TVA

Tennessee Valley Authority, Post Office Box 2000, Spring City, Tennessee 37381-2000

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10 CFR 50.4

ATTN: Document Control Desk
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555-0001

Watts Bar Nuclear Plant, Unit 2
NRC Docket No. 50-391

Subject: **Watts Bar Nuclear Plant (WBN) Unit 2 – Individual Plant Examination of External Events Design Report (IPEEE) – Response to Requests for Additional Information - Revised**

Reference:

1. TVA letter dated December 17, 2010, "Watts Bar Nuclear Plant (WBN) Unit 2 – Individual Plant Examination of External Events Design Report (IPEEE) – Response to Requests for Additional Information"

2. TVA letter dated February 17, 1998, "Watts Bar Nuclear Plant (WBN) Unit 1 - Generic Letter 88-20, Supplements 4 and 5 - Individual Plant Examination of External Events (IPEEE) for Severe Accident Vulnerabilities (TAC No. M83693)"

This letter provides revised responses to requests for additional information (RAIs) Nos., IPS-1f and IPO-2, previously provided in Reference 1. Further discussions with the staff during a telecon on March 11, 2011, created the need to provide these revised responses. In addition, this letter also provides a response to a new NRC RAI received during the telecon involving the definition of vulnerability used for the IPEEE Fire analysis. Enclosure 1 provides both the revised responses with revision bars indicating the changes along with the response to the new RAI.

To facilitate staff review, Enclosure 2 provides Attachment 5 of the report previously provided in Reference 2. Enclosure 1 refers to Attachment 5 to supplement the answer to RAI IPO-2.

This letter does not contain any new commitments. If you have any questions, please contact Bill Crouch at (423) 365-2004.

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NRR

I declare under penalty of perjury that the foregoing is true and correct. Executed on the 1st day of April, 2011.

Sincerely,

David Stinson
Watts Bar Unit 2 Vice President

Enclosures:

1. Revision to Previously Provided Responses to RAI Questions IPS-1f and IPO-2 and Response to New RAI

2. Excerpt entitled, "Attachment 5 - Watts Bar Nuclear Plant (WBN) - Individual Plant Examination for External Events - High Winds, Floods, and Other External Events

cc (Enclosures):

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ENCLOSURE 1

Tennessee Valley Authority - Watts Bar Nuclear Plant - Unit 2, Docket No. 50-391
Revision to Previously Provided Responses to
RAI Questions IPS-1f and IPO-2 and Response to New RAI

SEISMIC EVENTS

IPS - 1f

For the WBN1 Individual Plant Examination (IPE) your definition of vulnerability was in terms of contribution to core damage frequency. What is your definition of vulnerability for the Seismic Margin Analysis you carried out for the WNB2 IPEEE, and have you found any seismic vulnerabilities?

Response:

Watts Bar Units 1 and 2 is a focused scope plant with a 0.3g review level earthquake per NUREG-1407. Identification of seismic vulnerabilities is performed based on the criteria and guidelines of the EPRI Seismic Margin methodology (EPRI Report No. NP-6041). Consistent with the U1 IPEEE approach, a potential vulnerability would be identified as any component identified on the Safe Shutdown Equipment List (SSEL) for which the HCLPF capacity is computed as less than 0.3g.

Results will be reported consistent with that reported for Unit 1, as shown in Table 2.2 of the Unit 2 IPEEE Design Report (Reference 2). No vulnerabilities have been identified to date.

Note that based on further analysis, a revised HCLPF capacity of 0.52g has been established for Main Control Room (MCR) ceiling, rather than the Unit 1 value of 0.36g in Table 2.2 of the Unit 2 IPEEE Design Report (Reference 2).

OTHER EXTERNAL EVENTS

IPO - 2

What is your definition of vulnerability for the "Other External Events" analysis of WBN2, and have you found any vulnerabilities from the "Other External Events" analysis?

Response:

In accordance with GL 88-20 and NUREG-1407, the other external events analysis is a confirmation of compliance with the 1975 NUREG-0800 Standard Review Plan (SRP). Consequently, the definition of vulnerabilities from the "other external events" would be the identification of a structure system or component that is not in compliance with the 1975 SRP.

No vulnerabilities have been identified to date. Please note that as described in Section 3.2 of the Unit 2 IPEEE Design Report (Reference 2), TVA is currently re-establishing probable maximum flood (PMF) levels for all sites. Any increase in PMF elevation for Unit 2 will be handled as a design issue and not within IPEEE.

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NRC requested in the telecon of March 11, 2011, for a more detailed comparison of WBN U2 design requirements and the requirements of the 1975 SRP to supplement the previous discussion above. Enclosure 2 provides a document entitled, "Attachment 5, Watts Bar Nuclear Plant (WBN) - Individual Plant Examination for External Events - High Winds, Floods, and Other External Events." This document is from the Other External Events section of the Unit 1 IPEEE Report previously provided in Reference 2. It provides this same kind of comparison for Unit 1 and, with the exception noted above regarding PMF, is equally applicable to Unit 2 design requirements since the Unit 2 IPEEE approach is the same as Unit 1.

New NRC RAI: What definition of vulnerability was used for the IPEEE Fire analysis?

Response: The IPEEE uses the Fire Induced Vulnerability Evaluation (FIVE) methodology for evaluating the plant vulnerability to fires. The screening criteria was 1.0E-6 for a given fire area. If the probability of core damage was greater than 1.0E-6, then it would have been classified as a vulnerability.

