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NUCLEAR PRODUCTION DEPARTMENT

August 24, 1981

U. S. Nuclear Regulatory Comm. ssion
Office of Nuclear Reactor Regulation
Washington, D. C. 20555

Attention: Mr. Harold R. Denton, Director

Dear Mr. Denton:

Subject: Grand Gulf Nuclear Station
Units 1 and 2
Docket Nos. 50-416 and 50-417
Files 0260/0862
Transmittal of Proposed FSAR Changes and Responses to NRC Questions and SER Open Items
AECM-81/316

In response to your request for additional information, Mississippi Power & Light Company is submitting the enclosed materials updating information pertaining to the Grand Gulf Safety Analysis Report (FSAR).

The proposed FSAR changes will be incorporated into the next available amendment to the FSAR. If you have any questions or require further information, please contact this office.

Yours truly,

L. F. Dale
Manager of Nuclear Services

DWF/JDR:mb

Attachments (See Next Page)

RECEIVED AUG 26 1981 U.S. NUCLEAR REGULATORY COMMISSION

B001 S1/1

Attachments:
1. PSB SER Open Item-Diesel Generator Automatic Control System
2. SEB SER Open Item-Reg. Guide 1.12 (Seismic Instrumentation)
3. SEB SER Open Item-Allowable Tangential Shear
4. SEB SER Open Item-Masonry Walls
5. SEB SER Open Item-Fluid-Structure Interaction
6. SEB SER Open Item-Tornado Missiles
7. SEB SER Open Item-Stress Analysis of Members
8. SEB SER Open Item-Turbine Missiles
9. SEB SER Open Item-Allowable Compression Stress of Concrete
10. HGEB SER Open Item-Ultimate Heat Sink-Effect of Flooding
11. SAB SER Open Item-Toxic Gas Hazard
12. Question & Response 211.176
13. Question & Response 130.29

cc: Mr. N. L. Stampley
Mr. G. B. Taylor
Mr. R. B. McGehee
Mr. T. B. Conner

Mr. Victor Stello, Director
Office of Inspection & Enforcement
U. S. Nuclear Regulatory Commission
Washington, D. C. 20555

SER Open Item

Diesel Generator Automatic Control System - (PSB)

Response

The diesel generator unit design does include an emergency override of the test mode to permit response to bona fide emergency signals and return control of the diesel generator unit to the automatic control system. Since the diesel generator test circuitry allows only one unit to be tested at a time, the other unit is in standby, ready to respond to an emergency signal. Thus only one unit at a time needs to be returned from the test mode to the ready to load status.

This return from test mode status is accomplished through relay logic. An incoming LOCA signal will break the seal in the circuit which holds the unit in the test mode. This action initiates a sequence of events in which the unit which was being tested is tripped off the line without stopping the diesel. That is, the diesel generator will be disconnected from the ESF busses and maintained in a ready to load status. The diesel generator governor and voltage regulator will be placed in the no load position and the governor will be switched back to the isochronous mode. At this point the automatic control system will load the unit as required.

Since no operator action is called for in this sequence of events, there is no concern that an operator's inaction or wrong action would reduce the safety margin with regard to onsite AC power supply.

SER Open Item

Reg Guide 1.12 - Seismic Instrumentation - (SEB)

Response

1. The five Peak Strain Gages (PSG) will be replaced by Peak Recording Accelographs (PRA) prior to fuel load.

2. Prior to start-up, following the first refueling, monitoring of either the reactor equipment support or the reactor piping support will be accomplished by installing a (triaxial) Strong Motion Accelerometer (SMA) to satisfy the requirements of Reg Guide 1.12, Section C.1.c(1) which requires a triaxial response spectrum recorder. The SMA cannot be installed until first fuel reload due to a mid-December vendor delivery date, which is too late to install before fuel load.

   A tape recorder will also be provided to enable the signal from the SMA to be played back into the response spectrum analyzer permanently installed in the control room. This provides a time/history response spectra from 0-33 Hz at 62 frequency points as against 12 frequency setpoints available from the triaxial response spectra recorder. This detailed information is available to the operator immediately following a seismic event.

SER Open Item

Allowable Tangential Shear -- (SEB)

Response

At the time of the Grand Gulf drywell design, the initial criteria for the allowable tangential shear stress of concrete was being developed. The ASME/ACI 359 code was in draft form (May, 1974) and issued for comments. Industry and the NRC were in disagreement as to what the design criteria should be. The following is the contested criteria of the May, 1974 code:

CC-3411.5 Tangential Shear. An example of this type of shear is the shear forces resulting when the containment structure is subjected to earthquake motion.

CC-3411.5.1 Reinforced Concrete. Tangential shear stress, v_c may be taken equal to 12,000 p for $p \leq 0.01$, and equal to 93 + 2,700 p for $0.01 \leq p \leq 0.025$, where v_c is given in psi and p is the lesser of the reinforcement steel ratios in meridional and circumferential directions. The maximum allowable tangential shear stress carried by the concrete, v_c , shall not exceed 160 psi.

Tangential shear may be carried by the concrete provided that the concrete meets the requirements listed below:

a) The specified design compressive strength of the concrete shall be not less than 3,000 psi.

b) Concrete aggregates shall conform to ASTM C-33 "Standard Specification for Concrete Aggregates."

c) The maximum loss by weight of the coarse aggregate when tested in accordance with ASTM C-131 "Resistance to Abrasion of Small Size Coarse Aggregate by Use of the Los Angeles Machine," shall not exceed 40%.

d) The roughness of the crack surface shall be sufficient to develop the shear capacity along the crack without excessive slip.

For containments which have concrete not qualifying to the requirements of items (a) through (d), the following shall be used:

For containments which do not support equipment laterally above the base slab, membrane shear stress carried by the concrete, v_c , may be taken as maximum of 40 psi, provided the ratio of reinforcement both vertically and horizontally is a minimum of $60/f_y$ in addition to that required for membrane tension. For containments which also stabilize the equipment laterally, the value of v_c shall be taken as zero. The excess of v_u above v_c shall be resisted by inclined reinforcement. Greater values of v_c than the above, and other arrangements of reinforcement, may be permitted if it can be demonstrated that the containment and equipment can tolerate larger strains, and the integrity of the liner is not impaired thereby. The value of the nominal shear stress, v_u , shall not exceed $8\sqrt{f'_c}$ unless v_c is assumed to equal zero.

The major point of disagreement was part (d) of the concrete property requirements. The industry contended that, with the use of 3/4 inch and 1 1/2 inch aggregate sizes, sufficient aggregate interlock existed to develop the shear capacity along concrete cracks. The NRC disagreed with this reasoning since no confirmatory testing had been done to substantiate the industry's claims. The NRC subsequently retained researchers from MIT and Cornell to evaluate concrete shear capacity along cracks. The drywell structure design was done during the time of this research effort. Based on the engineering judgement of the industry and the fact that 3/4 inch and 1 1/2 inch aggregate sizes were used in construction of the drywell, it was decided to use the ACI 359 criteria based on steel ratios for drywell tangential shear design. It was found that the limiting steel ratio for the drywell was: $p = 0.00787$.

The allowable concrete stress was then: $v = 12000\ p = 94.4$ psi.

The research tests showed that there was no excessive slip along the crack due to aggregate interlock. However, the NRC rejected the results of the report since, among other reasons, the effects of cracking due to biaxial tension loadings were not examined in the tests for shear capacity. Consequently, the NRC established its own criteria for allowable concrete tangential shear stress: $v = 60$ psi for SSE Loadings and
$v = 40$ psi for OBE Loadings

This criteria was recently amended in the 1980 Code to: $v = 40$ psi for all loadings.

