GESSAR II EXTERNAL EVENT RISK

CONTENTS

1. INTRODUCTION

In Reference 1, closure activities for the GESSAR II review in accordance with the proposed Commission Policy on Severe Accidents (Reference 2) were enumerated. One of the issues defined in Reference 1 for additional input by General Electric (GE) included consideration of external events which were not evaluated quantitatively. Heretofore, the NRC staff direction had been to provide quantitative risk evaluation of seismic events and internal fires and floods. GE responded with References 3-5 which provided the required information. In Reference 1 the staff required a qualitative assessment of the risk inherent from such events as hurricanes, tornadoes, external flooding, aircraft strike, hazardous materials impact, and sabotage.

It should be noted that sabotage has already been addressed by GE in Appendix 1F of GESSAR II and, in fact, the staff has already provided draft Safety Evaluation Report (SER) input in Reference 6 for review. In addition, GE provided a summary of sabotage considerations in the review of GESSAR II relative to Unresolved Safety Issue A-29 in Reference 7. Therefore, no further discussion of sabotage will be provided herein.

It is the purpose of this report to provide a qualitative assessment of risk from hurricanes, tornadoes, external floods, aircraft strike and hazardous materials. In performing this assessment, heavy reliance was placed on the information presented in Sections 2 and 3 of GESSAR II which provide the definition of the envelope of site-related parameters and the design bases for structures, components, equipment and systems. Compliance with the requirements in these sections of GESSAR II aids in minimizing the risk from external events.

2. CONSIDERATION OF EXTERNAL EVENTS

This section provides a qualitative assessment of risk of hurricanes, tornadoes, external floods, aircraft strike and hazardous materials.

In the Probabilistic Risk Assessment (PRA) Procedures Guide (Reference 8), screening criteria are suggested for the inclusion of external events into PRA studies. An external event is excluded from PRA studies if it is included in the definition of another event, or events, if the event can be shown not to occur close enough to the plant to affect it, if the event has a significantly lower mean frequency of occurrence than other events with similar uncertainties and could not result in worse consequences than those events, or if the event is of equal or less damage potential than the events for which the plant has been designed. These screening criteria have been utilized in the qualitative assessments contained herein.

2.1 Hurricanes

In Table 10-1 of Reference 8, hurricane events are considered to be included under external flooding and the wind forces are covered under external winds and tornadoes. Since external flooding and tornadoes are covered in Sections 2.3 and 2.2, respectively, hurricanes are not separately addressed in this subsection. This follows the direction of Reference 8 to exclude treatment of a specific event that can be included in the definition of another event or events.

2.2 Tornadoes

Design information on wind and tornado loadings is contained in Section 3.3 of GESSAR II. In Subsection 2.3.1.2 of GESSAR II, the discussion of regional meteorological conditions for design and operating bases contains the specific considerations for high winds and tornadoes. These include:

(1) The structures are designed to withstand wind velocities of 130 mph at 30 ft. above plant grade with a velocity distribution and gust factor as described in ASCE 3269 (Wind Forces on Structures - Reference 9).

(2) The safety-related structures and equipment are designed for the Design Basis Tornado described in NRC Regulatory Guide 1.76 for Region I. The characteristics of this tornado are:

Maximum Wind Speed (mph)	360
Rotational Speed (mph)	290
Translational Speed:	
Maximum (mph)	70
Minimum (mph)	5
Radius of Maximum Rotational Speed (ft.)	150
Pressure Drop (psi)	3.0
Rate of Pressure Drop (psi/sec)	2.0

Using the relationships provided in Reference 10, the tornado wind velocity probability of a maximum velocity of 360 mph is estimated to be less than 10^{-5}.

A discussion of design considerations for missiles generated by natural phenomena is contained in Section 3.5 of GESSAR II. Due to the compartmentalization and separation inherent in the GESSAR II design, it is highly unlikely that given an event that exceeds the design capability, all safety related equipment would be unavailable, especially considering that the ECCS equipment is located below grade level. Assuming a conservative probability estimate for the loss of core cooling capability of $\sim 10^{-4}$, and combining an event frequency of $<10^{-5}$ results in a probability of core damage of $<10^{-9}$. This value is clearly insignificant compared with other events.

2.3 External Floods

Subsection 2.4.2.1 of GESSAR II commits the Applicant to provide site specific flood data. This includes the date, level, peak discharge and related information for major flood events in the site region.

The GESSAR II plant design includes consideration for the probable maximum flood potential. Seismic Category I structures that may be affected by floods are designed to withstand floods using the "hardened" flood protection approach. Through the hardened protection approach, structural provisions are incorporated in the plant's design to protect safety-related structures, systems and components from postulated flooding. Seismic Category I structures required for safe shutdown remain accessible during all flood conditions.

Safety related systems and components are flood protected either because of their location above the design flood level, or because they are enclosed in reinforced concrete Seismic Category I structures which have the following requirements:

(1) wall thicknesses below flood level of not less than 2 ft;

(2) water-stops provided in all construction joints below flood level;

(3) watertight doors and equipment hatches installed below design flood level; and

(4) waterproof coating.

