Entergy

Entergy Operations, Inc.
17265 River Road
Killona, LA 70066
Tel 504 739 6660
Fax 504 739 6678

Charles M. Dugger
Vice President, Operations
Waterford 3

W3F1-99-0140
A4.05
PR

October 29, 1999

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

Subject: Waterford 3 SES
Docket No. 50-382
License No. NPF-38
Request for Review and Approval of Design Basis
Change Regarding Tornado Missiles

Gentlemen:

Pursuant to 10CFR50.90 and 10CFR50.59, Entergy hereby requests amendment of Facility Operating License NPF-38 for the Waterford 3 Steam Electric Station (Waterford 3). Entergy requests review and approval, pursuant to 10CFR50.59, of changes to the Waterford 3 design basis as described in the Updated Final Safety Analysis Report (UFSAR) for which it has been determined that an unreviewed safety question exists. The changes concern design requirements for physical protection from tornado missiles for safety-related systems, structures and components (SSC). Because the proposed changes evaluate acceptable as-found conditions that involve an unreviewed safety question, NRC Staff approval per 10CFR50.59 is required.

The changes are based on an evaluation using NRC Staff approved probability risk methodology and acceptance criteria for determining the SSCs that require physical protection from tornado missiles. Additional information and documents to support this application are provided as attachments to this letter. An affidavit supporting the facts set forth in this letter and its attachments is provided as Attachment 1. Attachment 2 provides the description, purpose, safety analysis, no significant

A053

PDR ADOCK

hazards consideration determination, operability determination and evaluation for environmental impact for the changes. Attachment 3 provides important details associated with the tornado missile strike probability analysis. Attachment 4 provides a copy of the marked-up UFSAR pages for the proposed changes. Attachment 5 addresses the commitments associated with this submittal.

Although this request is neither exigent nor an emergency, review and approval is requested by March 31, 2000.

After NRC Staff approval of this amendment request, the UFSAR will be revised as indicated in Attachment 4.

If you should have any questions on the above or on the attachments, please contact Everett Perkins at (504) 739-6379.

Very truly yours,

C.M. Dugger
Vice President, Operations
Waterford 3

CMD/RWP/ssf
Attachments

cc: E.W. Merschoff, NRC Region IV
C.P. Patel, NRC-NRR
J. Smith
N.S. Reynolds
NRC Resident Inspectors Office

ATTACHMENT 1 TO W3F1-99-0140

Affidavit

UNITED STATES OF AMERICA
NUCLEAR REGULATORY COMMISSION

In the matter of	)	
	)	
Entergy Operations, Incorporated	)	Docket No. 50-382
Waterford 3 Steam Electric Station	)	

AFFIDAVIT

Charles Marshall Dugger, being duly sworn, hereby deposes and says that he is Vice President, Operations - Waterford 3 of Entergy Operations, Incorporated; that he is duly authorized to sign and file with the Nuclear Regulatory Commission the attached Design Basis Change; that he is familiar with the content thereof; and that the matters set forth therein are true and correct to the best of his knowledge, information and belief.

Charles Marshall Dugger
Charles Marshall Dugger
Vice President, Operations
Waterford 3

STATE OF LOUISIANA	)	
	) ss	
PARISH OF ST. CHARLES	)	

Subscribed and sworn to before me, a Notary Public in and for the Parish and State above named this 29th day of October, 1999.

Brenda M. Folse
Notary Public

My Commission expires June - 2000.

ATTACHMENT 2 TO W3F1-99-0140

Changes Regarding Probabilistic Evaluation of Targets Potentially Susceptible to Damage from Tornado Missiles

Changes Regarding Probabilistic Evaluation of Targets Potentially Susceptible to Damage from Tornado Missiles

In accordance with 10CFR50.90 and 10CFR50.59, Nuclear Regulatory Commission (NRC) Staff review and approval is required for changes to the Waterford 3 Steam Electric Station (Waterford 3) design basis as described in the Updated Final Safety Analysis Report (UFSAR) when such changes involve an unreviewed safety question (USQ). Specifically, Entergy proposes to revise the UFSAR to discuss the probability threshold for when physical protection of safety-related components from tornado missiles is required for certain components. This change was determined to be a USQ. The following provides a description and the purpose of the proposed changes, as well as the associated safety analysis, evaluation for no significant hazards consideration, operability determination and environmental impact evaluation.

Description

The proposed changes involve the use of an NRC Staff approved probability risk methodology to assess the need for additional positive (physical) tornado missile protection of specific features at Waterford 3. During reviews of safety-related targets susceptible to tornado missile damage, it was identified that some safety-related components are not protected from tornado missiles. An analysis was performed to demonstrate that the probability of damage due to tornado missiles striking these components is acceptably low. This analysis was based on Electric Power Research Institute (EPRI) Topical Report, "Tornado Missile Risk Evaluation Methodology (EPRI NP-2005)," Volumes I and II, also known as TORMIS.

The UFSAR changes associated with this request reflect use of the TORMIS methodology. In this regard, the following is noted in the NRC Safety Evaluation dated October 26, 1983, issued for the EPRI topical report: "The current licensing criteria governing tornado missile protection are contained in Standard Review Plan (SRP) Sections 3.5.1.4 and 3.5.2. These criteria generally specify that safety-related systems be provided positive tornado missile protection (barriers) from the maximum credible tornado threat. However, SRP Section 3.5.1.4 includes acceptance criteria permitting relaxation of the above deterministic guidance, if it can be demonstrated that the probability of damage to unprotected essential safety-related features is sufficiently small."

"Certain Operating License (OL) applicants and operating reactor licensees have chosen to demonstrate compliance with tornado missile protection criteria for certain portions of the plant...by providing a probabilistic analysis, which is intended to show a sufficiently low risk, associated with tornado missiles. Some...have utilized the tornado missile probabilistic risk assessment (PRA) methodology developed by...EPRI in (the) two topical reports [i.e., EPRI NP-2005, Volumes I and II]." The NRC concluded: "...the EPRI methodology can be utilized when assessing the need for positive tornado missile protection for specific safety-related plant features in accordance with the criteria of SRP Section 3.5.1.4."

Also, the EPRI methodology has been previously applied by other licensees to resolve tornado missile protection issues by not requiring additional protection because of low missile strike probability.

Purpose

The purpose of this amendment is to apply the Waterford 3 specific criterion of having a total probability of tornado missiles striking an important system or component, shown by analysis, to be less than 10^{-6} per year in order to not require physical protection. This criterion would not only be applicable to features vulnerable during normal operation, but could also be applied to the temporary removal, under administrative controls, of existing protective barriers for plant maintenance and modification activities.

Safety Analysis

As noted above, the methodology of EPRI NP-2005 (TORMIS) was previously used for evaluation of tornado missile hazards. Based on the TORMIS methodology, a tornado missile analysis was performed for Waterford 3. The results of this tornado missile hazards analysis are such that the tornado missile strike hazard probability is approximately 6.0×10^{-7} per year. General guidance concerning the acceptance criteria for such analyses is provided in the Standard Review Plan (NUREG-0800), Section 3.5.1.4, "Missiles Generated by Natural Phenomena," and by reference Section 2.2.3, "Evaluation of Potential Accidents." In Section 2.2.3, the following guidance is provided: "The probability of occurrence of the initiating events leading to potential consequences in excess of 10CFR100 exposure guidelines should be estimated using assumptions that are as representative of the specific site as is practicable. In addition, because of the low probabilities of the events under consideration, data are often not available to permit accurate calculation of probabilities. Accordingly, the expected rate of occurrence of potential exposures in excess of the 10CFR100 guidelines of approximately 1×10^{-6} per year is acceptable if, when combined with reasonable qualitative arguments, the realistic probability can be shown to be lower." The 6.0×10^{-7} per year probability for Waterford 3 falls within the above guidelines.

The tornado missile hazards analysis for Waterford 3 contain applicable site-specific assumptions, and the results are within the range described in Standard Review Plan, Section 2.2.3. The site-specific assumptions for Waterford 3 are discussed in Attachment 3.

The NRC Staff concluded that this approach is an acceptable probabilistic approach for demonstrating compliance with the requirements of General Design Criteria 2 and 4 regarding protection of specific safety-related plant features from the effects of tornado and high wind generated missiles.

It is Entergy's position that utilization of this NRC Staff approved TORMIS methodology, which applies the probabilistic approach, is a sound and reasonable method of addressing tornado missile protection for the components that are not protected by tornado missile barriers at Waterford 3.

Proposed UFSAR Changes

The following is a summary of UFSAR changes that are being proposed. The associated marked-up UFSAR pages are included in the Attachment 4.

SUMMARY OF UFSAR UPDATES

SECTION	TITLE	DESCRIPTION
2.3.1.2.4	Tornadoes	• Corrected typo. • Added PRA and use of TORMIS as an evaluation technique that can be used for tornado missile protection for plant SSC. • Added acceptance criteria for PRA.
3.1.4	Criterion 4 – Environmental & Missile Design Basis	• Added a qualifying sentence for the plant SSC, located outdoors, to take credit for TORMIS analysis in the missile protection analysis referencing Section 3.5.1.4.1.
3.3	Wind and Tornado Loading	• Added protective barrier as an acceptable method for plant SSC against tornado missile loading for item (b). • Added item (c) to include PRA as an acceptable method to evaluate tornado missile protection need for plant SSC required to be designed for tornado

		loading.
3.3.2.1	Applicable Design parameters	• Added Standard Review Plan, Section 3.3.2 reference in item (c).
3.3.2.2	Determination of Forces on Structures	• Corrected sub-section number to 3.3.2.1 (b) for the paragraph starting with "The pressure differential (p) noted………". • Added phrase for structural analysis. • Assigned an equation number (6) to an equation already shown in this section. Corrected spelling error for word "same".
3.3.2.3	Effect of Failure of Structural…….Tornado Loads	• Corrected spelling error for word "assume" in subsection a) of this section.
3.5.1.4	Missiles Generated by Natural Phenomena	• Added reference to Tables 3.2-1, 3.5-3 and 3.5-3a for safety-related plant SSC requiring missile protection. • Added subsection 3.5.1.4.1 "System/Component not requiring tornado missile protection" • Added subsection 3.5.1.4.2 "Tormis description"
3.5.2	Systems To Be Protected	• Added reference to Table 3.2-1 for the systems protected from tornado missiles.
3.5.3.1.1	Concrete Barriers	• Corrected spelling for word "Petry". • Corrected equation for velocity factor 'V' by changing location of closing bracket in subsection a). • Defined parameter 'W' for missile weight in subsection a). • Added a Note defining 'K' value for steel rod missile in the parameter 'K' definition in subsection a)
3.5.3.1.2	Steel Barriers	• Corrected equation (13), "The Stanford Formula". • Deleted 'T' at the end of the definition for the parameter 'β'. • Revised equation (14), "The modified Stanford Formula". • Added bracket in parameter 'M' of

		equation (15), "Ballistic Research Laboratory Formula".
3.5.3.2.1	Concrete Barriers	• Added closing bracket after word "missiles" in the first sentence of the second paragraph. • Deleted an extra closing bracket from definition of "20t" in the sub-section b). • Change variable 'Vm' to 'V_m' in equation (23) and (24). • Corrected spelling for "Petry" in the definition of 'D', penetration depth.
3.5.3.2.2	Steel Barriers	• Revised variable 't1' to 't_1' in equation (26). • Corrected equation (27). • Corrected unit of the variable 'x' of equation (27) to (ft) from (in). • Corrected equation (28).
3.5	References	Added references 16, 17
Table 3.2-1	Classification of Structures, Systems and Components	• Revised Tornado Wind Criteria to reflect PRA as an acceptable alternate. • Added 'note c' and revised note b for Tornado Wind Criterion.
Table 3.5-3	Missile Protection-Outside Containment	• Revised probability numbers for the exposed Main Steam, Feedwater and Emergency Feedwater piping. • Added a note referencing section 3.5.1.4.1 in the "Missile Protection" column of the CCW and Ultimate Heat Sink system. • Added reference to Section 3.5.1.4.1 in Missile Protection column for Station Service Transformers and 480V MCC.

Evaluation for Significant Hazards Consideration

In accordance with 10CFR50.92, a proposed change to the operating license involves no significant hazards consideration if operation of the facility in accordance with the proposed change would not: (1) involve a significant increase in the probability or consequences of any accident previously evaluated, (2) create the possibility of a new or different kind of accident from any accident previously evaluated; or, (3) involve a significant reduction in a margin of safety.

The proposed changes, i.e., revising the current UFSAR descriptions addressing tornado missile barrier protection at Waterford 3 have been evaluated against these three criteria, and it has been determined that the changes do not involve a significant hazard because:

(1) The proposed activity does not involve a significant increase in the probability or consequences of any accident previously evaluated.

The associated UFSAR changes reflect use of the Electric Power Research Institute (EPRI) Topical Report, "Tornado Missile Risk Evaluation Methodology, (EPRI NP-2005)," Volumes 1 and II. This methodology has been reviewed, accepted and documented in a NRC Safety Evaluation dated October 26, 1983. The NRC concluded that: "the EPRI methodology can be utilized when assessing the need for positive tornado missile protection for specific safety-related plant features in accordance with the criteria of SRP Section 3.5.1.4."

The EPRI methodology has been previously applied by other licensees to resolve tornado missile protection issues.

The results of the tornado missile hazards analysis are such that the calculated total tornado missile hazard probability for safety-related SSC's is approximately 6.0×10^{-7} per year. This is lower than the value determined to be acceptable, i.e., 1×10^{-6} per year by the NRC Staff.

With respect to the probability of occurrence or the consequences of an accident previously analyzed in the UFSAR, the possibility of a tornado reaching Waterford 3 causing damage to plant systems, structures and components is a design basis event considered in the UFSAR. The changes being proposed herein do not reduce the probability that a tornado will reach the plant. However, it was determined that there are a limited number of safety-related components that theoretically could be struck. The probability of tornado-generated missile strikes on these components were analyzed using the NRC Staff approved probability methods described above. On this basis, the proposed change is not considered to constitute a significant increase in the probability of occurrence or the consequences of an accident, due to the low probability of a tornado missile striking these components.

Therefore, the proposed changes do not involve a significant increase in the probability or consequences of previously evaluated accidents.

(2) The proposed activity does not create the possibility of a new or different kind of accident from any accident previously evaluated.

The proposed changes involve evaluation of whether any physical protection of safety-related equipment from tornado missiles is required relative to the probability of such damage without physical protection. A tornado at Waterford 3 is a design basis event considered in the UFSAR. This change involves recognition of the acceptability of performing tornado missile probability calculations in accordance with established regulatory guidance. Therefore, the change would not contribute to the possibility of, or be the initiator for any new or different kind of accident, or to occur coincident with any of the design basis accidents in the UFSAR. The low probability threshold established for tornado missile damage to system components is consistent with these assumptions.

Therefore, the proposed changes do not create the possibility of a new or different kind of accident.

(3) The proposed activity does not involve a significant reduction on a margin of safety.

The request does not involve a significant reduction in a margin of safety. The existing licensing basis for Waterford 3 with respect to the design basis event of a tornado reaching the plant, generating missiles and directing them toward safety-related systems and components is to provide positive missile barriers for all safety-related systems and components. With the change, it will be recognized that there is an extremely low probability, below an established acceptance limit, that a limited subset of the "important" systems and components could be struck. The change from "protecting all safety-related systems and components" to "an extremely low probability of occurrence of tornado generated missile strikes on portions of important systems and components" is not considered to constitute a significant decrease in the margin of safety due to that extremely low probability.

Therefore, the proposed changes do not involve a significant reduction in a margin of safety.