ENCLOSURE 2

Excerpt entitled, "Attachment 5 - Watts Bar Nuclear Plant (WBN) - Individual Plant Examination for External Events - High Winds, Floods, and Other External Events

ATTACHMENT 5

WATTS BAR NUCLEAR PLANT (WBN) - INDIVIDUAL PLANT EXAMINATION FOR EXTERNAL EVENTS - HIGH WINDS, FLOODS, AND OTHER EXTERNAL EVENTS

5. HIGH WINDS, FLOODS, AND OTHER EXTERNAL EVENTS

5.1 INTRODUCTION

Selection of external events for the IPEEE and the technical approach recommended for evaluation of such external events are discussed in Section 2 and Section 5 of NUREG-1407 (Chen et al 1991) respectively. The High Winds, Floods, and Other External Events are evaluated and dispositioned in WBN calculation WCG-1-1837.

The selection of external events for inclusion in the IPEEE was done by the NRC staff and its consultants by examining which external initiators have the potential of initiating an accident that may lead to severe reactor core damage or large radioactive release to the environment. The external events examined included:

- Seismic Events
- Internal Fires
- High Winds and Tornadoes
- External Floods
- Transportation and Nearby Facility Accidents
- Lightning
- Severe Temperature Transients (Extreme Heat, Extreme Cold)
- External Fires (Forest Fires, Grass Fires)
- Extraterrestrial Activity (Meteorite Strikes, Satellite Falls)
- Volcanic Activity

The NRC Staff reviewed the past probabilistic risk assessments of external events and performed a generic evaluation of the sites and design information for a number of nuclear power plants to arrive at the following list of external events to be specifically included in the IPEEE:

- Seismic Events
- Internal Fires
- High Winds and Tornadoes
- External Floods
- Transportation and Nearby Facility Accidents

NUREG-1407 further requires all licensees to confirm that no plant-unique external events known to the licensee today with potential severe accident vulnerability are being excluded from the IPEEE.

NUREG-1407 gives detailed procedures for performing the IPEEE of seismic events and internal fires. For the "other" external events, a progressive screening approach is recommended. Figure 1-1 shows the analytical steps of increasing level of detail, effort and resolution that are contained in the following screening approach.

1. Review plant-specific hazard data and licensing bases.

2. Identify significant changes since the operating license (OL) was issued. This includes a review of (1) military and industrial facilities within 5 miles of the site, (2) transportation near the site, or (3) development changes since the issuance of the operating license.

3. Determine if the plant and facilities design meets the 1975 Standard Review Plan (SRP) criteria.

   After reviewing the information obtained in the previous three steps, a confirmatory walk down of the plant should concentrate on outdoor facilities that could be affected by high winds and off site developments. If the walk down does not reveal any potential vulnerabilities not already considered in the original design basis analysis and the plant and facility design meets the 1975 Standard Review Plan, it is judged that the contribution from the hazard to core damage frequency is less than 10^{-6} per year and the IPEEE screening criterion is met.

   If the review reveals that the 1975 SRP criteria will not be met, one or more of the following steps should be taken to further evaluate the situation.

4. Determine if the hazard frequency is acceptably low. If the current design basis does not meet the regulatory criteria given in the 1975 Standard Review Plan requirements, the next step is to demonstrate that the current design basis hazard is sufficiently low - that is, less than 10^{-5} per year, and the conditional core damage probability is judged to be less than 10^{-1}.

   If the current design basis hazard combined with the conditional core damage probability is not sufficiently low (i.e., less than the screening criterion of 10^{-6} per year), additional analyses should be performed.

5. Perform a bounding analysis

   This analysis is intended to provide a conservative calculation showing that either the hazard would not result in core damage or the core damage frequency is below the reporting criterion. The level of detail is that level needed to defend the above conclusion; judgment is needed for determining the proper level of detail and needed effort.

6. Perform a probabilistic risk assessment (PRA).

The application of the above approaches involves considerable judgment with regards to the required scope and depth of the study, level of analytical sophistication, and level of effort to be expended. This judgment depends on how important the external initiators are compared with internal initiators, and a perceived need for accurately characterizing plant capacity or core damage frequency. Consistent with engineering practice, expert opinions, simplified scoping studies, and bounding analyses are used, as appropriate, in forming these judgments.

5.2 TECHNICAL APPROACH OF WATTS BAR IPEEE

A review was performed of the external events described in NUREG-1407 and other external events to confirm that no unique external events are excluded from the IPEEE for Watts Bar (Ref. Calculation WCG-1-1837). External events contained in the FSAR were reviewed to determine if any changes around and at Watts Bar have taken place since the issuance of the operating license (November 9, 1995).

