CHAPTER 19
PROBABILISTIC RISK ASSESSMENT

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PROBABILISTIC RISK ASSESSMENT

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This section of the referenced DCD is incorporated by reference with no departures or supplements.

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This section of the referenced DCD is incorporated by reference with no departures or supplements.

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This section of the referenced DCD is incorporated by reference with no departures or supplements.

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This section of the referenced DCD is incorporated by reference with no departures or supplements.

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This section of the referenced DCD is incorporated by reference with no departures or supplements.

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This section of the referenced DCD is incorporated by reference with no departures or supplements.

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This section of the referenced DCD is incorporated by reference with no departures or supplements.

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This section of the referenced DCD is incorporated by reference with no departures or supplements.

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This section of the referenced DCD is incorporated by reference with no departures or supplements.

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This section of the referenced DCD is incorporated by reference with no departures or supplements.

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This section of the referenced DCD is incorporated by reference with no departures or supplements.

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This section of the referenced DCD is incorporated by reference with no departures or supplements.

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This section of the referenced DCD is incorporated by reference with no departures or supplements.

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This section of the referenced DCD is incorporated by reference with no departures or supplements.

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This section of the referenced DCD is incorporated by reference with no departures or supplements.

19.44 MAAP4.0 CODE DESCRIPTION AND AP1000 MODELING

This section of the referenced DCD is incorporated by reference with no departures or supplements.

19.45 FISSION PRODUCT SOURCE TERMS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

19.46 NOT USED

This section was not required for DCD and is not used by DCD and FSAR.

19.47 NOT USED

This section was not required for DCD and is not used by DCD and FSAR.

19.48 NOT USED

This section was not required for DCD and is not used by DCD and FSAR.

19.49 OFFSITE DOSE EVALUATION

This section of the referenced DCD is incorporated by reference with no departures or supplements.

19.50 IMPORTANCE AND SENSITIVITY ANALYSIS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

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This section of the referenced DCD is incorporated by reference with no departures or supplements.

19.52 NOT USED

This section was not required for DCD and is not used by DCD and FSAR.

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This section was not required for DCD and is not used by DCD and FSAR.

19.54 LOW POWER AND SHUTDOWN PRA ASSESSMENT

This section of the referenced DCD is incorporated by reference with no departures or supplements.

19.55 SEISMIC MARGIN ANALYSIS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

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This section of the referenced DCD is incorporated by reference with no departures or supplements.

19.57 INTERNAL FIRE ANALYSIS

This section of the referenced DCD is incorporated by reference with no departures or supplements.

19.58 WINDS, FLOODS, AND OTHER EXTERNAL EVENTS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

19.58.3 CONCLUSION

Add the following information at the end of DCD Subsection 19.58.3:

VCS SUP 19.58-1 Table 19.58-201 documents the site specific external events evaluation that has been performed to VCSNS Units 2 and 3. This table provides a general explanation of the evaluation and resultant conclusions and provides a reference to applicable sections of the FSAR where more supporting information (including data used, methods and key assumptions) regarding the specific event is located. Based upon this evaluation, it is concluded that the VCSNS Units 2 and 3 site is bounded by the High Winds, Floods and Other External Events analysis documented in DCD Section 19.58 and APP-GW-GLR-101 (Reference 201) and no further evaluations are required at the COL application stage.

19.58.4 REFERENCES

201. Westinghouse Electric Company LLC, “AP1000 Probabilistic Risk Assessment Site-Specific Considerations,” Document Number APP-GW-GLR-101, Revision 1, October 2007.

Table 19.58-201 (Sheet 1 of 2)
External Event Frequencies for VCSNS Units 2 and 3