Operability Determination for Affected Components

Generic Letter 91-18, Revision 1, "Information to Licensees Regarding NRC Inspection Manual Section on Resolution of Degraded and Nonconforming Conditions, Change to Current Licensing Basis," dated October 8, 1997, makes the following discussion regarding changing the licensing basis to accept a nonconforming or degraded condition:

> [One] situation [to consider] is a final resolution in which the licensee plans to change the current licensing basis to accept the as-found nonconforming

condition. In this case, the 10CFR50.59 evaluation is of the change from the SAR-described condition to the existing condition in which the licensee plans to remain (i.e., the licensee will exit the corrective action process by revising its licensing basis to document acceptance of the condition). If the 10CFR50.59 evaluation concludes that a change to the TS or a USQ is involved, a license amendment must be requested, and the corrective action process is not complete until the approval is received, or other resolution occurs. In order to resolve the degraded or nonconforming condition without restoring the affected equipment to its original design, a licensee may need to obtain an exemption from 10CFR Part 50 in accordance with 10CFR50.12, or relief from a design code in accordance with 10CFR50.55a. The use of 10CFR50.59, 50.12, or 50.55a in fulfillment of Appendix B corrective action requirements does not relieve the licensee of the responsibility to determine the root cause, to examine other affected systems, or to report the original condition, as appropriate.

In both of these situations, the need to obtain NRC approval for a change (e.g., because it involves a USQ) does not affect the licensee's authority to operate the plant. The licensee may make mode changes, restart from outages, etc., provided that necessary equipment is operable and the degraded condition is not in conflict with the TS or the license. The basis for this position was previously discussed in Section 4.5.1.

Entergy has performed an operability determination of these components that are affected by postulated tornado missiles to allow the plant to continue to operate. Based on tornado missile damage probability using TORMIS, the strike probability of the affected system components is less than the 1×10^{-6} per year strike probability criterion.

Therefore, the potentially affected systems and components have been determined to be operable with respect to protection from postulated tornado missiles. Since required equipment is operable and Entergy is requesting NRC Staff approval for the license basis change, plant operation does not pose an undue risk to public health and safety.

Environmental Impact Consideration

The proposed request was evaluated against the criteria of 10CFR51.22 for environmental considerations. The proposed changes do not significantly increase individual or cumulative occupational exposures, do not significantly change the types or significantly increase the amounts of effluents that may be released offsite; and, as discussed in this attachment, do not involve a significant hazards consideration. Considering the foregoing, it has been concluded that the proposed changes meet the criteria given in 10CFR51.22 for categorical exclusion from the requirement for an Environmental Impact Statement.

ATTACHMENT 3 TO W3F1-99-0140

Tornado Missile Strike Probability Analysis Details

TORNADO MISSILE STRIKE PROBABILITY ANALYSIS DETAILS

The following is a description of the details associated with the tornado missile strike probability analysis.

TORNADO MISSILE STRIKE PROBABILITY METHODOLOGY

The probability of a tornado missile strike at Waterford 3 is calculated using the following equation.

$$P_T = \sum_{i}^{N} P(T_i)$$

Where;

P_T = Probability of tornado missile striking all targets at Waterford 3, per year

$P(Ti)$ = Probability of tornado missile striking a particular target, Ti, per year.

N = Number of unprotected safety-related vulnerable targets

The target probabilities, $P(T_i)$ values will be calculated using TORMIS computer code originally developed by EPRI. (References 1 and 2) The target probabilities, $P(T_i)$, for Waterford 3 can be described by the following equation:

$$P(T_i) = C \times \sum_{0}^{6} P(T_i / F_j) P_G(F_j)$$

Where;

$P(Ti/F_j)$ = Probability of tornado missile striking target, T_i, given that the tornado of Fujita F-Scale intensity Fj has occurred.

C = $P_L(F) / P_G(F)$

$P_L(F)$ = Probability of tornado strike in local region defined by 1-degree square area centered at Waterford 3 per year using data compiled by Dr. McDonald and adjusted for unreported tornado and to account for large waterbodies near Waterford 3 site.

$P_G(F)$ = Probability of tornado strike at Waterford 3 site, using Fujita F-Scale, based on the NRC global Region I, per year.

$P_G(F_j)$= Probability of tornado strike of Fujita F-Scale intensity in NRC Region I.

To introduce conservatism in the tornado missile strike probabilities for all targets, occurance rates based on broad region (NRC Region I) are used in TORMIS because not all tornado characteristics of local region are available for TORMIS analysis. The target probabilities thus calculated by TORMIS analysis based on the NRC global region are scaled down to arrive at the target probabilities based on the local region. The scaled down, C, factor is derived using a more conservative local probability value as described below.

LOCAL AND GLOBAL PROBABILITY CALCULATION:

The Waterford 3 site is located at

29° 59' 42" North Latitude
90° 28' 16" West Longitude

As described in UFSAR Section 2.3.1.2.4 "Tornadoes", the probability of a tornado strike at Waterford 3 is 7.68×10^{-5} per year. The probability is based on 112 tornadoes reported within 50 nautical miles (58 statute miles) between 1950 to 1977 with an average path length and width of 3.36 miles and 318 feet respectively. For the TORMIS analysis, a refined probability for a tornado strike is developed using reported tornado data from the Storm Prediction Center (SPC), National Oceanic and Atmospheric Administration, in Norman, Oklahoma for the years 1954-1995 for the 1-degree square near Waterford 3. The reported tornado data is adjusted to account for potentially unreported tornadoes in the 1-degree region using the methodology developed by Allen (1981). This tornado assessment also accounts for the presence of large water bodies near Waterford 3. The new probability value was compared to the 7.68×10^{-5} value from UFSAR Section 2.3.1.2.4. The more conservative of these two values was used in the Waterford 3 analysis.

The distribution of reported and unreported tornadoes in the 1-degree square region is shown in the table below.

Distribution of Reported and Unreported* Tornadoes in the 1-Degree Square Region for Waterford 3 1954-1995

Fujita Scale	F0	F1	F2	F3	F4	F5	TOTAL
Reported	26	60	20	4	2	0	**112**
Unreported *	6	14.5	5	1	0.5	0	**27**
Total	32	74.5	25	5	2.5	0	**139**

* As derived by Dr.McDonald

The mean damage path area was calculated for each Fujita, F-Scale, classification. The information on the path area comes from SPC tornado database. A linear regression analysis was performed to obtain a continuous area-intensity function. Upper and lower bound values were calculated in order to obtain 95% confidence limit on the tornado hazard probability assessment. The tornado strike probability for each wind intensity for the Waterford 3 site local region was then calculated.

The total site probability, $P_L(F)$, is then obtained summing all probability values calculated for each wind speed. The refined tornado strike probability (local 1-degree square), 2.23×10^{-4} includes unreported tornado for the local region. This probability was used to compute the overall target strike probability since it is more conservative compared to the tornado strike probability, 7.68×10^{-5}, documented in the UFSAR Section 2.3.1.2.4.

The global probability, $P_G(F)$, for Waterford 3 is calculated using tornado occurrence rate and tornado mean path area for Fujita F-Scale wind intensities for NRC Region I. The calculated probability value is 42.70×10^{-5}.

Based on the calculated value of $P_L(F)$ and $P_G(F)$, the scale down factor *'C'* is calculated as below:

$$C = P_L(F) / P_G(F)$$

$$C = \frac{2.23X\ 10^{-4}}{42.70X\ 10^{-5}} = 0.52$$

MISSILE DATA

Reference 1 indicates that missiles beyond the circle of about 1/2 mile radius from the plant center are unlikely to reach plant structures in the event of a tornado. In this evaluation, a region of 5000′ X 5000′, with the Reactor Building being at the center, is considered adequate. This region is divided into ten (10) missile zones. This division of the region was based on the observation of structures and buildings during a walkdown, site plan drawing G-128 (UFSAR Figure No. 1.2-2) and an aerial photograph.

The missiles at the plant site are simulated by the missile spectrum shown in UFSAR Table 3.5-10.

All missile types are postulated in all missile zones except missile Zones 1, 4 and 7. Missiles are not postulated in Zone 1 (Mississippi River). Missile Zones 4 and 7 are parking areas where only auto and utility pole type missiles are postulated.

The selection of the total number of missiles in each zone is partly based on industry experience and partly based on the density of missile producing structures (non safety-related buildings, trailers, sheds, etc.) in the missile zones. In these areas, the estimates are based on 25 missiles in every 10-ft cube of the shed volume. i.e., in a shed of 200′ X 50′ X 20′ (high) the total number of postulated missiles would be 5000. Similarly, the autos in the parking areas are estimated based on one auto for every 100-sq. ft. of the parking area.

Based on these estimates, a total of 71,800 missiles are postulated in 9 missile zones. This number is considered conservative on the basis of the example problem in Reference 1 where a total of 65,550 missiles were postulated for a one unit plant site. In this total, 8450 missiles were considered minimally restrained (i.e., unrestrained) and 57,100 were considered partly restrained. In this report all missiles are conservatively considered to be minimally restrained.

Missile types planks, pipes and rods are postulated to be equal in number in all missile zones. The remaining two types, autos and utility poles, are postulated as

10% of others. In the parking areas, the postulated number of utility poles are 10% of the auto missiles.

The missiles in each missile zone can be located either at the ground elevation or at elevations higher than the ground. This variability is expressed in TORMIS by specifying a range of missile injection height for each missile type. In a non-safety related structures missiles may potentially be found anywhere from the floor to the roof of the structure. To account for this, the injection heights of plank, pipe and rod missiles are considered to be between 5′ - 30′. The autos are located on the ground level; therefore, the injection height is assumed to be between 0′ - 5′. For utility pole, the injection height is assumed to be between 15′ - 25′.

PLANT DATA

The following general assumptions regarding plant data were used for the analysis:

- There are no tornado generated missiles that can directly impact irradiated fuel, even the spent fuel stored in the Fuel Handling Building (FHB). Any missiles postulated to enter the spent fuel storage portion of the FHB would be stopped by the concrete walls and roof.

- It is assumed that a safety or an important to safety system or component simply being struck by a tornado missile will result in damage sufficient to preclude it from performing its intended safety function, although this is not realistic for all cases since missile barrier protection is afforded to majority of the systems and certain plant SSC's are located below grade and protected by concrete walls and sub-compartments and the components postulated to be struck have some inherent capacity that is ignored.

In TORMIS, rectangular and cylindrical buildings are idealized as six-sided parallelepiped, and three-sided cylindrical surfaces respectively. TORMIS considers each surface as a target and calculated its conditional probability.

The selection of the buildings to be included in the model is such that all vulnerable targets are represented by one or more of the modeled building surfaces. At Waterford 3, the targets are located on the Auxiliary Building roof, on the Reactor Building wall, and in the cooling tower cells which are open from the top. With these considerations the following buildings were selected for inclusion in the TORMIS model.

- Auxiliary Building
- Cooling Towers including cells
- Fuel Handling Building
- Reactor Building

- Turbine Building

TARGET DATA

The targets are identified in following table. The target areas for the cylindrical targets such as conduits, pipes, etc. are based on the full surface areas amplified by a factor of 1.1. This will increase the target area of cylindrical object by 1.1 times 3.14 to equal 3.45 times. For rectangular targets such as electrical switch boxes, the target areas are based on full exposed areas amplified by a factor of 1.1. For planer targets such as door openings actual opening areas are used.

Targets and Category

Target I.D.	Target Category
Ultimate Heat Sink – 'A' and 'B' Train Components • Dry Cooling Towers Fans, Motors • Associated conduits and electrical boxes • Component Cooling Water (CCW) piping, Accumulators and Cabinets	1
Other Safety-Related Components • Main Steam Header Supply to Emergency Feed Pump Turbine Piping and EFW Pump Discharge Piping to isolation valve • Plant Stack, Terry Turbine Exhaust Stack and EDG Stacks (East & West Side) • Containment Escape Hatch and Doors (D051, D266 & D270) • Control Room Differential Pressure Sensing Lines (2),	2

Target I.D.	Target Category
Non-Safety Related Components • Sump Pump Motor & Floor Drain for Sump No. 2 • Control Room Breathing Air System Storage Tank • Main Steam line Relief Valves Vent Stacks (East & West Side) • Waste Management Piping • Main Steam Dump Valves vent to atmosphere (East & West side) • Reactor Building Roof Drains	3

The target probabilities for each category is shown below:

Category - 1

This category contains safety-related targets associated with the Ultimate Heat Sink (UHS). The total probability of these targets is 4.3×10^{-7} per year. The original design and licensing basis for the UHS was a qualitative evaluation of low missile strike probability due to physical plant features and layout. This evaluation did not address the specific missile strike probability for the UHS. However, this TORMIS analysis confirms the original qualitative description presented in the initial FSAR.

Category - 2

This category contains safety-related targets other than those in the Category 1. The total probability of these targets is 1.7×10^{-7} per year.

Category - 3

This category group contains the remaining targets. The total probability of these non-safety related but important targets is 0.4×10^{-7} per year.

The cumulative tornado generated missile strike probability for safety-related SSCs at Waterford 3 is 6.0×10^{-7}. The total Waterford 3 plant probability for safety and non-safety related plant SSCs is the summation of the probabilities of the three groups, and is calculated to be 6.4×10^{-7} per year.

The calculated total probability for safety-related SSCs is 6.0×10^{-7} per year is within the acceptance criteria of 10^{-6} per year established by the NRC Staff. Therefore, the identified targets need no additional physical protection from a tornado missile strike. Following conservatism is built into TORMIS analysis.

- The targets are conservatively assumed to be damaged upon the missile strike.
- The surface areas of the cylindrical targets such as pipes, conduits and stacks are calculated based upon their full surface area amplified by 10%.
- The conduits and pipes run in groups. The shielding effects of any one conduit or pipe over the rest of conduits and pipes in a group is ignored.
- The surface area of all six sides of electrical boxes is used in analysis instead of projected area.
- Certain non-safety related targets (Category 3) are included in the analysis.
- Missile population used in the analysis is conservative.

RESOLUTION OF NRC'S FIVE POINTS IN THE TORMIS SAFETY EVALUATION REPORT ON TORMIS

The following explanation provides the Waterford 3 specific responses to the five points the NRC Staff, raised in the evaluation of the EPRI TORMIS methodology.

1. "Data on tornado characteristics should be employed for both broad regions and the small areas around the site. The most conservative values should be used in the risk analysis or justification provided for those values selected."

   Response:

   The Waterford 3 site is located near the Gulf of Mexico coastline. Tornadoes recorded near the coastline are generally weaker than those occurring further inland. The lower wind speeds predicted by the model based on the 1-degree square local region supports this argument. Tornadoes near the coastline are sometimes associated with the passage of hurricanes. Hurricane generated tornadoes tend to be less intense than inland tornadoes in accordance with Federal Emergency Management Agency publication, "Taking a Shelter From the Storm". Therefore, the local regional data is the most appropriate data to use.

   As described in UFSAR Section 2.3.1.2.4 "Tornadoes", the probability of a tornado strike at Waterford 3 is 7.68 x 10^{-5} per year. This probability is based on 112 tornadoes reported within 50 nautical miles (58 statute miles) between

1950 to 1977. For the TORMIS analysis, a refined probability for tornado strike is developed using reported tornado data from the Storm Prediction Center (SPC), of the National Oceanic and Atmospheric Administration, in Norman, Oklahoma for the years1954-1995 for the 1-degree square near Waterford 3. The reported tornado data is adjusted to account for potentially unreported tornadoes and presence of large water bodies in the 1-degree square region using the methodology developed by Allen (1981). The refined probability value was be compared to the 7.68×10^{-5} value from UFSAR Section 2.3.1.2.4. The more conservative of these two values will be used in the Waterford 3 analysis.

2. "The EPRI study proposes a modified tornado classification, F' Scale, for which the velocity ranges are lower by as much as 25% than the velocity ranges originally proposed in the Fujita F-Scale. Insufficient documentation was provided in the studies in support of the reduced F' Scale. The F-Scale tornado classification should therefore be used in order to obtain conservative results."