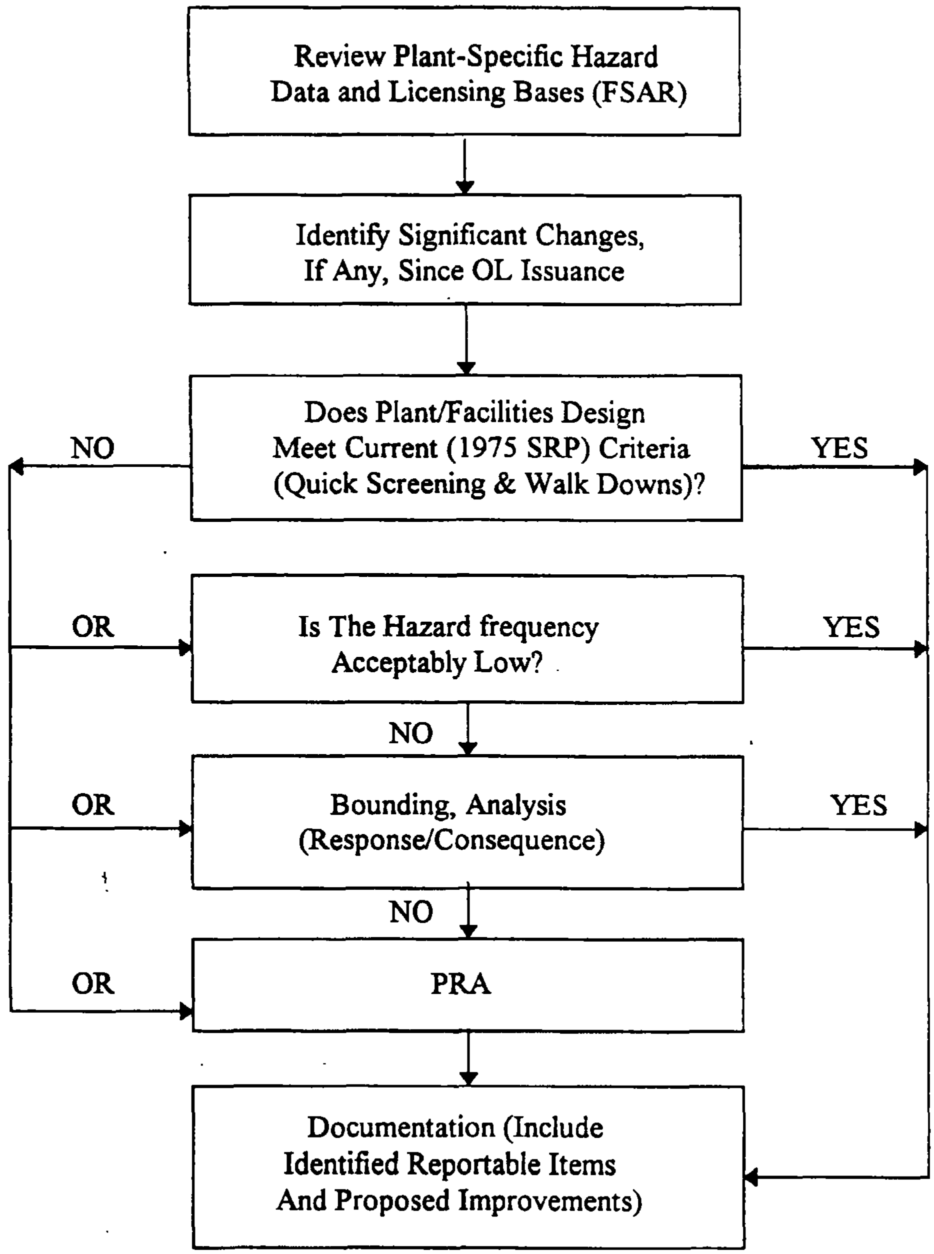

FIGURE 1-1: RECOMMENDED IPEEE APPROACH FOR WINDS, FLOODS,
AND OTHERS

5.3 PLANT INFORMATION

5.1 SITE LOCATION

Watts Bar Nuclear Power Plant is located in Rhea County, Tennessee on the western shore of Chickamauga Lake (Tennessee River). The Watts Bar site is approximately 50 miles northeast of Chattanooga, Tennessee and 31 miles northeast of the Sequoyah Nuclear Power Plant.

5.2 PLANT LAYOUT

Figure 2-1 is a layout of the plant showing the location of major structures which contain equipment on the IPEEE Component List; these structures are:

- Reactor Building
- Auxiliary Building
- Control Building
- Diesel Generator Building
- Emergency Raw Cooling Water Intake Building
- Refueling Water Storage Tank (RWST)

5.3 PLANT IPEEE WALK DOWN

An IPEEE walk down of Watts Bar was made on November 15-20, 1996, with the objective of collecting information on "other" external events. A review of plant design documents and updated FSAR was done prior to the walk down. The IPEEE walk down was performed to confirm that no significant changes to the plant and in the site region have occurred since the issuance of the operating license (November 9, 1995).[1] The IPEEE walk down concentrated on outdoor facilities that could be affected by high winds, tornadoes and off site developments.

The following personnel participated in the IPEEE walk down:

B.C. Perkins, TVA
R.D. Rowell, TVA

The following summarizes the IPEEE walk down findings and data collected.

High Winds and Tornadoes

The walk down concentrated on outdoor tanks and equipment, entrances to concrete buildings, openings in buildings such as air intakes, diesel exhaust stacks, and louvers, block walls in structures with openings, structures which could collapse and impact buildings containing safety-related equipment, and availability of objects which could become missiles in a tornado. Table 2-1 extracted from the Probabilistic Safety Analysis Procedures Guide (1985) is a check list followed to inspect items in the plant IPEEE walk down.

The following is a summary of walk down observations with respect to high winds and tornadoes.

WBN FSAR Sections 3.3, 3.5.1.4, 3.5.2, 3.5.3 and WBN tornado design calculations were reviewed prior to initiating the walk down to familiarize the walk down team with site requirements and design attributes.

Metal-sided structures on site were verified to not contain Category I equipment. The most significant metal-sided building, closest to a Category I structure, is the Turbine Building. The Turbine Building is a metal-sided building whose panels are assumed to fail at loads less than Design Basis Tornado (DBT). The impact of the resulting missiles on other Category I structures has been evaluated in the design calculations and found to be acceptable. No other metal-sided structures on site were found to be of greater significance than the Turbine Building as a source of tornado missiles.

During the walk down, it was confirmed that Category I building entrances and exterior openings in walls and slabs, which were determined to require protection as part of design basis, are protected against tornado generated missiles which could penetrate and hit safety related equipment. The only exception is an opening in the concrete canopy on the unit 2 side of the Auxiliary Building. This opening has the potential to allow tornado missiles to penetrate the Auxiliary Building from the unit 2 area. Problem Evaluation Report WBPER970050 was initiated to evaluate this condition and provide any required corrective action.

Block walls were qualified for tornado depressurization during the design basis evaluation. During the confirmatory walk down, no modifications to block wall were observed that would compromise the design basis evaluation.

The only outdoor safety related tank is the RWST. Although it is not designed to withstand a DBT event, a storage basin is located around the tank to retain sufficient borated water in the event of a rupture.

The number of potential objects available to be picked up by a tornado and become missiles is not unusually large since there is no major construction activity at the plant site.