Category	Event	Applicable to site? (Y/N)[a]	Explanation of Applicability Evaluation	Event Frequency
High Winds	EF0 Tornado	Y	Tornado activity in the surrounding counties of the VCSNS Units 2 and 3 site is provided in FSAR Table 2.3-227 from 1950 through August 2003. Due to the relative proximity of Laurens County to the other surrounding counties, activity in this area was also included within the evaluation. The event frequency was determined for each tornado category using a point probability method [**PS=n(a/A)**]. First, the average impacted area (**a**) was calculated by averaging the area of each category of tornado activity (events with an area of zero value were conservatively disregarded in determining the average area). Second, the tornado frequency (**n**) was calculated by dividing the total count of tornado events in each category including those with zero area by the measured duration (54 years). Third, the point probability of a tornado impacting a square mile (site area estimated as 1 mi^2.) is calculated by taking the product of the average impacted area and the average tornado frequency and dividing by the total area of the surrounding counties (**A**). This computation assumes that tornadoes with a zero path length have an area equal to the average area of the category.	1.17E-05
	EF1 Tornado	Y		1.26E-05
	EF2 Tornado	Y		8.38E-05
	EF3 Tornado	Y		7.34E-05
	EF4 Tornado	Y		3.91E-05
	EF5 Tornado	Y		No Recorded Events
	Cat. 1 Hurricane	Y	Historical data for tropical weather is archived by the National Coastal Services Center and covers from 1851 to 2006. FSAR Subsection 2.3.1.3.3 summarizes the frequencies of occurrence of the various categories of hurricanes that have tracked within approximately 100 nautical miles of the VCSNS site. This data was used to analyze the event frequency of hurricane activity (in an extremely conservative manner since the site is located greater than 100 miles inland from the coast) traveling in the vicinity of the VCSNS site. The storms were sorted to remove duplicate values. The event frequency is determined by dividing the number of occurrences of tropical weather by the measured duration (155 years).	4.52E-02
	Cat. 2 Hurricane	Y		1.94E-02
	Cat. 3 Hurricane	Y		6.45E-03
	Cat. 4 Hurricane	Y		6.45E-03
	Cat. 5 Hurricane	Y		No Recorded Events
	Extratropical Cyclones	Y	The 100 nautical mile area was considered to be excessively conservative for the evaluation of extratropical storms (which by nature of the event are storms expected to occur more inland than hurricanes) and therefore a 25 mile radius around the site was evaluated for these events. The event frequency is determined by dividing the number of occurrences of tropical weather by the measured duration (155 years), and while the event frequency slightly exceeded that given in Table 3.0-1 of APP-GW-GLR-101, this has been attributed to rounding, by Westinghouse, of the information that was provided by the NuStart member utilities. As documented in COLA FSAR Table 2.0-201, the VCSNS site characteristic tornado wind loadings are equal to the AP1000 DCD site characteristic tornado wind loadings. The VCSNS site characteristic operating basis wind speed (102 mph) is below the DCD site characteristic operating basis wind speed of 145 mph. Therefore, it is concluded that the safety features of the AP1000 are unaffected and the resultant CDFs given in APP-GW-GLR-101 Table 3.0-1 for these events are applicable to VCSNS Units 2 and 3.	3.22E-02

Table 19.58-201 (Sheet 2 of 2)
External Event Frequencies for VCSNS Units 2 and 3

Category	Event	Applicable to site? (Y/N)[a]	Explanation of Applicability Evaluation	Event Frequency
External Flood	External Flood	N	As discussed in COLA FSAR Subsections 2.4.1.1 and 2.4.10 the site grade of 400 ft NAVD88 (which corresponds to DCD grade elevation 100 ft.) is about 150 ft above the Broad River flood plain. Additionally, as discussed in COLA FSAR Subsections 2.4.2.2 and 2.4.2.3, the maximum water level in the power block area due to any local PMP flood event is below the entrance and openings to safety related structures. Therefore, no external flood protection measures are required for VCSNS Units 2 and3. Subsections 2.4.3 and 2.4.4 also discuss other natural and man-made (dams) flooding scenarios which further reinforce the VCSNS site is not susceptible to any external floods which would adversely impact safe operation of VCSNS Units 2 and 3.	N/A
Transportation and Nearby Facility Accidents	Aviation (commercial/ general/military)	N	Subsections 2.2.2.7 and 2.2.2.7.6 provide the detailed evaluation that confirms the probability of an aviation accident is less than 10E-07 and therefor requires no further evaluation. Therefore, it is concluded that the PRA remains applicable.	N/A
	Marine (ship/barge)	N	As discussed in FSAR Subsection 2.2.2.4, since neither the Broad River, Parr Reservoir, nor the Monticello Reservoir is used as commercial transport waterways, the potential safety effect to the site is regarded as being insignificant. Thus, no further analysis is necessary.	N/A
	Pipeline (gas/oil)	N	As stated in FSAR Subsection 2.2.2.3.1, the only pipeline in the general vicinity of the site is a 12 inch natural gas buried pipeline located greater than a mile from VCSNS Units 2 and 3. This pipeline is bounded by the evaluation performed in APP-QW-GLR-101, and therefore no further evaluation is necessary.	N/A
	Railroad	N	Potential explosion and flammable vapor cloud hazards to VCNS Units 2 and 3 resulting from railroad accidents are discussed in FSAR Subsection 2.2.3.1.1.3. The results of this evaluation concluded that no adverse impacts to VCSNS Units 2 and 3 are expected. Based upon the quantitative consequence evaluations performed, no risk-important events related to rail transportation have been identified for VCSNS Units 2 and 3. Therefore, the potential for hazards from these sources are minimal and will not adversely affect safe operation of VCSNS Units 2 and 3.	N/A
	Truck	N	Potential hazards resulting from trucks were discussed in FSAR 2.2.2.5. The evaluation that was performed to address the explosion of a tanker truck on site as it filled on-site storage tanks was considered bounding for any highway accident and therefore no additional evaluation was required. The evaluations to address these onsite truck hazards are described in FSAR Subsections 2.2.3.1.1.1 and 2.2.3.1.2.1, and the results of these evaluations concluded that the hazards do not result in any significant damage to the plant.	N/A