Prior to the NRC's rejection of the research test results, the drywell was designed, reinforcement was fabricated, and the wall was constructed in accordance with the May, 1974 criteria using steel ratios.

Another uncertainty at the time of the drywell design was whether or not to design the drywell for tangential shear since:

1) The criteria of ACI 359 was written for containments only.

2) The drywell is not the primary leakage barrier. The problems of excessive slip across the cracks are primarily addressed to avoid compromising the containment liner which is the primary leakage barrier of the containment.

It was decided to analyze and design the drywell for tangential shear. Consequently, the NRC imposed the same tangential shear requirements of the containment onto the drywell in the SRP.

SER Open Item

Masonry Walls - (SEB)

Response

Attached is the revision to FSAR subsection 3.8.4.4.5 indicating that the design of safety related CMU walls will be consistent with NRC IE Bulletin 80-11. This revision will be included in the next available amendment.

Subsequent to the issuance of the NRC's information request on Category I masonry walls, dated April 21, 1981, IE Bulletin 80-11 was originated. Although this bulletin applies only to power reactor facilities with an Operating License, we initiated a reevaluation of concrete masonry walls in Category 1 structures at Grand Gulf. To date, the following work has been completeed:

1. A comprehensive field survey was conducted between November 108, and January 1981. This survey identified all safety-related items attached to or located in proximity to masonry walls at that time. In addition, data was recorded to determine the wall geometry, location of penetrations and type of closures, location and magnitude of attachment loads, type of wall support, and any additional information which could affect the structural integrity of the walls.

2. Upon completion of the survey, the information obtained was used to reevaluate the ability of these walls to perform their intended functions during all postulated loadings, without impairing the integrity of Category 1 systems and components attached to or in proximity to these walls. Criteria were generated for the reevaluation, which consider present state-of-the-art analysis and design techniques, as well as licensing commitments contained in the FSAR.

3. Any masonry walls which did not conform with the criteria were modified as required, and appropriate design drawings were issued to implement these modifications.

During the fall of 1981, a second field survey will be initiated. The purpose of this survey is to identify any additional wall attachments or changes in wall confirgurations subsequent to the first survey. The walls will then be reevaluated as necessary, and modification designs, if required, will be issued.

In December, 1981, we will submit a formal report on the reevaluation of concrete masonry walls at Grand Gulf. This report will contain all information requested in IE Bulletin 80-11, as well as a comparison of the Grand Gulf masonry wall design criteria with Revision 1 of the NRC's "SEB Interim Criteria for Safety Related Masonry Wall Evaluation" (July 1981).

resist the most critical loading case as well as tornado generated missiles. Ass exterior walls are designed as shear walls tc transmit lateral loads to the foundation. All vertical loads from roof and floor slabs are transmitted to the foundation through the exterior walls and interior steel columns.

The control building is designed as a sealed building for tornado pressure drop to comply with the extreme environmental condition. A design pressure of 3 psi was used for all exterior walls. During construction of the Unit-2 side of the control building and when Unit-1 is operating, there may be a select number of penetrations that will be left open for cable pulling operations. The structural effects of the tornado pressure drop, while these penetrations are kept open, were investigated. The resulting differential wind pressures were used for the design of the interior walls. Concrete missile barriers 2 feet thick are provided to protect all louvers and other vulnerable openings against tornado generating missiles.

The steel and concrete elements of the control building were designed using classical methods of analysis. The composite steel beams and columns were designed elastically for the loads and load combinations of subsection 3.8.6.3 in accordance with the Specification for Design, Fabrication and Erection of Structural Steel for Buildings, AISC, 1969. The concrete walls, slabs and foundation were designed using ultimate strength technique for loads and load combinations of subsection 3.8.6.2 in accordance with the Building Code Requirements for Reinforced Concrete, ACI-318-71. Concrete block masonry unit (CMU) construction was used for interior walls. These are non-load bearing walls (with a few exceptions where walls support roofs over isolated rooms). The design and construction of these walls were performed in accordance with "National Concrete Masonry Association" (NCMA) Specification (1970). The Uniform Building Code earthquake criteria for Zone 1 was used in the design of non-Category I CMU walls. Whenever the safety of seismic Category I systems and components is involved, these walls were designed consistent with the requirements of NRC I&E Bulletin 80-11, Masonry Wall Design; May 8, 1980.

3.8.4.4.6 Diesel Generating Building

The diesel generator building has been designed as a monolithically constructed, reinforced concrete structure supported on a structural backfill foundation. The analysis techniques include classical beam and plate theory. The design was preformed in accordance with ACI 318-71, Building Code Requirements for Reinforced Concrete, for concrete structures and with the Specification for Design, Fabrication and Erection of Structural Steel for Buildings, AISC, 1969, for steel structures.

The diesel generator building roof was designed as composite beams with two-foot thick concrete slabs resting on steel beams. The concrete roof serves as a horizontal diaphragm which transfers.

SER Open Item

Fluid - Structure Interaction - (SEB)

Response

Attached are the revisions to FSAR subsections 3.8.1.4.1.1.1 and 3.8.1.4.1.1.2 indicating the Grand Gulf position on fluid-structure interaction in the suppression pool boundary. These revisions will be incorporated into the next available amendment to the FSAR.

the support brackets/piers embedded in the shell. Effects of these loads are considered by use of the analytical references listed above.

The containment wall above the auxiliary building roof and the dome will be substantially exposed to a tornado wind, since the enclosure building siding will be assumed to be breached on the windward side. All siding will be stripped on the leeward and the other two sides, and all roof decking will be stripped.

The finite element model used in ASHSD for determining the structural response due to the non-axisymmetrical safety/relief valve loads showing the assumed boundary conditions, demarcation of soil stratum, distribution of shell and solid elements, and the modeling of associated internals, is shown in Figures 3.8-54 and 3.8-55.

The actuation of safety/relief valves results in dynamic loads on the suppression pool boundaries. These dynamic loads are formulated by applying a non-dimensional time function to the attenuated pressures in the suppression pool which result from single and multiple valve discharge. These attenuated pressures are calculated based upon the methodology presented in Appendices 6A and 6D. The non-dimensional time function is the oscillation of the bubble pressure within the suppression pool, which is shown in Appendix 6D, Figure 3B.A.5.11. The magnitude of the pressure at any point within the pool decreases with time, with the duration of the load being less than 1 second. Once this pressure time history has been formulated, it is represented in terms of a Fourier series and then used as input for ASHSD.

The response of the containment and internals, considering proportional damping in the system, is determined throughout the time domain by the direct integration scheme in ASHSD. This analysis results in displacement, stress, and acceleration time histories throughout the structure.

Harmonic acceleration time-histories calculated in ASHSD are summed for a full Fourier series and input into Computer Code CE802 (see Appendix 3D), which calculates in-structure response spectra at critical areas of interest. Soil-structure interaction effects are accounted for in the ASHSD direct integration analysis. Structures adjacent to the containment building will not experience significant effects from suppression pool loads in the containment.