   Response:

   The Fujita Scale (F-Scale) wind speeds were used in lieu of the TORMIS wind speeds (F'-Scale) for the F_0 through F_5 intensities. In addition, a wind speed range from 318 to 360 mph was used for the F_6 intensity to correspond to the tornado wind speed described in UFSAR Section 3.3.2.1 "Applicable Design Parameters".

3. "Reductions in tornado wind speed near the ground due to surface friction effects are not sufficiently documented in the EPRI study. Such reductions were not consistently accounted for when estimating tornado wind speed at 33 feet above grade on the basis of observed damage at lower elevations. Therefore, user should calculate the effect of assuming velocity profile with ratios V_0 (speed at ground level)/V_{33} (speed at 33 feet elevation) higher than that in the EPRI study. Discussion sensitivity of the results to changes in the modeling of the tornado wind speed profile near the ground should be provided."

   Response:

   A more conservative near-ground profile was used than the base case in TORMIS, resulting in a higher tornado ground wind speed to ~246 mph giving a ratio of V_0/V_{33} equal to 0.82.

For the TORMIS analysis, injection height for the potential tornado missiles into the tornado wind field is selected above the surface of the ground. The increased injection height will also increase the wind speed acting on the missiles.

4. "The assumptions concerning the locations and numbers of potential missiles presented at a specific site are not well established in the EPRI studies. However, the EPRI methodology allows site-specific information on tornado missile availability to be incorporated in the risk calculation. Therefore, users should provide sufficient information to justify the assumed missile density based on the site specific missile sources and dominant tornado paths of travel."

   Response:

   A site-specific walkdown was performed to include the contents of the warehouses, office buildings, sheds, trailers, parking lots, and switch yards. Based on the walkdown, a total of 71,800 missiles were postulated. This number is considered conservative on the basis of the example problem in the EPRI study where a total of 65,550 missiles were postulated for a one unit plant site.

5. "Once the EPRI methodology has been chosen, justification should be provided for any deviations from the calculational approach."

   Response:

   The Waterford 3 analyses does not have any deviations from EPRI NP-2005, except as noted in items 1 through 4 above.

REFERENCES:

1. Electric Power Research Institute (EPRI) Report No. NP-2005, "Tornado Missile Simulation Methodology - Computer Code Manual," August 1981.

2. EPRI Report No. NP-2005 Vol. 2, "Tornado Missile simulation and design methodology - Volume 2: Model Verification and Database Update," August 1981.

3. USNRC Regulatory Guide 1.76, "Design Basis Tornado for Nuclear Power Plants," April 1974.

4. USNRC Standard Review Plant (SRP) 3.5.1.4, "Missile Generated by Natural Phenomena.

5. Safety Evaluation Report – Electric Power Research Institute (EPRI) Topical Reports Concerning Tornado Missile Probabilistic Risk Assessment (PRA) Methodology. October 26, 1983.

6. USNRC Standard Review Plant (SRP) 2.2.3, "Evaluation of Potential Accidents"

ATTACHMENT 4 TO W3F1-99-0140

Marked-Up UFSAR Pages

Listing of UFSAR Pages Included	
2.3-3	Table 3.2-1 (Sheet 18 of 25)
2.3-4	Table 3.2-1 (Sheet 19 of 25)
Insert for Section 2.3.1.2.4	Table 3.2-1 (Sheet 20 of 25)
3.1-2	Table 3.2-1 (Sheet 21 of 25)
3.1-4	Table 3.2-1 (Sheet 22 of 25)
3.1-5	Table 3.2-1 (Sheet 23 of 25)
3.3-1	Table 3.2-1 (Sheet 24 of 25)
3.3-2	Table 3.2-1 (Sheet 25 of 25)
3.3-3	Table 3.5-3 (Sheet 1 of 4)
3.3-4	Table 3.5-3 (Sheet 2 of 4)
3.3-5	Table 3.5-3 (Sheet 3 of 4)
3.5-15	Table 3.5-3 (Sheet 4 of 4)
Insert for Section 3.5.1.4.1	
Insert for Section 3.5.1.4.2	
3.5-16	
3.5-17	
3.5-18	
3.5-19	
3.5-20	
3.5-21	
3.5-22	
3.5-23	
Insert New References for Section 3.5	
Table 3.2-1 (Sheet 1 of 25)	
Table 3.2-1 (Sheet 2 of 25)	
Table 3.2-1 (Sheet 3 of 25)	
Table 3.2-1 (Sheet 4 of 25)	
Table 3.2-1 (Sheet 5 of 25)	
Table 3.2-1 (Sheet 6 of 25)	
Table 3.2-1 (Sheet 7 of 25)	
Table 3.2-1 (Sheet 8 of 25)	
Table 3.2-1 (Sheet 9 of 25)	
Table 3.2-1 (Sheet 10 of 25)	
Table 3.2-1 (Sheet 11 of 25)	
Table 3.2-1 (Sheet 12 of 25)	
Table 3.2-1 (Sheet 13 of 25)	
Table 3.2-1 (Sheet 14 of 25)	
Table 3.2-1 (Sheet 15 of 25)	
Table 3.2-1 (Sheet 16 of 25)	
Table 3.2-1 (Sheet 17 of 25)	

2.3.1.2.3 Thunderstorms

Thunderstorms with damaging winds and hail are relatively infrequent. The most damaging thunderstorms are those associated with the passage of a cold front or squall line.[2]

Based on 21 years of records of the US Weather Bureau at Moisant International Airport (1949-1969), the mean number of days with thunderstorms is:

Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec	Annual
2	2	3	5	6	9	16	13	7	2	1	2	68

The maximum thunderstorm occurrence during the months of July and August is also reflected in the monthly average precipitation.

During the period 1955-1967, hail 0.75 in. or greater in diameter was reported 13 times in the one-degree latitude-longitude square containing the site[8]. These occurrences are relatively infrequent especially when compared to over 100 such hail reports at some locations in Oklahoma.

The site area experiences an annual average of 75 days with observable lightning or thunder. There are about 19 cloud to ground strikes per square mile per year[19]. The most serious lightning displays will obviously occur in those thunderstorms associated with frontal passages.

The probability of the Waterford Reactor Building being struck by lightning in any year may be calculated using the procedures presented in Lightning Protection by J. L Marshal as 0.78 or approximately one lightning strike every 1.3 years.[19] All critical components and structures at the Waterford plant are protected against lightning damage by an extensive electrical grounding system.

2.3.1.2.4 Tornadoes

A few of the more severe thunderstorms and hurricanes generate tornadoes. According to Thom[9], the total frequency of tornadoes for the 10 year period, 1953-1962, by one-degree latitude-longitude squares for southeastern Louisiana is:

	89-90 W	90-91 W
29-30 N	9	9
30-31 N	12	11

The mean annual frequency of tornadoes per one degree square in the site area, therefore, is about one.

Thom[9] also gives the probability of a tornado striking a point based on the path width and length of all tornadoes reported in Iowa during 1953-1962. The average path area of these storms is given by Thom as 2.8209 square miles. Using this information, the tornado frequency presented above and the method suggested by Thom, the annual probability of a tornado striking the site is approximately 6.3×10^{-4} or about once every 1585 years.

An examination of tornado statistics for 1950-1977[20] showed that during this period a total of 112 tornadoes had been reported within 50 nautical miles (58 statute miles) of the Waterford site. The average path length and width of these 112 tornadoes is 3.36 miles and 318 ft. respectively; these values yield an average path area of 0.20 square miles.

Using the above, site specific, statistics and ~~Thomas'~~ Thom's method the probability of a tornado striking the Waterford site is 7.68 x 10^{-5} or once in 13,029 years. (See Section 3.5.1.4.2 for the annual probability of tornado strike used in the "TORMIS" analysis.

The site specific tornado data described above shows that the two most severe tornadoes to occur in the site vicinity were classed F4 according to the Fujita Tornado intensity scale[21]. This scale, which was developed by T.T. Fujita of the University of Chicago, classifies tornado intensity and maximum wind speed based upon the observed extent of damage attributable to the storm. The F4 classification is associated with wind speeds (rotational and translational combined) estimated to be between 207 and 260 mph.

Even though the probability of a tornado at the site is small, all structures and equipment necessary to initiate and maintain a safe plant shutdown have been designed to withstand short-term loadings resulting from a tornado funnel with a peripheral tangential velocity of 300 mph and a translational velocity of 60 mph with an external pressure drop of three psi in three seconds. * ADD INSERT SHOWN ON NEXT PAGE

2.3.1.2.5 Air Pollution Potential

Qualitative estimates of the dispersion characteristics of a site can be made from tabulated summaries of meteorological data. Two types of summaries readily available to meteorologists consist of tabulations of mixing heights and tabulations of stagnating anticyclone (i.e., high pressure system) occurrences.

The mixing height of the atmosphere is defined as the height of that surface based layer through which pollutant material released to the atmosphere will be thoroughly mixed. The lower the mixing height, the more unfavorable dispersion conditions become. When low mixing heights are in turn combined with low wind speeds in the mixing layer air pollution problems can result. Using mixing height and wind speed data for the period 1960-1964, Holzworth[10] examined and generally summarized the relative potential for adverse dispersion conditions for urban areas throughout the contiguous United States. Although the Waterford 3 site is located in a rural area, Holzworth's analyses are reasonably applicable. Holzworth's results indicate that the site area can expect to experience between 10 and 15 days each year of "limited dispersion". This value is somewhat high in comparison to much of the eastern US where 5-10 such days generally occur each year but is quite low in comparison to those parts of the U.S. west of the Rocky Mountains.

As indicated earlier, the occurrence frequency of stagnating anticyclones represents another easily obtainable index of high air pollution potential. Stagnating anticyclones are in fact a cause of low mixing heights, so the two sets of data are interrelated. Using pressure gradient and low wind speed criteria, Korshover[11] has determined that from 1936 through 1965, approximately 30 stagnation incidents covering a total of 110 days occurred in the site area. Such statistics are higher than those for the northeastern U.S. and the mid-

Insert for Section 2.3.1.2.4 "Tornadoes"

Protection from the design basis tornado is provided by design margins and the judicious use of missile barriers such that the probability does not exceed acceptable value.

A "TORMIS" analysis was performed using tornado data for the years 1954-1995 to compute tornado strike probability at Waterford 3. The "TORMIS" analysis was then used to evaluate the protection requirements of certain components vulnerable to tornado generated missiles. The "TORMIS" analysis uses a NRC approved methodology developed by the Electric Power Research Institute (EPRI). The methodology is implemented using the computer program TORMIS.

Should the Waterford 3 evaluations using the TORMIS methodology provide results indicating that the plant configuration exceed W3's 10^{-6} acceptance criteria, then missile protective barrier will be utilized to reduce the total cumulative probability value to below the acceptance criteria value of 10^{-6}.

ADD

so that any desired item of information is retrievable for reference. These records of the design, fabrication, erection and testing of structures, systems and components important to safety are maintained as required by the LP&L quality assurance program.

3.1.2 CRITERION 2 - DESIGN BASES FOR PROTECTION AGAINST NATURAL PHENOMENA

CRITERION:

Structures, systems and components important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami and seiches without loss of capability to perform their safety functions. The design bases for these structures, systems and components shall reflect: (1) Appropriate consideration of the most severe of the natural phenomena that have been historically reported for the site and surrounding area, with sufficient margin for the limited accuracy, quantity, and period of time in which the historical data have been accumulated, (2) appropriate combinations of the effects of normal and accident conditions with the effects of the natural phenomena and, (3) the importance of the safety functions to be performed.

RESPONSE:

The integrity of systems, structures and components important to safety is included in the reactor facilities design evaluations. The structures, systems and components important to safety are designed to withstand the effects of natural phenomena without loss of capability to perform their safety functions. Those structures, systems and components vital to the shutdown capability of the reactor are designed to withstand the maximum probable natural phenomenon expected at the site determined from recorded data for the site vicinity with appropriate margin to account for uncertainties in historical data. Those structures, systems and components vital to the mitigation and control of incident conditions are designed to withstand the effects of a loss-of-coolant accident coincident with the effects of the safe shutdown earthquake. The structures, systems, and components important to safety are listed in Table 3.2-1.

For further discussion, see the following sections: 2.3 Meteorology, 2.4 Hydrologic Engineering, 2.5 Geology, Seismology and Geotechnical Engineering, 3.2 Classification of Structures, Components and Systems, 3.3 Wind and Tornado Loadings, 3.4 Water Level (Flood) Design, 3.5 Missile Protection, 3.7 Seismic Design, 3.8 Design of Category I Structures, 3.9 Mechanical Systems and Components, 3.10 Seismic Qualification of Seismic Category I Instrumentation and Electrical Equipment, and 3.11 Environmental Design of Mechanical and Electrical Equipment.

3.1.4 CRITERION 4 - ENVIRONMENTAL AND MISSILE DESIGN BASES

CRITERION:

Structures, systems and components important to safety shall be designed to accommodate the effects of, and to be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents including Loss-of-Coolant Accidents (LOCA). These structures, systems, and components shall be appropriately protected against dynamic effects, including the effects of missiles, pipe whipping and discharging fluids that may result from equipment failures and from events and conditions outside the nuclear power unit.

RESPONSE:

Structures, systems and components important to safety are designed to accommodate the effects and to be compatible with the pressure, temperature, humidity, chemical and radiation conditions associated with normal operation, maintenance, testing, and postulated accidents, including a loss-of-coolant accident in the area in which they are located.

Protective walls and slabs, local missile shielding, or restraining devices are provided to protect the containment and Engineered Safety Features Systems within and without the containment against damage from missiles generated by equipment failures. The concrete enclosing the Reactor Coolant System serves as radiation shielding and as an effective barrier against internal missiles. Local missile barriers are provided for control element drive mechanisms. Penetrations and piping extending to and including isolation valves are protected from damage due to pipe whipping, and are protected from damage by external missiles, where such protection is necessary to meet the design bases.

Non-seismic category piping is arranged or restrained so that failure of any non-seismic category piping will not cause radioactivity to be released to the environment nor prevent essential seismic Category I structures or equipment from mitigating the consequences of such an accident.

Seismic Category I piping has been arranged or restrained such that, in the event of rupture of a seismic Category I pipe which causes a loss-of-coolant accident, resulting pipe movement, will not result in loss of containment integrity and adequate Engineered Safety Features Systems operation will be maintained.

The containment interior structure is designed to sustain dynamic load which could result from failure in major equipment and piping, such as jet thrust, jet impingement, and local pressure transients, where containment integrity is needed to cope with the conditions.

The external concrete shield protects the steel containment vessel from damage due to external missiles such as tornado propelled missiles. The functional capability of any safety related structures, systems or components located outdoors (e.g., cooling towers) are designed for protection against externally generated missiles, or shown that their failure is not credible because tornado induced failure modes are considered improbable as mentioned in section 3.5.1.4.1

For those components which are required to operate under extreme conditions such as design seismic loads or containment post accident environmental conditions, the manufacturers submit type test, operational or calculational data which substantiate this capability of the equipment.

For further discussion, refer to the following sections: 3.3 Wind and Tornado Loadings, 3.4 Water Level (Flood) Design, 3.5 Missile Protection, 3.6 Protection Against Dynamic Effects Associated with the Postulated Rupture of Piping, 3.7 Seismic Design, 3.8 Design of Category I Structures, 3.11 Environmental Design of Mechanical and Electrical Equipment, and 6.0 Engineered Safety Features.

3.1.5 CRITERION 5 - SHARING OF STRUCTURES, SYSTEMS AND COMPONENTS

CRITERION:

Structures, systems, and components important to safety shall not be shared among nuclear power units unless it can be shown that such sharing will not significantly impair their ability to perform their safety functions including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units.

RESPONSE:

As per the Louisiana Power & Light letter (LPL-362) of October 19, 1971 to Dr P.A. Morris (then with the AEC), Unit No. 4 is no longer being considered for construction; therefore, this criterion is not applicable.