a) An event is applicable (Y) to the VCSNS site if the initiating event frequency is greater than 1E-07, or if a quantitative consequence evaluation has demonstrated that there are site specific parameters that exceed the parameters used in APP-GW-GLR-101. An event is not applicable (N) to the VCSNS site if the initiating event frequency is less than 1E-07 or if the quantitative consequence evaluation has demonstrated that the event will not adversely impact the safe operation of VCSNS Units 2 and 3.

19.59 PRA RESULTS AND INSIGHTS

This section of the referenced DCD is incorporated by reference with the following departures and/or supplements.

19.59.10.5 Combined License Information

STD COL 19.59.10-1

A review of the differences between the as-built plant and the design used as the basis for the AP1000 seismic margins analysis will be completed prior to fuel load. A verification walkdown will be performed with the purpose of identifying differences between the as-built plant and the design. Any differences will be evaluated and the seismic margins analysis modified as necessary to account for the plant-specific design, and any design changes or departures from the certified design. A comparison of the as-built SSC high confidence, low probability of failures (HCLPFs) to those assumed in the AP1000 seismic margin evaluation will be performed prior to fuel load. Deviations from the HCLPF values or assumptions in the seismic margin evaluation due to the as-built configuration and final analysis will be evaluated to determine if vulnerabilities have been introduced.

The requirements to which the equipment is to be purchased are included in the equipment specifications. Specifically, the equipment specifications include:

1. Specific minimum seismic requirements consistent with those used to define the Table 19.55-1 HCLPF values. This includes the known frequency range used to define the HCLPF by comparing the required response spectrum (RRS) and test response spectrum (TRS). The range of frequency response that is required for the equipment with its structural support is defined.

2. Hardware enhancements that were determined in previous test programs and/or analysis programs will be implemented.

STD COL 19.59.10-2

A review of the differences between the as-built plant and the design used as the basis for the AP1000 PRA and DCD Table 19.59-18 will be completed prior to fuel load. The plant specific PRA-based insight differences will be evaluated and the plant specific PRA model modified as necessary to account for plant-specific design and any design changes or departures from the design certification PRA.

As discussed in Section 19.58.3, it has been confirmed that the Winds, Floods, and Other External Events analysis documented in DCD Section 19.58 is applicable to the site. The site-specific design has been evaluated and is consistent with the AP1000 PRA assumptions. Therefore, Section 19.58 of the AP1000 DCD is applicable to this design.

STD COL 19.59.10-3

A review of the differences between the as-built plant and the design used as the basis for the AP1000 internal fire and internal flood analyses will be completed prior to fuel load. Plant specific internal fire and internal flood analyses will be evaluated and the analyses modified as necessary to account for the plant-specific design, and any design changes or departures from the certified design.

