TUELECTRIC

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William G. Counsil
Executive Vice President

May 27, 1988

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, D.C. 20555

SUBJECT: COMANCHE PEAK STEAM ELECTRIC STATION (CPSES)
DOCKET NOS. 50-445 AND 50-446
RESPONSE TO NRC INSPECTION REPORT NOS.
50-445/88-29 AND 50-446/88-25

REF: 1) TU Electric letter dated March 21, 1988, from Mr. W. G. Counsil to the NRC (Response to NRC IR Nos. 50-445/87-19, 50-446/87-15).

2) TU Electric letter dated April 11, 1988, from Mr. W. G. Counsil to the NRC (Response to NRC IR Nos. 50-445/87-37, 50-446/87-28).

Gentlemen:

We have reviewed your report dated April 11, 1988, which provided results of your inspection of the CPSES Design Validation Program. The inspection was conducted by the Office of Special Projects as well as NRC contractors from February 22, to March 29, 1988, at the Stone & Webster offices in Boston and Cherry Hill, and at Comanche Peak.

In accordance with your request, attached are TU Electric's responses to the Systems Interaction Program open items S-16 through S-30, Mechanical/Fluid Systems open items F-44 through F-51, and Electrical open items E-31 through E-34.

IE01
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Also, please find TU Electric's revised responses to the following open items from references (1) and (2) based on the NRC follow-up inspection conducted from April 25 through April 29, 1988, at the Stone & Webster offices in Boston:

Mechanical/Fluid Systems open items F-1, 2, 3, 4, 6, 7, 8, 10, 11, 12, 13, 15, 16, 17, 18, 19, 25, 26, 29, 30, 33, 34, 35, and 39;

Instrumentation & Controls open items I-1, 2, 4, 7, 8, 9, 11, 13, 14, 18, 20, 21, and 22;

Electrical open items E-2, 3, 9, 12, 15, 17, 18, 19, 22, 23, 25, 26, 27, and 29;

Civil/Structural open items C/S-4, 17, 18, 19, 20, 21, 22, 23, 24, 26, 28, 30, 32, 35, 40, 41, 44, 45, 53, and 54;

Systems Interaction Program open item S-7.

The revisions are denoted by a change bar in the right hand margin.

Very truly yours,

W. G. Counsil

By: John W. Beck
John W. Beck
Vice President,
Nuclear Engineering

JCH/grr
Attachment

c-Mr. R. D. Martin, Region IV
Mr. D. P. Norkin, OSP
Resident Inspectors, CPSES (3)

OPEN ITEM F-1

Document Number: Calculation 16345-ME(B)-169, Revision 0, Containment Spray Flow Rates

Calculation for NPSH in injection mode:

1. DBD-ME-232 is used to reference flowrates to other components (ECCS); however, the DBD does not delineate flow assumed in this calculation. EFE did not address.

2. 120°F RWST temperature was assumed; DBD states a 100°F RWST maximum temperature. EFE addressed.

RESPONSE

The primary source for the ECCS flow rate used in calculation 16345-ME(B)-169 was WPT-3358, "RWST Level Setpoints and ECCS Switchover" dated July 16, 1980. DBD-ME-232 was not intended to be the reference for flow rates. When calculation 16345-ME(B)-169 was being prepared, attachments from a related containment spray calculation were used as part of calculation 16345-ME(B)-169. Reference numbers were not changed to reflect the attachment and the reference for the flow value in DBD-ME-232 due to administrative errors.

New calculation 16345-ME(B)-236, which supercedes 16345-ME(B)-169 has been completed and properly references the source for the maximum allowable ECCS flow rates when determining NPSHs.

DBD-ME-232 identifies RWST water temperature correctly in the design requirements section (Section 4.3), but incorrectly in Section 5.3. RWST temperature in Section 5.3 has been corrected to 120°F, in Revision 1 of DBD-ME-232.

SIGNIFICANCE/EXTENT

The attachment which was the source of the incorrect reference was only utilized for this calculation. Therefore, the use of an incorrect reference identified in the open item is limited to this calculation and is considered isolated. This was an administrative error and had no safety significance.

An inconsistency in maximum flow rates between DBD-ME-260 and Westinghouse letter WPT-3358 was noted during the NRC inspection. This inconsistency is due to the DBD stating a single train flow requirement whereas the Westinghouse letter addressed two train operation. The Westinghouse letter is the appropriate input for the subject calculation. No document changes are necessary.

The inconsistency between RWST temperatures identified in the open item is not a safety concern because the correct temperature was used in the calculations. However, the open item is relevant to other mechanical DBDs. DBD Sections 1 through 4 (which describe system design basis criteria) were being revised at the time the open item was identified. DBD Sections 5 through 10 (which describe how the system meets the design criteria) are scheduled to be updated to reflect the results of the validation effort by June 30, 1988.

OPEN ITEM F-2

Document Number: Calculation 16345-ME(B)-169, Revision 0, Containment Spray Flow Rates

Calculation for NPSH in recirculation mode utilizes 120°F sump suction temperature. This violates Regulatory Guide 1.1, which requires utilization of maximum containment sump water temperature (>212°F). EFE was apparently insensitive to LOCA conditions and instead addressed the RWST temperature as pertaining to the recirculation mode.

RESPONSE

The maximum RWST temperature was used instead of the maximum containment sump water temperature. The calculation has been superseded by 16345-ME(B)-236, which calculates NPSH in accordance with the CPSES position on Regulatory Guide 1.1 as stated in the FSAR Appendix 1A(B) (CPSES position is that the containment pressure is equal to the vapor pressure of the sump water). This error is attributed to an isolated oversight on the part of a qualified and experienced checker and independent reviewer of calculation 16345-ME(B)-169. Adequate NPSH exists for the Containment Spray Pump in the recirculation mode as shown in completed calculation 16345-ME(B)-236.

SIGNIFICANCE/EXTENT

There is no safety concern since adequate NPSH is demonstrated in calculation 16345-ME(B)-236. Use of improper sump temperature in determining NPSH is isolated to this case. The other ECCS systems which take suction from the sump have been evaluated in accordance with Regulatory Guide 1.1 as stated in FSAR Appendix 1A(N).

OPEN ITEM F-3

Document Number: Calculation 16345-ME(B)-169, Revision 0, Containment Spray Flow Rates

Containment Spray pump minimum flow is defined (750 GPM). However, maximum allowable flow should also be defined for comparison to both this calculation and startup flow calculation. EFE did not address.

RESPONSE

Calculation 16345-ME(B)-236, which superceded calculation 16345-ME(B)-169, calculates the maximum steady state flowrate during injection and recirculation modes to be below 4000 gpm per pump. Therefore, the calculated maximum flow in calculation 16345-ME(B)-236 can be met by the pump.

Calculation 16345-ME(B)-276 determines the maximum flowrate during the fill transient to be 5100 gpm per pump.

The Best Efficiency Point (BEP) flowrate for this pump is 4250 gpm. The transient fill flowrate of 5100 gpm is 20 percent greater than the BEP flowrate which is within the normal band for stable pump operation. This judgement has been confirmed by the vendor, Bingham-Willamette.

The pump and its motor have been evaluated for this transient flowrate and documented to be acceptable in calculation 16345-ME(B)-276.

SIGNIFICANCE/EXTENT

There is no safety concern since the pump/motor can withstand this transient.

OPEN ITEM F-4

Document Number: Calculation 16345-ME(B)-169, Revision 0, Containment Spray Flow Rates

Containment Spray flow analysis neglects spray additive eductor hydraulics. EFE did not address.

RESPONSE

The eductor was not modeled because its contribution to the flowrates was judged to be negligible. There is no impact on the calculation results and the engineering judgement is correct although not documented in Calculation 16345-ME(B)-169. Eductor flow rates have been included in Calculation 16345-ME(B)-236 which supersedes 16345-ME(B)-169 and acceptable results have been achieved.

SIGNIFICANCE/EXTENT

There is no safety concern since acceptable results are achieved in calculation 16345-ME(B)-236. This open item is limited to the containment spray eductors (calculations 16345-ME(B)-169 and 16345-ME(B)-057) which are the only safety-related eductors.

These calculations have since been superseded by calculation 16345-ME(B)-236 and calculation 16345-ME(B)-276.

OPEN ITEM F-6

Document Number: Calculation 16345-ME(B)-169, Revision 0, Containment Spray Flow Rates

Attachment B - Pipe and Fitting Losses

Page B4 - Combining flow path resistances in parallel (equivalent header resistance calculations) - Calculation method given is only valid for parallel flow paths originating and discharging to the same HGL (Hydraulic Grade Line). Spray header parallel flow calculations originate at the same node, but discharge to nodes having different HGL. EFE addressed this.

Page B3 - 24" suction header, CS/ECCS flow is 26,000 GPM per reference 7/page 4, but the reference does not give this flow rate. EFE did not address.

Page B3 - RWST Sparger is not accounted for in the hydraulic resistance calculations. EFE did not address.

RESPONSE

Page B4 - This calculation used a combined equivalent flow path to calculate head loss. Spray header elevation differences need not be taken into account because it was assumed that the balancing orifices in each of the spray header risers are sized to counteract the effects of different elevations. Calculation 16345-ME(B)-236, which supersedes calculation 16345-ME(B)-169, addresses header elevation differences by using the most restrictive header flow path.

Page B3(1) - This item is identical to Open Item F-1, No. 1.

Page B3(2) - Calculation 16345-ME(B)-169 did account for RWST sparger hydraulic resistance by stating in the engineering judgement that it was negligible. Calculation 16345-ME(B)-236 models sparger hydraulic resistance. This calculation shows that NPSH during injection for the containment spray pumps is adequate and that the hydraulic resistance effects due to the sparger are negligible.

The vendor has confirmed that the values used in the calculation for "NPSH Required" are correct.

SIGNIFICANCE/EXTENT

The open items relate to the technical justification for calculation assumptions and methods and are limited to calculation 16345-ME(B)-169 and calculation 16345-ME(B)-057. Revised calculations 16345-ME(B)-236 and 16345-ME(B)-276, which address these open items, verify that the calculation results are correct.

OPEN ITEM F-7

Document Number: Calculation 16345-ME(B)-169, Revision 0, Containment Spray Flow Rates

Attachment C

Page C29 - Heat exchanger K factor of calculation. 14.12 PSID is based on a velocity of 9.5 feet/sec. It is not clear whether this relates to pipe velocity, heat exchanger tube velocity or some other basis. This was not addressed by EFE.

Page C97 - Sump Suction Path

(EFE addressed some of the below items.)

- No containment sump recirculation screen pressure drop is accounted for; however, G&H Sump Performance Study assumes .4 feet head loss.

- There is no piping inlet loss factor for the protruding sump suction pipe.

- The calculation refers to a 16 x 16 x 12 tee with no flow in the run, giving a loss factor of 0.26. This loss factor appears low, and it also appears that there is flow in the run.

- The suction piping includes a transition involving both 16' x 3/8" wall pipe and 16" SCH 120 pipe. The size transition expansion and contraction losses should be accounted for.

- Hydraulic losses for only one suction path are given in the calculation. Friction losses for the other path should be calculated.

It is noted that the frictional components delineated above, although individually relatively insignificant, are collectively important due to the small NPSH margin available for the recirculation mode (i.e., >212°F temperature).

RESPONSE

Page C29- A "K" factor of 24 was calculated based on the data given on the heat exchanger data sheet (7200 GPM, DP = 14.12 psid, V = 9.5 ft/sec.). The velocity of 9.5 ft/sec is the tube velocity. The difference between the tube velocity and pipeline velocity is small, making the results acceptable. However, a complete description of the approach used was not provided. Calculation 16345-ME(B)-236, which supersedes calculation 16345-ME(B)-169, used an alternate approach in determining friction loss coefficients and has been completed with acceptable results.

OPEN ITEM F-7

RESPONSE (Continued)

Page C97 - Containment sump screen DP, pipe entrance losses, and expansion/contraction losses from 16" - SCH 120 pipe transition to 16" - 3/8" wall pipe were not included in the calculation due to their expected insignificant contribution to total head loss and the margin in the final (but not determined) result based on the conservative sump water level assumption used in calculation 16345-ME(B)-169. However, these items have been included with acceptable results in calculation 16345-ME(B)-236, which supersedes calculation 16345-ME(B)-169.

The "K" factor of 0.26 is for flow through a tee run. The correct K factor for flow through the tee branch has been included in calculation 16345-ME(B)-236 with acceptable results.

Hydraulic losses were calculated in calculation 16345-ME(B)-169 for train "A" only. A similarity analysis was performed (subsequent to the audit) to compare train "A" to train "B" and the differences have been evaluated with respect to NPSH. Calculation 16345-ME(B)-236, which supersedes 16345-ME(B)-169, addresses similarity with acceptable results.

Calculation 16345-ME(B)-236 collectively addresses these and all related findings. The vendor has confirmed that the values used in the calculation for "NPSH Required" are correct. Acceptable results have been achieved.

SIGNIFICANCE/EXTENT

This open item relates to the technical justification of calculation methods and assumptions. There is no safety concern as shown in calculation 16345-ME(B)-236. The open item is limited to calculation 16345-ME(B)-169 and calculation 16345-ME(B)-057.

Revised calculations 16345-ME(B)-236 and 16345-ME(B)-276, which address this open item, verify that the calculation results are correct.

OPEN ITEM F-8

Document Number: Calculation 2323-535, Revision 0, RWST Sparger Sizing (Suction Line)

The calculation relies heavily on Reference 1 (Gould Pump Manual) Figure 5 to determine sparger submergence requirements but does not establish the applicability of this manual to the actual sparger configuration (82 suction holes in close proximity) and the flowrates involved.

The calculation results require a 12" minimum horizontal distance from sparger suction holes to the free surface of the borated water to preclude air entrainment. However, suction holes located at the extreme ends of the sparger (Brown & Root drawing BRP-S1-1-YD-001, Revision 16) do not meet this requirement.

RESPONSE

Calculation 2323-535 was validated based on the low level setpoint assuring 5 feet of water above the sparger. The responsible engineer's review copy states this, but this information was not added to the calculation validation record. Confirmation required based on the results of the review of calculation 2323-522 was included on the validation record.

Calculation 2323-522 was later superseded by calculation 16345-ME(B)-124, which calculates a lower setpoint. During the process of removing confirmation required from the calculation validation record for G&H Calculation 535, it was determined that verification of the adequacy of the Gould Pump Manual assumption was required.

Based on the results of this verification, the calculation record was revised and an evaluation of the sparger design was performed. This evaluation is contained in calculation 16345-ME(B)-282. The evaluation concludes that sufficient sparger submergence exists to prevent vortexing (air entrainment).

The calculation validation record for calculation 2323-535 is scheduled to be completed by October 30, 1988.

SIGNIFICANCE/EXTENT

There is no safety concern because sufficient sparger submergence exists to prevent vortexing in this case. Calculation 16345-ME(B)-172, "CST-Critical Depth for Vortex Flow" documents acceptable submergence for the auxiliary feedwater pumps regarding vortex formation. The Reactor Makeup Water Storage Tank (RMWST) will also be evaluated for acceptable submergence.

OPEN ITEM F-10

Document Number: Calculation 16345-ME(B)-096, Revision 0, Containment Spray Heat Exchanger Convection Coefficient

It appears that the 80 percent fouling allowance used for the containment spray heat exchanger calculations results in an overall heat transfer coefficient about 30 to 40 percent higher than the heat transfer coefficient obtained with use of Westinghouse RHR system design fouling allowance. Note that the containment spray and RHR heat exchangers utilize the same fluids on both sides. S&W should either justify the fouling allowance difference for the two heat exchangers or assess the impact of using the higher fouling allowance for the containment spray heat exchanger.

DBD-ME-232 contains numerical discrepancies (Section 10.3.3) with respect to velocities, flowrate and pressure drop for the containment spray heat exchanger.

RESPONSE

As a result of this item, a more conservative fouling factor, rather than the 80 percent cleanliness factor, was used as input in calculation 16345-ME(B)-283 which superseded calculation 16345-ME(B)-096. This new fouling factor was then used to evaluate containment spray heat exchanger capacity to ensure that containment heat removal and depressurization requirements were met.

At the time of this inspection, Section 10.3.3 of DBD-ME-232 had not been fully developed. Numerical information on the heat exchanger will be evaluated during the confirmation phase of component validation for the heat exchanger. Any discrepancies in the DBD will be corrected during reconciliation of DBD Sections 5-11 (June 30, 1988).

SIGNIFICANCE/EXTENT

The concern is limited to the Containment Spray, Spent Fuel Pool Cooling, and Component Cooling Water Heat Exchangers. Each of these heat exchangers is being reevaluated using a conservative fouling factor. The conservative fouling factor being applied to the CCW heat exchangers is addressed in detail in the response to Item F-33.

OPEN ITEM F-11

Document Number: DBD-0206, Auxiliary Feedwater System

Referenced Codes and Standards:

The Design Basis Document for this system does not adequately reference applicable codes, regulatory requirements and design guidance documents applicable to this system's design. USNRC Standard Review Plans are not referenced. Further, reference to all relevant design guidance documents, such as applicable NUREG documents, IE Bulletins, INPO Experience Reports, etc., should be made within those sections of the Design Basis Document which derive their technical requirements from these documents. This Design Basis Document references FSAR section extensively. However, the FSAR should not be considered as a source for system design basis.

RESPONSE

DBD-ME-206, Revision 1, has been issued which references all relevant design guidance documents for design criteria in Sections 1 through 4. The documents that were reviewed included but not limited to applicable NUREG documents, IE Bulletins, and INPO Experience Reports from which the technical requirements are derived. Those documents which result in design requirements to the system have been included in Section 4.0. Other relevant documents will be listed in Section 11.0 when Revision 2 of the DBD is issued. However, the FSAR may contain licensing commitments not reflected in other source documents and as such is reviewed for relevant design criteria.

DBD-ME-206 is scheduled to be revised by June 30, 1988.

SIGNIFICANCE/EXTENT

The open item is relevant to all mechanical DBDs. Sections 1 through 4 (Criteria Sections) were being revised at the time the open item was identified. All DBDs have been reissued with design criteria which do not refer to the FSAR directly.

OPEN ITEM F-12

Document Number: DBD-0206, Auxiliary Feedwater System

System Function:

The Design Basis Document describes the system requirement to provide a minimum flowrate to steam generators. However, there is no discussion of the anticipated variation in flow demand, and possible control valve operational deficiencies which may surface due to the character of steam generator level response during hot standby and cooldown conditions.

The Westinghouse Steam Systems Design Manual (SIP 10-1), Appendix A, page A33 lists a criterion that auxiliary feedwater regulation "...valves be equipped with safety grade accumulators of sufficient capacity to permit operation of valves for the maximum number of anticipated cycles of operation..." While this Westinghouse manual is not currently referenced in the Design Basis Document, it is noted that accumulators are sized to provide five valve cycles during a 30 minute period allotted before manual local modulation of auxiliary feedwater valves is assumed (DBD Section 4.3.2.3).

There is no documented evidence that five valve operating cycles is adequate for the intended service. The concern here is the anticipated large level swings which may occur in hot standby conditions when safety relief valves lift and reseat. For some plants this level swing can cause level indications off-scale high or low, which in turn may induce the operator to attempt AFW flow control actions more frequently than the installed air accumulators allow. These phenomena should be technically addressed and operational cautions established if warranted.

RESPONSE

On pages 5-4-7 and 5-4-10 of SIP 10-1, Westinghouse recommends that accumulators "Permit remote valve closure for isolation of a secondary system pipe break within the required time period following an incident." For CPSES, based on system design and mass/energy release to the containment, these valves do not need to be cycled any earlier than 30 minutes following an incident. Since CPSES Operations has committed to achieving local operation at 30 minutes after an incident, the accumulators are not required to cycle the valves, only shut them once. All subsequent valve operation will be accomplished by local manual control. Westinghouse confirms that there are no additional cycle requirements for these control valves. The five cycles have been utilized in the accumulator sizing calculations, even though the valves are not required to be cycled at all during the first 30 minutes after the accident.

The concern regarding anticipated large steam generator level swings that may occur in hot standby conditions when safety relief valves lift and reseat is not applicable for CPSES. Westinghouse has provided verification, via letter WPT-9903, that the CPSES model D4 and D5 steam generators will not experience large level swings during this condition.

DBD-ME-206, Section 5, will be revised to reflect this design by June 30, 1988. This item has previously been addressed by TU Electric Technical Evaluation Report TSR-87-28.

OPEN ITEM F-12 (Continued)

SIGNIFICANCE/EXTENT

There is no safety concern. Sections 1 through 4 of the mechanical DBDs were being revised at the time the open item was identified. Sections 5 through 11 are scheduled to be updated to reflect the results of the validation effort by June 30, 1988.

OPEN ITEM F-13

Document Number: DBD-0206, Auxiliary Feedwater System

Operating Modes:

Section 5.2.1A of this DBD states that Auxiliary Feedwater System operation is discontinued once "...67 percent steam generator level is maintained...".

It should be made clear if this statement applies to the narrow or wide range level instrumentation, and if the same values are applicable to Units 1 and 2, since level spans for each unit are different.

Section 5.2.2A indicates that the Auxiliary Feedwater System is used during LOCA "...to prevent primary to secondary leakage..". This statement should be modified to factor in purposes presented in the Westinghouse Steam Systems Design Manual, SIP 10-1 (heat removal and radiological concerns).

In Section 5.2.2 B&C it is stated that a steam line break or feedwater line break is "...initiated by..."; "indicated by" are apparently the intended words.

Section 5.2.2.C implies that a feedwater line break will be indicated by low steam generator levels, although a single line break of intermediate size may not cause these conditions. It is also noted that there is no discussion of the loss of offsite power operating condition, or station blackout considerations. The applicable spectrum of postulated accidents and resulting indications/actions should be addressed to determine enveloping scenarios for system design.

RESPONSE

Sections 5.2.1A, 5.2.2B, and 5.2.2C - These items have been identified by TU Electric Technical Evaluation TSR 87-28. These items will be corrected in the next revision of Auxiliary Feedwater DBD-0206, scheduled for completion by June 30, 1988.

Section 5.2.2A - The wording of Section 5.2.2A, which is taken directly from the Westinghouse Steam Systems Design Manual, SIP 10-1, describes an additional function of the auxiliary feedwater system during a LOCA when steam generator tube leaks are present. The heat removal functional requirements of the Auxiliary Feedwater System are described in Section 2.2 of the DBD.

Section 5.2.2C - The wording of Section 5.2.2C will be revised to clarify that only a large feedwater line break will be indicated by low steam generator levels.

The next revision to the DBD will include a discussion of auxiliary feedwater operation for the applicable spectrum of postulated accidents.

SIGNIFICANCE/EXTENT

The descriptive sections of all DBDs (Sections 5 through 11) will be reviewed for completeness of operating mode conditions and revised as necessary to reflect the results of the validation effort by June 30, 1988.

OPEN ITEM F-15

Document Number: Calculation 16345-ME(B)-006, Auxiliary Feedwater System Instrument Setpoints

A pressure switch located on the pump suction piping is used to indicate low suction pressure and trip the applicable pump to protect the pump from damage. In the calculations to determine switch setpoints, errors were found due to lack of use of appropriate units. For example:

On Page 11, suction pressure is correctly calculated as 46.11; however, units of absolute feet are omitted.

46.11 feet absolute is converted to PSIA correctly (46.11 * 61.7/144 = 19.76 PSIA). However, this value is incorrectly labeled "Ft."

The 19.76 value is incorrectly converted to "PSIG" by multiplying by 0.43.

RESPONSE

Calculation 16345-ME(B)-006 mistakenly labels 19.76 PSIA as 19.76 ft. The resultant conversion to PSIG is incorrect. As a result of this error the calculated setpoint was more conservative than the correct setpoint. This calculation was revised to correct this setpoint.

In addition, the AFW pump trip on low suction pressure has been deleted by approved DCA 58826, dated October 9, 1987. Calculation 16345-ME(B)-006 has been revised to delete AFW pump trip on low suction pressure.

SIGNIFICANCE/EXTENT

There is no safety concern since the calculated setpoint is conservative. Other calculations prepared by the same engineer were reviewed for similar items. No similar items were identified in these calculations. Therefore, this open item is considered isolated.

OPEN ITEM F-16

Document Number: Calculation 16345-ME(B)-026, Auxiliary Feedwater System Instrument Setpoints

If pump flow approaches a minimum value, a recirculation path must be opened to avoid pump damage or undesirable vibrations within the system. Control actions for pump recirculation valves utilize flow settings which will require orifice differential pressure instrument repeatability on the order of .01 PSID (for an instrument rated at several PSID and instrument pressure rating of thousands of PSIG). System flow latitude margins may need to be relaxed to allow less restrictive instrument requirements. The team understands that this should be resolved in the normal mechanical/I&C interface which had not been completed at the time of the review.

RESPONSE

As part of the normal Mechanical/Instrumentation & Controls interfaces, the Instrumentation & Controls Group uses mechanical setpoint calculations as input to determine the actual instrument setpoints. If it is determined that the proposed setpoint cannot be accommodated with the instruments that have been installed, the mechanical calculation is revised to accommodate the actual instrument's range while still accomplishing the required function.

For the applicable instruments, FB-2456/2457, the Mechanical/Instrumentation and Controls interfaces have been resolved. The instrument setpoint calculations, 16345-IC(B)-059/060, have been issued.

SIGNIFICANCE/EXTENT

There is no safety concern because the instrument setpoints can be accommodated with the installed instruments while still accomplishing the required function.

OPEN ITEM F-17

Document Number: Calculation 16345-ME(B)-053, Auxiliary Feedwater System Performance

Several design basis items were not adequately addressed within the calculations:

For all evaluated cases of a faulted steam generator, friction of high energy piping upstream of the steam generator was included in the calculations. This causes nonconservative spill flowrates with respect to CST inventory requirements and pump runout flowrates.

The DBD states that maximum runout flow of 700 GPM is precluded by flow restricting orifices within the system. This calculation indicates flowrates exceeding this value. When actual pump retesting is performed, test data should be obtained for operating points beyond all normally expected flowrates to verify acceptable pump operations, NPSH, etc.

The DBD presents pump test head/capacity acceptance criteria. This condition represents a worn pump that provides less capacity than the original new pump. The calculations are performed with new pump test curve input data, and do not illustrate that pumps meeting the DBD acceptance criteria will meet system function criteria. Allowable pump wear margins, and pump periodic testing acceptance criteria should be factored into the subject system performance calculation.

In addition, the calculation did not account for the pressure loss due to the steam generator inlet sparger pipe.

RESPONSE

The following response address the four items noted above in the same order:

a. Although the friction losses upstream of the steam generators were judged to be inconsequential, calculation 16345-ME(B)-053 was revised to include this term. The new flowrate is 0.08% greater than the original flowrate. There is no impact on containment overpressurization or CST inventory.

   The results of the reanalysis confirms the initial assumption.

b. The calculation is correct. Sections 5 through 11 of DBD-ME-206 will be revised to reflect the calculation results by June 30, 1988. Also, manufacturers data or pump test data will be referenced in the DBD to identify the correct pump runout flow.

OPEN ITEM F-17

RESPONSE (Continued)

c. Calculation 16345-ME(B)-053 was performed to determine system performance with new pumps only. As part of the SWEC CAP validation program, the surveillance requirements of the Technical Specifications are reviewed. As part of this program, Technical Specification 3.7.1.2, Requirement 4.7.1.2 which addresses acceptable minimum auxiliary feedwater pump performance was validated. It is this validation record (No. 1-11H-T-0018) that specifically addresses pump wear. Validation record 1-11H-T-0018 identifies the need for an additional calculation to be performed. Upon completion of this additional calculation (16345-ME(B)-241), the Technical Specification and the descriptive section of the DBD will be revised to reflect the verified acceptance criteria.

d. Per Westinghouse Drawing 1105J07, there is no sparger on the auxiliary feedwater inlet of the steam generators. It is an open path; therefore, the exit loss is one (1) per Crane Technical Paper No. 410. Calculation 16345-ME(B)-053, Revision 0, uses the value "1" for this loss.

Calculation 16345-ME(B)-241 has been completed.

SIGNIFICANCE/EXTENT

There is no safety concern since the calculations verify that the Auxiliary Feedwater System can meet its performance requirements. As part of the review of CPSES Technical Specifications and the CPSES retest procedures for safety systems, acceptance criteria are established by calculation and test results are reconciled.

OPEN ITEM F-18

Document Number: Calculation 16345-ME(B)-054, Auxiliary Feedwater Pump NPSH

The calculation utilizes pump rated flows for NPSH requirements instead of maximum expected flows, such as would occur just before pressure is reached which allows use of the RHR system.

For the case of spill flow to a faulted steam generator, common suction piping would experience flowrates in excess of those assumed for this analysis (see Run 4A).

RESPONSE

For conservatism, calculation 16345-ME(B)-054 was revised to use pump flow rates for the case which includes spill flow to a faulted Steam Generator. Sufficient NPSH margin exists.

SIGNIFICANCE/EXTENT

There is no safety concern because the use of pump flow rather than maximum expected flow is conservative.

OPEN ITEM F-19

Document Number: Calculation 16345-ME(B)-143, Maximum Pressure Differential for MOV's

The calculation provides static differential pressures across the valves only. It does not address the transient pressure rise which occurs during valve closure due to deceleration of a fluid column.

The BWR Owners Group Report on Operational Design Basis of Selected Safety Related Motor Operated Valves, draft dated August 1986, General Electric NEDC No. DRF-E12-00100-75 serves as an example of the type of analysis which utilizes transient valve differential pressure build-up methods.

RESPONSE

Calculation 16345-ME(B)-143 was performed to provide input to TU Electric's Motor Operated Valve (MOV) testing program, which was implemented in response to IEB 85-03. Representative CPSES motor operated valves will be stroke tested while subjected to as near the maximum operating differential pressure (dp) and fluid flow conditions as is practicable to achieve. Where test parameters do not conservatively represent required flow paths and conditions, an analysis will be performed to address the effects due to the physical parameters that influence the results. The actual dp against which the valve is stroked will therefore be the sum of the applied steady-state dp plus the resulting transient dp rise. In-line pressure gauges will be used to measure the steady-state dp after the valve is closed. Special MOV test equipment will be used to measure the stem thrust required to close against the sum of steady-state dp plus the transient dp rise (TDPT). If the tested steady-state dp value (DPT) is less than the calculated maximum operating steady-state dp value (DPR), then the stem thrust to close against the sum of the DPR plus the resulting transient dp rise (TDPR) will be calculated by straight line extrapolation. If the tested steady-state dp is the maximum achievable by the system for the most severe system configuration within the plant design basis, the value of DPR may be reduced to DPT. This reduces TDPR to TDPT and eliminates the need for extrapolation.

The above information was previously transmitted to the U. S. Nuclear Regulatory Commission by TU Electric letter TXX-88381 dated April 8, 1988.

Although the magnitude of transient dp rise is neither measured nor included in the value of DPR, the test method described above will result in MOV torque switch settings which reflect the actual transient dp rise. Further, since the effective pipe length from the MOV to either the source of supply or the system discharge location is relatively short in pressurized water reactors, the actual value of the transient dp rise should be small relative to the steady-state dp. (This is supported by General Electric Report NEDC-31322 dated September 1986). Other factors which serve to minimize the transient effect include the relatively slow closing times (5-10 seconds) and low flow velocities.

OPEN ITEM F-19

RESPONSE (Continued)

It is also expected that the actual value of the transient pressure rise will be less than that value which could be calculated using the methodology presented in General Electric Report NEDC-31322. This is so since the method of calculation prescribed by General Electric does not consider plant specific conditions such as system energy loss due to piping configuration and component design. Plant specific effects were calculated for Detroit Edison Company's Enrico Fermi, Unit 2. The results of this analysis, provided to the NRC, showed that the actual transient dp rise was significantly less than that predicted by the General Electric method.

SIGNIFICANCE/EXTENT

There is no safety concern. The CPSES program to satisfy the requirements of IE Bulletin 85-03 adequately addresses the transient pressure rise which occurs during valve closure due to deceleration of a fluid column.

OPEN ITEM F-25

Document Number: Calculation 16345-ME(B)-073,
Component Cooling Water Surge Tank Volume

The calculation states (pg. 41) "That there is not adequate expansion volume between HI level and HI HI level; however, it is not a critical design parameter." Apparently no further action was taken.

It is noted that the HI HI alarm setpoint is designated to alert the operator that there is potentially as little as 16 seconds to determine which CCW train is experiencing inleakage, and to isolate the affected CCW loop, this conflicts with the above conclusion on page 41. The calculated liquid expansion may result in the violation of the DBD Section 5.4 criteria prohibiting crossover flow.

RESPONSE

As discussed in Open Item F-24, certain differential volumes between CCW surge tank setpoints, including the volume discussed above, were analyzed for information only, and therefore do not have acceptance criteria. There is no specific time requirement to determine which CCW train is experiencing inleakage. The effects of crossover flow on system performance have been evaluated and it has been determined that crossover flow is not detrimental to the proper operation of the system.

Sections 5-11 of the DBD will be revised to delete the prohibition of crossover flow when it is updated to incorporate the results of the validation (6/30/88).

In the next revision of the calculation (6/30/88) the revised DBD criteria will be referenced and the informational analysis will be deleted.

SIGNIFICANCE/EXTENT

There is no safety concern because the safety-related system performance criteria are met.

OPEN ITEM F-26

Document Number: Calculation 16345-ME(B)-073,
Component Cooling Water Surge Tank Volume

The calculation states (pg. 40) that the volume allowance between LO level and HI level should be sized for volume fluctuation during normal plant operations. 465 gallons is provided; however, no basis or numerical calculation justifies this volume.

The calculation shows (pg. 40) volume changes between LO level, LO LO level, and Empty setpoints as several hundred percent in excess of stated requirements. It may be possible that the liberal margins between these setpoints could be utilized between level setpoints where inadequate capacity exists (Open Item F-25), i.e., by revising setpoints.

RESPONSE

The criteria for the volume allowance between HI and LO level is not safety-related. In view of the 1 gpm system leakage rate determined earlier in the calculation, no additional justification for the 465 gallon volume allowance was deemed necessary. As discussed in Open Item F-24, all safety-related design criteria for the CCW surge tank have been met.

The margins provided between the LO, LO-LO and Empty level process setpoints are required for instrument accuracy considerations.

SIGNIFICANCE/EXTENT

There is no safety concern because the safety related level setpoints appropriately consider instrument inaccuracies.

OPEN ITEM F-29

Document Number: Calculation 16345-ME(B)-094, Determination of Minimum Pressure in Air Receiver Tanks to Provide 5 Diesel Starts

The calculation does not address additional air consumption that will occur during first start attempts with high inlet air pressure and resulting increased air density.

The calculation is based on requirements of the manufacturer, 2.1 seconds cranking time, whereas the DBD and SRP require consideration of a longer cranking interval (3 seconds per start attempt). This longer interval results in a minimum initial air receiver pressure of approximately 250 psig vs. 220 psig delineated in this calculation. The calculation should use the largest air start requirement, in accordance with the SRP and DBD.

RESPONSE

The calculation was only intended as a rough check of the air receivers as sizing of the receivers is within the diesel generator vendor's scope.

Vendor test data indicates that the diesel started 12 times with an initial receiver pressure of 252 psig and a final pressure of 124 psig (five times with an initial receiver pressure of 210 psig and a final pressure of 156 psig).

The CPSES commitment (FSAR Section 9.5.6.2) is that each air receiver is sized to contain enough air for five starts of the diesel generator. The CPSES SER confirms this position. This sizing criterion ensures that the diesel generator has adequate starting air on demand by providing five times the air required to start the diesel once. Preoperational testing was performed in the field to confirm the diesel generator air receiver capability by starting the diesel five times from an initial pressure of 250 psig to a final pressure of 154 psig (1CP-PT-29-05). CPSES is not committed to SRP requirements. The calculation has been voided and DBD-ME-011 will be revised to clarify this requirement by June 30, 1988.

Based on the information provided above, the CPSES diesel generator air receiver capability was verified by shop and field tests.

SIGNIFICANCE/EXTENT

There is no safety concern because the diesel generator start capability was verified by shop and field tests.

OPEN ITEM F-30

Document Number: Calculation 16345/6-ME(B)-228,
Spent Fuel Pool Cooling and Cleanup System Instrument
Setpoint Calculation

The fuel pool cooling pump discharge low pressure alarm setpoint is based on the pump reaching "runout" flow discharge pressure conditions. This condition is not relevant to system functional requirements of providing at least 3600 GPM system flow. The alarm setpoint should be based on the minimum pump discharge pressure which will provide minimum flowrate within the system.

The setpoint calculation considers only pump total dynamic head pressure. The calculation needs to consider pump inlet pressure (static head minus suction piping losses) to determine pump discharge pressure.

RESPONSE

The purpose of this alarm is to provide indication that the operating pump has stopped, malfunctioned or that the pump is approaching runout due to abnormal system conditions. It is not provided to monitor flow since other flow indication is provided (low flow alarm).

The calculation has been revised to include inlet pressure in the pump discharge low pressure alarm setpoint determination.

SIGNIFICANCE/EXTENT

There is no safety concern because the low pressure alarm does not perform a safety function.