3.1.6 CRITERION 10 - REACTOR DESIGN

CRITERION:

The reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.

RESPONSE:

In ANSI N18.2, Nuclear Safety Criterion for the Design of Pressurized Water Reactor Plants (January 1973), plant conditions are categorized in accordance with their anticipated frequency of occurrence and risk to the public, and design requirements are given for each of the four categories. The categories covered by this criterion are Condition I - Normal Operation and Condition II - Faults of Moderate Frequency.

3.3 WIND AND TORNADO LOADINGS

Structures, systems or components whose failure due to design wind loading could prevent safe shutdown of the reactor, or result in significant uncontrolled release of radioactivity from the unit, are protected from such failure by one of the following methods:

a) the structure or component is designed to withstand design wind, or

b) the system or components are housed within a structure which is designed to withstand the design wind.

Structures, systems or components whose failure could prevent safe shutdown of the reactor, or result in significant uncontrolled release of radioactivity from the unit, are protected from such failure due to design tornado wind loading or missiles by one of the following methods:

a) the structure or component is designed to withstand tornado wind and/or tornado missile loads (refer to Subsection 3.5.1.4 for tornado missile criteria) ~~or~~ and/or protected by a barrier

b) the system or components are housed within a structure which is designed to withstand the tornado wind and/or missile loads. ^

c) system or component failure is not credible because tornado induced failure modes are considered improbable as mentioned in Section 3.5.1.4.1

Table 3.2-1 lists all safety related structures, systems and components and the method of wind/tornado protection where applicable. The a or b designation in the table refers to item a or b above.

3.3.1 WIND LOADINGS

3.3.1.1 Design Wind Velocity

The plant structures defined as seismic Category I structures are designed for a maximum wind of 200 mph at 30 feet above plant grade.

3.3.1.2 Basis for Wind Velocity Selection

The basis for the selection of the above wind velocity for design is presented in Section 2.3. The 100 year recurrence interval indicates a maximum wind velocity of approximately 100 mph. However, to assure the integrity of these structures under extreme wind conditions, a 200 mph wind is selected to provide sufficient conservatism in design.

3.3.1.3 Determination of Applied Forces

The wind loads which are applied to structures as static forces are derived from, the recommendations of ASCE paper No. 3269, "Wind Forces on Structures

The dynamic wind pressure (q) in pounds per square foot is calculated from the wind speed using the formula:

$$q = 0.002558 V^2 \quad (1)$$

where V is the wind speed in miles per hour.

NO CHANGES: For information only

The local pressure at any point on the surface of a building is equal to:

$$P_L = C_{pe}q \qquad (2)$$

where C_{pe} represents the local pressure coefficient which depends upon the geometric form of the building and the relative location of the point in question with respect to the direction of the wind. Values of C_{pe} for several different shapes, of buildings are presented in ASCE Paper No. 3269 and ASCE Paper No. 4933[2]. Values of C_{pe} for the containment dome as shown in Figures 3.3-1 and 3.3-2 are slightly simplified from those of Reference 2. The values of C_{pe} are assumed constant across the width of the dome instead of using more than one value of C_{pe} for each strip as suggested in the ASCE-paper.

In general, C_{pe} is positive for windward parts of buildings and negative for leeward parts of buildings.

The values given in equation (2) represent the dynamic wind pressure on the surface of the building only in the case in which the building is airtight. If there are openings on the surface of a building, then an internal pressure (P_i) will be increased or decreased depending on whether the openings are mainly on the windward or leeward surfaces as given in the following:

$$P_i = C_{pi}q \qquad (3)$$

where C_{pi} is the internal pressure coefficient. Detailed test values of C_{pi} for certain buildings are listed in Reference 1.

In the design of walls and roofs, the pressure coefficient includes the summation of the external and the internal pressures. Considering equation (2) and equation (3), the total dynamic pressure (P_t):

$$P_t = P_L + P_i$$

or $$Pt = q(Cpe + Cpi) \qquad (4)$$

The total directional wind pressure for the building, in the direction of the wind is given by:

$$P_t = C_D q \qquad (5)$$

where C_D is the average drag or shape coefficient for the building and q is the dynamic wind pressure at the given height. C_D includes the effects of positive pressure on the windward wall and negative pressure on the leeward wall.

C_D and the pressure distribution around the cylindrical Reactor Building are determined by using References 1 and 2.

Table 3.3-1 and Figures 3.3-1 and 3.3-3 list the applied force magnitude gust factor used, and pressure distribution calculated for each plant safety related structure.

3.3.2 TORNADO

3.3.2.1 Applicable Design Parameters

Parameters applicable to the design basis tornado for seismic Category I structure design are in accordance with the following criteria:

a) external wind forces resulting from a tornado funnel with a horizontal rotation velocity of 300 mph and a horizontal translational velocity of 60 mph. The tornado rotational (tangential) velocity and translational velocity are summed algebraically, and applied on the entire building structure,

b) a decrease in atmospheric pressure of three psi at a rate of one psi/sec,

c) the effect on (a) and (b) are considered to act simultaneously, and/OR in accordance with standard Review plan Section 3.3.2

d) the external tornado generated missiles considered, as described in Subsection 3.5.1.4.

e) Category I structures are designed without venting (eg. blow-out panels) provisions.

In the design of steel structures, an increase in code allowable stresses was permitted for tornadic loading in combination with other loadings. Stresses less than or equal to 90 percent of yield for flexure and less than or equal to 58 percent of yield for shear were allowed.

The design basis tornado for Waterford 3 is based upon the tornado wind and pressure characteristics considered appropriate by the nuclear industry and the AEC at the time the plant was designed prior to the issuance of Regulatory Guide 1.76 in April 1974. Both the total wind speed and the maximum negative pressure are the same for the Waterford design basis tornado as those specified in Regulatory Guide 1.76. In addition, the effect of 2 psi/sec pressure drop as specified in Regulatory Guide 1.76 has been evaluated. The natural period of the structure systems is 0.02 to 0.30 sec. Utilizing the method to determine the maximum dynamic load factor, (DLF) maximum of one-degree elastic systems, undamped and subjected to constant force with finite rise time as given in "Introduction to Structural Dynamics" by John M. Briggs, (DLF) maximum is determined to be approximately equal to 1.00 and 1.02 for the pressure drop rate of 1 and 2 psi/sec respectively. The increase of two percent in (DLF) maximum is acceptable within the conservatism used in calculating the equivalent static pressure loads. Therefore, the design of the seismic Category I structure meets the intent of Regulatory Guide 1.76.

3.3.2.2 Determination of Forces on Structures

Tornado wind speed is converted into equivalent dynamic pressure loadings and the computations for wind pressure, their distribution on surface area of buildings, shape factors and drag coefficients are based on the procedures outlined in ASCE Paper No. 3269. Because of the unique characteristics of tornados, gust factor and velocity variation with height are not considered. With respect to the pressure distribution around the Reactor Building, wind force data reported in ASCE Papers 3269 and 4933 are used in the design.

The effect of (a), (b), and (c) given in Subsection 3.3.2.1 are considered.

The dynamic pressure corresponding to the 360 (i.e., 300 mph + 60 mph) mph wind velocity calculated in the standard form is:

$$q = 0.002558\, V^2$$

$$q = 0.002558\, (360)^2 = 332 \text{ psf}$$

For large structures or parts of structures whose horizontal dimensions perpendicular to the wind force are comparable to the radius of the tornado vortex at which the maximum tangential wind speed occurs, a more realistic, average tornado wind speed of 300 mph can be used in equation(1) to calculate the dynamic wind pressure for the structure as a whole(1). Local dynamic wind pressure is still based on 360 mph for equations (2), (3), and (4).

The pressure differential (p) noted in Subsection 3.3.2.1 ~~(c)~~ b is considered in calculating tornado pressure loading for closed buildings. The maximum pressure drop of three psi occurs at the center of the vortex and diminishes with distance from the vortex center. Theoretically, this pressure drop ranged from 1.5 psi at the point of maximum tornado tangential wind speed to three psi at the center of the tornado where the tangential speed is zero. However, the plant design conservatively used the maximum pressure drop of three psi throughout for structural analysis. For these buildings, the local pressure loading, equation (2), is combined with the pressure differential (p) to give:

$$P = qC + p \qquad (6)$$

$$P = qC_{pe} + 0.5\,p$$ (for Special Doors and Maintenance Hatch Shield Door Only and RAB Roof Hatch HC-31 Covers)

The total directional wind pressure on the entire building in the direction of the maximum wind speed will remain the ~~sane~~ same as given by equation (5). The equivalent static pressure loading for the various structures are given on Table 3.3-2 and Figures 3.3-2 and 3.3-4.

The total structural response due to the design basis tornado is determined by combining the static analysis results that account for the tornado pressure loading as given by equation (6) and the equivalent static loads as obtained from the missile impactive analysis discussed in Subsection 3.5-3.

3.3.2.3 Effect of Failure of Structures or Components not Designed for Tornado Loads

Non-seismic structures, such as the Turbine Building and the intake superstructure framing and crane have been designed for tornadic wind on the exposed steel surfaces but have not been designed to resist tornado generated missiles. The failure of any structural member or component in either of these non-seismic structures, that would be caused by being hit by a tornado generated missile, would be local in nature causing no damage to seismic Category I structures or components and would not prevent the safe shutdown of the reactor or result in uncontrolled release of radioactivity to the environment.

The Turbine Building has been evaluated for tornado loadings to the following extent:

a) Siding in Place - The building is designed to resist a wind load of 200 mph (assume pressure drop to be zero).

b) Siding Failure - Siding fails for winds above 200 mph. The siding is designed to fail but remain balanced and restrained by the central portion of the panel against the girts. The exposed steel framing is designed to withstand a tornado load of 360 mph.

c) Tornado-born missiles are not considered in the design.

SECTION 3.3: REFERENCES

(1) ASCE 3269, "Wind Forces on Structures," American Society of Civil Engineers, Transactions, Vol 126, Part II, 1961

(2) "Wind Loads on Dome-Cylinder and Dome-Cone Shapes, "F J Maher, Journal of the Structural Division, ASCE Vol 92, No. S T 5 Proc Paper 4933, October 1966

These estimates for probabilities are very conservative due to the assumptions involved in these calculations. The penetration capability of the missile calculations assume that the impact velocity is the same as ejection velocity. It is also considered that the missile impacts normal to the barrier surface and does not deform, thereby retaining the original minimum equivalent diameter that it had prior to the penetration of the first barrier. In reality the missile impact velocity will be less than the ejection velocity due to air attenuation and relative elevation of impact location. The missile rarely impacts normal to the barrier and so the effective thickness of the barrier is always more than the actual thickness. Also, the missile will deform and thus, present a larger equivalent diameter for the next barrier.

The NRC in Regulatory Guide 1.115 assumes a missile generation probability, based on historical failure data for the turbine, of 10^{-4} per turbine year and, therefore, suggests that the strike and damage probability for the plant should be within 10^{-3} per turbine year. However, due to redundancy and periodic testing features of the turbine overspeed protection and the quality control of the manufacturing processes and materials, the actual probability of missile generation is expected to be significantly lower than the NRC suggested values[5] for missile generation probability, P_1.

The overall plant unacceptable strike damage probability ($P_1 \times P_2 \times P_3$) for this plant from the design overspeed failure event due to low trajectory strike is almost zero and that due to high trajectory strike is 2.6×10^{-8} per turbine year using the NRC[5] Value of P_1 as 6×10^{-5}.

The overall plant unacceptable strike and damage probability ($P_1 \times P_2 \times P_3$) from destructive overspeed failure event due to low trajectory strike is 3.4×10^{-6} per turbine year and that due to high trajectory impacts is 3.4×10^{-6} per turbine year assuming the NRC[5] value of P_1 as 4×10^{-5}.

The combined probability of strike and damage for the total plant due to high and low trajectory impacts is 2.6×10^{-8} per turbine year for the design overspeed failure event and 6.8×10^{-6} for the destructive overspeed failure event.

3.5.1.3.7 Turbine Manufacturer Probability Analysis

In 1994 the turbine manufacturer performed a revised calculation of P_1 using newer values of valve failure rates. This analysis [16] uses an NRC assumed value of 1×10^{-2} for $P_2 \times P_3$. The results shoow that for a quarterly turbine speed control valve test interval, the combined probability of strike damange is 6.5×10^{-9} for the design overspeed case and 4.58×10^{-6} for the destructive overspeed case.

3.5.1.4 <u>Missiles Generated by Natural Phenomena</u>

The postulated missiles generated by natural phenomena are the tornado missiles. The plant is designed for multiple tornado missiles and the design bases of Subsection 3.5.1.

The design tornado missiles are listed in Table 3.5-10.

The safety related systems and structures and their protection from tornado missiles are tabulated in Tables ~~3.5-8.~~ 3.2-1, 3.5-3 and 3.5-3a.

3.5.1.4.1 SYSTEM/COMPONENT NOT REQUIRING TORNADO MISSILE PROTECTION

3.5.1.4.2 TORMIS DESCRIPTION

ADD

3.5.1.4.1 System/components not requiring unique tornado missile protection

A limited amount of safety related systems and components located on RAB roof at +69' elevation, at +46' elevation and in the cooling tower areas are evaluated as not requiring unique tornado missile protection barriers.

Safety-related systems and components are generally protected from tornado generated missiles. The limited amount of unprotected portions of safety-related systems and components will be analyzed using probabilistic missile strike analysis as permitted in Standard Review Plan 3.5.1.4 "Missiles Generated By Natural Phenomena". This analysis is conducted to establish the total (cumulative) probability per year of missiles striking safety-related structures, systems and components due to postulated tornadoes. This information will be then used to determine the specific design provisions that must be provided to maintain the estimate of strike probability below an acceptable level.

The acceptable level established for the protection of such systems and components at Waterford 3 is consistent with the acceptance criteria in Standard Review Plan 2.2.3 "Evaluation of Potential Accidents", i.e., that a probability of occurrence of initiating events (those that could lead to potential consequences in excess of the 10 CFR Part 100 Guidelines) of "approximately 10^{-6} per year is acceptable if, when combined with reasonable qualitative arguments, the realistic probability can be shown to be lower. The Waterford 3 specific acceptance criteria is that the total probability of tornado missiles striking a safety-related system or component must be shown by analysis to be less than 1×10^{-6} per year.

This acceptance criteria contains the following conservatism:

- There are no tornado generated missiles that can directly impact on irradiated fuel, even on the spent fuel stored in the Fuel Handling Building (FHB). Any missiles postulated to enter the fuel storage area would be stopped by concrete walls and roof barriers.

- It is assumed that a safety-related system or component simply being struck by a tornado missile will result in damage sufficient to preclude it from performing its intended safety function, although this is not realistic for all cases since missile barrier protection is afforded to majority of the systems and certain plant SSC are located below grade and protected by concrete walls and sub-compartments.

The analysis uses an NRC[16] approved methodology developed by the Electric Power Research Institute (EPRI) [17]. The methodology is implemented using the computer program TORMIS, which is further described in section 3.5.1.4.2.

Should the Waterford 3 evaluations using the TORMIS methodology provide results indicating that the plant configuration exceed W3's 10^{-6} acceptance criteria, then missile protective barrier will be utilized to reduce the total cumulative probability value to below

ADD

the acceptance criteria value of 10^{-6}. Temporary removal of protective features will be permitted under administrative controls, if removal is determined to be necessary for plant maintenance or configuration changes.

3.5.1.4.2. TORMIS DESCRIPTION

TORMIS implements a methodology developed by the Electric Power Research Institute [17]. TORMIS determines the probability of striking walls and roofs of buildings on which exposed portions of the safety-related systems and components are located. The probability is calculated by simulating a large number of tornado strike events at the site for each tornado wind speed intensity scale. After the probability of striking the walls or the roof is calculated, the exposed surface areas of the components are factored in to compute the probability of striking a particular target.

