Attachment 5
to U-602512

50.59 Thermo-Lag
Safety Evaluations

SAFETY EVALUATION FORM

Document Evaluated: 1.1 L&S Log # 94-0056

1.2 Number: USAR Appendix F 1.3 Revision: N/A

1.4 Title: EVALUATION OF THERMO-LAG IN FIRE ZONE A-1a
USAR Appendix E and F Revision

1.5 References:
See page 6.

BLOCK A - DESCRIPTION OF CHANGE
(Use additional pages if required)

A.1 Describe the basic document or system and the changes being made. Discuss how the change affects the SAR description. Discuss the reason for change.

CPS USAR Appendix F, subsection 3.3.1.3 discusses the provision of 1-hour rated cable fire wrap to protect Division 2 power, control and instrumentation cables in fire zone A-1a, which is a general access corridor at elevation 707 feet 6 inches in the Auxiliary Building. The purpose of this evaluation is to accept the fire wrap as-is even though the fire wrap material used in A-1a, Thermo-Lag 330-1, does not provide the 1-hour rating. The proposed USAR change will delete the reference to the 1-hour rating of the fire barrier. In addition, this deviation from Appendix R requirement for 1-hour rated fire barrier will be included in USAR Appendix F, Section 4.2.
(Continued on page 8)

NF-002-1 (2/94)

A.2 Identify the equipment, systems and parameters that may be affected by the change:

Fire Zone Affected: Fire Zone A-1a, General access north area at elevation 707 feet 6 inches (USAR Appendix E, Figures FP-2a and 2b; USAR Appendix F, cable tray Figure 2 and Deviation Figure 4.2.4.4-1).

Description of Safe shutdown Equipment and/or cables:
The systems affected include RHR A and B, RCIC and Division 2 diesel generator systems.

The cables of concern to this Appendix R deviation are certain safe shutdown cables located in fire zone A-1a. A list of the Division 2 safe shutdown power, control and instrumentation cables protected by Thermo-Lag in fire zone A-1a is provided in Enclosure 2. Enclosure 2 also lists Division 1 safe shutdown power, control and instrumentation cables located within 20 feet of the wrapped trays.
(Continued on page 10)

94-0056

BLOCK B - RADWASTE TREATMENT SYSTEMS

B.1 The proposed activity involves a modification to a radioactive waste treatment system or the way in which it is operated as described in Chapter 11 of the SAR.

Yes ______

No __X__

B.2 Because: The proposed USAR changes affect only the fire protection and safe shutdown analyses contained in the USAR. They do not impact the radwaste system or its operation.

If B.1 is yes, complete form NF-003.

BLOCK C - TECHNICAL SPECIFICATION IMPACT

C.1 The proposed activity requires a change to any part of the Technical Specifications.

Yes ______

No __X__

C.2 Justification if "NO", Technical Specification change package identification number if "YES".

The CPS Technical Specification does not contain any operability requirements for the fire protection features other than for containment isolation. This evaluation shows that the safe shutdown analysis is unaffected by the proposed change. This change does not impact the CPS Fire Protection Program discussed in Technical Specification 6.8.4.e.

BLOCK D - UNREVIEWED SAFETY QUESTION DETERMINATION

(Attach additional pages with the responses to the block D questions. Identify your answers to Parts I, II, III, and IV.)

Part I - Impact on equipment malfunctions evaluated as the design basis.

1. For the equipment and systems identified in A.1 and A.2, identify any failures evaluated in the SAR.
   See page 21.

2. Discuss the impact of the change on the performance of the equipment and systems identified in A.1 and A.2.
   See page 21.

3. Identify what new failure modes could be introduced by the change.
   See page 21.

4. Identify any impact of the change on the consequences of the failures evaluated in the SAR.
   See page 22.

5. Identify any impact of the change on the probabilities of the failures evaluated in the SAR.
   See page 22.

94-0056

SAFETY EVALUATION FORM

BLOCK D - UNREVIEWED SAFETY QUESTION DETERMINATION

SUMMARY

Based on item 4, are the consequences of any malfunction of equipment evaluated in the SAR increased?

YES ______

NO ___X___

Based on item 5, is the probability of a malfunction of equipment evaluated in the SAR increased?

YES ______

NO ___X___

If the answer to any of the above questions is yes, the change is an unreviewed safety question.

Part II - Impact on the accidents evaluated as the design basis See page 22.

1. Identify the accidents evaluated in the SAR which could be affected by the change.
2. Discuss how the change impacts the consequences of these accidents.
3. Discuss how the change impacts the probability of these accidents.

SUMMARY

Based on item 2, are the consequences of an accident evaluated in the SAR increased?

YES ______

NO ___X___

Based on item 3, is the probability of an accident evaluated in the SAR increased?

YES ______

NO ___X___

If the answer to any of the above questions is answered yes, the change is an unreviewed safety question.

Part III - Potential for Creation of a New Unanalyzed Event See page 22.

1. Based on Part I, items 1 and 3, could this change initiate a new type of accident or equipment malfunction? Discuss the basis for this determination.

2. Determine if the new accident or malfunction identified above has sufficient probability or consequences to be considered in the Licensing basis. Discuss the bases for this determination.

94-0056

SAFETY EVALUATION FORM

BLOCK D - UNREVIEWED SAFETY QUESTION DETERMINATION

SUMMARY

Based on item 2, does the change create the possibility for an equipment malfunction or accident of a different type than previously evaluated in the SAR?	YES	
	NO	X

If the answer is yes, the change represents an unreviewed safety question.

Part IV - Impact on the Margin of Safety See page 22.

1. Identify how any of the protective barriers are directly affected by the change.
2. Discuss the impact of the change on the approach to the acceptance limits for any of the protective barriers.
3. Discuss the impact of the change on the bases of the Technical Specifications.

SUMMARY

Based on item 2, is any parameter in chapter 7 of the Safety Evaluation Manual exceeded?	YES	
	NO	X
Based on items 2 and 3, does the change reduce the margin of safety provided for the protective barriers?	YES	
	NO	X

If the first of these two questions is answered yes, the change may be unsafe and requires further justification. If the first question is answered no and the second is answered yes, the change is safe to implement but is an unreviewed safety question and requires prior NRC approval.

94-0056

SAFETY EVALUATION FORM

BLOCK E - SUMMARY

Based on the evaluation in Block C and Block D, the change

_X_ is safe and is not an unreviewed safety question and requires no Technical Specification change. This change may be implemented in accordance with applicable procedures.

____ is safe but is an unreviewed safety question or requires a Technical Specification change. The change requires NRC approval, prior to implementation.

____ is unsafe and cannot be implemented.

MEO, SRW, CRS, BTF, M&M, KAL

	printed name	signature	date
Preparer	R. P. Bhat	Ram P. Bhat	11/7/94
Director	J. R. Langley	J R Langley	11/7/94
Manager, NSED	N. A.	N/A	
Manager, L&S	R. F. Phares	[signature]	11-8-94
FRG	Patrick D Yocum	[signature]	11/[illegible]/94

EVIDENCE OF NRC APPROVAL, IF REQUIRED:

License Ammendment No. __________

printed name	signature	date
	N/A [initials] 11-8-94	

The department responsible for vaulting the parent document must vault this completed form with the document evaluated.

NF-002-5 (2/94)

1.5 References

1. "Clinton Power Station Updated Safety Analysis Report", Revision 6 Appendix E, Subsection 3.2.1.1, Figures FP-2a and FP-2b, Appendix F, Subsections 3.1.2.3.1.1.3, and 4.1.1.1.1, Cable Tray Figure 2, Deviation, Figure 4.2.4.4-1, Section 9.5-1.

2. "Clinton Power Station Technical Specifications", Amendment 93, Section 6.8.4.e.

3. 10CFR 50 Appendix R, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979", Section III.G.

4. Generic Letter 86-10, "Implementation of Fire Protection Requirements".

5. Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers".

6. NRC Information Notice IN 94-22, "Fire Endurance and Ampacity Derating Test Results of 3-hour Fire Rated Thermo-Lag 330-1 Fire Barriers".

7. CPS Operating License, License Condition 2-F.

8. NSED Calculation IP-M-0177, "Fire Loads for CPS Fire Zones", Rev. 3.

9. NSED Calculation IP-M-0200, "Evaluation of Thermo-Lag Fire Barrier in Fire Zone CB1e", Rev. 0.

10. NSED Calculation IP-M-0390, "Detailed Fire Modeling for Fire Zone A-1a", Rev. 0.

11. EPED Calculation 19-AI-8, "Derating for 3-hour TSI Tray Wrap", Rev. 6.

12. NSED Standard ME-08.00, "Thermo-Lag Combustibility Evaluation Methodology Plant Screening Guide", Rev. 0.

13. NSED Standard ME-09.00, "NEI Application Guide for Evaluation of Thermo-Lag Fire Barrier Systems", Rev. 1.

14. EPRI Final Report TR-100370, dated April 1992 (including Revision 1), "Fire Induced Vulnerability Evaluation (FIVE)".

15. Condition Report 1-92-07-024, "NRC Bulletin 92-01; Indeterminate Fire Rating of Thermo-Lag", Rev. 0.

1.5 References (continued)

16. CPS Procedure 1001.06, "CPS Fire Brigade", Rev. 4.

17. CPS Procedure 1893.02, "Fire Prevention - Control of Ignition Source", Rev. 5

18. CPS Procedure 1893.03, "Control of Flammable and Combustible Liquids and Combustible Materials", Rev. 7.

19. CPS Procedure 1893.04, "Fire Fighting", Rev. 6.

20. CPS Procedure 1893.04 M100, "707' Auxiliary: General Access Area, Prefire Plan" Rev. 3.

21. CPS Procedure 4200.01, "Loss of A. C. Power", Rev. 8.

22. Illinois Power Policy Memorandum PM 1.05, "No Smoking Rules, Enforcement of", Rev. 0.

23. CPS Procedure 1019.01, "Housekeeping", Rev. 10.

24. EPED Calc. 19-G-31, "Ampacity of Control Cables in Completely Filled Trays", Rev. 0.

BLOCK A.1 Continued

Reason for Thermo-Lag in Fire Zone A-1a
The Thermo-Lag 330-1 cable fire wrap in fire zone A-1a was originally installed to meet the requirement of 10 CFR 50, Appendix R, Section III.G. The current USAR description in Section 9.5-1 states that deviations from Appendix R requirements will be provided in the Clinton Safe Shutdown Analysis, Section 4.2.

Appendix R Requirement

Appendix R subsections III.G.2.a, III.G.2.b and III.G.2.c address specific requirements for the protection of safe shutdown capability in the event of a fire. Appendix R requires compliance with one of the three alternatives outlined by the three subsections.

Appendix R, III.G.2.a requires:

the separation of cable and equipment and associated non-safety circuits of redundant trains by a fire barrier having a 3-hour rating.

Appendix R, III.G.2.b requires:

1. 20 feet of separation, with no intervening combustibles, between redundant cables, equipment and associated non-safety circuits,
2. fire detectors and
3. automatic fire suppression system.

Appendix R, III.G.2.c requires

1. enclosure of the component of one redundant train in a fire barrier having a 1-hour rating,
2. fire detectors and
3. automatic fire suppression system.

CPS Compliance with Appendix R in Fire Zone A-1a

While the Appendix R requirements refer to fire areas, the CPS fire areas have been further divided into fire zones using natural boundaries. The use of fire zones is consistent with the NRC guidance provided in GL 86-10, Question and Answer Section 3.1.5., and CPS USAR Appendix F, Safe Shutdown Analysis. The impact of the proposed change is limited to fire zone A-1a, it does not impact the other fire zones in fire area A-1.

In the center of fire zone A-1a the original design utilized the option of 20 feet separation (III.G.2.b) using Thermo-Lag as a fire break by wrapping a 20-foot length of the intervening tray of non-safe shutdown Division 2 instrumentation cables for a 20-foot length in the west side. East of the fire break, the option of 1-hour fire barrier (III.G.2.c) is utilized, using Thermo-Lag to enclose the trays of Division 2 safe shutdown power and control cables. Enclosure 1 shows the location of Thermo-Lag in fire zone A-1a. In addition, an ionization fire detection and an automatic wet pipe sprinkler system are provided in the entire fire zone. This combination of options is consistent with the NRC guidance provided in GL 86-10, Question and Answer Section 3.5.1.

The proposed deviation is from the requirement of 10CFR50, Appendix R, Section III.G for a 1-hour fire barrier. It is proposed that the USAR delete references to the 1-hour rating of the Thermo-Lag fire wrap in fire zone A-1a.

As discussed in Generic Letter 86-10, Paragraph F, a deviation from a commitment made in the FSAR is governed by the provisions of 10CFR50.59. The CPS Operating License Condition 2-F states, "IP may make changes to the approved fire protection program without prior approval of the commission only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire."

This Thermo-Lag safety evaluation is consistent with Generic Letter 86-10 guidance, the CPS fire protection licensing condition and with the CPS process for revising the fire protection program elements contained in the USAR.

BLOCK A.2 continued

Proposed Deviation

The deviation proposed as the new subsection 4.2.2.16 in USAR Appendix F states, "The Thermo-Lag 330-1 cable fire wrap installed in fire zone A-1a is not 1-hour fire rated".

Summary of Justification for Deviation

The Appendix R Subsection III.G requirements concern the ability to achieve and maintain safe shutdown. The deviation from the requirement for a 1-hour rated fire barrier enclosing one division of safe shutdown cables in fire zone A-1a is justified on the basis that several design and programmatic fire protection features are in place at CPS to *ensure that the safe shutdown capability is maintained.* The following is an outline of the defense-in-depth features.

NOTE:	More detailed discussion of each of these features is provided later in this section of the safety evaluation.

1. It is not credible to postulate a fire capable of affecting safe shutdown cables in fire zone A-1a due to the administrative controls and the physical design of fire zone A-1a.

2. Fire modeling of the fire zone A-1a has shown that the fixed and transient combustibles, either individually or collectively, present no credible risk of safe shutdown cable damage in fire zone A-1a.

3. In the event that a fire occurs in fire zone A-1a, it is not credible to postulate that a fire will damage both redundant divisions of safe shutdown cable trays due to the location of the cable tray stacks (high, horizontal tray runs),the concrete slab between the redundant divisional cable trays and the presence of the wet pipe sprinkler system.

4. Even if no credit is taken for the wet pipe sprinkler system extinguishing the fire, the as-built Thermo-Lag cable wrap will protect the wrapped Division 2 safe shutdown cable trays for a duration sufficient to permit manual fire fighting by the CPS fire brigade.

Justification for Deviation (continued)

5. In the event that the fire is not extinguished by both the sprinkler system or by the fire brigade, the Probabilistic Risk Assessment (PRA) evaluation did not identify any safety benefit, with regard to core damage prevention, containment isolation, containment heat removal or containment hydrogen control provided by the Thermo-Lag installed in fire zone A-1a.

6. In the unlikely event of a fire in A-1a that disables both divisions of redundant safe shutdown equipment, it is reasonable to expect that operator training, Emergency Response Organization (ERO) activation, and symptom-based procedures provide a final line of defense to ensure plant safety.

1. **Detailed Justification for Deviation**

Administrative Controls and Physical Layout

Several CPS administrative controls currently in place and the layout of this fire zone minimize the potential for fire initiation in fire zone A-1a.

(a) **Administrative Controls**

- CPS procedure 1893.02, "Fire Protection - Control of Ignition Sources", establishes controls for hot work including welding, grinding, flame cutting, brazing and soldering operations. This procedure requires precautions to be taken (such as removing or protecting nearby combustibles and posting of a fire watch) prior to the start of hot work in order to minimize the potential for fire ignition.

- CPS procedure 1893.03, "Control of Flammable and Combustible Liquids and Combustible Materials", governs the handling and limitation of the use of combustible solids and liquids and flammable liquids. This procedure limits the quantities of transient materials that can be introduced into the plant and prescribes area clean-up, adequate ventilation, access for fire protection equipment, etc., in order to minimize the potential for fire initiation and extent of fire propagation.

- Illlinois Power enforces a no smoking policy within the company buidlings as outlined in Policy Memorandum PM1.05, "No Smoking Rules, Enforcement of". Noncompliance with this policy results in disciplinary action up to and including termination. Additionally, smoking is prohibited in this fire zone by CPS Procedure 1019.01, "Housekeeping".

1. **Administrative Controls and Physical Layout (continued)**

(b) **Physical Layout**

- The floor of fire zone A-1a is a 9-foot 8-inch concrete slab on grade. The ceiling is 14-inch minimum concrete with areas of removable concrete slabs and an open stairwell. The walls are 18-inch minimum concrete or 19 5/8-inch minimum solid concrete block. The walls are 3-hour fire rated. Even though the floor and the ceiling slabs are not fire rated, the substantial concrete construction provides structural separation for this fire zone from the adjacent fire zones.

- Fire zone A-1a is a relatively open area, providing access to the ECCS pump rooms and contains relatively few sources of ignition.

- Since the cable trays are all located high in this fire zone (minimum 14 feet above the floor) and there are no vertical floor-to-ceiling cable runs, it is not credible to postulate safe shutdown cable damage due to a fire originating at the floor.

With these administrative controls and the physical layout of this fire zone, it is not credible to postulate a fire capable of affecting safe shutdown cables in fire zone A-1a.

2. **Fire Modeling**

A detailed fire modeling analysis, NSED Calculation IP-M-0390, Revision 0, was performed for fire zone A-1a. It took into account all potential fixed and transient ignition sources, spatial locations and heat release rates within fire zone A-1a, the room volume of fire zone A-1a, and the spatial locations and damage temperatures of all potential targets within fire zone A-1a. The modeling methodology and assumptions were primarily taken from EPRI Fire Induced Vulnerability Evaluation (FIVE) guide. This fire model is conservative in that no credit is taken for the following:

- the stairway opening in the ceiling to fire zone A-1b above, which would further prevent information of a hot gas layer

- the substantial concrete construction of the floor, walls, and ceiling, which would absorb more energy than the 70% value used in the fire model

- the installed wet pipe system which further reduces the potential for cable damage

94-0056

2. **Fire Modeling (continued)**

- the intervening 12-inch thick concrete cantilever slab approximately 20 feet above the floor which would divert and absorb plume and radiant fire effects from the Division 2 cable trays located above the slab

- the solid bottoms on all cable trays in fire zone A-1a which would minimize the tray-to-tray fire propagation within the cable tray stack and reduce temperatures at the cables by acting as heat sinks.

- the Thermo-Lag, installed on the Division 2 power and control cables which would reduce the temperatures at the wrapped cables

- the Thermo-Lag installed on the Division 2 instrumentation cable tray which acts as a fire break

The fire modeling results show that, for all potential fixed and transient ignition sources, the fire will not propagate beyond the ignition source and the resulting temperature rise (from both plume and radiant fire effects) at potential targets is far below that needed to induce damage. Fire modeling also shows that a hot gas layer can not be formed. This is due to the following factors in fire zone A-1a:

- the unvented construction of electrical panels

- the use of conduit for all cables not routed in cable trays

- the high floor-to-ceiling height (28 feet, 4 inches) and large floor area (2964 ft^2)

- the large distances between potential ignition sources and targets

- the use of IEEE-383 qualified EPR - Hypalon cable insulation

- the absence of any credible oil-pool type fire scenarios

The detailed fire modeling shows that even if a fire were to occur in fire zone A-1a, it would not result in loss of any safe shutdown equipment.

3. Fire Protection Design Features

As shown in Enclosure 1, the Division 1 safe shutdown cable trays enter fire zone A-1a from the east side and are routed, for approximately one half of the length of the fire zone. The Division 2 safe shutdown cable trays are routed along the entire east-west length of the fire zone. The 3-deep Division 2 cable tray stack is located above the 3-deep Division 1 cable tray stack. The lowest Division 1 cable tray is located at 722 feet elevation, 14 feet and 6 inches above the floor. The lowest Division 2 cable tray is located at 729 feet, 6 inches elevation, 4 feet above the highest Division 1 cable tray.

The two stacks of divisional cable trays are separated by a horizontal 12" concrete slab which is cantilevered off the south wall. Since this concrete slab does not span the entire length or width of the fire zone, it is not considered a fire barrier; however, due to its location between the redundant divisional trays and its reinforced concrete construction, it provides substantial protection from direct vertical fire propagation from one divisional tray stack to the redundant divisional cable tray stack.

Wet pipe sprinklers are provided at two levels, arranged separately above the Division 1 and above the Division 2 trays. If a fire starts either in the lower (Division 1) or in the upper (Division 2) cable trays, it would be suppressed by the wet pipe, 165° F rated fusible link sprinkler system.

In summary, in the event that a fire occurs in fire zone A-1a, it is not credible to postulate damage to both the redundant divisions of safe shutdown cable trays due to the location of the cable tray stacks (high, horizontal tray runs), the concrete slab between the redundant divisional cable trays and the presence of the wet pipe sprinkler system.

4. Thermo-Lag Fire Endurance

NRC's Generic Letter 92-08 identified concerns related to the fire endurance capability of Thermo-Lag 330-1 material and the evaluation and application of fire tests to determine the fire endurance ratings of Thermo-Lag 330-1 fire barriers. Condition Report 1-92-07-024 documents the concerns identified by NRC Bulletin 92-01 with regard to the indeterminate fire rating of Thermo-Lag fire barriers. An engineering calculation, IP-M-0200, was performed to determine the fire endurance capability of the as-built Thermo-Lag installation in fire zone A-1a with regard to its capability to perform its fire barrier function under ASTM E-119 fire conditions.

4. Thermo-Lag Fire Endurance (continued)

Three cable trays in fire zone A-1a are wrapped with Thermo-Lag 330-1 fire barrier material. The fire wraps on portions of two of the trays, Division 2 safe shutdown power and control cable trays, were intended to be fire rated barriers to meet the Appendix R Section III.G.2.c requirement for a 1-hour rated fire barrier. The fire wrap on a portion of the third tray, Division 2 non-safe shutdown instrumentation cable tray, was intended to be a fire break to address the intervening combustible concern. As shown in Enclosure 1, the fire break provides 20 feet of separation between the Division 1 safe shutdown trays and the unwrapped portions of the Division 2 safe shutdown trays.

Calculation IP-M-0200 utilized NSED Standard ME-09.00, "NEI Application Guide for Evaluation of Thermo-Lag Fire Barrier Systems". The guide was issued by the Nuclear Energy Institute (NEI) and provides the industry with the data and the methodology necessary for evaluating Thermo-Lag fire barriers. The information provided by the guide was obtained from NEI and utility fire barrier endurance test programs.

Based on detailed analysis using the NSED Standard ME-09.00 methodology, NSED Calculation IP-M-0200 determined the fire endurance capability of the CPS as-built Thermo-Lag 330-1 fire barrier installation in fire zone A-1a to be at least 28 minutes. This methodology assumes the fire wrap to be subjected to an ASTM E-119 standard time-temperature curve. These temperatures are much higher than those resulting from any credible fire scenario in this fire zone. The Thermo-Lag would, therefore, have a longer endurance under a realistic fire scenario. Additionally, the cable "failure temperature" used in this methodology (approximately 325°F) is significantly lower than realistic cable damage temperature (approximately 700°F).

NSED Calculation IP-M-0177, Rev. 3, shows that the calculated equivalent fire severity in fire zone A-1a is 59 minutes. NSED Standard ME-06.00, "Guidelines for Determining Fire Loads and Preparing Fireload Calculations", provides the methodology for calculating fire loads and equivalent fire severities in CPS fire zones. This methodology requires all material that is not classified as non-combustible to be included as fire loads. As a result, approximately 60% of the fire load in fire zone A-1a is due to the cable insulation and approximately 30% of the fire load is due to Thermo-Lag itself. Both the IEEE-383 qualified cable with EPR Hypalon insulation and Thermo-Lag 330-1 have high (greater than 900 °F) ignition temperatures. As explained in the fire modeling discussion, it is not credible to postulate a temperature of this magnitude at the elevations of the cables in this fire zone. The realistic equivalent fire severity in this fire zone would therefore be significantly less than the calculated 59 minutes.

4. **Thermo-Lag Fire Endurance (continued)**

In the event of a fire in A-1a, the main control room will receive annunciation of the sprinkler system actuation and the activation of multiple fire detectors in the fire zone. Manual fire fighting by the fire brigade is facilitated by the location of hose stations and portable extinguishers in this fire zone, in fire zone A-1b above this fire zone at elevation 737 feet. Also located nearby at the 737 feet elevation of the Turbine Building are additional hose stations, portable extinguishers and the fire brigade equipment storage cage.