OPEN ITEM F-33

Document Number: Calculation 16345/6-NU(B)-023,
Ultimate Heat Sink and Maximum Sump Temperature

Nominal fouling conditions were assumed in accordance with the heat exchanger data sheet. The "80% cleanliness allowance" used to determine this unit's performance is unrealistic, and results in a non-conservative heat transfer coefficient for the component cooling water heat exchanger which is about 65% higher than the value obtained by use of industry accepted standard fouling factors (Section 2.3, TEMA Standards). The heat exchanger cleanliness dictated by the analysis will be difficult to continuously maintain. It is noted that CPSES calculation 0509-2 shows a Langelier's index of 1.45 and Rynar index of 4.7, both of which indicate moderate to heavy scaling tendency in the service water system heat exchanger tubes. Even if one assumes a very minimal fouling resistance for this heat exchanger, such as the fouling resistance associated with the very clean deionized primary reactor water of the RHR heat exchanger, the overall heat transfer coefficient obtained is lower than the heat transfer coefficient used as input to this analysis. This illustrates the unrealistically high cleanliness assumed in this analysis.

RESPONSE

The calculations have been revised to use a more realistic fouling factor of 0.0003 for both sides of the CCW heat exchanger surface. The data was selected from HEI Standard for Power Plant Heat Exchangers. This value, coupled with the monitoring program described below, is considered adequate for the evaluation of the existing design to ensure that the necessary heat removal capability exists. These factors will be used in lieu of the nominal 80 percent value in the next revision to calculation 16345/6-NU(B)-023, which evaluates the combined effects on CCW maximum temperature. The calculation also considers the effects described in Open Items F-34, F-35, and F-42. In addition, this calculation maximizes CCW temperature by choosing design inputs (flows, temperatures, single train operation, etc.) such that the results are conservative.

The results indicate that the maximum CCW temperature is acceptable with respect to the design ratings of the cooled components.

During normal plant operations, a monitoring program will be implemented by TU Electric to evaluate the CCW heat exchanger capability. The appropriate heat exchanger cleaning will be accomplished to ensure that the degree of fouling during inservice conditions does not decrease the heat transfer capability to unacceptable levels.

SIGNIFICANCE/EXTENT

As discussed in the response to Open Item F-10, each of the affected heat exchangers is being reevaluated using a conservative fouling factor. These evaluations have been completed and Calculation 16345/6-NU(B)-023 has been revised.

OPEN ITEM F-34

Document Number: Calculation 16345/6-NU(B)-023,
Ultimate Heat Sink and Maximum Sump Temperature

For the residual heat removal heat exchanger, which also provides heat flux into the component cooling water system, the heat exchanger is correctly assumed to be in the clean condition. However, adjustments have not been made to account for increased flowrate on the tube side of the exchanger.

The higher operating temperature for the analysis also causes an increase in the heat transfer coefficient; this has not been accounted for. The heat transfer coefficient should be about 25% higher than the value used as input for the analysis. This discrepancy causes results in the non-conservative direction.

RESPONSE

The original purpose of calculation 16345/6-NU(B)-023 was to determine the total integrated heat which was rejected to the ultimate heat sink over a 30 day time period. The original objective of the analysis was later expanded to include the development of the maximum outlet temperature of the component cooling water (CCW) heat exchanger. However, the maximum RHR system flow rate was not used.

Calculation 16345-ME(B)-316, Revision 0, has been developed to determine the heat exchanger coefficient (UA) for the RHR exchanger based on a clean heat exchanger, maximum RHR system flow rates, and maximum containment sump temperature. The results from this calculation were used as input into Revision 1 of 16345/6-NU(B)-023.

SIGNIFICANCE/EXTENT

There is no safety concern because the effect of the conservative RHR heat exchanger parameters now used as input into the integrated heat load analysis is negligible. The revised analysis has a slight effect on maximum CCW temperature; however, the revised temperature is acceptable.

OPEN ITEM F-35

Document Number: Calculation 16345/6-NU(B)-023,
Ultimate Heat Sink and Maximum Sump Temperature

Heat flow into the component cooling water system from other miscellaneous sources is listed as 5.146 million BTU per hour. This value does not include pump energy input of 1000 horsepower. This load should be increased to 7.691 million BTU per hour.

Resolution of the above discrepancies may result in an increase of cooling supply temperature to 150°F, and maximum return temperatures to 200°F. Such results need to be evaluated for potential overheating of safety related equipment.

Open Items F-33 through F-35, taken together, are significant due to their cumulative potential for overheating safety related equipment. These items are related to Open Item F-10 (previous inspection) concerning the containment spray heat exchanger heat transfer coefficient. Appropriate corrections should be made to other containment cooling/ultimate heat sink evaluations (e.g., maximum containment pressure and temperature analysis).

RESPONSE

The heat input from the CCW pumps has been included in a revised analysis, assuming the entire 1,000 Bhp results in heat input to the CCW. Also included in the revised analysis are the higher fouling factors discussed in Items F-10 and F-33. The calculated load is 2.55×10^6 BTU/hr per pump, which, combined with the LOCA heat load of 367.85×10^6 BTU/hr and flow of 14,757 gpm results in a maximum CCW temperature which is acceptable with respect to the design ratings of the cooled components. Revision 1 of calculation 16345-NU(B)-023 satisfactorily resolved this issue.

SIGNIFICANCE/EXTENT

There is no safety concern because the affected heat load analyses properly address the effect of the additional CCW pump heat load and the revised fouling factors of Open Items F-10 and F-33.

OPEN ITEM F-39

Document Number: Design Basis Document DBD-0233, Revision 0, Station Service Water System

DBD Section 6.3, Service Water System Monitoring, states "the CCW heat exchanger alarms when the pressure differential between service water and component cooling water is low enough to indicate a tube leak in the exchanger." It is not clear how a tube leak would be indicated by this alarm.

RESPONSE

At the time of the audit the design description sections of the DBDs had not been updated to reflect the results of the design validation. Upon review of this design feature, it was concluded that only a severe leak in the heat exchanger could reduce the differential pressure sufficiently to actuate this alarm. Other system abnormalities could also cause this indication. For example, tube leakage in the CCW heat exchanger could be detected by CCW surge tank level changes. When DBD-ME-233 Sections 5-11 are revised to incorporate the results of the validation effort, the function of the differential pressure alarm will be corrected. (June 30, 1988).

SIGNIFICANCE/EXTENT

There is no safety concern because the results of the system validation indicates that the CCW heat exchanger differential pressure alarm has no safety function and is not required to detect a tube leak in the heat exchanger.

OPEN ITEM F-44

Document Number: Calculation 16345-ME(B)-196, Rev. 0, dated 12/31/87, "CCW Worst Case Non-Seismic Pipe Break"

The calculation assumes two guillotine breaks in 10-inch non-seismic piping to and from ventilation chillers. The breaks are downstream of a butterfly valve that is assumed to be only 32° open. Since the valve is the main point restricting the flow and also in non-seismic piping, the postulated break does not represent the "worst case." A "worst case" break should be postulated just downstream of the class break from class 3 to class 5 pipe. Non-seismically designed components may fail during a seismic event. Therefore, any non-seismic piping connected to seismic portions of the CCW system should be assumed to fail next to the class break point. For a single Comanche Peak unit, this represents four places in the CCW system, i.e., the entrance to and exit from the non-seismic portions servicing the ventilation chillers and the instrument air compressors. The surge tank capacity and available NPSH should be calculated for the larger flows.

The currently calculated maximum leak rate for this scenario is about 3000 gpm, whereas it appears that leak rates of about three times this value are possible if no artificial restrictions are assumed within the system.

RESPONSE

Calculation 16345-ME(B)-196, Rev. 0 postulates and analyzes the worst case break at the seismic/non-seismic interface. Non-nuclear safety (NNS) piping downstream of a Safety Class/NSS class boundary is seismically designed up to the first support or anchor. The piping and valve XCC-080 in question, are seismically designed up to the ventilation chiller nozzle (Stress Problem Number 1-063A). Therefore, no break is postulated upstream of valve XCC-080.

The system is designed to remain operable during and after a worst case non-seismic piping failure. This position is technically acceptable and agrees with industry practice and ANS 56.11 Draft 3, (March 1987) "Criteria to Accommodate Compartment Flooding in Light Water Reactors" which states in part:

> Postulation of one break at a time in non-seismic piping systems is consistent with the latest draft of ANS 58.2 regarding protection against pipe rupture and consistent with current industry and regulatory practice. It also appears to be consistent with actual industry experience, such as Seismic Qualification Utility Group (SQUG) walkdowns, since piping systems evaluated in industrial facilities following actual earthquake events have been shown to be very unlikely to experience significant damage.

SIGNIFICANCE/EXTENT

There is no safety concern since the worst case piping failure required to be postulated has been evaluated with acceptable results.

OPEN ITEM F-45

Document Number: Calculation 16345-ME(B)-196, Rev. 0, dated 12/31/87, "CCW Worst Case Non-Seismic Pipe Break"

The calculation states, "Where the pipe centerline elevation exceeds the EGL (hydraulic energy grade line) at connected nodes, the breaks are represented by dead-end segments." This method may be non-conservative with respect to air voids entering into the system.

When the EGL (hydraulic energy grade line) is less than the elevation of the break, air infiltration could be significant, could delay the surge tank "empty" signal from being activated, and could severely disrupt pump and heat exchanger performances after the break is finally isolated.

The effect of air infiltration on the system operation following the worst case pipe break scenario should be fully examined, including the recovery phase after non-safety loops have been isolated if it is judged that a significant amount of air has entered the system. The effect of the air should be considered on:

- pump operation
- heat exchanger performance (from air entrapment at the tube sheets)
- surge tank and standpipe leg operation

The venting scenario should also be identified and evaluated.

RESPONSE

The purpose of the calculation was to determine the maximum flow from a non-seismic pipe break. The piping configuration, operating modes and various other inputs were chosen to maximize this flow. No conclusions were made in the calculation with regard to air inleakage since the calculation did not evaluate this effect.

The potential for air inleakage following the break has been evaluated with acceptable results. The water level in the piping downstream of the break does drop due to pump demand; however, the level stabilizes well above the suction headers to the pumps. After the surge tank empty level setpoint is reached, the train related isolation valves in the suction headers close, further eliminating the possibility of air entrainment.

SIGNIFICANCE/EXTENT

There is no safety concern because air inleakage cannot affect system safety performance and is automatically isolated on valve closure.

OPEN ITEM F-46

Document Number: Calculation 16345-ME(B)-196, Rev. 0, dated 12/31/87, "CCW Worst Case Non-Seismic Pipe Break"

For the calculation of available pump NPSH, friction loss in the surge tank legs was calculated to be almost negligible. Yet, the flow out of the bottom of the surge tank was assumed to be equal to the flow out of the double-ended 10-inch pipe break. The calculation should be reworded to show the effect of the friction on the available pressure at the pump suction during this postulated event.

RESPONSE

Calculation No. 16345-ME(B)-196 was performed to maximize the flow out of the non-seismic pipe break. Loss of NPSH during this event was not a concern for this operating condition. The reduction of suction pressure for the length of time postulated (30 seconds) is not a severe transient and is expected to be acceptable. The pump vendor will be contacted to verify that this transient is acceptable.

SIGNIFICANCE/EXTENT

There is no safety concern since the system can withstand this transient and perform its safety function.

OPEN ITEM F-47

Document Number: Calculation 16345-ME(B)-196, Rev. 0, dated 12/31/87, "CCW Worst Case Non-Seismic Pipe Break"

A partial pipe break just downstream of the vent chiller condenser should be examined if the pipe pressure could be subatmospheric. The resulting inflow of air would not be detected either by a CCW flow increase to the vent chiller condenser or by a decrease in level of the surge tank to the "empty" level. The effect of massive air infiltration into the system should be evaluated to determine if it would degrade the operation of critical components.

RESPONSE

The piping downstream of the vent chiller condenser is maintained at a positive pressure. Therefore, a partial pipe break at this location will cause water to flow out of the break rather than air in.

SIGNIFICANCE/EXTENT

There is no safety concern since the CCW system is pressurized such that a crack at any location will cause a water outflow, not air inleakage.

OPEN ITEM F-48

Document Number: Calculation 16345-ME(B)-255, dated November 25, 1987, "Effects of Residual Heat Removal and Spent Fuel Pool Operation on Component Cooling Water Pump Performance"

The calculation addresses only the steady state flowrates existing before and after the switchover from one flow alignment to another. On examining flow resistances and valve operating times, it appears that there is a possibility of very large system flow rates occurring during the transient phase of system switchover from one operating mode to another. For the case of transition from normal operation to a LOCA alignment with a single component cooling water pump, flowrates approaching 25,000 gpm may occur. This is far in excess of presently defined maximum runout conditions.

Manufacturers of large pumps typically recommend that pump discharge valves be brought to a restricted (partly closed) position before startup to avoid undesirable flow conditions. For some plants, the sequencing times for motor operated valves have been coordinated to avoid runout conditions during these transient conditions.

RESPONSE

This open item postulates an S-signal followed immediately by a P-signal, coincident with the single failure of the standby CCW pump to start. At this time the safeguards loops isolation valves start to close, the non-safeguards loop isolation valves start to close, and the RHR and Containment Spray valves start to open. These valves are large motor-operated butterfly valves (24 in. and 18 in.) with stroke times of 30 seconds (maximum). The running pump, at approximately 15 seconds into this scenario, will tend to run out due to these valves all passing flow at their mid-stroke position.

Due to the design of these pumps, and the short duration of this flow condition, no damage to the CCW pump would result. A transient condition of very high flow is a unique occurrence and would be of short duration (15 to 30 seconds). It would have no effect on the component cooling water pumps after the transient is finished. By the nature of their design and construction, a short period of excess flow accompanied by loss of suction pressure represents less of a threat to pump performance than the conditions present during conventional shop testing for NPSH values. Verification that these effects are acceptable will be obtained from the pump motor vendor.

The pumps do not trip on thermal overload (overloads alarm only). Due to motor characteristics, the motor does not trip on pump runout, but will trip on an electrical fault such as locked rotor current. Thus, these pumps will not trip on the postulated runout flow condition.

SIGNIFICANCE/EXTENT

There is no safety significance since the CCW pumps can withstand this transient and function properly.

OPEN ITEM F-49

Document Number: Calculation 16345-ME(B)-267, Rev. 0, dated 12/10/87, "Component Cooling Water System Flow Distributions"

To correct for low hydraulic flow resistance, the hydraulic losses are increased by (a) installing fixed orifices to restrict flow to some cooled components, or (b) by assuming a throttled position of valves which carry flow into or out of various heat exchangers.

To accomplish this task of throttling a valve to some desired preset position, the computer model is modified by utilizing a "Selected K" for various flow paths ("k" is the universally used symbol representing hydraulic resistance in a piping circuit). All of the "Selected K" values must be greater than the K value existing before the assumed throttling of the valve.

The two major technical concerns for these flow evaluations are:

a) How the "Selected K" values are established by actual manual valve settings at the plant.

b) What controls assure that the as-modeled "Selected K" values remain consistent with the as-built CCW system configuration for all future operation.

The setting of fixed throttle valves should include a plan which considers errors and tolerances in those parameters which provide guidance for obtaining "Selected K" values. Additional tolerance should be considered to account for variations in manual settings, in accordance with accepted error analysis. Criteria should be established to verify valve positions.

Once throttle valves have been set in their desired positions, controls are necessary to preclude radical changes in these setpoints. This situation may occur if a cooled component requires more than its rated (normal maximum) flowrate due to any number of malfunctions. Operators may attempt to attain extra cooling by opening up preset throttle valves, thus changing the system's hydraulic configuration.

A significant change in the cooling system's hydraulic character may not show any anomalies for the normal alignments of the system. However, if the system is called upon to provide extra cooling associated with emergency or accident conditions the hydraulic computerized model may not accurately represent parameters for the system.

OPEN ITEM F-49 (Continued)

RESPONSE

"Selected K" hydraulic resistances are selected based on the capability of the installed valves and simulate typical flow balancing performed during preoperational testing. Flow balancing and throttle valve setting was performed by preoperational test 1CP-PT-11-01. Additional testing will be performed by test 1CP-PT-11-01-SFT-1.

The throttling of valves is performed to distribute flow to meet design requirements in various system operating modes. Therefore, the criteria and requirements for the setting of fixed throttle valves are included in the scope of the system design basis documents. Throttle valve requirements may require either, or both, maximum and minimum flow requirements.

The setting of fixed throttle valves involves flow measurement. Acceptable flow ranges will be considered and will be reflected in the design basis documents.

Valves which are required to be throttled are to be reflected as Locked In Position (LIP) on the system flow diagrams and the bases and criteria for locking provided in the system design basis document. Once valves have been set in their throttled position, administrative controls preclude unauthorized changes to the position. The throttle valve position (number of turns) is recorded in the Technical Data Manual (TDM). Station Operating Procedures identify throttle valves and refer to the TDM for position. Throttle valves locked in position are also controlled by ODI-103, "Locked Valve Program."

If a situation occurred where a cooled component required more than its rated (normal maximum) flowrate for any reason, extra cooling could be obtained via procedures for temporary modifications which include a 10CFR50.59 safety evaluation.

Therefore, the procedures and controls are in place to ensure that a system's hydraulic characteristics are adequately maintained.

DBD-ME-0229 will be revised to include throttle valve requirements (6/30/88) and the CCW flow diagram will be revised to reflect the locking requirements (September 30, 1988).

SIGNIFICANCE/EXTENT

There is no safety concern since these methods and procedures will be applied to all safety systems where valve throttling is a safety requirement.

OPEN ITEM F-50

Document Number: 16345-ME(B)-166, Rev. 2, dated 2/25/88, "Effect on Component Cooling Water System of a Thermal Barrier Tube Rupture"

This analysis shows more than 65 cubic feet per second of hot steam/water mixture entering the 8-inch pipe with virtually no effect on this piping. The following questions should be addressed for this scenario:

a) Since the blowdown flow arrests the flow from connected intact thermal barrier pipes, is it possible that flow in the 8-inch pipe is also arrested?

b) Could pressures/temperatures within the 8-inch pipe be higher than current piping ratings?

c) It is assumed that the blowdown flow is quenched by the component cooling water in the 8-inch pipe. How much of a steam bubble must enter the 8-inch pipe in order to satisfy transport (energy transfer) equations? Could waterhammer/steamhammer conditions be caused for concern?

d) If the blowdown steam/water flow pervades further into the component cooling water system, what is the effect of this void formation on surge tank piping frictional losses, surge tank pressure, and system pressures?

RESPONSE

The existing analysis evaluated a steady state condition where flow in the 8 inch header created a steam plume of sufficient size and heat transfer capability to allow mixing. The analysis did not consider the initial transient effect of the steam/water flow which will enter the pipe with enough velocity and momentum to stagnate flow in the 8 inch header. If mixing does not occur, the steam will simply push water down the CCW headers and the steam pressure in the 4 inch header could rise above that previously calculated.

This initial transient is difficult to analyze and predict with a high degree of accuracy. Lengthy, complicated analysis of the transient and water hammer effects would be required. As an alternative, the pipe was arbitrarily assumed to fail and the radiological effects of a CCW pipe failure outside containment were investigated. Evaluation of this event indicates that the doses from this release of reactor coolant would be within the NRC guidelines (10 percent of the 10CFR100 dose limit) presently committed in FSAR Chapter 15 for "Small LOCA Outside Containment." The calculated dose presently reported in the FSAR is from a letdown line break and would have to be revised to a slightly higher value. In lieu of further transient analysis, water hammer analysis, and changes to FSAR radiological results, a design change is being implemented to automatically isolate the event rather than relying on later manual action. Redundant, automatic isolation valves will limit the amount of steam entering CCW and eliminate any significant effects on the safety portion of the system.

SIGNIFICANCE/EXTENT

There is no safety concern since the radiological release from the worst possible consequences (piping failure) of a thermal barrier rupture is within the NRC guidelines committed in the CPSES FSAR.

OPEN ITEM F-51

Document Number: 16345-ME(B)-166, Rev. 2, dated 2/25/88, "Effect on Component Cooling Water System of a Thermal Barrier Tube Rupture"

In this calculation, certain portions of the component cooling water piping were determined to be experiencing pressure and temperature above rated design conditions (150 psig/200°F design vs. approximately 300 psig/420°F for the thermal barrier rupture). SWEC provided calculation 16345-ME(B)-194 which addresses this condition. It is noted that the 194 calculation only addresses pipe wall thickness, and does not address thermal expansion considerations, which may cause pipe stresses higher than allowable for some piping configurations.

RESPONSE

This item concerns piping thermal expansion from temperatures resulting from the RCP thermal barrier break. Pipe temperatures as defined in the thermal modes calculations are used for stress analysis. Calculations 16345-ME(B)-034 and 16345-ME(B)-244 are the thermal modes calculations for CCW large and small bore pipe, respectively. These calculations document the pipe temperature for a RCP thermal barrier rupture using the temperature and pressure for the rupture from Calculation 16345-ME(B)-166. These line temperatures from the thermal modes calculations are then used for stress analysis of the lines.

SIGNIFICANCE/EXTENT

There is no safety concern since the calculated conditions have been evaluated as acceptable.

OPEN ITEM I-1

Document Numbers: Calculation IC-028, Revision 0, Motor Driven AFW Pump 01 Recirculation Flow "LO", "HI-1", "HI-2" for Channel 1-FB-2456A/B

Calculation IC-028 values for the input parameters for pump flow differ (as shown below) from values found in process Calculation 206-11. This discrepancy in the original Gibbs & Hill calculations was not pointed out in the calculation validation review by either the I&C or the process group.

	I&C-028	206-11
1-FB-2456A	50 GPM	20 GPM
1-FB-2456B1	550 GPM	500 GPM
1-FB-2456B2	650 GPM	650 GPM

RESPONSE

Data discrepancy between the two calculations was observed by the reviewer during the validation process and was noted in the confirmation remark (Item 13) of the Calculation Validation Record (CVR): "Mechanical Calculation 206-11 to be checked later for Setpoint Parameter Values."

New mechanical calculations for the auxiliary feedwater system (16345-ME(B)-006 and 063) have recently been issued with different data from those shown on calculation 206-11. The new data has been reflected into new setpoint calculations 16345-IC(B)-008 and 009 which have been issued. Existing calculation IC-028 has been superseded by 16345-IC(B)-008 and 009 and the CVR has been reissued to indicate that the previous calculations have been superseded. The original discrepancy had been adequately documented and has been properly dispositioned.

SIGNIFICANCE/EXTENT

There is no safety concern because the setpoint values used in IC-028 were conservative and the system would have operated in a safe manner. The data discrepancy had previously been identified and documented and was scheduled to be corrected during the confirmation phase of the CAP review in accordance with project procedure PP-223.

OPEN ITEM I-2

Document Number: Calculation IC-032, Revision 0, Containment Spray Pump 02 Discharge Header Flow

The percentage of error in the instrument channels could increase the nominal minimum flow rate from 705 GPM to 950-1000 GPM. This higher flow rate should be evaluated for potential impact on the piping design and system performance.

RESPONSE

The maximum flow through the minimum flow recirculation line is dependent on line size and the pressure drops within the line. The setpoint is for the protection of the pump from running against a shutoff head and serves only to open and close the recirculation line. Thus, higher flowrate would have no impact on piping design or system performance.

SIGNIFICANCE/EXTENT

There is no safety concern because even with the instrument error only a given flow rate could pass through the minimum flow recirculation line due to its size and flow resistance as supported by a pressure drop calculation. Also, there is sufficient flow to the spray header even if the minimum recirculation valve were to fail open. Each pump output flow rate is 5,000 gpm and only 3,600 gpm is required.

OPEN ITEM I-4

Document Numbers: DBD-ME-003, Revision 0, Control Room Habitability
DBD-ME-304, Revision 0, Control Room Air Conditioning System

FSAR Sections 6.4.2.1 and 9.4.1.1 and the DBDs are not consistent in the definition of the areas called "Control Room Complex" and the nomenclature for the various rooms making up the control room complex.

RESPONSE

The definition of the Control Room Complex Area found in the DBDs is consistent with the FSAR, however, the areas within the control room complex were inconsistently labelled in the FSAR sections. An FSAR change was implemented in Amendment 68 to reflect the descriptions used for each area/room in the DBDs.

SIGNIFICANCE/EXTENT

There is no safety concern. The revision to the FSAR sections was issued to clarify and make the FSAR and DBD consistent as to nomenclature of the various rooms within the control room complex. The CAP review ensures technical consistency between the Design Basis Documents and the FSAR.

OPEN ITEM I-7

Document Numbers: Calculations IC-026 (Revision 0: DVP 1), SC-48-07 (Revision 2: DVP-1-11I), and 232-14 (Revision 1)

Calculation IC-026 defines the range of LT-4752 as 0-112 in., while the companion scaling Calculation SC-48-07 defines the ranges as 0-120 in. This requires verification of the installed transmitters actual range. Equivalent calculations for level transmitter 4753 were not available to the team and should be reviewed for the same potential inconsistency.

The team reviewed the physical connections for the two level transmitters to determine if there were any problems relating to the generic issue on separation, and to determine how the tank level was being measured. It was noted that the pictorial representations on the flow diagram and the calculation are different.

The documents reviewed included:

Number	Title
2323-M1-2607 CP-3	Instrument Location Drawing
2323-M1-2507-02, Rev. 7	Instrument Tabulation
2323-M1-2609 CP-2	Primary Connection Location
2323-M1-2104-06 CP-3	Instrument Detail Sheet

RESPONSE

The scaling calculation (SC-48-07, Rev. 4) for the chemical additive tank level transmitters (LT-4752 and 4753) has an input range of 7.98 to 119.70 and 8.48 to 120.20 in. water (PG-003 of SC-48-07) which is a span of 111.72 in. water. This span has been corrected for in. (Water Column) using a correction factor of 1.33 (specific gravity of NaOH). The actual span corresponds to 0-84 in. tank level. The setpoint calculations (IC-026 and 027) and the scaling calculation (SC-48-07) both use a span of 112 in. (corrected for in. W.C.). This was validated by SWEC under the Corrective Action Program.

The differences between pictorial representations on the flow diagram and the calculation are inconsequential. Both are schematic representations which provide the required information for that application.

SIGNIFICANCE/EXTENT

There is no safety concern because both the scaling calculation SC-48-07 and the setpoint calculation IC-026 for LT-4752 utilized a span of 112 in.

OPEN ITEM I-8

Document Numbers: Calculations IC-026 (Revision 0: DVP 1), SC-48-07 (Revision 2: DVP-1-11-I), and 232-14 (Revision 1)

The physical instrumentation documentation package does not reference a physical drawing defining the standpipe connections used to measure the level of the tank contents. The standard hook-up details (2323-M1-2104-06) for flow measurements (Detail 4G) is very general for a differential pressure measurement taken on a standpipe. Even with the supporting text in the standpipe "Instrument Installation & Separation" document (DBD-EE-035, Revision 0) the detail is not adequate to insure a proper installation.

RESPONSE

Various documents are used to provide all information needed to install D/P instruments. The instrument tabulation sheet, 2323-M1-2507-02, refers to:

1. 2323-M1-2104-06, Detail No. 4G which shows the general installation requirements/material to be furnished and installed by the instrument installation contractor downstream of the root valve.

2. 2323-M1-2607 which shows the instrument locations safeguard building plan at elevation 790 ft -6 in.

3. 2323-M1-2609, Part Plan "X" which is a exploded view of the chemical additive tank area. This view shows that:

	LT-4752	LT-4753
Location of LP tap (root VV) is	800' 9"	800' 9"
Location of HP tap (root VV) is	792' 3"	792' 3"
Location of transmitter is	792' 6"	792' 3 3/4"

The above documents and the instrument installation Specification CPES-I-1018 provide the necessary installations details.

SIGNIFICANCE/EXTENT

There is no safety concern. Existing plant documents provide the details to ensure a proper installation.

OPEN ITEM I-9

Document Number: DBD-EE-035, Revision 0, Instrument Installation and Separation

Section 5.2 of the DBD requires impulse lines for redundant instruments to have a minimum separation in free air of eighteen inches in all directions. (The preferred separation distance is five feet.) The directions for this preferred separation distance are not defined.

For impulse lines from a common tap which split into two or more lines serving redundant instruments, paragraph 5.2.6 of the DBD states "There is no requirement for barriers in the area between the point where the lines split and where the 18 in. of separation is achieved." The team considers that this failure to provide barriers in the area where the 18 in. of separation is not met is not consistent with the governing criteria of IEEE Standard 279-1971 and its clarification documents.

The DBD also states that "... the instrument tubing coming off a shared tap shall remain a single line as far as is convenient for field routing." The team considers that the DBD should provide more specific guidelines, e.g., restricting the length of the single line, in order to preclude common mode failure.

RESPONSE

The statement in Paragraph 5.2.6 of the DBD considers that the single line from the shared tap includes not only the single line itself but also the transition area from where the line splits to the point where the 18 in. of separation is achieved. Therefore, in this context, it is felt that this design criteria does meet the governing standards and guides.

Section 5.2.6 also states that "safety-related instrument tubing will not share a common tap with other safety-related instrument tubing unless approved by the engineers." When this situation occurs, the engineers must approve each potential tubing run on a case-by-case basis. Since the DBD only provides the general design criteria of instrument and tubing installation and separation, it is not feasible to state the explicit need of barriers or a restriction of maximum length of the single line coming off the shared tap. The constructor follows the requirements of the installation specification, CPES-I-1018, not the DBD.

Specification CPES-I-1018 requires that all safety-related tubing runs be on design drawings approved by the engineers.

DBD-EE-035 has been revised such that section 5.2.6 is as follows "Safety-related instrument tubing will not share a common tap with other safety related instrument tubing unless approved by the engineers. This approval shall be based on a review consisting of, but not limited to, the following: single failure analysis, proposed tubing routing, and the need for barriers due to potential hazards. For those..."

SIGNIFICANCE/EXTENT

There is no safety concern. The existing common tap installations, on R.C. loops for flow input, were analyzed and it was determined that loss of a common instrument line will cause the actuating instrument to fail in a safe direction and will result in the generation of a reactor trip signal.

OPEN ITEM I-11

Document Number: DBD-ME-0229, Revision 0, Component Cooling Water System

Isolation of the non-safeguards loop could remove instrument air compressors and thermal barrier coolers from operation for a long time period. It is not clear that sufficient compressed air is available to perform safety-related functions during such a time period or if prolonged loss of thermal barrier protection will damage the reactor coolant system pumps.

RESPONSE

Loss of the instrument air compressors will result in loss of operation of many air operated valves and dampers. In order to ensure operability of the valves, the following methods are employed to perform safety-related functions during the time period that the instrument air compressors are unavailable:

1. Valve and damper positions are fail-open or fail-closed depending on the position important to safety.

2. Where required to perform a safety function, air accumulators are installed to provide a backup source of instrument air to ensure valve/damper operability. Calculations have been performed to validate the size of these accumulators. The sizing considers the number of damper/valve operations to be performed, the time during which the air accumulators are required to support the valve/damper safety function, and the volumes of air required to accomplish these operations.

3. Where required, handwheels are installed to provide the capability to manually operate the valve/damper. The choice of handwheels has been limited to a few valves/dampers in order to avoid excessive operator actions outside the control room post-accident.

Loss of CCW flow to the reactor coolant pump thermal barriers is acceptable and will not damage the pumps in the short term as long as seal injection from the Chemical and Volume Control System is not interrupted. Westinghouse recommends that flow be reestablished within 24 hours or the pumps be shut down.

SIGNIFICANCE/EXTENT

There is no safety concern because the valves and dampers fail to their position of greater safety, the system design provides air supplies for the valves and dampers that are required to perform safety-related functions, and handwheels are provided for critical valves and dampers to permit manual operation.

OPEN ITEM I-13

Document Number: Drawing No. 2323-M1-2229, ICDs for CCW System - 9 Sheets
Drawing No. 2323-M1-2230, ICDs for CCW System - 2 Sheets
Drawing No. 2323-M1-2231, ICDs for CCW System - 7 Sheets

Instrumentation and controls are provided for the CCW system which result in automatic isolation of the non-safeguard loop from both safeguard loops on receipt of a containment isolation signal. The resulting zero flows in the non-safeguards loop will activate more than 20 alarms. The alarms will be unimportant to the operator, but they must be acknowledged.

The concern about operator "data overload" during critical periods is a generic one. The team was informed that a control room design review in accordance with NUREG 0700 has been completed by TU Electric. The results of the alarm system review were not available to the SWEC project team at the time of this audit. These results should be evaluated pertinent to the above "data overload" example.

RESPONSE

A Phase A Containment Isolation Signal (CIA) will result in only three low flow alarms - flow to letdown chillers, the excess letdown heat exchanger and the reactor coolant drain tank heat exchanger. Acknowledgment of these three alarms will not result in "operator data overload."

A Phase B Containment Isolation Signal (CIB), initiated by containment spray actuation, may result in 22 low flow alarms caused by the isolation of CCW to non-essential components. Control Room operators with extensive training in emergency operating procedures will respond to these alarms when they are actuated. This is not considered to be an overly stressful situation for the operators.

During accident conditions, multiple alarms from many systems will be initiated. Under these conditions, the operators will follow station emergency response procedures. These annunciator alarms will be silenced by the operator but response to the alarm will not be initiated until the plant has been stabilized in accordance with the emergency response procedures.

In addition, the CPSES Operations Personnel are trained on a plant specific simulator. This training includes operator response to both normal and emergency operating conditions, thereby ensuring the operators are aware of the alarms that are expected for each plant condition.

SIGNIFICANCE/EXTENT

There is no safety significance because acknowledgement of the three low flow alarms following a CIA will not present the operators with data overload. In the event of a CIB signal, emergency response procedures will assure that the plant condition is stable before response to alarms is initiated.

OPEN ITEM I-14

Document Numbers: Calculations 16345-IC(B)-016, Revision 0, CCW Surge Tank Level Lo-Lo, Hi, Empty 1-LB-4500 A/B, A1/B1 and 16345-IC(B)-015, Revision 0, CCW Surge Tank Level Lo-Lo, Hi, Empty 1-LB-4501 A/B, A1/B1

Despite the fact that both calculations had the signatures of one preparer, two reviewers, and one independent reviewer, the following errors were found.

a. On pages 3 and 17 of both calculations, the descriptions of the reset points are incorrect for the four bistables. The calculations show "incr" (increasing) when they should show "decr" (decreasing) and vice versa.

b. On pages 3 and 15 of Calculation 16345-IC(8)-15), a total of 14 tag number errors were identified.

The above errors are non-substantive. As such, the team would expect them to have been identified even by a cursory review. The fact that they were not identified by several reviewers may indicate a programmatic problem with calculation reviews.

RESPONSE

Calculations 16345-IC(B)-015 and 016 have been revised to correct the deficiencies. The majority of the deficiencies occurred because one calculation was being utilized to represent redundant instrument loops with unique tag numbers. The errors were transcription errors which occurred when copying the calculation for the redundant instrument loop.

SIGNIFICANCE/EXTENT

There is no safety concern. A random sample of similar Class I setpoint calculations was performed, which revealed no tag number or reset description errors. Therefore, it is determined that no programmatic problem with calculation reviews exist and that the deficiencies found are limited to calculations 16345-IC(B)-015 and 016.

Additionally, as part of the reconciliation and confirmation phase of the design validation program (IAW PP-223), all I&C calculations will be reviewed to confirm input data and assumptions and to ensure that the calculation results are consistent with the CPSES design basis.

OPEN ITEM I-18

Document Number: DBD-ME-0229 Section 5.4, System Limitations and Precautions

The total CCW system thermal contraction and expansion is on the order of 1600 gallons. As a result, it is not clear how small leaks and their locations are to be identified when the CCW loops are not isolated from each other.

RESPONSE

CCW system thermal contraction and expansion during normal plant operation (plant on-line) is minimal and will not actuate an alarm. Maximum thermal expansion and contraction will only occur during system start-up and shutdown with extreme weather conditions.

Makeup is provided automatically to the surge tank based on level. Frequent makeup, which is indicated in the control room, over a period of time would be indicative of small system outleakages. This is the only method of detecting small leaks and is not significantly affected by whether or not the loops are cross connected. Once detected, the loops would be isolated from one another in order to determine which loop is leaking. Larger leaks would be more quickly identified by the level instruments.

SIGNIFICANCE/EXTENT

There is no safety concern because small leaks do not affect the required CCW operation because of automatic makeup and would be detected based on frequent makeup over a significant period of time.

OPEN ITEM I-20

Document Numbers: Drawing No. 2323-EI-0050, Sh. 26, Rev. CP-1, Sh. 27, Rev. CP-1, Sh. 47, Rev. 2, and Sh. 49, Rev. 3

The DBD considers valves HV 4631A, HV 4631B, FV 4650A, and FV 4650B to be active valves. They are required to operate during the various operating modes that the system must perform in order to shut down the plant and maintain the plant in a safe shutdown condition. The DBD gives no information as to how the valves contribute to the safe shutdown of the plant. In fact, the DBD gives conflicting information as to the required conditions for operation of the valves. For example, Table 5-3, CPSES Component Cooling Water System Required Flow Rates, shows the valves open for all plant conditions including an S-signal. However, DBD Sections 6.4e and 6.4i indicate that the valves will close on an S-signal.

RESPONSE

The discrepancies identified in Sections 5 and 6 of DBD-ME-229 will be corrected when Sections 5-11 of the DBDs are updated (6/30/88).