STD COL 19.59.10-4

The AP1000 Severe Accident Management Guidance (SAMG) from APP-GW-GLR-070, Reference 1 to DCD Section 19.59, is implemented on a site-specific basis. Key elements of the implementation include:

- SAMG based on APP-GW-GLR-070 is provided to Emergency Response Organization (ERO) personnel in assessing plant damage, planning and prioritizing response actions and implementing strategies that delineate actions inside and outside the control room.
- Severe accident management strategies and guidance are interfaced with the Emergency Operating Procedures (EOP's) and Emergency Plan.
- Responsibilities for authorizing and implementing accident management strategies are delineated as part of the Emergency Plan.
- SAMG training is provided for ERO personnel commensurate with their responsibilities defined in the Emergency Plan.

STD COL 19.59.10-5

A thermal lag assessment of the as-built equipment required to mitigate severe accidents (hydrogen igniters and containment penetrations) will be performed to provide additional assurance that this equipment can perform its severe accident functions during environmental conditions resulting from hydrogen burns associated with severe accidents. This assessment will be performed prior to fuel load and is required only for equipment used for severe accident mitigation that has not been tested at severe accident conditions. The ability of the as-built equipment to perform during severe accident hydrogen burns will be assessed using the Environment Enveloping method or the Test Based Thermal Analysis method discussed in EPRI NP-4354 (DCD Section 19.59, Reference 3).

Add the following new information after DCD Subsection 19.59.10.5:

STD SUP 19.59-1

19.59.10.6 PRA Configuration Controls

PRA configuration controls contain the following key elements:

- A process for monitoring PRA inputs and collecting new information.
- A process that maintains and updates the PRA to be reasonably consistent with the as-built, as operated plant.
- A process that considers the cumulative impact of pending changes when applying the PRA.
- A process that evaluates the impact of changes on currently implemented risk-informed decisions that have used the PRA.
- A process that maintains configuration control of computer codes used to support PRA quantification.
- A process for upgrading the PRA to meet PRA standards that the NRC has endorsed.
- Documentation of the PRA.

PRA configuration controls are consistent with the regulatory positions on maintenance and upgrades in Regulatory Guide 1.200.

Schedule for Maintenance and Upgrades of the PRA

The PRA update process is a means to reasonably reflect the as designed and as operated plant configurations in the PRA models. The PRA upgrade process includes an update of the PRA plus a general review of the entire PRA model, and as applicable, the application of new software that implements a different methodology, implementation of new modeling techniques, as well as a comprehensive documentation effort.

- During construction, the PRA is upgraded prior to fuel load to cover those initiating events and modes of operation contained in NRC-endorsed consensus standards on PRA in effect one year prior to the scheduled date of the initial fuel load for a Level 1 and Level 2 PRA.
- Prior to license renewal the PRA is upgraded to include all modes of operation.
- During operation, PRA updates are completed as part of the upgrade process at least once every four years.
- A screening process is used to determine whether a PRA update should be performed more frequently based upon the nature of the changes in design or procedures. The screening process considers whether the changes affect the PRA insights. Changes that do not meet the threshold for immediate update are tracked for the next regulatory scheduled update. If the screening process determines that the changes do warrant a

PRA update, the update is made as soon as practicable consistent with the required change importance and the applications being used.

PRA upgrades are performed in accordance with 10 CFR 50.71(h).

Process for Maintenance and Upgrades of the PRA

Various information sources are monitored to determine changes or new information that affects the model assumptions or quantification. Plant specific design, procedure, and operational changes are reviewed for risk impact. Information sources include applicable operating experience, plant modifications, engineering calculation revisions, procedure changes, industry studies, and NRC information.

The PRA upgrade includes initiating events and modes of operation contained in NRC-endorsed consensus standards on PRA in effect one year prior to each required upgrade.

This PRA maintenance and update incorporates the appropriate new information including significant modeling errors discovered during routine use of the PRA.

Once the PRA model elements requiring change are identified, the PRA computer models are modified and appropriate documents revised. Documentation of modifications to the PRA model include the changes as well as the upgraded portions clearly indicating what has been changed. The impact on the risk insights is clearly indicated.

PRA Quality Assurance

Maintenance and upgrades of the PRA are subject to the following quality assurance provisions:

Procedures identify the qualifications of personnel who perform the maintenance and upgrade of the PRA.

Procedures provide for the control of PRA documentation, including revisions.

For updates of the PRA, procedures provide for independent review, or checking of the calculations and information.