As a result of the site IPEEE walk down, the only potential deviation from tornado winds / missile design basis commitments was the opening remaining in the concrete canopy identified in WBPER970050.

Transportation and Industrial Facility Accidents

No highways, railroads, etc. have been constructed near the site since the operating license was granted. Similarly, there are no industrial and military facilities constructed within 5 miles of the plant since the operating license. However, TVA is in the process of increasing the height of the levee at the Watts Bar Dam Facilities to prevent the levee from being overtopped during the probable maximum flood. The increased levee height does not increase or impact on the original WBN flood design.

TABLE 2-1

IPEEE WALK DOWN INSPECTION LIST

ITEM	GENERIC COMMENTS	WBN COMMENTS
Locate all safety related equipment and structures	Equipment should be categorized as completely protected, partially protected or unprotected.	Equipment and protection are identified on plant general arrangement drawings.
Verify thickness of concrete protecting equipment	Concrete enclosures for safety related equipment with thickness less than 12 inches should be noted.	Concrete wall and roof thickness were evaluated (see Section 4.2.3).
Check for metal-sided structures	The proximity to safety structures and how they are detailed for venting in tornado is important for interaction effects.	Turbine building is a metal-sided building whose panels would fail at loads less than DBT; the impact of resulting missiles on the control building are evaluated in the design (see Section 4.2.2).
Inspect building entrances	Missile doors or concrete barriers should be noted. Potential paths for tornado missiles impacting equipment should be investigated.	Missile doors and concrete barriers are noted on the drawings and no direct paths to safety related equipment were identified. However, an opening in the Auxiliary Building unit 2 will be evaluated by WBPER970050.
Inspect other types of openings to buildings, such as, air intake, exhaust stacks, louvers, etc.	Potential paths for tornado missiles impacting equipment should be investigated.	Opening in the exterior walls and roofs were evaluated (see Section 4.2.3).
Note block walls in structures which could fail and fall on safety related equipment.	DBT could create internal pressure differential which causes block walls to fail.	Block walls have been evaluated for pressure differential due to tornado (see Section 4.2.1).

TABLE 2-1 (Continued)

IPEEE WALK DOWN INSPECTION LIST

ITEM	GENERIC COMMENT	WBN COMMENT
Look for structures which could fail, fall, and impact buildings which contain safety related equipment (indoor or outdoor).	Non-category I buildings should be noted.	Failure of the turbine building was evaluated for potential impact on safety related structure (see Section 4.2.2).
Look for missile paths through weaker buildings, which could impact equipment.	Safety related equipment in metal-sided buildings should be investigated.	The turbine building and other metal-sided buildings do not contain any safety-related equipment.
Inspect outdoor water storage tanks which are safety-related.	Record details of the tank and any concrete barriers.	The only safety related outdoor tank is the RWST. This steel tank is 5/16-inch minimum thickness and well anchored (48 anchors) to a 3.5 ft. thick concrete foundation. A storage basin is below the tank to retain sufficient borated water in the event of rupture (see FSAR Section 3.8.4.1.3).
Make an inventory of potential missiles within 1,000 ft. of the site boundary.	Record number of missiles by class and location. Missiles should include weaker structures, such as, trailers which could be damaged and become missiles.	A detailed survey of objects was judged to be unnecessary. A comparison of WBN to the plants studied in the literature (e.g., Twisdale and Dunn, 1981) was made to determine the number of objects that could become tornado missiles.

5.4 INITIAL SCREENING OF EXTERNAL EVENTS

The approach followed in NUREG-1407 and the supporting documents (Budnitz and Kimura, 1987; Kimura and Prassinos, 1989) was reviewed in light of Watts Bar specific information. The objective was to verify if the screening of events done in NUREG-1407 is applicable to Watts Bar. In addition, any known external hazards that may have a potential to damage Watts Bar were examined. The external hazards and the screening criteria listed in the PRA Procedures Guide (ANS-IEEE-NRC, 1983) were used to ensure that all potential external hazards are considered.

5.4.1 EXTERNAL HAZARDS TO BE STUDIED

Table 3-1 summarizes the initial screening of external events. The findings of the screening are that, aside from seismic and internal fire events which have been addressed separately in the Watts Bar IPEEE, the following events require further examination:

- Extreme Winds, Hurricanes and Tornadoes
- External Flooding including Intense Local Precipitation
- Transportation and Nearby Facility Accidents
  - Airports and Airways
  - Military and Industrial Facilities Accidents
  - Transportation Accidents (River, Railroad and Highway)

TABLE 3-1

SCREENING OF EXTERNAL EVENTS FOR WATTS BAR NUCLEAR PLANT

EVENT	GENERIC BASIS	APPLICABILITY TO WATTS BAR
Seismic Events	NUREG-1407 requests a detailed examination for seismic events.	Watts Bar is performing the IPEEE for seismic events using a modified site specific program.
Internal Fire	NUREG-1407 requests a detailed examination for internal fires.	Watts Bar is performing the IPEEE for internal fires using the "FIVE" methodology.
High Winds and Tornadoes	NUREG-1407 requests that this event be examined in the IPEEE. A progressive screening approach is recommended. If the plant does not meet the NRC criteria (1975 version of the Standard Review Plan), more detailed examination is required.	A review of the FSAR indicates that tornado wind design does not strictly meet the Standard Review Plan. For further discussion see Section 4.
External Floods	NUREG-1407 requests that flooding be evaluated if the plant design basis does not meet the criteria (Regulatory Guide 1.59; it also requires the use of the latest probable maximum precipitation (PMP) criteria which may result in higher site flooding levels and greater roof ponding loads than have been used in the plant design basis.	A review of the FSAR indicated that the design meets the NRC regulatory position 2 of the Regulatory Guide 1.59. The new PMP criteria was evaluated and WBN was designed to withstand this flood and prevents water from entering safety related structures (see Section 5).
Transportation and Nearby Facility Accidents	NUREG-1407 requests that older plants need systematic examination for plant specific vulnerabilities from these events.	The FSAR previously examined the impact of potential transportation and nearby facility accidents and concluded that their contribution to plant risk is negligible. The transportation accident statistics and nearby facilities will be reviewed for any changes to this conclusion as part of the IPEEE (see Section 6).