These valves have been designated as "Active," as defined in the DBD, and receive train related actuation signals to close in order to isolate selected portions of the nonsafety loop. The valves are considered safety-related because they enhance the reliability of the CCW system to remove heat from components by maintaining design flow. The valves, FV4650A and B, receive Train B signals to close to compensate for the flow through two partially opened RHR valves with only one CCW pump operating. Both CCW pumps are automatically started following an accident; therefore, the postulated single failure would be a loss of one CCW pump. There is no common failure which could selectively affect one CCW pump and both Train B valves. Single failure of an entire Train (A or B) would not require the subject valves to be closed.

The DBD will be revised by June 30, 1988 to describe the above scenario and valve function.

SIGNIFICANCE/EXTENT

There is no safety concern because the valves do perform a safety function for a specific CCW alignment and are properly being treated as active components.

OPEN ITEM I-21

Document Number: Drawing No. 2323-EI-0050, Sh. 26, Rev. CP-1, Sh. 27, Rev. CP-1, Sh. 47, Rev. 2, and Sh. 49, Rev. 3

The DBD lists Criterion 44 of 10CFR50 Appendix A as part of the Design Basis. This criterion addresses cooling water systems including "...suitable redundancy in components and features.... shall be provided to ensure that... the system safety function can be accomplished assuming a single failure."

Isolation of component cooling water to the vent chillers, while listed in the DBD as being required to operate to safely shut down the plant, is actuated only by Train B. The cooling water source is common to cooling water Trains A and B. A single failure could block the isolation function.

Isolation of the component cooling water to the process sampling system is also listed in the DBD as being required to operate to safely shut down the plant. It is actuated only by Train A of the ESFAS. The cooling water source is common to cooling water Trains A and B. A single failure could block the isolation function.

As indicated in Open Item I-20, the rationale for establishing the closing of valves FV 4650A, FV 4650B, HV 4631A, and HV 4631B as required for the safe shutdown of the plant is not clearly identified. In addition, the above single failure issue needs to be addressed.

RESPONSE

As discussed in Open Item I-20, portions of the nonsafety loop can be isolated to enhance reliability of the cooling water supply to selected non-safety related components, including those listed above. The components supplied from this portion of the nonsafety loop are not required to safely shutdown the plant as described in DBD-ME-229. MOVs 4524, 4525, 4526, and MOV 4527 perform the safety/nonsafety loop isolation function. They are designed to perform this function and to meet single failure requirements. The response to Open Item I-20 addresses valves FV 4650A/B and HV 4631A/B.

SIGNIFICANCE/EXTENT

There is no safety concern because valves FV 4650A/B and HV 4631A/B do perform a safety function. The valves will continue to be shown as safety-related on all documentation. The DBD will be revised to reflect the operation and status of these valves.

OPEN ITEM I-22

Document Numbers: Calculations 16345-IC(B)-029, Revision 0, Station Service Water Supply Header Pressure Lo Channel 1-PIS-4250 and 16345-IC(B)-030, Revision 0, Station Service Water Supply Header Pressure Lo Channel 1-PIS-4251

The maximum pressure at which the ITT Barton Switches (1-PIS-4250 and 1-PIS-4251) will reset may be above the normal service water pump discharge pressure. As a result, there may be conditions where there is satisfactory service water pressure, but the low pressure alarm, the service water pump auto start signal and the component cooling water pump auto start signal will not clear. The calculations show a maximum reset point that is not a true maximum reset point. Rather, it is the maximum reset point when the switch has been recently calibrated. The true maximum reset point is 10% (deadband) above the maximum calculated pressure at which the switch may actuate. For these switches, the true maximum reset point is 23.1 psig (upper setpoint limit) + 4.5 psig (total expected error) + 6 psig (maximum deadband) or 33.6 psig. Normal operating pressure of the system is shown as 30.2 psig.

DBD-EE-037 "BOP Safety-Related Setpoints" does not address reset points as affected by overall long term inaccuracy of instrument setpoints. It considers only reset points as affected by minimum and maximum adjusted setpoints. Therefore, the design criteria in the DBD are deficient in this regard. For the above cases, the instruments selected may be unsuitable for the service. Previously completed setpoint calculations should be rechecked to determine if the worst case reset point could interfere with the intended operation of equipment/systems.

RESPONSE

Calculation 16345-ME(B)-230, Revision 2 lowered the process allowable value to 12 psig. This will produce a maximum reset point of: 16.5 psig (adjusted setpoint) + 4.5 psig (total expected error) + 6 psig (maximum deadband) or 27.0 psig which is below the operating pressure of 30.9 psig. Based on the above, setpoint calculations 16345-IC(B)-029 and -030 have been similarly revised.

DBD-EE-037, Revision 1, "BOP Safety-Related Setpoint," will be revised to include the following statement: "For all instruments having fixed or non-adjustable deadband maximum, reset point (based on maximum possible actuation point) will be determined and checked to assure that it does not adversely affect system operation."

SIGNIFICANCE/EXTENT

There is no safety concern because the safety function of this device is not affected by the reset point. The setpoint calculations for the remaining 24 ITT Barton switches were reviewed and will be revised to establish maximum reset points by June 30, 1988. None of the remaining switch setpoints would have adversely affected system operations.

OPEN ITEM E-2

Document Number: Calculation 16345-EE(B)-031, Revision 0, Protective Relay Settings for 6.9 KV Safeguard Buses

The calculations for both the 700 HP motor and the 1,000 HP motor are based on assumed values for the full load current and the locked rotor currents. The test data values are available. (See Calculation TNE-EECA-0008-265, Revision 0, Ref. 4.1, pages 3 and 13.) The use of assumed motor data in the calculation of final relay settings may not always provide a conservative relay setting. Calculation 031 should be updated to reflect the test data. The DBD should include a requirement to use test data where available.

RESPONSE

During the review of calculation TNE-EE-CA-0008-265, Revision 0, and the preparation of supplemental calculation 16345/6-EE(B)-031, Revision 0, locked rotor currents from the motor test data sheets were compared with calculated locked rotor currents based on the KVA code letter from the motor nameplate. The larger value was used in the calculation for conservatism. The preparer had determined that the test data available was not necessarily specific to the motors. It was a generic report submitted prior to manufacturing.

The DBD has been changed to specify the type of motor data to be used for the calculation of relay settings. The full load current should be the greater of either nameplate value or vendor test data. The locked rotor current should be a vendor test report value if available or the upper end value of nameplate KVA code letter.

Subsequent to this open item, complete data for all 6.9 KV motors has been received from the vendor. The relay setting calculations will be revised by June 10, 1988 to include this data.

SIGNIFICANCE/EXTENT

There is no safety concern because conservative locked rotor currents were used in the calculation.

OPEN ITEM E-3

Document Number: Calculation 16345-EE(B)-053, Revision 0, Sizing Verification - Class 1E Batteries and Battery Chargers

The design basis document states that the battery normal voltage is 125 V dc, with a range of 105 V (minimum) and 140 V dc (maximum). The battery vendor manual, "Stationary Battery Installation and Operating Instructures," requires that the battery be kept at a float charge level of 2.17 - 2.25 V dc per cell. This will result in a normal dc system voltage of 130.2 - 135 V dc for a 60-cell battery. This higher voltage could lead to a loss of life for the equipment designed for the DBD required 125 V dc normal voltage.

RESPONSE

IEEE Standard 946, "IEEE Recommended Practice for the Design of Safety-Related DC Auxiliary Power Systems for Nuclear Power Generating Stations," states that nominal voltages of 250, 125, 48, and 24 volts are generally utilized in station battery systems. The standard goes on to list operating voltage ranges of equipment typically connected to a nominal 125 V dc system.

All connected loads are specified for operation with a maximum input voltage of 140 V dc in accordance with CPSES FSAR Section 8.3.2.1b.

This will be demonstrated by reviews of typical continuously energized DC components as described below.

DC components constantly energized in the plant include solenoid valves and protective and auxiliary relays. ASCO Test Report No. AQR-6736 Rev. 1 was presented and reviewed to show that solenoids are not a concern. Adequacy of protective and auxiliary relays to function at 140 V dc battery equalizing voltage will be verified by reviewing elementary drawings of the components which are subjected to the equalizing voltage of 140 V. Maintenance records will be reviewed for typical protective and auxiliary relays (constantly energized during the equalizing period) to assure that no failures determined to be caused by overvoltage have been experienced.

SIGNIFICANCE/EXTENT

There is no safety concern because all components have been specified to operate with a maximum voltage of 140 V dc and no evidence of malfunctions determined to be caused by overvoltage as a result of equalizing voltage has been identified in the review to date.

OPEN ITEM E-9

Document Number: Specification 2323-ES-5, 7.2 KV Metal Clad Switchgear and Accessories

The specification for 7.2 kV Metal Clad Switchgear and Accessories is consistent with Calculaton 16345-EE(B)-053 and requires equipment suitable for operation up to a maximum of 140 V dc. However, the data sent by the vendor (Gould, Inc.) indicates that the spring charging motor is only suitable for 90-130 V dc operation (Ref. Calculation Number 16345-EE(B)-037, Revision 0, Appendix Page 13).

RESPONSE

On May 23, 1988, ASEA Brown Boveri (formerly Gould, Inc.) sent a letter stating that documentation review shows that circuit breaker spring charging motors in the 7.2 kV metal clad switchgear shipped to CPSES were tested at 140 V dc.

The 90-130 V dc range was predicated or conformance to ANSI C37.09, which was changed in 1979 to 90-140 V dc. The CPSES breakers were shipped between 1977-1979. However, the vendor has been testing at 140 V dc maximum since 1976.

Calculation 16345-EE(B)-037, Revision 1, deletes the operating voltage range table since it is not germane to the calculation.

SIGNIFICANCE/EXTENT

There is no safety concern because the spring charging motor will operate per specification.

OPEN ITEM E-12

Document Number: Calculation 16345-EE(B)-007, Revision 0, 480 V ac Motor Control Center (MCC) Starter Coil Pickup Analysis

Our review of eight randomly selected configurations revealed problems with the input data for two of those.

Configuration 7A1

Page 464 of 1010 shows relay 42x as the other load. Page 13 of 36 shows this load to be R=78, X=91.19. However, the maximum allowable circuit length calculation on Page 22 of 36 indicates the same load is R=39, X=45.6.

Configuration 8C

On Page 32 of 36, the impedance values of the 200 VA control power transformer are shown as R=.339 and X=1.085. Based on other data in the calculation, these values should be R=3.39, X=1.085. Even though this change will reduce the maximum allowable circuit length, it is unlikely to require any component changes.

In our random sample of eight configurations, we found input data errors in two cases. The input data for all of the configurations need to be verified. These data errors impact the maximum allowable circuit lengths which form the basis for acceptability for many circuits. In some cases, e.g., the 7A1 configuration, the error may have been conservative, and some of the presently projected component changes might not be needed.

RESPONSE

In the above two of approximately 40 cases, there was an error in transferring data from one place in the calculation to the individual cases. This calculation has been revised to correct the data input and transfer of information discrepancy. All cases were rechecked and no additional inconsistencies were discovered.

SIGNIFICANCE/EXTENT

There is no safety concern. Based on a sample of other electrical calculations it was determined that there may be a limited number of electrical calculations which could contain similar inconsistencies. Preparers and reviewers of electrical calculations have been retrained in calculation preparation procedures. The majority of electrical calculations have been revised. Electrical calculations will be reviewed as part of the confirmation activity.

OPEN ITEM E-15

Document Number: DBD-EE-054, Revision 0, Control Circuit Parameters/Loading Requirements, Section 7.1.5

The design basis document in Section 7.1.5 states, "The circuit breakers are tripped via electrically resettable lock-out relays, ITE Type J14, located in the switchgear."

The contact rating for the Type J14 relays is not sufficient to trip or close 7.2 kV breakers. As per ITE, these relay contacts have a make and break rating of 1.1 amperes. The 7.2 kV breakers have a trip current of approximately 5 amperes. Therefore, the relays specified are not suitable for the application.

RESPONSE

Subsequent to the date of the finding, the vendor was required to supply information on the contact rating of the J-14 relay. Vendor letter dated August 20, 1987 stated that the relay contacts have a make and break rating of 1.1 amperes. Vendor letter dated May 6, 1988 states that the 1.1 ampere make and break rating is a pilot duty rating that is not applicable for the CPSES application. The actual duty is to make and carry 6 amperes dc for about 6 milliseconds. The J-14 relay (with J-20 contact block-standard) is UL listed to make and carry 10 amperes dc, which meets the requirements of the CPSES application. The 60 ampere make rating as included in vendor letter dated August 20, 1987, is also not required for the CPSES application per vendor letter dated May 6, 1988. Therefore, the relays specified are suitable for applications which do not require interrupting (breaking) current.

The vendor letter dated March 23, 1988 states that other auxiliary functions for which the "J" relays are commonly applied require interruption but the current levels are typically well under 50 milliamps. The J-14 relays will not be used in any application requiring interrupting duty more than 50 milliamps dc inductive at CPSES. A review will be conducted to assure that all J-14 relays utilized at CPSES meet this requirement. DBD-EE-54 will be revised accordingly.

SIGNIFICANCE/EXTENT

There is no safety concern because the vendor letter indicates that the relays are suitable for the application.

OPEN ITEM E-17

Document Number: DBD-EE-052, Revision 0, Cable Philosophy and Sizing Criteria

Paragraph 5.3 in the DBD correctly states, "...with insulation thickness based on 133 percent voltage level". This is clearly stated for the 8 kV cable, where the system is low resistance grounded. However, for the 480 Vac system, which is a high resistance grounded system, the DBD does not relate insulation thickness to the 173% voltage level.

RESPONSE

Design Basis Document DBD-EE-052 Rev. 1 states that low voltage power cable is specified for use on the 480 V, 3 phase, 60 Hz, high resistance grounded system. The specification has been reviewed and is in agreement with the DBD.

The cable manufacturer, Okonite has confirmed in a letter to SWEC dated April 27, 1988, that the cable supplied to Comanche Peak is rated for 480 V, 173 percent insulation level.

SIGNIFICANCE/EXTENT

There is no safety concern because the cables supplied for the 480 Vac system have appropriate insulation for the intended application.

OPEN ITEM E-18

Document Number: Calculation 16345-EE(B)-052, Revision 0, Firestop Cable Ampacity Derating Factors

As per Calculation 16345-EE(B)-052, page 33, when passing through firestops, all cables cannot simultaneously carry 125 percent full load current. (Refer to Item b. above.) This limitation is inconsistent with the above (item b) DBD requirement.

RESPONSE

Calculation 16345-EE(B)-052 has been revised as discussed in response to Open Item E-19. The derating factor for random filled tray cables passing through silicone foam firestop is based on all cables carrying 100 percent rated load. DBD-EE-052 will be revised to reflect this.

SIGNIFICANCE/EXTENT

There is no safety concern because the cable current carrying capacity in the subject calculation is conservative.

OPEN ITEM E-19

Document Number: Calculation 16345-EE(B)-052, Revision 0, Firestop Cable Ampacity Derating Factors

The calculation on page 34 concludes that no derating is required for cable sizes no. 4 AWG and smaller. This conclusion is based on the assumption that it is "... not practical to consider all cables operating at 1.25 x Ifl, ...". This is not in compliance with Criterion 2b above.

The calculation uses the following documents as the basis for the above conclusion:

a. "Ampacity of Cables in Trays With Firestops", IEEE Transactions on Power Apparatus and Systems, Vol. PAS-100, No. 7, July 1981.

b. "Ampacity Test of a Silicone Foam Firestop in a Cable Tray", IEEE Transactions on Power Apparatus and Systems, Vol. PAS-100, No. 11, November 1981.

The above technical papers do not appear directly applicable to Comanche Peak because:

1) The data is based on the use of much larger cables, i.e., 4/0, 2 AWG and 6 AWG, as opposed to 4 AWG and smaller for Comanche Peak.

2) The cables used in test were aluminum cables, as opposed to copper for Comanche Peak. Even though the aluminum test cables have a lower thermal conductivity than copper, they utilize larger cross-sectional area for the same ampacity.

3) The cables were carefully placed in the tray to ensure contact between the cables and to minimize air pockets, which is not consistent with general field installations.

In addition these above differences, Reference a. indicates that, for a 9" to 12" thick silicone foam firestop, the temperature rise could be 12°C to 19°C higher than the temperature rise without the firestop. Reference b. States that for smaller cables the temperature rise could be up to 40°C higher with these firestops.

Based on the above discussion, the calculations do not provide adequate basis for the conclusion (on pages 34 and 35) that, "For random filled cables sizes no. 4 AWG and smaller - no derating need be applied".

OPEN ITEM E-19 (Continued)

RESPONSE

The referenced technical papers do not explicitly apply to Comanche Peak because of size and type of wire used in the technical paper vs. that used at Comanche Peak. A new calculation has been produced (16345/6-EE(B)-082) which concluded a derating factor of 7 percent is required for these size cables. The DBD-EE-052 has been revised to define fire stop derating factors for different types of cables. The development of the derating factors is based on the condition that all power cables in the tray will carry 100 percent full load amperes simultaneously.

SIGNIFICANCE/EXTENT

A review of other calculations indicates that this is the only instance where test data/reports that were not applicable to the job conditions were used. The problem is limited to Calculation 16345/6-EE(B)-052.

There is no safety concern because the original calculations were conservative.

The "original" base ampacities were based on 40% tray fill. When the firestop derating was implemented, the base ampacities were increased, since percent fill was changed to 30%.

OPEN ITEM E-22

Document Number: DBD-EE-040, Revision 0, 6.9 kV Electrical Power System

The DBD describes the 6.9 kV electrical power system as a low resistance grounded system. When the system is connected to the offsite power system through the station service auxiliary transformers, the grounding resistors at the transformers provide a low resistance path for the ground fault current. When the plant is operating in this mode, the 6.9 kV cable insulation thickness (for the 133 percent voltage level) is in accordance with the industry standard.

However, when the safety buses are powered by the diesel generators, i.e., on loss of offsite power, the only system grounding is through the diesel generator grounding system. In this mode, the 6.9 kV system operates as a high resistance grounded system. The 6.9 kV cable insulation thickness requirement (173 percent voltage level) has not been addressed in the DBD.

The 6.9 kV electrical distribution system is undergoing a major redesign effort which includes the addition of new station service auxiliary transformers. Because of the significance of this change, the following documents will be reviewed later in order to assess compliance with the design criteria.

a. 6.9 kV and 480 Vac one-line diagram
b. Elementary diagrams for 6.9 kV bus transfer schemes
c. Station service voltage regulation calculation
d. 6.9 kV short circuit calculation
e. DBD-EE-040, 6.9 kV Electrical Power System (revised)
f. Validation of diesel generator loading capability
g. DBD-EE-62, Containment Electrical Penetration Protection
h. Calculation No. 17, electrical penetration protection
i. Electrical penetration protection problem resolutions

RESPONSE

The 6.9 kV system operates normally as a low resistance grounded system, when fed from offsite power via transformers XST1 and XST2. A line-to-ground fault would be cleared within 1 min. Under these conditions, the 8 kV power cable installed at Comanche Peak more than complies with the ICEA S-68-516 standard, since the cable is rated 8kV 133 percent and ICEA would only require 100 percent insulation level.

During a safety injection signal coincident with loss of offsite power (XST1 and XST2) the safety related 6.9 kV buses are fed from a diesel generator. The diesel generator is high impedance grounded via a non-Class 1E neutral grounding transformer. DBD-EE-052 will be revised to include the cable voltage rating requirement for this condition (i.e., 6.9 kV high resistance grounded). A line to ground fault condition would be annunciated, if the neutral grounding transformer is available. Since the neutral grounding transformer is a non-Class 1E component, credit can not be taken for its availability. A line to ground fault under these conditions would remain for an indeterminate time until a line to line fault developed. The line to line fault would be detected and the fault isolated.

OPEN ITEM E-22

RESPONSE (Continued)

The cable manufacturer, Okonite, has indicated in a letter to SWEC on March 9, 1988 that the insulation thickness on the 8 kV power cable and the quality of the insulation supplied is such that the insulation could withstand the full 6.9 kV voltage (which occurs during the line to ground fault) across the insulation indefinitely. In their April 27, 1988 letter to SWEC, Okonite indicted that the 8 kV power cable as supplied to Comanche Peak meets the intent of ICEA-S-68-516 for the 6.9 kV ungrounded system at 173 percent insulation level.

Diesel generator neutral grounding is accomplished by connection to a single dry-type transformer with a resistor connected across the secondary winding designed to limit generator ground fault current to approximately 2 amperes. The connection is via a single conductor No. 4/0 AWG cable routed in conduit and is designated an associated circuit. The following analysis demonstrates that Class 1E circuits with which the neutral grounding is interconnected are not degraded below an acceptable level.

The non-Class 1E grounding transformer may fail either open or short circuited. An open circuit would result in an ungrounded 6.9 kV power system and would not affect any Class 1E circuits. A short circuit would result in a low impedance grounded power system allowing the diesel generator breaker under certain conditions and feeder breakers to trip on a ground fault.

Under normal condition with off-site power available the diesel generator is not running and the diesel generator breaker remains open. As there is no other energy source connected to the grounding equipment there would be no effect on Class 1E circuits from either an open circuit or short circuit failure of the grounding transformer.

Under conditions when the off-site power is lost the diesel generator starts and the diesel generator breaker will close (generator protection is not bypassed). An open circuit failure in the grounding transformer will disable the ground overcurrent protection on the 6.9 kV system leaving it ungrounded. A short circuit failure can cause the diesel generator breaker to trip for bus ground faults. An orderly shutdown of the reactor is still achievable using the redundant bus.

Under an accident condition concurrent with loss of offsite power, the generator protection is bypassed except for differential protection and engine overspeed trip. Tripping from the ground protection is blocked by an engine emergency start signal but is alarmed in the control room if a ground is detected. An open circuit failure will disable the ground detection on the 6.9 kV system. A short circuit failure would not jeopardize the Class 1E system's capability for an orderly shutdown of the reactor because a ground fault:

1. At any of the 6.9 kV loads will result in tripping of that load only.
2. At the 6.9 kV bus will be sensed and alarmed in the control room.
3. At the diesel generator the differential protection will result in tripping of the diesel generator.

OPEN ITEM E-22

RESPONSE (Continued)

In summary, this scenario is no different than a phase-to-phase or three phase fault occurring under similar conditions.

The neutral grounding transformer is located in a mild environment and is tested as a minimum to the ANSI requirements for neutral grounding transformer. The neutral grounding transformer mounting has been evaluated to be seismically adequate. A short circuit failure is unlikely. This failure in and of itself, if it should occur, has no effect on the Class 1E system. The additional occurrence of a ground fault within the Class 1E system when the diesel generator is connected to the Class 1E bus is very unlikely. Such a scenario is bounded by the single failure criteria applied to the Class 1E Electrical System.

The Class 1E Electrical System is designed such that the unavailability of one train for whatever reason does not jeopardize the capability to start and run the required shutdown systems, emergency systems and engineered safety feature loads.

SIGNIFICANCE/EXTENT

There is no safety concern because the insulation system is capable of operating under the postulated condition. This open item is limited to DBD-EE-052.

OPEN ITEM E-23

Document Number: DBD-EE-057, Revision 0, Separation Criteria

Section 6.5.1.7 OF DBD-EE-057 states that the minimum separation of 1 inch between control and instrumentation cable trays is permitted in cable spreading areas. Further, Section 6.5.2.7 states that the same separation is permitted in general plant areas.

The IEEE Standard and the Regulatory Guide require these distances to be:

a. 1 ft. Horizontal x 3 ft. Vertical (Cable Spreading Room)

b. 3 ft. Horizontal x 5 ft. Vertical (General Plant Area)

We were unable to find adequate testing and/or analysis to justify 1" separation as stated in the DBD.

Further, these criteria are applicable to separation between Class 1E and non-Class 1E trays. In the case of non-Class 1E trays more than one cable can be carrying fault current simultaneously. This reduced clearance needs to be justified for this situation.

RESPONSE

The DBD was revised to permit a separation distance of 1 inch between Class 1E and between Class 1E and non-Class 1E control and instrument trays with a single enclosure. The adequacy of this arrangement has been demonstrated by testing (as demonstrated in Wyle Lab Test Report 48037-02). This test indicated 1 inch between cables without enclosure was sufficient for cables No. 12 AWG and smaller.

Events resulting in more than one cable carrying fault currents simultaneously in the same non-Class 1E raceway in seismic category I structures is highly unlikely at CPSES because all control and instrumentation cable is purchased as Class 1E (including non-1E cables), breakers are purchased from the same specifications as Class 1E safety-related equipment, and all cable trays in seismic I structures are installed seismic category I. Therefore, the probability of multiple faults occuring in a non-Class 1E tray, and faults not being cleared by breakers or upstream breakers is not likely. When Revision 0 of the DBD was issued, evaluation of separation testing which had been previously performed was in progress. The completed evaluation showed that the reduced separation values in conjunction with a single enclosure were adequate and the DBD was revised accordingly.

SIGNIFICANCE/EXTENT

There is no safety concern because the test has indicated that reduced separation is justified.

OPEN ITEM E-25

Document Number: DBD-EE-057, Revision 0, Separation Criteria

Report No. 17666-02, Electrical Separation Verification Testing Report for the Beaver Valley Power System, indicates that tests for power cable fault testing used #6 AWG cable as the worst case heat source. We were unable to find any analyses and/or justification that #6 AWG fault cable is the worst case heat source, e.g., compared to the larger cables, e.g., 2/0, 500 MCM, etc.

RESPONSE

Report No. 17666-02 presents the results of a series of tests that in part demonstrate the acceptability of single enclosed raceway in lieu of two enclosed raceways as presented in R.G. 1.75, Rev. 1, and IEEE-384-1974. In addition, the equivalence of a protective wrap of woven silicone dioxide to a metal enclosed raceway with respect to electrical separation was demonstrated.

The analysis relative to No. 6 AWG fault current was developed to support the single enclosed raceway concept.

The CPSES design relative to separation between power circuits and between power and control/instrument circuits is in full compliance with R.G. 1.75, Rev. 1, and IEEE 384-1974.

Where the required 5 feet vertical and 3 feet horizontal (in general plant areas) and the required 3 feet vertical and 1 foot horizontal (in cable spreading areas) between cables can not be achieved, then both cable groups are placed in enclosed raceways and those enclosed raceways are separated by 1 inch.

SIGNIFICANCE/EXTENT

There is no safety concern because such circuits at CPSES are in full compliance with R.G. 1.75 and IEEE 384-1974.

OPEN ITEM E-26

Document Number: DBD-EE-057, Revision 0, Separation Criteria

Report No. 48037-02, Raceway Separation Verification Testing for Comanche Peak, in part, uses 105 Amperes (A) for #12 AWG cable as the worst case fault current. In portions of tests, we found higher currents, e.g., 120A and 135A, producing higher insulation jacket temperatures. No justification was apparent for using 105A as the worst case test current.

RESPONSE

The worst case installed configuration I was established for No. 12 AWG cable (fault cable) by determining the current that would produce the highest temperature in the target cable. The fault cable was stabilized at the rated conductor temperature of 90°C and then the current was increased in 15 amp increments until the conductor fused. The maximum target temperature was achieved at 105 amps. Reference attached Figures I-3, II-2, and II-3, which demonstrate target cable temperature versus current and temperature of fault cable.

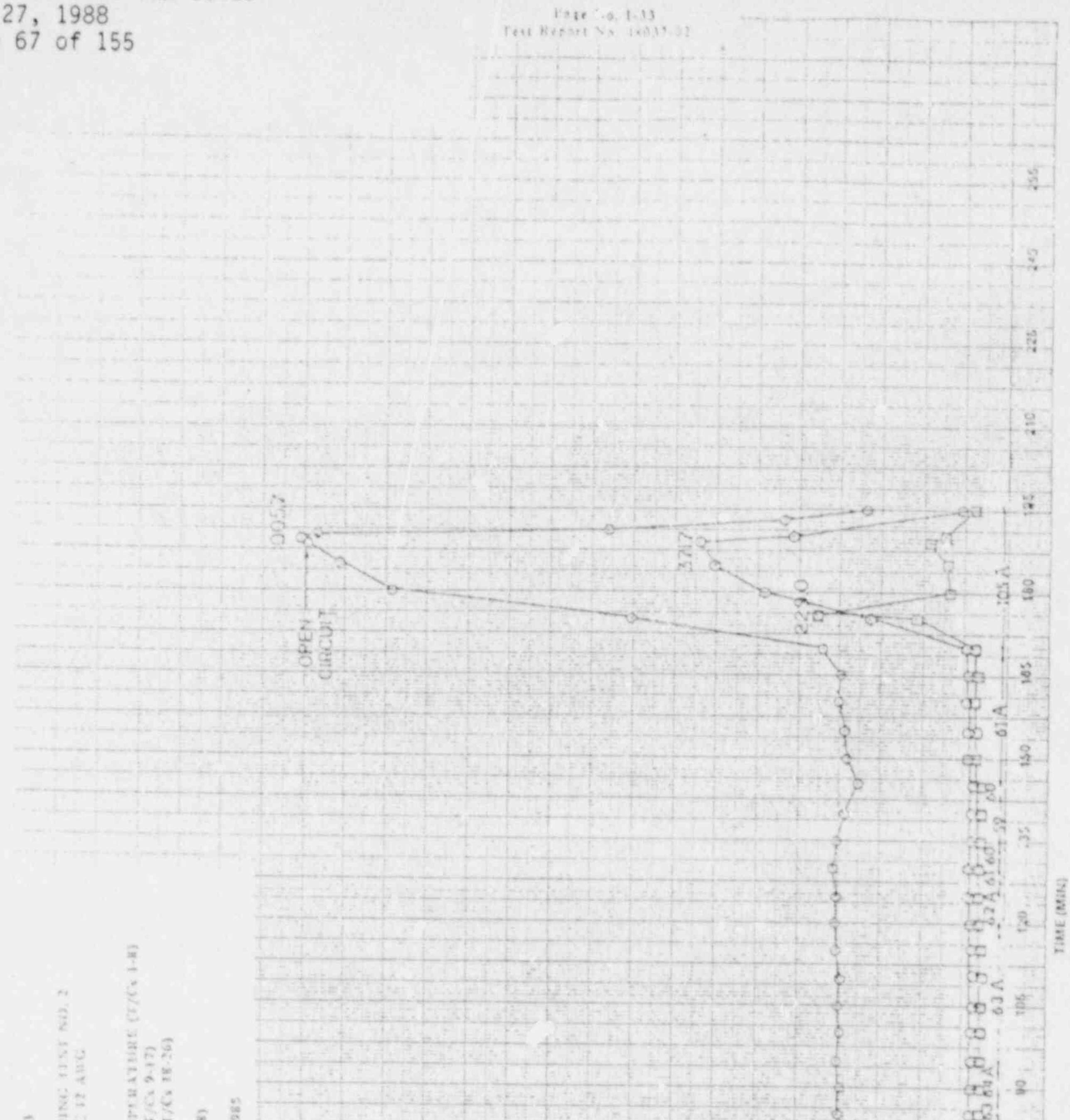
In some instances 120A and 135A produced higher insulation jacket temperatures in the faulted cable in configuration I, but in no instance did these amperages cause the target cable to exceed that produced by 105 amps as shown in Figure I-3.

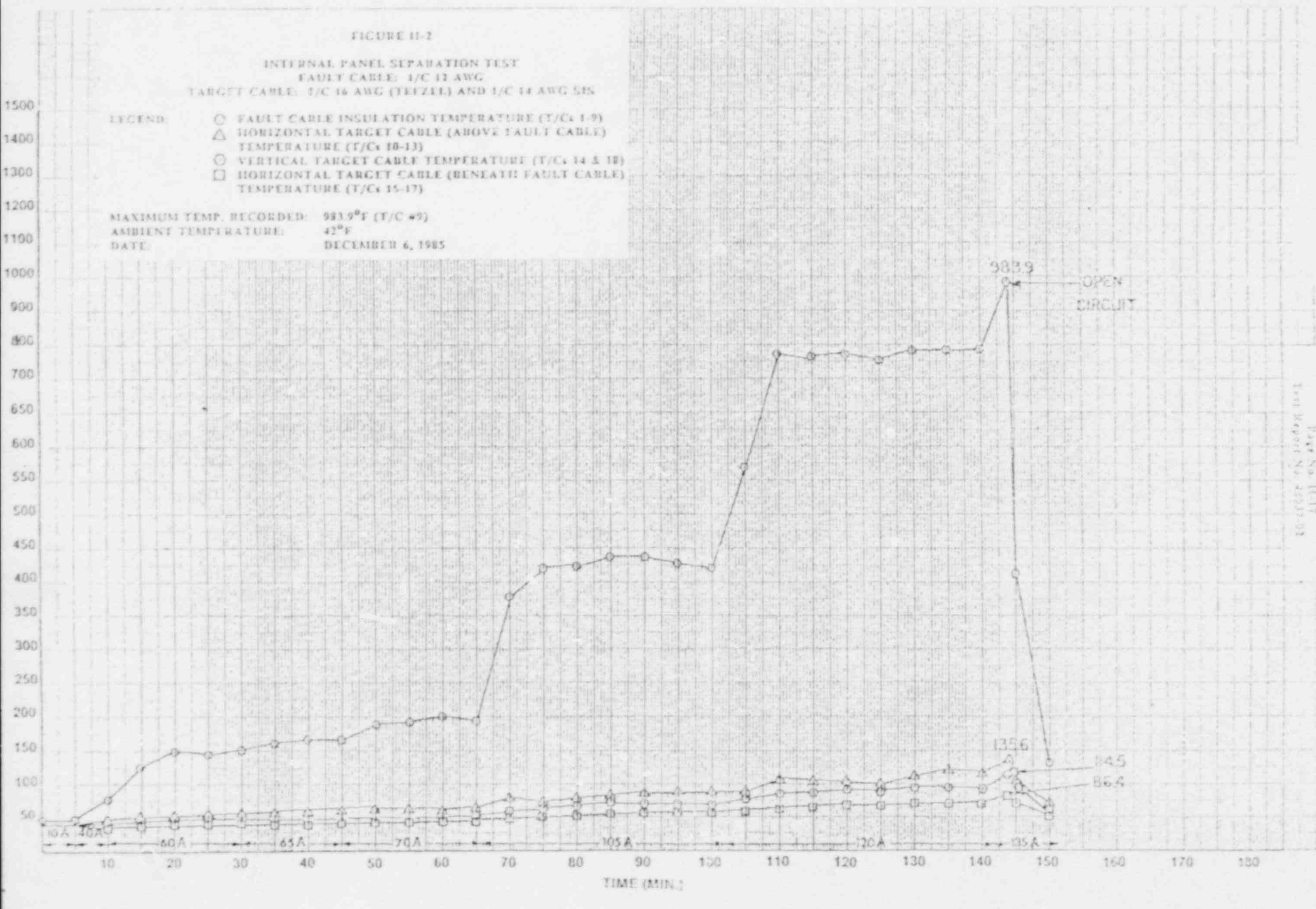
In configuration II, tests were conducted until fault cable fused. In this configuration fault currents of 120A and 135 amps did cause higher target temperatures. In this configuration, the faulted cables were in conduit and thus the heat was dissipated/conducted directly to the target cables (Reference Figure IV-18 attached). Figures IV-14 and IV-19 show increase temperatures (attached). Fault currents of 120A and 135A were used in tests for configuration II.

Therefore, in response to the question, 105A was used for configuration I and 120A and 135A were used for configuration II.

SIGNIFICANCE/EXTENT

There is no safety concern because the 105 amps (in configuration I) produced the highest target cable temperature. Higher currents in test configuration II pose no safety concerns since target cable met all acceptance criteria.


Page No. 1-33
FIGURE 1-3
CONTROL CABLE SCREENING TEST NO. 2
FAULT CABLE: 2/C 12 AWG
LEGEND:
FAULT CABLE JACKET TEMPERATURE (T/Cs 1-8)
1" ARRAY TEMPERATURE (T/Cs 9-17)
2" ARRAY TEMPERATURE (T/Cs 18-26)
MAXIMUM TEMP. RECORDED: 1005.7°F (T/C #8)
AMBIENT TEMPERATURE: 26°F
DATE: DECEMBER 3, 1985
1005.7
OPEN CIRCUIT
371.7
229.0
40A
50A
55A
60 A
63 A
61 A
105 A
TEMPERATURE (°F)
TIME (MIN)


Page No. II-17
FIGURE II-2
INTERNAL PANEL SEPARATION TEST
FAULT CABLE: 1/C 12 AWG
TARGET CABLE: 7/C 16 AWG (TEFZEL) AND 1/C 14 AWG SIS
LEGEND:
○ FAULT CABLE INSULATION TEMPERATURE (T/Cs 1-9)
△ HORIZONTAL TARGET CABLE (ABOVE FAULT CABLE) TEMPERATURE (T/Cs 10-13)
○ VERTICAL TARGET CABLE TEMPERATURE (T/Cs 14 & 18)
□ HORIZONTAL TARGET CABLE (BENEATH FAULT CABLE) TEMPERATURE (T/Cs 15-17)
MAXIMUM TEMP. RECORDED: 983.9°F (T/C #9)
AMBIENT TEMPERATURE: 42°F
DATE: DECEMBER 6, 1985
983.9
OPEN CIRCUIT
135.6
84.5
86.4
10A
40A
60A
65A
70A
105A
120A
135A
1500
1400
1300
1200
1100
1000
900
800
700
650
600
550
500
450
400
350
300
250
200
150
100
50
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
TIME (MIN.)