The TORMIS analysis for W3 is in accordance with the TORMIS program, as described in Reference 17, using site-specific parameters described below:

1. The probability of a tornado strike at WF3 is based upon broad region values associated with the Fujita F-Scale.

2. The Fujita Scale (F-Scale) wind speeds were used in lieu of the TORMIS wind speeds (F'-Scale) for the F_0 through F_5 intensities. In addition, a wind speed range from 300 to 360 mph was used for the F_6 intensity to correspond to the tornado wind speed described in Section 3.3.2.1 "Applicable Design parameters".

3. A more conservative near-ground profile was used than the base case in TORMIS, resulting in a higher tornado ground wind speed to ~246 mph giving a ratio of V_0/V_{33} equal to 0.82. NRC has accepted this value for other nuclear sites submittal using TORMIS analysis.

4. A site-specific walkdown was performed to include the contents of the warehouses, office buildings, sheds, trailers, parking lots, and switch yards. Based on the walkdown, a total of 71,800 missiles were postulated in 9 missile zones. This number is considered conservative on the basis of the example problem in Ref. 17 where a total of 65,550 missiles were postulated for one unit plant site.

3.5.1.5 <u>Missiles Generated by Events Near the Site</u>

Railroad facilities, main roadways, Mississippi River shipping channel, industrial facilities, pipelines, and military installations are located a sufficient distance from the safety related portions of the plant so that the missiles from the design basis explosive events do not reach or damage safety related portions of the plant. (Refer to Subsection 2.2.3).

3.5.1.6 <u>Aircraft Hazards</u>

Aircraft impact is not considered as a design basis event for the Waterford 3 safety-related structures. Section 2.2 contains a discussion on aircraft hazards.

3.5.2 SYSTEMS TO BE PROTECTED

Systems and structures to be protected from internally-generated missiles outside containment are listed in Table 3.5-3. System protection from internally-generated missiles inside the containment is described in Subsection 3.5.1.2 and Table 3.5-4. System protection from tornado missiles is listed in Tables 3.2-1, 3.5-3 and 3.5-3a.

3.5.3 BARRIER DESIGN PROCEDURES

The procedures employed in the design of structures and barriers to withstand the missiles are described in the following subsections. Waterford 3 design of structural barriers for tornado missiles does not depend on the composite resistances of steel and concrete. Only concrete barriers or steel barriers have been utilized.

3.5.3.1 <u>Local Damage Prediction</u>

3.5.3.1.1 Concrete Barriers

Concrete barriers are designed to prevent missile perforation of the barrier. For local damage prediction of missile impact on concrete barrier structures, the following formula suggested by Amirikian(10), known as the Modified Petr~~i~~y Formulas, are given below:

a) Where slab thickness is greater than three times the penetration depth:

$$D = K A_p V' \qquad (10)$$

where:

D = penetration of missile, ft.

V' = velocity factor = $\log_{10}\left(1 + \frac{V^2}{215{,}000}\right)$

V = missile impact velocity, ft/sec

A_p = W/A_c = sectional pressure, lb/ft^2

A_c = missile contact area, ft^2

W = missile weight, lbs

K = material constant = 4.76×10^{-3} (Note: For steel rod missile, $K = 2.75 \times 10^{-3}$ in accordance with Ref. 7)

b) Where slab thickness is less than three times the penetration depth but greater than two times the penetration depth:

$$D' = D\left[1 + \exp\left(-4(a - 2)\right)\right] \qquad (11)$$

where:

D' = revised missile penetration, ft.

a = T/D

T = slab thickness, ft.

D = penetration of missile from above, ft.

In no case is the slab or wall thickness less than 2D. Table 3.5-4 shows results of missile penetration and the available minimum thickness of concrete for the selected missiles discussed in Subsection 3.5.1.

3.5.3.1.2 Steel Barriers

Steel gratings are designed to prevent perforation of the barrier. For local damage prediction of missile impact, the following formulas are used:

Stanford Research Formula

$$\frac{E}{D} = \frac{S}{46{,}000}\left(16{,}000\, T^2 + 1500\, \frac{W}{W_s}\, T\right)$$

where:
- T = steel thickness to be penetrated (in.)
- E = critical kinetic energy required for penetration (ft-lb)
- W = length of a square side between rigid supports (in.)
- W_s = length of a standard width (4 in.)
- D = missile diameter (in.)
- S = ultimate tensile strength of the target steel plate (psi)

This formula is good for the following ranges:

$0.1 < T/D < 0.8$
$0.002 < T/L < 0.05$
$10 < L/D < 50$
$5 < W/D < 8$
$8 < W/T < 100$
$70 < V_c < 400$

where L is the missile length (in) and the missile is assumed to be cylindrical, and V_c is the missile velocity (fps).

Rewritten the Stanford formula becomes.

$$T = \sqrt{\frac{2.91E}{DS} + 0.0022f^2} - 0.047f \qquad (13)$$

where f = window factor, and f = W/D is used in lieu of W/W_S

The Stanford formula is further modified for the steel grating with the following correction factors:

α = Correction factor for reduced contact area

β = Correction factor for Poisson's effect T

The modified Stanford formula becomes.

$$T = \sqrt{\frac{2.91E\alpha}{D\beta S} + 0.0022f^2} - 0.047f \qquad (14)$$

where α (for 2" x 4" plank) = 5.33

α (for 3" diameter pipe) = 3.67

α (for 4000 lb auto) = 3.67

α (for 1" diameter rod) = 2.91

α (for 13.5" diameter pole) = 3.74

$\beta = 1 - \nu^2 = 0.91$

To ensure conservatism for (W/D) ratios greater than 8, or (W/T) ratios greater than 100, use

$f = W/D \leq 8$

or

$f \leq 100\ (T/D)$, whichever is lower

<u>Ballistic Research Laboratory formula:</u>

$$T^{3/2} = \frac{0.5\ MV^2}{17400\ K^2 \quad D^{3/2}} \qquad (15)$$

where T = thickness to be penetrated (in.)

M = mass of missile $\frac{(wt)}{g}$ $\left(\frac{lb\text{-}sec^2}{ft}\right)$

V = velocity of missiles (fps)

D = diameter of missile (in.)

K = constant depending on the grade of steel and is usually about one.

The modified Ballistic Research Laboratory formula is also modified for the steel grating with the same correction factors α and β as shown for the modified Stanford formula.

$$T^{3/2} = \frac{0.5\ MV^2\ \alpha}{17400\ (K\beta)^2\ D^{3/2}} \tag{16}$$

Table 3.5-13 shows results of missile penetration from both formulas. This reveals that the thickness of the steel grating (7") is much greater than the recommended 1.25 T, where T is the depth of penetration.

3.5.3.2 Overall Damage Prediction

3.5.3.2.1 Concrete Barriers

The overall structural capacity is determined to preclude structural collapse under missile impact concurrent with tornado wind and tornado differential pressure loadings (Subsection 3.3.2.2).

For all reinforced concrete structural elements subjected to impactive loads (i.e., tornado-generated missiles) the structural response is determined by using impulse, momentum, and energy balance techniques of Williamson and Alvy (9). For concrete barriers, strain energy capacity is ~~limited by~~ the ductility criteria specified in Table 3.5-12.

The force-time function is considered as a simplified pulse type function and the actual structure is idealized as an equivalent single-degree-of-freedom system. For the equivalent structure system, the load, mass, load mass factors, and the parameters involving the maximum resistance, spring constant, and dynamic reactions of the systems under various loading conditions are determined. (13), (14).

The ultimate load capacity of concrete barriers is based on the yield line theory of reinforced concrete slabs. The resistance and yield displacement values are calculated in accordance with the boundary conditions and long/short sides ratio of the two-way slab. The ductility factors are shown in Table 3.5-12.

The procedure used to determine the force-time function, deformation criteria, and the methods of analysis are discussed below.

a) For soft missiles characterized by significant local deformation of the missile during impact (wood plank and utility pole, excluding automobile), the peak of the impactive force is determined by the formula:

$$F_{crushing} = \sigma_{crushing} \times A_{net} \tag{17}$$

where: σ crushing = 3750 psi for wood missiles

A_{net} = net cross sectional area of the missile

Assuming a rectangular impulse for the force function the duration of the impulse. t_d is determined by the formula:

$$t_d = \frac{mV_m}{F\ \text{crushing}} \qquad (18)$$

t_d - Time duration of impact

where: m = mass of missile

V_m = striking velocity of the missile

b) For an automobile, a forcing function for frontal impact striking a rigid barrier is:

$F(t) = 0.625\ V_sW \sin 20\ t \quad 0 \le t \le 0.0785$ sec (19)

$F(t) = 0 \quad t > 0.0785$ sec (20)

where:

F (t) = amplitude of the force

V_s = striking velocity of the automobile

W = weight of the automobile

t = time after impact (seconds)

20t = (20 radians/sec) (t)

Based on the above formula, the forcing function for the automobile is approximated as a rectangular shape of magnitude:

$F = 0.625\ V_sW$ (21)

and total time duration, t_d, of

$$t_d = \frac{M\ V_s}{F} \qquad (22)$$

where M is the mass of the automobile.

c) For rigid missiles characterized by significant local penetration during impact.(solid steel rod and steel pipe), the following equations are used to determine F and t_d for a rectangular pulse:

subscripts: V_m

$$F = \frac{mVm^2}{2D} = \frac{W\ Vm^2}{2gD} \quad (23)$$

$$t_d = 2D/V^m \quad (24)$$

subscript V_m

where:

D = penetration depth calculated from the Modified ~~Petri~~ Petry formula as described in Subsection 3.5.3.1.

3.5.3.2.2 Steel Barriers

For steel barriers, the equivalent static load concentrated on the impact area is determined by Williamson & Alvy's methods [9] [10].

Impact with penetration

$$F_i = \frac{WV^2}{gx} \quad (25)$$

$$t_1 \ \cancel{t_I} = \frac{2x}{v} \quad (26)$$

$$F \cancel{=} F_i \cancel{\frac{(2\mu - 1)^{1/2}T}{\pi t_1} + \frac{1 - \frac{-1}{2\mu}}{1 + \frac{0.7T}{t_1}}} \quad (27)$$

where:

F_i = peak force of impact (lb)
W = weight of missile (lb)
V = velocity of missile (ft/sec)
g = gravitational force (32. ft/sec^2)
X = penetration depth ~~(in)~~ (ft)
t_1 = duration of impact (sec)
F = equivalent static load (lb)
T = natural period of system (sec)
μ = ductility ration = 26 (for flexure design)
= 10 (for shear design)

$$F = F_i / \left[\frac{(2\mu - 1)^{1/2}T}{\pi t_1} + \frac{1 - \frac{1}{2\mu}}{1 + \frac{0.7T}{t_1}} \right]$$

Impact without penetration

$$q_y = \left(\frac{\mu}{2\mu - 1}\right)(W)\left[1 + \left[1 + \left(\frac{2\mu - 1}{\mu^2}\right)\left(\frac{2\pi V}{gT}\right)^2\right]^{1/2}\right] \qquad (28)$$

where: q_y = equivalent static load (lb)

The equations (25) and (26) set up the characteristics of impulse force. and equation (27) or (28) expresses the equivalent static load. The capability of the grating panel to resist the impulse force is a function of its natural period. yielding strength. ductility and time duration of impulse. Table 3.5-13 shows the calculated equivalent static loads which are all smaller than the resistance capability of the grating panel Rm (equals to 807.9 kips).

Gratings are made of a series of bearing plates (7"x 3/8") And cross bars (1 1/4" X 1/4"). Impact forces are mainly taken by the bearing plates. local punching shear was calculated. In addition. the shear stress of the cross bars was also calculated: this further assures that the cross bars are able to transfer any impact force to the bearing plates. and the structural integrity of the grating panel can thus be assured. The results are also shown in Table 3.5-13. they are all within the allowable stress limit (equals to 21.6 ksi).

$$q_y = \frac{\mu W}{(2\mu - 1)}\left[1 + \left[1 + \frac{(2\mu - 1)}{\mu^2}\,\frac{(2\pi V)^2}{(gT)^2}\right]^{1/2}\right]$$

REFERENCES: SECTION 3.5

1. "Report Covering the Effects of a High Pressure Turbine Rotor Fracture and Low Pressure Turbine Disc Fractures at Design Overspeed." Westinghouse Steam Turbine Division. April 1975.

2. "Report Covering the Effects of a Turbine Accelerating to Destructive Overspeed." Westinghouse Steam Turbine Division. April 1975.

3. "Analysis of the Probability of the Generation and Strike of Missiles from a Nuclear Turbine." Shaffer, D. M., Chay, S. C., McLain, D. K., and Power, B. A., Westinghouse Research Laboratories, March 1974.

4. "Probability of Damage to Nuclear Components Due to Turbine Failure." Bus, S. H., Nuclear Safety, Vol 14, No. 3, May-June 1973.

5. "Standard Review Plan, Section 3.5.1.3 Turbine Missiles." NUREG-75/087, Revision I - Nuclear Regulatory Commission.

6. Nuclear Regulatory Commission, Regulatory Guide 1.115 Rev. 1, "Protection Against Low Trajectory Turbine Missiles," July 1977.

7. "Full-Scale Tornado - Missile Impact Tests," Prepared by Sandia Laboratories, Nevada EPRI No. 440, Project 399, July 1977.

8. "Concrete Manual" Bureau of Reclamation 8th Edition, 1975, pp. 45

9. Impact Effect of Fragments Striking Structural Elements" by R.A. Williamson and R. R. Alvy; Holmes & Narver Inc., November 1973.

10. Amirikian, A "Design of Protective Structures" U.S. Navy Bureau of Yards and Docks, August 1950.

11. "Full-Scale Tornado Missile Impact Tests" EPRI NP-440, July 1977.

12. "A Review of Procedures for the Analysis and Design of Concrete Structures to Resist Missile Impact Effects" by R. P. Kennedy; Holmes and Narver Inc., September 1975.

13. Norris, C. H., etc., "Structural Design for Dynamic Loads" McGraw Hill, 1969.

14. "Introduction to Structural Dynamics" by J. Biggs, McGraw Hill Book Co., 1964.

15. "Turbine Valve Testing Frequency for Entergy Opeations Waterford Station" Westinghouse Technical Memo TM-94246, October 1994.

16. See attached Insert for New References

17.

16. Letter, Rubenstein (NRC) to Miraglia (NRC) entitled "Safety Evaluation Report – Electric Power Research Institute (EPRI) Topical Reports Concerning Tornado Missile Probabilistic Risk Assessment (PRA) Methodology", dated October 26, 1983.
17. Twisdale, L.A. and Dunn, W.L., EPRI NP-2005, Tornado Missile Simulation and Design Methodology, Volumes I and II, Final Report dated August 1981.