The containment shell, drywell shell and containment base mat are extremely stiff steel lined reinforced concrete structures which form the suppression pool boundary. Thus, effects of fluid-structure interaction upon the total containment building response due to dynamic suppression pool boundary loads will be small. Suppression pool boundary loads, as defined in Appendices 6A and 6D, are applied to the ASHSD mathematical model shown in Figures 3.8-54 and 3.8-55 as rigid wall loads. The mass of the suppression pool water has been lumped at those node points of Figure 3.8-54 which form the suppression pool boundary. The effect of negative safety/relief valve pool boundary loads upon the suppression pool liner is discussed further in subsections 3.8.1.1.2 and 3.8.1.4.2.

realistically to the imposed boundary condition of fixity between the drywell wall and the foundation mat. The idealized finite element model used for these loadings showing the assumed boundary conditions, demarcation of soil strata, and distribution of elements shown in Figures 3.8-56 and 3.8-57.

The design basis accident (DBA), a loss-of-coolant accident (LOCA), results in dynamic loads on the suppression pool boundaries. These dynamic loads are formulated by applying a time function to the attenuated pressures in the suppression pool. The attentuated pressures are calculated based upon the methodology presented in Appendices 6A and 6D. Once the pressure time-histories are formulated, they are represented in terms of a Fourier series and then used as input for ASHSD.

The response of the containment and internals is determined throughout the time domain by the direct integration scheme in ASHSD, using the same finite element model as was used for the dynamic non-axisymmetric safety/relief valve loadings described in subsection 3.8.1.4.1.1.1.

3.8.1.4.1.1.3 Major Penetrations

The major penetrations which intersect the containment wall include the equipment hatch and two personnel locks as described in subsection 3.8.1.1. The state of stress around these openings is determined by the use of analytical-numerical techniques as delineated in References 4 and 5. This anlysis is based on the split-rigidity concept of stiffened shells. Since the reinforced concrete section will crack from thermal and mechanical loadings, the membrane and bending stiffnesses will change from that of an isotropic, elastic, homogeneous section. In the vicinity of the opening, the containment wall is idealized as having an equivalent reduced membrane thickness/stiffness and an equivalent reduced bending thickness/stiffness. These effective thicknesses are incorporated into the governing differential equations of Reference 4, the equations are then resolved, and certain material-geometric parameters are subsequently modified to be used in conjunction with References 4 and 5. The references above are used to find the stress amplification around the openings from meridional membrane forces, pressure loadings (internal and external), and thermal moments. Reference 6 is used to evaluate the state of stress around the openings from tangential shears which are induced by a seismic event or by wind loadings.

3.8.1.4.1.1.4 Variation of Physical Material Properties

The effects of possible variations in the physical properties of materials of the analytical results are as follows. Since the containment is a non-prestessed, conventionally reinforced concrete structure, significant reduction in the concrete modulus of elasticity from sustained creep effects is not expected. A

SER Open Item

Tornado Missiles - (SEB)

Response

The calculations providing the derivation of the time histories for 12 inch diameter pipe and an automobile are proprietary to Bechtel and will be forwarded under a separate letter to the NRC. This letter will include the reference describing the origin of the formula for resistance function.

SER Open Item

Stress Analysis of Members - (SEB)

Response

Attached is a technical justification for the selection of one girder, an interior wall, and three steel beams and a justification for the equation used to perform the stress analysis of these members in the auxiliary building.

Each structural member in the auxiliary building is designed to function for the load factor equations of FSAR subsection 3.8.6. A comparison of the load combinations used by Grand Gulf and those contained in the SRP is shown in Tables 3.8-35 and 3.8-36. Each SRP equation is compared to the corresponding Grand Gulf equation on a case basis and the degree of conservatism of the Grand Gulf equation with respect to the corresponding SRP equation is noted. Table 3.8-35 reveals that Grand Gulf equation (2) is less conservative than SRP equations (2a) and (2b) for concrete structures. Table 3.8-36 reveals that Grand Gulf equation (2) is less conservative than SRP equations (2) for steel structures. Consequently, FSAR Table 3.8-37 (for concrete structures) and Tables 3.8-38 through 3.8-40 (for steel structures) were generated to determine the degree of conservatism of the Grand Gulf design for those cases identified in Tables 3.8-35 and 3.8-36 where the Grand Gulf criteria was less conservative than the SRP criteria. Since FSAR Tables 3.8-37 through 3.8-40 reveal that the Grand Gulf design is conservative where the SRP criteria bounds the Grand Gulf criteria, the Grand Gulf design is conservative with respect to the SRP criteria for the auxiliary building.

The concrete interior wall analyzed in Table 3.8-37 is a typical, critical structural element in the auxiliary building which must withstand a range of loadings including earthquake, compartment pressure and pipe anchor loads. The structural integrity of this element is critical to the functional design of the auxiliary building. Similarly, the beams and girder analyzed in Tables 3.8-38 through 3.8-40 are typical, critically loaded structural elements which must withstand pipe anchor, earthquake and safety-related equipment loads. These members are critical to the functional design of the auxiliary building since failure of any of these elements would result in partial collapse of the floor.

SER Open Item

Turbine Missiles - (SEB)

Response

Attached is a technical justificatior of the Grand Gulf turbine missile protection design. Also attached is the completed NRC request form on low and high trajectory missile barriers.

GRAND GULF TURBINE MISSILE PROTECTION

Turbine missile protection is provided at Grand Gulf Nuclear Station by the placement of barriers to reduce the overall site probability of damage due to high or low trajectory missiles to less than 10^{-7} per year.

Protection against high trajectory turbine missiles is provided as follows: A probability study was performed assuming that missile damage to the external boundary of any structure containing safety-related systems resulted in unacceptable damage. The probability procedure is outlined in detail in FSAR subsection 3.5.1.3. This study contained several very conservative considerations. First, by utilizing gross structural targets, as opposed to individual systems, the potential safety-related impact area is increased. Secondly, the study assumed a conservative probability of missile generation equal to 10^{-4} per unit-year. This value was applied exclusively to destructive overspeed missiles, instead of distributing some of the generation probability to design overspeed missiles. The total site probability of unacceptable damage due to potential high trajectory missile generation is calculated to be approximately 3.1×10^{-8} per year.

Protection against low trajectory missiles is provided by 4' - 6" thick shield walls which are located within very close proximity to the turbine generator. These barrier walls are designed to provide adequate protection against any postulated destructive overspeed missile. The Ballistics Research Laboratory (BRL) formula for concrete perforation was used to derive the required 4' - 6" concrete wall thickness. Conservatively, the last stage disk (Disk No. 5, Ref. 1) was used to represent the most damaging missile. This missile was assumed to have a velocity of a smaller disk (Disk No. 1). Therefore, the missile used in all barrier analysis had an initial energy greater than any missile postulated in Ref. 1. However, calculations indicated a margin of approximately 20% for the shield wall. The modified NDRC formula was considered too conservative and was not used in any calculations. This conservatism can be seen in the attached Figure 1 (Ref. 2) and Figure 2 (Ref. 3), which were originally presented at the April, 1981 EPRI Seminar on Steam Turbine Disc Integrity. All test data, either full or 1/11 scale representations of a Westinghouse 120° missile, showed that even though the NDRC formula predicted perforation, it did not occur. In one case, a missile with an initial velocity of 440 fps did not perforate a scale 3' - 6" barrier although the NDRC formula predicted perforation at an impact velocity near 200 fps.

The BRL formulation was also selected because the results derived from its application to turbine missile barriers was very similar to results derived from a less empirical method developed by McMahon, Sen and Meyers (Ref. 4). This method calculates concrete perforation using an energy summation technique and is less sensitive to extrapolation beyond available data. Figure 3 shows a comparison of the three methods discussed above for a General Electric 120° missile. The semi-empirical and the BRL solutions compare favorably; however, the NDRC solution is significantly more conservative.