TABLE 3-1 (Continued)

SCREENING OF EXTERNAL EVENTS FOR WATTS BAR NUCLEAR PLANT

EVENT	GENERIC BASIS	APPLICABILITY TO WATTS BAR
Lightning	In accordance with NUREG-1407, the primary impact of lightning on nuclear power plants is loss of offsite power which is included as part of the internal events IPE. The NRC staff has judged that the probability of a severe accident caused by lightning (other than one due to loss of offsite power) is relatively low and further consideration of lightning effects should be performed only for plant sites where lightning strikes are likely to cause more than just loss of offsite power or a scram.	Watts Bar meets the requirements of NFPA Code No. 78-1975 and has no additional operating experience indicating that anything other than loss of offsite power would result from lightning strikes. Lightning protection was evaluated in calculation WBNEEBMSTI190025. Therefore, the generic data used in screening lightning is applicable to Watts Bar.
Severe Temperature Transients	In accordance with NUREG-1407, the effects of these events are usually limited to reducing the capacity of the ultimate heat sink and loss of offsite power. The capacity reduction of the ultimate heat sink would be a slow process that allows plant operators sufficient time to take proper actions such as reducing power output level or achieving safe shutdown. The other potential impact on the plant, loss of offsite power, will be considered within the realm of the station blackout rule. Therefore, the temperature transients need not be addressed in the IPEEE.	Watts Bar site is not exposed to temperature transients more severe than other nuclear power plants in the U.S. Therefore, the generic data used in screening this event is applicable to Watts Bar.

TABLE 3-1 (Continued)

SCREENING OF EXTERNAL EVENTS FOR WATTS BAR NUCLEAR PLANT

EVENT	GENERIC BASIS	APPLICABILITY TO WATTS BAR
Severe Weather Storms	In accordance with NUREG-1407, the potential effects of severe weather storms are loss of offsite power and station blackout; these will be addressed in the internal events IPE. Thus, severe weather storms need not be examined further in the IPEEE.	Watts Bar has no additional information to supplement NUREG-1407. Therefore, the generic data used in screening of this event is applicable to Watts Bar.
External Fires	In accordance with NUREG-1407, the potential effects on the plant could be loss of offsite power, forced isolation of the plant ventilation, and possible control room evacuation. Usually, external fires are unable to spread onsite because of site clearing during construction stage. The effect of loss of offsite power will be addressed in the internal events IPE. The other effects have been evaluated during operating license review against sufficiently conservative criteria; thus they do not need to be reassessed in the IPEEE.	Watts Bar agrees with the generic basis and confirms that the plant site is generally cleared which would preclude the possibility of an external fire spreading onsite. Therefore, external fires will not be considered further in the IPEEE.
Extraterrestrial Activity	In accordance with NUREG-1407, the probability of a meteorite or satellite strike is estimated to be negligibly small (less than 10^{-9}) and the event is dismissed on the basis of low event frequency.	Watts Bar agrees with the generic basis; therefore, this event will not be considered further in the IPEEE.

TABLE 3-1 (Continued)

SCREENING OF EXTERNAL EVENTS FOR WATTS BAR NUCLEAR PLANT

EVENT	GENERIC BASIS	APPLICABILITY TO WATTS BAR
Volcanic Activity	In accordance with NUREG-1407, plant sites too far away from active volcanoes to expect any effect need not be considered in the IPEEE.	Watts Bar is far removed from an active volcano; therefore, this event will not be considered further in the IPEEE.
Turbine Missile	Based on the regular inspection of low pressure turbine discs and overspeed protection system followed by the utilities, the probability of turbine failure leading to missiles is considered acceptably small.	The plant arrangement for WBN is such that safety related structures, systems and components are essentially protected from low trajectory turbine missiles. FSAR Section 10.2.3 describes the analysis performed to estimate the probability of damage to WBN from turbine missiles. The probability was determined to be less than 1×10^{-7} per year. Also, WBN is committed to an inspection program of the turbine discs on a regular basis. This provides the basis for not considering the turbine missiles further in the IPEEE.

5.5 HIGH WINDS

5.5.1 NRC REQUIREMENTS

High Winds refer to tornadoes, hurricanes and straight winds ("extra-tropical cyclones or thunderstorms"). Since Watts Bar is an inland site, hurricane effects will be minimal. Between tornadoes and straight winds, tornadoes are potentially more damaging although their frequencies of occurrence at the site may be much less than straight winds.

Regulatory Guide 1.76 and the Standard Review Plan (SRP) 1975 Edition, define the Design Basis Tornado for Region I (WBN is in this region) by the following parameters:

- Maximum Rotational Speed = 290 miles per hour
- Maximum Translational Speed = 70 miles per hour
- Minimum Translational Speed = 5 miles per hour
- Maximum pressure drop = 3 pounds per square inch
- Maximum Rate of Pressure Drop = 2 PSI per sec.

Regulatory Guide 1.117 identifies the structures, systems and components that should be protected from the effects of the Design Basis Tornado including tornado missiles, and remain functional. Tornado missiles and criteria for designing the barriers to protect from these tornado missiles are described in the Standard Review Plan, Sections 3.5.1.4 and 3.5.3. Another consideration in the tornado design is that failure of any structure or component not designed for tornado loads will not affect the capability of the structures, systems and components identified above to perform the necessary safety functions (SRP 3.3.2-3).