The CPS fire brigade is available and onsite at all times, with the Shift Supervisor having the Commander of the Fire Brigade designation. The fire brigade composition, function and fire fighting guidance are provided in CPS procedures 1001.06, "CPS Fire Brigade", 1893.04, "Fire Fighting" and the 1893.04 M100 which provides the detailed pre-fire plan for fire zone A-1a.

CPS fire drills record the time from the gaitronics announcement of fire to when the fire brigade is ready to start fire fighting at the scene. Fire drills conducted in fire zones adjacent to A-1a have shown this time to be less than 10 minutes. The gaitronics announcement from the control room is expected to be prompt since in addition to the alarm from the ionization detectors from fire zone A-1a, the smoke communicating through the open stairwell is also likely to cause alarm from fire zone A-1b above. It is therefore concluded that the CPS fire brigade would be able to respond in a fire within the calculated time of Thermo-Lag fire endurance.

In summary, even if no credit is taken for the wet pipe sprinkler system extinguishing the fire, the as-built Thermo-Lag cable wrap will protect the Division 2 safe shutdown cable trays for a duration sufficient to permit effective manual fire fighting by the CPS fire brigade.

5. **Thermo-Lag Safety Benefit**

The Probabilistic Risk Assessment (PRA) evaluation which analyzes the safety significance of potential Thermo-Lag fire barrier failure in fire zone A-1a is included as Enclosure 3 of this safety evaluation. This analysis consists of three major parts.

5. **Thermo-Lag Safety Benefit (continued)**

- The first part of the analysis is to identify all modeled components that could be affected by a fire in zone A-1a and the basic events in the IPE model that represent these components. This list of components contains not only the equipment located within the fire zone, but also the equipment located outside this fire zone that are affected by damage to cables in this fire zone. This part also identifies the basic events (equipment failures) in the IPE model that are protected by Thermo-Lag. Part 1 is described in attachments PRA-1 and PRA-4 of Enclosure 3.

- The second part of the analysis involves calculating the conditional core damage probability (CCDP) for two different situations using the basic events list from Part 1 as an input. The first situation is Thermo-Lag failing to perform adequately as a fire barrier. This is the postulated "worst case" in which a fire occurs and all cables and equipment in the fire zone are damaged. The second situation is Thermo-Lag performing its intended fire barrier function in which all cables not wrapped by Thermo-Lag are damaged by a postulated fire. Attachments PRA-2 and PRA-5 of Enclosure 3 describe the CCDP determination.

  While preventing core damage is an important consideration for plant safety, maintaining containment integrity by protecting containment isolation and heat removal capabilities is also a concern. Additionally, containment analysis in the IPE report identified the loss of containment hydrogen control as a major cause of containment failure. Correspondingly, the effect of a fire in zone A-1a on these functions was also examined. This analysis is detailed in attachments PRA-2 and PRA-5 of Enclosure 3.

- The third part of the analysis was to determine the fire ignition frequency in zone A-1a. This calculation utilizes the methodology described in the Fire-Induced Vulnerability Evaluation (FIVE) Guide, EPRI TR-100370 and the Fire Risk Analysis Implementation Guide, EPRI Project 3385-01. Ignition frequency calculation is described on attachments PRA-3 and PRA-6 of Enclosure 3.

The results of this analysis showed that the CCDP calculated for each of the two situations (Thermo-Lag failing and Thermo-Lag performing its design function) was identical. Additionally no benefit from Thermo-Lag was found to exist for containment isolation, containment heat removal or containment hydrogen control.

5. **Thermo-Lag Safety Benefit (continued)**

In summary, no safety benefit was identified with regard to core damage prevention, containment isolation, containment heat removal or containment hydrogen control is provided by the Thermo-Lag installed in fire zone A-1a.

6. **Operator Response to Fires Affecting Safe Shutdown Equipment**

While it is not possible to predict exactly what equipment will be lost or impaired due to any given fire, it is possible to assume "worst-case" for an area of the plant involved in a fire. For the areas involving safe shutdown equipment, the issue becomes knowing what is left for the operator to use for any given fire. The operator is trained to control plant parameters per the Emergency Operating Procedures (EOP's) independent of the cause of the off-normal/emergency conditions. That is, the EOP's are symptom-based and not event-based. In this sense, equipment loss due to multiple failures, sabotage, seismic event, etc., is not different from equipment loss due to fire. The operators are given a list of systems to use, not necessarily in a preferential order (what is used is based on what will work).

The operating crews receive intense, continuing training on the EOP's with multiple equipment failures and on loss of power events. Procedural guidance exists in CPS Procedure 4200.01, "Loss of AC Power" for a Station Black Out (SBO). These steps guide the operator actions to minimize the impact on plant equipment while preserving the equipment that is left. For fires that affect systems to an extent less than an SBO, portions of the Loss of AC Power procedure will apply. CPS crews have demonstrated the ability to implement these procedures while maintaining the reactor in a safe condition. A fire in A-1a resulting in the loss of offsite power, RCIC, RHR A, LPCS and all Division 2 equipment was simulated on the CPS simulator and the operator actions resulted in achieving hot shutdown and maintaining stable reactor parameters.

Emergency Plan Procedure EC-02 directs activation of the Emergency Response Organization (ERO) during any significant plant fire. While minimum shift manning will allow for successfully achieving hot shutdown conditions, the additional resources provided by the ERO will be valuable in minimizing the impact of the fire on the plant and assisting with recovery and repairs.

6. **Operator Response to Fires Affecting Safe Shutdown Equipment (continued)**

In summary, in the event of a fire in A-1a that disables both divisions of redundant safe shutdown equipment, it is reasonable to expect that operator training, ERO activation and symptom-based procedures provide the final line of defense to ensure plant safety.

Evaluation of Ampacity Derating Impact of Thermo-Lag

The ampacity derating factors for cables in raceway wrapped by Thermo-Lag has become a concern due to questions raised in Generic Letter 92-08. The NRC questions are related to the original Thermo-Lag manufacturer's recommended ampacity derating factors as well as the wide range of ampacity derating factors applied across the industry. In Information Notice (IN) 94-22, the NRC provided some preliminary information about the results of tests the NRC had conducted to establish ampacity derating factors for cables in conduits and trays wrapped by Thermo-Lag 330-1 fire barrier material.

Ampacity limits are placed on cables to ensure that the cables will operate within their design parameters and are unrelated to a fire scenario. Without ampacity limitations, the current carried by a cable could generate too much heat and result in the cable operating at a temperature above its design rating, thus causing a reduction in the cable's design life. The cables utilized at CPS are rated for 90°C operation and the ampacity limits selected were based on that value. Since different installation configurations (such as covered trays, or fire stops) can limit the dissipation of the heat generated by the current passing through the cable, derating factors were developed to further restrict the current which the cable will be allowed to carry when these configurations are part of the cable routing.

The CPS design defined the boundary between power, control, and instrumentation circuits based on both voltage and current levels. Separate raceways are provided for the different cables so that instrument cables are isolated from noise that could be generated by the power and control cables and the control cables are separated from the heat and induced voltage that could be generated by the power cables. As shown by NSED Calculation EPED 19-G-31, Rev. 0, the currents passing through control and instrumentation cables do not generate sufficient heat to challenge the cable design ratings.

Evaluation of Ampacity Derating Impact of Thermo-Lag (continued)

Enclosure 4 identifies the CPS power cables protected by Thermo-Lag 330-1 fire barrier material and the available ampacity margin for each cable in fire zone A-1a. A review of this data indicates that the power cables wrapped by Thermo-Lag 330-1 in fire zone A-1a could be derated by as much as 37.7% or more without impacting their design functions or design life. The highest ampacity derating identified in IN 94-22 is 46.4% for a #8 AWG conductor in a tray wrapped by a 3-hour rated Thermo-Lag 330-1 fire barrier. The Enclosure 4 ampacity evaluation concludes that the NRC ampacity derating concerns expressed in IN 94-22 will not have adverse impact on the two most heavily loaded power cables (120 and 25 amps respectively) in fire zone A-1a. This conclusion was reached upon comparing conservatism chosen in the CPS design ampacity limits with the derating methodology used by the NRC in IN 94-22. Since the two most heavily loaded cables will not be impacted by the concerns expressed in NRC's IN 94-22, the rest of the cables in fire zone A-1a are also acceptable from the ampacity derating view point.

Currently, there exist no conclusive ampacity derating factors for cables wrapped by Thermo-Lag 330-1 fire barriers due to the many outstanding issues with regard to past tests and test results; however, as discussed above, the Thermo-Lag cable tray fire wrap in fire zone A-1a does not adversely impact the current carrying capability of the cables.

94-0056

BLOCK D, Part I

1. Failures associated with a design-basis fire in fire zone A-1a are discussed in USAR Appendix F, Fire Protection Safe Shutdown Analysis (SSA), Subsection 3.1.1.

   Currently, Subsection 3.1.1.2 states "Division 2 safe shutdown cables are routed in trays along the entire length of Fire Zone A-1a. The Division 1 safe shutdown cables enter from the east side of the auxiliary building and are routed in trays and conduit for one-half the length of the zone. The Division 1 and 2 cable trays are separated by a concrete cantilever (a horizontal barrier). However, an exposure fire in this zone could still destroy cables required by both methods since the cantilever does not completely enclose one division of cables and equipment. Therefore, in order to ensure that a fire will not render both shutdown methods inoperable, protection will be provided for Division 2 cables and equipment, as described in modification Subsection 3.1.1.3 and deviation Subsection 3.1.1.4".

   Currently Subsection 3.1.1.3 states, "Division 2 power and control cable trays in Fire Zone A-1a will be protected by a 1-hour fire rated material from column 124 to column 110. Division 2 instrumentation cable tray will be protected by a 1-hour fire rated material for 20 feet, to act as a fire break between the Division 1 and 2 safe shutdown cables".

   These Subsections, 3.1.1.2 and 3.1.1.3, are proposed to be revised based on a new deviation to be added to Subsection 4.2.2.16. The new deviation will eliminate the reference to the 1-hour fire rating of Thermo-Lag. The justification for this deviation, and for removing the subsections 3.1.1.2 and 3.1.1.3 wording which implies that there is a safe shutdown concern if the 1-hour rated fire wrap is not installed, is provided in detail under the Block A.2 discussions.

2. For the reasons provided in the Block A.2 discussion, the performance of the safe shutdown systems in fire zone A-1a is not adversely impacted by the Thermo-Lag fire rating being changed from 1-hour to no specific rating.

3. Even though the Thermo-Lag fire rating is now considered to be less than 1-hour and the reference to the rating is deleted, this reduced capability of the Thermo-Lag fire wrap does not cause any new failure modes. The justification for the reduced capability being acceptable is provided in the Block A.2 discussion.

BLOCK D, Part I (continued)

4. The USAR Appendix F, Safe Shutdown Analysis, documents the capability of the CPS safe shutdown systems to achieve and maintain cold shutdown condition in the event of a single fire anywhere in the plant with a loss of offsite power. As explained by the Block A.2 discussion, it is not credible to postulate a fire scenario capable of adversely affecting the safe shutdown capability in fire zone A-1a despite the reduced Thermo-Lag capability.

5. The probability of the failures evaluated in the USAR is not impacted as discussed in the Block A.2 discussion.

BLOCK D, Part II

1, 2, and 3. The accidents identified in the USAR are not affected by the proposed change to the Thermo-Lag fire wrap rating in fire zone A-1a. As explained in the Block A.2 discussion, the plant safe shutdown capability in the event of a fire in A-1a is not adversely impacted. Likewise, the consequences or the probability of a fire in A-1a is not impacted.

BLOCK D, Part III

1 and 2. As explained in the Block A.2 discussion, the Thermo-Lag combustibility and ampacity derating concerns were evaluated and found to have no impact on fire zone A-1a safe shutdown capability. No new type of accident or equipment malfunction has been created.

BLOCK D, Part IV

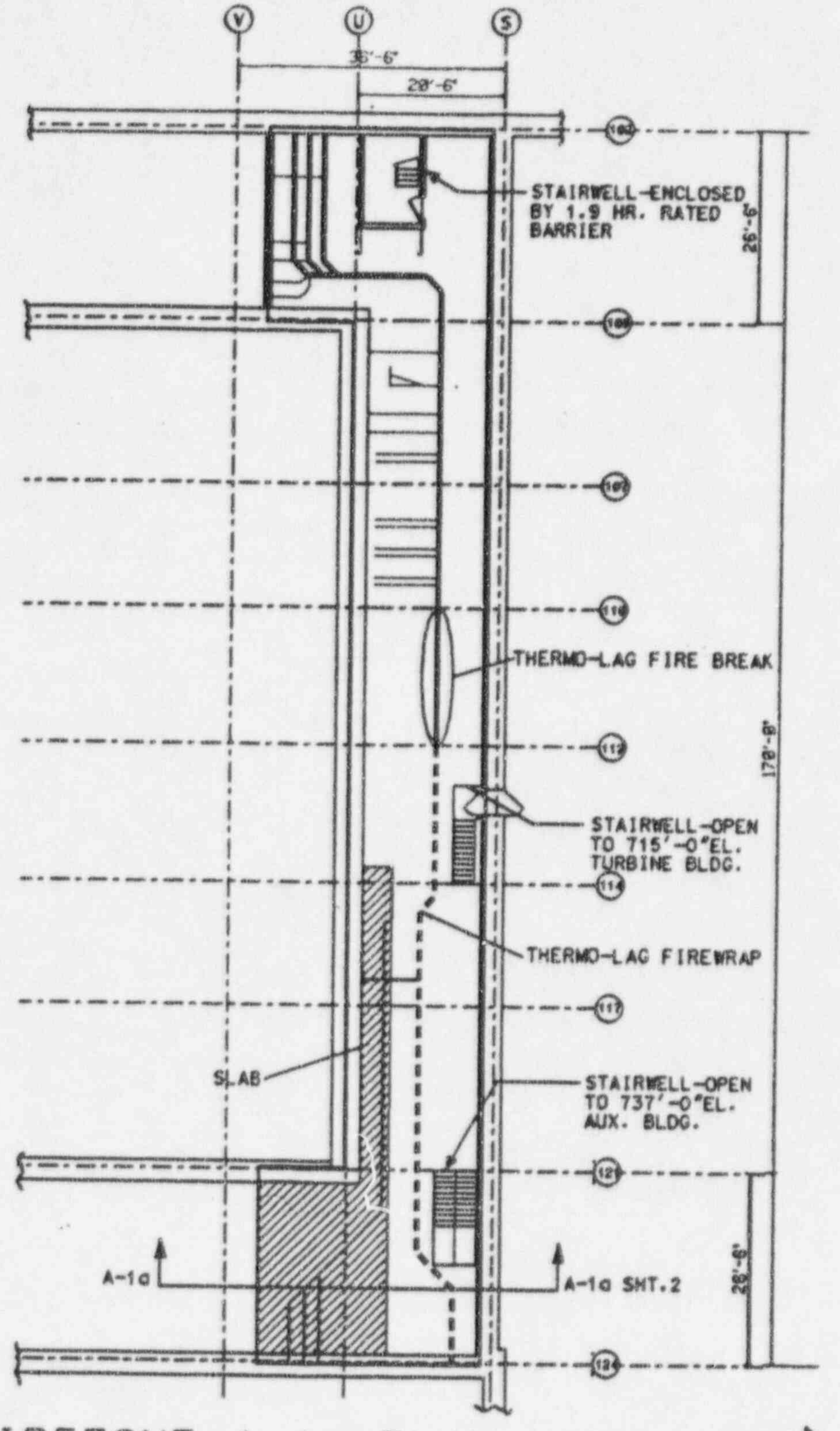
1 and 2. None of the protective barriers, the approach to the acceptance limits for any of the protective barriers, or the margin of safety is directly affected by this change. The safe shutdown capability in fire zone A-1a has been determined to be acceptable after the impact of the change was evaluated as explained in the Block A.2 discussion.

3. The CPS Fire Protection Program as stated in Tech. Spec. 6.8.4.e is unchanged. The bases of the Technical Specifications is not affected by this change.

94-0056

ENCLOSURE 1

SHEET 1 OF 2



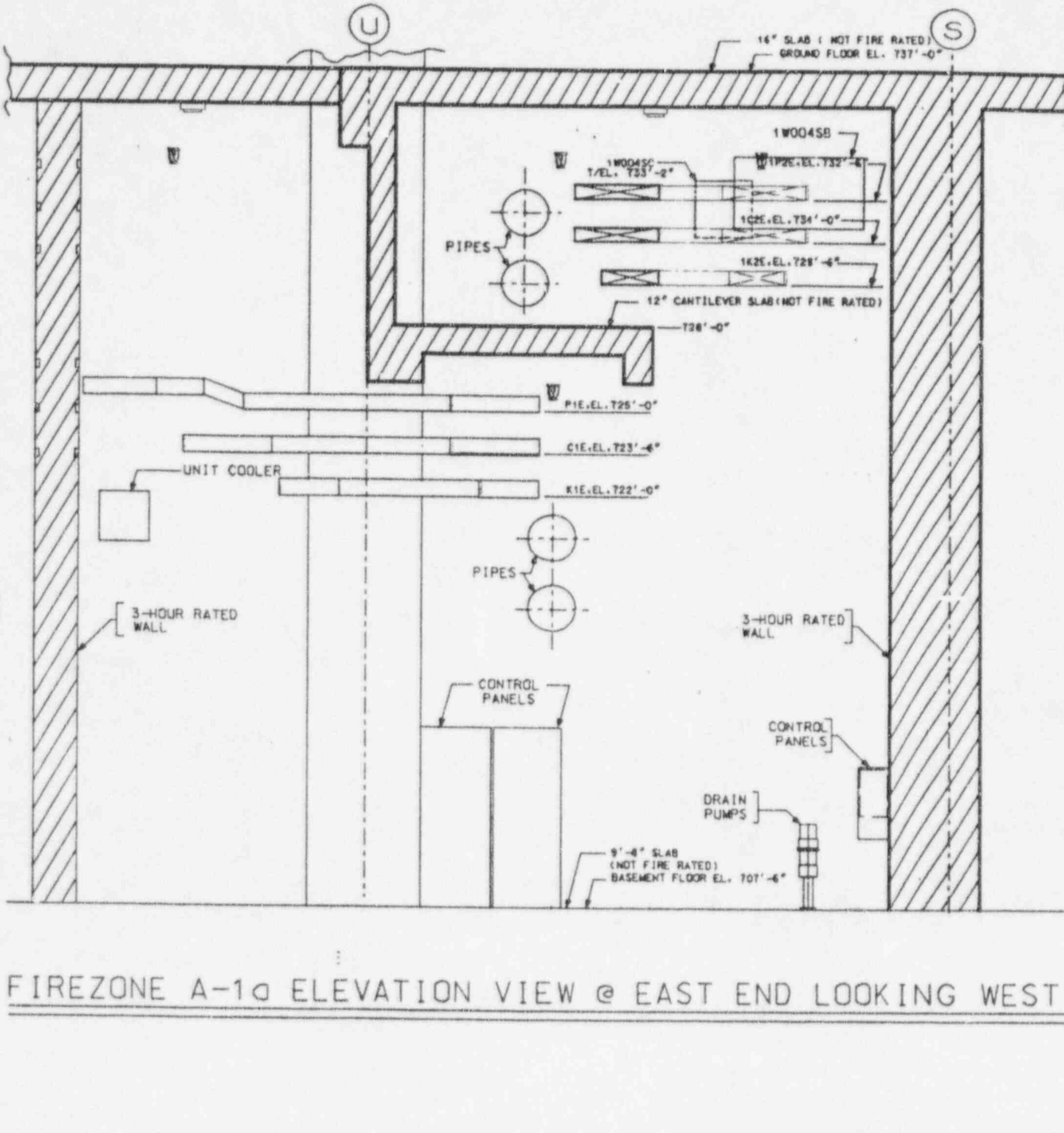
FIREZONE A-1a PLAN VIEW

DIVISION 1 CONDUIT	DIVISION 2 CONDUIT
DIVISION 1 TRAY	DIVISION 2 TRAY

/WORK/rbhat-fiee-2.dgn

94-0056

ENCLOSURE 1
SHEET 2 OF 2



FIREZONE A-1a ELEVATION VIEW @ EAST END LOOKING WEST

DIVISION 1 SAFE SHUTDOWN CABLE TRAYS

FIRE DETECTORS/SPRINKLERS

IONIZATION SMOKE DETECTORS

165 °F SPRINKLERS

DIVISION 2 SAFE SHUTDOWN CABLE TRAYS
-PORTIONS WRAPPED WITH 1/2" THERMO-LAG.

Division II Safe-Shutdown Cables Protected by Thermo-Lag in Fire Zone A-1a

Raceway	Cable Number	FIREZ. A-1A	Cable Function
P2E	1AP29B	X	4KV feed from 1AP09EB to 4160V/480V xfmr of unit sub 0AP06E
P2E	1AP34N	X	125VDC control power main feed from 1DC14E to 0AP06E
P2E	1AP34V	X	125VDC control power reserve feed from 0AP06E to 1AP12E
P2E	1AP34W	X	125VDC control power reserve feed from 1AP12E to 0AP06E
P2E	1AP36E	X	480V feed from 1AP12E to DG bldg MCC 1AP61E
P2E	1DG21J	X	125VDC control power feed from 1DC14E to Div 2 DG control pnl 1PL12JB
K2E	1LD26E	X	Signal from 1E31-N005B (RCIC area cooler inlet temp) to MCR delta temp sw. Sw actuation cause RCIC isolation.
K2E	1LD26F	X	Signal from 1E31-N006B (RCIC area cooler outlet temp) to MCR delta temp sw. Sw actuation cause RCIC isolation.
K2E	1LD26G	X	Signal from 1E31-N004B (RCIC area ambient temp) to MCR temp sw. Sw actuation causes RCIC isolation.
K2E	1LD28A	X	Signal from 1E31-N027B (RHR A Ht Ex Rm cooler inlet temp) to MCR delta temp sw. Sw actuation causes RCIC and RHR isolation
K2E	1LD28B	X	Signal from 1E31-N028B (RHR A Ht Ex Rm cooler outlet temp) to MCR delta temp sw. Sw actuation causes RCIC and RHR isolation
K2E	1LD28C	X	Signal from 1E31-N002B (RHR B Ht Ex Rm cooler inlet temp) to MCR delta temp sw. Sw actuation causes RCIC and RHR isolation
K2E	1LD28D	X	Signal from 1E31-N003B (RHR B Ht Ex Rm cooler outlet temp) to MCR delta temp sw. Sw actuation causes RCIC and RHR isolation
C2E	1RI19C	X	125VDC control for air sol vlvs 1E51-F004 and F025 (RCIC turb exh drain line isolation vlvs), vlvs isolate/close on loss of power.
P2R	1RP02C	X	125VDC feed from 1DC14E to 1C71-S001B (Div2 NSPS inverter). Loss of feed causes inverter to transfer to alternate source,1RP02E.
P2E	1VD02A	X	480V feed from 1AP12E to 1VD01CB (Div2 DG room vent supply fan). Loss of vent fan impacts operation of Div 2 DG.
P2E	1VD10A	X	480V feed from 1AP75E (MCC 1B1) to1TZ-VD002A (operator for outside air intake damper 1VD01YB). Damper fails closed .
P2E	1VD10B	X	480V feed from 1AP75E (MCC 1B1) to1TZ-VD002B (operator for return air damper 1VD02YB). Damper fails open .
P2E	1VD10C	X	480V feed from 1AP75E (MCC 1B1) to1TZ-VD002C (operator for exhaust air damper 1VD03YB). Damper fails closed .
C2E	1VD10J	X	Control circuit between 1AP75E (MCC 1B1) and 1TZ-VD002C (operator for exhaust air damper 1VD03YB). Damper fails closed.