Since the initial study was completed, more test data has become available to justify the 4' - 6" wall thickness. Full scale test data (Ref. 2) and small scale test data (Ref. 5) using turbine missile shapes are now available and are summarized in Tables 1 & 2. These test results are included in Figure 2 which superimposes this data against several perforation formulas. The CEA-EDF and Chang formulas represent the data more closely than the NDRC formula. Twisdale (Ref. 3) and Sliter (Ref. 5) have both shown the CEA-EDF formula to have the most reasonable correlation with available test data. Also, Sliter (Ref. 6) analyzed the results of 145 missile tests involving steel missiles and reinforced concrete barriers. He found the CEA-EDF formula to best predict perforation thicknesses. In addition to correlating well with the EPRI turbine missile data, the CEA-EDF formula is further substantiated by the CEA-EDF data as reported by Twisdale (Ref. 3). These tests, involving an 8000 pound disk fragment, are summarized in Figure 4 with the superimposed CEA-EDF formula. The CEA-EDF formula was originally generated by the interpretation of 52 impact tests as reported by Sliter (Ref. 6).

Therefore, available test data indicates that the CEA-EDF formula best predicts concrete perforation due to turbine missile impact. Table 3 summarizes the required thickness of concrete, using the CEA-EDF formula, to protect against perforation by the five disks summarized by Allis-Chalmers (Ref. 1). The average area of impact was used in the calculations. In all cases, the 4' - 6" thickness provided by the shield wall is sufficient to preclude perforation by a significant margin.

Although the EPRI test program on turbine missiles is not complete, available data and the formula which is most representative of this data indicate that a 4' - 6" reinforced concrete barrier is sufficient to preclude perforation by any of the postulated turbine missiles at Grand Gulf.

TABLE 1

SUMMARY OF FULL-SCALE TEST RESULTS

Test No.	Missile Weight (lb.)	Impact Orientation	Impact Velocity (fps)	Kinetic Energy (10^6 ft-lb)	Penetration Depth (in.)	Backface Response
1	3250 (W)	Sharp	295	4.4	17	Cracks
2	3250 (W)	Blunt	300	4.5	13	Cracks
3	3250 (W)	Sharp	428	9.3	24	1.6-in. Liner Deflection
4	4540 (CE)	Sharp	377	10.0	26	2-in. Liner Deflection

(Note: 1 lb. = 0.453 kg; 1 in. = 2.54 in; 1 fps = 0.305 m/s; 1ft.-1b. = 1.356N-m)

TABLE 2

SCALE MODEL NONSYMMETRIC MISSILE IMPACT TEST RESULTS[(a)]

Experiment Number	Missile Impact Velocity[(b)] (ft/s ± 3%)	Target	Concrete Strength[(b)] (psi ± 7%)	Shear Stirrups	Liner Plate	Measured Frontface Penetration Depth[(b)] (in. ± 5%)	Backface Response
40	305	Thick	3570	Yes	No	1.6	No Cracking
803	305	Thick	3798	Yes	No	1.2	No Cracking
47	365	Thick	3730	Yes	No	1.6	Light Cracking
804	430	Thick	3655	Yes	No	2.0	Light Cracking
805	550	Thick	3470	Yes	No	2.2	Scabbing
806	550	Thick	3716	Yes	Yes	2.4	Liner Plate Bowed
807	630	Thick	3815	Yes	Yes	2.6	Liner Plate Bowed
808	440	Thin	3633	Yes	No	2.1	Scabbing
809	647	Thin	3320	Yes	Yes	3.3	Liner Plate Bowed

(a) Missile Weight: 2.51 lbs.

(b) Bounds denote precision of measurement

Nine scale model missile tests were performed: 7 with thick targets, 2 with thin targets. The lowest missile velocity (305 ft/s) was similar to the first full-scale test. However, the range of missile velocities in the scale model tests was greater than in the full-scale tests.

TABLE 3

CONCRETE PERFORATION THICKNESS USING THE CEA-EDF FORMULA

Disk	1	2	3	4	5
Burst Speed (rpm)	3312	3312	3312	3268	3312
Weight (lbs)	5848	5774	4349	5500	7535
Energy (10^6 ft-lbs)	20.23	9.89	16.07	17.47	18.81
Velocity (fps)	472	332	488	452	401
Thickness (4000 psi concrete)	42.7"	32.4"	37.3"	39.2"	41.5"

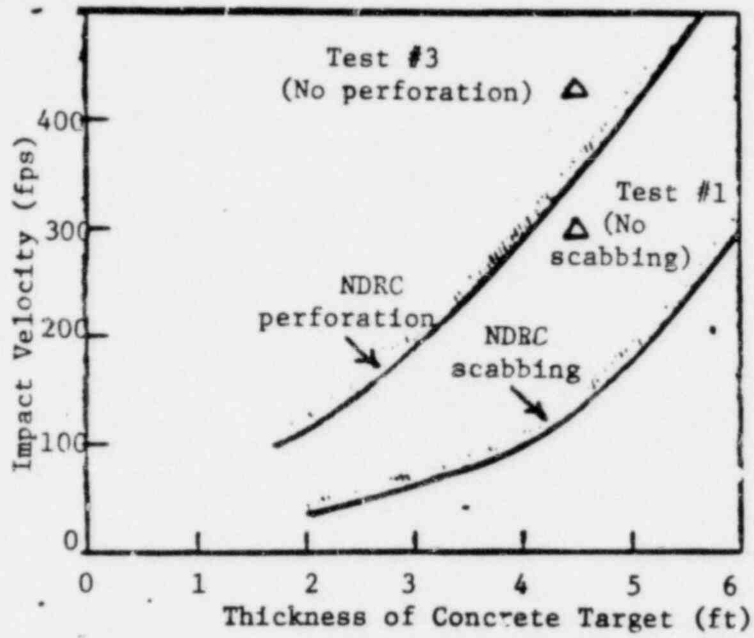


Fig. 1 Comparison of Full-scale Test Results with Predictions of NDRC Design Formula (3250-lb. Missile, Sharp-end Impact)

Fig. 2. **Perforation Comparison with EPRI Data**

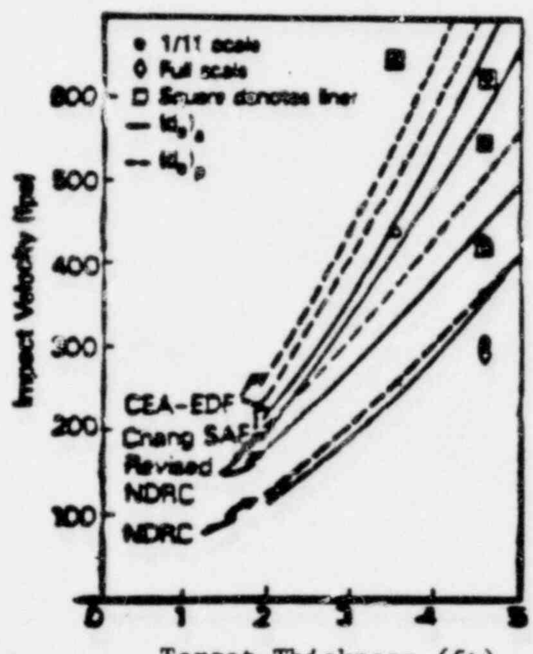


Fig. 3. - Comparison of Concrete Perforation Analysis for a typical General Electric 120° Segment Turbine Missile