Procedures provide for an independent review of the model after an upgrade is completed. Additionally, after the PRA is upgraded, the PRA is reviewed by outside PRA experts such as industry peer review teams and the comments incorporated to maintain the PRA current with industry practices. Peer review findings are entered into a tracking system. PRA upgrades receive a peer review for those aspects of the PRA that are upgraded.

PRA models and applications are documented in a manner that facilitates peer review as well as future updates and applications of the PRA by describing the

processes that were used, and provide details of the assumptions made and their bases. PRA documentation is developed such that traceability and reproducibility is maintained. PRA documentation is maintained in accordance with Regulatory Position 1.3 of Regulatory Guide 1.200.

Procedures provide for appropriate attention or corrective actions if assumptions, analyses, or information used previously are changed or determined to be in error. Potential impacts to the PRA model (i.e., design change notices, calculations, and procedure changes) are tracked. Errors found in the PRA model between periodic updates are tracked using the site tracking system.

PRA-Related Input to Other Programs and Processes

The PRA provides input to various programs and processes, such as the Maintenance Rule implementation, reactor oversight process, the RAP, and the RTNSS program. The use of the PRA in these programs is discussed below, or cross-references to the appropriate FSAR sections are provided.

PRA Input to Design Programs and Processes

The PRA insights identified during the design development are discussed in DCD Subsection 19.59.10.4 and summarized in DCD Table 19.59-18. DCD Section 14.3 summarizes the design material contained in AP1000 that has been incorporated into the Tier 1 information from the PRA. A discussion of the plant features important to reducing risk is provided in DCD Subsection 19.59.9.

PRA Input to the Maintenance Rule Implementation

The PRA is used as an input in determining the safety significance classification and bases of in-scope SSCs. SSCs identified as risk-significant via the Reliability Assurance Program for the design phase (DRAP, Section 17.4) are included within the initial Maintenance Rule scope as high safety significance SSCs.

For risk-significant SSCs identified via DRAP, performance criteria are established, by the Maintenance Rule expert panel using input from the reliability and availability assumptions used in the PRA, to monitor the effectiveness of the maintenance performed on the SSCs.

The Maintenance Rule implementation is discussed in Section 17.6.

PRA Input to the Reactor Oversight Process

The mitigating systems performance indicators (MSPI) are evaluated based on the indicators and methodologies defined in NEI 99-02 (Reference 201).

The Significance Determination Process (SDP) uses risk insights, where appropriate, to determine the safety significance of inspection findings.

PRA Input to the Reliability Assurance Program

The PRA input to the Reliability Assurance Program is discussed in DCD Subsection 19.59.10.1.

PRA Input to the Regulatory Treatment of Nonsafety-Related Systems Programs

The importance of nonsafety-related SSCs in the AP1000 has been evaluated using PRA insights to identify SSCs that are important in protecting the utility's investment and for preventing and mitigating severe accidents. These investment protection systems, structures and components are included in the D-RAP/MR Program (refer to Subsection 17.4), which provides confidence that availability and reliability are designed into the plant and that availability and reliability are maintained throughout plant life through the Maintenance Rule. Technical Specifications are not required for these SSCs because they do not meet the selection criteria applied to the AP1000 (refer to Subsection 16.1.1).

MOV Program

The MOV Program includes provisions to accommodate the use of risk-informed inservice testing of MOVs (Subsection 3.9.6).

19.59.11 REFERENCES

Add the following text to the end of DCD Subsection 19.59.11:

201. NEI 99-02, Nuclear Energy Institute, "Regulatory Assessment Performance Indicator Guideline," Technical Report NEI 99-02, Revision 5, July 2007.

APPENDIX 19A
THERMAL HYDRAULIC ANALYSIS TO SUPPORT SUCCESS CRITERIA

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 19B
EX-VESSEL SEVERE ACCIDENT PHENOMENA

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 19C
ADDITIONAL ASSESSMENT OF AP1000 DESIGN FEATURES

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 19D
EQUIPMENT SURVIVABILITY ASSESSMENT

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 19E
SHUTDOWN EVALUATION

This section of the referenced DCD is incorporated by reference with no departures or supplements.

APPENDIX 19F
MALEVOLENT AIRCRAFT IMPACT

This section of the referenced DCD is incorporated by reference with no departures or supplements.