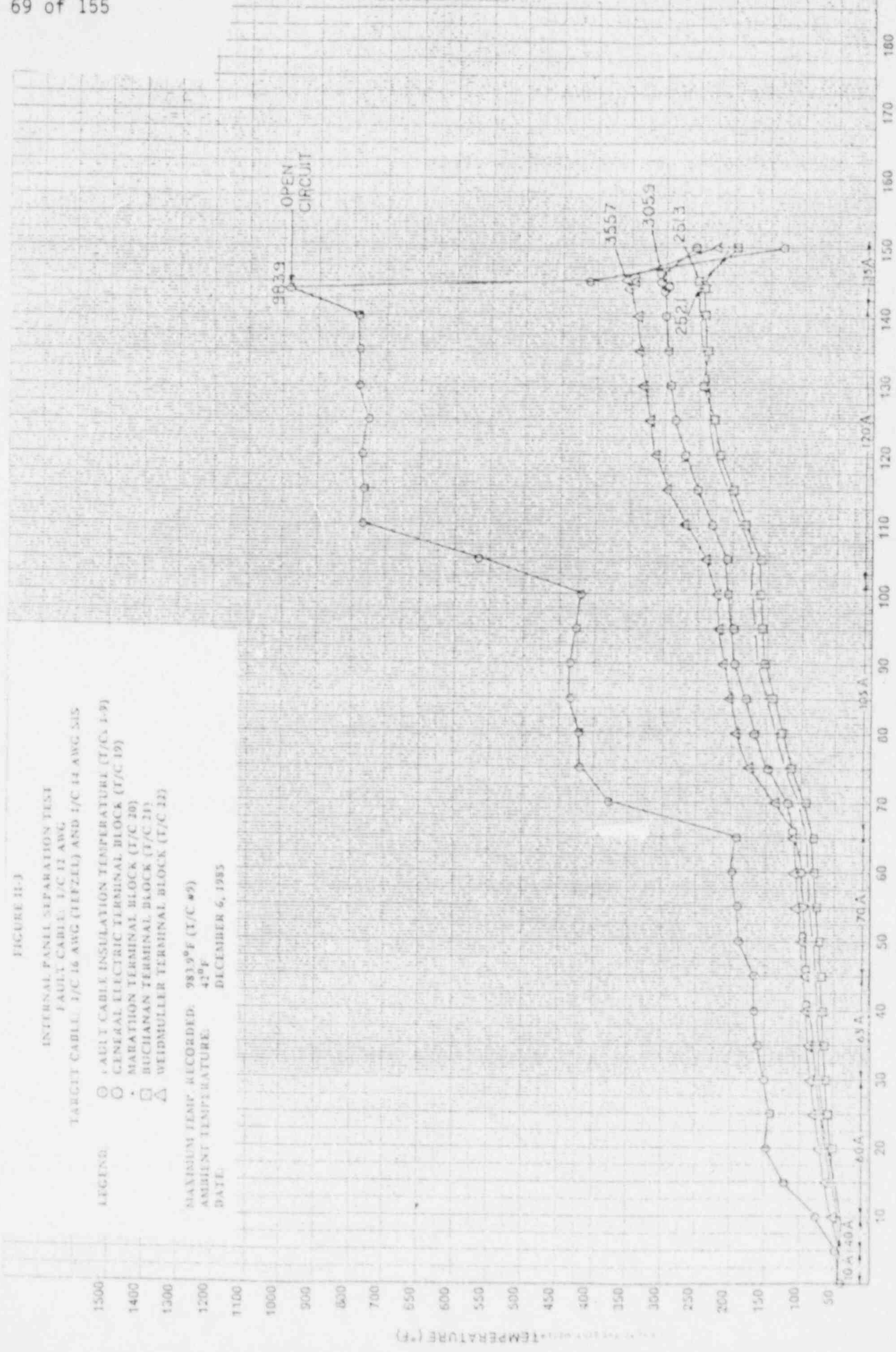


FIGURE II-3
INTERNAL PANEL SEPARATION TEST
FAULT CABLE: 1/C 12 AWG
TARGET CABLE: 1/C 16 AWG (TEFZEL) AND 1/C 14 AWG SIS
LEGEND
FAULT CABLE INSULATION TEMPERATURE (T/C 1-9)
GENERAL ELECTRIC TERMINAL BLOCK (T/C 19)
MARATHON TERMINAL BLOCK (T/C 20)
BUCHANAN TERMINAL BLOCK (T/C 21)
WEIDMULLER TERMINAL BLOCK (T/C 22)
MAXIMUM TEMP. RECORDED: 983.9°F (T/C #9)
AMBIENT TEMPERATURE: 42°F
DATE: DECEMBER 6, 1985
TEMPERATURE (°F)
TIME (MIN.)
OPEN CIRCUIT
983.9
355.7
305.9
251.3
252.1
10A
40A
60A
65A
70A
105A
120A
135A

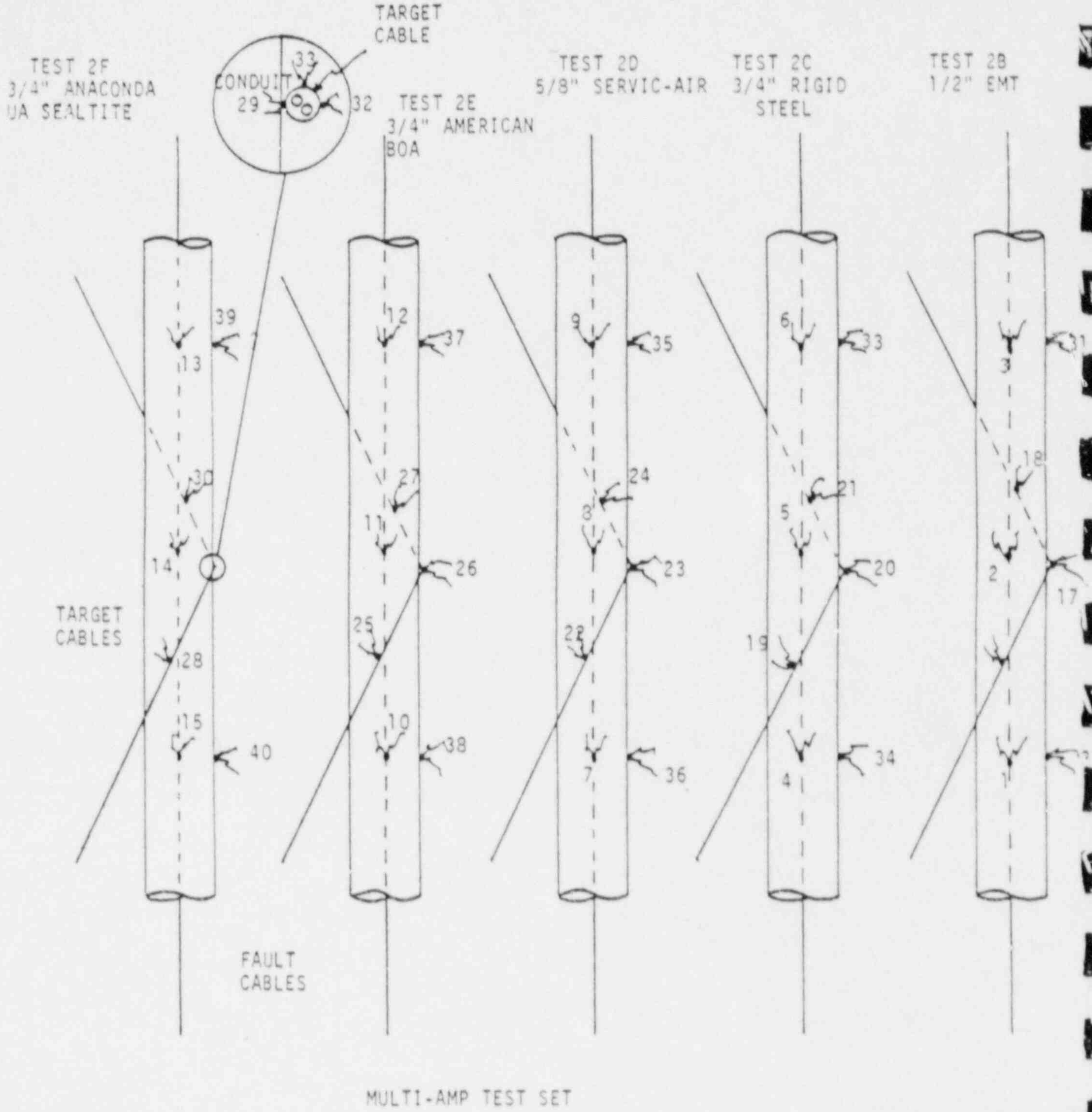


FIGURE IV-18: TEST SETUP AND THERMOCOUPLE LOCATIONS FOR TESTS 2B THROUGH 2F

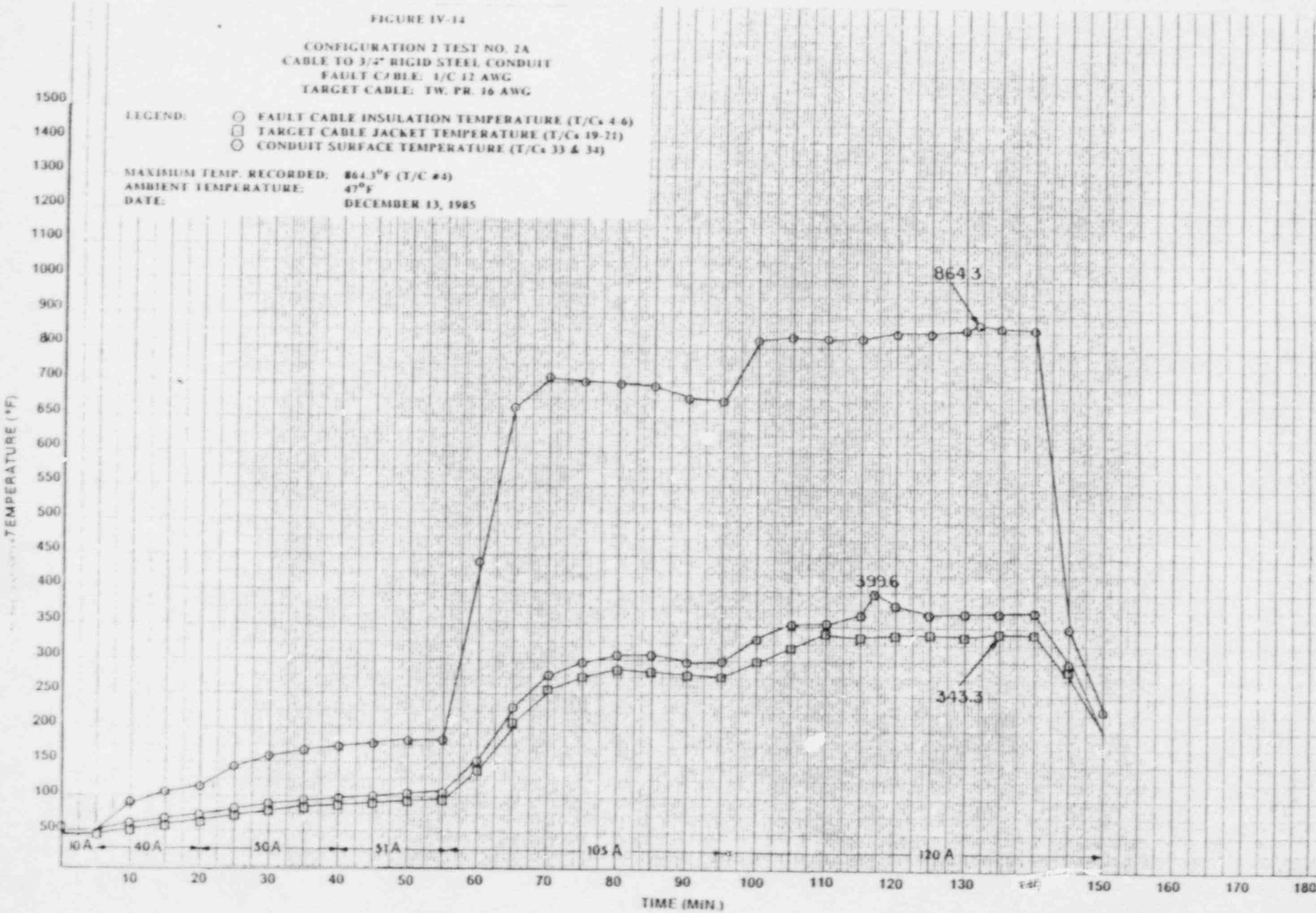


FIGURE IV-14
CONFIGURATION 2 TEST NO. 2A
CABLE TO 3/4" RIGID STEEL CONDUIT
FAULT CABLE: 1/C 12 AWG
TARGET CABLE: TW. PR. 16 AWG
LEGEND:
○ FAULT CABLE INSULATION TEMPERATURE (T/Cs 4-6)
□ TARGET CABLE JACKET TEMPERATURE (T/Cs 19-21)
○ CONDUIT SURFACE TEMPERATURE (T/Cs 33 & 34)
MAXIMUM TEMP. RECORDED: 864.3°F (T/C #4)
AMBIENT TEMPERATURE: 47°F
DATE: DECEMBER 13, 1985
864.3
399.6
343.3
10 A
40 A
50A
51A
105 A
120 A
TEMPERATURE (°F)
TIME (MIN.)

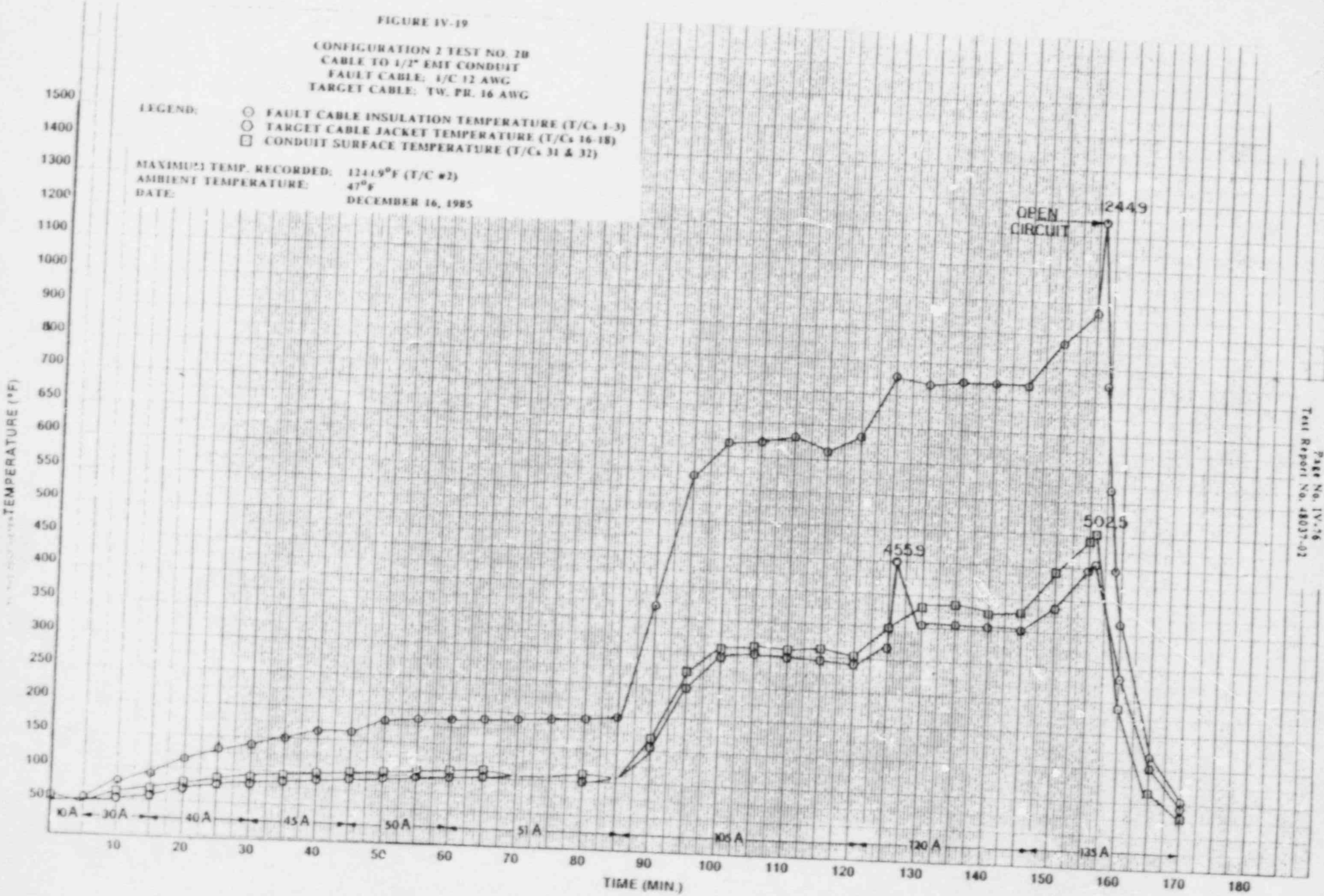


FIGURE IV-19
CONFIGURATION 2 TEST NO. 2B
CABLE TO 1/2" EMT CONDUIT
FAULT CABLE: 1/C 12 AWG
TARGET CABLE: TW. PR. 16 AWG
LEGEND:
FAULT CABLE INSULATION TEMPERATURE (T/Cs 1-3)
TARGET CABLE JACKET TEMPERATURE (T/Cs 16-18)
CONDUIT SURFACE TEMPERATURE (T/Cs 31 & 32)
MAXIMUM TEMP. RECORDED: 1244.9°F (T/C #2)
AMBIENT TEMPERATURE: 47°F
DATE: DECEMBER 16, 1985
OPEN CIRCUIT
1244.9
502.5
455.9
10A
30A
40A
45A
50A
51A
105A
120A
135A
TEMPERATURE (°F)
TIME (MIN.)

OPEN ITEM E-27

Document Number: DBD-EE-057, Revision 0, Separation Criteria

The IEEE standard requires that, for reduced separation, the circuits will be run in enclosed raceways that qualify as barriers. Section 6.4.1 in DBD-EE-057 permits a protective wrap of woven silicon dioxide as equivalent to a metal enclosed raceway. It is not clear that such a protective wrap serves the same barrier function as a metal enclosed raceway. When any cable is faulted and gases are generated in the insulation, the glass tape could rupture. In addition, handling during installation and time related aging may compromise the barrier. These aspects need to be addressed.

RESPONSE

Based on testing, when the 3M Scotch No. 69 glass tape is installed in accordance with the Electrical Installation Specification, 2323-ES-100, the glass tape barrier does not rupture, as documented in Wyle Labs Test Report No. 17666-02.

In addition, the glass tape vendor has stated that since the adhesive is a thermosetting silicone rubber with a peroxide catalyst and since the glass tape is porous, overlapping the tape (as required in the Electrical Installation Specification 2323-ES-100) will result in cross linking of the layers (Reference Attachment No. 1).

Aging is not a concern for the Siltemp wrap because of its inorganic composition.

Through the Arrhenius Technique it can be demonstrated that the glass tape has a thermal life much greater than 40 years (Reference Attachment No. 2). An activation energy of 0.269 eV for the glass tape would be required to show 40 years life at CPSES 50^{o}C ambient with the life expectancy of 22,000 hrs (2 1/2 years) at 180^{o}C continuous operating temperature as stated by 3M (Reference Attachment No. 3). Activation energies for silicone from EPRI Report NP-1558, Appendix B range from 0.9 to 1.64 eV. Utilizing an activation energy of 0.9 eV results in a thermal life of several thousand years. Other test data indicates that silicone rubber would last for greater than 40 years (Reference Attachment No. 4).

The glass tape retains its electrical/mechanical properties after exposure to 1 x 10E9 rads.

SIGNIFICANCE/EXTENT

There is no safety concern because the glass tape installation depicted in the installation specification is adequate to provide the necessary protective barriers in accordance with the requirements of IEEE 384-1974. The glass tape has insignificant time/temperature degradation in CPSES application and therefore maintenance of the barrier over the design of the plant is ensured.

Attachment I

J.O. No. 18345/18346

File No. 27-1-8 ESG/CAG

Subject: "Scotch" Brand Electrical Tape No. 69

STONE & WEBSTER ENGINEERING CORPORATION

TELEPHONE DISCUSSION ✓ (Check One)

INFORMAL DISCUSSION ____

LDNace		RMHogenmiller	
OWLowe		WGardel	
		JCamobreco*	
RWAckley	1	DEGraves*246/14	
MPObert		EHeneberry*	1
SLStamm	1	RPoltrino*	
HMCarmichael		AYC Wong*	
JSCarty*		LKelly*	
DPBarry		APrusi	
WJParker*		GUDean	
CDNardella*		DLeach	1
LEShea*		WASmith	
JCumiskey			
JConly		EDC/Chrono (CAG)	1
RJLong*			
PAWiley		EDC/Chrono (ESG)	1
APKamdar			
WTTucker			
WNKennedy			

* Located in CAG

INSTRUCTIONS: Summarize your discussion, noting date, time, and participants. Indicate desired distribution at right. Reporter must insert file number(s) in space provided above. Correspondence Control Coordinator retains original for Chrono File.

Reporter's Noted Stamp: NOTED MAY 4 1988 C.W.Earle

Call date: 5/4/88 Time: 2:05 PM

Incoming: X (Return Call) Outgoing: ____

Between: ____ & ____ (TUE)

C. Earle & ____ (S&W)

____ & ____ (CPRT)

J. Beasley & ____ (CONTRACTORS OR OTHERS)

of: Electrical Product Div/3M
St. Paul, Minnesota 55144

SUMMARY:

Mr. Beasley was contacted to verify the life expectancy of #69 Tape. In a letter between Mr. Beasley and Mr K. Petty of Stone & Webster dated February 19 1985 (attached) the thermal life was theoretically set at 40 years.

In a previous conversation on May 2, 1988 Mr. Beasley indicated that the adhesive was made of a Silicone Rubber and Per-Oxide Catalyst.

The following information was conveyed through Mr.

NOTES OF TELEPHONE CONVERSATION/INFORMAL DISCUSSION

SUMMARY: (Continued)

Beasley from Mr. M. Cartier (3M Material Specialist), the Adhesive material (composition) has not changed and that the activation energies of 0.9 to 1.64 eV taken from the EPRI could be used to show thermal life. In addition since the #69 tape was [illegible] and that tape was over lapping, the adhesive of one layer would [illegible] with the adhesive of the other layer (i.e. the catalyst would cause the silicone layers to cross link).

Attachment II (COPY)

J.O./W.O./CALCULATION NO.	REVISION	PAGE
18051.03		1 OF 2

CLIENT/PROJECT	QA CATEGORY/CODE CLASS
TU ELECTRIC/COMANCHE PEAK STEAM ELECTRIC STATION	

SUBJECT/TITLE

Thermal Life of 3M "Scotch" No. 69 Glass Tape

OBJECTIVE OF CALCULATION

The purpose of this calculation is to demonstrate that the Thermal Life of 40 years is conservative.

CALCULATION METHOD/ASSUMPTIONS

Arrhenius Technique as accepted by NUREG-0588, Revision 1

SOURCES OF DATA/EQUATIONS

EPRI Report NP-1558, Appendix B
3M Letter Date February 15, 1985

CONCLUSIONS

Based on the differences in activation energies of 0.269 acceptable and those given in EPRI Report NP-1558 of 0.9 to 1.64, the Thermal Life of 40 years given by 3M in the letter dated February 15, 1985 is conservative.

REVIEWER(S) COMMENTS		
none	PREPARER Charles W. Earle Charles W. Earle	DATE 5/5/88
	REVIEWER/CHECKER DEBORAH KING Deborah King	DATE 5/5/88
	INDEPENDENT REVIEWER DEBORAH KING Deborah King	DATE 5/5/88

STONE & WEBSTER ENGINEERING CORPORATION

CALCULATION SHEET

CALCULATION IDENTIFICATION NUMBER				
J.O. OR W.O. NO. 18051.03	DIVISION & GROUP	CALCULATION NO.	OPTIONAL TASK CODE	PAGE 2

METHOD

Arrhenius Equation

$$t2 = t1\, e^{-A(1/T1 - 1/T2)/K}$$

t1 - Normal/Service time
t2 - Accelerated Aging time
T1 - Normal Ambient Temperature
(50 C/323.2 K Max Normal Anticipated Temperature)
T2 - Accelerated Aging Temperature
(180 C/453.2 K from 3M Letter)
A - Activation Energy
K - Boltamann's Constant (8.617 x 10E-5)

The minimum activation energy that would support a qualified life of 40 years can be determined by using the data point from the 3M letter and the Maximum anticipated temperature of CPSES (50 C). The Arrhenius equation can be re-written solving for the activation energy and minimum value obtained (below)

$$A = [-K \ln (t2/t1)]/(1/T1 - 1/T2)$$

Substituting 3M and CPSES conditions

$$A = [-(8.617 \times 10E-5) \ln (50/2.5)]/(1/323.2 - 1/453.2) = -0.269$$

From EPRI Report NP-1558, Appendix "B" using the activation energy of 0.9 t2 can be calculated to be equal to greater than 26 thousand years.

$$1/t1 = (1/t2)\, e^{-A(1/T1 - 1/T2)/K}$$

$$1/t1 = (1/2.5)\, e^{-0.9(1/323.2 - 1/453.2)/8.617E-5}$$

t1 = 26 thousand years

Attachment III

Electrical Products Division/3M

3M Center
St. Paul, Minnesota 55144
612/733 1110

3M

February 19, 1985

Stone and Weber Engineering
PO Box 2325
Boston, MA 02107

Attention: Mr. Keith Petty

Dear Keith:

This is in response to your request for information concerning the construction of #69 tape, its thermal rating relative to a 40 year life and its ability to withstand radiation.

1. Construction: This tape is comprised of a woven-glass cloth backing coated with a thermosetting silicone adhesive. See enclosed specification for full description.

2. Thermal Life: Theoretically, the operating life of the tape could be as long as 40 years under an intermittent temperature of 70°C. We, however, have extrapolated its life expectancy out to 20,000 hours (2 1/2 years) at a continuous operating temperature of 180°C under normal atmospheric conditions.

   Because our tapes are used in a variety of applications with various temperature requirements, we feel that it is more meaningful and practical for the end-user to conduct his own life-cycle study with respect to his particular requirements.

3. Radiation Resistance: Based upon laboratory results, #69 retained its flexibility and good mechanical and electrical properties after exposure to 10^9 rods of accumulative gamma radiation. In as much as this was a short term screening test and does not simulate all end-use conditions, it is advisable that the user conduct his own study to insure suitability.

Should you find that I can be of further service, do not hesitate to let me know.

Sincerely,

J.J. Beasley
Technical Service &
Applications Engineering
Bldg 260-5B-04
Telephone: 612/733-9166

cc: D. Baratto
R. Conner
G. Long - West Caldwell Branch

TABLE I

PHYSICAL REQUIREMENTS

TEST DESCRIPTION	UNITS	REQUIRED FOR QUAL.	REQUIRED FOR INSP.	TEST METHOD	REQUIREMENTS: AVERAGE OF SPECIFIED NO. OF DETERMINATIONS	REQUIREMENTS: TOLERANCE
Width	Inches (mm)	Yes	Yes	Para. 4.5.1	As Specified	±1/32 (1)
Thickness	Inches (mm)	Yes	Yes	Para. 4.5.2	.0070 (.1778)	±0.001 (.0
Adhesion to Steel	Oz./In. (N/10 mm)	Yes	Yes	Para. 4.5.3	35 (3.8)	Minimum
Tensile Strength	Lbs./In. (N/10 mm)	Yes	Yes	Para. 4.5.6	120 (210)	Minimum
Dielectric Breakdown	Volts (KV)	Yes	Yes	Para. 4.5.8	2000 (2.0)	Minimum
Corrosion Factor	Ratio	Yes	No	Para. 4.5.9	0.95	Minimum
Corpper Corrosion	None	Yes	No	Para. 4.5.10	See Para. 4.5.10.2	
Insulation Resistance	Megohms (Megohms/25 mm)	Yes	Yes	Para. 4.5.11	50 (50)	Minimum

A PRODUCT SPECIFICATION FOR WHITE, GLASS CLOTH THERMOSETTING PRESSURE-SENSITIVE SILICONE ELECTRICAL TAPE ("SCOTCH" BRAND ELECTRICAL TAPE NO. 69)

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1. SCOPE

This specification defines a white, glass cloth, thermosetting silicone, pressure-sensitive adhesive electrical insulating tape.

2. REQUIREMENTS

2.1 Qualification:

The electrical insulation tape furnished under this specification shall be a product which has been tested and has passed the Qualification tests specified herein.

2.2 Construction:

The tape shall consist of .0045" (.114 mm) glass cloth coated on one side with a white non-corrosive thermosetting silicone pressure-sensitive adhesive.

2.3 Rolls:

The tape shall be furnished in 36 yard (33 m) lengths wound on 3-inch (76.2 mm) inside diameter cores.

2.4 Physical Requirements:

The tape shall conform to the physical requirements specified in Table I.

2.5 Workmanship:

The workmanship shall be in accordance with high-grade manufacturing practice for this type of product.

3. APPLICABLE DOCUMENTS

The following publications shall form a part of this specification to the extent specified herein.

3.1 ASTM Designation D-1000 Latest Issue
(Copies of this document may be obtained from the American Society for Testing Materials, 1916 Race Street, Philadelphia , Pennsylvania 191

3.2 "Direct Method of Measuring Electrolytic Corrosion"
(Copies of this document may be obtained from the EM&S Laboratory, The 3M Company, 3M Center, St. Paul, MN 55101).

4. QUALITY ASSURANCE PROVISIONS

4.1 Classification of Tests - Tests to establish the conformance of tape to this specification shall be divided into Qualification and Inspection Tests.

(a) Qualification Tests - Qualification tests are those tests initially performed on the tape to secure approval of the tape as an acceptabl product.

(b) Inspection Tests - Inspection tests are those preformed on individua lots shipped against a purchase order.

4.2 Qualification Tests. -

4.2.1 Sampling Instructions - The Qualification test samples shall consist of five rolls uspplied by the vendor on order of the purchaser.

4.2.2 Tests. - The Qualification tests shall consist of all those so identified in Table I, and shall be performed according to the appropriate paragraphs of this specification.

4.2.3 Rejection. - Failure of any sample to conform to all the requirements of this specification shall disqualify the product represented.

4.3 Inspection Tests -

4.3.1 Sampling Instructions. - Inspection test samples shall be selected in accordance with ASTM D-1000.

4.3.2 Tests. - The Inspection tests shall consist of all those so identified in Table I.

4.3.3 Rejection and Retest. - Failure of any sample to conform to all of the applicable requirements of this specification shall be cause for retest. Two additional samples shall be retested; failure of either shall be cause for rejection of the entire lot represented.

4.4 Test Conditions. -

4.4.1 Selection and Conditioning of Specimens. - Specimens from sample rolls shall be selected, removed, and subsequently handled and conditioned according to the procedures outlined in ASTM-D-1000 unless otherwise specified.

4.5 Test Methods. - The tests referred to in Table I shall be performed in accordance with the following paragraphs.

4.5.1 Width. - A specimen of tape, at least 18 inches (457 mm) long, shall be removed from the roll and placed adhesive side up on a smooth flat surface. The specimen shall be allowed to relax to remove any latent elongation induced by the tension exerted on the tape during removal from the roll. The width of the relaxed specimen shall then be measured to the nearest 1/64-inch (.4 mm) using a standard steel scale. Ten measurements shall be made uniformly distributed along the length of the specimen. The width of the sample shall be the average of the ten measurements made on the specimen.

4.5.2 Thickness. - Thickness determinations shall be made in accordance with ASTM-D-1000.

4.5.3 Adhesion to Steel. - Tests for adhesion to steel shall be performed in accordance with ASTM-D-1000. Both sides of double coated tapes shall be tested.

4.5.4 Adhesion to Backing. - Tests for adhesion to backing shall be performed in accordance with ASTM-D-1000.

4.5.5 Resin Adhesion to Backing. - The sides of a 8" (203 mm) x 8" (203 mm) metal pan or other suitable container shall be lined with "SCOTCH" Brand #60 or #61 TFE-Fluorocarbon tape. The bottom of the pan is then lined with the tape to be tested by butt lapping the tape adhesive side down leaving a 2" (50 mm) tab at one end. The backing surface of the tape shall be cleaned with acetone saturated lintless wiping tissue. A room cure epoxy resin, "SCOTCHCAST" Brand No. 8 preferred, shall be poured onto the backing to an approximate depth of 1/8" (3.2 mm) and allowed to cure at room temperature for 24 hours. The sample shall then be removed and the tape slit in 1" (25.4 mm) widths from the adhesive side. (Do not attempt to cut through the resin.) Determine the adhesion of the tape backside to resin by pulling back at 180° on a tensile tested in accordance with the ASTM-D-1000 adhesion to steel method. Record the average value in oz./inch (N/10 mm) of four samples.

4.5.6 Tensile Strength - Ultimate tensile or breaking strength shall be measured in accordance with ASTM-D-1000.

4.5.7 Ultimate Elongation. - Ultimate elongation shall be measured coincidentially with tensile strength in accordance with ASTM-D-1000.

4.5.8 Dielectric Breakdown - Dielectric Breakdown tests shall be made in accordance with ASTM-D-1000.

4.5.9 Corrosion Factor - Corrosion factor determinations shall be made on three specimens prepared and tested according to the "Direct Method for Measuring Electrolytic Corrosion" (see paragraph 3.2 of this specification).

4.5.10 Copper Corrosion -

4.5.10.1 Preparation of Specimens and Test Method - Two identical copper plates (such as bus bar of 1/4" (6.35 mm) x 3" (76.2 mm) cross-section) shall be thoroughly polished with a 100 grit aluminum oxide flap wheel to remove all surface contamination. Three tape specimens of convenient length shall be cut from each sample roll and placed adhesive side down on one plate. An area of the plate at least equal to twice the area of the largest specimen shall be left uncovered as a control area. The second plate shall then be placed directly over the first and the two clamped firmly and uniformly together using "C" clamps or an equivalent device. The assembly shall then be placed in an oven at 100 ± 2°C. for 72 hrs. The oven used shall have forced ventilation. Upon removal from the oven, the assembly shall be permitted to cool to 23 ± 1.1°C. before the plates are unclamped and the samples removed.

4.5.10.2 Evaluation of Results - The plate surfaces in contact with back and face (adhesive) sides of the specimens shall be examined for the characteristic blue-black color of copper sulfide. Tape producing such discoloration in comparison with the control area shall have failed the test.

4.5.11 Insulation Resistance - Insulation resistance shall be measured in accordance with The Resistance Method for Indirect Measurement of Electrolytic Corrosion, ASTM-D-1000.

4.5.12 Bond Separation After Cure - Bond separation after cure shall be determined by measuring the time to failure of an adhesive-to-adhesive bond subjected to a constant shear stress at elevated temperature after cure. The tests shall be conducted in accordance with ASTM-D-1000. The weight and cure temperature to be used are specified in Table I. Test temperature shall be 130 ± 2°C.

Attachment IV

THE ROCKBESTOS COMPANY
NEW HAVEN, CONNECTICUT 06504 USA TELEPHONE (203) 772-2250 TELEX 710-465-2149

March 11, 1985

Stone & Webster Engineering Corp.
245 Summer Street
Boston, Massachusetts 02107

Attention: Mr. Keith Petty

SUBJECT: QUALIFIED LIFE FOR SILICONE RUBBER AT TEMPERATURE GREATER THAN 125°C

Dear Mr. Petty:

Review of our aging and qualification data on Rockbestos Firewall SR (Silicone Rubber) insulation indicates that although considerable margin is contained in the 125°C qualification (approximately 100%) predicted qualified life falls off sharply with increasing temperature.

Attached is a computer printout of temperature (with no margin) for which the insulation could be considered qualified based on as tested aging (1400 hrs. at 180°C). The calculation was repeated based on the actual Arrhenius data. These calculations are reflected in the attached plot.

The results seem to indicate that, based on this data, 150°C is the present practical limit on which qualification can be based.

After you have reviewed this data, I would welcome your thoughts or suggestions.

Very truly yours,

THE ROCKBESTOS COMPANY

Robert J. Gehm
Mgr. Electrical & Product Eng.

