (mph)[2] Extreme	Maximum Ver. Velocity (mph)[2] Mean	Maximum Ver. Velocity (mph)[2] 90% Quantile	Maximum Ver. Velocity (mph)[2] Extreme
1	1-in. Rod	150	300	146.5	186.6	235.6	137.4	180.0	231.1	57.3	71.3	96.1 ✓
2	Utility Pole	20	300	44.0	59.6	100.9	36.3	55.1	97.5	23.0	26.2	35.1 ✓
3	3-in. Pipe	150	300	150.3	189.5	249.3	141.0	184.7	240.6	58.1	72.4	91.3 ✓
4	6-in. Pipe	150	300	114.7	148.5	198.6	98.4	137.8	193.7	58.1	68.2	83.3 ✓
5	12-in. Pipe	10	250	23.6	30.6	43.2	16.2	26.0	40.6	16.2	17.9	22.3
6			300	29.8	41.9	79.8	29.0	38.7	77.2	16.1	18.5	24.5
7		33	200	36.7	42.7	51.4	20.4	31.2	43.2	29.8	31.6	35.9
8			250	44.2	56.2	74.0	31.4	47.5	68.8	29.7	32.6	38.2
9			300	56.6	76.3	119.0	46.9	70.1	115.5	29.4	33.5	41.6
10		150	150	66.9	71.5	79.0	24.0	35.9	50.8	61.9	65.3	68.6
11			200	74.0	84.2	101.3	39.8	58.9	81.2	61.2	65.7	72.0
12			250	85.2	103.5	144.2	58.8	84.5	126.5	59.9	66.1	72.9
13			300	104.6	132.7	186.0	85.3	119.4	174.8	59.0	68.2	78.4 ✓
14	Vehicle	10	200	24.3	32.5	48.1	17.3	28.4	45.5	16.0	18.3	23.6
15			250	33.7	49.9	101.9	28.6	47.4	100.5	16.2	19.8	25.4
16			300	47.2	77.0	140.3	43.1	74.0	136.9	17.2	22.6	43.6 ✓
17	Plank	150	300	185.8	231.4	309.9	178.1	226.0	309.3	75.9	102.4	140.9 ✓

[1] At 33 ft.
[2] Statistics based on 1,000 observations for each missile-injection height-windspeed combination, except the plank (500 observations).

Source: Reference 8

ATTACHMENT 8

SBC-367
p. 41/41

Enclosure 3 to NYN-03081

Commitments Associated With NYN-03081

Condition Report	Commitment
CR 03-07663	FPLE Seabrook commits to maintaining a program in effect to control the administration of potassium iodide (KI) to Control Room personnel during core alterations when the Primary Containment Equipment Hatch is open. This interim measure will remain in effect until the current license basis for unfiltered CRE leakage is revised.