94-0056

Div I Safe-Shutdown Cables in Fire Zone A-1A within 20 ft of the Div II Safe-Shutdown Thermo-lag wrapped cables

RACEWAY	CABLE #	CABLE FUNCTION
K1E	1CM75A	Signal from 1LT-CM030 (Suppression pool level) to MCR.
K1E	1LD26D	Signal to MCR for leak detection based on inlet, outlet temperatures of RCIC room cooler (1VY04S) as well as room ambient.
K1E	1LD27C	Signal from 1E31-N018A (RHR HX A room ambient temp) to MCR for leak detection.
K1E	1LD27F	Signal from 1E31-N001A (RHR HX B room ambient temp) to MCR for leak detection.
K1E	1LD27G	Signal to MCR for leak detection based on inlet, outlet temperatures of RHR A HX room cooler (1VY03S) and room ambient.
K1E	1LD27H	Signal to MCR for leak detection based on inlet, outlet temperatures of RHR HX B room cooler (1VY05S) and room ambient.
P1E	1LP01A	4KV power from 1AP07E to 1E21-C001 (LPCS pump motor).
K1E	1LP78B	Signal from 1E21-N052 (LPCS pump discharge pressure) to MCR for input to ADS logic.
K1E	1LP78C	Signal from 1E21-N053 (LPCS pump discharge pressure) to MCR for input to ADS logic.
P1E	1RH01A	4KV power from 1AP07E to 1E12-C002A (RHR A pump motor).
C1E	1RH01J	Control interlock from 1AP07EC to 1PL61JA to start 1VY02C (ECCS supply fan) when RHR A pump is started.
C1E	1RH06A	Control circuit for position of 1E12-F066 (RHR suction from Fuel pool cooling) as input to pump run logic. Cable short puts trip signal to pump motor.
P1E	1RH07A	480V feed from 1AP73E to 1E12-F003A (RHR A HX shell side outlet valve).
C1E	1RH07B	Control circuit between MCC and 1E12-F003A operator. Cable damage could impact valve operation.
P1E	1RH09A	480V feed from 1AP73E to 1E12-F004A (RHR A pump suction valve).
C1E	1RH09B	Control circuit between MCC and valve operator for interlocks with other valves
C1E	1RH09F	Control circuit between 1C61-P001A and valve.
C1E	1RH09G	Control circuit between MCC and 1E12-F004A operator. Cable damage could impact valve operation.
P1E	1RH12A	480V feed from 1AP73E to 1E12-F006A, RHR A shutdown cooling injection isolation valve

RACEWAY	CABLE #	CABLE FUNCTION
C1E	1RH12B	Control circuit between MCC and 1E12-F006A operator. Cable damage could impact valve operation.
P1E	1RH22A	480V feed from 1AP73E to 1E12-F024A (RHR A test return to suppression pool valve).
C1E	1RH22B	Control circuit between MCC and 1E12-F024A operator. Cable damage could impact valve operation.
P1E	1RH33A	480V feed from 1AP73E to 1E12-F048A (RHR A HX shell side bypass valve).
C1E	1RH33B	Control circuit between MCC and 1E12-F048A operator. Cable damage could impact valve operation.
P1E	1RH40A	480V feed from 1AP73E to 1E12-F068A (RHR A HX service water discharge valve).
C1E	1RH40B	Control circuit between MCC and 1E12-F068A operator. Cable damage could impact valve operation.
P1E	1RH50A	480V feed from 1AP73E to 1E12-F064A (RHR A pump min flow valve).
C1E	1RH50B	Control circuit between MCC and 1E12-F064A operator. Cable damage could impact valve operation.
K1E	1RH78A	Signal from 1E12-N007A (RHR A HX SX water inlet flow) to MCR
K1E	1RH78B	Signal from 1E12-N015A (RHR A flow) to MCR
K1E	1RH93A	Signal from 1E12-N052A (RHR A flow) to MCR
K1E	1RH96A	Signal from 1E12-N055A (RHR A pump discharge) to MCR.
K1E	1RH96B	Signal from 1E12-N056A (RHR A pump discharge) to MCR.
P1E	1RI01A	480V feed from 1AP72E to 1E51-C003 (RCIC water leg pump).
P1E	1RI04A	125VDC feed from 1DC13E to 1E51-F010 (RCIC suction from RCIC storage tank valve)field and series windings.
C1E	1RI04B	Control circuit between MCC and 1E51-F010 operator. Cable damage could impact valve operation.
P1E	1RI04E	125VDC feed from 1DC13E to 1E51-F010 (RCIC suction from RCIC storage tank valve) armature windings.
P1E	1RI08A	125VDC feed from 1DC13E to 1E51-F031 (RCIC suction from suppression pool valve) field and series windings.
C1E	1RI08B	Control circuit between MCC and 1E51-F031 operator. Cable damage could impact valve operation.

94-0056

RACEWAY	CABLE #	CABLE FUNCTION
P1E	1RI08E	125VDC feed from 1DC13E to 1E51-F031 (RCIC suction from suppression pool valve) armature windings.
P1E	1RI09A	125VDC feed from 1DC13E to 1E51-F045 (RCIC steam to turbine valve) field and series windings. (paralleled to 1RI09I)
C1E	1RI09B	Control circuit between MCC and 1E51-F045 operator. Cable damage could impact valve operation.
C1E	1RI09D	Control circuit between MCR and 1E51-F045 operator. Serves as input to RCIC logic for operation and isolation. Cable damage could impact system logic.
P1E	1RI09H	125VDC feed from 1DC13E to 1E51-F045 (RCIC steam to turbine valve) armature windings (paralleled to 1RI09J).
P1E	1RI09I	125VDC feed from 1DC13E to 1E51-F045 (RCIC steam to turbine valve) field and series windings(paralleled to 1RI09A).
P1E	1RI09J	125VDC feed from 1DC13E to 1E51-F045 (RCIC steam to turbine valve) armature windings (paralleled to 1RI09H).
P1E	1RI10A	125VDC feed from 1DC13E to 1E51-F046 (RCIC turbine lube oil cooling water supply valve) field and series windings.
C1E	1RI10B	Control circuit between MCC and 1E51-F046 operator. Cable damage could impact valve operation.
P1E	1RI10E	125VDC feed from 1DC13E to 1E51-F046 (RCIC turbine lube oil cooling water supply valve) armature windings.
C1E	1RI18C	120V control and indication circuits for 1E51-F005 (RCIC turbine exhaust drain isolation valve) and 1E51-F026 (Steam line drain isolation valve).
C1E	1RI18G	Control signal from 1E51-N037 (RCIC drain line water level switch) to MCR for input to RCIC logic for auto-open of 1E51-F005.
C1E	1RI24A	Control and indication signals between MCR and 1E51-C002D. Carries trip signal for turbine stop valve and position, pressure temperature data for annunciators.
C1E	1RI24C	Control circuit between MCR and 1E51-C002D carries valve position data for input to RCIC operation logic.
C1E	1RI24J	DC control power for 1E51-N591 (EGM control box)
C1E	1RI24K	DC control power for 1E51-N590 (Ramp signal converter)

RACEWAY	CABLE #	CABLE FUNCTION
P1E	1RI25A	125VDC feed from 1DC13E to 1E51-C002F (RCIC gland seal air compressor).
C1E	1RI25E	120VAC feed from 1AP72E to space heater in 1E51-C002F (gland seal air compressor).
P1E	1RI26A	125VDC feed from 1DC13E to 1E51-C002E (RCIC turbine trip valve) field and series windings.
C1E	1RI26B	Control circuit between MCC and 1E51-C002E operator. Cable damage could impact valve operation.
P1E	1RI26E	125VDC feed from 1DC13E to 1E51-C002E (RCIC turbine trip valve) armature windings.
P1E	1RI26G	125VDC feed from 1DC13E to 1E51-C002E (RCIC turbine trip valve) field and series windings.
P1E	1RI26H	125VDC feed from 1DC13E to 1E51-C002E (RCIC turbine trip valve) armature windings.
P1E	1RI31A	125VDC feed from 1DC13E to 1E51-F095 (RCIC turbine steam supply bypass valve) field and series windings.
C1E	1RI31B	Control circuit between MCC and 1E51-F095 operator. Cable damage could impact valve operation.
P1E	1RI31F	125VDC feed from 1DC13E to 1E51-F095 (RCIC turbine steam supply bypass valve) armature windings.
K1E	1RI76B	Signal from RCIC EGM control box to MCR transient test panel 1H13-P640.
K1E	1RI76C	Signal circuits between MCR and RCIC controls for input to 1E51-C002-1 (Turbine speed meter) and from flow controller in MCR to signal converter at RCIC.
K1E	1RI76E	Signal from 1E51-N003 (RCIC pump discharge flow) to 1E51-K601 (square root converter) in MCR for RCIC control.
K1E	1RI76F	abandoned spare
K1E	1RI78A	Signal from 1E51-N050 (RCIC pump discharge pressure) to MCR.
K1E	1RI78B	Signal from 1E51-N051 (RCIC pump discharge flow) to MCR.
K1E	1RI79C	Signal from 1E51-N055A (RCIC turbine exhaust pressure) to MCR for isolation logic.
K1E	1RI79D	Signal from 1E51-N055E (RCIC turbine exhaust pressure) to MCR for isolation logic.

RACEWAY	CABLE #	CABLE FUNCTION
K1E	1RI84A	Signal from RCIC governor control panel to MCR for GETARS.
K1E	1RI84B	Signal from RCIC governor control panel to MCR for GETARS.
K1E	1RS75A	Signal from 1C61-N001 (RHR A flow xmtr) to 1C61-P001 (Remote shutdown panel) for indication.
P1E	1SX20A	480V feed from 1AP73E to 1E12-F014A (RHR A HX SSW inlet valve).
C1E	1SX20B	Control circuit between MCC and 1E12-F014A operator. Cable damage could impact valve operation.
P1E	1SX59A	480V feed from 1AP73E to 1SX173A (RHR A HX bypass valve).
C1E	1SX59B	Control circuit between MCC and 1SX173A operator. Cable damage could impact valve operation.
P1E	1VY02A	480V feed from 1AP72E to 1VY02C (ECCS RHR A pump room supply fan).
C1E	1VY02C	Control circuit between 1AP72E and 1PL61JA includes auto-start signal for fan 1VY02C and control power for SX solenoid valves.
C1E	1VY02E	Alarm circuit from 1PL61JA to MCR for annunciation of RHR A ECCS ventilation problems.
P1E	1VY03A	480V feed from 1AP72E to 1VY03C (ECCS RHR A HX room supply fan).
C1E	1VY03C	Control circuit between 1AP72E and 1PL61JA includes auto-start signal for fan 1VY03C and control circuit for SX solenoid valves
P1E	1VY04A	480V feed from 1AP72E to 1VY04C (ECCS RCIC pump room supply fan).
C1E	1VY04C	Control circuit between 1AP72E and 1PL62J includes auto-start signal for fan 1VY04C and control power for SX solenoid valve.
C1E	1VY10B	120V control power feed from 1AP72E to 1PL61JA (RHR A pump room and HX room ventilation panel).
C1E	1VY10C	120V control power feed from 1AP72E to 1PL62J (RCIC pump room ventilation panel).

PRA EVALUATION OF SAFETY SIGNIFICANCE OF POTENTIAL THERMOLAG FIRE BARRIER FAILURE

This evaluation is intended for use as supporting documentation in the safety analysis of Thermo-Lag 330-1 cable wrap material in firezone A-1a. This study used the IPE model and fire databases as they stood on 11/02/94 as inputs. Subsequent changes to the IPE model and/or fire databases could significantly affect the results of this evaluation. Careful attention to the method used in this evaluation is important in the correct interpretation and application of the final results. Use of the material presented here in any other context could be inappropriate and potentially misleading or erroneous.

METHOD

This analysis is composed of three major parts. The first part of the analysis is to identify all modeled components that could be affected by a fire in zone A-1a (elevation 707', Auxiliary Building Hallway) and the basic events in the IPE model that represent these components. This list of components contains not only the equipment itself, but also any cables required for a piece of equipment to perform it's modeled function. This part also includes identifying the basic events in the CPS model that are not protected by Thermolag. Part 1 is described in attachments PRA-1 and PRA-4.

Using the basic events list from part 1 as an input, the second part of the analysis involves calculating the conditional core damage probability (CCDP) for two different situations. The first situation is the case in which a fire occurs and all cables and equipment in a fire zone are damaged. This situation models Thermolag failing to perform adequately as a fire barrier. The second situation is the case in which only cables not wrapped by Thermolag throughout the firezone are damaged by a postulated fire. This situation models Thermolag performing per design. Attachments PRA-2 and PRA-5 describe the CCDP determination.

While preventing core damage is an important consideration for plant safety, maintaining containment integrity by protecting containment isolation and heat removal capabilities is also a concern. Additionally, containment analysis in the IPE report identified the loss of containment hydrogen control as a major cause of containment failure. Correspondingly, the effect of a fire in zone A-1a on these functions was also examined. This analysis is detailed in attachments PRA-2 and PRA-5.

The third part of the analysis was to determine the fire ignition frequency in zone A-1a. This calculation utilizes the methodology described in the Fire-Induced Vulnerability Evaluation (FIVE) Guide, EPRI TR-100370 and the Fire Risk Analysis Implementation Guide, EPRI Project 3385-01. Ignition frequency calculation is described on attachments PRA-3 and PRA-6.

CONCLUSION

The results of this analysis showed that the CCDP calculated for each situation was identical, which means that the Thermolag installed in fire zone A-1a provided no quantifiable benefit in preventing core damage. Additionally, no impact or benefit from Thermolag was found to exist relating to containment isolation capability, containment heat removal or containment hydrogen control.

94-0056

Attachment PRA-1
Fire Database Development
and Fire Susceptible Events for
Thermolag Installations

The purpose of the fire PRA databases is to provide location specific information for the PRA model. This information includes the location of all PRA modeled equipment and supporting cables, the basic events (BE)s associated with said equipment, and the PRA initiators that could result from a fire in any fire zone. A major resource for this task was the SLICE database system maintained by the NSED electrical design group. Database development covered all firezones in the plant instead of being specific to individual firezones.

How Database Was Developed

Database development was performed by completion of the following steps:

1. Identification of all basic events included in the PRA model. This task was performed by creating a BE report from the PROJECT.BE file using the CAFTA code.

2. Determine which basic events apply to each piece of modeled equipment. This task was performed by separating the BEs from task 1 by system and having each system analyst identify the equipment associated with each basic event. Some basic events, such as certain flow diversion events, had more than one piece of equipment associated with it. Human errors and maintenance unavailabilities were excluded from this task since these BEs would occur prior to a fire. This task generated database ELDB2.DBF.

3. Identify all power, control and instrumentation cables associated with each piece of modeled equipment. The SLICE database CABLE.DBF was used for this task. All equipment identified in task 2 were compared with the FR_EQUIPMT AND TO_EQUIPMT fields in the CABLE.DBF database. The resulting cables were then traced until either the 4.16KV/6.9KV or main control room cable risers/termination cabinets were reached. Tracing the cables involved not only the CABLE.DBF database, but also plant E02 and E03 drawings. The CPS safe shutdown analysis contained in USAR Appendix F was also reviewed to ensure all cables in that analysis associated with modeled equipment were included in the fire database. Cables to modeled equipment that would not disable the equipment if lost, such as position indication on non-interlocked valves, were not included in the database. Cables to the RAT and ERAT, though not explicitly modeled in the PRA, were included as a means of identifying zones where a fire could result in a loss of offsite power.

4. Identify the routing points associated with all identified cables. Routing points are intermediate locations on a cable tray or conduit. Using SLICE data, the trays containing each cable were identified, as well as all intermediate routing points.

5. Identify fire zone associated with each routing point. Using a SLICE system cross-index of routing point to fire zone, the location of cables contained in cable trays was identified.

6. Identify fire zones associated with each piece of modeled equipment. This task was performed by a combination of plant general arrangement review and plant walkdown.

7. Identify fire zones associated with conduits and open cables. Since the SLICE database does not contain location information on conduit or open cables, this task was performed by a combination of plant general arrangement review and plant walkdown.

8. Identify equipment susceptible to spurious actuation from fire. This information was taken directly from the safe shutdown analysis contained in USAR Appendix F.

9. Identify internal events initiators that could occur due to a fire in a fire zone. Using information gathered in previous tasks, all equipment and cables in this zone were identified. This list was reviewed and a list of initiators resulting from the loss of all equipment and cables in zone A-1a was compiled. This list was reviewed by an IPE analyst and a SRO and a final initiator list was developed.

Utilizing the information gathered in the previous steps, the fire location database ELDB1.DBF was completed.

Selection of Fire Susceptible BEs in Thermolag Areas

The structure of ELDB1 was set up so that for each piece of equipment, cables were identified up to the 4.16KV/6.9KV busses and/or the main control room termination cabinets. This resulted in listing some cables, particularly power cables, several times for different pieces of equipment. This approach allowed a database sort on fire zone without losing control, power or instrumentation dependencies. Once the equipment and cables contained in a zone were identified, the associated BEs were also determined. This list of BEs was reviewed and BEs that would not be affected by a fire were removed from the list of fire susceptible BEs. Examples of the type of BEs removed include the following: manual valve plugging, check valves failing to open, orifices plugging, all pre-event human errors and all maintenance

94-0056

unavailabilities. Attachment PRA-4 contains the lists of BEs and initiators generated from database ELDB1.DBF.

Prepared: Mark O'Flaherty Date: 11/3/94
Reviewed: Peter E Walberg Date: 11/3/94

94-0056

Attachment PRA-2

CONDITIONAL CORE DAMAGE FREQUENCY
AND CONTAINMENT IMPACT
FOR THERMOLAG INSTALLATIONS

For fire zone A-1a, all the basic events in the PRA that could be affected by a fire in the area were identified using the databases that were prepared for the fire PRA. For a basic event to be affected by a fire, either a fire susceptible component or associated power, control, or important instrumentation cable had to be located in fire zone A-1a. These basic events are called fire-susceptible basic events. The development of the data bases and the lists of fire susceptible basic events are described in attachment PRA-1.

CONDITIONAL CORE DAMAGE PROBABILITY

After the appropriate basic events were identified, two analyses were performed. First, all the fire-susceptible basic events involving that area were set to TRUE (meaning failed) in the original models, the model was requantified and the resulting conditional core damage probability (CCDP) was determined. This represents the case in which Thermolag is ineffective. Secondly, all the fire-susceptible basic events involving that area, except those which are protected with Thermolag, were set to TRUE in the models, and the resulting CCDP was determined. This represents the case in which there is an effective Thermolag fire barrier. The difference between the two results represents the importance of the fire barrier. The bigger difference there is between the two numbers, the more important is the Thermolag installation in that area. For firezone A-1a, the list of basic events for both cases were identical. This can be explained by the fact that the Division 2 cables protected by Thermo-lag are only protected for a portion of their length in this firezone and are therefore susceptible to damage from a whole zone fire scenario. Attachment PRA-4 contains the list of basic events used in zone A-1a.

For thoroughness, it is important to go back to the original models to fail the appropriate components, because in the normal process of quantifying a PRA, many combinations of events that are unlikely without a fire are truncated out of the solution because they contribute very little to the overall core damage frequency result. Subsequent results when trying to fail these components will be inaccurate if their failure could contribute significantly to the probability of core damage. By failing them before truncation, no significant contributor can be lost.
The analysis of this area included failure of affected components as described above, plus the certain occurrence

of the initiating events that would be precipitated by a fire in each area. All other initiators were trimmed out by setting them to FALSE.

CONTAINMENT FUNCTION EVALUATION

For defense in depth, the containment function is important, as well as core damage frequency. Because a low fraction of postulated core damage events lead to containment failure, a simplified method of assessing the impact of Thermolag failure was employed. Three functions that support containment integrity were analyzed independently. These functions are isolation, heat removal, and hydrogen control. The reliability of these functions was compared with the Thermolag failed and with the Thermolag assumed capable of performing as designed.

Examples of the various batch files and SETS user programs to perform this analysis are included in attachment PRA-5.

RESULTS

The CCDP calculated both with and without Thermolag was 1.23E-02. This result shows that Thermolag provides no quantifiable benefit in preventing core damage in zone A-1a. Additionally, no difference in failure probability was found between the two analyzed cases relating to containment isolation, heat removal or hydrogen control capabilities in zone A-1a.

Prepared: Mark O'Flaherty Date: 11/3/94
Reviewed: Peter E. Walberg Date: 11/3/94

Attachment PRA-3
Fire Ignition Frequencies
for Thermolag Areas

Following calculation of the conditional core damage probabilities (CCDPs), the results were reviewed and all fire zones with CCDPs greater than 1.0E-07 were identified. Fire zones with lower CCDPs were screened without additional analysis. In this zone, even though the CCDP is greater than 1.0E-07, calculation of the ignition frequency is not necessary since the CCDP calculated for the two cases is identical. However, the ignition frequency calculation for zone A-1a is presented here as additional information.

Development of Ignition Frequencies

The ignition frequency was calculated in accordance with the EPRI Fire PRA Implementation guide and the Fire-Induced Vulnerability Evaluation (FIVE) manual (EPRI TP-100370). The contractor for the fire PRA tailored collaboration, Scientific Applications International Corp. (SAIC), supplied EXCEL spreadsheets that duplicate the printed ignition frequency worksheets from the implementation manual. Generic fire frequencies were taken directly from the "Fire Events Database, Final Draft Report", dated 12/30/91, that was prepared by SAIC for Nuclear Safety Analysis Center (NSAC). Location weighting factors and ignition source weighting factor methods are specified by the implementation guide.

The major difficulty in the ignition frequency calculation methodology was the determination of the number and location of the plant ignition sources for both zone A-1a and the plant as a whole. The implementation guide described the types of ignition sources that must be considered. Using the SLICE system EQUIPMEN.DBF database, all equipment matching the component type guidelines were identified. The SLICE system is maintained by the NSED electrical design group. Significant judgment was required in determining which components to include as sources. The bases for component selection were supplied by SAIC. For example, pumps of less than or equal to 5 HP were eliminated as ignition sources. Cables and junction boxes were eliminated as possible ignition sources since essentially all cable in the plant is IEEE-383 rated cable. Using the ignition source list developed from the SLICE system as a guide, zone A-1a was then walked down and any additional ignition sources were added to the list. Selected system dumps from the MEL system were also reviewed. This was particularly important for the electrical cabinet categories since each individual breaker cubicle is counted as an individual cabinet.

Following the identification of the zone A-1a ignition sources, the plant wide ignition sources were identified and fire zones associated with these sources were determined by comparing the column and row information from SLICE and MEL with the plant general arrangements. Selected areas were also reviewed from plant elevation drawings (E2X series). Walkdowns in approximately 10% of the plant fire zones were also performed as a check of the accuracy of the documentation review. It should be noted that the implementation guide allows equipment numbers and locations to be estimated by engineering judgment alone. Once locations were identified, the number of plant-wide components for each category were determined both plant-wide and by location type. Fire zones are characterized as belonging to different location types. Some location types were obvious, such as the main control room or turbine building. Others, such as switchgear rooms and reactor building locations were less apparent. Switchgear rooms were selected based on the existence of either 4.16 KV or 6.9 KV switchgear. The reactor building category was based on Mark I and Mark II containment layouts and encompassed zones in the Fuel, Auxiliary, Control and Diesel Generator buildings that were not included in other specific location types.

With the plant wide and location type component tabulations complete, the fixed ignition sources contributing to the ignition frequency in zone A-1a were determined and entered onto the worksheets. In addition to fixed ignition sources, transient ignition sources were also examined. Transient ignition weighting factors were identified using the implementation guide. Specifically, contribution from smoking and candles were eliminated from consideration. The hot pipe contribution was also excluded for those zones without high energy piping. Once all component location information was entered, the zone ignition frequency was calculated. The zone A-1a ignition frequency is 1.6E-03 per year. For additional information, Attachment PRA-6 contains the zone A-1a ignition frequency worksheet.