RJG/agh

Attachment

cc E. J. O'Aquanno
W. J. Patterson

****KS 500 (SILICONE RUBBER)****

CALCULATION OF ARRHENIUS REGRESSION LINE BASED ON 50
% RETENTION OF ELONGATION AFTER AIR OVEN AGING
THERE ARE 3 DATA POINTS

HOURS	TEMPERATURE (DEG C)	LOG(e) HOURS	RECIP ABS TEMP (1/DEG K X 1000)
340	200	5.8289	2.1140
900	190	6.8023	2.1598
2400	180	7.7832	2.2075

Life (HRS) = A*exp(B/T)　　　　LOG(e) HRS = LOG(e) A + B/T
REF IEEE STD 101A-1974 APPENDIX A

SLOPE (B) = +20943.4758
INTERCEPT (LOG(e) A) = -38.4436
CORRELATION COEFFICIENT (R) = -.9999

REGRESSION POINT TEMPERATURE FOR 40 YEARS = 135.9636 DEG C

REGRESSION POINT TEMPERATURE FOR 100 HOURS = 213.5060 DEG C

ACTIVATION ENERGY = 1.8047 eV

BASED ON 1400 HRS AT 180 DEG C. QUALIFIED LIFE AT 125 DEG C IS:
832732.16 HOURS OR 95.06 YEARS

BASED ON 1400 HRS AT 180 DEGREES C. QUALIFIED TEMPERATURE FOR 40
YEARS SERVICE IS 131.66 DEGREES C

BASED ON 1400 HRS AT 180 DEGREES C. QUALIFIED TEMPERATURE FOR 30
YEARS SERVICE IS 173.92 DEGREES C

BASED ON 1400 HRS AT 180 DEGREES C. QUALIFIED TEMPERATURE FOR 20
YEARS SERVICE IS 137.19 DEGREES C

BASED ON 1400 HRS AT 180 DEGREES C. QUALIFIED TEMPERATURE FOR 1[illegible]
YEARS SERVICE IS 1[illegible].79 DEGREES C

BASED ON 1400 HRS AT 180 DEGREES C. QUALIFIED TEMPERATURE FOR [illegible]

BASED ON 1400 HRS AT 180 DEGREES C. QUALIFIED TEMPERATURE FOR 2 YEARS SERVICE IS 156.52 DEGREES C

BASED ON 1400 HRS AT 180 DEGREES C. QUALIFIED TEMPERATURE FOR 1 YEARS SERVICE IS 162.71 DEGREES C

BASED ON 2400 HRS AT 180 DEGREES C. QUALIFIED TEMPERATURE FOR 40 YEARS SERVICE IS 138.23 DEGREES C

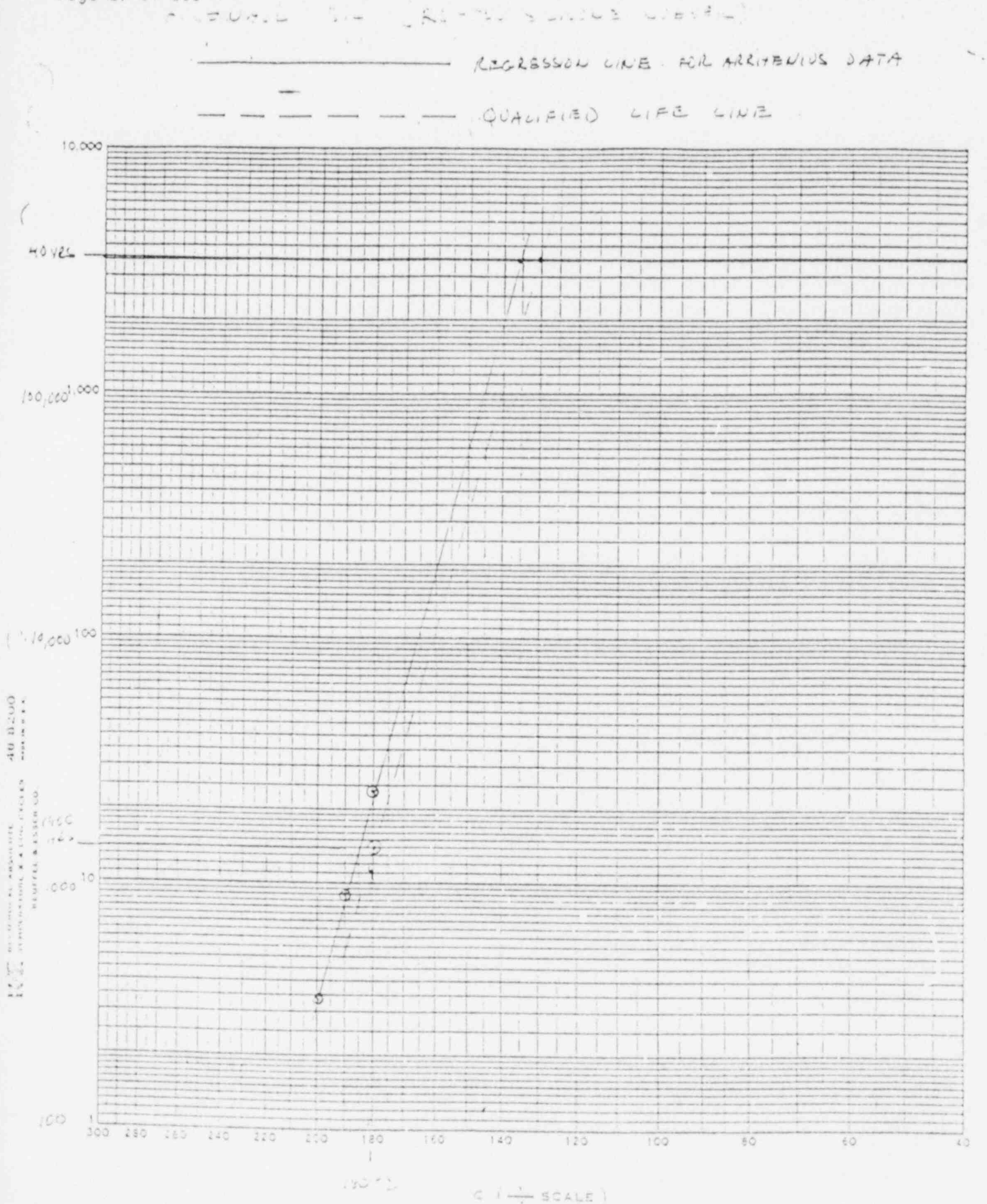
BASED ON 2400 HRS AT 180 DEGREES C. QUALIFIED TEMPERATURE FOR 20 YEARS SERVICE IS 141.53 DEGREES C

BASED ON 2400 HRS AT 180 DEGREES C. QUALIFIED TEMPERATURE FOR 10 YEARS SERVICE IS 147.29 DEGREES C

BASED ON 2400 HRS AT 180 DEGREES C. QUALIFIED TEMPERATURE FOR 5 YEARS SERVICE IS 153.12 DEGREES C

BASED ON 2400 HRS AT 180 DEGREES C. QUALIFIED TEMPERATURE FOR 2 YEARS SERVICE IS 161.32 DEGREES C

BASED ON 2400 HRS AT 180 DEGREES C. QUALIFIED TEMPERATURE FOR 1 YEARS SERVICE IS 167.65 DEGREES C


REGRESSION LINE FOR ARRHENIUS DATA
QUALIFIED LIFE LINE
40 YRS
10,000
1,000
100
10
1
300
280
260
240
220
200
180
160
140
120
100
80
60
40
SCALE

OPEN ITEM E-29

Document Number: DBD-EE-057, Revision 0, Separation Criteria

Section 4.1.3 in DBD-EE-057 states, "Lack of isolation device shall be justified by analysis". We found that analyses and justifications were prepared for the power level circuits. Similar analyses for the control and instrumentation circuits were not available.

We also reviewed the disposition of various field identified problems (Refer to documents listed under 1.f through 1.s.) These have been adequately dispositioned in accordance DBD-EE-057.

RESPONSE

Refer to Amendment 68 FSAR Section 8.3.1.2.1, paragraph 7.B and C for isolation of control and instrumentation circuits.

The DBD-EE-057, Section 4.1.3 provision for "Lack of isolation device shall be justified by analysis" has not been utilized. In all cases an isolation device has been provided. All Class 1E elementary diagrams have been reviewed to assure that all circuit devices are either specified as Class 1E or an isolation device is provided.

SIGNIFICANCE/EXTENT

There is no safety concern because the FSAR change documents analyses of isolation devices for the control and instrumentation circuits.

OPEN ITEM E-31

Document Number: SWEC Drawing 2323-E1-0031, Sheet 7, Rev. #CP-3, "6.9 kV Switchgear Buss 1EA2 Breaker #1EA2-2, Schematic Drawings"

The drawing does not show the contacts from the lockout relays 86-1/ST1 and 86-2/ST1 in the tripping circuit of breaker 1EA2-2. These lockout relays are actuated by the transformer XST1 primary and backup protective relaying schemes. As such, for a fault on this transformer or its associated cables, the breaker 1EA2-2 must be tripped to isolate the faulted section. Also, permissives from the relays 86-1/ST1 and 86-2/ST1 must be provided in the breaker 1EA2-2 closing circuit to prevent its closing onto a faulted section.

Other schematic drawings should be reviewed for similar problems.

RESPONSE

Changes are required to lockout relays in the circuit breaker control circuits due to the addition of a new startup transformer. The circuits involved are safety related systems.

DCA 73121 has been issued to revise the functional operation of lockout relays 86-1/ST1 and 86-2/ST2 where required.

The open item arose from review of drawings which had not yet been revised to reflect the lockout relay scheme changes due to the addition of the new startup transformer.

All elementary diagrams impacted by the CPSES station service modification, as defined by the Design Modification Change document, have been revised.

SIGNIFICANCE/EXTENT

There is no safety significance because the elementary diagrams will be reviewed and revised as required by the Design Modification Change process which is in progress.

OPEN ITEM E-32

Document Number: Pre-Operational Test Procedure, 1CP-PT-29-04, RT-1, Rev. 0, "Diesel Generator Sequencing and Operational Stability Test - Retest"

The test report does not show how the test objectives were met. Actual step loading was considerably below the current design step loading. This report does not show the capability of the diesel generator to accept the current design loads without exceeding the specification limits has been proven.

RESPONSE

The intent of preoperational test procedure 1CP-PT-29-04, RT-1, Rev. 0 was to demonstrate that each unit is capable of accepting sequenced equipment, utilizing actual plant loads appropriate for the existing plant conditions, without exceeding specification and design criteria and this was demonstrated. However, this test objective is not clearly stated and the procedure is now being revised to address it. Due to conservatism in the calculation (use of name plate H.P. rather than BHP) and actual plant conditions, the actual loads seen by the machine during the test were significantly less than the design loads. The capability to accept the design loads is addressed in the response to Item E-33.

Pre-operational Test Procedure 1CP-PT-29-04, RT-1, Rev. 0, (Diesel Generator Sequencing and Operational Stability Test (Retest)) is currently being revised and will be re-performed under the Pre-Start Test Program to satisfactorily demonstrate its intended Test Objective. The Test Procedure will be revised to demonstrate that each unit is capable of independently accepting sequenced equipment without exceeding manufacturer specifications and design criteria. Due to System/Equipment test limitations, the test will be performed utilizing actual plant loads apropriate for the existing plant condition; however, verification of diesel generator capability to accept the current design loading is demonstrated by vendor shop tests as addressed in the response to Item E-33. An FSAR change has been initiated to revise CPSES FSAR Table 14.2-2 to clarify the diesel generator test methodology.

SIGNIFICANCE/EXTENT

There is no safety significance because the vendor shop test demonstrates the capability of the diesel generator to accept plant design load.

OPEN ITEM E-33

Document Number: Gibbs & Hill Calculation V-5, Rev. 9, "Emergency Diesel Generator Sizing"

On sheet 44A of this calculation, a curve providing motor starting capability of the diesel generator has been included. This curve forms the basis for proving the diesel generator adequacy. However, the basis of acceptability of this curve has not been established, e.g., based on test data.

RESPONSE

The basis for the motor starting capability curve could not be produced by the Vendor, IMO DeLaval. The motor starting capability of the diesel generator is adequate for the loads (G&H Calculation V-5 validation record 1-13 k-C-076-1) based on a review of the IMO DeLaval Inc., factory sequence load test and as confirmed by IMO DeLaval letter dated April 21, 1988 attached hereto.

For all starting steps except one, starting KW is less than or equal to the factory test report results. For this one exception, the required starting KW is marginally above the tested starting KW. The factory test is not the limiting capability of DG as can be observed by the small variation of the frequency. It can be readily determined from the small change in frequency shown in the factory test report, that the capability of the diesel generator had not been exceeded. The permissible frequency variation is -5 percent. The maximum test variation was less than 1.0 percent. This has been confirmed by IMO DeLaval's April 21, 1988 letter.

In reference to Item 7 of that letter, the base load of 6232 KW is not developed by an increment of a single load of 1538 KW. The 1538 KW is the sum of two sequenced loads (418 KW and 8 KW) and many manually started loads. The addition of 1538 KW in multiple increments produces a total loading within the rating of the generator.

The maximum kVA increase for the diesel-generator is in step 1 of blackout loading and it is 9388 kVA. The test report showed the maximum voltage dip of 12 percent at a load of 9010 kVA. The permissible voltage dip should not exceed 20 percent. Since the excitation system response over small increments may be considered linear the expected value of voltage drop should be less than 13 percent. The voltage recovery time during this test was 0.44 seconds. The permissible voltage recovery time is 2 seconds. Therefore, the 9388 kVA step is within the diesel-generator capability because voltage dip will be less than 20 percent and it will recover within 2 seconds. The other load steps are less and will result in lower voltage dips. This has been confirmed by DeLaval letter (Item 4).

The validation record will be updated by 6/30/88 to reflect that the factory sequence load test is the basis for the acceptability of the motor starting capability of the diesel generator instead of the motor starting capability curve supplied by the vendor.

SIGNIFICANCE/EXTENT

There is no safety significance since the factory sequence load test demonstrates the capability of the diesel generator to provide the required motor starting capability and to meet the licensing commitments.

Imo Delaval Inc.
Enterprise Engine Division
Enterprise Way and 85th Avenue
P. O. Box 2161
Oakland, CA 94621
415 577 7400

April 21, 1988

STONE & WEBSTER ENGINEERING CORPORATION
245 Summer Street
Boston, Massachusetts 02107

Attention: Rocky Schustrin

Gentlemen:

I have compared the factory sequential loading test results with the loading sequence outlined in the Stone and Webster telefax of 4/8/88, and can report as follows:

1. LOCA loading transients are less severe than blackout loading transients. Therefore, the analysis is confined to the latter sequence.

2. The response curve for the factory sequential loading test (2.6.6.1A) shows that a significant margin existed above the specified minimum response. Those specifications required that voltage not dip below 20% of rated voltage and it must recover to 100% of rated within 2 seconds. Frequency dip must not exceed 5% of rated frequency, and must recover to 98% within 2 seconds. The values therefore are 6.9 KV rated, 5.52 KV minimum, 60 HZ rated, 57 HZ minimum, recovering to 58.8 HZ within two seconds. The minimum voltage experienced at the factory was 6.075 KV at step #1, while the minimum frequency in all steps, except #6, was 58.6 HZ. Step 6 will be addressed below. Voltage recovery occurred at less than one second, except for step 1, where it required a little over one second, while frequency recovery was worst case at step 4, requiring .96 seconds. It must be remembered that frequency deviation is caused by changes in generator shaft torque absorption, and this is a function of KW, KVAR not playing a role.

3. Frequency control is in part a function of the system's ability to change the rate of heat release in the engine cylinders. This ability remains rather constant as long as the upper end of the control range is not

encountered. The engine's fuel injection pumps have a mechanical stop at 48 MM of fuel pump rack travel because it was determined by test that injection spray characteristics deteriorate significantly above this travel, to the extent that even though more fuel can be injected, it results in more smoke and not more shaft torque. Full rated load of 7000 KW can be developed using 38 MM of fuel rack travel, allowing 10 MM for governing.

Therefore, any load transient which requires the governing system to call for more than 48 MM of fuel rack travel will cause a larger than normal frequency dip and require a larger than normal recovery time. It is obvious that any given transient applied from a higher base load level will approach this stop more closely than if applied from a lower base load level. Such was the case at step 6, where a transient of about 24% of rated KW capacity was applied to a base load of about 75% of rated KW capacity. Note that step 4 is also a transient of about 24%, but since it was applied at a 50% base level, frequency control was much better.

4. Voltage control is a function of the system's ability to change the excitation current in the generator windings. The regulating device senses KVA, and since compound excitation is used, loan current is utilized in providing field current. It follows then, that at step 1, where there is no base load current, voltage excursions will be greatest upon application of a transient load. The factory test results confirm this, with a 9009 KVA application at step 1 producing a larger voltage change than the 9445 KVA transient applied at step 6.

5. Comparison of the two sequences shows the S & W loading step #1 will apply 9388 KVA to the system, or 4.2% more than the factory test. Since, over small increments, the excitation response can be considered linear, the voltage should dip 4.2% more than in the factory test, or to 6.042 KV, still well within specification. Step

2, 6 and 7 of the S & W sequence will apply significantly more KVA than the factory test, but well below the 9445 KVA of the factory's step #6. Therefore, the voltage response will still be within specification.

6. Step 2 of the S & W sequence will apply 0.9% more of rated capacity in KW to the engine than did the factory test. But since this step produced a frequency dip of only 0.6 HZ, and it is applied at very low base loading, there is plenty of margin to accomodate this small increase. All other S & W load steps are less severe than the factory test with respect to the engine loading and these steps diminish in size as higher base loads are developed. Therefore, there will be no problem expected with this sequence with respect to frequency control.

7. It is assumed, in the above discussion, that the "after 4 hours" base load of 6232 KW will be developed in several small steps. If on the contrary, it is developed by applying a single step, such as to raise the load 1538 KW from the base of 67% of rated KW, then the upper end of the frequency control range could be encountered, with the result being similiar to the data noted in the factory test traces at step 6. The final step load will occur at 6232 KW, or 89% of rated KW, and will elevate the base load by 5%, and should produce results similiar to step 7 of the factory test.

Regards,

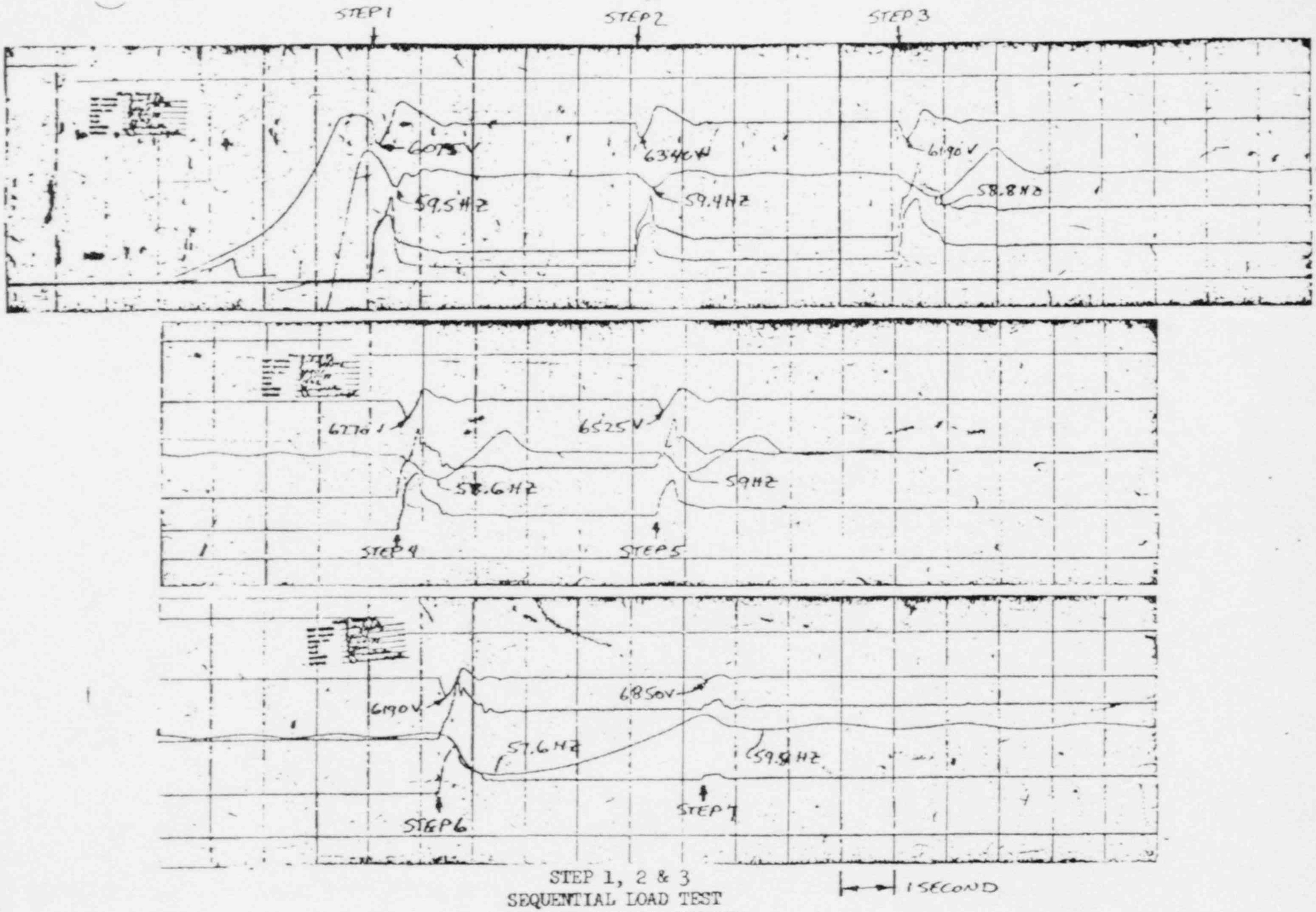
Maurice Lowrey

Maurice Lowrey
Senior Design Engineer, P.E.

ML/sc

cc: C. Renfro
J. Manno

CR042101.Q



STEP 1, 2 & 3
SEQUENTIAL LOAD TEST
SIMULATED LOCA CONDITION
2.6.6 1A

J.O./W.O./CALCULATION NO.	REVISION	PAGE
16345.03		3 OF 3

ORIGINATOR/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
R SHUSTRIN / 4/8/88		

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
CPSES DIESEL GEN LOADING - BLACKOUT (NO LOCA)	

STARTING & RUNNING LOADS - BLACKOUT (NO LOCA)

BLACKOUT LOADING

STEP	TIME SECONDS	CALCULATED				REMARKS
		BASE KW	BASE P.F.	STARTING		
				KVA	P.F	
1	10	[illegible] 0	—	9388	0.300	
2	30	1418 (1418)	0.895	7976	0.274	
3	35	2369 (951)	0.898	6205	0.376	
4	40	3059 (690)	0.892	5088	0.279	
5	50	3651 (592)	0.894	2825	0.293	
6	60	3875 (224)	0.891	2785	0.200	
7	75	4121 (246)	0.891	1464	0.154	
8 & 9	85	4247 (126)	0.891	797	0.200	
10	90	4247 (0)	0.891	6774	0.251	
—	≥ 100	4694 (447)	0.890	7215	0.251	
—	AFTER 4 HOURS	6232 (1538)	0.894	2617	0.268	
—	—	6582 (350)	0.896	—	—	FINAL LOAD IN D.G.

Requirements: < 20% V dip → 2 Sec → 5520V
< 5% Hz dip → 2 Sec (98%)
57 Hz 58.8 Hz

SS =
6762 → 7038 ✓
58.8 → 61.2

100% rejection 7590 V max

STONE & WEBSTER ENGINEERING CORPORATION

J.O./W.O./CALCULATION NO.	REVISION	PAGE
16345.03		2 of 3

PREPARER/DATE	REVIEWER/CHECKER/DATE	INDEPENDENT REVIEWER/DATE
R Shustrin / 4/8/88		

SUBJECT/TITLE	QA CATEGORY/CODE CLASS
CPSES DIESEL GEN. LOADING - LOCA LOADS	

STARTING & RUNNING LOADS - LOCA (DBA)

LOCA LOADING

STEP	TIME SECONDS	CALCULATED				REMARKS
		BASE KW	BASE P.F.	STARTING KVA	STARTING P.F.	
1	10	0	—	8228	0.303	16.9%
2	15	1184 (1184)	0.906	4402	0.288	
3	20	1664 (380)	0.907	3222	0.255	
4	25	1916 (352)	0.911	8984	0.297	13.6%
5	30	2866 (950, 50%)	0.922	6455	0.292	
6	35	3652 (786)	0.921	5993	0.382	
7	40	4343 (691)	0.913	5385	0.290	
8	75	5091 (748, 17%)	0.911	1249	0.146	
9	90	5217 (126)	0.911	3826	0.246	
10	100	5394 (177)	0.906	2687	0.265	
—	>100	5706 (312)	0.901	1994	0.34	
—	—	5945 (239)	0.904	—	—	FINAL LOADING D.G

OPEN ITEM E-34

Document Number: SWEC Calculation 16345-EE(B)-73, Rev. 1, "Station Service Study-Voltage Profiles of Class 1E Systems Down to 480 Vac MCC"

FSAR Section 8.2.2, page 8.2-14, states that "Operating voltage for the respective grids has been calculated to be within the range of 340.17 kV to 352.74 kV and 135.53 kV to 140.70 kV for normal and credible contingency conditions.

The maximum limits are 363 kV and 144 kV and the minimum limits are 325 kV and 130 kV for the offsite power grid... No transmission contingencies are anticipated wherein the extreme voltages, either high or low, would exist for more than one or two hours..."

In discussions with the SWEC personnel, the team was told that the degraded grid protection will be actuated for voltages lower than that used in the calculation (i.e., 340.17 kV and 135.53 kV). The degraded grid relay setting calculations should address the lower voltages. For higher voltages (i.e., 363 kV and 144 kV), analyses should be performed to show that, under extreme conditions, the connected equipment voltage rating is not exceeded.

RESPONSE

FSAR Section 8.2.2 is being revised to state that the operating voltages at the 345 kV and 138 kV power grid are within the range of 340 kV to 361 kV and 135 kV to 144 kV respectively.

The station service system will be analyzed and modified as necessary to assure that voltages at connected equipment are within equipment ratings under all design basis operating conditions. A revised degraded grid relay setting calculation will address the low end voltages. A revised voltage profile calculation will address the high and low end voltages. The revised relay setting and voltage profile calculations will utilize the methodology in the current calculations. These calculations are expected to be revised and available for review by the end of June, 1988.

SIGNIFICANCE/EXTENT

There is no safety concern as a result of the revised power grid operating ranges.

The above concern is not safety significant since the station service modification design has not been finalized.

The extent is limited to the voltage profile calculation which is unique.

OPEN ITEM S-7

Document Number: DBD-ME-007, Revision 0, Pipe Break Postulation and Effects

Attachment 4 provides a procedure for locating a plastic hinge (i.e., the point about which a pipe begins to whip) following a pipe break. The team's review of the equations for plastic moment capacity and distance of plastic hinge from center line of broken run determined there were significant missing portions. The team determined that the missing portions could not be typed on a normal keyboard and were to be manually added by the author. The applicant advised that no evaluations have been completed and released that where based on this procedure.

RESPONSE

During the revision process, the procedure for locating a plastic hinge was changed from Attachment 4 to Attachment 3. The missing portions of equations (1) and (2) were added in Revision 1 of DBD-ME-007, issued January 8, 1988, as follows:

1) Calculate plastic moment capacity (Mp) of the straight pipe under consideration as below:

$$Mp = (4/3)\ (1.1\ \sigma y)\ [(R_o)^3 - (R_i)^3]$$

Where σy = Static yield stress of the pipe material
R_o = Outside radius of the pipe
R_i = Inside radius of the pipe

2) Calculate the location of plastic hinge (Lp) using the following formula:

$$Lp = 1.5\ (Mp/F)\ [1 + \sqrt{1 + (8/3)\ (F/Mp)\ (M/m)}\ ]$$

Where Lp = Distance of plastic hinge from center line of the broken run.

Mp = Plastic moment capacity of straight pipe as calculated above.

F = Blowdown force due to pipe rupture = K P A

Where K = Thrust Coefficient based on the fluid state and the amount of subcooling per ANSI 58.2 Procedure.

P = Pressure of fluid inside the pipe.

A = Inside area of the pipe.

M = Total pipe mass from first elbow to break point plus any additional masses due to a valve that may exit between these two points.

m = Mass per unit length of pipe.

OPEN ITEM S-7 (Continued)

SIGNIFICANCE/EXTENT

All of the Ebasco pipe rupture calculations were reviewed to determine if any hinge locations were calculated using the incomplete formula in DBD-ME-007. The results of this review concluded that there were no calculations utilizing the incomplete formula. Therefore, this open item did not have an impact on the Ebasco pipe rupture analysis.

OPEN ITEM S-16

Document Number: Ebasco Calculation CPE-SI-CA-0000-666, Rev. 0, dated 12/2/87, "HELB System Analysis - Room 113"

Sheet 7 of the calculation credits a single flow switch per train for mitigation of a steam generator blowdown (SGBD) break. Drawing ECE-M1-0202, Rev. CP4 and ICD-2323-M1-2202, Sheet 06A, Rev. CP-2 indicate that the activation of any flow switch on the SGBD lines would close all 8 outboard isolation valves automatically. Failure of the flow switch to actuate the valves would prevent isolation of the break within the time frame calculated. The calculation did not address the failure of the flow switch. The team does not consider this to be a technical problem because other switches would be activated and would perform the isolation function. However, the calculation did not indicate this.

RESPONSE

The Steam Generator Blowdown System Break mitigation scheme consists of four flow switches and eight isolation valves. The design of the mitigation scheme is predicated on the fact that a break in any one of the SGBD Loops will cause an immediate decrease in back pressure in the three remaining loops. The decreased back pressure will cause an increased flow rate in each loop which will be sensed by the flow switches. Upon recognition of high flow, each flow switch will transmit a closure signal to all eight isolation valves. Therefore, if a single active component failure is assumed for one of the flow switches, the postulated pipe break would be mitigated by the remaining flow switches.

The break mitigation scheme described on Sheet 7 of calculation CPE-SI-CA-0000-666, Rev. 0 did not adequately describe the break mitigation scheme discussed above. This calculation is in the process of being revised to clarify the SGBD Break mitigation scheme and is scheduled to be issued by June 30, 1988.

SIGNIFICANCE/EXTENT

This open item reflected a lack of clarity in the System Blow Down calculations in the area of Break Mitigation time justification. In this particular calculation, the proper mitigation scheme has been designed and installed; however, it was not adequately described in the calculation. Currently, all system blowdown calculations are being consolidated on a systems basis. During this process, the justification for break mitigation times is being reviewed and revised as necessary. To date, no other inadequacies of this type have been identified.

OPEN ITEM S-17

Document Number: Ebasco Calculation CPE-SI-CA-0000-669, Rev. 0, "HELB System Analysis Break Room 80"

The calculation credits a single non-redundant alarm (UA-5385) for detection, but it appears that single active failure of this alarm was not addressed. In addition, low readouts from TE-130, PI-131, and FE-132 apparently do not activate alarms on the control boards but, instead, an operator is required to monitor the actual process readout (temperature, pressure or flow). It appears unlikely that these gauges will be read often enough to support an isolation time of 10 minutes after the break. In addition, the assumption of an 11-minute blowdown time may be unrealistic.

It is noted that this is not the bounding break for Room 80, but may become bounding if the single failure criteria is properly addressed.

RESPONSE

The assumption of an 11-minute break mitigation time was predicated on alarm UA-5385 and control room indications from instruments TE-130, PI-131 and FE-132. As stated above, this assumption is unrealistic due to the fact that the gauges may or may not be read often enough to support an isolation time of 10 minutes. However, DCA-69686 was initiated to install alarm UA-5385-A for the purpose of providing redundant alarms for high energy line break mitigation. Calculation CPE-SI-CA-0000-669 will be revised to take credit for the redundant alarm capability.

SIGNIFICANCE/EXTENT

This open item reflected an unrealistic assumption utilized to determine break mitigation times. The assumption is that Control Room indication, without an alarm, is adequate to alert Plant Operators of a pipe break event. Currently, all system blowdown calculations are being consolidated on a systems basis. During this process, the justification for break mitigation times is being reviewed and revised as necessary. To date, no other unrealistic assumptions have been indicated.

OPEN ITEM S-18

Document Number: Ebasco Calculation CPE-SI-CA-0000-714, Rev. 0, dated 10/26/87, "Pipe Rupture Analysis - Auxiliary Feedwater System Outside Containment Problem 10B&C Unrestrained"

During the team's field walkdown to verify the HELB interaction record to Problem 1-10C, Break 593C, it was found that pipe whip restraint AF-1-096-901-S57W was not listed as a target of the jet from the downstream portion of the break. Based on the team's discussions with Ebasco, it appeared that the walkdown documentation excluded the restraint from consideration as a jet target. The restraint was either considered to be a structure (which is exempt from jet and pipe whip consideration for source sizes under 6" diameter) or a moment restraint (which is also exempt by design).

The team's concern is that pipe whip restraints are devices engineered to withstand a given pipe whip load. If the restraint experiences a jet load from the non-restrained portion of the break concurrently with the whip load, as is the case here, the restraint must be evaluated to assess both loads. The procedure covering the HELB target identification does not provide sufficient guidance for proper identification of pipe whip restraints as jet targets.

The walkdown interaction record was reviewed for the adjacent room 100A-2, also shown on zone-of-influence (Z of I) drawing 1ZI 100A, Sheet 2 of 3. This room is essentially a mirror image of the room reviewed above. It was found that jet loading on the similar restraint AF-1-098-901-S-57W was also not identified; thus, this is not an isolated case. Pipe whip restraints were identified as jet targets on other non-related cases that were walked down as part of this inspection.

RESPONSE

Procedure CPE-EB-FVM-SI-34, Rev. 1 did not explicitly require pipe whip restraints to be listed as HELB targets. In order to eliminate any possible confusion, Procedure FVM-SI-34 is currently being revised to explicitly require pipe whip restraints associated with the source line to be identified as targets. In addition, all pipe whip restraints within the zone of influence of a HELB shall be reviewed to ensure that jet loads are considered, if appropriate. The procedure revision, back-fit review and walkdown book revisions are estimated to be complete by August 18, 1988.

OPEN ITEM S-18 (Continued)

SIGNIFICANCE/EXTENT

The fact that the actual load on a pipe whip restraint was not utilized in the design of restraint renders the functionality of the support indeterminable. This could have a significant impact on the ability of the plant to achieve safe shutdown after a postulated high energy line break. To evaluate the significance, Ebasco is currently identifying all design load combinations for the pipe whip restraints. These loads will be compared to the maximum design loads of the restraints. Any corrective action required as a result of this evaluation will be documented in the final closure report of SDAR CP-87-133. This significant deficiency analysis report on the HELB analysis has been determined to be reportable under the provisions of 10CFR50.55(e) (Reference TXX-88118) and is being utilized to track all required corrective actions.

OPEN ITEM S-19

Document Number: Ebasco Calculation CPE-SI-CA-0000-501, Rev. 1, dated 2/22/88, "Pipe Rupture Analysis - Reactor Coolant and Safety Injection System - Problem 1-13A&B"

Page 13 of the calculation discusses the whip point for break 667CB. This discussion utilizes the plastic hinge length and elastic limit values from break 661CB & 662CB that were calculated on page 9 of the calculation. Page 9 from the Rev. 0 calculation appears to adequately address whipping potential. Revision 1 to this calculation deleted page 9 because it contained breaks, such as arbitrary intermediate breaks, that were no longer applicable. However, this action resulted in deleting documentation for break 661CB which is still applicable. In addition, this deleted cross-reference interfaces with break 667CB, as noted above.

Calculation of the whipping potential of the balance of the breaks was found to be correctly accomplished utilizing the design criteria in Attachment 4 of the DBD. The results are presented such that they may be clearly interpreted.

RESPONSE

Page 9 was inadvertently deleted from Revision 1 of the calculation. The plastic hinge length and elastic limit values which appeared on page 9 will be reinserted via revision to the calculation.

SIGNIFICANCE/EXTENT

Similar administrative errors have been identified through QA audits and surveillances as well as by the SWEC Engineering Functional Evaluation Group. However, none of the identified administrative errors have had an impact on the calculation results. Nevertheless, to minimize these types of errors, the System Interaction Program has committed to provide additional training and closer supervision for the calculation process by June 15, 1988. In addition, Ebasco has reviewed the pipe rupture calculations and identified and corrected other administrative errors of this type.

OPEN ITEM S-20

Document Number: Ebasco HELB Interaction Record Form, Problem 1-52Z, Break 166C, dated 1/29/88.
Zone of Influence Sketch 1ZI 77N, Rev. CP-2

The walkdown review for break 166C revealed two targets that were not entered on the HELB Interaction Record Form. These targets are a) snubber support SI-1-079-007-S42K for line 10" SI-1-079-601R-2 and b) line 3-CS-1-074-2501R-2, both of which were found in the pipe whip path shown on the Z of I Sketch 1ZI 77N, Rev. CP-2.

RESPONSE

The walkdown book for Room 77N has been revised to include support SI-1-079-007-S42K and line 3-CS-1-074-2501R-Z.

SIGNIFICANCE/EXTENT

During the course of this audit, the review team inspected seven postulated break zones of influence. The areas inspected contained over 150 targets. Due to the fact that only two targets were inadvertently omitted, this finding is considered isolated.

These targets have been evaluated and deemed not to be required for plant safe shutdown in the event of a postulated pipe break at break location 166CA. Therefore, there is no safety concern because of these omissions.

OPEN ITEM S-21

Document Number: Ebasco Calculation No. CPE-SI-CA-0000-604, Rev. 0, dated 1/11/88, "Pipe Rupture Analysis - CVC System Inside Containment"
Ebasco Calculation No. CPE-SI-CA-0000-599, Rev. 1, dated 2/24/88, "Pipe Rupture Analysis - Safety Injection System Inside Containment"
Ebasco Calculation No. CPE-SI-CA-0000-611, Rev. 1, dated 2/1/88, "Pipe Rupture Analysis - Reactor Coolant System"
Ebasco Calculation No. CPE-SI-CA-0000-603, Rev. 1, dated 2/5/88, "Pipe Rupture Analysis - Feedwater System Inside Containment"

Standard Review Plan 3.6.2, Section III.2.a states that the inelastic behavior of the piping and restraint system should stay within the design limits of 50% of the ultimate uniform strain. ANS 58.2, Section 6.6.2 also addresses the same design limits concerning plastic deformation designs for piping and pipe whip restraints. The acceptance criteria for the process pipe (Mmax/Mult $\leq$ 0.8) being used in the Ebasco calculations deviates from the standards. Technical justification provided by Ebasco to show that the criteria (Mmax/Mult $\leq$ 0.8) meets the intent of the standards was based on selected pipe sizes and materials at temperature. The approach and methodology being used in this technical justification appears to be acceptable. However, a wider range of pipe sizes and materials should be considered to make the justification generic to CPSES pipe rupture calculations.

