UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

JUN 15 1979

NOTE TO: Sue Lynd, FMEA Study Coordinator

FROM: R. G. Fitzpatrick, Power Systems Branch, DSS

THRU: Faust Rosa, Chief, Power Systems Branch, DSS

SUBJECT: FMEA INFORMATION REQUESTED BY THE PRESIDENTS TMI COMMISSION

PSB requirements for and use of FMEA's are as follows. The responses are keyed to the unsigned June 15, 1979 note to the DSS Branches requesting this FMEA information:

1. R.G. 1.70 requires an FMEA to be submitted in SAR's to demonstrate the single failure criterion has been met with the design of the onsite emergency power system.

   Other specific FMEA's are requested on a case by case basis, at the discretion of the reviewer, to facilitate the review of new or unique design features.

2. An FMEA provides insight into a design and a measure of whether or not the design meets the design bases. The applicant is requested to perform the FMEA, learn from it, and then submit it for our review.

3. We use applicant-supplied FMEA's to expedite our review of the SAR. The conclusions drawn from the results of the FMEA contribute to the bases for acceptability of the design.

4. We do FMEA's (the degree of formality and depth varies widely not only on a case by case but also reviewer by reviewer basis) when we independently review a design for meeting the single failure criterion.

R. G. Fitzpatrick
Power Systems Branch
Division of Systems Safety

cc: V. Moore
R. Satterfield
V. Benaroya

8.3.1.2 Analysis. Provide analyses to demonstrate compliance with the Commission's General Design Criteria and to indicate the extent to which the recommendations of regulatory guides and other applicable criteria are followed. Especially important are the analyses to demonstrate compliance with GDC 17 and 18 and the discussion to indicate the extent to which the recommendations of Regulatory Guides 1.6 and 1.9 (Safety Guides 6 and 9) and of Regulatory Guide 1.32 are followed. The discussion should identify all aspects of the onsite power system that do not conform to Regulatory Guides 1.6, 1.9, and 1.32 and should explain why such deviations are not in conflict with applicable General Design Criteria.

Identify all safety-related equipment that must operate in a hostile environment (e.g., radiation, temperature, pressure, humidity) during and/or subsequent to a postulated accident (e.g., loss-of-coolant accident, steam line break). All the conditions under which the equipment must operate should be tabulated. Provide bases, criteria, and analyses of the potential effects of (1) radiation (i.e., radiation due to accident conditions superimposed on that for long-term normal operation) on safety-related electric equipment throughout the plant and (2) loss-of-coolant accidents or steam line breaks on all safety-related electric equipment within primary reactor containment (e.g., motors, cables) that must operate during and/or subsequent to such an accident. The successful completion of any applicable qualification tests for the above cases should be documented. Where such tests have not been previously completed, plans and schedules of the qualification tests proposed should be documented. The FSAR should document the results of these tests.

8.3.1.3 Physical Identification of Safety-Related Equipment. Describe the means proposed to identify physically the onsite power system equipment as safety-related equipment in the plant to ensure appropriate treatment, particularly during maintenance and testing operations. The description should include the method used to readily (without the necessity for consulting reference material) distinguish between redundant Class 1E systems, associated circuits assigned to redundant Class 1E divisions, and non-Class 1E systems.

8.3.1.4 Independence of Redundant Systems. Present the criteria and their bases that establish the minimum requirements for preserving the independence of redundant Class 1E electric systems* through physical arrangement and separation and for ensuring the minimum required equipment availability during any design basis event.* A discussion should be included of the administrative responsibility and control to be provided to ensure compliance with these criteria during the design and installation of these systems. The criteria and bases for the installation of electrical cable for these systems should, as a minimum, include a description of the extent to which the recommendations of Regulatory Guide 1.75, "Physical Independence of Electric Systems," are followed.

* Class 1E electric systems and design basis events are defined in IEEE Std 308-1971.

** R.G. 1.32 Endorses IEEE STD 308 (ATTACHED)

standby power supply. The power supply that is selected to furnish electric energy when the preferred power supply is not available.

unit. A nuclear steam supply system, its associated turbine-generator, auxiliaries and engineered safety features.

4. Principal Design Criteria

4.1 General. The Class IE power systems shall be designed to assure that no design basis event will cause:

(1) A loss of electric power to a number of engineered safety features, surveillance devices, or protection system devices sufficient to jeopardize the safety of the station.

(2) A loss of electric power to equipment that could result in a reactor power transient capable of causing significant damage to the fuel or to the reactor coolant system.

Illustrative design basis events are given in Table 1.

Table 1
Illustrative Design Basis Events

Natural Phenomena	
Earthquake	Rain, ice, and snow
Wind	Floods
Hurricane	Lightning
Tornado	Temperature
Postulated Phenomena	
Postulated accident environment (humidity, temperature, pressure, chemical properties, and radiation)	
Fires	
Accident-generated missiles	
Fire-protection system operation	
Accident-generated flooding, sprays, or jets	
Postulated loss of the preferred power supply combined with any of the above	
Single equipment malfunction	
Single act, event, component failure, or circuit fault that can cause multiple equipment malfunctions	
Single equipment maintenance outage	

4.2 Design Basis Event Effects. Design basis events shall be established for each individual unit and the severity and magnitude of each event defined. The Class IE power systems shall be capable of performing their function when subjected to the effects of any design basis event.

4.3 Power Quality. The variations of voltage and frequency in the Class IE power systems during any design basis event shall not degrade the performance of any load to the extent of causing significant damage to the fuel or to the reactor coolant system.

4.4 Location of Indicators and Controls. The design shall provide controls and indicators in the control room and provision shall be made for control outside the control room for the following:

(1) Circuit breakers required to switch the Class IE buses between the preferred and standby power supply

(2) Standby power supply

4.5 Identification. Components of Class IE power systems, and their associated design, operating, and maintenance documents, shall be marked or labeled in a distinctive manner.

4.6 Equipment Protection. Class IE power equipment shall be physically separated from its redundant counterpart or mechanically protected as required to prevent the occurrence of common failure mode.

4.7 Equipment Qualification. Each type of Class IE power equipment shall be qualified by analysis, successful use under similar conditions, or by actual test to demonstrate its ability to perform its function under normal and design basis events.

4.8 Failure Mode and Effects Analysis. An analysis of the failure modes of Class IE power systems and the effect of these failures on the electric power available to Class IE loads shall be performed to demonstrate that a single component failure does not prevent satisfactory performance of the minimum Class IE loads required for safe shutdown and maintenance of post-shutdown or post-accident station security.

4.9 Connection of Non-Class IE Equipment. Non-Class IE equipment which is required to maintain the station in a safe and orderly condition, may be supplied from Class IE power systems, provided that the Class IE systems are maintained at an acceptable level with respect to the requirements of this document.

5. Supplementary Design Criteria

5.1 Class IE Power Systems.

5.1.1 *Description.* The Class IE power systems shall consist of an alternating-current power system, a direct-current power system, and a vital instrumentation and control pow-