Prepared: M. E. O'Flaherty Date: 8/3/94

Reviewed: Peter E. Ulberg Date: 8/3/94

94-0056

Attachment PRA-4
Basic Events and Initiators
Used In Analysis

SETS Code Input For Firezone A-1a
Same Input Deck For Protected and Unprotected Cables

Resulting CCDP = 1.23E-02

BASIC EVENT DESCRIPTION

A06EX4BCBD	FAILURE OF CIRCUIT BREAKER 0AP06E CUB 4B OPEN
A06EX4CCBD	FAILURE OF CIRCUIT BREAKER 0AP06E CUB 4C OPEN
ADG01KBDGR	FAILURE OF DIESEL GENERATOR 01KB TO RUN
ADG01KBDGS	FAILURE OF DIESEL GENERATOR 01KB TO START
ADG01KBLMX	FAILURE OF DG01KB INITIATION CIRCUITS
ADO01PBMPR	FAILURE OF PUMP DO01PB TO RUN GIVEN START
ADO01PBMPS	FAILURE OF PUMP DO01PB TO START
AP552ALCBD	FAILURE OF CIRCUIT BREAKER 0AP55EB CUB 2AL OPEN
APX400BCBD	FAILURE OF CIRCUIT BREAKER 400B1 OPEN
AVD01CBFNR	FAILURE OF FAN VD01CB TO RUN
AVD01CBFNS	FAILURE OF FAN VD01CB TO START
AVD01YBDMO	FAILURE OF DAMPER VD01YB TO OPEN
D1RP02ETFZ	TRANSFORMER 1RP02E FAILS TO PROVIDE POWER
DAF24ARCBD	FAILURE OF CIRCUIT BREAKER MCC F2 CUB 4AR OPEN
DC71S1BSSO	STATIC XFER SWITCH C71S001B FAILS OPEN
DC71S1BSSX	STATIC XFER SWITCH C71S001B IMPROPER XFER
DCS001BIVD	FAILURE OF OUTPUT FROM INVERTER S001B
DVX13CBFNR	FAILURE OF FAN VX13CB TO RUN
DVX13CBFNS	FAILURE OF FAN VX13CB TO START
DXVX14CFNR	FAILURE OF FAN VX14C TO RUN
DXVX14CFNS	FAILURE OF FAN VX14C TO START
ERHF094MVO	SX TO RHR F094 MOV FAILS TO OPEN
ERHF096MVO	SX TO RHR F096 MOV FAILS TO OPEN
ERHFLOWXVC	RH DIVERSION FLOW VALVE FAILS TO CLOSE
ESXFLOWXVC	SX DIVERSION FLOW VALVE FAILS TO CLOSE
FCD01PCMPR	PUMP 1CD01PC FAILS TO RUN
FCD01PCMPS	PUMP 1CD01PC FAILS TO START
GIA026AFLP	DIV 2 ADS AIR BOTTLE LINE FILTER PLUGGED
GIA026BFLP	DIV 1 ADS AIR BOTTLE LINE FILTER PLUGGED
GIA044AAVT	DIV 2 PRESSURE REG VLV FAILS TO REMAIN OPEN
GIA044BAVT	DIV 1 PRESSURE REGULATOR VLV FAILS TO REMAIN OPEN
GIA128ARVT	DIV 2 ADS AIR RELIEF VLV FAILS OPEN
GIA128BRVT	DIV 1 ADS AIR RELIEF VLV FAILS OPEN
GRDISKAPIL	DIV 2 RUPTURE DISK FAILS
GRDISKBPIL	DIV 1 RUPTURE DISK FAILS
I1VY04CFNR	SUPPLY FAN 1VY04C FAILS TO RUN
I1VY04CFNS	SUPPLY FAN 1VY04C FAILS TO START
IRIC003MPR	WATER LEG PUMP FAILS TO RUN
IRIF010MVT	RCIC SUCT VLV IMPROPERLY CLOSES
IRIF013MVO	MOV F013 FAILS TO OPEN
IRIF019MVO	MIN FLOW VLV FAILS TO OPEN
IRIF031MVO	RCIC SUCT VLV FAILS TO OPEN
IRIF045MVO	STEAM SUPPLY ISOL VLV FAILS TO OPEN
IRIF046MVO	LUBE OIL COOLING WATER SUPPLY VLV FAILS TO OPEN
IRIF063MVT	MOV F063 IMPROPERLY SHUTS
IRIF064MVT	MOV F064 IMPROPERLY SHUTS
IRIF068MVT	TURBINE EXHAUST VALVE F068 FAILS TO OPEN
[illegible]C002EMVT	TURBINE TRIP VALVE IMPROPERLY CLOSES

SETS Code Input For Firezone A-1a
Same Input Deck For Protected and Unprotected Cables

Resulting CCDP = 1.23E-02

BASIC EVENT	DESCRIPTION
KXN004ATSZ	RCIC HI ROOM TEMP N004A TRANS FAILS TO ACTUATE
KXN004BTSZ	RCIC HI ROOM TEMP N004B TRANS FAILS TO ACTUATE
KXN005ATSZ	RCIC ROOM HI DELTA TEMP N005A TRANS FAILS HIGH
KXN005BTSZ	RCIC ROOM HI DELTA TEMP N005B TRANS FAILS HIGH
KXN006ATSZ	RCIC ROOM HI DELTA TEMP N006A TRANS FAILS LOW
KXN006BTSZ	RCIC ROOM HI DELTA TEMP N006B TRANS FAILS LOW
KXN083AFSZ	RCIC LINE HI STEAM FLOW N083A TRANS FAILS TO ACTUATE
KXN083BFSZ	RCIC LINE HI STEAM FLOW N083B TRANS FAILS TO ACTUATE
KXXF063MVC	RHR & RCIC STEAM SUPPLY INBD ISOL VLV FAILS TO CLOSE
KXXF064MVC	RHR & RCIC STEAM SUPPLY OUTBD ISOL VLV FAILS TO CLOSE
LP0C001MPR	FAILURE OF PUMP 0C001 TO RUN GIVEN START
LP0C001MPS	FAILURE OF PUMP 0C001 TO START
LPVY01CFNR	FAILURE OF FAN VY01C TO RUN
LPVY01CFNS	FAILURE OF FAN VY01C TO START
LPXF001MVT	LPCS SUCT MOV F001 IMPROPERLY CLOSES
LPXF011MVC	FAILURE OF LPCS MIN FLOW MOV F011 TO CLOSE
LPXF011MVT	LPCS MIN FLOW VLV FAILS TO REMAIN OPEN BELOW 875 GPM
LPXF012MVT	LPCS TEST RETURN VALVE XF012 IMPROPERLY TRANSFERS OPEN
NC11C1AMPR	CRD PUMP 1C11C001A FAILS TO RUN
R12F008MVO	SUCTION MOV FROM RR FAILS TO OPEN
R12F009MVO	SUCTION MOV FROM RR FAILS TO OPEN
R1C002AMPR	PUMP A FAILS TO RUN
R1C002AMPS	PUMP A FAILS TO START
R1F003AMVT	FAILURE OF HX A OUTLET MOV TO REMAIN OPEN
R1F004AMVC	SUPP POOL SUCTION MOV A FAILS TO CLOSE
R1F004AMVT	RHR A SUCT LINE MOV FAILS TO REMAIN OPEN
R1F006AMVO	SDC SUCTION MOV A FAILS TO OPEN
R1F024AMVO	FAILURE OF FULL FLOW TEST MOV A TO OPEN
R1F024AMVT	FAILURE OF FULL FLOW TEST MOV A TO REMAIN CLOSED
R1F048AMVC	FAILURE OF HX A BYPASS MOV TO CLOSE
R1F048AMVT	FAILURE OF HX BYPASS MOV A TO REMAIN OPEN
R1F064AMVC	FAILURE OF MIN FLOW LINE MOV A TO CLOSE ABOVE 1100 GPM
R1F064AMVT	MIN FLOW VLV A FAILS TO REMAIN OPEN
R1VY02CFNR	RHR A PUMP RM COOLER FAN FAILS TO RUN
R1VY02CFNS	RHR A PUMP RM COOLER FAN FAILS TO START
R1VY03CFNR	RHR A HX ROOM FAN FAILS TO RUN
R1VY03CFNS	RHR A HX ROOM COOLER FAN FAILS TO START
R2C002BMPR	PUMP B FAILS TO RUN
R2C002BMPS	PUMP B FAILS TO START
R2F003BMVT	FAILURE OF HX B OUTLET MOV TO REMAIN OPEN
R2F004BMVC	SUPP POOL SUCTION MOV B FAILS TO CLOSE
R2F004BMVT	RHR B SUCT LINE MOV FAILS TO REMAIN OPEN
R2F006BMVO	SDC SUCTION MOV B FAILS TO OPEN
R2F024BMVO	FAILURE OF FULL FLOW TEST MOV B TO OPEN
R2F024BMVT	FAILURE OF FULL FLOW TEST MOV B TO REMAIN CLOSED
R2F027BMVT	INJECTION LINE OB CIV B FAILS TO REMAIN OPEN
R2F037BMVT	FAILURE OF FC LINE MOV B TO REMAIN CLOSED
R2F048BMVC	FAILURE OF HX B BYPASS MOV TO CLOSE

SETS Code Input For Firezone A-1a
Same Input Deck For Protected and Unprotected Cables

Resulting CCDP = 1.23E-02

BASIC EVENT	DESCRIPTION
R2F048BMVT	FAILURE OF HX BYPASS MOV B TO REMAIN OPEN
R2F064BMVC	FAILURE OF MIN FLOW LINE MOV TO CLOSE ABOVE 1100 GPM
R2F064BMVT	MIN FLOW MOV B FAILS TO REMAIN OPEN
R2VY05CFNR	RHR B HX ROOM COOLER FAN FAILS TO RUN
R2VY05CFNS	RHR B HX ROOM COOLER FAN FAILS TO START
R2VY06CFNR	RHR B PUMP RM COOLER FAN FAILS TO RUN
R2VY06CFNS	RHR B PUMP RM COOLER FAILS TO START
R3C002CMPR	PUMP C FAILS TO RUN
R3C002CMPS	RHR PUMP C FAILS TO START
R3F021OMVT	RHR C FULL FLOW TEST MOV FAILS TO REMAIN CLOSED
R3F042CMVO	INJECTION LINE C MOV FAILS TO OPEN
R3F064CMVC	FAILURE OF MIN FLOW MOV TO CLOSE ABOVE 1100 GPM
R3F064CMVT	RHR C MIN FLOW MOV FAILS TO REMAIN OPEN
R3F105OMVT	RHR C SUCT LINE MOV FAILS TO REMAIN OPEN
R3VY07CFNR	RHR C ROOM COOLER FAN FAILS TO RUN
R3VY07CFNS	RHR C ROOM COOLER FAN FAILS TO START
RE12C02MPR	RHR B/C WATER LEG PUMP FAILS TO RUN
RE21C02MPR	RHR A/LPCS WATER LEG PUMP FAILS TO RUN
X1SX033AVO	DISCHARGE VALVE 1SX033 FAILS TO OPEN
X1SX037AVO	DISCHARGE VALVE 1SX037 FAILS TO OPEN
X1SX189AVO	DISCHARGE VALVE 1SX189 FAILS TO OPEN
XRF014AMVO	INLET VALVE 1E12F014A FAILS TO OPEN
XRF014BMVO	INLET VALVE 1E12F014B FAILS TO OPEN
XRF068AMVO	OUTLET VALVE 1E12F068A FAILS TO OPEN
XRF068BMVO	OUTLET VALVE 1E12F068B FAILS TO OPEN
XSX023AAVO	DISCHARGE VALVE 1SX023A FAILS TO OPEN
XSX023BAVO	DISCHARGE VALVE 1SX023B FAILS TO OPEN
XSX027AAVO	DISCHARGE VALVE 1SX027A FAILS TO OPEN
XSX027BAVO	DISCHARGE VALVE 1SX027B FAILS TO OPEN
XSX027CAVO	DISCHARGE VALVE 1SX027C FAILS TO OPEN
XSX029AAVO	DISCHARGE VALVE 1SX029A FAILS TO OPEN
XSX029BAVO	DISCHARGE VALVE 1SX029B FAILS TO OPEN
XSX029CAVO	DISCHARGE VALVE 1SX029C FAILS TO OPEN
XSX063BMVO	DISCHARGE VALVE 1SX063B FAILS TO OPEN
XSX173AMVC	MINIMUM FLOW VALVE 1SX173A FAILS OPEN
XSX173AMVO	MIN FLOW VALVE 1SX173A FAILS TO OPEN
XSX173BMVC	MINIMUM FLOW VALVE 1SX173B FAILS OPEN
XSX173BMVO	MIN FLOW VALVE 1SX173B FAILS TO OPEN
XSX181BAVO	DISCHARGE VALVE 1SX181B FAILS TO OPEN
XSX185BAVO	DISCHARGE VALVE 1SX185B FAILS TO OPEN
XSX193BAVO	DISCHARGE VALVE 1SX193B FAILS TO OPEN
YTRANISTRX	TRANSIENT WITH ISOLATION INITIATOR

94-0056

Attachment PRA-5
Analysis of Conditional Core Damage
Frequencies and Containment Degradation
For Thermolag Firezones

ANALYSIS OF CONDITIONAL CORE DAMAGE FREQUENCIES AND CONTAINMENT DEGRADATION FOR THERMOLAG FIRE ZONES

This attachment describes the method used for determining the likelihood of core damage, given that a fire has destroyed all essential equipment in a specified fire area. Basically, the method fails all components in a given area in the appropriate fault trees, and then re-solves the entire PRA model. This method was used rather than failing events in the core damage results from the PRA, because many components that do not appear in the core damage cutsets because they are inherently reliable may be failed by a fire. Therefore just starting with the core damage cutsets would not yield a true picture of the possible consequences from a fire in a given area. This method was used for the 94 fire areas of interest for the fire PRA.

INPUTS

The method starts with three inputs: the linked CAFTA fault tree models for the plant, the SETS user programs for solving the system and sequences for the level 1 PRA, and a list for each fire area of the basic events that are assumed failed and the initiating events that could result from a fire in a given area.

The linked CAFTA fault trees are in ZCNMT.CAF.

The SETS user programs for the PRA are as listed in appendix F of the PRA update report.

The lists of basic events and initiators are of the following example format.

<u>Example text input file (Area CB3B)</u>

```
D164A16CBD
D174A18CBD
D1DC03EBYD
D1DC04EBYD
D1DC08EBCD
D1RP04ETFZ
DBUSNXCSWH
DC164A1CBD
DC174A1CBD
DC71S1DSSO
DC71S1DSSX
DCC71SABCD
DCC71SBBCD
DCS001DIVD
DCS004AIVD
DCS004BIVD
DCUPS1AIVD
DCUPS1ASSO
DCUPS1ASSX
DCUPS1BIVD
```

```
DCUPS1BSSO
DCUPS1BSSX
DD16E17CBD
DD17E19CBD
DDC1D1ACBD
DDC1D1BCBD
DDC1D1CCBD
DDC1E1ACBD
DDC1E3BCBD
DDC1E6BCBD
DDC1E7ACBD
DDC1F1ACBD
DDC1F3BCBD
DDC1F7ACBD
DDC1F8ACBD
DXVX14CFNR
DXVX14CFNS
ESXFLOWXVC
X1SX189AVO
X1VX14SHXP
YLOSSDCTRX
YTRANISTRX
```

IMPORTING FAULT TREES

The first step in solving the PRA model is to read the CAFTA fault tree files into SETS, simplify them, and form independent subtrees (IST) and stem equations. Two steps are taken before doing this in order to ensure that top events necessary for the sequence solutions are not unintentionally included in the ISTs. The first step is identical to that taken for the base PRA solution; to construct an additional fault tree containing all the events that we wanted to keep out of ISTs and then combine this with ZCNMT (the combined IPE fault tree model). The second step was similar, but necessary for this analysis and not the base PRA solution, because in the process of simplifying fault trees with many failed events, some top event equations are dropped if they evaluate to OMEGA (failed). A second auxiliary fault tree was constructed with all the top events that are necessary for the event tree sequence solutions. When this was combined with the ZCNMT, few top events vanished in the reformatting process.

INDEPENDENT SUBTREES

The reformatting process is implemented with the FRMNEWFT procedure in SETS. The user program for this procedure is produced by a BASIC program (ISTPREP) that reads the failure event text file and sets all the included events to OMEGA (true, ie. failed) and then continues to write a SETS program to set all initiators to 0.0 except those included in the failure event text file which are set to 1.0.

An example program to produce ISTs is shown here.

<u>Example SETS user program for form ISTS (CB3BIST.IN)</u>

```
PROGRAM$FORMIST.
COMMENT$ REFORM CAFTA FAULT TREE USING INDEPENDENT SUBTREES$
                    DLTBLK(CPS-STEM,CPS-IST,CPS-STEM1,CPS-IST1,CPS-STEM2).
FRMNEWFT(FORM1$ SETSIN / CPS-TEMP *NAME$
YFIRE= XYFIRE ,
YIETP= XYIETP ,
YIET3= XYIET3 ,
```

```
YIES1= XYIES1 ,
YIEA= XYIEA ,
YIEIA= XYIEIA ,
YIET2= XYIET2 ,
YIET4= XYIET4 ,
YIET5= XYIET5 ,
YIES2= XYIES2 ,
YIET9= XYIET9 ,
YIESW= XYIESW ,
YIEDC= XYIEDC ,
YC2= XYC2 ,
YC2A= XYC2A ,
YU1= XYU1 ,
YC8= XYC8 ,
YW= XYW ,
YDG= XYDG ,
YO= XYO ,
YO1= XYO1 ,
YO2= XYO2 ,
YX1= XYX1 ,
YU2= XYU2 ,
YC1= XYC1 ,
YC3= XYC3 ,
YC= XYC ,
YC4= XYC4 ,
YC5= XYC5 ,
YC6= XYC6 ,
YC7= XYC7 ,
YC9= XYC9 ,
YDG1= XYDG1 ,
YDG2= XYDG2 ,
YL1= XYL1 ,
YL4= XYL4 ,
YL6= XYL6 ,
YU= XYU ,
YDIES1= XYDIES1 ,
YDIES2= XYDIES2 ,
YM1= XYM1 ,
YP1= XYP1 ,
YX2= XYX2 ,
YH1= XYH1 ,
YIET9B= XYIET9B ,
YIET9C= XYIET9C ,
YIET9D= XYIET9D ,
YM= XYM ,
YP= XYP ,
YW1= XYW1 ,
YX= XYX ,
YU3= XYU3 ,
YW2= XYW2 ,
YRHALONG= XYRHALONG ,
YRHBLONG= XYRHBLONG ,
YRHCLONG= XYRHCLONG ,
YHPLONG= XYHPLONG ,
YLPLONG= XYLPLONG ,
YCRD= XYCRD ,
YCDCBSUM= XYCDCBSUM ,
R1LPCIAX= XR1LPCIAX ,
R2LPCIBX= XR2LPCIBX ,
R3LPCICX= XR3LPCICX ,
YLPCS= XYLPCS).

FRMNEWFT(FORM3$ CPS-TEMP,NONMOD,FIRETOPS / CPS-STEM1,CPS-IST *OMEGA$
D164A16CBD,
D174A18CBD,
D1DC03EBYD,
D1DC04EBYD,
D1DC08EBCD,
D1RP04ETFZ,
DBUSNXCSWH,
DC164A1CBD,
DC174A1CBD,
DC71S1DSSO,
DC71S1DSSX,
DCC71SABCD,
DCC71SBBCD,
DCS001DIVD,
DCS004AIVD,
DCS004BIVD,
DCUPS1AIVD,
DCUPS1ASSO,
DCUPS1ASSX,
DCUPS1BIVD,
DCUPS1BSSO,
DCUPS1BSSX,
DD16E17CBD,
DD17E19CBD,
```

```
DDC1D1ACBD,
DDC1D1BCBD,
DDC1D1CCBD,
DDC1E1ACBD,
DDC1E3BCBD,
DDC1E6BCBD,
DDC1E7ACBD,
DDC1F1ACBD,
DDC1F3BCBD,
DDC1F7ACBD,
DDC1F8ACBD,
DXVX14CFNR,
DXVX14CFNS,
ESXFLOWXVC,
X1SX189AVO,
X1VX14SHXP).

FRMNEWFT(FORM1$ CPS-STEM1 / CPS-STEM *TRIM$ GATE01).
DLTBLK(CPS-TEMP,CPS-STEM1).
BLKSTAT.
```

The first call to FRMNEWFT (Form1) renames all the top events required for the event tree sequence solution to correspond the auxiliary fault tree. The second call (Form3) is the procedure call that OMEGAs the appropriate basic events and forms the ISTs and STEM. Finally the third call removes the logic for the first auxiliary fault tree, so that no time is wasted in solving it.

INITIATOR FREQUENCY CORRECTION

Before the fault trees are solved, the initiators are adjusted using the other program that is produced by the BASIC program ISTPREP.

Example SETS user program to adjust initiator frequencies (CB3BDATA.IN)

```
PROGRAM$FIREDATA.
COMMENT$ READS IN FIRE PRA-SPCIFIC SCENARIO INITIATORS $
RDVALBLK(CPSBEDAT).

VALUE BLOCK$ CPSBEDAT.

COMMENT$ INITIATOR ADJUSTMENTS FOR FIRE AREA $
 0.00    $ YLOSSFWTRX   $
 0.00    $ YTRANSYTRX   $
 1.00    $ YTRANISTRX   $
 0.00    $ YIORVXXTRX   $
 0.00    $ YLLOCAXTRX   $
 0.00    $ YMEDLOCTRX   $
 0.00    $ YSBLOCATRX   $
 0.00    $ YLOOPXXTRX   $
 1.00    $ YLOSSDCTRX   $
 0.00    $ YLOSSIATRX   $
 0.00    $ YLOSSSWTRX   $
 0.00    $ YISLOCATRA   $
 0.00    $ YISLOCBTRX   $
 0.00    $ YISLOCCTRX   $
 0.00    $ YISLOCDTRX   $
```

EVENT TREE HEADING SOLUTION

After these two programs are run, then the ISTs and the STEM equations are solved. This is done with straight-forward applications of the GENFTEQN procedure, using the SOLVIST and SOLVE

SETS user programs. These programs are edited to set the truncation level at 1E-7.

After these solutions, it is necessary to form an equation block with only the top events which are needed for the event tree sequence solutions. This is done with another SETS user program, but it must be unique for each fire area. As mentioned above, when a top event is evaluated as OMEGA, the equation is lost. Therefore when that top event subsequently appears in a sequence equation, the sequence equation cannot be solved. In order to avoid the need to rewrite the sequence solutions for each fire area, the top events that are lost need to be re-defined. In addition, combination events are sometimes lost, as well. For example, high pressure injection (YU) is a combination of high pressure core spray (YU1) and feedwater (YQ1). If one of these is evaluated as OMEGA, then YU should equal the other input. SETS doesn't handle this correctly. To accommodate these two shortcomings, another BASIC program (SUPREP) was developed to read the output of the FRMNEWFT procedure and make the proper equation adjustments. An example SETS user program resulting from the BASIC program follows.

<u>Example SETS user program to form top event equation block (CB3BSU.IN)</u>

```
PROGRAM$SQSETUP.
COMMENT$ SET UP BLOCK WITH EVENT TREE HEADINGS $
LDBLK(CPS·STEM-EQN).

YQ = OMEGA.
SUBINEQN(YQ,YQ).
YQ2 = OMEGA.
SUBINEQN(YQ2,YQ2).
YCDCBSUM = OMEGA.
SUBINEQN(YCDCBSUM,YCDCBSUM).
YQ1 = OMEGA.
SUBINEQN(YQ1,YQ1).
YCRD = OMEGA.
SUBINEQN(YCRD,YCRD).
YIEA = /OMEGA.
SUBINEQN(YIEA,YIEA).
YX = GGATE01.
SUBINEQN(YX,YX).
YX1 = GGATE01.
SUBINEQN(YX1,YX1).
YU = YU1.
SUBINEQN(YU,YU).

DLTBLK(CPS-TOPS).
FRMBLK(CPS-TOPS* ONLY$ YFIRE, YIETP,YIET3,YIES1,YIEA,YIETA,YIET2,
     YIET4,YIET5,YIES2,YIET9,YIESW,YIEDC,YC2,YC2A,YU1,YC8,YW,
     YDG,YQ,YQ1,YQ2,YX1,YU2,YC1,YC3,YC,YC4,YC5,YC6,YC7,YC9,
     YDG1,YDG2,YL1,YL4,YL6,YU,YDIES1,YDIES2,YM1,YP1,
     YX2,YH1,YIET9B,YIET9C,YIET9D,YM,YP,YW1,YX,YU3,YW2,YRHALONG,
     YRHBLONG,YRHCLONG,YHPLONG,YLPLONG,YCRD,YCDCBSUM,R1LPCIAX,
     R2LPCIBX,R3LPCICX,YLPCS).

BLKSTAT.
```

EVENT TREE SEQUENCE SOLUTIONS

After these mechanizations, the sequence equations are used to solve all the event tree sequences. The SETS user programs were adjusted to analyze all sequences to a truncation level of 1.0E-7. The final result cutsets are truncated at 2.0E-7. One other modification to the sequence solution was made to eliminate the

analysis for dependent human failures. Because so many headings turned out to be OMEGA, the dependent HRA analysis would have to be customized for each fire case, and the work necessary for that was judged to be excessive for the benefit that could be gained. One change was made to SEQTRAN.IN to avoid formation of an empty block when all transient initiators become ISTs.

THERMOLAG BENEFIT

For areas in which Thermolag is employed as a fire barrier, the above analysis was repeated. The first analysis was with all basic events in the area failed, as though Thermolag provides no benefit. The second analysis assumed that Thermolag was effective, and the protected basic events were not failed.

CONTAINMENT FUNCTIONS

In order to be thorough in evaluating the Thermolag importance, the benefit of Thermolag to containment function, in addition to core damage potential, needed to be evaluated. Running the entire suit of containment sequence solution SETS user programs for all Thermolag applications would be very time consuming. It would also be very difficult, with unique programs required for each area because of the loss of terms that evaluate to OMEGA, as described above. Consequently a simplified method was used. Three containment functions were evaluated as follows: containment heat removal, containment isolation, and hydrogen control. These functions were evaluated independently, rather than through containment event tree sequences.