RESPONSE

The acceptance criteria for the ultimate uniform strain (Mmax/Mult) has been formally documented in calculation CPE-SI-CA-0000-779. This acceptance criteria will be referenced in DBD-ME-007, Rev. 2 and EME 2.24-05, REV 1. In addition, this calculation considers all the pipe sizes and material utilized in the pipe rupture calculations.

SIGNIFICANCE/EXTENT

This open item concerned the use of the ultimate uniform strain acceptance criteria in pipe rupture calculations. To address this open item, the acceptance criteria was formally documented and expanded to envelope all piping sizes and materials evaluated in the pipe rupture calculations. The criteria has been utilized correctly in the pipe rupture calculation performed to date. Therefore, this open item did not have an impact on the pipe rupture analysis.

OPEN ITEM S-22

Document Number: Ebasco Calculation No. CPE-SI-CA-0000-604, Rev. 0, dated 1/11/88, "Pipe Rupture Analysis - CVC System Inside Containment"
Ebasco Calculation No. CPE-SI-CA-0000-599, Rev. 1, dated 2/24/88, "Pipe Rupture Analysis - Safety Injection System Inside Containment"
Ebasco Calculation No. CPE-SI-CA-0000-611, Rev. 1, dated 2/1/88, "Pipe Rupture Analysis - Reactor Coolant System"
Ebasco Calculation No. CPE-SI-CA-0000-603, Rev. 1, dated 2/5/88, "Pipe Rupture Analysis - Feedwater System Inside Containment"

Mass point spacing criteria was not mentioned in the design basis document or in the calculations being reviewed. To ensure that the piping and pipe whip restraint system are modeled in sufficient detail to reflect its dynamic characteristics under thrust and wave forces during the pipe rupture event, mass point spacing criteria should be incorporated into the design basis document and be followed through the applicable calculations.

Ebasco provided the team with criteria on mass point spacing which are judged acceptable for straight runs of pipe. Mass point spacing criteria should also be incorporated in the DBDs and assurance should be provided that the criteria have been correctly implemented in pipe rupture calculations.

RESPONSE

The pipe rupture mass spacing criteria has been formally documented in calculation CPE-SI-CA-0000-779. This calculation will be referenced in DBD-ME-007, Rev. 2 as follows:

"A ruptured pipe, which is restrained by means of pipe whip restraint, is modeled into the PIPERUP, ABAQUS or SHPLAST computer programs as a series of lumped masses adequately spaced. Mass-point-spacing guidelines as well as stability criteria for (Mmax/Mult) are included in Reference 9."

This calculation contains mass point spacing criteria for straight runs of pipe, components and fittings.

SIGNIFICANCE/EXTENT

All pipe rupture analyses performed to date comply with the mass point spacing criteria contained in calculation CPE-SI-CA-0000-779. Therefore, this open item did not have an impact on the pipe rupture analyses.

OPEN ITEM S-23

Document Number: Ebasco Calculation No. CPE-SI-CA-0000-604, Rev. 0, dated 1/11/88, "Pipe Rupture Analysis - CVC System Inside Containment"
Ebasco Calculation No. CPE-SI-CA-0000-599, Rev. 1, dated 2/24/88, "Pipe Rupture Analysis - Safety Injection System Inside Containment"
Ebasco Calculation No. CPE-SI-CA-0000-611, Rev. 1, dated 2/1/88, "Pipe Rupture Analysis - Reactor Coolant System"
Ebasco Calculation No. CPE-SI-CA-0000-603, Rev. 1, dated 2/5/88, "Pipe Rupture Analysis - Feedwater System Inside Containment"

Calculation No. CPE-SI-CA-0000-603, Rev. 1 - By reviewing the piping response curve at selected points on the pipe, it cannot be concluded that the run time is sufficient enough to show that the dynamic response of the piping system has stabilized and that the peak response was enveloped.

RESPONSE

In the judgement of the pipe rupture analyst, the maximum dynamic response of the piping system was shown by the points plotted on the response curves. To support this conclusion, additional points were plotted to demonstrate that the maximum deflection of the piping system had been determined. Calculation CPE-SI-CA-0000-603 is currently being revised to include the extended piping response curve.

SIGNIFICANCE/EXTENT

All other restrained piping rupture analyses have been reviewed to ensure that the response curves adequately identify and justify the maximum piping system displacement. This review concluded that the response curves were adequate. Therefore, this open item did not have an impact on the pipe rupture analysis.

OPEN ITEM S-24

Document Number: Ebasco Calculation No. CPE-SI-CA-0000-604, Rev. 0, dated 1/11/88, "Pipe Rupture Analysis - CVC System Inside Containment"
Ebasco Calculation No. CPE-SI-CA-0000-599, Rev. 1, dated 2/24/88, "Pipe Rupture Analysis - Safety Injection System Inside Containment"
Ebasco Calculation No. CPE-SI-CA-0000-611, Rev. 1, dated 2/1/88, "Pipe Rupture Analysis - Reactor Coolant System"
Ebasco Calculation No. CPE-SI-CA-0000-603, Rev. 1, dated 2/5/88, "Pipe Rupture Analysis - Feedwater System Inside Containment"

Calculation No. CPE-SI-CA-0000-611, Rev. 1 - Clarify the statement on page 53, "There is no requirement to arrest the pipe after break and consequently no limits for the displacements."

RESPONSE

The purpose of calculation CPE-SI-CA-0000-611 is to assure the Pressurizer Compartment wall can withstand the pipe whip impact. This is accomplished by utilizing a crushable pipe bumper restraint assembly. The statement "There is no requirement to arrest the pipe after break...." is predicated on the fact that the entire Pressurizer Compartment is assumed to be within the Zone of Influence of a high energy line break (Ref. Z of I 1ZI-16 Rev. 2). Therefore, any potential target within the Pressurizer Compartment is initially assumed to be lost from an HELB within the compartment. Calculation CPE-SI-CA-0000-611 will be revised to add the technical justification for the statement in question.

SIGNIFICANCE/EXTENT

Calculation CPE-SI-CA-0000-611 is unique, due to the fact it is the only pipe rupture calculation performed to ensure that a compartment wall can withstand the pipe whip impact loads. Therefore, this is the only calculation that would contain a statement such as "There is no requirement to arrest the pipe.....". Due to the fact this open item did not affect the results of the calculation and it is a unique case, this item did not have an impact on the pipe rupture analyses.

OPEN ITEM S-25

Document Number: Ebasco Calculation No. CPE-SI-CA-0000-604, Rev. 0, dated 1/11/88, "Pipe Rupture Analysis - CVC System Inside Containment"
Ebasco Calculation No. CPE-SI-CA-0000-599, Rev. 1, dated 2/24/88, "Pipe Rupture Analysis - Safety Injection System Inside Containment"
Ebasco Calculation No. CPE-SI-CA-0000-611, Rev. 1, dated 2/1/88, "Pipe Rupture Analysis - Reactor Coolant System"
Ebasco Calculation No. CPE-SI-CA-0000-603, Rev. 1, dated 2/5/88, "Pipe Rupture Analysis - Feedwater System Inside Containment"

Calculation No. CPE-SI-CA-0000-599, Rev. 1 - Restraint No. SI-1-181-902-C47W listed on page 4 is not included in the analysis model on page 14; restraint No. SI-1-091-903-C47W in the analysis model on page 14 is missing from the list on page 4.

RESPONSE

The listing of restraint SI-1-181-902-C47W on page 4 of the calculation was an administrative error. The error was caused by combining two restraint numbers. Restraint SI-1-181-902-C47W does not exist and will be deleted from calculation CPE-SI-CA-0000-599.

The omission of restraint SI-1-091-903-C47W on page 4 was an oversight by the analyst. However, based on the analysis contained in calculation CPE-SI-CA-0000-599, this restraint is not required to restrain breaks postulated in stress problem 1-17C. Therefore, this restraint will be deleted from calculation CPE-SI-CA-0000-599 and physically removed from the plant.

SIGNIFICANCE/EXTENT

This open item identified two administrative errors in calculation CPE-SI-CA-0000-599. These errors did not affect the results of the calculation. Errors of a similar nature have been identified through QA Audits and Surveillances, as well as, by the SWEC Engineering Functional Evaluation Group. However, none of the identified administrative errors have had an impact on the calculation results. Nevertheless, to minimize these types of errors, the System Interaction Program has committed to provide training and closer supervision for the calculation process by June 15, 1988. In addition, Ebasco has reviewed the pipe rupture calculations and identified and corrected other administrative errors of this type.

OPEN ITEM S-26

Document Number: SWEC Calculation No. 16345-EM(B)-030, Revision 1, 12/5/87, "Supplement to Calculation SSB-134C, Set 2, Design of Jet Shield"
Gibbs & Hill Calculation No. SSB-134C, Set 2, Revision 2, 3/28/84

FSAR Sections 3.8.3.3 and 3.8.3.5 provide loads and load combinations and acceptance criteria for structural steel members for Containment - Internal Structures. The loads were used for the subject jet shield which is located in the Safeguards Building.

RESPONSE

FSAR Section 3.8.3.3 and 3.8.3 were inadvertently referenced instead of FSAR Section 3.8.4 in the calculation. The calc lation has been revised to correct this reference.

Although all of the load combinations in Section 3.8.4 were considered, those which did not control the design were not discussed in the calculation. All pertinent load combinations will be addressed in the next revision of the calculation (6/30/88).

SIGNIFICANCE/EXTENT

There is no safety concern because the load combinations used were appropriate based on the purpose of the calculation. The planned calculation review associated with the confirmation activity is in progress and identifies and adequately addresses required confirmations and documentation for the basis of engineering judgements for all Civil/Structural calculations.

OPEN ITEM S-27

Document Number: Ebasco Calculation No. CPE-DS-CA-0000-640, Revision 0, "Interaction Zone of Non-Seismic Components in Containment Building"
Ebasco Calculation No. CPE-DS-CA-0000-642, Revision 0, "Interaction Zone of Non-Seismic Components in Other Category I Buildings"

The seismic interaction resulting from insufficient physical clearance (seismic gap) between adjacent seismic/non-seismic components is not addressed in DBD-ME-005, "Seismic/Non-Seismic Interaction Program". The team noted that such interactions between adjacent Seismic Category I components are to be reviewed per SWEC Specification CPSES-S-1021, "Commodity Clearance," and SWEC Field Verification Method for Commodity Clearance, CPE-SWEC-FVM-CS-068.

RESPONSE

Commodity clearance for Seismically Supported (Seismic Category I & II) Components, is addressed by Stone and Webster in accordance with Specific Technical Issue Report STIR-CPRT-S-018. For non-seismic sources, commodity clearance is being addressed by the Systems Interaction Program (SIP). The SIP assesses the seismic interaction of non-seismic sources with safety related targets in accordance with DBD-ME-005 and EME 2.24-01 using two possible methodologies:

Dynamic Impact Criteria (DIC)
Earthquake Experience Data

Commodity Clearance Using DIC. Sources resolved by the DIC have, by definition, addressed the commodity clearance issue since complete failure of source has been postulated and the source-target interaction is assumed to occur within a conservatively defined zone of influence, which will envelope any possible concerns due to possible deflections of the source.

Commodity Clearance Using Earthquake Experience Data. EQE engineers are experienced regarding the performance of equipment subjected to past earthquake excitations. Earthquake investigations include:

Documenting equipment failure following seismic events.

Reviewing equipment flexibility and impact to adjacent equipment or structural components.

Developing criteria for each database equipment category to assure structural integrity and operability during and after an earthquake.

OPEN ITEM S-27

RESPONSE (Continued)

Sources resolved by earthquake experience data have the commodity clearance issue addressed in one of two ways:

Commodity clearance is documented directly on the structural integrity evaluation sheets derived for each database category equipment.

Commodity clearance is evaluated using the engineering experience of the EQE engineers during the walkdown.

Four examples of commodity clearance concerns which are addressed directly on the structural integrity evaluation sheets are:

Database Category: Control & Instrumentation Panels, Floor Mounted -
Commodity Clearance Issue: Potential for impact of adjacent multiple section cabinets due to out-of-phase cabinet section response.
Structural Integrity Evaluation Sheet Requirement: Require multiple cabinet sections to be bolted together.

Database Category: Distribution Panels, Floor Mounted -
Commodity Clearance: Potential for impact of adjacent multiple section cabinets due to out-of-phase cabinet section response.
Structural Integrity Evaluation Sheet Requirement: Require multiple cabinet sections to be bolted together.

Database Category: Monorail Trolleys & Hoists -
Commodity Clearance Issue: Potential for the trolley and hoist to travel down length of the monorail and overrun the end.
Structural Integrity Evaluation Sheet Requirement: Require stops on each of the monorail beams.

Database Category: Fire Extinguishers -
Commodity Clearance Issue: Potential for pin-hung fire extinguishers to swing and impact adjacent components.
Structural Integrity Evaluation Sheet Requirement: Require fire extinguishers to have a bracket restraining the fire extinguisher from swinging.

The remaining commodity clearance issues for sources resolved by the earthquake experience database are reviewed by experienced engineers at the time of the walkdown. The majority of the reviewed sources are rigid and will not deflect during the earthquake. Flexible sources such as floor mounted control cabinets are reviewed for commodity clearance concerns. Instances where a source could damage the safety related function of a target are noted on the source component's structural integrity evaluation sheet. Corrective actions resulting from the resolution of interactions by EQE's Earthquake Experience Database will be addressed in accordance with DBD-ME-005 and EME-2.24-01.

OPEN ITEM S-27 (Continued)

SIGNIFICANCE/EXTENT

The response discussed above outlines the methodology utilized to evaluate seismic/non-seismic component interactions. As discussed above, the structural integrity and component deflection are evaluated for identified non-seismic sources. Therefore, DBD-ME-005, Rev. 1 does address seismic interactions resulting from insufficient physical clearance between adjacent seismic/non-seismic components using either Dynamic Impact Criteria or Earthquake Experience Data.

OPEN ITEM S-28

Document Number: Field Walkdown Seismic/Non-Seismic Interaction Matrix Sheet 1 of 1, dated 11/17/87, Area No. 54, Safeguards Building El. 773'-0"

1 1/2-inch diameter piping for the chilled water system located near P-A speaker P-8 was not identified as a target, as required by the zone of influence walkdown criteria of Ebasco Procedure CPE-EB-FVM-SI-40, Attachment C, Table 5.

RESPONSE

The procedure in effect at the time of data acquisition, 10-1-87, (Reference Matrix Sheet 1 of 1 for Area No. 54, Safeguards Bldg. Elev. 773'-0") was CPE-EB-FVM-SI-40, Revision 0, ICN-01 (issued 8-19-87). Section 8.5 states in part that, "Interactions will be documented by listing the potential source and targets on the matrix sheet." Contrary to this, the preparer of the matrix sheet omitted the 1 1/2-inch diameter Class 3 chilled water piping as a potential target to PA Speaker P-8, although other targets were identified as having unacceptable interactions.

Subsequent to the data acquisition by the preparer, an independent review of the prepared matrix was performed which identified the subject piping as a target. However, at the time of the review, (11-17-87) the procedure in effect was FVM-40, Revision 1 (issued 11/9/87). As such, unique identification of all affected targets was not required when a source component has unacceptable interactions with one or multiple targets, (Reference FVM-40, Rev. 1, Section 8.5). It should be noted that it was previously established during the time of data acquisition that the preparer identified other targets having unacceptable interactions with the source PA Speaker P-8. Based on these targets alone, the PA Speaker required further evaluation to assure its seismic adequacy. Also, Revision 1 of the procedure (issued 11/9/87) did not require that all targets be listed individually on the matrix sheet when a source has an unacceptable interaction with one target. The addition of another target at this point and time (i.e., the 1 1/2-inch Class 3 pipe) would not have impacted the evaluation of the PA Speaker, because its seismic adequacy was already required to be addressed due to interactions with other targets. As a result, it was unnecessary and not procedurally required for the subject piping to be added to the matrix sheet as a target during the independent review process.

Therefore, by complying with the procedural requirements in effect at the time of the review process, the subject 1 1/2-inch Class 3 chilled water piping was not added to the referenced matrix sheet as a target for the source PA Speaker P-8.

SIGNIFICANCE/EXTENT

As discussed above, the seismic adequacy of PA Speaker P-8 was evaluated due to interactions with other targets. The listing of the 1 1/2-inch line as a target is not required due to a revision to procedure FVM-40. Due to the fact that the speaker's seismic adequacy was evaluated, this open item did not impact the Seismic/Non-seismic Interaction Program.

OPEN ITEM S-29

Document Number: Field Walkdown Seismic/Non-Seismic Interaction Matrix Sheets 1, 2, and 3, dated 11/17/87, Area No. 73, Safeguards Building El. 790'-6".

Seismic/Non-Seismic Interaction Evaluation Sheet 14 (of 47) showed that the wall mounted security cabinet TC-207 could impact the long vertical cantilevered support for conduit C13G07225. The interaction was resolved per dynamic impact criterion No. 8 of Paragraph 4.3.4 of DBD-ME-005, but requires additional justification or analytical calculations to show that the impact load on the conduit support is acceptable.

The team agreed in other respects with the identification of targets and resolution of source/target interactions for the area.

RESPONSE

Interaction between the wall mounted security cabinet TC-207 (source) and long vertical cantilevered support for conduit C13G07225 (Target) in Area 73 of Safeguard Bldg., was resolved by use of Dynamic Impact Criterion No. 8 per DBD-ME-005. The target under consideration is at worst on the edge of the zone of influence and therefore the impact will be of a glancing blow nature. The fact that impact will be a glancing blow was brought out by the walkdown engineer on the walkdown evaluation form. Dynamic Impact Criterion No. 8 which states target is massive and ductile, was used in view of the glancing blow nature of the impact and the fact that the target consists of 4" x 4" structural tube steel. Considering the facts stated above, the resolution that the interaction is acceptable is well justified.

SIGNIFICANCE/EXTENT

This is not safety concern because this open item does not impact the Seismic/Non-seismic Interaction Program.

OPEN ITEM S-30

Document Number: Ebasco Calculation TNE-DS-CA-0000-615, Rev. 0, dated 11/24/87, "Pipe Rupture Analysis - Steam Generation Systems - Problem 1-079E&F"

At the time of the review, the evaluation of targets identified in the HELB Interaction Record had not been performed. This is a generic comment which applies to all cases where the team performed a walkdown to validate Ebasco target identification. Resolution of this item will require the team's inspection of a sample of target evaluations, preferably for the cases addressed in this report (see the succeeding calculations).

RESPONSE

Due to recent discussion between TU Electric, Ebasco and the NRC, the Systems Interaction Program is in the process of revising the jet impingement methodology to the requirements of ANSI/ANS 58.2, Working Draft Rev. 7, 1987. Due to this revision, some of the HELB walkdowns for target identification that were reviewed by the audit team will be required to be reperformed. Based on current schedules the target evaluations for cases addressed in this report will be completed by 8/18/88.

OPEN ITEM C/S-4

Document Number: Calculation 16345/6-CS(C)-006, Revision 0, Auxiliary Building

Supporting information is required to justify the rigidity assumption made in the floor ARS development approach used by SWEC and G&H for vertical response. The information should demonstrate that ARS based on this assumption will envelope the "spectra developed at the critical locations of each floor" such that seismic analysis of equipment, piping systems, etc. will not fail to account for the out-of-plane flexibility of the floor. Similar supporting information is required for horizontal accelerations associated with attachments to walls.

RESPONSE

The CPSES design basis response spectra are conservative because they were developed to envelope the ARS computed at the extreme corners or edges of the structure including the effects of rocking and torsion. Effects such as floor and wall flexibility will cause variations in the response depending upon specific location. Incorporating these effects is not necessary because of the inherent conservatisms in the seismic analysis and design. Those conservatisms have been identified in the NRC-sponsored Seismic Safety Margin Research Program NUREG/CR-1489.

NUREG/CR-1489 examines several elements of conservatism in these methods by using the "Best Estimate Method" (BEM) of analysis.

Calculation 16345/6-CS-012 considers the effects of floor flexibility by adding additional degrees-of-freedom at the centers of 5 floor slabs. The calculation's objective is to establish whether or not the level of conservatism in the original methodology for calculating amplified response spectra (ARS) is adequate to compensate for neglecting floor flexibility effects in the dynamic models used in the development of amplified response spectra. The BEM of NUREG/CR-1489 is employed using the real earthquake records which serve as the basis for Regulatory Guide 1.60.

Each set of three acceleration time histories is normalized so its larger horizontal component has a peak CPSES OBE ground acceleration of 0.06g, with the other components adjusted in proportion so the ratio to the corresponding recorded ground accelerations is maintained. This is consistent with the methodology in NUREG/CR-1489. These sets of time histories are used to analyze the Auxiliary/Electric Building and the Safeguard Building in which the selected floors slabs are located. The ARS calculated are the mean plus one standard deviation of the ARS for each of the normalized triaxial records. The ARS are compared to the design basis OBE spectra.

OPEN ITEM C/S-4

RESPONSE (Continued)

Figures 1 through 15 show the comparison of the design basis OBE spectra and the spectra computed in this study. Examination of the ARS reveals that the horizontal design basis ARS envelop the horizontal ARS computed in this study. For the vertical ARS, there are two exceedances in the Auxiliary/Electric Building at elevation 899 ft-6 in. and 852 ft-6 in. as shown in Figures 1 and 4. The exceedance at elevation 899 ft-6 in. is insignificant. The exceedance at elevation 852 ft-6 in. is confined to a very narrow zone near a period of 0.11 second. The exceedance is in the order of 18 percent at the center of this slab. The ARS for the edge of the slab is plotted as a solid line and is substantially below the original design ARS. This small exceedance is therefore limited to a small area at the center of the slab.

In the above study the mean plus one standard deviation of the peak acceleration of the 24 vertical records is about 0.032g. An additional study was performed on this floor slab (at elevation 852'-6") to study the effects of normalizing the vertical acceleration to 0.04g. In this study, only the 24 vertical records were used as input to the analysis and the effect of radition damping was included. Frequency dependent impedance function of the foundation medium was determined using REFUND program and this was used in the dynamic analysis of the structure. The mean plus one standard deviation of the vertical ARS at the center and the edge of the slab were shown in figure 16. The figure shows that by normalizing the vertical acceleration to 0.04g and including the effects of radiation damping, there is a small exceedance in the order of about 10% near the period of 0.11 second.

Based on the above studies, comparing the computed BEM ARS based on the real earthquake records and the broadened design spectrum clearly indicates that there is more power (energy) in the design spectra than in the BEM ARS. Design of structures and systems based on the design spectra is therefore generally conservative as compared to the BEM ARS.

Figures 5 and 6 show the horizontal spectra at elevation 852 ft-6 in. As indicated in the figures, there is substantial conservatism in these spectra. In the design of systems and components, the effects of both vertical and horizontal earthquakes must be considered; the conservatism in the horizontal ARS (at all periods) and the conservatism in the vertical ARS at most periods will more than offset the small exceedance.

Based on the results of the analyses using the technique as discussed in NUREG/CR-1489, this calculation demonstrates that there is sufficient conservatism in the original design response spectra to compensate for the effects of floor flexibility.

SIGNIFICANCE/EXTENT

There is no safety concern because the design basis ARS is conservative.

FIGURE 1

CPSES AUX. BUILDING SEISMIC OBE FLOOR FLEXIBILITY STUDY
VERT ARS (Y DIR.) EL 899.50 FEET 2% OSCILLATOR DAMPINGS
AMPLIFIED RESPONSE SPECTRA USING 24 TIME HISTORIES

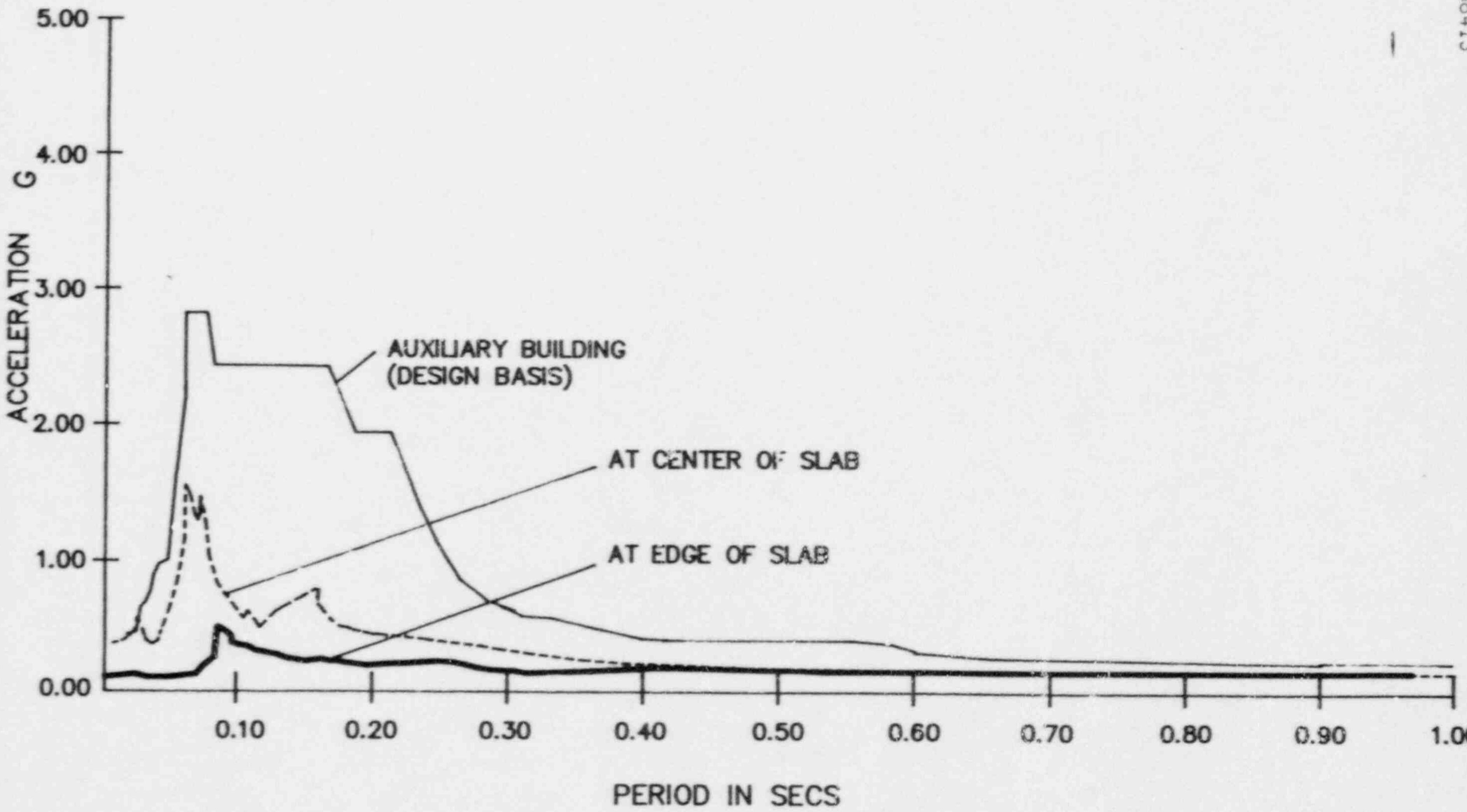


FIGURE 2

CPSES AUXILIARY BUILDING SEISMIC OBE FLOOR FLEXIBILITY STUDY
HORIZ. ARS (X DIR.) EL 899.50 FEET 2% OSCILLATOR DAMPINGS
AMPLIFIED RESPONSE SPECTRA USING 24 TIME HISTORIES

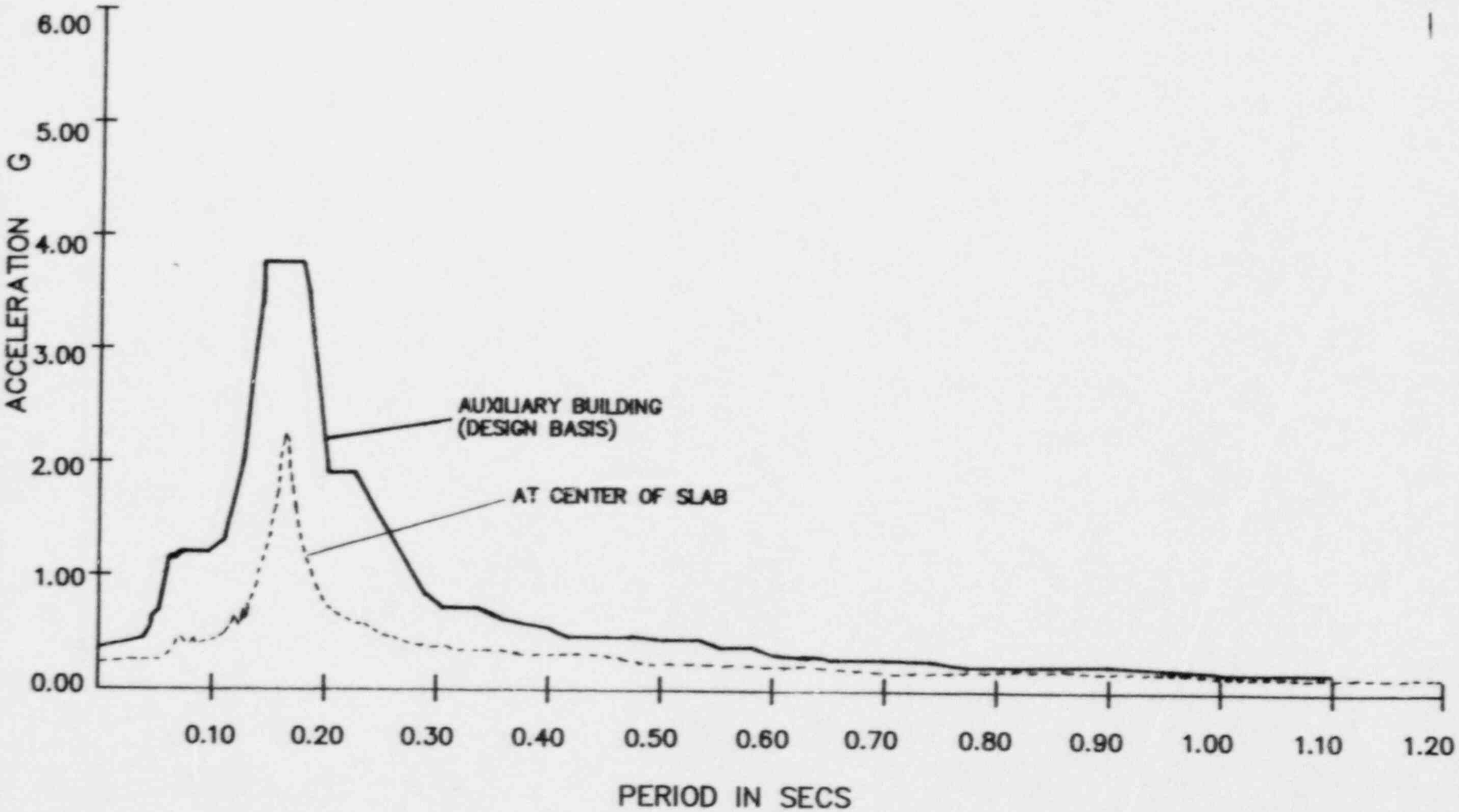


FIGURE 3

CPSES AUXILIARY BUILDING SEISMIC OBE FLOOR FLEXIBILITY STUDY
HORIZ. ARS (Z DIR.) EL 899.50 FEET 2% OSCILLATOR DAMPINGS
AMPLIFIED RESPONSE SPECTRA USING 24 TIME HISTORIES

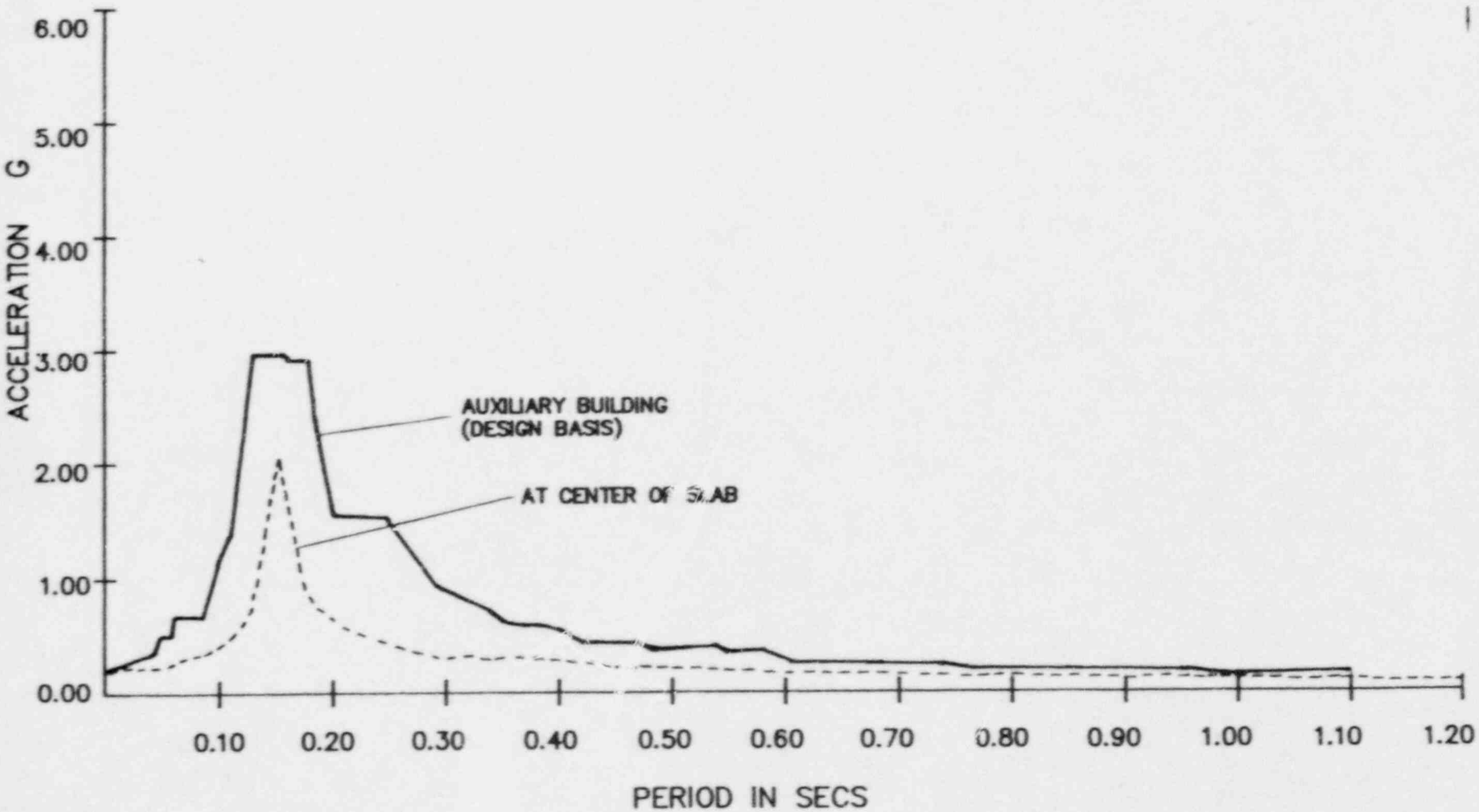


FIGURE 4

CPSES ELECTRICAL BUILDING SEISMIC OBE FLOOR FLEXIBLITY STUDY
VERT. ARS (Y DIR.) EL 852.50 FEET 2% OSCILLATOR DAMPINGS
AMPLIFIED RESPONSE SPECTRA USING 24 TIME HISTORIES