ADD

TABLE 3.2-1 (Sheet 1 of 25)

CLASSIFICATION OF STRUCTURES, SYSTEMS AND COMPONENTS (13)(19)

Structures	Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
Shield Building	- (a)	I	a	b	
Containment Vessel	2	I	b	b	
Reactor Auxiliary Building	-	I	a	a	
Fuel Handling Building	-	I	a	a	
Containment Internal Structure	-	I	b	b	
Supports for Category I Equipment	-	I	a or b or c	b	
Masonry Walls (concrete block)	-	(d)	b	b	17
Missile Barriers					
a) RAB - MS/FW valves, diesel generator intakes	-	I	~~a~~ b or c	-	
b) Dry Cooling Towers-towers, piping, transformers, MCC	-	I	a or b or c	-	
c) RAB - doors	-	I	a or c	a or b	
d) RCB - rollaway missile shield over RV	-	I	b	b	
Fuel transfer tube shielding	-	I	b	b	
Jet Impingement Barriers	-	I	b	b	
Plant Shielding (II.B.2) - reinforced concrete stub walls	-	I	b	b	
Emergency Support Centers (III.A.1.2)					
a) Technical Support Center	-	I	b	b	
b) Operational Support Center	-	-	-	-	17
Systems and Components					
Reactor Coolant System					
Reactor Pressure Vessel	1	I	b	b	
a) Vessel Internals	-	I	b	b	
Steam Generators					
a) Vessel (primary side)	1	I	b	b	
b) Vessel (secondary side)	2	I	b	b	
c) Snubbers and Restraints	-	I	b	b	
d) Supports (sliding base)	-	I	b	b	
e) Piping inside containment	1 or 2	I	b	b	

NO CHANGES : FOR INFORMATION ONLY

TABLE 3.2-1 (Sheet 2 OF 25) Revision 8 (5/96)

Reactor Coolant System (Cont'd)	Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
Reactor Protective System	IE	I	b	b	1, 7, 18
Reactor Coolant System Vents (II.B.I)	2 or NNS	I or -	b	b	16, 17
Reactor Coolant Pumps					2
a) Pumps (pressure retaining portions)	1	I	b	b	
b) Supports	-	I	b	b	
c) Operating and Backup Oil Lift Pumps	NNS	(b)	(c)	(c)	
d) Motor Heat Exchanger	NNS	-	-	-	
Pressurizer					
a) Vessel	1	I	b	b	
b) Heaters	NNS	-	a	-	
c) Supports (Integral)	-	I	b	b	
d) Safety Valves	1	I	b	b	
e) Position Indication System	NNS	-	b	b	
Reactor Coolant System Valve Indications (II.D.3)	NNS	-	b	b	17
Control Rod Drive Mechanism	-	I	b	b	3
Control Rod Drive Mechanism Housing	1	I	b	b	
Control Rod Drive Mechanism Supports	-	I	b	b	3
Control Element Drive Mechanism Exhaust Fans	NNS	I	b	b	27
Control Element Assemblies	-	I	b	b	4, 3
Fuel Assemblies	-	I	b	b	
Quench Tank	NNS	-	-	-	
Piping and Valves					5
a) Part of RCPB	1 or 2	I	b	b	6
b) Other than the RCPB	NNS	-	-	-	
Safety Injection System					
Safety Injection Tanks	2	I	b	b	
Low Pressure Safety Injection Pumps	2	I	b	b	
High Pressure Safety Injection Pumps	2	I	b	b	
S.I. Sump & Screens	-	I	b	b	
Trisodium Phosphate Baskets	-	I	b	b	

TABLE 3.2-1 (Sheet 3 OF 25)

Safety Injection System (Cont'd)	Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
Piping and Valves					5
a) Part of RCPB	1 or 2	I	b	b	6
b) Required only for initial injection of water for emergency core cooling	2	I	b	b	
c) Required for recirculation on containment sump water for emergency core cooling	2	I	b	b	
d) Whose failure would prevent operation of portion of system covered in a. b or c	3	I	b	b	
e) Normally isolated or automatically isolated from parts of system covered by a. b. c or d.	NNS	-	-	-	
Instrumentation					7. 18
1. Primary Elements for:					
-Piping & valves for Type a)	IE	I	b	b	
-Piping & valves for Type b & c)	IE	I	b	b	
-Piping & valves for Type d)	IE	I	b	b	
-Piping & valves for Type e)	NNS	-	b	b	17
2. Signal Transmitters for:					
-Controls and interface	IE	I	b	b	
-Status displays	IE	I	b	b	
-Alarm & computer logging	NNS	-	b	b	17
3. Signal Processing & Interlocking for:					
-Panel controls and indicators/recorders	IE	I	b	b	
-Alarm/computer	NNS	-	b	b	17
Shutdown Cooling System					
Shutdown Heat Exchangers					
a) Reactor coolant side	2	I	b	b	
b) Component cooling water side	3	-	b	b	
Piping and Valves					5
a) Required for residual heat removal	2	I	b	b	
a) Part of RCPB	1 or 2	I	b	b	6
b) Other than the RCPB	NNS	-	-	-	
Safety Injection System					
Safety Injection Tanks	2	I	b	b	
Low Pressure Safety Injection Pumps	2	I	b	b	
High Pressure Safety Injection Pumps	2	I	b	b	
S.I. Sump & Screens	-	I	b	b	
Trisodium Phosphate Baskets	-	I	b	b	

NO CHANGES: FOR INFORMATION ONLY

TABLE 3.2-1 (Sheet 4 of 25) Revision 2 (12/88)

	Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
Shutdown Cooling System (Cont'd)					
b) Normally isolated or automatically isolated from parts of system covered by a.	NNS	-	-	-	
Instrumentation					7, 18
1. Primary Elements for piping & valves:					
-Type a) and b)	1E	I	~~x~~b	b	b
2. Signal transmitter for:					
-Controls and interface	1E	I	b	b	
-Status display	1E	I	b	b	
-Alarms and Computer logging	NNS	-	b	b	17
3. Signal processing and/or interlocking for:					
-Panel controls and indicators/ recorders	1E	I	b	b	
-Alarms/computer	NNS	-	b	b	17
Refueling Water Level Indicating System					
RCPB Isolation Valves	1 or 2	I	b	b	
Piping, Tubing and Valves	3	I	b	b	
Instrumentation	NNS	-	b	b	
Chemical and Volume Control System					
Charging Pumps	2	I	b	b	
Boric Acid Makeup Tanks	3	I	b	b	
Letdown Heat Exchanger					
a) Reactor coolant side	2	I	b	b	
b) Component cooling water side	3	I	b	b	
Regenerative Heat Exchanger	2	I	b	b	
Volume Control Tank	2	I	b	b	
Boric Acid Batching Tank	NNS	-	-	-	
Purification Ion Exchangers	2	I	b	b	
Deborating Ion Exchangers	2	I	b	b	
Piping and Valves					5
a) Part of RCPB	1 or 2	I	b	b	6
b) Required only for reactor coolant letdown and makeup	2	I	b	b	

TABLE 3.2-1 (Sheet 5 OF 25)

Chemical and Volume Control System (Cont'd)	Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
c) Required for injection of concentrated boric acid or whose failure would prevent the operation of that portion of system covered in a or b.	3	I	b	b	
d) Normally or automatically isolated from parts or system covered by a, b or c.	NNS	-	-	-	7, 18
Boric Acid Pumps	3	I	b	b	
Chemical Addition Tank	NNS	-	-	-	
Chemical Addition Pump	NNS	-	-	-	
Pulsation Dampeners	2	I	b	b	
Instrumentation					7, 18
1. Primary Elements for:					
a) Charging Pump, Boric Acid Make-up Tank, Volume Control Tank, Boric Acid Pumps	IE	I	b	b	21
b) Letdown Heat Exchanger, Boric Acid Batching Tank, Purification Ion Exchanger, Deborating Ion Exchanger	NNS	-	b	b	17
2) Digital Signals and Transmitter Signals for:					
a) Controls & Interface for Type 1a above	IE	I	b	b	
b) Controls & Interface for Type 1b above	NNS	-	b	b	17
c) Alarms and Computer	NNS	-	b	b	17
3) Controls and transfers to Remote Shutdown Panel	IE	I	b	b	
4) Controls, Displays and Interlocks for Type 1b	NNS	-	b	b	17
Containment Spray System					
Containment Spray Pumps	2	I	b	b	

NO CHANGES: FOR INFORMATION ONLY

Containment Spray System (Cont'd)	Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
Piping and Valves					
a) Required for long-term recirculation of SIS sump water for spray	2	I	b	b	
b) Normally or automatically isolated from parts of system covered by a.	NNS	-	-	-	
Containment Spray Nozzles Instrumentation	2	I	b	b	
1. Primary elements for:					7, 18
a) Containment Spray Pumps	IE	I	b	b	
b) Long term recirculation	IE	I	b	b	
c) Isolation valves	IE	I	b	b	
2. Signal transmitters/Digital Signals for:					
a) Controls & interface	IE	I	b	b	
b) Status display	IE	I	b	b	
c) Alarms and computers	NNS	-	b	b	17
3. Signal processing and/or interlocking for:					
a) Control panel controls	IE	I	b	b	
b) Indicators	IE	I	b	b	
c) Alarms and computer inputs	NNS	-	b	b	17
Waste Management System					
Waste Tanks and Pumps	NNS	-	-	-	
Waste Storage Tank "C"	NNS	-	-	-	
Laundry Tanks and Pumps	NNS	-	-	-	
Waste Concentrator Package	NNS	-	-	-	
Waste Condensate Ion Exchanger	NNS	-	-	-	
Waste Condensate Tanks and Pumps	NNS	-	-	-	
Gas Surge Tank	NNS	(d)	b	b	17
Spent Resin Tank	NNS	-	-	-	
Dewatering Tank and Pump	NNS	-	-	-	
Waste Gas Compressors	NNS	-	b	b	17
Gas Decay Tanks	NNS	(d)	b	b	3, 17
Waste Concentrate Storage Tank and Pump	NNS	-	-	-	
Chemical Waste Tank and Pump	NNS	-	-	-	

NO CHANGES: — FOR INFORMATION ONLY

	Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes	
Waste Management System (Cont'd)						
Piping and Valves					5	
a) Not isolated from SC 3 Components	3	I	b or c	b	3,17	4
b) Associated with GDT	NNS	(d)	-	-	17	
c) Other	NNS	-	-	-		
Boron Management System						
Reactor Drain Tank	NNS	-	-	-		
Equipment Drain Tank	NNS	-	-	-		
Holdup Tanks	3	I	b	b		
Holdup Recirculation Pump	NNS	-	-	-		
Holdup Recirculation/Drain Pump	NNS	-	-	-		
Holdup Drain Pump	NNS	-	-	-		
Equipment Drain Tank Pump	3	I	b	b		
Reactor Drain Tank Pump	3	I	b	b		
Flash Tank	3	I	b	b		
Flash Tank Pumps	3	I	b	b		
Preconcentrator Ion Exchangers	NNS	-	-	-		
Boric Acid Concentrator Packages	NNS	-	-	-		
Boric Acid Condensate Ion Exchangers	NNS	-	-	-		
Boric Acid Condensate Tanks and Pumps	NNS	-	-	-		
Piping and Valves					5	
a) Not isolated from SC 3 components	3	I	b	b		
b) Other	NNS	-	-	-		
Component Cooling Water System						
Component Cooling Water Surge Tank	3	I	b	b		
Component Cooling Heat Exchangers	3	I	b	b		
Component Cooling Water Pumps	3	I	b	b		
Component Cooling Water Makeup Pumps	3	I	b	b		
~~Auxiliary Component Cooling Water Pumps~~	3	I	b	b		
Wet Cooling Towers/Basin	3	I	a or b or c	b		
Dry Cooling Towers	3	I	a or b or c	b		
Piping and Valves					5	
a) Required for performance of safety functions	3	I	b or C	b		
b) Normally or automatically isolated from parts covered by a.	NNS	-	a, b or C	-		
Instrumentation:					7, 18	
1. Primary elements for:						
a) CCW Pumps, Heat Exchangers and Surge tank	1E	I	b	b		

TABLE 3.2-1 (Sheet 8 OF 25)

Component Cooling Water System (Cont'd)	Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
b) Dry and Wet Cooling Towers	IE	I	b, c	b	
c) Isolation valves for Dry & Wet Cooling Towers	IE	I	b, c	b	
2. Signal transmitters and digital signal for:					
a) Dry and Wet Towers	IE	I	b, c	b	
b) Status display and controls	IE	I	b	b	
c) Alarms and Computer	NNS	-	b	b	17
3. Signal processing and/or interlocking for:					
a) Panel controls	IE	I	b	b	17
b) Indicators	IE	I	b	b	
c) Indicators-controllers	IE	I	b	b	
d) Computer inputs	NNS	-	b	b	17
e) Alarms	NNS	-	b	b	17
Sampling System					
Sample Heat Exchangers	NNS	-	-	-	
Sample Collecting Tank	NNS	-	-	-	
Piping and Valves					5
a) Part of RCPB	2	I	b	b	
b) Normally or automatically isolated from RCPB	NNS	-	-	-	
Containment Cooling System					
Containment Fan Coolers	2	I	b	b	
Ductwork	2 or NNS	I or -	b	b	8
Instrumentation:					7, 18
1. Primary elements for:					
a) CCW in	IE	I	b	b	
b) CCW out	IE	I	b	b	
c) Optical flow detectors	NNS	-	b	b	17

TABLE 3.2-1 (Sheet 9 of 25) Revision 9 (12/97)

Containment Cooling System (Cont'd)	Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
2. Signal Transmitters for:					
a) Types 1a and 1b above	IE	I	b	b	
b) Type c	NNS	-	b	b	17
3. Signal processing and displays:					
a) Panel indicators for Type 1a and 1b	IE	I	b	b	
b) Signal to computer Type 1c	NNS	-	b	b	17
Essential Services Chilled Water System					
Water Chillers	3	I	b	b	
Chilled Water Pumps	3	I	b	b	
Chilled Water Expansion Tanks	3	I	b	b	
					5
a) Required for performance of safety function	3	I	b	b	
Instrumentation:					7, 18
1. Primary elements for:					
a) Water Chillers	IE	I	b	b	
b) Chilled Water Tanks	IE	I	b	b	
c) Piping (safety and isolation)	IE	I	b	b	
2. Signal Transmitter for:					
a) Controls	IE	I	b	b	
b) Indication and Data logging	IE	I	b	b	
3. Signal Processing for					
a) Panel indicators	IE	I	b	b	
b) Computer	NNS	-	b	b	17

NO CHANGES: FOR INFORMATION ONLY

TABLE 3.2-1 (Sheet 10 of 25) Revision 9 (12/97)

Fuel Handling System (Cont'd)	Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
Spent Fuel Handling Machine and Tool	NNS	I	b	b	17
Refueling machine	NNS	I	b	b	17
CEA Change Mechanism	NNS	-	b	b	17
Fuel Transfer Equipment Set	NNS	-	b	b	17
Fuel Transfer Tube and Penetration Assembly	2	I	b	b	
Spent Fuel Pool System					
Fuel Pool Pumps	3	I	b	b	
Fuel Pool Heat Exchangers	3	I	b	b	
Refueling Canal Drain Pump	NNS	-	-	-	
Fuel Pool Purification Pump	NNS	-	-	-	
Fuel Pool Ion Exchanger	NNS	-	-	-	
Piping and Valves					5
a) Spent fuel cooling subsystem	3	I	b, c	b	
b) Purification subsystem	NNS	-	-	-	
c) Spent fuel pool purification pump suction piping	NNS	d			
Instrumentation:					7, 18
1. Primary elements for:					
a) Pool Pumps and Purification Pump	NNS	-	b	b	17
b) Heat Exchanger	NNS	-	b	b	17
c) Ion Exchanger	NNS	-	b	b	17
d) Spent Fuel Pool Piping	NNS	-	b	b	17
2. Signal Transmitters for:					
Types 1a, 1b, 1c and 1d	NNS	-	b	b	17
3. Signal Processing for:					
a) Alarms	NNS	-	b	b	17
b) Computer	NNS	-	b	b	17
c) Indicators	NNS	-	b	b	17

TABLE 3.2-1 (Sheet 11 of 25)

	Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
Main Steam and Feedwater System					
Piping and Valves					9
a) From Steam Generator to outermost isolation valve	2	I	b	b	
b) Main Steam to Emergency Feedwater Pump A/B	3	I	~~b~~ b or c	b	
c) From Isolation Valves to Col. G	NNS	I	~~b~~ b or c	b	
d) Other	NNS	-		-	
Flow Measurement Primary Elements (Flow Venturis)	2	I	b	b	
Instrumentation:					7, 18
a) From Steam Generator to Isolation Valves	IE	I	b	b	
b) From Isolation Valves to Turbine	NNS	-	b or c	b	17
2. Signal Transmitters for:					
- Type 1a above	IE	I	b	b	
- Type 1b above	NNS	-	b	b	17
3. Signal Processing and Interlocking for:					
- Type 1a above (except Alarm and computer)	IE	I	b	b	
- All other (incl Alarms and computer)	NNS	-	b	b	17
Emergency Feedwater System					
Emergency Feedwater Pumps	3	I	b, c	b	5
Piping and Valves					
a) From Steam Generator up to and including outermost isolation valve	2	I	b	b	
b) Emergency Feedwater piping from CSP to isolation valves to SG 1	3	I	b	b	
c) Emergency Feedwater piping from CSP to isolation valves to SG 2	3	I	~~b~~ b, c	b	
d) Normally or automatically isolated from parts covered by a), b) and c).	NNS	-	-	-	

	Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
Emergency Feedwater System (Cont'd)					
Instrumentation:					7, 18
1. Initiaion Elements for:					
a) Switchgear operation	IE	I	b	b	
b) Alarms	NNS	-	b	b	17
c) Computer	NNS	-	b	b	17
2. Signal Transmitters	IE	I	b	b	17
3. Signal Processing					
a) Panel Displays (Lights)	IE	I	b	b	
b) Alarms	NNS	-	b	b	17
Compressed Air Systems					
Compressors & Receivers	NNS	-	-	-	
Accumulators					
a) Required for the performance of safety functions of safety class 1, 2 or 3 valves	3	I	b or c	b	10
b) Other	NNS	-	-	-	
Containment Isolation System					
Piping and Valves (of all systems penetrating containment)					
a) Part of RCPB	1 or 2	I	b	b	6
b) From first isolation valve inside containment or from containment penetration weld to outermost isolation valve	2	I	b	b	
Instrumentation:					7, 18
1. Primary Elements for all Valves and Piping	IE	I	b	b	
2. Signal Transmitters for all equipment	IE	I	b	b	

TABLE 3.2-1 (Sheet 13 of 25)

	Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
Containment Isolation System (Cont'd)					
3. Signal Processing:					
-Panel displays	IE	I	b	b	
-Alarms and Computer	NNS	-	b	b	17
Emergency Diesel Generator System					
Diesel Oil Storage Tanks	3	I	b	b	
Diesel Oil Transfer Pumps	3	I	b	b	
Diesel Oil Storage Feed Tanks	3	I	b or c	b	
Maintenance Lube Oil Storage Tank	NNS	-		-	
Motor-Driven Jacket Water Pump	3	I	b	b	
Emergency Diesel Generators	IE	I	b	b	12
Emergency Diesel Engine	3	I	b	b	
Starting Air Receivers	3	I	b	b	
Starting Air Compressors	NNS	-	-	-	
Jacket Water Heat Exchanger	3	I	b	b	
Jacket Water Standpipe	3	I	b	b	
Lube Oil Heat Exchanger	3	I	b	b	
Lube Oil Pump	3	I	b	b	
Diesel Generator Intakes and Exhausts	-	I	a or b or c	b	
Instrumentation:					7, 18
1. Primary elements for					
a) Generator	IE	I	b	b	
b) Diesel oil	IE	I	b	b	
c) Air supply	IE	I	b	b	
d) Water for cooling	IE	I	b	b	
e) Alarms and computer interface	NNS	-	b	b	17
2. Signal Transmitters/Digital signals for:					
- Type 1a, 1b, 1c and 1d above	IE	I	b	b	
- Type 1e above	NNS	-	b	b	17
3. Signal processing and/or interlocking for:					
- Type 1a, 1b, 1c and 1d above	IE	I	b	b	
- Type 1e above	NNS	-	b	b	17

TABLE 3.2-1 (Sheet 14 OF 25)

Control Room Air Conditioning System		Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
Control Room Emergency Filtration Units	S-8	3	I	b	b	15
Control Room Air Handling Units	AH-12	3	I	b	b	
Control Room Toilet Exhaust Fans	E-34	NNS	I	b	b	
Control Room Conference and Kitchen Exhaust Fan	E-42	NNS	-	-	-	17
Supplemental Recir Air Handling Units	AH-31	NNS	-	-	-	17
Chlorine & Broad Range Detectors		NNS	-	b	b	17, 25
Ductwork and Dampers						
a) Required for the performance of Safety Functions		3	I	b	b	
b) Other		NNS	-	-	-	
Instrumentation:						7, 18
1. Panel mounted components for all units		IE	I	b	b	
2. Control relays in Auxiliary Panel for all units		IE	I	b	b	
3. Alarm signals for all units		IE	I	b	b	
4. Computer signals for all units		NNS	-	b	b	17
RAB Cable Vault and Switchgear Areas Ventilation System						
Switchgear Area Air Handling Units	AH-25	3	I	b	b	
Switchgear Area Air Handling Units	AH-30	3	I	b	b	
Battery Rooms Exhaust Fans	E-29, 30, 31	3	I	b	b	
Battery Room Exhaust Fans	E-46	3	I	b	b	
H&V Room Ventilation Fans	E-52	3	I	b	b	
Ductwork and Dampers						
a) Required for the performance of Safety Functions		3	I	b	b	
b) Other		NNS	-	-	-	

NO CHANGES: FOR INFORMATION ONLY

TABLE 3.2-1 (Sheet 15 OF 25)

RAB Cable Vault and Switchgear Areas Ventilation System (Cont'd)		Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
Instrumentation:						7, 18
1. Panel mounted components (switches, lamps) for all units		IE	I	b	b	
2. Control relays in Auxiliary Panels for all units		IE	I	b	b	
3. Alarms signals for all units		IE	I	b	b	
4. Computer signals for all units		NNS	-	b	b	17
RAB H&V Equipment Room Ventilation System						
Supply Air Handling Units	AH-13	3	I	b	b	
Exhaust Fans	E-41	3	I	b	b	
Ductwork and Dampers						
a) Required for the performance of Safety Functions		3	I	b	b	
b) Other		NNS	-	-	-	
Instrumentation:						7, 18
1. Primary elements for Supply Air Hand Units and Exhaust Fan		IE	I	b	b	
2. Signal Transmitter (PAC)		IE	I	b	b	
3. Signal processing and/or interlocking		IE	I	b	b	
4. Alarms and Computer Signals		NNS	-	b	b	17
FHB Ventilation System						
FHB H&V Room Exhaust Fans	E-21	3	I	b	b	
FHB Emergency Filtration Units	E-35	3	I	b	b	15
Ductwork and Dampers						
a) Required for the performance of Safety Functions		3	I	b	b	
b) Other		NNS	-	-	-	

NO CHANGES: FOR INFORMATION ONLY

TABLE 3.2-1 (Sheet 16 OF 25)

FHB Ventilation System (Cont'd)		Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
Instrumentation:						7, 18
1. Primary elements for H & V Room Exhaust Fan (Thermocouple)		IE	I	b	b	
2. Signal processing (through PAC) for both units (E21 and E35)		IE	I	b	b	
3. Alarms displayed in CP-18 secton of RTGB		IE	I	b	b	
4. Computer signals		NNS	-	b	b	17
Containment Atmospheric Release System						
CARS Supply Fans	S-3	2	I	b	b	11
CARS Exhaust Fans	E-18	2	I	b	b	11
Ductwork and Dampers						
a) Required for the performance of Safety Functions		2	I	b	b	
Instrumentation:						7, 18
1. Panel mounted components (switches, lamps) for both Supply Fan and Exhaust Fan		IE	I	b	b	
2. Control Relays in Auxiliary Panels for both units		IE	I	b	b	
3. Alarms and Computer Signals for both units		NNS	-	b	b	17
Shield Building Ventilation System						
Filtration Units	E-17	2	I	b	b	15
Ductwork and Dampers						
a) Required for the Performance of Safety Functions		2	I	b	b	

NO CHANGES: FOR INFORMATION ONLY

TABLE 3.2-1 (Sheet 17 OF 25)

Shield Building Ventilation System (Cont'd)		Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
Instrumentation:						7, 18
1. Panel mounted controls and displays		IE	I	b	b	
2. Control relays in AUxiliary		IE	I	b	b	
3. Alarms in CP-18 Section of the RTGB		IE	I	b	b	
Controlled Ventilation Area System						
Filtration Units	E-23	3	I	b	b	15
Ductwork and Dampers						
a) Required for the performance of Safety Functions		3	I	b	b	
b) Other		NNS	-	-	-	
Instrumentation:						7, 18
1. Primary Elements for:						
a) Exhaust Fans		IE	I	b	b	
b) Electric Heating Coils		IE	I	b	b	
2. Signal Transmitter for:						
a) Recording		IE	I	b	b	
b) Alarms		IE	I	b	b	
c) Computer recording		IE	I	b	b	
3. Signal processing and/or interlocking for:						
a) Panel controls and alarms		IE	I	b	b	
b) Panel Recorder		IE	I	b	b	
c) Auxiliary panels relays for interlocks		IE	I	b	b	
d) Computer data logging		NNS	-	b	b	17
Reactor Cavity Cooling System						
Supply Fans	S-2	NNS	I	b	b	

No CHANGES: FOR INFORMATION ONLY

TABLE 3.2-1 (Sheet 18 OF 25)

Emergency Diesel Generator Ventilation System (Cont'd)		Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
Exhaust Fans	E-28	3	I	b	b	
Ductwork and Dampers						
a) Required for the rperformance of Safety Functions		3	I	b	b	
b) Other		NNS	-	-	-	
Miscellaneous HVAC Equipment						
Safeguards Pump Rm Air Handling Units	AH-2	3	I	b	b	
Shutdown Heat Exchanges Air Handling Units	AH-3	3	I	b	b	
Component Cooling Water Pumps Air Handling Units	AH-10	3	I	b	b	
Emergency FW Pump Air Handling Units	AH-17	3	I	b	b	
Charging Pumps Air Handling Units	AH-18	3	I	b	b	
Component Cooling Water Pump AB Air Handling Unit	AH-20	3	I	b	b	
Safeguard Pump AB Air Handling Unit	AH-21	3	I	b	b	
Charging Pump AB Air Handling Units	AH-22	3	I	b	b	
Component Cooling Water Heat Exchanger Air Handling Units	AH-24	3	I	b	b	
Control Room (Mechanical Equip RM) Handling Unit	AH-26	3	I	b	b	
Ductwork and Dampers						
a) Required for the performance of Safety Functions		3	I	b	b	
b) Other		NNS	-	-	-	
Instrumentation:						7, 18
1. Primary elements for all equipment		IE	I	b	b	
2. Signal Transmitter on all equipment used for:						
- Computer signal (isolator)		IE	I	b	b	
- Alarms		IE	I	b	b	

NO CHANGES: FOR INFORMATION ONLY

TABLE 3.2-1 (Sheet 19 OF 25)

Miscellaneous HVAC Equipment (Cont'd)	Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
3. Controls and Displays					
- Panels mounted controls and status displays	IE	I	b	b	
4. Signal interlocking					
- relays in Auxiliary Panels	IE	I	b	b	
Combustible Gas Control					
Hydrogen Recombiners	2	I	b	b	
Hydrogen Analyzer System	IE	I	b	b	7
Piping and Valves:					
1. Hydrogen Recombiners	N/A	N/A	N/A	N/A	20
2. Hydrogen Analyzer					
a) All piping and valves inside containment up to and including outmost isolation valve of sample feed header	2	I	b	b	
b) All piping and valves inside containment up and including the outmost isolation valve of sample return line	2	I	b	b	
Instrumentation:					
1. Hydrogen Recombiner					7, 18
a) Power Meter	IE	I	b	b	
b) Potentiometer (Power Adjust)	IE	I	b	b	
c) Off-on Switch	IE	I	b	b	
d) Power Available Light	IE	I	b	b	
2. Hydrogen Analyzer					
a) Analyzer Cell	IE	I	b	b	
b) Pressure and Flow Switches	IE	I	b	b	
c) Hydrogen Concentration Recorder	IE	I	b	b	
d) Mode Selector Switch	IE	I	b	b	
e) Sample Light Indicators	IE	I	b	b	

NO CHANGES: FOR INFORMATION ONLY

TABLE 3.2-1 (Sheet 20 OF 25)

Containment Vacuum Relief Actuation System	Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
Instrumentation:					7, 18
1. Primary elements:					
a) Containment/Annulus Differential Pressure Switch	IE	I	b	b	
b) Valves and valve position switches	IE	I	b	b	
2. Digital signals for:					
a) Starting signal and interlock	IE	I	b	b	
b) Data logging in multiplexor	NNS	-	b	b	17
3. Signal processing for:					
a) Panel Cntrol switches	IE	I	b	b	
b) Panel Status lights	IE	I	b	b	24
c) Alarms	IE	I	b	b	
Containment Pressure Indication System					
Instrumentation:					7, 18
1. Primary elements	IE	I	b	b	
2. Signal transmitters	IE	I	b	b	
3. Signal processing and displays:					
a) Panel Indicators	IE	I	b	b	
b) Alarms	NNS	-	b	b	17
Containment Water Level Indication System					
Instrumentation:					7, 18
1. Primary Elements	IE	I	b	b	
2. Signal transmitters	IE	I	b	b	
3. Signal processing for:					
a) Panel Indicators	IE	I	b	b	
b) Data logging in multiplexors	NNS	-	b	b	

NO CHANGES: FOR INFORMATION ONLY

TABLE 3.2-1 (Sheet 21 of 25)

	Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
Electrical Systems and Equipment					12, 14
Safety System 4.16 kV Switchgear	IE	I	b	b	
Safety System 480 V Switchgear and Transformers	IE	I	b/c	b	
Safety System 480 V Motor Control Centers	IE	I	b/c	b	
Safety System Motors	IE	I	b or c	b	
Containment Electrical Penetrations	IE	I	b	b	
Vital dc Switchgear and Control Boards	IE	I	b	b	
Station Batteries and Chargers	IE	I	b	b	
Safety System Power, Control and Instrument Cables and Raceways	IE	I	b or c	b	
Vital ac Inverters and Distribution Panels	IE	I	b or c	b	
Cable splices, Connectors, Terminal Blocks	IE	I	b	b	
Fire stops	NNS	-	b	b	
Boric Acid Heat Tracing System	IE	I	b	b	
Safety System 125V DC and 120VAC Power Distribution Panels	IE	I	b	b	
Radiation Monitoring					7,18
Process Rad Monitors - CCWS	IE	I	b	b	
Area Rad Monitors (Channels RE-24 through 33)	IE	I	b	b	
Airborne Rad Monitors:					
Containment Atmosphere	IE	I	b	b	
Main Control Room	IE	I	b	b	
Plant Stack	IE	I	b, c	b	
Process Radiation Monitors	NNS	-	b	b	17
Effluent Radiation Monitors	NNS	-	b	b	17
In Plant Airborne Rad Monitors	NNS	-	b	b	17
Area Radiation Monitors	NNS	-	b	b	17
Portable Continuous Air Monitors	NNS	-	b	b	17
Gamma Spectrometer	NNS	-	b	b	17
Liquid Scintillation	NNS	-	b	b	17
Accident Radiation Monitors					
Plant Vent Stack	NNS	-	b/c	b	17
Main Steam Line	NNS	-	b	b	17
Condenser Vacuum Pump	NNS	-	~~b~~ -	b	17
FHB Emergency Exhaust	NNS	-	b	b	17
High Range Containment	IE	I	b	b	7, 18
Post Accident Sampling System (II.B.3)	NNS	-	b	b	17

TABLE 3.2-1 (Sheet 22 of 25) Revision 4 (12/90)

	Safety Class	Seismic Category	Tornado* Wind Criterion	Flood** Criterion	Notes
Inadequate Core Cooling Instrumentation (II.F.2)	1E	I	b	b	17, 22
1. Saturation Margin Monitor 2. Heated Junction Thermocouples 3. Core Exit Thermocouples 4. Signal Processing and Display					
Miscellaneous					
Spent and New Fuel Storage Racks	-	I	b	b	
Main Control Panel	1E	I	b	b	7, 12, 18
Containment Vacuum Relief System	2	I	b	b	
FHB Bridge Crane	-	I	b	b	
Reactor Polar Crane	-	I	b	b	
Containment Piping Penetrations	2	I	b	b	
Radwaste Cask Handling Bridge Crane	-	I	b	b	
Maintenance Hatch Shielding Door	-	I	~~b~~ a	b	
Auxiliary Control Panel (Hot Shutdown) (Table 7A-3)	1E	I	b	b	7, 18
Reactor Building Canal Liner	-	I	b	b	23
FHB Spent Fuel & Spent Fuel Cask Storage Pools & Pool Liners	-	I	b	b	23
RAB Condensate & Refueling Water Storage Pools and Pool Liners	-	I	b	b	23
Fuel Transfer Tube and Penetration Assembly	2	I	b	b	
UHS Sump Pumps (Cooling Tower Areas)	NNS	(d)	b or c	b	17
Decontamination - Area Structure	-	I	b	b	
Meterological data collection equip.	NNS	-	-	-	17
Containment - Personnel Lock, equipment hatch and escape lock	2	I	a or b or c	b	
Annulus access lock	-	I	a	a	
Plant-safety-parameter display console (I.D.2)	NNS	-	b	b	17, 18
Engineered safety features actuation system	1E	I	b	b	7, 18
RCP Oil Collection System	NNS	-	b	b	
ATWS Mitigating Systems	1E or NNS	I or -	b	b	26	4

* Tornado Wind Criterion (Section 3.3)

a. Structure or component is designed to withstand design wind.

b. The system or components are housed within a structure and/or protected by a barrier which is designed to withstand the design winds and/or missile loads.

c. System or component failure is not credible because tornado missile induced failure modes are considered improbable. Ref section 3.5.1.4.1

**Flood Criterion (Section 3.4)

a. Structure or component is part of NPIS which is protected against flooding.

b. System or component is housed within another structure (NPIS) designed to protect against flooding.