5.5.2 CONFORMANCE OF WBN TO NRC REQUIREMENTS

The WBN wind and tornado loadings are described in the FSAR Section 3.3 and the tornado generated missile spectra is described in the FSAR Section 3.5.1.4. The WBN wind and tornado loading / spectra were issued prior to the issue of the Regulatory Guides and Standard Review Plan (SRP). WBN does not strictly conform to the 1975 SRP Criteria. However, these differences have been evaluated by the NRC and found to be acceptable. WBN has thus been found to conform to the intent of 1975 SRP. NRC Safety Evaluation Report (SER) Sections 3.3.2 and 3.5.1.4 state that the conservative design basis used for Category I structures with DBT loadings is acceptable and the missile spectra are representative of the missiles on site and acceptable. Thus, all structures, systems and components important to safety have been designed to withstand the effects of wind and tornado without loss of capability to perform their safety function.

Tornado Design of Category I Structures

The Category I structures are designed for the effects of the 300 mph rotational wind, the 60-mph translational wind, a negative differential pressure of 3 psi in 3 seconds and the tornado generated missiles. At the time of WBN design, these parameters of the Design Basis Tornado were considered to be the state of the art and acceptable. They are equivalent to the Design Basis Tornado defined in Regulatory Guide 1.76. Note that the NRC has recently revised its position on the maximum tornado windspeed for DBT parameters in Region I as 300 mph. This windspeed is the sum of the maximum rotational windspeed and the maximum translation windspeed (USNRC, 1994). The tornado used for WBN design is judged conservative compared to the revised DBT described above.

Venting is utilized to reduce the effective tornado generated differential pressure in portions of the Auxiliary Building. A relief panel area of 400 sq-ft is provided in the roof over the Spent Fuel Pool Room and Cask Loading Room at Elevation 814.75 for venting purposes during a tornado. The relief panels are held in place by gravity. An upward pressure of 0.25 PSI is sufficient to offset the weight of the panels and to cause them to be lifted from their normal positions. Two corners of each panel are chained to the roof to prevent the panel from becoming a missile after it relieves the differential pressure (FSAR Sec. 3.3.2.2)

Pressure differentials and assorted air velocities are expected in all areas which depressurize due to the venting of the building. Structures (including masonry block walls) have been evaluated for the differential pressure from depressurization. In the room(s) where the differential pressure exceeds the wall design, administrative operating instructions will ensure that the doors will remain open during a tornado event to reduce the differential pressure to an acceptable value. Abnormal Operating Instruction AOI-8 "Tornado Watch/Warning" describes these procedures.

Ability of Category I Structures to Perform Despite Failure of Structures not Designed for DBT

FSAR section 3.3.2.3 describes the analyses made and procedures adopted to ensure that the Category I structures will perform their intended function despite failure of structures not designed for tornado loads. The effect of tornado loading on the Turbine Building was made in this context to conclude the following:

1. The metal siding panels will fail at loads considerably below the DBT loading and will become missiles that could impact the Control Building, The siding will fail before the main girts are overloaded enough to cause failure. The failure of the parapet girts is likely, resulting in the release of 16WF 15.5 in 4-foot lengths, 8C11.5 in 8-foot lengths, 18 x 3/8 inch plate in varying lengths, and ST4WF8.5 in 7-foot lengths.

   The roof of the Control Building was evaluated (calculation WCG-1-114) and found to be adequately designed to resist the above missiles.

2. Following the failure of the siding, the structural steel framing of the building will be exposed to tornado forces acting upon the steel structure, equipment, piping, and other items in the path of the wind. Calculation WCG-1-1737 documents that the structural steel framing is qualified for the DBT wind loading, and the turbine building and control building will not contact each other during the DBT event.

3. The Turbine Room cranes, if not anchored, could possibly be blown from the crane girders, either falling on the operating floor or out the end of the building onto the Control Building roof. To preclude this from happening, the cranes are anchored to stops at one end of the runway during tornado events (see AOI-8).

4. The Potable Water Tanks and Gland Seal Water Tanks on the roof Elevation 796 could be blown on the Control Building roof along with air intake hoods, auxiliary boiler stack, and heating and vent equipment on the roof Elevation 796. The Control Building roof was evaluated and concluded to be adequate to withstand the impact of the above mentioned missiles(WCG-1-114).

Tornado Missile Protection

The missile spectra used at Watts Bar was reviewed and approved by the NRC at the Construction Permit stage before issuance of the SRP. The NRC reevaluated the missile spectra and concluded that they are representative of missiles at the site and acceptable in accordance with the SER. FSAR Section 3.5.1.4 describes the tornado generated missile spectra for which the various Category I structures are qualified (See FSAR Tables 3.5-7,8,9 and 17). Most of the Category I structures are designed to the missile spectrum A. The Diesel Generator Building equipment doors and bulkheads were originally designed to withstand the impact of missiles B1, B2 and B3 given in Table 3.5-8 and were subsequently evaluated against B4, B5 and B6 missiles. Missile spectrum C was used in the design of Category I structures not covered by spectra A, B and D. Missile spectrum D was used in the design of the Additional Diesel Generator Building and any new Category I structure after July 1979.

Calculation WCG-1-608 documents the adequacy of the thickness of concrete walls and roofs for Category I structures to prevent perforation, spalling, or scabbing of the barrier in the event of missile impact from site spectrum missiles. The ERCW intake pumping station adequacy is documented in calculation WCG-1-622. Although certain concrete barriers (walls and roofs) do not meet the SRP suggested thickness, they are all equal to or greater than 12 inches in thickness. Simulation studies performed by EPRI have indicated that the probability of scabbing damage (Twisdale and Dunn 1981) is less than 1 x 10^{-7} per year for concrete barriers of 12 inches or greater thickness.

Calculation WCG-1-622 documents that the intake pumping station and the structural steel grillage roof system provides protection from impact by a postulated tornado generated missile.