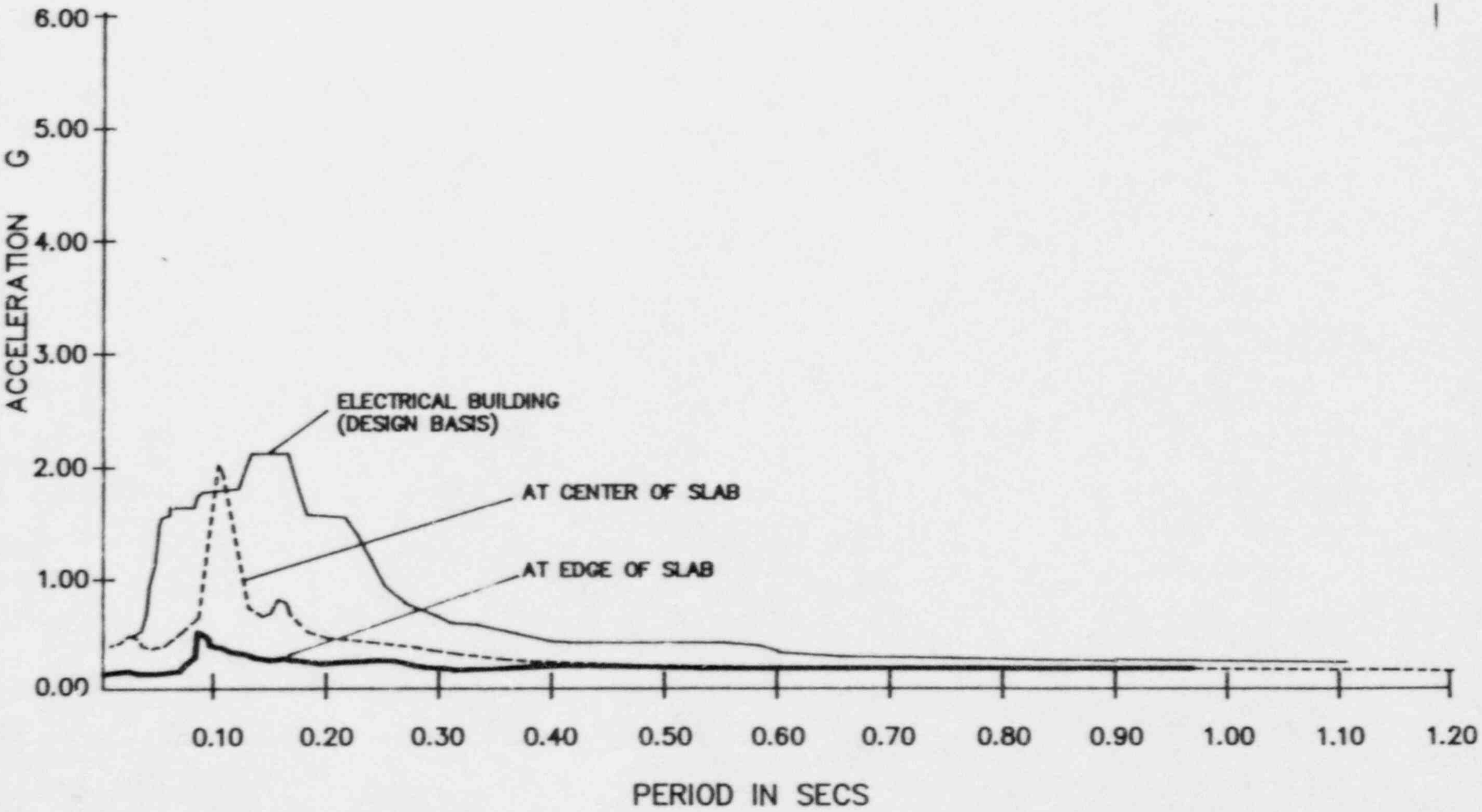


FIGURE 5

CPSES ELECTRICAL BUILDING SEISMIC OBE FLEXIBILITY STUDY
HORIZ. ARS (X DIR.) EL 852.50 FEET 2% OSCILLATOR DAMPING
AMPLIFIED RESPONSE SPECTRA USING 24 TIME HISTORIES

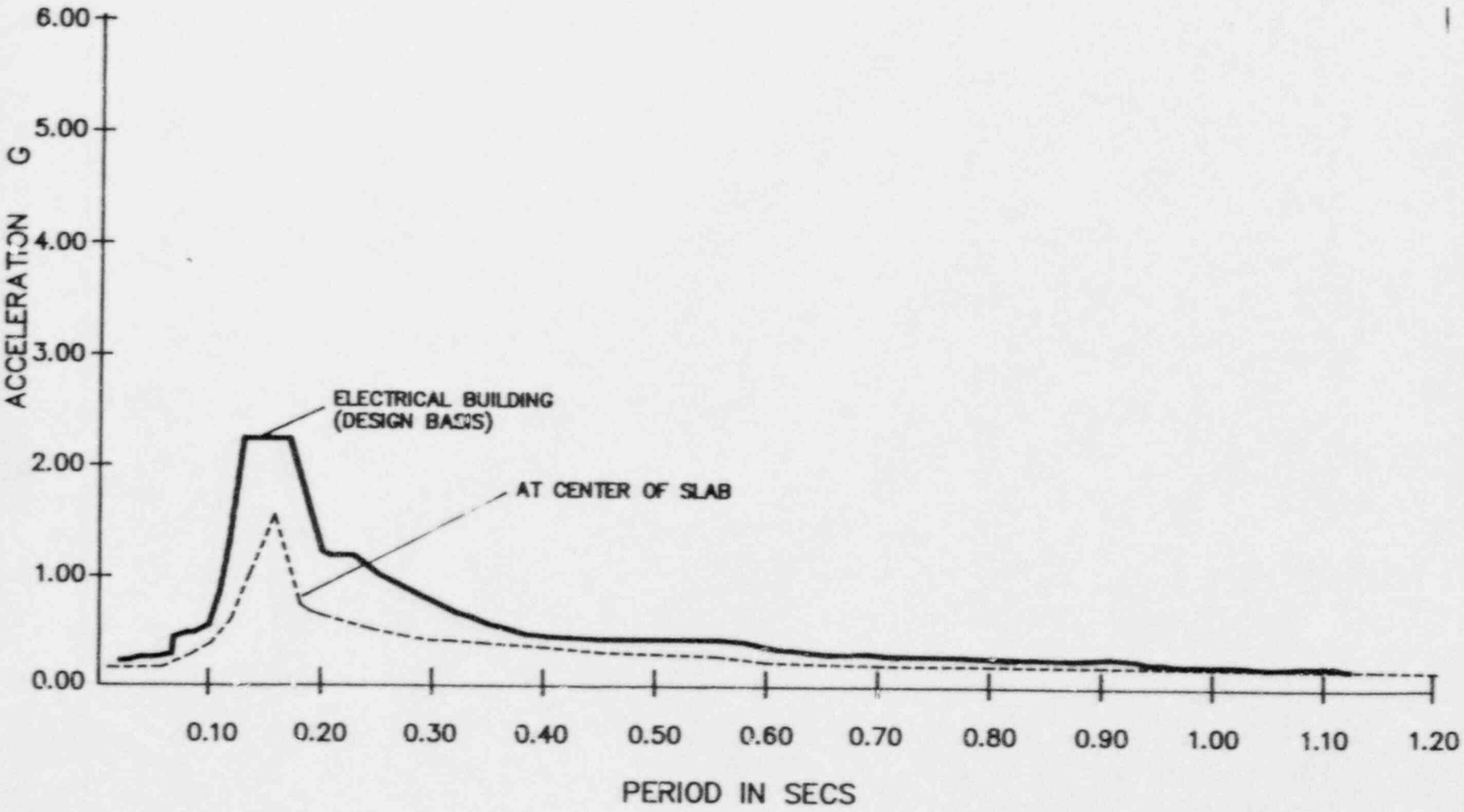


FIGURE 6

CPSES ELECTRICAL BUILDING SEISMIC OBE FLOOR FLEXIBILITY STUDY
HORIZ. ARS (Z DIR.) EL 852.50 FEET 2% OSCILLATOR DAMPINGS
AMPLIFIED RESPONSE SPECTRA USING 24 HISTORIES

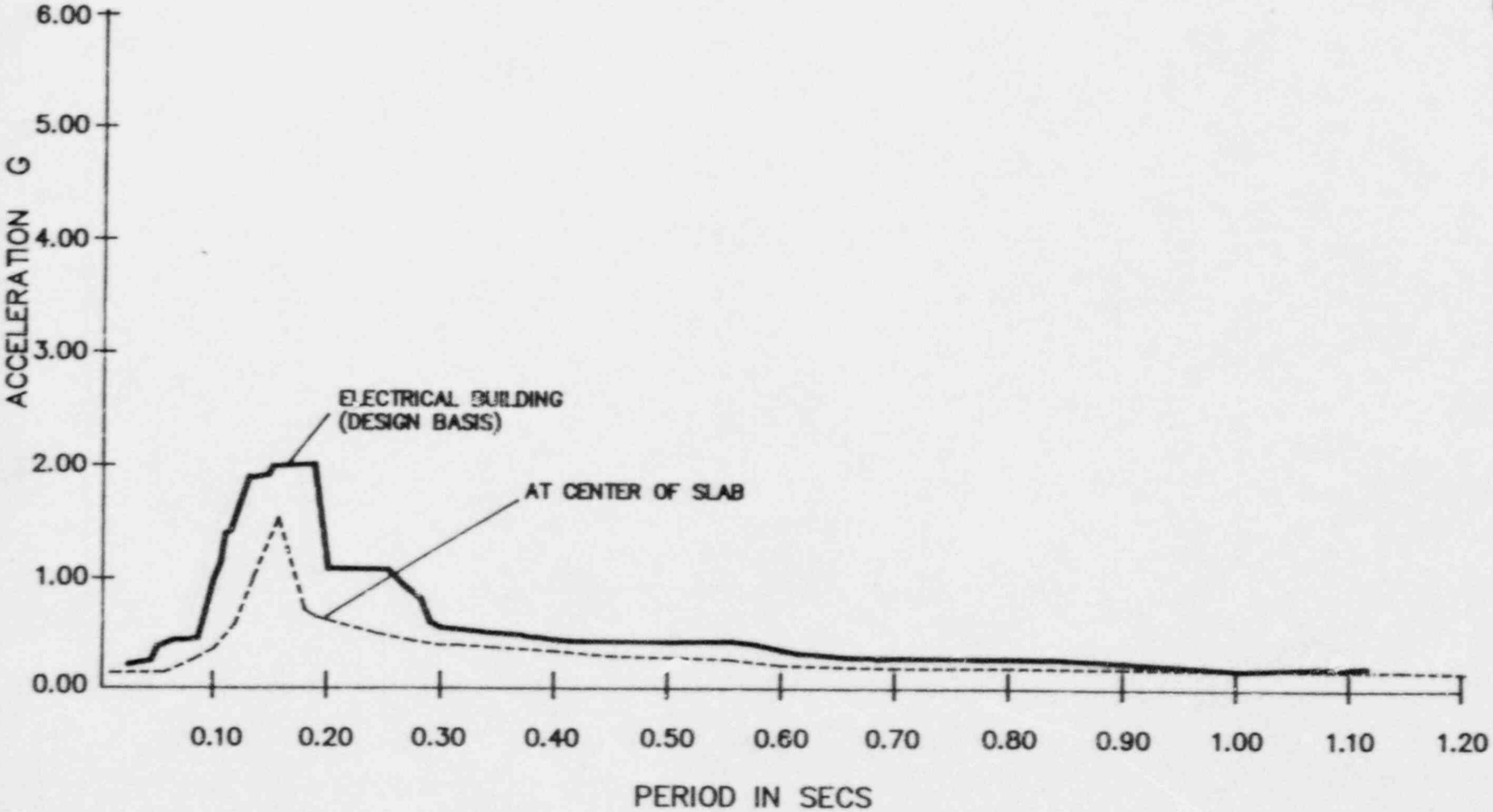


FIGURE 7

CPSES ELECTRICAL BUILDING SEISMIC OBE FLOOR FLEXIBLITY STUDY
VERT. ARS (Y DIR.) EL 831.50 FEET 2% OSCILLATOR DAMPINGS
AMPLIFIED RESPONSE SPECTRA USING 24 TIME HISTORIES

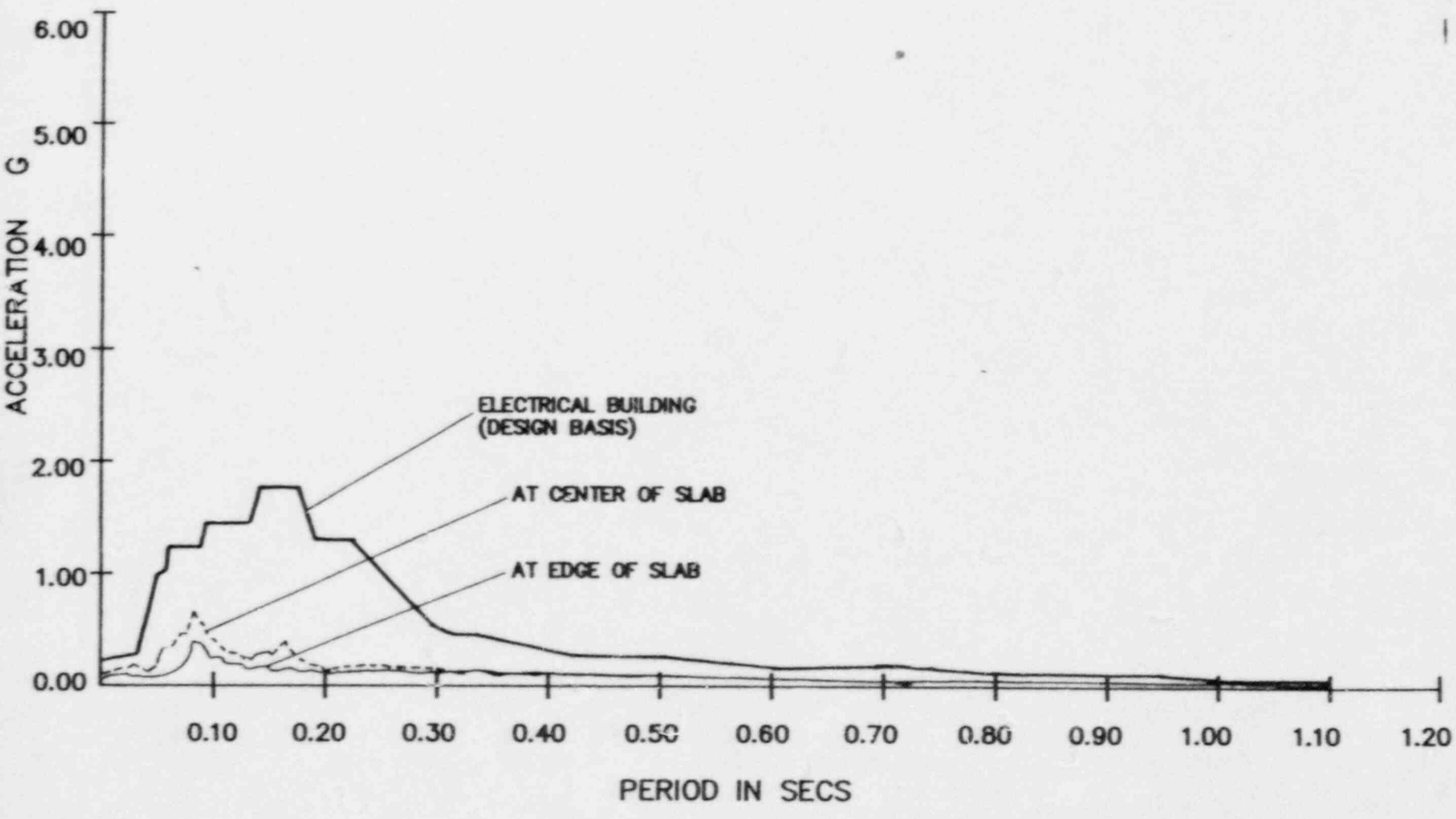


FIGURE 8

CPSES ELECTRICAL BUILDING SEISMIC OBE FLOOR FLEXIBLITY STUDY
HORIZ. ARS (X DIR.) EL 831.50 FEET 2% OSCILLATOR DAMPINGS
AMPLIFIED RESPONSE SPECTRA USING 24 TIME HISTORIES

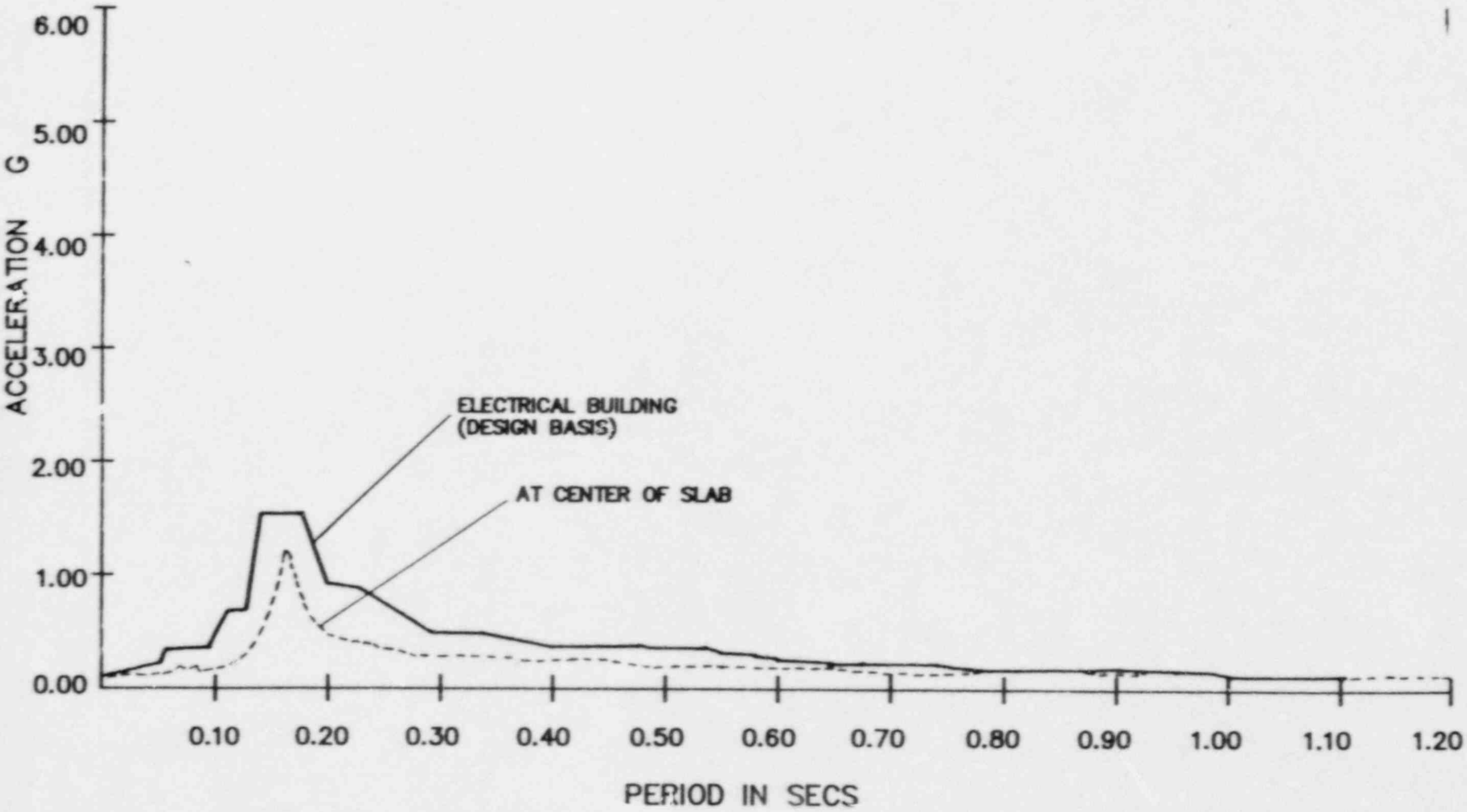


FIGURE 9

CPSES ELECTRICAL BUILDING SEISMIC OBE FLOOR FLEXIBLITY STUDY
HORIZ. ARS (Z DIR.) EL 831.50 FEET 2% OSCILLATOR DAMPINGS
AMPLIFIED RESPONSE SPECTRA USING 24 TIME HISTORIES

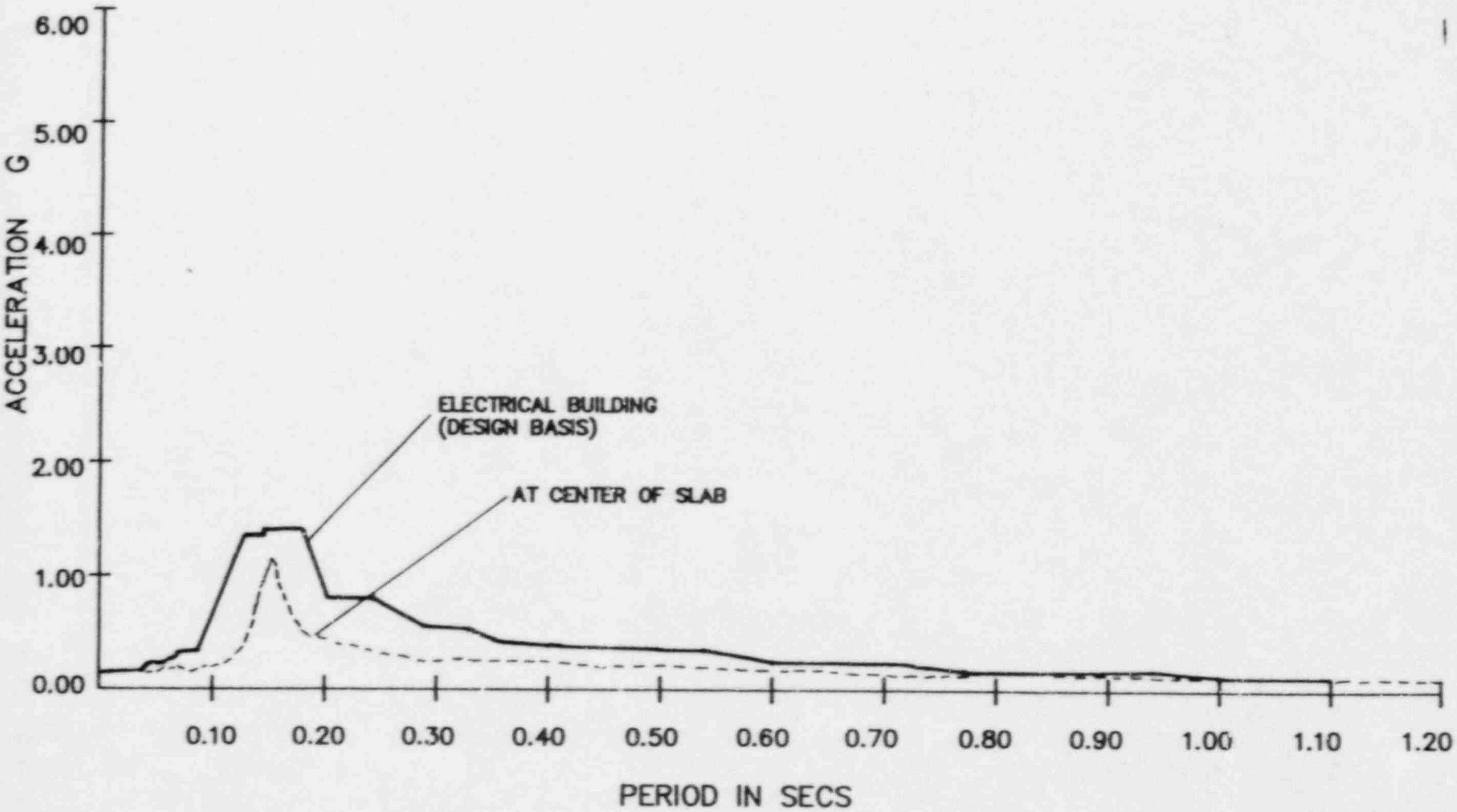


FIGURE 10

CPSES SAFEGUARD BUILDING SEISMIC   OBE FLOOR FLEXIBILITY STUDY
VERT. ARS (Y DIR.) EL 831.50 FEET   2% OSCILLATOR DAMPINGS
AMPLIFIED RESPONSE SPECTRA USING 24 TIME HISTORIES

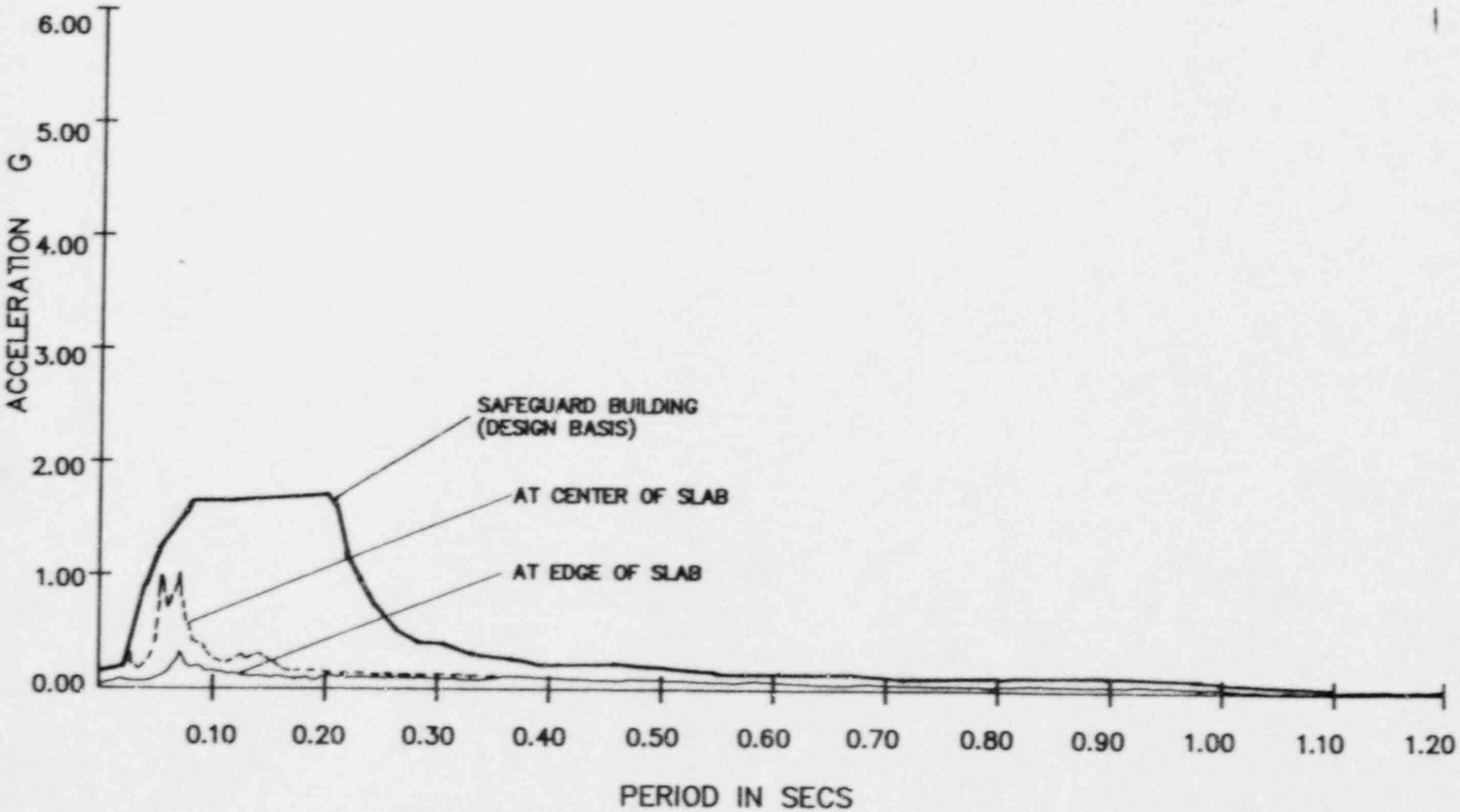


FIGURE 11

CPSES SAFEGUARD BUILDING SEISMIC OBE FLOOR FLEXIBILITY STUDY
HORIZ. ARS (X DIR.) EL 831.50 FEET 2% OSCILLATOR DAMPINGS
AMPLIFIED RESPONSE SPECTRA USING 24 TIME HISTORIES

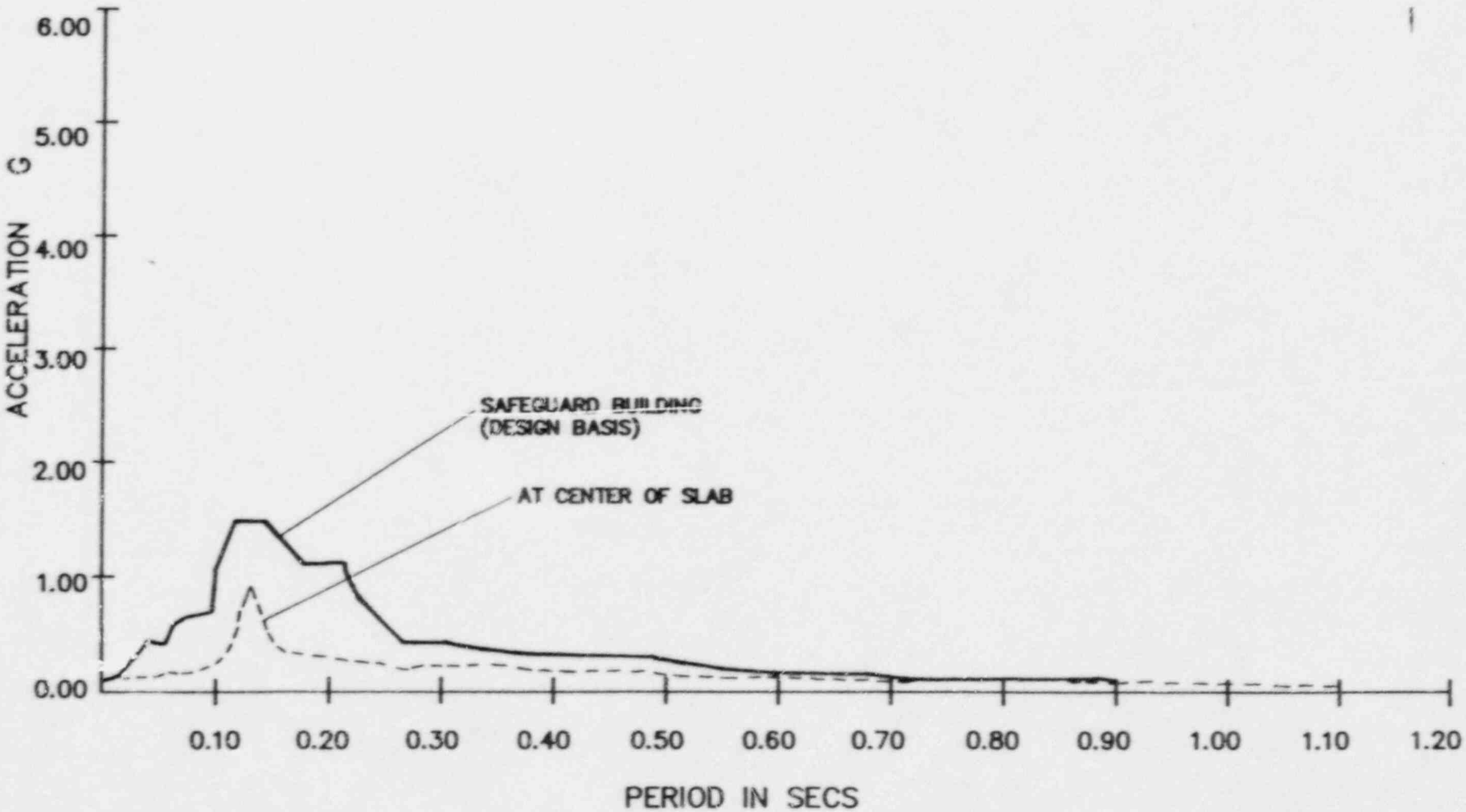


FIGURE 12

CPSES SAFEGUARD BUILDING SEISMIC OBE FLOOR FLEXIBILITY STUDY
HORIZ. ARS (Z DIR.) EL 831.50 FEET 2% OSCILLATOR DAMPINGS
AMPLIFIED RESPONSE SPECTRA USING 24 TIME HISTORIES

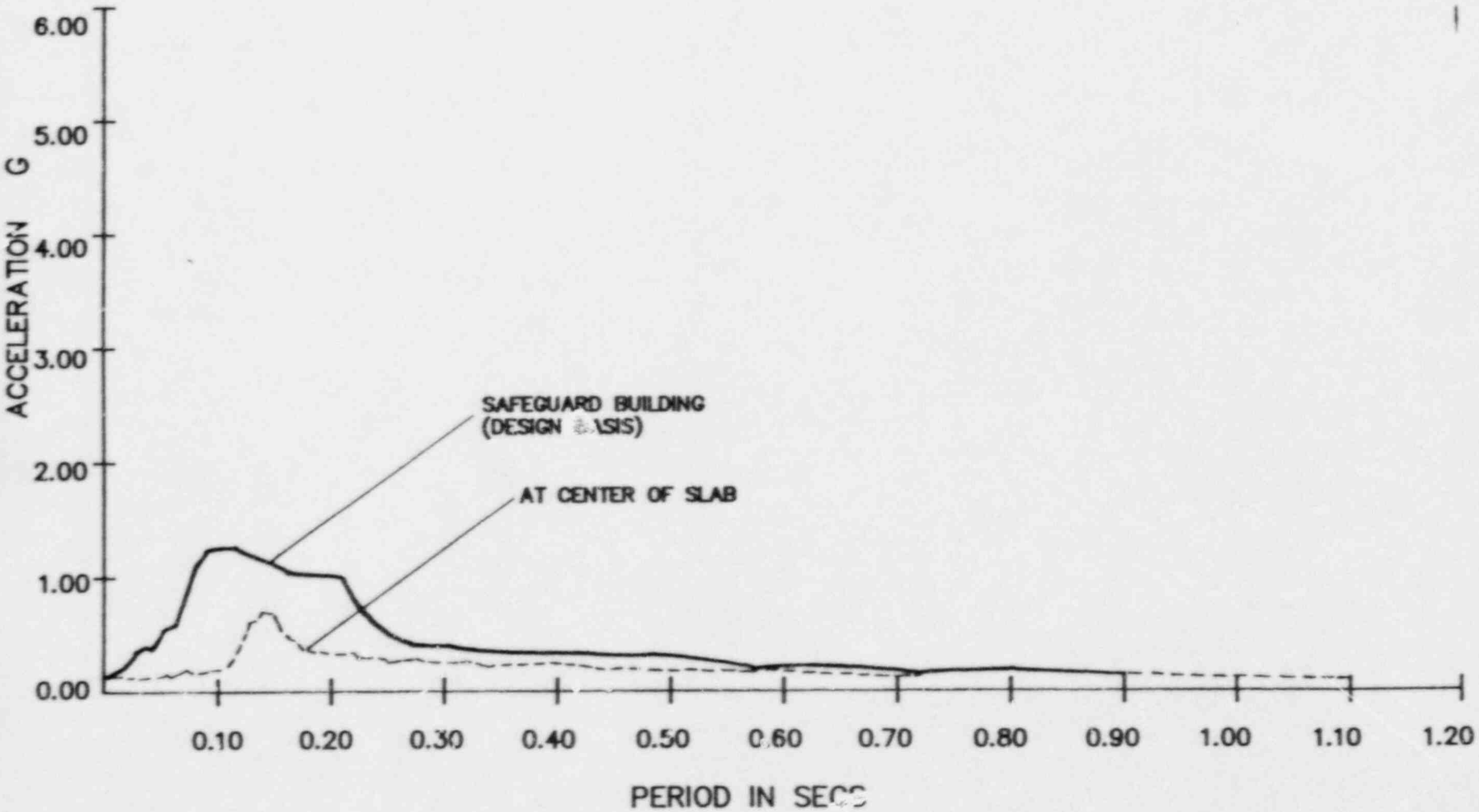
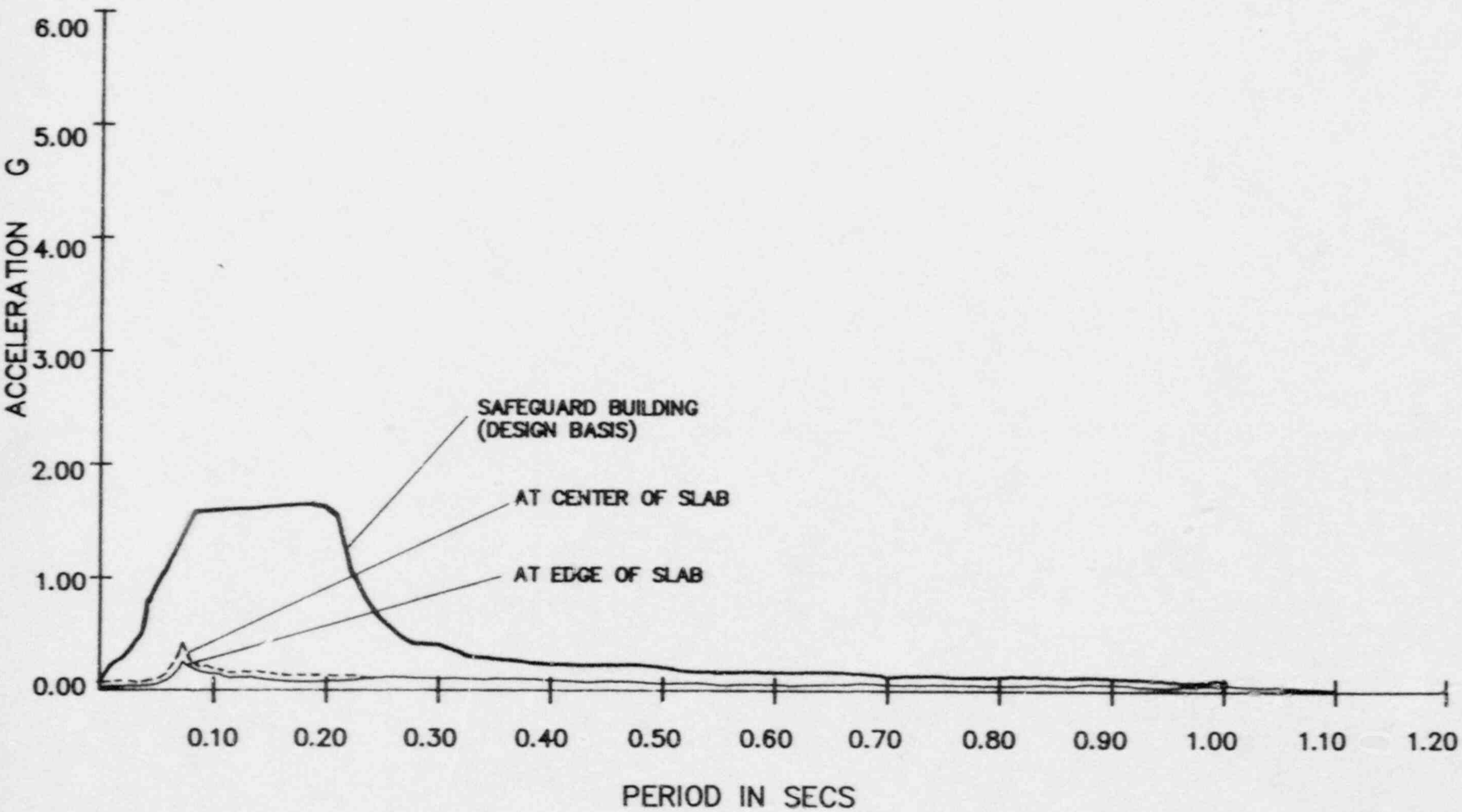