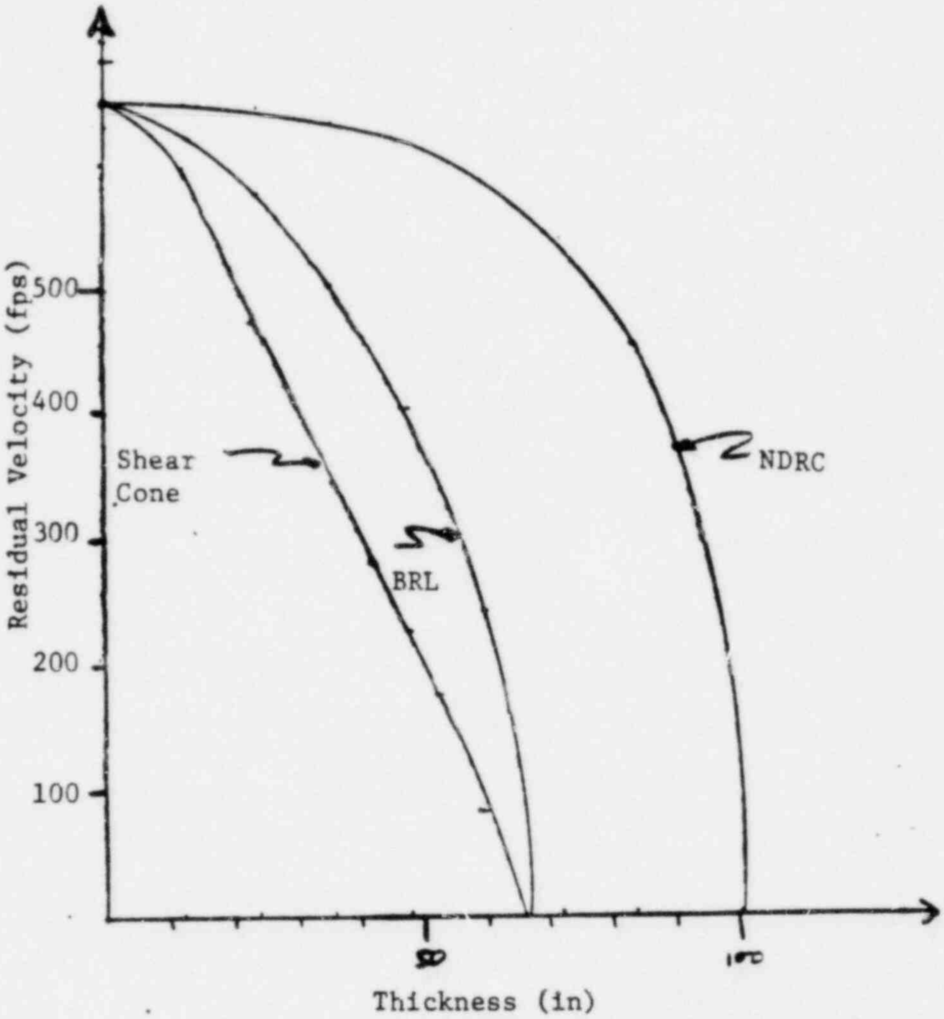
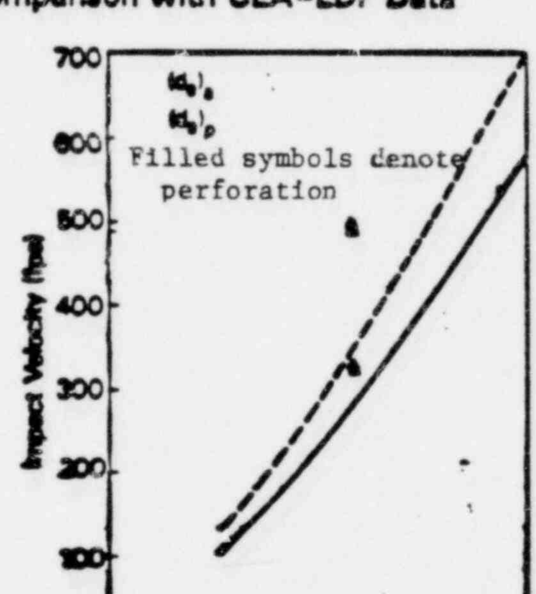


Fig. 4. **Perforation Comparison with CEA-EDF Data**



REFERENCES

1 - Allis Chalmers Engineering Report Number ER-503 - Turbine Missile Analysis, Amendment 1, December 1975.

2 - Sliter, "Status of EPRI Turbine Missile Program", Eighth Water Reactor Safety Research Information Meeting, October 27 - 31, 1980.

3 - Twisdale & Frank, "Concrete Impact Prediction Techniques", EPRI #RP 1549-2, presented at EPRI Seminar on Steam Turbine Disc Integrity, April, 1981.

4 - McMahon, Sen & Meyers - "Bahavior of Reinforced Concrete Barriers Subject To The Impact of Turbine Missiles" - Fifth SMIRT Conference, Berlin, 1979.

5 - Gupta, Seaman, McH·gh, "Scale Model Experiments of Reinforced Concrete Under Impact Loading, EPRI #RP-393, presented at EPRI Seminar on Steam Turbine Disc Integrity, April 1981.

6 - Sliter, 'Assessment of Empirical Concrete Impact Formulas", presented at ASCE Conference on Civil Engineering and Nuclear Power, Boston, April 1979.

GRAND GULF TURBINE MISSILES

1) Barriers - Low Trajectory Missiles

A. Moisture Separators

Material - SA 515 Grade 70
Thickness - 7/8" = 3/4" + 1/8" corrosion
f_s - (ultimate) - 70,000 psi

B. Shield Wall

Material - reinforced concrete
Thickness - 4'-6"
Reinforcement - #9 @ 12" EF Hor; #11 @ 12" EF Vert.
f'_c - 4000 psi

C. Outside Wall of Control Building/Containment Building at Line G

Material - reinforced concrete
Thickness - 2'-0"
Reinforcement - #8 @ 12" EF Hor; #11 @ " EF Vert.
f'_c - 4000 psi

2) Barriers - High Trajectory Missiles

A. Control Building

1. Roof
Material - reinforced concrete
Thickness - 2'-0"
Reinforcement - #7 @ 12" T&B E-W, #9 @ 12" T&B N-S
f'_c - 4000 psi

2. Floor at elev. 188-190
Material - reinforced concrete
Thickness - 1'-0"
Reinforcement - #6 @ 12" T&B N-S; #5 @ 12" T&B E-W
f'_c - 4000 psi

3. Floor at elev. 177 (Partial)
Material - reinforced concrete
Thickness - 4"
Reinforcement - #6 @ 12" T NS; #5 @ 18" T E-W
f'_c - 4000 psi

4. Floor at elev. 165-166
Material - reinforced concrete
Thickness - 9"
Reinforcement - #5 @ 12" T&B N-S; #5 @ 18" T&B E-W
f'_c - 4000 psi

5. Floor at elev. 148
Material - reinforced concrete
Thickness - 1' - 0"
Reinforcement - #6 @ 12" T&B N-S; #5 @ 18" T&B E-W
f'_c - 4000 psi

3) Containment

1. Dome
   Material - reinforced concrete
   Thickness - 2'-6"
   6 Layers Reinforcement - #18 @ 18" + #10 @ 18" Hoop + #14 @ 18 ; #18 @ 0° -40' + #10 @ 0° -40' meridional
   Liner Plate Thickness - 0'-0 1/4"
   f'_c = 5000 psi

2. Drywell Head
   Water Depth above (minimum) - 7'-4"
   Thickness - Min 1 1/8" @ crown
   Material - SA-240 Type 304
   f_s (ultimate) - 75,000 psi

C. Turbine Building Barrier Overhead

Material - reinforced concrete
2'-6" Thickness - 2.5/SM 35.5 = 4.3'/or 2.5'/or C
Reinforcement - #7 @ 12" T&B N-S; #9 @ 12" T&B E-W Containment Side (West)
#7 @ 12" T&B N-S; #6 @ 12" T&B E-W Switchyard Side (East)
f'_c - 3000 psi

SER Open Item

Allowable Compression Stress of Concrete - (SEB, SER Section Page 12)

Response

FSAR Table 130.29-1 lists the comparison of allowable stresses for concrete compression betweet ASME/ACI 359-80 and ACI 349 (Title 69-2). For factored loads, the primary plus secondary membrane and bending stress allowable (Fc) is equal to 0.85 f'c for both codes and this was the condition for which the containment structure was checked and resulting controlling stresses reported in FSAR Tables 3.8-2, 3, 3a, and 3b.