Containment heat removal capability was modeled as possible by the RHR fault tree, containment spray (YCNMSA, YCNMTSB) and suppression pool cooling (YSPCA, YSPCB) modes. Containment isolation was evaluated with the containment isolation fault tree (KGATE01), and hydrogen control was modeled with its fault tree (CGATE101). The first comparison was for which of these headings were OMEGAd in the Form New Fault Tree procedure call as discussed above under the EVENT TREE HEADINGS heading. If the same events were OMEGAd for both the Thermolag failure and Thermolag success cases, no further action was required, as Thermolag provided no benefit to the model. For cases in which there were differences in the headings that were OMEGAd (This happened for only CNMT heat removal in two areas.), a user program was developed to evaluate the combination of YCNMTSA, YCNMTSB, YSPCA, and YSPCB with the appropriate events OMEGAd. The difference in results between the Thermolag failure and Thermolag success in this analysis is the importance of Thermolag in the area to protecting the containment heat removal function.

BATCH FILE AUTOMATION

The entire process described above, except for the final CNMT heat removal analysis, is implemented by using batch files. The complete solution for a list of areas can be performed by calling

TLSOLN with a list of areas as command line parameters. TLSOLN in turn calls other batch files. The first one called is TLPREP, which runs the BASIC programs to produce the input files. The second call is to TLSYS, which solves the system and event tree heading equations and prepares the equation block with all the necessary headings for the event tree solutions. The third is TLSEQ, which solves the individual event tree sequences, does all recoveries, combines the sequences into final results, and then processes and prints the final results. TLSOLN then calls TLSIFT to identify the containment functions that are failed for each case. The programs and data to complete this process are listed below.

<u>TABLE OF CALLED PROGRAMS AND PROCEDURES</u>

(Note: AREA is used as a generic term to be replaced by each area designation.)

PROGRAM	DESCRIPTION	CALLS	DATA
TLSOLN.BAT	Does entire solution for listed areas	TLPREP.BAT TLSYS.BAT TLSEQ.BAT TLSIFT.BAT	
TLPREP.BAT	Prepares SETS inputs for specified area INPUTBLK.FIR	KEY-FAKE.COM ISTPREP.BAS SUPREP.BAS	
KEY-FAKE.COM	Public Domain utility for command line BASIC parameters		
ISTPREP.BAS	Prepares input to form ISTs and adjust initiators AREA.TXT Writes AREAIST.IN and AREADATA.IN TEMPIST.TXT		
AREA.TXT	Text files containing BE's to be failed and intiators to occur		
SUPREP.BAS	Prepares SETS input for setting up ET top events AREAIST.OUT Writes AREASU.IN		
INPUTBLK.FIR	SETS block file containing only the fault trees from CAFTA		
TLSYS.BAT	Solves for event tree headings	READTL.IN AREAIST.IN AREADATA.IN SOLVIST.IN SOLVE.IN AREASU.IN BLOCKSTA.IN WRITETOP.IN READBLKS.BAS PURGE.COM DO.BAT	
READFIRE.IN	Prepared from CAFTA files for ZCNMT, ZNONMOD, and ZTL. Makes initial SETS block for remainder of programs.		
SOLVIST.IN	Uses SETS procedure GENFTEQN with the SAVE option for ISTs		
SOLVE.IN	Uses SETS procedure GENFTEQN to solve all stem equations. Prepared by using the GENFTEQN with the WRITE option on the		

original models with no events OMEGAd in order to solve and save all ET headings.

BLOCKSTA.IN	Uses SETS procedure BLKSTAT to check status of equation block
WRITETOP.IN	Uses SETS procedures WRTBLK and WRTVALBLK to prepare switch file (SWFL) to form a new block file with only ET headings
READBLKS.BAS	Prepares SETS input file READTEMP.IN to form a new block file READBLKS.IN
PURGE.EXE	Utility file to remove excessive line and form feeds from SETS output
DO.BAT	Utility to print text in small font with small line spacing
TLSEQ.BAT	Calls all sequence SETS user programs in sequence to solve multiple sequences, including recoveries CUTVAL.BAS
CUTVAL.BAS	Reads output from SETS COMTRMVAL and lists the results in CUTVAL.OUT
TLSIFT.BAT	Prepares lists of CNMT function headings that have been set to OMEGA. ISTSIFT.BAS

ISTSIFT.BAS Picks out CNMT function headings that have been set to OMEGA by the AREAIST SETS user program.

PROGRAM LISTINGS

TLSOLN.BAT

```
:START
IF %1A==A GOTO END
ECHO %1
CALL TLPREP.BAT %1
CALL TLSYS.BAT %1
CALL TLSEQ.BAT %1
REM CALL TLIMP.BAT %1
PKZIP -A D:\FIRE\%1RES \PCS\FIRE\SEQ\CUTCOMB.OUT
PKZIP -A D:\FIRE\%1RES \SETSBU\SEQCOMB.FIR
COPY \SETSBU\SEQCOMB.FIR %1COMB.RES
REM DEL \SETSBU\%1*.FIR
CALL TLSIFT.BAT %1
SHIFT
GOTO START
:END
```

TLPREP.BAT

```
CD INPUT
DEL PREPBAT.DAT
:START
IF %1A==A GOTO END
REM ****************** PREPARE IST AND DATA FILES
ECHO %1
KEY-FAKE "%1" 013
E:\SY\BASIC\GWBASIC \PCS\TL\INPUT\ISTPREP >> PREPBAT.DAT
REM
COPY \SETSBU\INPUTBLK.FIR BKFL
REM **************  FORM ISTS
COPY %1IST.IN INFL
E:\SY\PCSETS\PCSETS > %1IST.OUT
FIND "ERROR" %1IST.OUT
FIND "ERROR" %1IST.OUT >> PREPBAT.DAT
REM **********************  PREPARE SETUP PROGRAM
KEY-FAKE "%1" 013
E:\SY\BASIC\GWBASIC \PCS\TL\INPUT\SUPREP
REM *************** RECYCLE AND START OVER
SHIFT
GOTO START
:END
CD..
ECHO R
```

TLSYS.BAT

```
:START
IF %1A==A GOTO END
F:
CD\PCS\TL\SYS
DEL SYSBAT.DAT
REM GOTO JUMP
DEL BKFL
COPY F:\SETSBU\READFIRE.IN D:\SCRATCH\READCAF.IN
COPY D:\SCRATCH\READCAF.IN INFL
E:\SY\PCSETS\PCSETS > D:\SCRATCH\READCAF.OUT
FIND "ERROR" D:\SCRATCH\READCAF.OUT > SYSBAT.DAT
FIND "ERROR" D:\SCRATCH\READCAF.OUT
REM DEL READCAF.OUT
REM **************  FORM ISTS
COPY \PCS\TL\INPUT\%1IST.IN INFL
E:\SY\PCSETS\PCSETS > %1IST.OUT
FIND "ERROR" %1IST.OUT
FIND "ERROR" %1IST.OUT >> SYSBAT.DAT
REM ####### READ AREA DATA ##########
COPY \PCS\TL\INPUT\%1DATA.IN INFL
E:\SY\PCSETS\PCSETS > %1DATA.OUT
FIND "ERROR" %1DATA.OUT
FIND "ERROR" %1DATA.OUT >> SYSBAT.DAT
REM **************  ISTS
COPY SOLVIST.IN INFL
E:\SY\PCSETS\PCSETS > SOLVIST.OUT
FIND "ERROR" SOLVIST.OUT
FIND "ERROR" SOLVIST.OUT >> SYSBAT.DAT
FIND "NO EQUATION" SOLVIST.OUT >> SYSBAT.DAT
COPY BKFL F:\SETSBU\%1IST.FIR
GOTO SKIPSTEM
```

```
REM ***************   STEMS
DCOPY SOLVSTEM.IN INFL
E:\SY\PCSETS\PCSETS > SOLVSTEM.OUT
FIND "ERROR" SOLVSTEM.OUT
FIND "ERROR" SOLVSTEM.OUT >> SYSBAT.DAT
FIND "NO EQUATION" SOLVSTEM.OUT >> SYSBAT.DAT
COPY BKFL F:\SETSBU\%1STEM.FIR
:SKIPSTEM
REM ***************   STEMS
COPY SOLVE.IN INFL
E:\SY\PCSETS\PCSETS > SOLVE.OUT
FIND "ERROR" SOLVE.OUT
FIND "ERROR" SOLVE.OUT >> SYSBAT.DAT
REM FIND "NO EQUATION" SOLVE.OUT >> SYSBAT.DAT
COPY BKFL F:\SETSBU\%1STEM.FIR
GOTO SKIPEQN
REM ***************
REM COPY GENFTUPG.IN INFL
REM E:\SY\PCSETS\PCSETS > GENFTUPG.OUT
REM CALL DO HP SGFL.SUP CO
REM ******************
:SKIPEQN
REM SEQ SET UP ******************************
COPY \PCS\TL\INPUT\%1SU.IN INFL
E:\SY\PCSETS\PCSETS > %1SU.OUT
FIND "****" %1SU.OUT >> SYSBAT.DAT
FIND "NO EQUATION" %1SU.OUT >> SYSBAT.DAT
FIND "ERROR" %1SU.OUT >> SYSBAT.DAT
COPY BKFL F:\SETSBU\%1HDG.FIR
COPY \PCS\BLOCKSTA.IN INFL
E:\SY\PCSETS\PCSETS > BLOCKSTA.OUT
REM MAKE ET SWFL ***********************
ECHO Y | DEL D:\SCRATCH\*.*
DEL SWFL
COPY WRITETOP.IN INFL
E:\SY\PCSETS\PCSETS > WRITETOP.OUT
FIND "****" WRITETOP.OUT >> SYSBAT.DAT
FIND "NO EQUATION" WRITETOP.OUT >> SYSBAT.DAT
FIND "ERROR" WRITETOP.OUT >> SYSBAT.DAT
E:\SY\BASIC\GWBASIC F:\PCS\READBLKS >> SYSBAT.DAT
DEL BKFL
COPY D:\SCRATCH\READTEMP.IN INFL
E:\SY\PCSETS\PCSETS > D:\SCRATCH\READTEMP.OUT
FIND "****" D:\SCRATCH\READTEMP.OUT >> SYSBAT.DAT
FIND "NO EQUATION" D:\SCRATCH\READTEMP.OUT >> SYSBAT.DAT
FIND "ERROR" D:\SCRATCH\READTEMP.OUT >> SYSBAT.DAT
COPY BKFL \SETSBU\%1TOPS.FIR
REM **************** OUTPUTS
DIR F:\SETSBU\%1*.FIR >> SYSBAT.DAT
DIR %1*.OUT >> SYSBAT.DAT
REM COPY BLOCKSTA.OUT SETS.OUT
REM E:\SY\PCSETS\PURGE
REM TYPE TEMP.DOC >> SYSBAT.DAT
CALL DO HP SYSBAT.DAT CO
rem COPY %1.OUT SETS.OUT
REM E:\SY\PCSETS\PURGE
REM CALL DO HP TEMP.DOC CO
CD ..
SHIFT
GOTO START
:END
ECHO R R
ECHO DONE
ECHO RR
```

TLSEQ.BAT

```
:START
IF %1A==A GOTO FINISH
F:
CD \PCS\TL\SEQ
REM  ASSUMES THAT THE LATEST BLOCKFILE ETTOPS.FIR IS IN \SETSBU
REM  AND THAT THE LATEST FIRE SOLUTION ISTSOLN.FIR IS IN \SETSBU
DEL SEQBAT.DAT
REM GOTO JUMP
REM ******* FORMAT AND READ IN IST EQUATIONS ***********
DEL BKFL
COPY \SETSBU\%1IST.FIR BKFL
DEL SWFL
COPY WRITISTS.IN INFL
E:\SY\PCSETS\PCSETS > WRITISTS.OUT
FIND "****" WRITISTS.OUT >>  SEQBAT.DAT
FIND "NO EQUATION" WRITISTS.OUT >>  SEQBAT.DAT
REM FIND "ERROR" WRITISTS.OUT >>  SEQBAT.DAT
E:\SY\BASIC\GWBASIC F:\PCS\READISTS >> SEQBAT.DAT
```

Attachment PRA-6
Ignition Frequency Wcrksheet

EMB - A-1A.XLT-9:55 AM

COMPARTMENT FIRE FREQUENCY WORKSHEET

PLANT - CLINTON
COMPARTMENT A-1a

Reference Area: Reactor Building (BWR)

Transients allowed in this zone: Welding, Ext. cords, Heaters, Open flame, Heating of combustibles

Flammable liquid or gas tanks/piping in this zone: Yes ___ No X

Components	Generic Fire Frequency (f) (1)	Location Weighting Factor (WL) (2)	M (3)	Ignition Source Weighting Factor WI			Compartment Fire Frequency
Rx BLDG COMPONENTS				Number of these ignition sources in the compartment	Total number of these ignition sources in the Reactor Building		
Electrical Cabinets	5.0E-02	1.0E+00	B	6	782	8.6E-03	3.3E-04
Pumps	2.5E-02	1.0E+00	B	2	59	3.4E-02	8.5E-04
PLANT-WIDE COMPONENTS				Weight (or Btus) of cable insulation in this compartment	Weight (or Btus) of cable insulation in Appendix R areas, excluding radwaste or containment		
Non-qualified cable run	8.3E-03	1.0E+00	E	0	0	0.0E+00	0.0E+00
Junction box/splice in NQ cable	1.6E-03	1.0E+00	E	0	0	0.0E+00	0.0E+00
Junction box in Q cable	1.6E-03	1.0E+00	E	0	0	0.0E+00	0.0E+00
				Number of these ignition sources in the compartment	Total number of these ignition sources in all locations listed in Table 1-3		
Fire Protection Panels	2.4E-03	1.0E+00	F	0	114	0.0E+00	0.0E+00
RPS MG sets	5.5E-03	1.0E+00	F	0	2	0.0E+00	0.0E+00
Transformers	7.9E-03	1.0E+00	F	0	189	0.0E+00	0.0E+00
Battery Chargers	4.0E-03	1.0E+00	F	0	8	0.0E+00	0.0E+00
Air compressors	4.7E-03	1.0E+00	F	0	11	0.0E+00	0.0E+00
Ventilation Subsystems	9.5E-03	1.0E+00	F	3	630	4.8E-03	4.5E-05
Elevator motors	8.3E-03	1.0E+00	F	0	6	0.0E+00	0.0E+00
Dryers	8.7E-03	1.0E+00	F	0	3	0.0E+00	0.0E+00
				Number of these ignition sources in the compartment	Total number of these ignition sources in all plant locations (including those not specified in Table 1-3)		
Off-gas/H2 recombiner	8.6E-02	1.0E+00	G	0	4	0.0E+00	0.0E+00
Hydrogen Tanks	3.2E-03	1.0E+00	G	0	0	0.0E+00	0.0E+00
Gas turbines	3.1E-02	1.0E+00	G	0	0	0.0E+00	0.0E+00
				Enter 1 if these fires could occur, enter 0 they can not occur.	Total number of compartments where misc. other hydrogen fires could be present		
Miscellaneous hydrogen fires	3.2E-03	1.0E+00	C	0	3	0.0E+00	0.0E+00
TRANSIENTS					Total number of compartments in Table 1-3 plant locations		
Cable fires - welding	5.1E-03	1.0E+00	C	1	121	8.3E-03	4.2E-05
Transient fires - welding	3.1E-02	1.0E+00	C	1	121	8.3E-03	2.6E-04
				Sum of ignition source weighting factors for transients	Total number of zones in Table 1-3 plant locations		
Transients-other	1.3E-03	1.0E+00	D	9	121	7.4E-02	9.7E-05
						TOTAL	1.6E-03

(1) From FEDB Report Table 1-3
(2) See FIVE Reference Table 1.1 for guidance
(3) Ignition source weighting factor method. See FEDB Table 1-3 for guidance.

Note: Walkdown performed 3/15/94

Evaluation of Ampacity Derating for Thermo-Lag Installation

Topic:

Consideration of the existing cable ampacities in this area with respect to the NRC concerns (IEIN 94-22) over the ampacity derating needed for Thermo-lag installations.

Design statement:

Clinton Power Station project ampacities for cables in tray were established in calculation 19-G-01. These values are conservative in magnitude and were used during the design process as one of the parameters for selecting the size and type of cable for a specific circuit. A separate calculation (19-AI-8) was performed to determine the amount of ampacity derating needed to account for the increased heat retention (due to the Thermo-lag installation) in the tray. Derating values are viewed as suspect in the IEIN, but no new values are established.

The Thermo-lag installation in fire zone A-1A consists of a one hour wrap. The power cables so enclosed were reviewed (see attachment one) and the review demonstrates that not only were none of these cables thermally overloaded by the currents passing through them but that they could be subjected to as much as a 37.7% ampacity derating requirement without being impacted.

The largest ampacity derating mentioned in the IEIN was 46.4% for a #8 AWG conductor in a tray with a three hour wrap of Thermo-lag applied. On first examination, this would seem to represent a potential impact to our design. However phone calls to the NRC have provided additional information (specifically the diameters of the tested conductors) which allows a comparative evaluation of the test results. On attachment two, the cables tested by Sandia lab for the NRC are examined with respect to the methodology developed by Stolpe (IEEE Transaction Paper 70 TP 557 PWR *Ampacities for cables in Randomly Filled Cable Trays* by J. Stolpe). For this evaluation, tray fill was determined per step 2.2 of ICEA P-54-440 which uses diameter squared for area without the pi/4 component. This resulted in a tray fill depth of 1.41" and the P-54-440 tabulated values for 1.5" fill were utilized in the comparison of data. All heat intensities were calculated using the actual cross-sectional area of the cable. Since the same numbers were used for each section of the evaluation, the heat intensities can be directly compared.

The first set of numbers translates the ampacities reported in 94-22 into heat intensities for open (unwrapped) and Thermo-lag wrapped trays. The NEMA numbers show the heat intensities that would be produced if the ampacity values from table 3-1 of P-54-440 were utilized for the cables tested by the NRC. The CPS numbers show the heat intensities

that would be produced if the methodology used for determining ampacity limits at CPS (Calc 19-G-1) were applied to these conductors, but using a 1.5" fill rather than the nominal 2" fill of CPS design. Tlag ampacity values for the NEMA and CPS tables were calculated based on the 32% derate factor derived in Calc 19-AI-8.

Comparison of the results shows that the NEMA values produce lower heat intensities (and therefore lower overall heat in the tray) than the NRC values. The CPS values are even more conservative with resultant lower intensities. Even though the derate factor for the NEMA and CPS sections is smaller than the NRC values (32% vs. 46.4%, 36%, and 35.3%), the Tlag heat intensities continue to demonstrate that the NEMA-based values produce more conservative results. The reasons for this are found in Stolpe's methodology.

In his paper, Stolpe describes a general method for calculating allowable cable ampacities. By determining the amount of heat that can be dissipated from the tray and distributing that heat through all the cables in the tray, Stolpe defines a conservative upper limit for cable ampacities. The method requires that the allowable depth of fill for the tray be known at the start of the design process so that the ampacity values can be determined before cable selection and installation. At CPS the initial design consideration was to select two inches as the nominal fill depth for power tray and determine the allowable cable ampacities accordingly.

In contrast, the test method used in 94-22 will produce very specific ampacity limits but it will be based on very specific configurations. Due to the limited data available at this time concerning the orientation and distribution of the reported conductors in the test tray, it is unclear just how configuration dependent these test results are. However, given the uneven heat production of the tested conductors it seems likely that relocating the conductors within the confines of the test tray would impact the heat distribution and could affect the reported results. This could mean that in order to use the ampacity values provided by this type of testing, there would have to be tests run for every type of cable singly, in multiples, and in combination with single and multiple specimens of every other type of cable. Whether the same combinations of cables would have to be tested in various sizes and configurations of tray would be a subject for debate. Just determining the various configurations to be tested would require a significant amount of review and evaluation.

To demonstrate the conservatism of the cable selection employed, the heaviest loaded cables in area A-1A were added to the attachment two table. As shown, the present loading of the cables (120 and 25 Amps respectively) results in heat intensities lower than the lowest values shown in the right hand column. Therefore these cables will not be impacted by the concerns expressed in IEIN 94-22 and since they are acceptable, the rest of the cables in fire zone A-1A are also acceptable.

Prepared Mark McMenamin 8/10/94

Reviewed Kevin M Forrest 8-10-94

References

ICEA P-54-440 (NEMA WC 51-1986)
IEEE Transaction paper 70 TP 557 PWR *Ampacities for Cables in Randomly Filled Cable Trays* by J. Stolpe
EPRI Power Plant Elec. Ref. Series Vol.4 *Wire and Cable*
IEIN 94-22
Calc 19-G-01 R/1
Calc 19-AI-8 R/0
Calc 19-AK-6 R/0
Calc 19-AN-4 R/11
Calc 19-D-24 R/4
Calc 19-D-29 R/11
K-2982 Power Cable Purchase Spec. Proposal Data
SLICE version 7.3
Drwg E02-1RD99-001 R/M
ROC Y-104156, dated 8/10/94

94-0056

Enclosure 4
Attachment 1

FIRE ZONE A-1A POWER TRAY CABLE AMPACITIES VS. PROJECT AMPACITIES

CABLE	TYPE	PROJECT AMPACITY	LOAD AMPERES	LOAD_%_OF AMPACITY		ALLOWABLE DERATING	
1AP29B	3/C,350MCM,5KV	286	104	36%		OVER 50%	
1AP34G	2/C,19/22,600V	10	0.1	1%		OVER 50%	
1AP34H	2/C,19/22,600V	10	0.1	1%		OVER 50%	
1AP34J	2/C,19/22,600V	10	0.1	1%		OVER 50%	
1AP34N	4/C,2/0,1KV	117	2	1.70%		OVER 50%	
1AP34V	3/C,1/0,1KV	97	0.9	0.90%		OVER 50%	
1AP34W	3/C,1/0,1KV	97	1.1	1.10%		OVER 50%	
1AP36E	3/C,350MCM,1KV	269	71	26%		OVER 50%	
1DG21J	3/C,1/0,1KV	97	40	41%		OVER 50%	
1RD31B	3/C,#6,1KV	32	25	78%		SEE NOTE 1	
1RP02C	4/C,2/0,1KV	117	40/cond	34%		SEE NOTE 2	
1SX29A	3/C,19/22,1KV	16	0.1	0.60%		OVER 50%	
1VD02A	3/C,4/0,1KV	175	120	68.60%		SEE NOTE 3	
1VD10A	3/C,19/22,1KV	16	0.2	1.25%		OVER 50%	
1VD10B	3/C,19/22,1KV	16	0.2	1.25%		OVER 50%	
1VC10C	3/C,19/22,1KV	16	0.2	1.25%		OVER 50%	
1VD10D	3/C,19/22,1KV	16	0	0		OVER 50%	
1VG24A	3/C,19/22,1KV	16	0.35	2.20%		OVER 50%	
1VG26B	3/C,19/22,1KV	16	0.35	2.20%		OVER 50%	
1VG28A	3/C,19/22,1KV	16	0.35	2.20%		OVER 50%	

NOTE 1) THE PROJECT AMPACITIES ARE BASED ON A TWO INCH DEPTH OF FILL IN THE TRAYS, IN ACCORDANCE WITH THE GUIDANCE OF ICEA P-54-440. THE TRAY SECTION IN FIRE ZONE A-1A HAS LESS THAN ONE INCH OF FILL. PER TABLE 3-12 IN P-54-440 THIS WOULD ALLOW THE AMPACITY OF THIS SIZE CABLE TO BE INCREASED BY (57-37)/37, OR 54% TO 49.3 AMPERES. THEREFORE THE INSTALLED CABLE 1RD31B IS LOADED TO ONLY 50.7% OF ITS PROJECT CAPABILITY AND COULD ACCEPT UP TO A 49% DERATE WITHOUT BEING AFFECTED. ADDITIONAL CABLES CAN ONLY BE INSTALLED THROUGH THE DESIGN PROCESS WHICH WOULD INCLUDE ANALYSIS OF THE TRAY THERMAL AMPACITY PRIOR TO DESIGN APPROVAL.

NOTE 2) CABLE 1RP02C HAS ITS CONDUCTORS PARALLELED FOR THE DC FEED THAT IT CARRIES, SO EACH CONDUCTOR COULD ONLY SEE A LOAD OF 40 AMPERES. IN ADDITION THE TOTAL LOAD SHOWN IS BASED ON THE CAPACITY OF THE INVERTER RATHER THAN THE EXISTING LOAD OF 25.23 AMPS.