Calculation WCG-1-877 provides the methodology and process for establishing the total population of openings in the exterior walls and roofs of Category I buildings; designing protective barriers for openings which are in areas containing safety related systems and/or equipment which may be impacted by postulated missiles going through the openings; evaluating adequacy of existing protective barriers for openings; and designing new protective barriers for openings as required. Calculation WCG-1-894 implements and augments the methodology and process described in calculation WCG-1-877.

5.5.3 CONCLUSION FOR IPEEE HIGH WINDS

Category I structures at WBN have been designed to resist tornado wind and missile effects equivalent to the 1975 Standard Review Plan criteria. Structures, systems and components important to safety were designed to withstand Design Basis Tornado and remain functional. There are no unique vulnerabilities for high winds. However, the opening in the concrete canopy identified by the IPEEE walk down is being disposition by WBPER970050. Therefore, high wind event is screened out from further consideration in the IPEEE of WBN (screening criterion met at level 3 in Figure 1-1).

5.6 EXTERNAL FLOODING

NUREG-1407 instructs the licensees to examine the external flooding for conformance with Regulatory Guide (R.G.) 1.59 and applicable Standard Review Plan criteria for the design basis flood, and resolution of Generic Safety Issue No. 103 for Probable Maximum Precipitation (Generic Letter 89-22, dated Oct. 19, 1989).

5.6.1 NRC REQUIREMENTS FOR DESIGN BASIS FLOOD (DBF)

The design basis flood is defined in the Regulatory Guide 1.59. WBN has chosen to comply with Regulatory Position 2 of Regulatory Guide 1.59 as described below:

As an alternative to designing hardened protection for all safety-related structures, systems, and components as specified in the Regulatory Position 1 of R.G. 1.59, it is permissible not to provide hardened protection for some of these features if:

a. Sufficient warning time is shown to be available to shut the plant down and implement adequate emergency procedures;

b. All safety-related structures, systems, and components identified in R.G. 1.29 are designed to withstand the flood conditions resulting from a Standard Project event with attendant wind-generated wave activity that may be produced by the worst winds of record and remain functional;

c. In addition to the analyses in paragraph b. above, reasonable combinations of less-severe flood conditions are also considered to the extent needed for a consistent level of conservatism; and

d. In addition to paragraph b. above, at least those structures, systems, and components necessary for cold shutdown and maintenance thereof are designed with hardened protective features to remain functional while withstanding the entire range of flood conditions up to and including the worst site related flood probable (e.g., probable maximum flood, seismically induced flood, hurricane, surge, seiche, heavy local precipitation) with coincident wind-generated wave action as described in Regulatory Position 1.

5.6.2 CONFORMANCE OF WBN TO NRC REQUIREMENTS

Section 2.4 of the FSAR describes how the WBN design meets the Regulatory Position 2 of Regulatory Guide 1.59.

The types of events evaluated to determine the worst potential flood included (1) Probable Maximum Precipitation (PMP) on the total watershed and critical sub watersheds, including seasonal variations and potential consequent dam failures and (2) dam failures in a postulated Safe Shutdown Earthquake (SSE) or one-half SSE with specified concurrent flood conditions.

The maximum flood level at the plant site from any cause is elevation 738.1. This elevation would result from the PMP critically centered on the watershed. The design basis flood (DBF) is the upper limit flood that includes the probable maximum flood (PMF) plus the wave runup caused by a 21 miles per hour wind resulting in maximum water elevation of 740.1.

All safety related systems and components are housed in structures which provide protection from flooding for all flood conditions up to plant grade at elevation 728.

The plant is required to be shut down for floods which exceed the plant grade elevation 728. Flood warning criteria and forecasting techniques have been developed to assure that there will always be adequate time to shut the plant down and be ready for floodwaters above plant grade as described in Abnormal Operating instruction AOI-7.01 "Maximum Probable Flood" and the plant Flood Protection Plan (Technical Requirement Manual, TR 3.7.2).

The "Flood Mode" is when flooding exceeds plant grade and all equipment required to maintain the plant safely is either designed to operate submerged, is located above the maximum flood level, or is otherwise protected.

The Reactor building will be maintained dry during the flood mode. The Diesel Generator Building also will remain dry during the flood mode since it is located above the design basis flood. The Intake Pumping Station is designed to have the ERCW system and the HPFP system fully functional for the DBF. The Auxiliary, Control and Turbine Building will be allowed to flood during the flood mode since equipment required for operation is above DBF or suitable for submerged operation.

Class IE electrical system conduit banks located below the Probable Maximum Flood (PMF) plus wind runup flood level are designed to function submerged.

5.6.3 EVALUATION OF WBN FOR NEW PROBABLE MAXIMUM PRECIPITATION (PMP)

Structures housing safety-related facilities, systems, and equipment are protected from flooding during a local PMP by the slope of the plant yard. The yard is graded so that the surface runoff will be carried to Chickamauga Reservoir without exceeding the lowest elevation of an exterior opening to safety related structures, which is at floor elevation 729. WBN recently reevaluated (calculation WCG-1-550) the plant drainage to ensure that the drainage will prevent water from entering exterior openings in safety related structures for the new Probable Maximum Precipitation. The new PMP is defined for TVA by the Hydrometeorological Branch of the National Weather Service and is described Hydrometeorological Report No. 56 (HMR-56).

In verifying the adequacy of the site drainage, all underground drains were assumed clogged. Peak drainage was determined using higher rainfall intensities over shorter time intervals and smaller areas given than previously considered. Runoff was assumed equal to rainfall. Each watershed was analyzed using the more appropriate of two methods: (1) when flow conditions controlled, standard-step backwater from the control section using peak discharges estimated from rainfall intensities corresponding to the time of concentration of the area above the control or (2) when ponding or reservoir-type conditions controlled, storage routing the inflow hydrograph equivalent to the PMP hydrograph using 2-minute time intervals. Computed maximum water surface elevations are below critical floor elevation of 729.