ASME/ACI 359-80 lists reduced concrete stress allowables of 0.6 f'c and 0.75 f'c for primary membrane, and primary plus secondary membrane loads respectively. These cases are considered trivial, as membrane loads, by nature, are evenly distributed over the entire width of wall, typically resulting in low concrete compressive stresses.

Primary membrane plus bending has a reduced concrete stress allowable (Fc) of 0.75 f'c. The containment analysis results of all loading conditions were reviewed for primary loads which would create a worst case condition, and the resulting concrete stresses were found to be below this reduced allowable.

In view of the above, it is concluded that containment concrete stresses meet the stress allowables set forth in ASME/ACI 359-80.

SER Open Item

Ultimate Heat Sink-Effect of Flooding - (HGEB)

Response

Attached is the response to various items connected with flooding and the availability of makeup water to the UHS after flooding. The items are as follows:

1. Frequency of a 103 ft. flood (level that clears levees on west bank).

2. Frequency of a 96 ft. flood (level at which plant service water is lost).

3. Duration of a flood of level 96 ft. or higher (i.e., length of time before river flow returns to normal volume).

4. Loss and repair of plant service water.

5. Makeup water sources for t .

Anhydrous ammonia, benzene, ethylene dichloride, formaldehyde, and sulfur dioxide were analyzed for the toxic gas concentration at the control room in the event of an accident on the river. It was assumed that a barge accident takes place at the closest point of the river to the nuclear station site (1.38 miles) and that only one chemical is involved in an accident. Typical maximum chemical transport quantities were obtained from chemical manufacturers and used in the analyses. The results of the accident analyses is summarized in Table 3.

As shown in Table 3, all calculated toxic gas concentrations at the control room are below their corresponding toxicity limits. Therefore, it is concluded that toxic chemicals and gases transported on the Mississippi River pose no hazard to the Grand Gulf Nuclear Station control room personnel.

Table 1

HAZARDOUS MATERIAL TRANSPORTED ON THE MISSISSIPPI RIVER IN 1974 FROM VICKSBURG, MISSISSIPPI TO BATON ROUGE, LOUISIANA

Description	Amount (Tons)
Oceangoing Hazardous Cargo	
Nitrogenous chemical fertilizers	1,294
Fertilizer and materials, NEC	5,170
Total oceangoing hazardous cargo	6,464
Total oceangoing cargo	279,803
Percentage of total oceangoing cargo	2.3%
Internal Hazardous Cargo	
Crude petroleum	4,345,979
Sulphur, liquid	33[illegible],010
Sodium hydroxide	704,667
Crude, tar, oil, gas products	760,257
Alcohols	1,146,860
Benzene toluene	513,713
Sulphuric acid	101,971
Basic chemicals and products, NEC	5,805,807
Gum and wood chemicals	8,800
Nitrogenous chemical fertilizers	1,265,594
Potassic chemical fertilizers	1,246
Phosphatic chemical fertilizers	371,724
Fertilizer and materials, NEC	1,602,288
Miscellaneous chemical products	78,364
Gasoline	6,652,131
Jet fuel	631,178
Kerosene	134,030
Distillate fuel oil	3,292,783
Residual fuel oil	6,004,246
Lubricating oils and greases	878,457
Naphtha, petroleum solvents	549,283
Asphalt, tar and pitches	1,220,214
Coke, petroleum coke	671,635
Liquified gases	258,361
Petroleum and coal products, NEC	54,723
Total internal hazardous cargo	37,388,321
Total internal cargo	108,646,724
Percentage of total internal cargo	34.41%

Source: Final Safety Analysis Report, Grand Gulf Nuclear Station, Units 1&2, Mississippi Power & Light, Table 2.2-3.

Table 2

Code	Product Description
289	**MISCELLANEOUS CHEMICAL PRODUCTS**
2891	ADHESIVES AND SEALANTS
28913	NATURAL BASE GLUES AND ADHESIVES
	Animal glues
28913 11	Hide (dry forms)
28913 14	Bone, green and extracted (dry forms)
28913 26	Flexible, nonwarp, and liquid glue (not glue stock)
	Protein adhesives
28913 41	Casein adhesives
28913 49	Other, including blood, fish, soybean, albumen, etc.
	Vegetable adhesives
28913 51	Dextrines
28913 55	Starches
28913 78	Bituminous adhesives, asphaltic and coal tar
28913 75	Other natural base glues and adhesives made from natural gums, shellac, silicates, lacquers, oleoresinous varnishes, etc., except rubber
28914	SYNTHETIC RESIN AND RUBBER ADHESIVES, INCLUDING ALL TYPES OF BONDING AND LAMINATING ADHESIVES
28914 11	Epoxy adhesives
	Phenolics and derivatives adhesives
28914 23	Phenolics and modified phenolics
28914 25	Resorcinol and modified resorcinol
28914 33	Urea and modified urea
	Vinyl type adhesives
	Polyvinyl acetate
28914 41	Latex type
28914 43	Solvent type
28914 45	Polyvinyl chloride and copolymers
28914 47	Other vinyl polymer type adhesives
28914 51	Cellulosic type adhesives, nitrocellulose and other
28914 53	Acrylic adhesives
28914 55	Polyester adhesives
28914 61	Polyamide adhesives
28914 65	Hot melt adhesives, including nylon, polyolefin, and other hot melts
28914 71	Adhesive films, all types, including pressure sensitive structural and nonstructural adhesive films
28914 48	Rubber and synthetic resin combinations
	Rubber cement, for sale as such
28914 81	Latex type
28914 83	Solvent type

source: Product Coding Guide, U.S. Department of Commerce, Domestic and International Business Administration for the American International Traders Register and the Trade Opportunities Program.

Table 2 cont.