NOTE 3) AS STATED IN NOTE 1, THE TRAY HAS LESS THAN ONE INCH OF FILL SO PER TABLE 3-12 IN P-54-440 THE AMPACITY OF A 3/C,4/0 CABLE COULD BE INCREASED BY (229-208)/208, OR 10.1% TO 192.7 AMPERES. THEREFORE CABLE 1VD02A IS LOADED TO ONLY 62.3% OF ITS CAPABILITY AND COULD ACCEPT UP TO A 37.7% DERATE WITHOUT BEING AFFECTED. ADDITIONAL CABLES CAN ONLY BE INSTALLED THROUGH THE DESIGN PROCESS WHICH WOULD INCLUDE ANALYSIS OF THE TRAY THERMAL AMPACITY PRIOR TO DESIGN APPROVAL.

NRC CABL... ACITIES (BASED ON TESTING) VS. NEMA AND CPS AMPACITIES (BASED ON STO... METHODOLOGY) AND THE RESULTANT HEAT INTENSITIES OF EACH

Cable	Diameter	Area	90C Resist	Open Amps	Watts/ft	Ht Intensity	Tlsg Amps	Watts/ft	Ht Intensity
NRC #8	0.23	0.04154766	0.0008	23.7	0.449352	10.81533834	12.7	0.129032	3.1056382
NRC #4	0.33	0.08553006	0.0003226	37.8	0.460943784	5.389260618	24.2	0.188927464	2.208901338
NRC #2/0	0.52	0.21237216	0.0001013	113.6	1.307272448	6.155573537	73.5	0.547247925	2.576834577
NEMA #8	0.23	0.04154766	0.0008	15.3	0.187272	4.507401861	10.4	0.086528	2.082620297
NEMA #4	0.33	0.08553006	0.0003226	34	0.3729256	4.36016998	23.12	0.172440797	2.016142599
NEMA #2/0	0.52	0.21237216	0.0001013	85.3	0.920015717	4.332091914	64.8	0.425362752	2.00291202
CPS #8	0.23	0.04154766	0.0008	13.1	0.137288	3.304349752	8.9	0.063368	1.525188181
CPS #4	0.33	0.08553006	0.0003226	29.1	0.273180906	3.193975381	19.8	0.126472104	1.47868602
CPS #2/0	0.52	0.21237216	0.0001013	81.5	0.672859925	3.1683057	55.4	0.310905908	1.463967349
3C,4/0,1KV	1.838	2.653272838	0.0000655	175	6.0178125	2.268071498			
1VD02A load	1.838	2.653272838	0.0000655	120	2.8296	1.066456476			
3C/#6,1KV	0.949	0.707332025	0.000534	32	1.640448	2.319205042			
1RD31B load	0.949	0.707332025	0.000534	25	1.00125	1.415530421			

Enclosure 4
Attachment 2

94-0056

B51-1800-94(11-09)-6
8A.100
L34-94(11-09)-6
Y-104445 (Revised)
November 11, 1994

TO: Director - Licensing

FROM: J. R. Langley [signature], NSED - Director, 11/7/94 Date

SUBJECT: Proposed Amendment to CPS SAR.

SAR Sections Affected: Appendix F, subsections 3.1.1.3, 3.1.1.4.1, 4.1.1.1.1 and 4.2.2.16, and Figure 4.2.4.4-1.

Safety Evaluation or Screening Form attached: ✓ YES ___ NO

SAR Section 1.8 impacted: ___ YES ___ NO

If yes, identify Section 1.8 impact and affected sections.

Justification of Change: The safety evaluation, Log # 94-056, provides detailed justification for this USAR change. The safety evaluation concludes that the change, deletion of reference to the 1-hour fire rating of the Thermo-Lag fire wrap in fire zone A-1a protecting Division 2 safe shutdown cables, has no adverse impact on the capability of the safe shutdown systems.

RB 11/7/94

Originator: Ram P. Bhat [signature], 11/7/94

Concurrence: N/A, ___
Division of Responsibility

Supervisor: [signature], 11/7/94

Attachments: Affected SAR Pages
Safety Evaluation/Screening, LIC Log No. 94-0056
(if applicable)

cc: K. A. Leffel, V-922
M. G. McMenamin, V-928B
C. R. Smail, V-928B
B. T. Ford, V-928B
S. B. Wilson, V-928
M. E. O'Flaherty, V-928A

F118

NF-139 (4/94)

3.1.1.3 Modifications in the Fire Area

- Division 2 power and control cable trays in Fire Zone A-1a will be protected by a ~~1-hour~~ fire rated material from column 124 to column 110. Division 2 instrumentation cable tray will be protected by a ~~1-hour~~ fire rated material for 20 feet, to act as a fire break between the Division 1 and 2 safe shutdown cables.

- The entire corridor in Fire Zone A-1a will be protected by an automatic wet-pipe sprinkler system.

- An automatic wet-pipe sprinkler system from column 114 to column 124 providing for partial zone coverage will be installed in the corridor in Fire Zone A-1b.

3.1.1.4 Deviations

Engineering justification for the following deviations is found in Section 4.2 of this report.

3.1.1.4.1 Fire Barrier

- There is a nonrated opening in the floor and ceiling slabs between Fire Areas A-1 and A-3 where the slabs meet at the containment wall (see Subsection 4.2.2.1).

- There are watertight doors between Fire Areas A-1, A-2, and A-3 (see Subsection 4.2.2.4).

- There is a nonrated metal air lock between Fire Zones A-1b and A-2d (see Subsection 4.2.2.3).

- Ventilation piping that penetrates 3-hour fire rated walls and floors does not have fire dampers (see Subsection 4.2.2.9).

- Bus duct penetrations through fire-rated barriers have not been tested or labeled as 3-hour fire rated penetrations (see Subsection 4.2.2.15).

- The Thermo-Lag 330-1 cable fire wrap installed in Fire Zone A-1a is not 1-hour fire rated (see Subsection 4.2.2.16).

4.1.1.1.1 Fire Zone A-1a

- Division 2 power and control cable trays in Fire Zone A-la will be protected by a ~~1-hour~~ fire rated material from column 124 to column 110. Division 2 instrumentation cable tray will be protected by a ~~1-hour~~ fire rated material for 20 feet, to act as a fire break between the Division 1 and 2 safe shutdown cables.

4.2.2.16 Thermo-Lag 330-1 Cable Fire Wrap Not 1-hour Fire Rated

Description of Duration

The Thermo-Lag 330-1 cable fire wrap installed in fire zone A-1a is not 1-hour fire rated.

Reference

10 CFR Part 50, Appendix R, Subsection III.G.2.

Fire Zone Involved

The fire zone involved in this deviation is A-1a.

While the Appendix R requirements refer to fire areas, the CPS fire areas have been further divided into fire zones using natural boundaries. The use of fire zones is consistent with the NRC guidance provided in GL 86-10, Question and Answer Section 3.1.5. The impact of the proposed change is limited to fire zone A-1a; it does not impact the other fire zones in fire area A-1.

Description of Safe Shutdown Equipment

In the center of fire zone A-1a the original design utilized the option of 20 feet separation (III.G.2.b) between Division 1 safe shutdown cables and the unwrapped portion of the Division 2 safe shutdown cables using Thermo-Lag as a fire break. The fire break is installed over a 20-foot length of the intervening tray of non-safe shutdown Division 2 instrumentation cables for a 20-foot length in the west side. East of the fire break, the option of 1-hour fire barrier (III.G.2.c) is utilized, using Thermo-Lag to enclose the trays of Division 2 safe shutdown power and control cables. Figure 4.2.4.4-1 shows the location of Thermo-Lag in fire zone A-1a. In addition, as shown in Figure FP-2b of USAR Appendix E, an ionization fire detection and an automatic wet pipe sprinkler system are provided in the entire fire zone. This combination of options is consistent with the NRC guidance provided in GL 86-10, Question and Answer Section 3.5.1.

Engineering Justification

The Appendix R Subsection III.G.2 requirements concern the ability to achieve and maintain safe shutdown. The deviation from the requirement for a 1-hour rated fire barrier enclosing the division of safe shutdown cables in fire zone A-1a is justified on the basis that several design and programmatic fire protection features are in place at CPS to *ensure that the safe shutdown capability is maintained*. The following is an outline of the defense-in-depth features.

1. It is not credible to postulate a fire capable of affecting safe shutdown cables in fire zone A-1a due to the administrative controls and the physical design features. The administrative controls include control of ignition sources, control of combustible and flammable materials and the "No Smoking" rules. The physical design features of fire zone A-1a include substantial concrete construction of the floor, walls and ceilings providing structural separation, relatively open layout and the location of cables high in the fire zone.

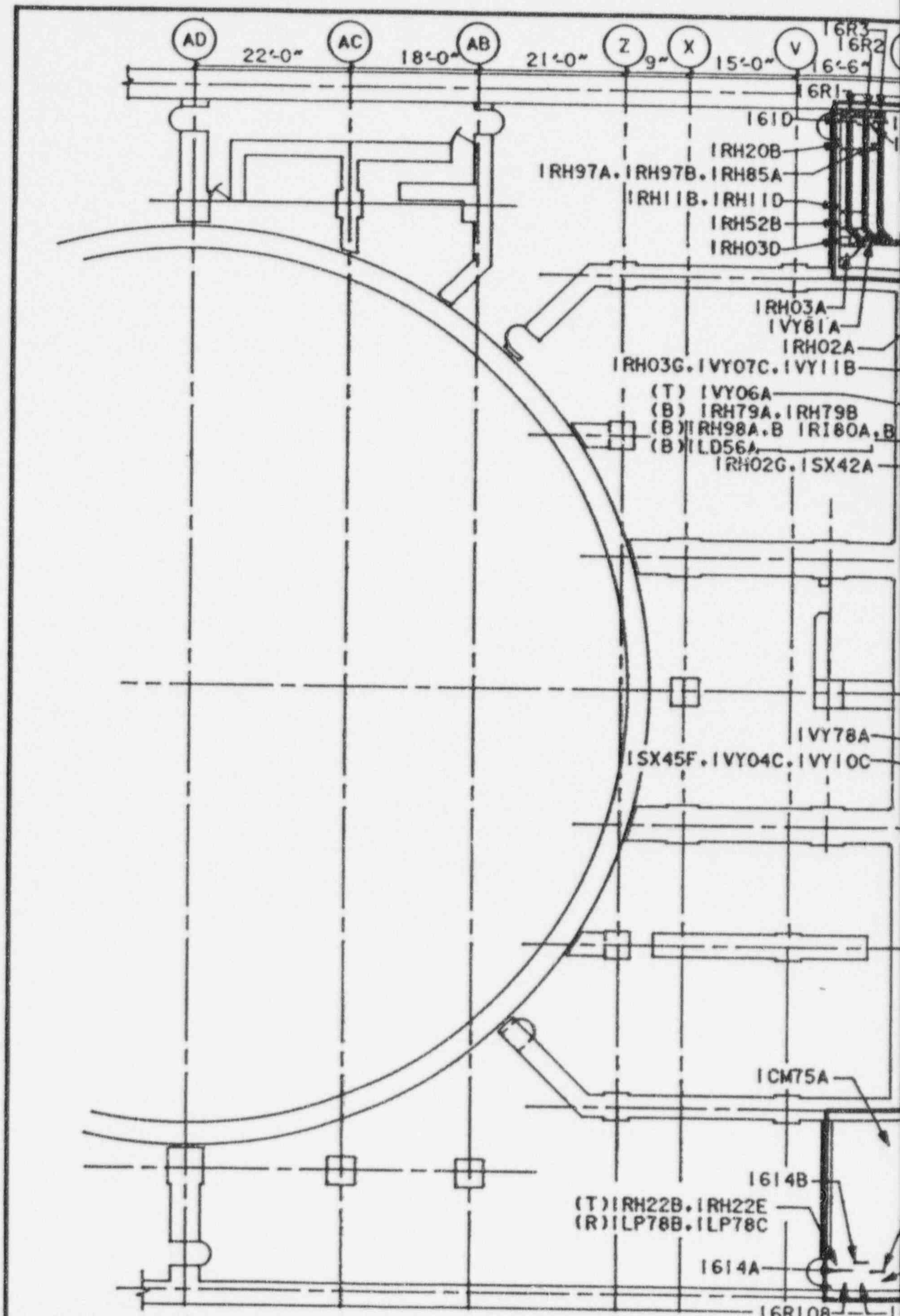
2. Fire modeling of fire zone A-1a has shown that the fixed and transient combustibles, either individually or collectively, present no credible risk of safe shutdown cable damage in fire zone A-1a.

3. In the event that a fire occurs in fire zone A-1a, it is not credible to postulate that a fire will damage both redundant divisions of safe shutdown cable trays due to the location of the cable tray stacks (high, horizontal tray runs), the 12" concrete slab between the redundant division cable trays and the presence of the wet pipe sprinkler system.

4. Even if no credit is taken for the wet pipe sprinkler system extinguishing the fire, the as-built Thermo-Lag cable wrap will protect the wrapped Division 2 safe shutdown cable trays for a duration sufficient to permit manual fire fighting by the CPS fire brigade.

5. In the event that the fire is not extinguished by both the sprinkler system or by the fire brigade, the Probabilistic Risk Assessment (PRA) evaluation did not identify any safety benefit, with regard to core damage prevention, containment isolation, containment heat removal or containment hydrogen control provided by the Thermo-Lag installed in fire zone A-1a.

6. In the unlikely event of a fire in A-1a that disables both divisions of redundant save shutdown equipment, it is reasonable to expect that operator training, Emergency Response Organization (ERO) activation, and symptom-based procedures provide a final line of defense to ensure plant safety.



S&L ECAD FILE: CLIETI.8

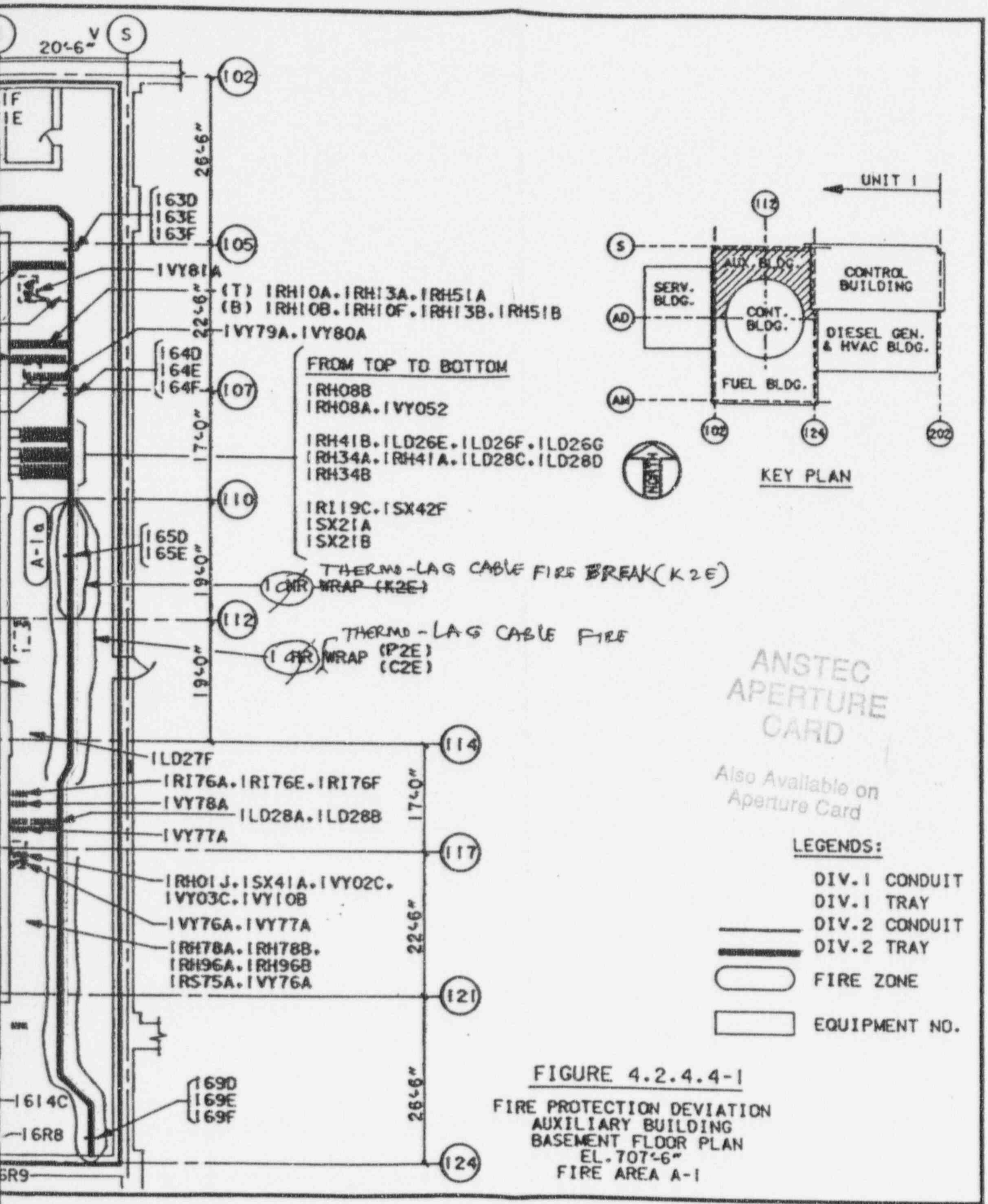


FIGURE 4.2.4.4-1

FIRE PROTECTION DEVIATION
AUXILIARY BUILDING
BASEMENT FLOOR PLAN
EL. 707'-6"
FIRE AREA A-1

9511150046-01

SAFETY EVALUATION FORM

Document Evaluated: 1.1 L&S Log # 94-0076

1.2 Number: USAR Appendix F 1.3 Revision: NA

1.4 Title: EVALUATION OF THERMO-LAG IN FIRE AREA C-2
USAR Appendix F Revision

1.5 References:
See page 6

BLOCK A - DESCRIPTION OF CHANGE

(Use additional pages if required)

A.1 Describe the basic document or system and the changes being made. Discuss how the change affects the SAR description. Discuss the reason for change.

Proposed USAR Change

CPS USAR Appendix F, subsection 3.2.2.3 discusses the provision of 1-hour fire rated fire wrap material to act as a firebreak for 20 feet on the Division 2 power, control, and instrumentation cable trays in the south side of fire area C-2 above elevation 803 feet 3 inches, which is the Containment Building excluding the Drywell. The purpose of this evaluation is to accept the firebreak as-is even though the fire wrap material used in C-2, Thermo-Lag 330-1, does not provide the 1-hour rating. The proposed USAR change will delete the reference to the 1-hour rating of the material.

(Continued on page 8)

NF-002-1 (2/94)

A.2 Identify the equipment, systems and parameters that may be affected by the change:

Fire Area Affected: Fire Area C-2, Containment Building outside drywell at elevation 803 feet 3 inches (USAR Appendix F, Figures 6a and 6b; USAR Appendix F, cable tray Figure 6 and Deviation Figure 4.2.3.1.10-5).

Description of equipment and/or cables:

The fire barrier material is installed on non-safe shutdown Division 2 cable trays which intervene between redundant safe shutdown cables on the south side at elevation 803 feet. As shown in the Enclosure 1 figures, on the southeast side of fire area C-2, Division 1 safe shutdown cables for Residual Heat Removal (RHR) valves are within 6 feet of the intervening trays; on the southwest side of fire area C-2, Division 2 safe shutdown cables for SRV's, RHR valves, and suppression pool instruments are in trays that connect with the intervening trays approximately 88 feet (along the trays) from where they pass the Division 1 trays.

(Continued on page 10)

BLOCK B - RADWASTE TREATMENT SYSTEMS

B.1 The proposed activity involves a modification to a radioactive waste treatment system or the way in which it is operated as described in Chapter 11 of the SAR.

Yes ______
No __X__

B.2 Because: The proposed USAR changes affect only the fire protection and safe shutdown analyses contained in the USAR. They do not impact the radwaste system or its operation.

If B.1 is yes, complete form NF-003.

BLOCK C - TECHNICAL SPECIFICATION IMPACT

C.1 The proposed activity requires a change to any part of the Technical Specifications.

Yes ______
No __X__

C.2 Justification if "NO", Technical Specification change package identification number if "YES".

The CPS Technical Specification does not contain any operability requirements for the fire protection features , other than for containment isolation. This evaluation shows that the safe shutdown analysis is unaffected by the proposed change. This change does not impact the CPS Fire Protection Program discussed in Technical Specification 6.8.4.e.

BLOCK D - UNREVIEWED SAFETY QUESTION DETERMINATION

(Attach additional pages with the responses to the block D questions. Identify your answers to Parts I, II, III, and IV.)

Part I - Impact on equipment malfunctions evaluated as the design basis.

1. For the equipment and systems identified in A.1 and A.2, identify any failures evaluated in the SAR.
   See page 19
2. Discuss the impact of the change on the performance of the equipment and systems identified in A.1 and A.2.
   See page 19
3. Identify what new failure modes could be introduced by the change.
   See page 19
4. Identify any impact of the change on the consequences of the failures evaluated in the SAR.
   See page 19 and 20
5. Identify any impact of the change on the probabilities of the failures evaluated in the SAR.
   See page 20

94-0076

SAFETY EVALUATION FORM

BLOCK D - UNREVIEWED SAFETY QUESTION DETERMINATION

SUMMARY

Based on item 4, are the consequences of any malfunction of equipment evaluated in the SAR increased? YES ______ NO __X__

Based on item 5, is the probability of a malfunction of equipment evaluated in the SAR increased? YES ______ NO __X__

If the answer to any of the above questions is yes, the change is an unreviewed safety question.

Part II - Impact on the accidents evaluated as the design basis See page 20

1. Identify the accidents evaluated in the SAR which could be affected by the change.
2. Discuss how the change impacts the consequences of these accidents.
3. Discuss how the change impacts the probability of these accidents.

SUMMARY

Based on item 2, are the consequences of an accident evaluated in the SAR increased? YES ______ NO __X__

Based on item 3, is the probability of an accident evaluated in the SAR increased? YES ______ NO __X__

If the answer to any of the above questions is answered yes, the change is an unreviewed safety question.

Part III - Potential for Creation of a New Unanalyzed Event See page 20

1. Based on Part I, items 1 and 3, could this change initiate a new type of accident or equipment malfunction? Discuss the basis for this determination.

2. Determine if the new accident or malfunction identified above has sufficient probability or consequences to be considered in the Licensing basis. Discuss the bases for this determination.

94-0076

SAFETY EVALUATION FORM

BLOCK D - UNREVIEWED SAFETY QUESTION DETERMINATION

SUMMARY

Based on item 2, does the change create the possibility for an equipment malfunction or accident of a different type than previously evaluated in the SAR?	YES ______ NO ___X___

If the answer is yes, the change represents an unreviewed safety question.

Part IV - Impact on the Margin of Safety See page 20

1. Identify how any of the protective barriers are directly affected by the change.
2. Discuss the impact of the change on the approach to the acceptance limits for any of the protective barriers.
3. Discuss the impact of the change on the bases of the Technical Specifications.

SUMMARY

Based on item 2, is any parameter in chapter 7 of the Safety Evaluation Manual exceeded?	YES ______ NO ___X___
Based on items 2 and 3, does the change reduce the margin of safety provided for the protective barriers?	YES ______ NO ___X___

If the first of these two questions is answered yes, the change may be unsafe and requires further justification. If the first question is answered no and the second is answered yes, the change is safe to implement but is an unreviewed safety question and requires prior NRC approval.

94-0076

SAFETY EVALUATION FORM

BLOCK E - SUMMARY

Based on the evaluation in Block C and Block D, the change

_X_ is safe and is not an unreviewed safety question and requires no Technical Specification change. This change may be implemented in accordance with applicable procedures.

____ is safe but is an unreviewed safety question or requires a Technical Specification change. The change requires NRC approval, prior to implementation.

____ is unsafe and cannot be implemented.

M&OM. MCO CRS BTF KAL SEW

	printed name	signature	date
Preparer	R.P. Bhat	Ram P. Bhat	11/15/94
Director	J.R. Langley	JR Langley	11/15/94
Manager, NSED	N.A.		
Manager, L&S	R.F. Phares	J Peterson	11-16-94
FRG	K.S. Moore	Kurt S. Moore	11-17-94

EVIDENCE OF NRC APPROVAL, IF REQUIRED:

License Ammendment No. ________

printed name	signature	date
	JP 11-16-94	

The department responsible for vaulting the parent document must vault this completed form with the document evaluated.