FIGURE 13

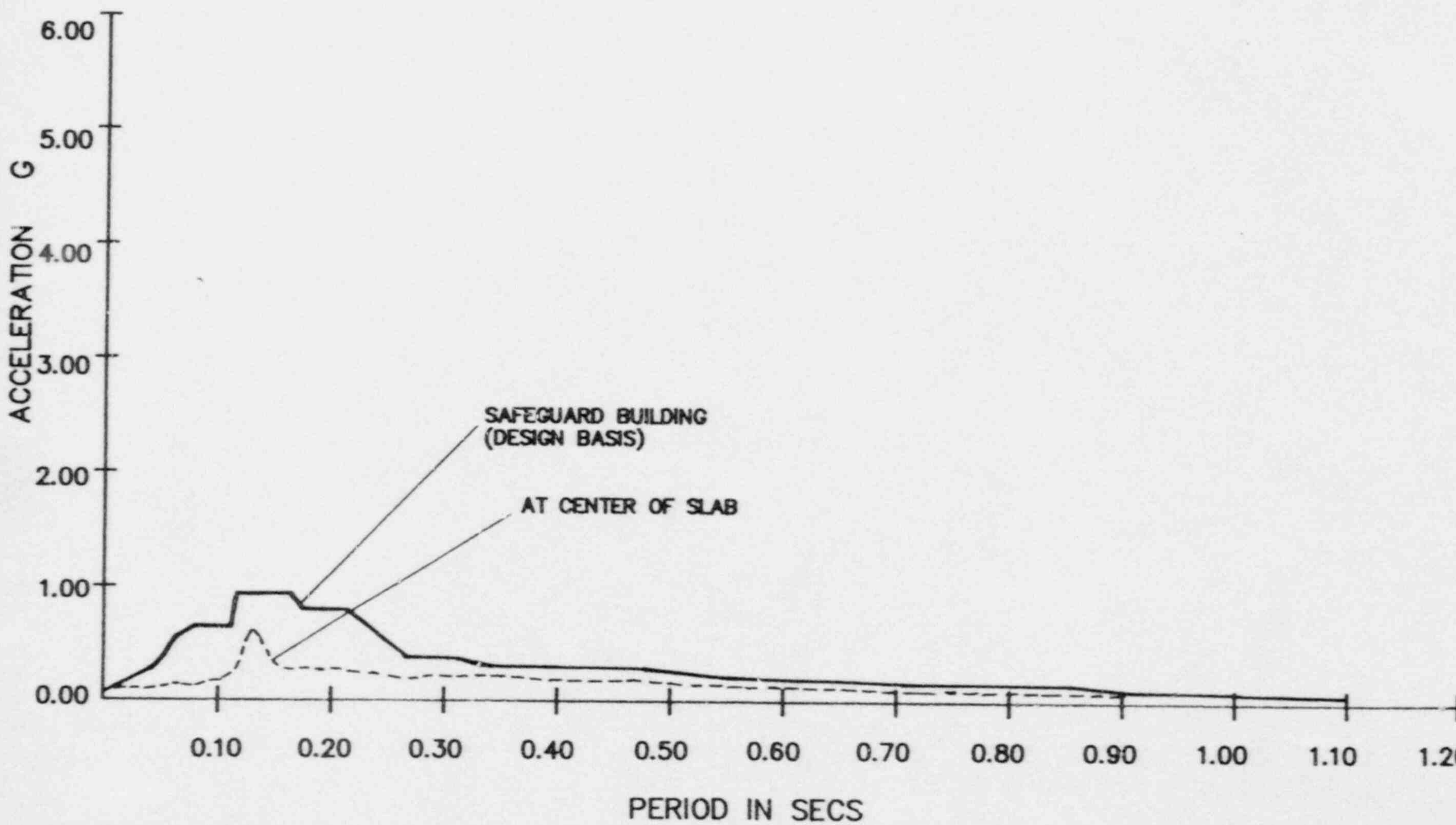
CPSES SAFEGUARD BUILDING SEISMIC OBE FLOOR FLEXIBILITY STUDY
VERT. ARS (Y DIR.) EL 810.50 FEET 2% OSCILLATOR DAMPINGS
AMPLIFIED RESPONSE SPECTRA USING 24 TIME HISTORIES



AOADOBOF0013

FIGURE 14

CPSES SAFEGUARD BUILDING SEISMIC OBE FLOOR FLEXIBILITY STUDY
HORIZ. ARS (X DIR.) EL 310.50 FEET 2% OSCILLATOR DAMPINGS
AMPLIFIED RESPONSE SPECTRA USING 24 TIME HISTORIES



AQAD0BCF1814

FIGURE 15

CPSES SAFEGUARD BUILDING SEISMIC OBE FLOOR FLEXIBILITY STUDY
HORIZ. ARS (Z DIR.) EL 810.50 FEET 2% OSCILLATOR DAMPINGS
AMPLIFIED RESPONSE SPECTRA USING 24 TIME HISTORIES

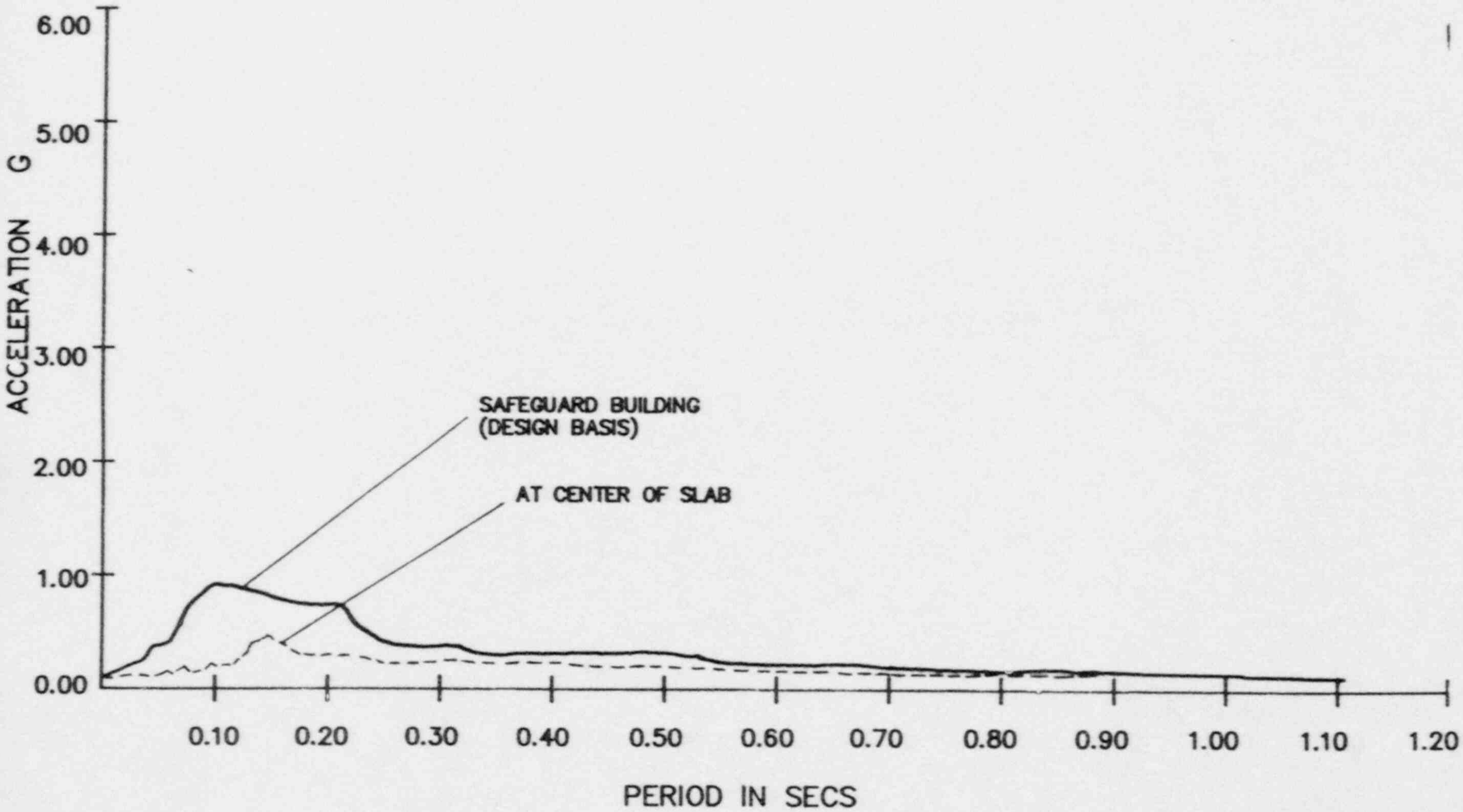
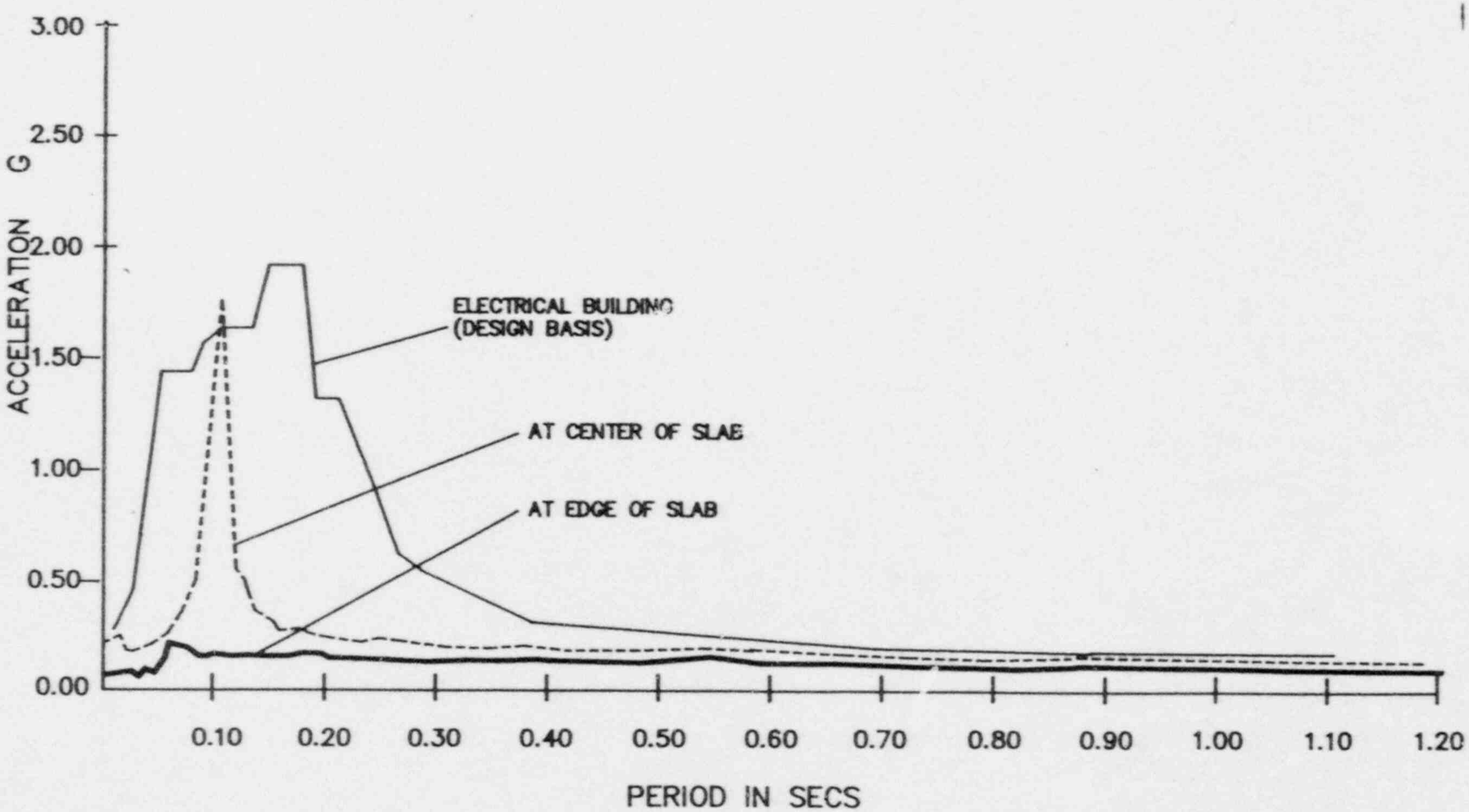


FIGURE 16

CPSES ELECTRICAL BUILDING SEISMIC OBE FLOOR FLEXIBLITY STUDY
VERT. ARS (Y DIR.) EL 852.50 FEET 2% OSCILLATOR DAMPINGS
AMPLIFIED RESPONSE SPECTRA USING 24 TIME HISTORIES NORMALIZED TO 0.04G
INCLUDING RADIATION DAMPING



OPEN ITEM C/S-17

Document Number: Calculation 16345-CS(C)-073, Revision 0, Floor Slab at El. 831'6" (Safeguards Building)

In determining the effects of the horizontal earthquake on the equipment on page 12, only one horizontal direction is considered in calculating the overturning moment at the base of the equipment. No justification could be found for omitting the effects of the second horizontal earthquake.

RESPONSE

The purpose of the calculation of equipment loads was to determine a reasonable load to evaluate the supporting slab capacity. Consideration of the one controlling horizontal direction seismic overturning moment applied to the critical span of the slab was an appropriate assumption and produced results consistent with the purpose of the calculation. Confirmation of the equipment loading should have been indicated.

The equipment load will be available from contractors and this validated load will be used to evaluate and confirm the adequacy of the slab.

SIGNIFICANCE/EXTENT

There is no safety concern because the judgement made was appropriate based on the purpose of the calculation. Based on a review of this calculation, it was determined that if this open item had gone undetected during the design process, it would not have adversely affected the safety of operation of the plant. The planned calculation review associated with the confirmation activity is in progress and identifies and adequately addresses required confirmations and documentation for the basis of engineering judgements for all Civil/Structural calculations.

OPEN ITEM C/S-18

Document Number: Calculation 16345-CS(C)-073, Revision 0, Floor Slab at El. 831'-6" (Safeguards Building)

The overturning moment of 50,200 ft/lb was calculated at the base of the M-G set for a single horizontal earthquake on page 11, but was subsequently omitted in actual design of slab "A" on pages 14 and 15. No justification could be found for omission of this load.

RESPONSE

The judgement to omit the loading for overturning moment should have been documented in the subject calculation. "Confirmation" should have been indicated for the equipment loading. Calculation 16345-CS(C)-073 (Rev. 0) will be revised to include an explanation of the method used to evaluate the slab when the validated equipment load is available from other contractors as part of the confirmation removal program.

SIGNIFICANCE/EXTENT

There is no safety concern because the judgement made was appropriate based on the purpose of the calculation. Based on a review of this calculation, it was determined that if this open item had gone undetected during the design process, it would not have adversely affected the safety of operation of the plant. The planned calculation review associated with the confirmation activity is in progress and identifies and adequately addresses required confirmation and documentation for the basis of engineering judgements for all Civil/Structural calculations.

OPEN ITEM C/S-19

Document Number: Calculation 16345-CS(C)-121, Revision 0, Beams at El. 831'-6" (Safeguards Building)

Beam B-15 supports a wall 24 in. to 36 in. thick and 20 ft-high. In calculating the loads on the wall, the designer did not include the 25 psf attachment loads as required by Section 4.8 of DBD-CS-081. The omission of attachment loads further reduced their seismic inertia load as required by Section 5.3.3 of DBD-CS-081.

RESPONSE

The criterion of the DBD-CS-081 Rev. 0 was not implemented in calculation 16345-CS-121. These loads were not included in the calculation because the additional moments and shears generated by these 25 psf vertical and horizontal loads together with seismic inertia effects are negligible when compared to the capacity of the structural elements.

SIGNIFICANCE/EXTENT

Had this item gone undetected, there would be no safety concern because the effects due to the 25 psf load is negligible when compared to the capacity of the structural elements. The extent is limited to C/S structural concrete building calculations. These calculations will be revised during confirmation removal to incorporate these loads.

OPEN ITEM C/S-20

Document Number: Calculation 16345-CS(C)-121, Revision 0, Beams at El. 831'-6" (Safeguards Building)

The calculation for negative moment Mu on page 22 showed that the additional external moment on the beam caused by the wall due to seismic acceleration perpendicular to the wall was also omitted. Additionally, seismic inertia load parallel to the wall was not addressed. DBD-CS-081, Section 5.3.3, last paragraph states, "Reactions from these inertial loads shall be considered in the design of the supporting structural elements."

A sample review of other beam designs (e.g., beams B-12, B-13, B-14, B-16, B-17, etc.) indicates that omissions similar to Open Items C/S-19 and C/S-20 exist throughout the calculation.

RESPONSE

Beam validation calculation 16345-CS(C)-121, Revision 0 included the dead and vertical seismic inertia loads from the wall above. A review of this calculation substantiated that the additional moments and shears generated by the two horizontal seismic inertia loads have a negligible effect on the capacity of the beams. Calculation 16345-CS(C)-121, Revision 0, will be revised to document the effect of the wall horizontal seismic inertia loads on the beam during the removal of confirmation. The expected completion date is August 15, 1988.

SIGNIFICANCE/EXTENT

There is no safety concern because the judgement made was appropriate based on the purpose of the calculation. Based on a review of this calculation, it was determined that if this open item had gone undetected during the design process, it would not have adversely affected the safety of operation of the plant. The planned calculation review associated with the confirmation activity is in progress and identifies and adequately addresses required confirmation and documentation for the basis of engineering judgements for all Civil/Structural calculations.

OPEN ITEM C/S-21

Document Number: Calculation 16345-CS(C)-074, Revision 0, Floor Slab @ El. 810'-6" (Safeguards Building)

The slab strip supporting the portion of the shield wall spanning in the eastwest direction has not been evaluated.

RESPONSE

Slab design calculation 16345-CS(C)-074 was based on the strip load which included the north-south wall and the heat exchanger. A review of the calculation for the loads from east-west wall distribution on the slab revealed that the north-south analysis controls the design.

SIGNIFICANCE/EXTENT

There is no safety concern because the judgement made was appropriate based on the purpose of the calculation. Based on a review of this calculation, it was determined that if this open item had gone undetected during the design process, it would not have adversely affected the safety of operation of the plant. The planned calculation review associated with the confirmation activity is in progress and identifies and adequately addresses required confirmation and documentation for the basis of engineering judgements for all Civil/Structural calculations.

OPEN ITEM C/S-22

Document Number: Calculation 16345-CS(C)-074, Revision 0, Floor Slab at El. 810'-6" (Safeguards Building)

The vertical seismic load due to the mass of the letdown heat exchanger is considered in the design but horizontal seismic forces are neglected.

RESPONSE

These loads were considered to be insignificant and therefore were not used in the calculation. A review of this calculation confirmed that the horizontal seismic effect of the Letdown Heat Exchanger equipment weight is negligible when compared to the values used in the design of the slab. Thus, neglecting these loads in the calculation was acceptable.

This calculation will be revised by August 15, 1988 during the confirmation removal activity to document the horizontal seismic effects of the equipment.

SIGNIFICANCE/EXTENT

There is no safety concern because the judgement made was appropriate based on the purpose of the calculation. Based on a review of this calculation, it was determined that if this open item had gone undetected during the design process, it would not have adversely affected the safety of operation of the plant. The planned calculation review associated with the confirmation activity is in progress and identifies and adequately addresses required confirmation and documentation for the basis of engineering judgements for all Civil/Structural calculations.

OPEN ITEM C/S-23

Document Number: Calculation 16345-CS(C)-074, Revision 0, Floor Slab @ El. 810'-6" (Safeguards Building)

Wall attachment loads of 25 psf (Section 4.8, DBD-CS-081) and their seismic inertia load (Section 5.3.3, DBD-CS-081) are not included in the design. This item is similar to Open Item C/S-19 for the beam designs.

RESPONSE

These loads were not used in the calculation because their effects on the structural element is negligible. Additional moments and shears generated by these 25 psf vertical and horizontal loads together with seismic inertia effects are small when compared to the capacity of the structural elements.

SIGNIFICANCE/EXTENT

Had this item gone undetected, there would be no safety concern because the effects due to the 25 psf load are negligible when compared to the capacity of the structural elements. There is no safety concern because the 25 psf loads are negligible. The extent is limited to C/S structural concrete building calculations. These calculations will be revised during confirmation removal to incorporate these loads.

OPEN ITEM C/S-24

Document Number: Calculation 16345-CS(C)-074, Revision, 0, Floor Slab @ El. 810'-6" (Safeguards Building)

The slab moment calculation does not include additional external moment caused by wall horizontal seismic inertia loads. A similar item was identified for beam design as Open Item C/S-20.

RESPONSE

The evaluation of the slab in calculation 16345-CS(C)-074 considered the external moments caused by the vertical seismic inertia loads from the wall above. However, horizontal seismic inertia loads due to the wall were not applied to the slab in question. This engineering judgement was not documented. A review of this calculation substantiates that the additional moments and shears generated by the two horizontal seismic inertia loads have a negligible effect on the slab. Calculation 16345-CS(C)-074 will be revised by August 15, 1988 to document the effect of the wall horizontal seismic inertia loads on the slab during the removal of confirmation activity.

SIGNIFICANCE/EXTENT

There is no safety concern because the judgement made was appropriate based on the objective of the calculation. Based on a review of this calculation, it was determined that if this open item had gone undetected during the design process, it would not have adversely affected the safety of operation of the plant. The planned calculation review associated with the confirmation activity is in progress and identifies and adequately addresses required confirmation and documentation for the basis of engineering judgements for all Civil/Structural calculations.

OPEN ITEM C/S-26

Document Number: Calculation 16345-CS(C)-129, Revision 0, Reactor Building - Unit 1 -Containment Analysis

Loads requiring confirmation listed on sample pages 10, 42 and 80 have not been listed in the Record of Confirmations sheet (Page 5). The calculation should be checked for completeness and accuracy of confirmation requirements.

RESPONSE

Not all items requiring confirmation had been identified on the Records of Confirmation sheet (page 5) of calculation 16345-CS(C)-129, Revision 0. This calculation has been revised to identify all items requiring confirmation on the Records of Confirmation sheet.

The body of all C/S calculations will be compared with the Record of Confirmations to identify any required confirmations which were not transferred to the Record of Confirmations. This review will be completed by May 31, 1988.

SIGNIFICANCE/EXTENT

There is no safety concern because the inputs requiring confirmation were identified in the body of the calculation. Based on a review of this calculation, it was determined that if this open item had gone undetected during the design process, it would not have adversely affected the safety of operation of the plant. The planned calculation review associated with the confirmation activity is in progress and identifies and adequately addresses required confirmation and documentation for the basis of engineering judgements for all Civil/Structural calculations.

OPEN ITEM C/S-28

Document Number: Calculation 16345-CS(C)-127, Revision 0, Reactor Building - Mat Analysis - Unit 1

Attachments 4 and 5 are the development of the significant containment internal loads used as input into the mat analysis (Page 93). Neither of these documents are identified as having been checked. The validity of these documents should be established.

RESPONSE

Attachments 4 and 5 relate to the dead load, live load, and seismic load reactions on the mat due to the reinforced concrete internal structures.

Attachment 4 is a load transmittal document which was used as input to calculation 16345-CS(C)-127. The load data contained in this transmittal was based on unissued calculations. Hence, this data should have been identified in Calculation 16345-CS(S)-127 as requiring confirmation and listed on the Record of Confirmations sheet.

Attachment 5 should have been included in the body of the calculation and checked.

As part of Revision 2 of this calculation the analysis which had previously been in Attachment 5 was made part of the body of the calculation and checked. The data taken from Attachment 4 was identified as requiring confirmation.

SIGNIFICANCE/EXTENT

There is no safety concern because the calculations provided in attachments 4 and 5, which have been incorporated into calculation 16345-CS(C)-127, were correct. Based on a review of this calculation, it was determined that if this open item had gone undetected during the design process, it would not have adversely affected the safety of operation of the plant. The planned calculation review associated with the confirmation activity is in progress and identifies and adequately addresses required confirmation and documentation for the basis of engineering judgements for all Civil/Structural calculations.

OPEN ITEM C/S-30

Document Number: Calculation 16345-CS(C)-083, Revision 0, Safeguard Buildings - Unit 1 - Wall Design - East-West

The mechanism (and resultant forces in slabs) to transfer seismic loads to walls are not addressed in this calculation 16345-CS(C)-083, Revision 0 or in calculations of slabs (16345-CS(C)-070, Revision 0 thru 16345-CS(C)-076, Revision 0).

RESPONSE

Calculation 16345-CS(C)-083, Revision 0 addresses the evaluation of wall section strength and not the global transfer of seismic forces to the walls. An assumption was made that the mechanism for the transfer of loads to the walls is provided by in-plane shear through the slabs. The slab calculations 16345-CS(C)-070 through 16345-CS(C)-076 will be revised by August 15, 1988 to incorporate a discussion of in-plane shear transfer capability of the slabs.

SIGNIFICANCE/EXTENT

There is no safety concern because the slabs do transfer loads to the walls. Based on a review of this calculation, it was determined that if this open item had gone undetected during the design process, it would not have adversely affected the safety of operation of the plant. The planned calculation review associated with the confirmation activity is in progress and identifies and adequately addresses required confirmation and documentation for the basis of engineering judgements for all Civil/Structural calculations.

OPEN ITEM C/S-32

Document Number: Calculation 16345-CS(C)-009, Revision 0, Development of Dynamic Model and Seismic Profile for the Safeguard Building

The seismic model does not consider structure below El. 790.5'. The stiffness properties of the beam between node points 3 and 4 are not adjusted to account for omission of lower structure.

RESPONSE

The founding level of the Safeguards Building is not uniform and the structure is founded at seven discrete elevations ranging from a high point of 806.5 feet to a low point of 767.33 feet. The mean founding level of the structure is located just below the lowest mass point in the model. The soil springs are attached to the model at elevation 784.83 feet. The exterior walls of the Safeguards Building below grade are poured against the surrounding rock, and will move as a unit with the rock. Thus, for modeling purposes the walls below El. 790.5 feet can be reasonably assumed to be rigid and no adjustment to the stiffness properties for the beam between nodes 3 and 4 is necessary. Consequently, use of the model in calculation 16345-CS(C)-009 to validate the results of the previous analysis is reasonable and conservative. The calculation will be revised to document and clarify this assumption.

SIGNIFICANCE/EXTENT

There is no safety concern because the judgement made was appropriate and the seismic model was adequate. Based on a review of this calculation, it was determined that if this open item had gone undetected during the design process, it would not have adversely affected the safety of operation of the plant. The planned calculation review associated with the confirmation activity is in progress and identifies and adequately addresses required confirmation and documentation for the basis of engineering judgements for all Civil/Structural calculations.

OPEN ITEM C/S-35

Document Number: DBD-CS-081, Revision 0, General Structural Design Criteria

The criteria for equipment/system attachment loads on the walls need further clarification since they are not applied uniformly and are apparently misunderstood in many design calculations.

RESPONSE

Section 4.8 of DBD-CS-081, Revision 0 provided a criterion for the application of a 25 psf load normal to a wall surface. This criterion was not properly implemented in calculations 16345-CS(C)-057, -066, -083, -090, and 16345-CS(B)-022.

DBD-CS-081, Revision 1 was revised to include a method for the application of the 25 psf vertical and horizontal loads together with their seismic inertia effects to the wall elements which are subjected to equipment/systems attachment loads.

A review of the subject calculations was performed to evaluate the effects of the application of 25 psf in accordance with the criteria of DBD-CS-081, Revision 1. The additional moments and shears generated by these loads are negligible in comparison to the capacities of the structural elements. The structural integrity of the wall elements and the structure will not be impacted by the application of the 25 psf loads.

The calculations listed above will be revised to document the application of the 25 psf horizontal and vertical loads with the seismic effects in accordance with the criteria of DBD-CS-081, Revision 1, during the removal of confirmation.

SIGNIFICANCE/EXTENT

Had this item gone undetected, there would be no safety concern because the effects due to the 25 psf load are negligible when compared to the capacity of the structural elements. The planned calculation review associated with the confirmation activity is in progress and identifies and adequately addresses required confirmation and documentation for the basis of engineering judgements for all Civil/Structural calculations.

OPEN ITEM C/S-40

Document Number: Calculation 16345-CS(B)-025, Revision 0, Penetration Anchorage Analysis - Unit 1

The allowable punching shear stress has been calculated using 1977 ASME Section III, Div. 2, Subsection CC-3421.6 (Page 13). This issue of the ASME code has not been authorized by DBD-CS-074 or the current revision of the FSAR.

In addition, the effect of biaxial tension has not been accounted for in calculating the allowable shear stress and therefore the penetration anchorage capacities have been overestimated.

RESPONSE

The code invoked by the FSAR was the April, 1973 proposed ASME B&PV Code Section III, Division 2, Subsection CC. Punching shear was not addressed in this code. Subsequent to issuance of calculation 16345-CS(B)-25, Revision 0, FSAR Amendment 68 was issued which invoked Section 11.10 of the ACI 318-71 code.

Design Basis Document DBD-CS-073 Concrete Containment Structure has been revised to require ACI 318-71 as the proper code. The allowable punching shear stress under biaxial membrane tension is further limited to $2\sqrt{f'c}$ without the inclusion of additional reinforcement. This requirement will be incorporated into DBD-CS-073 and the calculation will be revised to incorporate the above criteria. This is the correct DBD to specify concrete punching shear design.

A report by Cornell University entitled "Peripheral (Punching) Shear Strength of Biaxially Tensioned Reinforced Concrete Wall Elements" dated 1981, provides justification for using the allowable as stated. Therefore, the estimation of the penetration anchorage capacities is adequate.

SIGNIFICANCE/EXTENT

There is no safety significance because punching shear was addressed and the DBD/FSAR provide the required criteria. In addition, the test report discussed above had provided the appropriate justification for the use of the equation of ACI 318-71 in areas of biaxial membrane tension.

OPEN ITEM C/S-41

Document Number: Calculation 16345-CS(B)-040, Revision 0, Equipment Hatch Personnel and Emergency Air Locks Anchorage and Reinforcing Plate Analysis

The allowable punching shear stress has been calculated using 1977 ASME Section III, Div. 2, Subsection CC-3421.6 (Page 25). This issue of the ASME Code has not been authorized by DBD-CS-074 or the current revision of the FSAR.

In addition, the effect of bi-axial tension has not been accounted for calculating the allowable shear stress and therefore the penetration anchorage capacity has been overestimated (Page 10).

RESPONSE

The code invoked by the FSAR was the April, 1973 proposed ASME B&PV Code Section III, Division 2, Subsection CC. Punching shear was not addressed in this code. Subsequent to issuance of calculation 16345-CS(B)-40, Revision 0, FSAR Amendment 68 was issued which invoked Section 11.10 of the ACI 318-71 code.

Design Basis Document DBD-CS-073 Concrete Containment Structure has been revised to require ACI 318-71 as the proper code. The allowable punching shear stress (vc) under biaxial membrane tension is further limited to $2\sqrt{f'c}$ without the inclusion of additional reinforcement. This requirement will be incorporated into DBD-CS-073 and the calculation will be revised to incorporate the above criteria. This is the correct DBD to specify concrete punching shear design.

A report by Cornell University entitled "Peripheral (Punching) Shear Strength of Biaxially Tensioned Reinforced Concrete Wall Elements" dated 1981, provides justification for using the equation of ACI 318-71 in areas of biaxial membrane tension. Therefore, the estimation of the penetration anchorage capacities is adequate.

SIGNIFICANCE/EXTENT

There is no safety significance because punching shear was addressed and the DBD/FSAR provide the required criteria. In addition, the test report discussed above had provided the appropriate justification for the use of the equation of ACI 318-71 in areas of biaxial membrane tension.

OPEN ITEM C/S-44

Document Number: Calculation 16345-CS(C)-122, Revision 0, Beam Analysis - Floor El. 810'-6" (Safeguards Building)

The wall attachment load of 25 psf is not addressed in the design of beam B-29. This item is similar to Open Items C/S-19 and 23.

RESPONSE

The criterion of the DBD-CS-081, Rev. 0, was not implemented in calculation 16345-CS(C)-122. These loads were neglected in the calculation because of the small magnitude.

Additional moments and shears generated by these 25 psf vertical and horizontal loads together with seismic inertia effects are small when compared to the capacity of the structural elements.

SIGNIFICANCE/EXTENT

Had this item gone undetected, there would be no safety concern because the effects due to the 25 psf load are negligible when compared to the capacity of the structural elements. The extent is limited to Civil/Structural concrete building calculations. These calculations will be revised during the confirmation removal activity to incorporate these loads.

OPEN ITEM C/S-45

Document Number: Calculation 16345-CS(C)-122, Revision 0, Beam Analysis - Floor El. 810'-6" (Safeguards Building)

The equipment load due to electrical switchgears is omitted in the design of beams B-6 through B-13.

RESPONSE

The evaluation of beams B-6 through B-13 in calculation 16345-CS(C)-122 included a slab live load of 300 psf over the entire surface area of the slab The distributed equipment load for the Electrical Switchgear was determined in calculation 16345-CS(C)-074, page 8, which produced a load intensity of 125 psf. Therefore, the load under this equipment is less than the applied live load of 300 psf. Thus, the Electrical Switchgear load breakdown was not documented in calculation 16345-CS(C)-122 for the beam designs. Calculation 16345-CS(C)-122 will be revised to document the intensity of load under the Electrical Switchgear and its comparison to the live load during the confirmation removal activity.

SIGNIFICANCE/EXTENT

There is no safety significance because the slab is adequate as designed and the judgement made was appropriate. Based on a review of this calculation, it was determined that if this open item had gone undetected during the design process, it would not have adversely affected the safety of operation of the plant. The planned calculation review associated with the confirmation activity is in progress and identifies and adequately addresses required confirmation and documentation for the basis of engineering judgements for all Civil/Structural calculations.

OPEN ITEM C/S-53

Document Number: Calculation 16345-CS(C)-084, Revision 0, Safeguards Building Foundation Mat Analysis

Maximum soil pressure is not calculated. SWEC is in the process of calculating soil pressure under different loading conditions. Dynamic soil pressure on walls of the Safeguards Building is not considered in the mat analysis. Justification is required for neglecting the dynamic soil pressure on walls.

RESPONSE

In performing Revision 0 of calculation 16345-CS(B)-084, the dynamic soil loading on the Safeguards Building walls above the mat was judged to have an insignificant effect on the mat design. Revision 1 of the calculation incorporated these loads and demonstrated the adequacy of the judgement made.

SIGNIFICANCE/EXTENT

There is no safety concern because the judgement was appropriate and the mat analysis is adequate. Based on a review of this calculation, it was determined that if this open item had gone undetected during the design process, it would not have adversely affected the safety of operation of the plant. The planned calculation review associated with the confirmation activity is in progress and identifies and adequately addresses required confirmation and documentation for the basis of engineering judgements for all Civil/Structural calculations.

OPEN ITEM C/S-54

Document Number: Calculation 16345-CS(C)-084, Revision 0, Safeguards Building Foundation Mat Analysis

The seismic force distribution on walls and columns is based on the gross moment of inertia of all wall and column elements about the center of gravity of wall and column areas. This will introduce shear and moments in floor slabs connecting all elements. This shear distribution on walls and columns has not been addressed. (This item is similar to Open Item C/S-30.)

RESPONSE

Calculation 16345-CS(C)-084 did not determine shear distribution in walls and columns. Shear distribution on walls and columns was determined in Revision 0 of calculations 16345-CS(C)-081 and -079. The results from the above calculations were used as input in calculation 16345-CS(C)-084 for the analysis of the mat. The slab calculations 16345-CS(C)-070 through 16345-CS(C)-076 will be revised by August 15, 1988 to incorporate a discussion of shear transfer capability of the slabs.

SIGNIFICANCE/EXTENT

There is no safety concern because the shear distribution was addressed in calculations 16345-CS(C)-079 and -081 which were used as inputs to calculation 16345-CS(C)-084. The planned calculation review associated with the confirmation activity is in progress and identifies and adequately addresses the above item.