Code	Product Description
	MISCELLANEOUS CHEMICAL PRODUCTS Con.
	ADHESIVES AND SEALANTS Con.
28915	CAULKING COMPOUNDS AND SEALANTS
	Sealants, natural base
28915 54	Caulks, modified and unmodified oil base
28915 55	Bituminous base (coal tar or asphalt)
	Sealants, synthetic base
28915 56	General performance sealants (PVAC, butyl, vinyl, acrylic, neoprene, etc.)
28915 57	Special performance sealants (epoxy, urethane, polysulfide, silicone, etc.)
28915 58	Preformed tapes (butyl, polybutene, polyisobutylene, etc.)
2892	EXPLOSIVES
28921	EXPLOSIVES (EXCEPT GOVERNMENT-OWNED, CONTRACTOR-OPERATED PLANTS)
	Explosives
28921 13	Permissibles (approved by Bureau of Mines for underground coal mining)
28921 15	Dynamites (non-permissible)
28921 17	Ammonium nitrate, fuel sensitized, except slurry
28921 18	Slurry (all types)
28921 27	Other industrial explosives, including black blasting powder, shaped charges, liquid exygen explosives, nitroglycerin sold as such, etc.
28921 33	Propellants, including smokeless and black powder
	Blasting accessories
28921 41	Safety fuse
	Detonators
28921 43	Blasting caps, electric, delay
28921 45	Blasting caps, electric, except delay
28921 47	Blasting caps, except electric
28921 51	Blasting fuse
28921 61	Other blasting accessories (squibs, ignitors, boosters, etc.)
28921 71	Other explosives, including military detonators, jet starters, fuse and explosive assemblies, etc.
28922	EXPLOSIVES, PROPELLANTS, AND BLASTING ACCESSORIES (GOVERNMENT-OWNED PLANTS)
28922 11	Explosives, propellants, and blasting accessories produced in Government-owned, contractor-operated plants (including receipts for operation and maintenance of plant)
2893	PRINTING INK
28931	LETTERPRESS INKS (BLACK AND COLOR)
28931 05	News inks
28931 06	Publication inks
28931 15	Packaging inks
28931 19	Other letterpress inks
28932	LITHOGRAPHIC AND OFFSET INKS (BLACK AND COLOR)
28932 31	News inks
28932 32	Publication inks
28932 35	Packaging inks
28932 39	Other lithographic and offset inks

Table 2 cont.

Code	Product Description
	MISCELLANEOUS CHEMICAL PRODUCTS–Con.
	PRINTING INK–Con.
28933	GRAVURE INKS
28933 43	Packaging inks
28933 45	Publication inks
28933 49	Other gravure inks
28934	FLEXOGRAPHIC INKS
	Packaging inks
28934 82	Paper and board
28934 83	Film and foil
28934 84	Other flexographic inks
28935	PRINTING INKS, N. E. C.
28935 71	Textile printing inks
28935 85	Screen printing inks
28935 98	Other printing inks, including stencil inks
2895	CARBON BLACK
28950	CARBON BLACK (CHANNEL AND FURNACE PROCESS ONLY)
28950 11	Carbon black (channel and furnace process only)
2899	CHEMICAL PREPARATIONS, N. E. C.
28991	SALT
28991 11	Evaporated salt (bulk, pressed blocks and packaged)
28992	FATTY ACIDS
	Saturated acids
28992 11	Stearic acid (40-50 percent stearic content)
	Hydrogenated animal and vegetable acids
28992 23	Hydrogenated fatty acids having a maximum titer of 60°C and a minimum I. V. of 5
28992 25	Hydrogenated fatty acids having a minimum titer of 57°C and a maximum I. V. under 5
28992 27	High palmitic (over 60% palmitic–I. V. maximum 12)
28992 31	Hydrogenated fish and marine mammal fatty acids
28992 53	Coconut-type acids, I. V. 5 or over, including palm kernel and babassu, hydrogenated coconut acid
28992 55	Fractionated short-chain fatty acids, I. V. below 5, such as caprylic, capric, lauric, myristic
	Unsaturated acids
28992 [illegible]	Oleic acid, including white oleic and red oil
28992 83	Other unsaturated fatty acids, including animal fatty acids other than oleic (I. V. 36 to 80), vegetable or marine (I. V. maximum 115), and other unsaturated fatty acids (I. V. 116 and over)
	Tall oil fatty acids
28992 92	Tall oil fatty acids containing less than 2% rosin acids and more than 95% fatty acids
28992 94	Tall oil fatty acids containing 2% or more rosin acids
28994	GELATIN, EXCEPT READY-TO-EAT DESSERTS

Table 2 cont.

Code	Product Description
	MISCELLANEOUS CHEMICAL PRODUCTS–Con.
	CHEMICAL PREPARATIONS, N. E. C.–Con.
	GELATIN, EXCEPT READY-TO-EAT DESSERTS–Con.
28994 11	Food grade (excluding pharmaceutical and photographic)
28994 31	Pharmaceutical grade (except unfilled capsules)
28994 51	Photographic grade
28994 71	Technical (inedible) grade
28994 98	Other gelatin products, except ready-to-eat desserts, including unfilled capsules and gelatin sheets for theatrical use
28995	ESSENTIAL OILS, FIREWORKS AND PYROTECHNICS, SIZES, AND CHEMICAL PREPARATIONS, N. E. C.
	Essential oils, unblended (natural)
	Citrus oils
28995 11	Orange
28995 12	Lemon
28995 13	Other
28995 15	Peppermint oils
28995 19	Other natural essential oils
28995 29	Fireworks and pyrotechnics (including flares, jet fuel igniters, railroad torpedoes, toy pistol caps, etc.)
	Chemical preparations, n. e. c.
	Automotive chemicals
	Antifreeze preparations
28995 35	Permanent type
28995 36	Other
28995 37	Other automotive chemicals (including battery acid, deicing fluid, carbon removing solvents, etc.)
28995 39	Concrete curing and floor hardening materials
28995 41	Drilling mud materials, mud thinners, thickeners, and purifiers
28995 49	Foundry supplies, chemical (including binders, core oils, core wash, etc.)
28995 53	Household tints and dyes
28995 55	Insulation products (heat, electrical, other)
28995 59	Metal-treating compounds (nonoil base) for nitriding, pickling, drawing, and cutting
28995 61	Oil-treating compounds (nonoil base)
	Sizes
28995 63	Rosin sizes
28995 65	Other, including dextrin sizes
28995 72	Inks (writing and stamp pad ink, including indelible ink and marking fluid, excluding drawing inks.)
	Water-treating compounds
28995 73	Swimming pool chemical preparations
28995 77	Boiler compounds
28995 79	Other water softening compounds
28995 81	Waterproofing compounds (electrical, leather, masonry, textile, etc.)
28995 83	Embalming chemicals
28995 87	Vitreous enamel (frit)
28995 91	Plating compounds
28995 93	Lighter fluids (cigarette, charcoal, etc.)
28995 95	Waxes (animal, vegetable, mineral, including blends), excluding pure petroleum waxes.
28995 98	Other industrial chemical specialties, including fluxes and plastic wood preparations

TABLE 3

MAXIMUM TOXIC GAS CONCENTRATION AT THE CONTROL ROOM AIR INTAKE

Chemical	Quantity[1]	Toxicity Limit	Maximum Gas Concentration at the Control Room Air Intake	Assumptions Used in the Analysis[2]
Anhydrous Ammonia (100% conc.)	150 lb cylinder @ 114 psi	35 mg/m^3	28.7 mg/m^3 17.0 mg/m^3	a,c,d,e,f,g b,c,d,e,f,g
Benzene (100% conc.)	420,000 gal.	50 ppm	7.0 ppm*	b,d,e,f,g
Ethylene Dichloride (100% conc.)	1,000,000 lb	100 ppm	0.14 ppm	a,d,e,f,g
Formaldehyde (40% conc.)	2,500,000 lb	6 mg/m^3	0.9 mg/m^3	a,d.e,g
Sulfur Dioxide (100% conc.)	2,000 lb	5 ppm	0.14 ppm	c,d,e,g

Notes: 1. Maximum chemical quantities per container when transported by barge where obtained from chemical manufacturers:

2. Anhydrous Ammonia - Macheson Chemical Co., Lyndhurst, N.J.
Benzene - Ethyl Corporation, Baton Rouge, La.
Ethylene Dichloride - Ethyl Corporation, Baton Rouge, La.
Formaldehyde - DuPont Chemical Co., Wilmington, Del.
Sulfur Dioxide - Virginia Chemicals, Portsmouth, Va.