Additional flood protection from external sources is discussed in Subsection 3.4.1 of GESSAR II.

The structures of safety significance are designed for a design basis flood, as defined in Regulatory Guide 1.59, up to an elevation 1 ft. below plant grade including allowance for the effects of coincident waves and the resultant runup as calculated from site unique parameters.

Based on the above information, and the results obtained from the evaluation of internal flood events (Reference 4), the probability of core melt from external flood sources is believed to be an insignificant contributor to core melt risk.

2.4 Aircraft Strike

The GESSAR II design is intended for use at sites where the probability of an aircraft impact is $\leq 10^{-7}$ per year. It is the responsibility of the Applicant to show compliance with this requirement. If the Applicant's plant is located at a site where this probability is not $\leq 10^{-7}$ per year, the Applicant will provide an evaluation of the consequences of an aircraft crash considering the type and frequency of aircraft germane to his site in his safety analysis report. It is believed that the criteria used for aircraft crash will include at least 90% of the sites in the United States.

With the use of this aircraft strike criteria, the frequency is much less than the event frequency for tornadoes or hurricanes with missiles, with similar core damage probabilities given the event. Thus the contribution of aircraft strikes to incremental plant risk is negligible.

2.5 Hazardous Material

In assessing the risk from hazardous material, Reference 8 suggests including the risks from industrial or military facilities, pipeline accidents, release of chemicals in onsite storage, and transportation accidents. All of these are site dependent, and require site specific information to quantify any potential impact. This information will be provided by the Applicant as noted in Section 2.2 of GESSAR. Specific information will include:

1) Location and routes of any nearby industrial, transportation, and military facilities.

2) Descriptions of nearby industrial, transportation, and military facilities.

3) Descriptions of the products and materials regularly manufactured, stored, used, or transported in the vicinity of the plant.

4) Descriptions of nearby pipelines.

5) Information on navigable waterways adjacent to the site.

6) Projections of growth of current and new industrial activities in the vicinity of the plant.

Furthermore, the Applicant will provide a determination of design basis events (i.e. probability of occurrence $>10^{-7}$ per year and potential consequences serious enough to affect the safety of the plant to the extent that 10CFR100 guidelines could be exceeded) for each of the following accident categories: explosions, flammable vapor clouds (delayed ignition), toxic chemicals, fires, collisions with intake structures and liquid spills. Subsection 2.2.3.2 of GESSAR II commits the Applicant to provide an assessment of the effects of any potential design basis events included in these accident categories.

For those events not defined by the Applicant as design bases and separately evaluated, the low occurrence frequencies resulting in even smaller core melt risk is negligible.

3. CONCLUSIONS

For the reasons discussed in Section 2, which are summarized below, the probability of core damage and incremental plant risk from external events for the GESSAR II design is believed to be insignificant.

External Event	Basis for Conclusion
Hurricanes	• Included under Tornadoes and External Floods
Tornadoes	• GESSAR II design capability to withstand missile impact from maximum wind velocity • Low event probability with low core damage probability
External Floods	• GESSAR II design basis flood capability • Demonstrated capability in internal flood evaluation
Aircraft Strike	• GESSAR II aircraft strike criteria of $\leq 10^{-7}$ events per year
Hazardous Material	• GESSAR II commitment for Applicant determination of hazardous material design bases events ($>10^{-7}$ probability of occurrence per year) and assessment of consequences

4. REFERENCES

1. Memorandum for C. O. Thomas from D. C. Scaletti, "GESSAR II Meeting Summmary," June 7, 1984.

2. NUREG-1070, "NRC Policy on Future Reactor Designs: Decisions on Severe Accident Issues in Nuclear Power Plant Regulation", April 18, 1984 (Draft).

3. Letter for D. G. Eisenhut from J. F. Quirk, "GESSAR II Seismic Event Analysis in Support of the Severe Accident Review of GESSAR II," September 21, 1983.

4. Letter for D. G. Eisenhut from J. F. Quirk, "GESSAR II Fire and Flood External Event Analysis in Support of the Severe Accident Review of GESSAR II", November 7, 1983.

5. Letter for D. G. Eisenhut from J. F. Quirk, "In the Matter of 238 Nuclear Island General Electric Standard Safety Analysis Report (GESSAR II) Severe Accident Review of GESSAR II, December 29, 1983.

6. Memorandum for Roger J. Mattson from Olan D. Parr, "Status of Generic Issue A-29," March 23, 1984.

7. J. N. Fox, et.al., "Resolution of Applicable Unresolved Safety Issues and Generic Issues for GESSAR II," NEDO-30670, June 1984 (Draft).

8. NUREG/CR-2300, "PRA Procedures Guide - A Guide to the Performance of Probabilistic Risk Assessments for Nuclear Power Plants", January 1983.

9. ASCE Paper No. 3269, Wind Forces on Structures, Transactions of the American Society of Civil Engineers, Vol. 126, Part II (1961).

10. R. G. Garson, J. Morla-Catalan, and C. Allin Cornell, "Tornado Risk Evaluation Using Wind Speed Profiles," Technical Note, Journal of the Structural Division, ASCE, Vol. 101, ST5, 1975.