Roof ponding structural adequacy for the probable maximum precipitation (PMP) was approved by the Safety Evaluation Report (SER), Revision 0, Section 2.4.5. Acceptability for roof ponding was reviewed for IPEEE and found to be acceptable based on the following: Rainfall depth on safety related structures is conservatively taken to the top of parapet walls, and scuppers and drains are blocked yielding maximum depth of five (5) feet of water (Note: the parapet wall is only 4 ft. for the worst case concrete roof slab subsequently used). Calculation WCG-1-923 evaluated the worst case concrete roof slab for a load of 432 PSF which is more than the PMP loading of (5')(62.4 PCF)= 312 PSF and acceptable. Also, calculation WCG-2-5 was reviewed to evaluate the adequacy of the composite roof of the Auxiliary Building at El. 814.75 for ponding. Four tanks with a minimum capacity of 10,000 gallons governed the design with large seismic overturning moments that would not be present for the ponding load case. The load produced by the seismic overturning moment is larger than the ponding load and the composite roof is acceptable.

Therefore, it is concluded that the plant drainage systems and roofs of safety related structures are acceptable for the new PMP criteria.

5.6.4 CONCLUSIONS FOR IPEEE EXTERNAL FLOODING

WBN design meets the Design Basis Flood (DBF) requirements of Regulatory Guide 1.59 and the applicable sections of Standard Review Plan (SRP). The plant drainage systems and roofs were assessed for the new Probable Maximum Precipitation (PMP) criteria to ensure that water does not enter and adversely impacting safety related structures. No significant changes were identified since the issuance of the operating license with respect to external flooding. However the height of the levee is being increaed and will not increaes or impact the original WBN flood design. Therefore, external flooding event is screened out from further consideration in the IPEEE of WBN (screening criterion met at level 3 in Figure 1-1).

5.7 TRANSPORTATION AND NEARBY FACILITY ACCIDENTS

NUREG-1407 requires that the licensee evaluate the impact of potential transportation and nearby facility accidents on the nuclear power plant. In this Section, we describe how WBN meets this IPEEE requirement.

5.7.1 NRC IPEEE REQUIREMENTS

These events generally include:

- Transportation:
  - Railroad
  - Highway
  - River (Barge)
  - Airports and Airways
  - Pipelines

- Nearby Facility Accidents:
  - Military
  - Industrial Facilities

- Blockage of ERCW Intake Pumping Station.

The licensee should review the information on how these events were addressed in the plant design and examine the site for any significant changes since the operating license was issued with respect to these events.

The information obtained during the above review should be used to judge conformance to 1975 SRP criteria and perform a confirmatory walk down of the plant. If the comparison indicates that the plant conforms to the 1975 SRP criteria and the walk down reveals no potential vulnerabilities not included in the original design basis analysis, it is judged that the contribution from these events to core damage frequency is less than 10^{-6} per year and the IPEEE screening criterion is met.

5.7.2 CONFORMANCE OF WBN TO IPEEE REQUIREMENTS

These external events are generally considered in the plant siting and design. TVA had evaluated the potential for these events to occur near WBN during the plant licensing stage. FSAR section 2.2 describes the data and evaluations for these events.

Railroad

The nearest mainline railroad (Norfolk Southern Corporation) is about 7 miles west of the WBN site. A TVA railroad spur track connects with this main line and serves the Watts Bar Steam plant and Watts Bar Nuclear Plant. The spur has a derailer and the railroad track is discontinued outside the security fence to ensure that the railroad tracks are unusable for a safe distance. The distance from the derailer to the essential plant structures is at least 2,100 feet and acceptable in accordance with Regulatory Guide (R. G.) 1.91.

Highway

The nearest land transportation route is State Route 68, about one mile north of the Site. R.G. 1.91 gives a safe distance from the highway to the essential plant structures of about 1700 feet. Therefore, the highway is an acceptable distance away from WBN.

River Traffic

FSAR Section 2.2.2.1 states that the Tennessee River is a major barge route in which a 9 foot navigation channel is maintained. FSAR Section 2.2.3 describes a study that determined that the worst potential condition from an accident involving the products transported near the site would be the generation of smoke by the burning of these products. Neither fire or dense smoke will effect plant safety.

Airports and Airways

There are no airports within 10 miles of WBN. Mark Anton airport is 11 to 12 miles southwest of the site. It has no commercial facilities. Lovell Field located about 45 miles south-southwest is the nearest airfield with commercial facilities. Airway V51 passes near WBN site with very light traffic and does not pose a credible hazard to WBN.

Pipelines

There are no natural gas or petroleum pipelines located in the vicinity of WBN. Therefore, pipelines will not pose a hazard to the safety-related structures, systems and components at WBN.

Nearby Military and Industrial Facility Accidents

There are no military facilities within the vicinity of WBN site which would potentially pose a hazard to the safe operation of the plant. The only significant nearby industrial facility is the Watts Bar Steam Plant which is not currently operating. The Watts Bar Steam Plant is a coal fired electric generating facility with a capacity of 240,000 kW which during normal operation has about 100 employees.

Blockage of ERCW Intake Pumping Station

The Intake Pumping Station for Watts Bar Nuclear Plant is located on the convex bank of the river. According to flow theory and actual observations made on various rivers, surface drifting objects will not collect on the convex bank of the river. Also, the current of the river will sweep surface drifting objects past the embayment that leads to the intake structure. Therefore, the configuration assures that the Intake Pumping Station is free of blockage.

5.7.3 CONCLUSIONS ON IPEEE OF TRANSPORTATION AND NEARBY FACILITY ACCIDENTS

There are no credible hazards posed to WBN by transportation or nearby facility accidents; the applicable regulatory guides and SRP section requirements are met by the design of WBN. There are no additional vulnerabilities for transportation or nearby facilities not included in the original design basis analysis. This event is screened out since it satisfies screening level (3) in Figure 1-1.

5.8 REFERENCES

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