Assumptions used in the Analysis:

a. Chemical spill is confined to the barge; height of barge = 0.5 m; spill thickness = 1.0 cm.
b. Chemical spills into the river; spill thickness = 0.2 cm.
c. Instantaneous puff release and continuous release of the remaining liquid.
d. Meteorology - F Stability and wind speed = 1.5 m/s.
e. The whole volume of the chemical is involved in the spill.
f. Continuous release with forced convection over the spill.
g. Distance from accident to control room air intake - 1.38 miles and the height of the intake above the river = 62.2 meters.

* Gas concentration after dilution in the control room air intake system.

GG
FSAR

211.176 (15.3.3.2.2) For the "recirculation pump seizure" accident, coincident loss of offsite power is not simulated with the assumed turbine trip and coastdown of the undamaged pump. Reanalyze this transient assuming coincident loss of offsite power.

RESPONSE

The event severity of a coincident loss of offsite power with the postulated recirculation pump seizure accident is bounded by the analysis of "Loss of AC Power" as shown in subsection 15.2.6. The only difference of these two events is the core flow coastdown rate. The flow coastdown rate during the pump seizure event coincident with a loss of offsite power is faster than that during the loss of AC Power transient. Coincident loss of AC power causes this accident to be a pressurization event. The faster flow coastdown for a pressurization event will result in a less severe thermal power transient due to a negative void reactivity coefficient.

The "recirculation pump seizure" accident was addressed by the Licensing Review Group-Issue RSB-21. A summary of the resolution of that issue is discussed below.

The recirculation pump seizure event is considered to be an extremely unlikely event and as such falls into the category generally classified as an accident. The event is evaluated as a limiting fault. The potential effects of the hypothetical pump seizure "accident" are very conservatively bounded by the effects of the DBA-LOCA.

This is easily verified by comparison of the two events. In both accidents, the recirculation driving-loop flow decreases extremely rapidly. In the case of seizure, stoppage of the pump occurs; for the DBA-LOCA, the severance of the line has a similar, but more rapid and severe influence. Following a pump seizure event, water level is maintained, the core remains submerged, and this provides a continuous core cooling mechanism. However, for the DBA-LOCA complete flow stoppage occurs and water level decreases due to loss of coolant, thus resulting in uncovery of the reactor core and subsequent overheating of the fuel-rod cladding. Also, complete depressurization occurs with the DBA-LOCA, while reactor pressure does not significantly decrease for the pump seizure event. Clearly, the increased temperature of the fuel cladding and the reduced reactor pressure for the DBA-LOCA both combine to yield a much more severe stress and potential for cladding perforation for the DBA-LOCA than for the pump seizure. Therefore, it is concluded that the potential effects of the hypothetical pump seizure accident are very conservatively bounded by the effects of the DBA-LOCA. The following is provided to show the impact of not taking credit for non-safety grade equipment to terminate this event.

1) Level 8 Turbine Trip

The FSAR analysis of the pump seizure event assumes that the vessel water level swell due to pump seizure will cause high water level (Level 8) trips of the main turbine and the feedwater pumps. The safety grade Level 8 trip initiates a a reactor scram directly. In the case of the pump seizure without an L8 trip, the event is less severe than the analysis in the FSAR with the L8 trip for the following reason: A pump seizure, should it occur, would result in core flow reduction which reduces the core power and surface heat flux due to the effect of the negative void reactivity coefficient. A turbine trip would cause isolation which in turn would cause void collapse and slightly increase power. Therefore, a loss of Level 8 trip would result in a less severe event consequence to the fuel than that depicted in Subsection 15.3.1.2.

2) Main Turbine Bypass System

As a result of the NRC's concern respecting reactivity effects of pressure transients, GE and the NRC met on November 20 and 21, 1978 for a comprehensive review of turbine trip and load reject transients without bypass. The principal conclusion of that meeting was that the most limiting BWR transient event which takes credit for non-safety grade equipment is the feedwater controller failure. Analysis indicates that a CPR increase of approximately 0.06 applies to this transient without a functioning main turbine bypass system.

For recirculation pump seizure with a failure of turbine bypass system, the increase of CPR would be less than that for the feedwater controller failure for the following reason. As this event occurs, the reactor power drops significantly within the first 2 seconds due to decreased core flow. Therefore, by the time of turbine trip the reactor power is at a low level. The core power is the main parameter which relates to the fuel thermal limit. The effect of failure of the main turbine bypass system to stop the steam flow retains pressure on the core but contributes only a small positive reactivity feedback. This is a secondary effect of much less significance than the reactivity decrease due to fluid flow decreasing through the core. This increase of core power is more severe for feedwater controller failure (increasing) event than for a recirculation pump failure because it occurs at a higher power level.

3) Relief Function of Safety/Relief Valves

The contribution of MCPR from taking credit for the relief function rather than the safety function of safety/relief valves is not significant because the MCPR always reaches its lowest value before opening of the relief valves.

Analyses of recirculation pump seizure where coolant flow rate drops rapidly have shown that MCPR does not decrease significantly before fuel surface heat flux begins dropping enough to restore greater thermal margins as a plant intrinsically responds to the reduced flow rate. The effect of not taking credit for non-safety grade equipment is a CPR increase of 0.06. Therefore, the MCPR for pump seizure event is still well above the safety limit of 1.06.

SER Open Item - (SEB)

Attached is the response to NRC Question 130.29 indicating that the maximum shear allowable for the concrete in containment is limited to 40 psi for all load combinations.

GG

FSAR

130.29 (3.8.1) The criteria contained in the ACI-318-71 Code used as the leading document for design of containment are not acceptable to the Regulatory Staff. The acceptable criteria for design of concrete containment are those contained in the Article CC-3000 of the ACI-359 Code with the exceptions specified in the Standard Review Plan, (SRP), Section 3.8.1.II. Examination of the FSAR shows that there are several important deviations from the SRP, e.g., load factors used in load combination equations in Normal Operating and Severe Environmental Conditions are unity for the dead load and live load although the method of analysis used was the ultimate strength design of ACI-318-71. In order to enable the staff to evaluate compatibility between the two sets of criteria, compare the criteria used in the design of the containment with those contained in the ACI-359 and the SRP in sufficient detail to establish conservativeness of the design of the containment.

RESPONSE

As referenced in subsection 3.8.1.2.2.1g, the containment is designed according to the provisions of ACI Committee 349, Title 69-2. This Code specifies ACI-318-71 to be used as a design basis, except where specifically noted. Accordingly, the design methods used for service (S) and factored (U) load combinations utilize techniques presented in ACI-318-71, as outlined in revised subsection 3.8.1.4.1.2. An exception to the above occurs in the design for tangential shear where, in addition to the method outlined in Title 69-2, an alternate method similar to that presented in the proposed ACI-359 Code is applied, and the governing results used. This approach is also outlined in revised subsection 3.8.1.4.1.2. It should be noted that since both design methods for tangential shear are systematically applied, the maximum shear allowable for the concrete is limited to 40 psi for all load combinations.

The load combination equations used in the design are those presented in ACI 349, Title 69-2, along with additional equations which cover the suppression pool dynamic loading conditions presented in Appendices 6A and 6D [GE document 22A7000 Rev. 0 (GESSAR II, Appendix 3B)].

These load combinations are an updated version of those committed to in Item 130.12 of MP&L letter AECM-76/18 to Mr. W. F. Butler, NRC, dated March 30, 1976.