TABLE 3.2-1 (Sheet 23 OF 25)

(a) represents no safety class or quality group classification
(b) represents not designed to seismic Category I requirements
(c) represents no cirterion specified because not safety-related or seismically designed
(d) represents designed to seismic Category I requirements, but not classified seismic Category I

General Notes

Expendable and consumable items used in conjunction with safety-related equipment are considered safety-related. These items have and will receive applicable 10CFR50 Appendix B QA. Examples of these items are weld rod, diesel fuel oil, boric acid, etc.

NSSS Supplied Equipment

- All safety-related valve operators are procured as an integral part of the associated valve. All relevant requirements specified for the valve apply to the valve operator. Seismic qualification of valves and valve operators is described in the FSAR in the response to Item No. 18, Apendix 110A, Response to NRC Questions. This equipment has and will receive applicable 10CFR50 Appendix B QA.

- All safety-related motors for safety-related pumps are procured as an integral part of the associated pump. All relevant requirements specified for the pump apply to the pump driver. Seismic qualification of pump/driver assemblies is described in the FSAR in the responses to Items No. 26 and 27, Appendix 110A, Response to NRC Questions. This equipment has and will receive applicable portions of 10CFR50 Appendix B QA.

Non-NSSS Supplied Equipment

- Actuators are considered as part of valve assemblies. All safety-related valve assemblies are qualified to seismic Category I requirements. All safety-related motor and solenoid actuators and all safety-related electrical accessories on hydraulic and pneumatic actuators required for Accident Mitigation or Post-Accident Monitoring are IE qualified. In addition where such equipment on a non-active valve is connected to an electrical circuit or bus whose safety function may be adversely affected by failure of that accessory,m this equipment is also 1E qualified. These assemblies receive applicable portions of 10CFR50 Appendix B QA.

- All motors on safety-related pumps are qualified to seismic Category I requirements as part of th epump assemblies. All motors on safety-related pumps required for Accident Mitigation, Post-Accident Monitoring, or whose failure may adversely affect the safety function of its electrical bus or circuit, are qualified to 1E requirements. These motors receive applicable portions of 10CFR50 Appendix B QA.

ITEMIZED NOTES:

1. Class 1E as defined by IEEE 308.

2. Loss of cooling water to the reactor coolant pump motors caused by a failure ofthe non-seismic vategory (Quality Group D) motor bearing oil systems or the air coolers may prevent normal continuous operation of the pumps. However, continuous operation of the pumps is not required during or following a SSE because they do not serve a safety function. Therefore, the specific recommendations of Regulatory Guides 1.26 and 1.29 are not applied to these pump auxiliaries.

NO CHANGES: FOR INFORMATION ONLY

TABLE 3.2-1 (Sheet 24 OF 25)

<u>ITEMIZED NOTES</u> (Cont'd)

3. These components and associated supporting structures must be designed to retain structural integrity during and after a seismic event dut do not have to retain operability for protection of public safety. The basic requirement is prevention of structural collspse and damage to equipment and structures required for protection of public safety.

4. Includes partial length and full length control element assemblies (CEAs).

5. <u>Piping and Valves</u> - Piping and valves between seismic Category 1 equipment, components or tanks shall be Category 1. Piping shall be Category 1 up to and including the barrrier (as defined in Subsection 3.2.2.3) in the line from a Category 1 component to a non-seismic component. Reactor coolant pressure boundary (RCPB) is defined in 10CFR 50.2

6. Components which are connected to the RCS and are part of the RCPB are classified as Safety Class 2 provided:

   a) In the event of postulated failure of the component during normal reactor operation, the reactor can be shut down and cooled down in the orderly manner, assuming makeup is provided by Chemical and Volume Control System only, or

   b) The component is or can be isolated from the RCS by two valves (both closed, both open, or one closed and the other open). Each open valve must be capable of sutomatic actuation and assumin g the other valve is open, its closure time must be such that, in the event of postulated failure of the component during normal reactor operation, each valve remains operable and the reactor can be shut down and cooled down in an orderly manner, assuming makeup is provided by the Chemical and Volume Control System only.

7. <u>Instrumentation</u> - Instrumentation required to actuate, maintain operation of, or detect failure of equipment needed to safely shut down, isolate and maintain the reactor in a safe condition and prevent uncontrolled release of radioactivity from the station shall be Class 1E/seismic Category I. Instrumentation designated as Class 1E/seismic Category I shall include as Class 1E/Category I all sensing lines, instrument valves and instrumentation racks. All Class 1E/Category I instrumentation will receive applicable 10CFR50 Appendix B QA during the operations phase.

8. The only portion of the ductwork that is safety-related is the short ducted emergency outlet. The remaining portion is seismically supported.

9. The Main Steam and Feedwater lines are seismic Category 1 up to the system of restraints at column line G as shown on Figure 1.2-8.

10. For safety-related components which are not covered by ASME Section III, the design of the compoonent is in accordance with other recognized industry codes or standards applicable to that of component. The quality assurance program applied to the design, manufacture, installation, testing and operation of the component meets the applicable requirements of the facility QA program.

11. This is an outdated Safety Classification (i.e., Safety Class 2). Regulatory Guide 1.7 (April 1974) no longer requires the purge system to be redundant or be designated seismic Category I, except insofar as portions of the system constitute part of the primary containment boundary.

12. <u>Electrical Equipment</u> - All cables, relays, motors, switchgear and other electrical equipment serving safety system components required to function furing the SSE shall be Class 1E, if they are necessary for the performance of the component's safety function. All Class 1E electrical equipment will receive applicable portoins of 10CFR50 Appendix B QA during the operations phase.

NO CHANGES: FOR INFORMATION ONLY

TABLE 3.2-1 (Sheet 25 OF 25) Revision 8 (5/96)

ITEMIZED NOTES (Cont'd)

13. All structures, systems and components identified as Seismic Category I receive the 10CFR50 Appendix B Quality Assurance Program consistent with their safety function. Safety-related Seismic Category I items receive the full Quality Assurance Program while NNS Seismic Category I items receive the full Quality Assurance Program while NNS Seismic Category I items receive the pertinent quality assurance requirements specified in the Quality Assurance Program.

14. Collectively identifies safety-related components, including equipment in Cooling Tower Areas.

15. Operational 10CFR50 Appendix B QA is applied for HEPA filter & charcoal absorber.

16. Safety and seismic considerations meet the requirements of NUREG-0737.

17. These items will receive applicable 10CFR50 Appendix B QA during the operational phase. Items/services will be procured whenever possible from a vendor with a 10CFR50 Appendix B QA program. When this is not possible, additional steps will be taken by LP&L QA, such as a detailed receiving inspection to assure that it performs its required functions.

18. Isolators that connect the protective systems (Class 1E) to the plant computer (non-Class 1E) are Class 1E and seismic Category I.

19. This table is an overview of the structures, components, and systems. Refer to the station's Master Equipment List, process and instrument diagrams, and control wiring diagrams for futher detail.

20. The Hydrogen Recombiner has no piping and valves.

21. Suction pressure and lube oil pressure switches on charging pumps are Safety Class N2 (C-E Quality Class 2B).

22. The ICCI SYstem is environmentally and seismically qualified. Out-of-vessel components, i.e., cables and connectors are environmentally qualified in accordance with IEEE-323-1974. In addition, the HJTC System has been extensively tested and verified under conditions similar to what it may encounter during an ICC event. The CET's have also been tested and verified to function up to a temperature of 2300F. The ICCI System will be installed and operational prior to first cycle commercial operation. Although all cabling for the CET's is qualified to Class 1E criteria, some of the cabling is run in NNS cable trays, see Appendix 1.9A for details.

23. The canal, pools, and their liners are classified as structures and are therefore not assigned a safety class, but are designed and constructed as seismic Category I under the 10CFR50 Appendix B requirements. The liners and their nozzles are constructed to ASME Section VIII code requirements using ASME Section III materials.

24. Pressure switches PS-HV-5222 AS and BS function only to alarm on a loss of instrument air. This alarm function will not be lost as a result of a failure of the associated tubing. Therefore, the signal process tubing for these switches has been classified non-safety.

25. Detector design criteria is discussed in Subsection 6.4.4.2.

26. ATWS Instrumentation and components will receive NRC QA guidance for ATWS equipment, NRC Generic Letter 85-06, Quality Assurance Guidance for ATWS Equipment that is not safety related.

27. CEDM Exhaust Fan Motor cable/connector assemblies design criteria is discussed in Section 9.5.4.7.

NO CHANGES: FOR INFORMATION ONLY

MISSILE PROTECTION - OUTSIDE CONTAINMENT

TABULATION OF SAFETY RELATED STRUCTURES AND SYSTEMS

System or Structure	Location (Figure)	Description Section	FSAR Figure	Missile Protection
Main Control Room	1.2-8	6.4, 9.4	9.4-1 6.4-1, 2 & 3	Concrete walls of the main control room are designed to withstand tornado missiles. Main steam and feedwater lines do not contain components in the vicinity of the main control room which could be postulated as missiles, which would possibly penetrate the main control room walls.
Diesel Generators	1.2-9	9.5.4 thru 9.5.8 and 8.3	N/A	Diesel generators, including piping, are located in separate rooms. Exhaust silencers are also located in separate rooms. Air intake pipe is protected from tornado missiles by grating Diesel oil feed tanks are located in separate rooms. Main diesel oil tanks and pumps are in separate rooms. Diesel oil piping is routed from high energy piping.
Essential Services System	1.2-8	9.2.9	9.2.8	Equipment room where chillers are Chilled Water located is provided with missile doors and protection from external missiles.
Spent Fuel Storage Pool	1.2-15	9.1.2	N/A	Spent fuel pool is located inside of the Fuel Handling Building. There are no high energy lines in the Fuel Handling Building.

NO CHANGES: FOR INFORMATION ONLY

System or Structure	Location (Figure)	Description Section	FSAR Figure	Missile Protection
Main Steam and Feedwater	1.2-8 & 1.2-17	10.3 & 10.4.7	10.2-4 and 10.4-2	Main steam and feedwater isolation Systems and valves and their components are protected from tornado missiles by grating. There are no components in the vicinity of these valves which could be postulated as missiles. The probability of a damaging missile striking the exposed piping is less than 10^{-8} ~~$1.3X10^{-7}$~~ per year.
Electrical Equipment (4.16, 480V, and 125 V	1.2-9	8.3.1	N/A	All electrical switching equipment is located in the RAB. There is no high energy piping located in the switchgear room. The high energy compressed air bottles in the switchgear "B" room are seismically restrained, capped when not connected, and are capped when being transported in accordance with plant procedures to ensure they do not become potential missiles.
Containment Spray System and Safety	1.2-11	6.2 & 6.3	6.2-35 & 6.3-1	There are two separate rooms housing the HPSI, LPSI and containment spray pumps and the related Injection System instrumentation. In one room are located pumps and instrumentation associated with Channel A, and in the other room, channel B. The third HPSI pump is a spare pump that can be powered either from the electrical bus A or B, and is located in the same room with A pumps.**

** The Containment Spray and Safety Injection Systems are moderate energy systems and missiles from these systems are not postulated. Piping from the Containment Spray and Safety Injection Systems are not routed in the vicinity of the high pressure.

System or Structure	Location (Figure)	Description Section	FSAR Figure	Missile Protection
Emergency Feedwater System	1.2-11	10.4.9	10.4-2	Each motor driven emergency feedwater pump is located in its own room, and turbine driven pump is separated from high energy systems. Piping is routed away from components which are postulated as missiles. The probability of damaging missile striking the exposed EFW line to SG No. 2 is ~~$7.7x10^{-8}$~~ less than 10^{-8} per year. Emergency feedwater isolation valves and main steam supply valves to the emergency feedwater pump turbine are protected from tornado missiles by grating.
Component Cooling Water System & Ultimate Heat Sink	1.2-9, 1.2-24 & 1.2-25	9.2.2 & 9.2.5	9.2-1	Each component cooling water pump and each component cooling water heat exchanger is located in separate rooms. Protection of components outside the RAB from tornado missiles is described in Subsection 9.2.5.3.3 and protected from tornado generated missile as mentioned in Section 3.5.1.4.1. Piping is routed away high energy lines.
Containment Isolation	N/A	6.2.4	N/A	All containment isolation valves are located away or protected from missiles.
Containment	1.2-17 to 1.2-22	3.8.2	N/A	Concrete Shield Building is designed to withstand tornado missiles.
Containment Cooling System	1.2-18 & 1.2-19	6.2.2	9.4-7	Containment fan coolers are located in separate quadrants of the containment. Ductwork is routed away from high energy systems.

TABLE 3.5-3 (Sheet 4 of 4) Revision 9 (12/97)

System or Structure	Location (Figure)	Description Section	FSAR Figure	Missile Protection
Station Service Transformers 480V MCC	1.2-24	N/A	N/A	To be protected from tomado missiles by grating. Safety related conduits/cables that are not required for plant shutdown following a design bases tomado event (e.g. Wet cooling tower fan motors, Area radiation monitors for fuel handling building (FHB), emergency filtration units in FHB, some dry cooling tower fan motors, etc.) are not protected from potential missiles. See Section 3.5.1.4.1

ATTACHMENT 5 TO W3F1-99-0140

Commitments

COMMITMENT IDENTIFICATION/VOLUNTARY ENHANCEMENT FORM

Attachment *5* to ***W3F1-99-0140***
Subject: Request for Review and Approval of Design Basis Change Regarding Tornado Missiles
Date: October 29, 1999
Page 1 of 1

The following table identifies those actions which are considered to be regulatory commitments. Any other actions discussed in this submittal represent intended or planned actions, are described for the NRC Staff's information, and are not regulatory commitments.

COMMITMENT(S)	ONE-TIME ACTION*	CONTINUING COMPLIANCE*	SCHEDULED COMPLETION DATE (IF REQUIRED)	ASSOCIATED CR OR ER
After NRC Staff approval of this amendment request, the UFSAR will be revised as indicated in Attachment 4.				

*Check one only

VOLUNTARY ENHANCEMENT(S)	ASSOCIATED CR OR ER