1.5 References

1. "Clinton Power Station Updated Safety Analysis Report", Revision 6: Appendix E, Subsection 3.3.2.6 and 4.D.3.e., Figures FP-6a and FP-6b; Appendix F, Subsections 3.2.2 and 4.1.2.1, Cable Tray Figure 6, Deviation Figure 4.2.3.1.10-5, Table 4.2.3.1.10-5; Section 9.5-1.

2. "Clinton Power Station Technical Specifications", Amendment 93, Section 6.8.4.e.

3. 10CFR50 Appendix R, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979", Section III.G.

4. Generic Letter 86-10, "Implementation of Fire Protection Requirements".

5. Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers".

6. NRC Information Notice IN 94-22, "Fire Endurance and Ampacity Derating Test Results of 3-hour Fire Rated Thermo-Lag 330-1 Fire Barriers.

7. CPS Operating License, License Condition 2-F.

8. NSED Calculation IP-M-0177, "Fire Loads for CPS Fire Zones", Rev. 3.

9. EPED Calculation 19-AI-8, "Derating for 3-hour TSI Tray Wrap", Rev. 6.

10. NSED Standard ME-08.00, "Thermo-Lag Combustibility Evaluation Methodology Plant Screening Guide", Rev. 0.

11. NSED Standard ME-09.00, "NEI Application Guide for Evaluation of Thermo-Lag Fire Barrier Systems", Rev. 1.

12. Condition Report 1-92-07-024, "NRC Bulletin 92-01; Indeterminate Fire Rating of Thermo-Lag", Rev. 0.

13. CPS Procedure 1001.06, "CPS Fire Brigade", Rev. 4.

14. CPS Procedure 1893.02, "Fire Prevention - Control of Ignition Source", Rev. 5.

15. CPS Procedure 1893.03, "Control of Flammable and Combustible Liquids and Combustible Material", Rev. 7.

16. CPS Procedure 1893.04, "Fire Fighting", Rev. 6.

94-0076

SAFETY EVALUATION FORM

1.5 References (Continued)

17. CPS Procedure 1893-04M240, "803' Containment Pre-fire Plan", Rev. 3.

18. CPS Procedure 4200.01, "Loss of A.C. Power", Rev. 8.

19. Illinois Power Policy Memorandum PN 1.05, "No Smoking Rules, Enforcement of", Rev. 0

20. CPS Procedure 1019.01, "Housekeeping." Rev. 10

21. EPED Calculation 19-G-31, "Ampacity of Control Cables in Completely Filled Trays", Rev. 0

22. CPS Procedure 1019.04, "Control of Transient Equipment/Material and Foreign Material Exclusion Areas (FMEA's)", Rev. 4

23. EPRI Final Report TR-100370, dated April 1992 (including Revision 1), "Fire Induced Vulnerability Fvaluation (FIVE)."

24. S&L Electrical Drawings:

E27-1004-02A-CP	Rev. E
E27-1004-03A-CP	Rev. L
E27-1004-02A-EI	Rev. AK
E27-1004-03A-EI	Rev. AN

25. Pyrotronics Drawing PC-5678 Sheets 1-16

26. NFPA Fire Protection Handbook, 17th. Ed., "Firestopping", pp. 6-87 and 6-88.

94-0076

BLOCK A.1 (Continued)

Reason for Thermo-Lag in Fire Area C-2

The Thermo-Lag 330-1 cable fire wrap in fire area C-2 was installed to eliminate the "intervening combustible" within the 50 feet horizontal distance[1] separating the Division 1 and Division 2 safe shutdown cables.

Appendix R Requirement

Appendix R subsections III.G.2.a, III.G.2.b, and III.G.2.c address specific requirements for the protection of safe shutdown capability in the event of a fire. Appendix R requires compliance with one of the three alternatives outlined by the three subsections.

Appendix R, III.G.2.a requires:

> the separation of cable and equipment and associated non-safety circuits of redundant trains by a fire barrier having a 3-hour rating.

Appendix R, III.G.2.b requires:

1. 20 feet of separation, with no intervening combustibles, between redundant cables, equipment and associated non-safety circuits,
2. fire detectors and
3. automatic fire suppression system.

Appendix R, III.G.2.c requires:

1. enclosure of the component of one redundant train in a fire barrier having a 1-hour rating,
2. fire detectors and
3. automatic fire suppression system

[1]The fire protection industry has recognized 50 feet of horizontal separation with no intervening combustibles as providing equivalent protection to a 3-hour rated fire barrier. The two options are listed as equivalent in the NRC's BTP APCSB 9.5-1., Appendix A, Section F.10.

94-0076

SAFETY EVALUATION FORM

CPS Compliance with Appendix R in Fire Area C-2

Safe shutdown cables and equipment located in fire area C-2 belong to all methods of safe shutdown, and have been previously evaluated in the Safe Shutdown Analysis. For fire area C-2, the Appendix R option of separating redundant cables or equipment by 3-hour fire barriers (III.G.2.a) was selected to protect safe shutdown ability. As an equivalent measure of protection[1], the CPS design incorporates a horizontal distance of 50 feet with no intervening combustibles in lieu of 3-hour fire barriers as discussed in the Safe Shutdown Analysis. In fire area C-2, Division 1 and Division 2 safe shutdown cables and equipment are separated by a horizontal distance of at least 60 feet, and with the exception of the south end at elevation 803 feet, there are no intervening combustibles.

Above floor elevation 803 feet, Division 2 cable trays are routed within 6 feet of Division 1 trays. The Division 1 trays contain Division 1 safe shutdown cables 1RH61C and 1RH61D. At that point, however, there are no Division 2 safe shutdown cables. Division 2 safe shutdown cables enter the Division 2 trays at a point where the separation from the Division 1 trays is 80 feet. The concern here is that a fire in the Division 1 trays could spread to the Division 2 trays and then propagate along the Division 2 trays and damage Division 2 safe shutdown cables.

As discussed in Generic Letter 86-10, Paragraph F, a deviation from a commitment made in the FSAR is governed by the provisions of 10CFR50.59. The CPS Operating License Condition 2-F states, "IP may make changes to the approved fire protection program without prior approval of the commission only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire."

This Thermo-Lag safety evaluation is consistent with Generic Letter 86-10 guidance, the CPS fire protection licensing condition, and with the CPS process for revising the fire protection programs elements contained in the USAR.

[1] The fire protection industry has recognized 50 feet of horizontal separation with no intervening combustibles as providing equivalent protection to a 3-hour rated fire barrier. The two options are listed as equivalent in the NRC's BTP APCSB 9.5-1., Appendix A, Section F.10.

94-0076

BLOCK A.2 (Continued)

Summary of Justification for USAR Change

The Appendix R Subsection III.G requirements concern the ability to achieve and maintain safe shutdown. The deletion of the requirement that the fire break on Division 2 cable trays at elevation 803 feet of fire area C-2 be 1-hour fire rated material is justified on the basis that several design and programmatic fire protection features are in place at CPS to *ensure that the safe shutdown capability is maintained.* The following is an outline of the defense-in-depth features.

Note: More detailed discussion of each of these features is provided later in this Section of the Safety Evaluation.

1. It is not credible to postulate initiation of a fire capable of affecting safe shutdown cables in fire area C-2 due to the administrative controls and the physical design of fire area C-2.

2. In the event that a fire in C-2 does develop, the ignition resistance of the cables as well as the presence of the as-built Thermo-Lag fire break will prevent fire spread along the cable trays.

3. In the event that a fire occurs in fire area C-2, the as-built Thermo-Lag fire break would prevent damage to both the redundant divisions of safe shutdown cable trays and the CPS Fire Protection Program would ensure effective manual fire suppression by the CPS fire brigade.

4. In the event that the fire is not extinguished by the fire brigade, the Probabilistic Risk Assessment (PRA) evaluation did not identify any safety benefit with regard to core damage prevention, containment isolation, containment heat removal, or containment hydrogen control provided by the Thermo-Lag installed in fire area C-2.

5. In the unlikely event of a fire in C-2 that disables both divisions of redundant safe shutdown equipment, it is reasonable to expect that operator training, Emergency Response Organization (ERO) activation, and symptom-based procedures provide a final line of defense to ensure plant safety.

Detailed Justification for Deviation

1. Administrative Controls and Physical Layout

Several CPS administrative control currently in place and the layout of this fire area minimize the potential for fire initiation in fire area C-2.

(a) Administrative Controls

- CPS procedure 1893.02, "Fire Protection - Control of Ignition Sources", establishes controls for hot work including welding, grinding, flame cutting, brazing and soldering operations. This procedure requires precautions to be taken (such as removing or protecting nearby combustibles and posting of a fire watch) prior to the start of hot work in order to minimize the potential for fire ignition.

- CPS procedure 1893.03, "Control of Flammable and Combustible Liquids and Combustible Material", governs the handling and limitation of the use of combustible solids and liquids and flammable liquids. This procedure limits the quantities of transient materials that can be introduced into the plant and prescribes area clean-up, adequate ventilation, access for fire protection equipment, etc., in order to minimize the potential for fire initiation and extent of fire propagation.

- CPS procedure 1019.04, "Control of Transient Equipment/Material and Foreign Material Exclusion Areas (FMEA's) "designates Containment elevation 803 feet as a FMEA, where storage of material, equipment, and tools is prohibited during power operation." CPS 1019.04 also requires that such items are inventoried prior to bringing them into Containment so that their prompt removal is assured.

- Illinois Power enforces a no smoking policy within the company buildings as outlined in Policy Memorandum PM1.05, "No Smoking Rules, Enforcement of"; noncompliance with this policy results in disciplinary action up to and including termination. Additionally, smoking is prohibited in this fire area by CPS procedure 1019.01, "Housekeeping".

(b) Physical Layout

- The floor of fire area C-2 is a 9-feet 8-inch concrete slab on grade, covered by 19 feet of water, and is not fire rated. The inner and outer annular walls of C-2 are 36-inch minimum concrete with minimum 1-inch steel liner plates and are 3-hour fire rated. The intermediate floors within C-2 are 12-inch minimum concrete or 1-1/2-inch steel grating supported

1. **Administrative Controls (Continued)**

by steel beams, and are not fire-rated. The walls above elevation 803 feet and the domed ceiling are 30-inch minimum concrete and are not fire-rated. This construction provides substantial structural separation for this fire area from the adjacent fire areas.

- Fire area C-2 is a relatively open area, providing access from the upper containment pools to lower elevations and contains relatively few pieces of equipment which can be sources of ignition.

- As shown in Enclosure 1, the south end of fire area C-2 is essentially open from the concrete slab at elevation 793 feet 6 inches to the domed ceiling at elevation 927 feet. Fire or heat from a fire that originates from below the wrapped trays at elevation 816 feet 6 inches would pass through the steel gratings at elevations 803 feet 3 inches and 828 feet 3 inches and then collect under the domed ceiling. In order for a hot gas layer to descend to the cable trays, the substantial open volume under the domed ceiling would have to be filled, which is not a credible scenario.

- Since the cable trays are all located high in this fire area (minimum 103 feet above the floor and minimum 13 feet above the grating) and all vertical cable trays are sealed with a 3-hour fire stop material where they pass through concrete or grating floors, the potential for a fire originating at the floor or on the grating and affecting the safe shutdown cables is minimal.

With these administrative controls and the physical layout of this fire area, it is not credible to postulate a fire capable of affecting safe shutdown cables in fire area C-2.

2. **Thermo-Lag Performance as a Fire Break**

NRC's Generic Letter 92-08 identified concerns related to the fire endurance capability of Thermo-Lag 330-1 material and the evaluation and application of fire tests to determine the fire endurance ratings of Thermo-Lag 330-1 fire barriers. Condition Report 1-92-07-024 documents the concerns identified by NRC Bulletin 92-01 with regard to the indeterminate fire rating of Thermo-Lag fire barriers.

Three cable trays in fire area C-2 are wrapped with Thermo-Lag 330-1 fire barrier material. The fire wraps on all three trays were intended to be a fire break to prevent fire from originating at one Division of safe shutdown trays and using the intervening Division 2 non-safe shutdown trays to propagate to the other Division of safe shutdown trays. As shown in Enclosure 1, the fire break provides 20 feet

2. Thermo-Lag Performance as a Fire Break (Continued)

of "intervening combustible free" separation between the Division 1 safe shutdown trays and the Division 2 safe shutdown trays.

The Thermo-Lag 330-1 material on the trays in C-2 was not intended to be a fire barrier. Fire barriers are qualified per ASTM E-119, using the standard time-temperature curve, and the acceptance criteria is a limited temperature rise on the non-fire side of the barrier in order to protect a cable or piece of equipment from fire damage. The Thermo-Lag 330-1 was intended to be a fire break to provide a space devoid of any combustible and of sufficient width so that flames cannot jump across the space (similar to brush clearings used to fight forest fires). The acceptance criteria for a satisfactory fire break is only that it effectively prevent the spread of fire.

The continuity of potential combustibles around Containment at elevation 803-feet 3-inches (from the east to the west sides) in the form of the three non-safe shutdown cable trays was the basis for providing the fire break. All of the cables in the three intervening non-safe shutdown trays are IEEE-383 qualified, either as EPR-Hypalon jacket and insulation or as Tefzel-Tefzel. Fire tests by Sandia Labs as referenced in the EPRI Report TR-100370 concluded that IEEE-383 qualified cables will not propagate fire when installed in a horizontal cable tray; rather, the cables gradually self-extinguish after the external ignition source is removed or consumed. Therefore, the intervening non-safe shutdown cable trays will not propagate fire from one side of Containment to the other.

Thermo-Lag 330-1 was selected for the firebreak material because it had been installed in other locations as a fire barrier material; the 1-hour rated design was chosen for fire area C-2 because it was the minimum design available. Per the test results referenced in NSED Standard ME-08.00, Thermo-Lag may or may not be considered combustible, depending on whether or not 1) there exists a large enough fire load (including all combustibles) to overcome its thermal inertia, or 2) there exists a significantly close fire source to impart a high sustained heat flux to the Thermo-Lag. Fireloads in Containment are analyzed separately by elevation, and at 803-feet 3-inches the calculated equivalent fire severity is 16 minutes per NSED Calculation IP-M-0177, Rev. 3. It is noted that approximately 78% of the fireload is due to cable insulation and 10% is due to the Thermo-Lag itself, both of which have high (greater than 900°F) ignition temperatures. The Thermo-Lag cannot be ignited from existing hazards in the area, due to its high required ignition temperature and the large spatial distances from potential ignition sources. Neither of the above two conditions 1) and 2) are satisfied, and the Thermo-Lag in fire area C-2 is considered as non-combustible. The ASTM E-119 fire endurance rating (1-hour) as originally required is not applicable to the fire break function, and can therefore be deleted.

2. **Thermo-Lag Performance as a Fire Break (Continued)**

Appendix A section D.3.e of NRC's BTP APCSB 9.5-1 requires that:

> "Fire breaks should be provided as deemed necessary by the fire hazards analysis. Flame or flame retardant coatings may be used as a fire break for grouped electrical cables to limit spread of fire in cable ventings."

In USAR Appendix E section 4.D.3.e, CPS committed to compliance with the BTP:

> "Fire breaks are provided as required by the Fire Protection Evaluation Report and the Safe Shutdown Analysis."

This commitment is not affected by this USAR change.

In summary, the intervening non-safe shutdown cable trays will not propagate fire from one side of Containment to the other, and even if the cable trays were to ignite, the Thermo-Lag would perform its intended firebreak function.

3. **Manual Fire Suppression**

A fire in fire area C-2 would likely be identified by Operations, Security, or Radiation Protection personnel, all of whom regularly enter Containment. In the event of a fire in fire area C-2 that involves any of the safety-related trays at this elevation, the main control room will receive annunciation from the in-tray linear thermal detection system. Manual fire fighting by the fire brigade is facilitated by the location of multiple hose stations and portable extinguishers in this fire area. Access to the cable trays is good for manual suppression, in fact, hose streams can be directed onto the trays from above through the floor gratings at elevation 828 feet 3 inches.

The CPS fire brigade is available and on-site at all times, with the Shift Supervisor having the Commander of the Fire Brigade designation. The fire brigade composition, function and fire fighting guidance are provided in CPS procedures 1001.06, "CPS Fire Brigade", 1893.04, "Fire Fighting" and the 1893.04M240 which provides the detailed pre-fire plan for this elevation of fire area C-2.

CPS fire drills record the time from the Gaitronics announcement of a fire to when the fire brigade is ready to start fire fighting at the scene. Fire drills conducted in this fire area have shown this time to be less than 18 minutes.

In summary, in the event of a fire in fire area C-2, the as-built Thermo-Lag fire break would prevent fire from involving both Divisions of safe shutdown cable

3. Manual Fire Suppression (Continued)

trays and the CPS Fire Protection program would ensure effective manual fire fighting by the CPS fire brigade.

4. Thermo-Lag Safety Benefit

The Probabilistic Risk Assessment (PRA) evaluation which analyzes the safety significance of potential Thermo-Lag fire barrier failure in fire area C-2 is included as Enclosure 3 of this safety evaluation. This analysis consists of three major parts.

- The first part of the analysis is to identify all modeled components that could be affected by a fire in area C-2 and the basic events in the IPE model that represent these components. This list of components contains not only the equipment located within the fire area but also the equipment located outside this fire area that are affected by damage to cables in this fire area. This part also identifies the basic events (equipment failures) in the IPE model that are protected by Thermo-Lag. Part 1 is described in attachments PRA-1 and PRA-4 of Enclosure 3.

- The second part of the analysis involves calculating the conditional core damage probability (CCDP) for two different situations using the basic events list from Part 1 as an input. The first situation is Thermo-Lag failing to perform adequately as a fire barrier. This is the postulated "worst case" in which a fire occurs and all cables and equipment in the fire zone are damaged. The second situation is Thermo-Lag performing its intended fire break function in which all cables not wrapped by Thermo-Lag are damaged by a postulated fire. Attachments PRA-2 and PRA-5 of Enclosure 3 describe the CCDP determination.

  While preventing core damage is an important consideration for plant safety, maintaining containment integrity by protecting containment isolation and heat removal capabilities is also a concern. Additionally, containment analysis in the IPE report identified the loss of containment hydrogen control as a major cause of containment failure. Correspondingly, the effect of a fire in area C-2 on these functions was also examined. This analysis is detailed in attachments PRA-2 and PRA-5 of Enclosure 3.

- The third part of the analysis is to determine the fire ignition frequency in area C-2. This calculation utilizes the methodology described in the Fire-Induced Vulnerability Evaluation (FIVE) Guide, EPRI TR-100370 and the Fire Risk Analysis Implementation Guide, EPRI Project 3385-01. Ignition frequency calculation is described on attachments PRA-3 and PRA-6 of Enclosure 3.

4. **Thermo-Lag Safety Benefit (Continued)**

The results of this analysis showed that the CCDP calculated for each of the two situations (Thermo-Lag failing and Thermo-Lag performing its design function) was identical. Additionally no benefit from Thermo-Lag was found to exist for containment isolation, containment heat removal or containment hydrogen control.

In summary, no safety benefit was identified with regard to core damage prevention, containment isolation, containment heat removal or containment hydrogen control as being provided by the Thermo-Lag installed in fire area C-2.

5. **Operator Response to Fires Affecting Safe Shutdown Equipment**

While it is not possible to predict exactly what equipment will be lost or impaired due to any given fire, it is possible to assume "worst-case" for an area of the plant involved in a fire. For the areas involving safe shutdown equipment, the issue becomes knowing what is left for the operator to use for any given fire. The operator is trained to control plant parameters per the Emergency Operating Procedures (EOP's) independent of the cause of the off-normal/emergency conditions. That is, the EOP's are symptom-based and not event-based. In this sense, equipment loss due to multiple failure, sabotage, seismic event, etc., is not different from equipment loss due to fire. The operators are given a list of systems to use, not necessarily in a preferential order (what is used is based on what will work).

The operating crews receive intense, continuing training on the EOP's with multiple equipment failures and on loss of power events. Procedural guidance exists in CPS Procedure 4200.01, "Loss of AC Power" for a Station Black Out (SBO). These steps guide the operator actions to minimize the impact on plant equipment while preserving the equipment that is left. For fires that affect systems to an extent less than an SBO, portions of the Loss of AC Power procedure will apply. CPS crews have demonstrated the ability to implement these procedures while maintaining the reactor in a safe condition. A fire in the plant, concurrent with a loss of off-site power, which disabled RCIC, Division 1 and 2 instrument power, and all Division 1 and 2 ECCS equipment was simulated on the CPS simulator. Operator actions resulted in achieving hot shutdown and maintaining stable reactor parameters. It is unlikely that a fire in C-2 would affect the availability of off-site power, totally disable Division 1 or 2 ECCS, or totally disable Division 1 or 2 instrumentation.

During any scenario the operating crew will be monitoring Containment temperature and pressure. If the bulk Containment temperature increases to 122 F, the operators will begin following the EOP's (if they are not already doing so). If the fire were to continue such that the Containment pressure increases to 2.2 psig (corresponding to approximately 160 F bulk temperature), the EOP's would require

5. Operator Response to Fires Affecting Safe Shutdown Equipment (Continued)

manual initiation of the Containment spray mode of the RHR system, which would pump a considerable quantity of water from the suppression pool into the Containment atmosphere through a deluge sparger under the dome ceiling. This mode of the RHR system can be accomplished using either the Division 1 RHR pump, valves, and sparger or the Division 2 RHR pump, valves, and sparger. The cables for the Division 1 and 2 RHR valves are on opposite sides of Containment, and therefore one Division of Containment spray would likely be available during the fire.

Emergency Plan Procedure EC-02 directs activation of the Emergency Response Organization (ERO) during any significant plant fire. While minimum shift manning will allow for successfully achieving hot shutdown conditions, the additional resources provided by the ERO will be valuable in minimizing the impact of the fire on the plant and assisting with recovery and repairs.

In summary, in the event of a fire in C-2 that disables both divisions of redundant safe shutdown equipment, it is reasonable to expect that operator training, ERO activation and symptom-based procedures will provide the final line of defense to ensure plant safety.

Evaluation of Ampacity Derating Impact of Thermo-Lag

The ampacity derating factors for cables in raceway wrapped by Thermo-Lag has become a concern due to questions raised in Generic Letter 92-08. The NRC questions are related to the original Thermo-Lag manufacturer's recommended ampacity derating factors as well as the wide range of ampacity derating factors applied across the industry. In Information Notice (IN) 94-22, the NRC provided some preliminary information about the results of tests the NRC had conducted to establish ampacity derating factors for cables in conduits and trays wrapped by Thermo-Lag 330-1 fire barrier material.

Ampacity limits are placed on cables to ensure that the cables will operate within their design parameters and are unrelated to a fire scenario. Without limitations, the current carried by a cable could generate too much heat and result in the cable operating at a temperature above its design rating, thus causing a reduction in the cable's design life. The cables utilized at CPS are rated for 90 C operation and the ampacity limits selected were based on that value. Since different installation configurations (such as covered trays, or fire stops) can limit the dissipation of the heat generated by the current passing through the cable, derating factors were developed to further restrict the current which the cable will be allowed to carry when these configurations are part of the cable routing.

The CPS design defined the boundary between power, control, and instrumentation circuits based on both voltage and current levels. Separate raceways are provided for the different cables so that instrument cables are isolated from noise that could be generated

94-0076

SAFETY EVALUATION FORM

Evaluation of Ampacity Derating Impact of Thermo-Lag (Continued)

by the power and control cables and so that control cables are separated from the heat and induced voltage that could be generated by the power cables. As shown by EPED Calculation 19-G-31, Rev. 0, the currents passing through control and instrumentation cables do not generate sufficient heat to challenge the cable design ratings.

Enclosure 4 identifies the CPS power cables protected by Thermo-Lag 330-1 fire barrier material and the available ampacity margin for each cable in fire area C-2. A review of this data indicates that the power cables wrapped by Thermo-Lag 330-1 in fire area C-2 could be derated by as much as 50% or more without impacting their design functions or design life. The highest ampacity derating identified in IN 94-22 is 46.4% for a #8 AWG conductor in a tray wrapped by a 3-hour rated Thermo-Lag 330-1 fire barrier. The Enclosure 4 ampacity evaluation concludes that the NRC ampacity derating concerns expressed in IN 94-22 will not have adverse impact on the two most heavily loaded power cables (48.8 and 7.2 amps respectively) in fire area C-2. This conclusion was reached upon comparing conservatism chosen in the CPS design ampacity limits with the derating methodology used by the NRC in IN 94-22. Since the two most heavily loaded cables will not be impacted by the concerns expressed in NRC's IN 94-22, the rest of the cables in fire area C-2 are also acceptable from the ampacity derating view point.

Currently, there exist no conclusive ampacity derating factors for cables wrapped by Thermo-Lag 330-1 fire barriers due to the many outstanding issues with regard to past tests and test results. However, as discussed above, the Thermo-Lag cable tray fire wrap in fire area C-2 does not adversely impact the current-carrying capability of the cables.

94-0076

SAFETY EVALUATION FORM

BLOCK D, Part I

1. Failures associated with a design-basis fire in fire area C-2 are discussed in USAR Appendix F, Fire Protection Safe Shutdown Analysis (SSA), Subsection 3.2.2.

   Currently, Subsection 3.2.2.2 states "Although Division 1 and 2 shutdown cables and equipment occupy the same fire area, the divisions are separated by a distance of at least 60 feet, and with the exception of the south end at elevation 803 feet, there are no intervening combustibles between the Division 1 and 2 systems. Above floor elevation 803 feet, Division 2 cable trays are routed within 6 feet of Division 1 trays. The Division 1 trays contain Division 1 safe shutdown cables 1RH61C and 1RH61D. At that point, however, there are no Division 2 safe shutdown cables. Division 2 safe shutdown cables enter the Division 2 trays at a point where the separation from the Division 1 trays is 80 feet. The concern here is a fire in the Division 1 trays spreading to the Division 2 trays and then propagating down the tray and damaging Division 2 safe shutdown cable. This will be prevented by placing a firebreak in the Division 2 trays (see Subsections 3.2.2.3)."

   Currently, Subsection 3.2.2.3 states "A fire break, consisting of a 1-hour fire-rated material for 20 feet and sealed at each end, will be added to the three Division 2 Class 1E cable trays that are routed around the south end of the containment building above elevation 803 feet."

   Currently, Subsection 4.1.2.1 states "A fire break, consisting of a 1-hour fire-rated material for 20 feet and sealed at each end, will be added to the three Division 2 Class 1E cable trays that are routed around the south end of the containment building above elevation 803 feet."

   These Subsections 3.2.2.3 and 4.1.2.1 are proposed to be revised to eliminate the reference to the 1-hour fire rating of Thermo-Lag. The justification for this change is provided in detail under the Block A.2 discussions.

2. For the reasons provided in the Block A.2 discussion, the performance of the safe shutdown systems in fire area C-2 is not adversely impacted by the Thermo-Lag fire rating being changed from 1-hour to no specific rating.

3. Even though the Thermo-Lag fire rating is now considered to be less than 1-hour and the reference to the rating is deleted, this reduced capability of the Thermo-Lag fire wrap does not cause any new failure modes. The justification for the reduced capability being acceptable is provided in the Block A.2 discussion.

4. The USAR Appendix F, Safe Shutdown Analysis, documents the capability of the CPS safe shutdown systems to achieve and maintain cold shutdown condition in the event of a single fire anywhere in the plant with a lost of off-site power. As explained by the

SAFETY EVALUATION FORM

BLOCK D, Part I (Continued)

Block A.2 discussion, it is not credible to postulate a fire scenario capable of adversely affecting the safe shutdown capability in fire area C-2 despite the reduced Thermo-Lag capability.

5. The probability of the failures evaluated in the USAR is not impacted as discussed in the Block A.2 discussion.

BLOCK D, Part II

1,2, and 3. The accidents identified in the USAR are not affected by the proposed change to the Thermo-lag fire break rating in fire area C-2. As explained in the Block A.2 discussion, the plant safe shutdown capability in the event of a fire in C-2 is not adversely impacted. Likewise, the consequences or the probability of a fire in C-2 is not impacted.

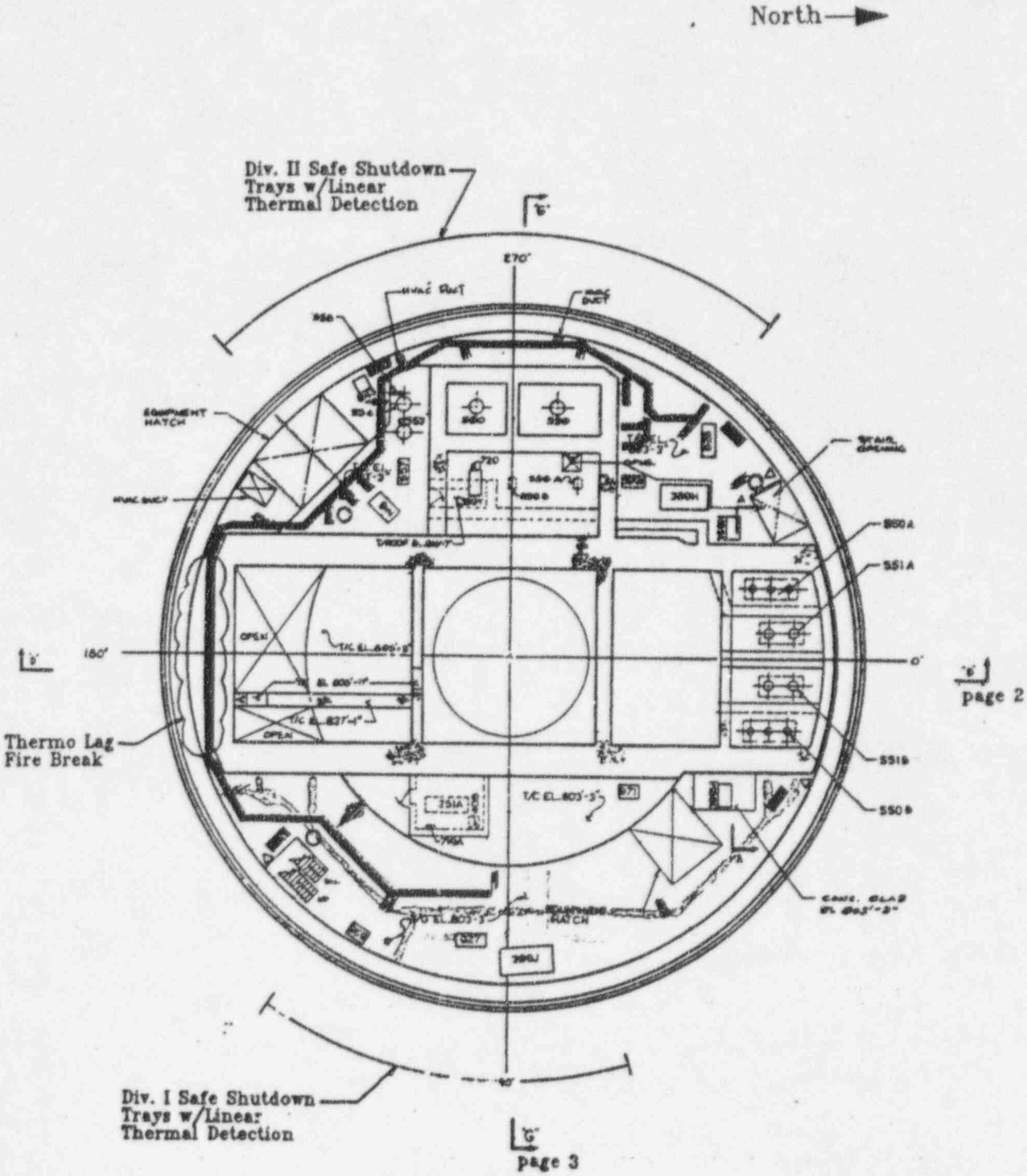
BLOCK D, Part III

1 and 2. As explained in the Block A.2 discussion, the Thermo-Lag combustibility and ampacity derating concerns were evaluated and found to have no impact on fire area C-2 safe shutdown capability. No new type of accident or equipment malfunction has been created.

BLOCK D, Part IV

1 and 2. None of the protective barriers, the approach to the acceptance limits for any of the protective barriers, or the margin of safety is directly affected by this change. The safe shutdown capability in fire area C-2 has been determined to be acceptable after the impact of the change was evaluated as explained in the Block A.2 discussion.

3. The CPS Fire Protection Program as stated in Tech. Spec. 6.8.4.e is unchanged. The bases of the Technical Specifications is not affected by this change.

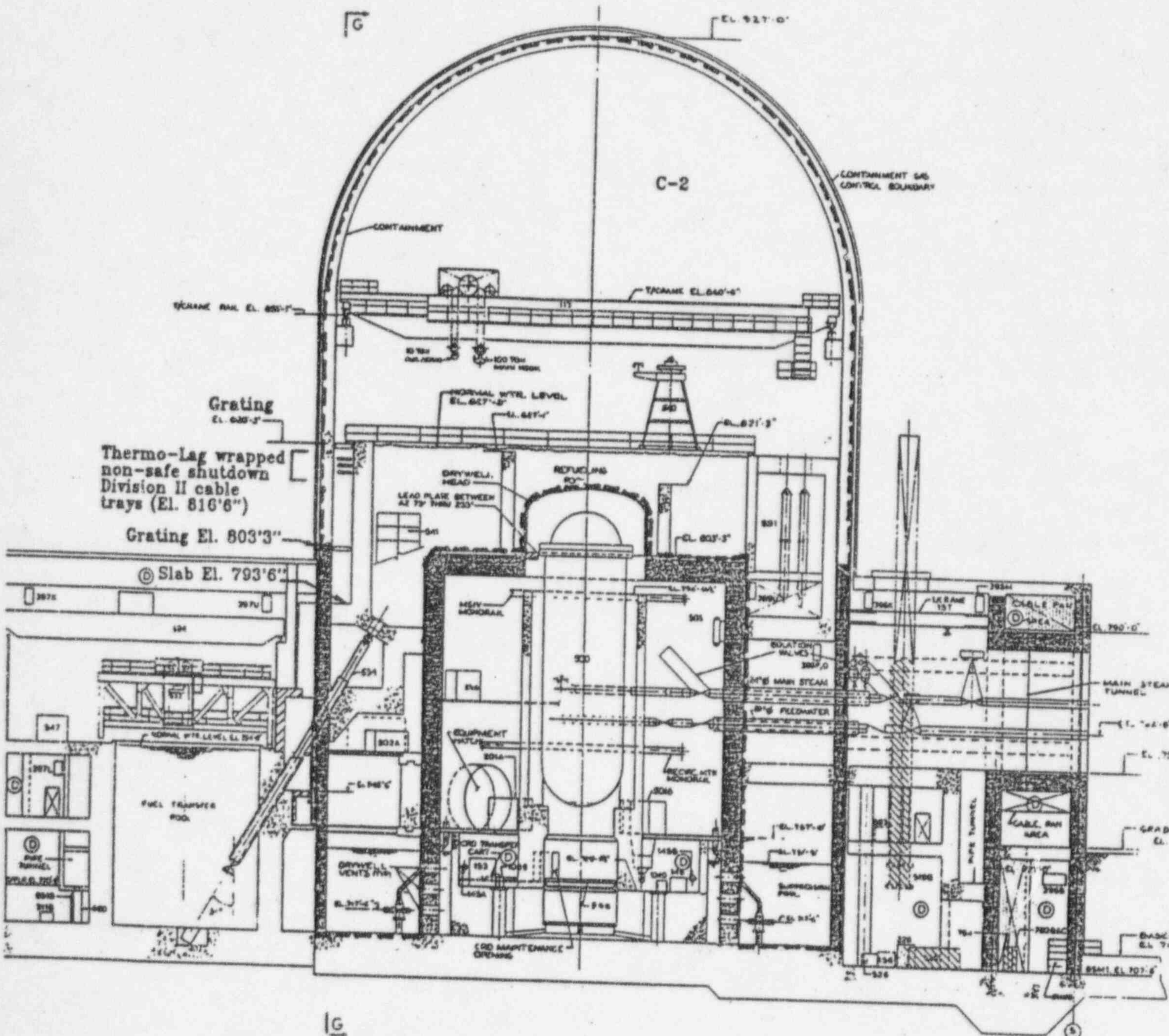


O Fire Extinguishers (3)
▬ Hose Stations (4)

Plan View of Fire Area C-2

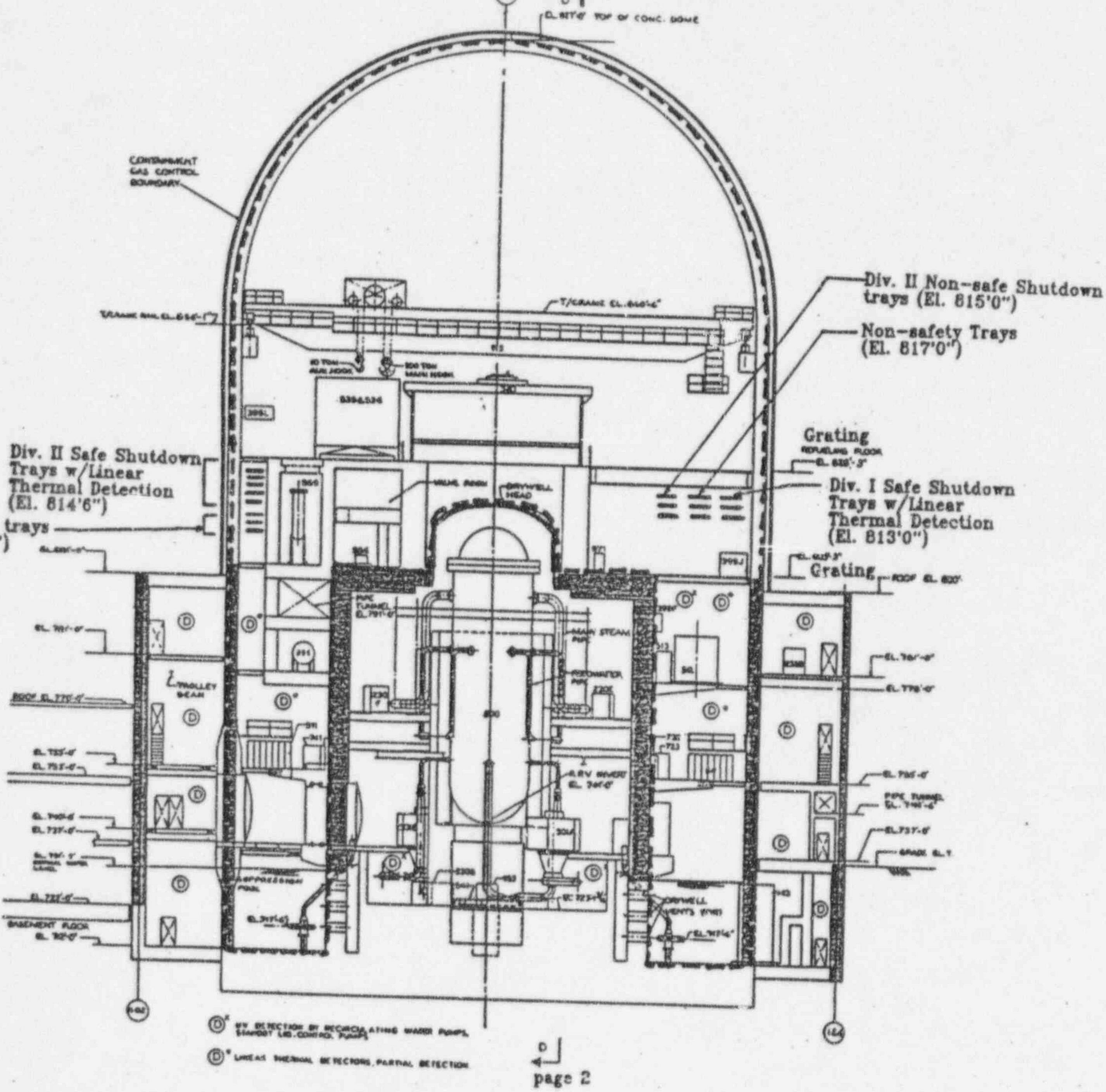
Containment Plan

Elevation 803 feet 3 inches



Containment

Section D-D



--- C-2 Boundary

Containment

Section G–G

Division II Safe-Shutdown Cables Protected by Thermo-Lag in Fire Zone C-2

Raceway	Cable Number	FIREZ. C-2	Cable Function
	NONE	X	

94-0076

PRA EVALUATION OF SAFETY SIGNIFICANCE OF POTENTIAL THERMOLAG FIRE BARRIER FAILURE IN FIRE ZONE C-2

This evaluation is intended for use as supporting documentation in the safety analysis of Thermo-Lag 330-1 cable wrap material in fire zone C-2. This study used the IPE model and fire PRA databases as they stood on 10/20/94 as inputs. Subsequent changes to the IPE model and/or fire PRA databases could significantly affect the results of this evaluation. Careful attention to the method used in this evaluation is important in the correct interpretation and application of the final results. Use of the material presented here in any other context could be inappropriate and potentially misleading or erroneous.

METHOD

This analysis is composed of three major parts. The first part of the analysis is to identify all modeled components that could be affected by a fire in zone C-2 (Containment Building, all elevations) and the basic events in the IPE model that represent these components. This list of components contains not only the equipment itself, but also any cables required for a piece of equipment to perform its modeled function. This part also includes identifying the basic events in the CPS model that are protected by Thermolag. Part 1 is described in attachments PRA-1 and PRA-4.

Using the basic events list from part 1 as an input, the second part of the analysis involves calculating the conditional core damage probability (CCDP) for two different situations. The first situation is the case in which a fire occurs and all cables and equipment in a fire zone are damaged. This situation models Thermolag failing to perform adequately as a fire barrier. The second situation is the case in which only cables not wrapped by Thermolag are damaged by a postulated fire. This situation models Thermolag performing per design. Attachments PRA-2 and PRA-5 describe the CCDP determination.

While core damage prevention is an important consideration for plant safety, it is not Thermolag's sole intended function. Maintaining containment integrity by protecting containment isolation and heat removal capabilities is also required by 10CFR50, Appendix R. Additionally, containment analysis in the IPE report identified the loss of containment hydrogen control as a major cause of containment failure. Correspondingly, the effect of a fire in zone C-2 on these functions was also examined. This analysis is detailed in attachments PRA-2 and PRA-5.

The third part of the analysis would normally be to determine the fire ignition frequency in zone C-2. This calculation would utilize the methodology described in the Fire-Induced

Vulnerability Evaluation (FIVE) Guide, EPRI TR-100370 and the Fire Risk Analysis Implementation Guide, EPRI Project 3385-01. Since the CCDPs and containment function effects calculated in part 2 were identical, no ignition frequency calculation is required for firezone C-2.

CONCLUSION

The result of this analysis showed that the CCDP calculated for each situation was identical, which means that the Thermolag installed in fire zone C-2 provided no quantifiable benefit in preventing core damage. Additionally, no impact or benefit from Thermolag was found to exist relating to containment isolation capability, containment heat removal or containment hydrogen control.

Attachment PRA-1
Fire Database Development
and Fire Susceptible Events for
Thermolag Installations

The purpose of the fire PRA databases is to provide location specific information for the PRA model. This information includes the location of all PRA modeled equipment and supporting cables, the basic events (BE)s associated with said equipment, and the PRA initiators that could result from a fire in any fire zone. A major resource for this task was the SLICE database system maintained by the NSED electrical design group. Database development covered all firezones in the plant instead of being specific to individual firezones.

How Database Was Developed

Database development was performed by completion of the following steps:

1. Identification of all basic events included in the PRA model. This task was performed by creating a BE report from the PROJECT.BE file using the CAFTA code.

2. Determine which basic events apply to each piece of modeled equipment. This task was performed by separating the BEs from task 1 by system and having each system analyst identify the equipment associated with each basic event. Some basic events, such as certain flow diversion events, had more than one piece of equipment associated with it. Human errors and maintenance unavailabilities were excluded from this task since these BEs would occur prior to a fire. This task generated database ELDB2.DBF.

3. Identify all power, control and instrumentation cables associated with each piece of modeled equipment. The SLICE database CABLE.DBF was used for this task. All equipment identified in task 2 were compared with the FR_EQUIPMT AND TO_EQUIPMT fields in the CABLE.DBF database. The resulting cables were then traced until either the 4.16KV/6.9KV or main control room cable risers/termination cabinets were reached. Tracing the cables involved not only the CABLE.DBF database, but also plant E02 and E03 drawings. The CPS safe shutdown analysis contained in USAR Appendix F was also reviewed to ensure all cables in that analysis associated with modeled equipment were included in the fire database. Cables to modeled equipment that would not disable the equipment if lost, such as position indication on non-interlocked valves, were not included in the database. Cables to the RAT and ERAT, though not explicitly modeled in the PRA, were included as a means of identifying zones where a fire could result in the loss of offsite power.

4. Identify the routing points associated with all identified cables. Routing points are intermediate locations on a cable tray or conduit. Using SLICE data, the trays containing each cable were identified, as well as all intermediate routing points.

5. Identify fire zone associated with each routing point. Using a SLICE system cross-index of routing point to fire zone, the location of cables contained in cable trays was identified.

6. Identify fire zones associated with each piece of modeled equipment. This task was performed by a combination of plant general arrangement review and plant walkdown.

7. Identify fire zones associated with conduits and open cables. Since the SLICE database does not contain location information on conduit or open cables, this task was performed by a combination of plant general arrangement review and plant walkdown.

8. Identify equipment susceptible to spurious actuation from fire. This information was taken directly from the safe shutdown analysis contained in USAR Appendix F.

9. Identify internal events initiators that could occur due to a fire in a fire zone. Using information gathered in previous tasks, all equipment and cables in this zone were identified. This list was reviewed and a list of initiators resulting from the loss of all equipment and cables in zone C-2 was compiled. This list was reviewed by an IPE analyst and a SRO and a final initiator list was developed.

Utilizing the information gathered in the previous steps, the fire location database ELDB1.DBF was completed.

Selection of Fire Susceptible BEs in Thermolag Areas

The structure of ELDB1 was set up so that for each piece of equipment, cables were identified up to the 4.16KV/6.9KV busses and/or the main control room termination cabinets. This resulted in listing some cables, particularly power cables, several times for different pieces of equipment. This approach allowed a database sort on fire zone without losing control, power or instrumentation dependencies. Once the equipment and cables contained in a zone were identified, the associated BEs were also determined. This list of BEs was reviewed and BEs that would not be affected by a fire were removed from the list of fire susceptible BEs. Examples of the type of BEs removed include the following: manual valve plugging, check valves failing to open, orifices plugging, all pre-event human errors and all maintenance

94-0076

unavailabilities. Attachment PRA-4 contains the lists of BEs and initiators generated from database ELDB1.DBF.

Prepared: Mark G. FitzLaherty Date: 10/25/94
Reviewed: P E Wilberg Date: 10/25/94

Attachment PRA-2

CONDITIONAL CORE DAMAGE FREQUENCY
AND CONTAINMENT IMPACT
FOR THERMOLAG INSTALLATIONS

For fire zone C-2, all the basic events in the PRA that could be affected by a fire in the area were identified using the databases that were prepared for the fire PRA. For a basic event to be affected by a fire, either a fire susceptible component or associated power, control, or important instrumentation cable had to be located in fire zone C-2. These basic events are called fire-susceptible basic events. The development of the data bases and the lists of fire susceptible basic events are described in attachment PRA-1.

CORE DAMAGE PROBABILITY

After the appropriate basic events were identified, two analyses were performed. First, all the fire-susceptible basic events involving that area were set to TRUE (meaning failed) in the original models, the model was requantified and the resulting core damage probability was determined. This represents the case in which Thermolag is ineffective. Secondly, all the fire-susceptible basic events involving that area, except those which are protected with Thermolag, were set to TRUE in the models, and the resulting core damage probability was determined. This represents the case in which there is an effective Thermolag fire barrier. The difference between the two results represents the importance of the fire barrier. The bigger difference there is between the two numbers, the more important is the Thermolag installation in that area. For fire zone C-2, the list of basic events for both cases was found to be identical. This result is explained by the fact that the cables protected by Thermo-Lag are only protected for a portion of their length and are therefore susceptible to damage from a whole zone fire scenario. Attachment PRA-4 contains the list of basic events used in zone C-2.

For thoroughness, it is important to go back to the original models to fail the appropriate components, because in the normal process of quantifying a PRA, many combinations of events that are unlikely without a fire are truncated out of the solution because they contribute very little to the overall core damage frequency result. Subsequent results when trying to fail these components will be inaccurate if their failure could contribute significantly to the probability of core damage. By failing them before truncation, no significant contributor can be lost.

The analysis of this area included failure of affected components as described above, plus the certain occurrence of the initiating events that would be precipitated by a fire in each area. All other initiators were trimmed out by setting them to FALSE.

CONTAINMENT FUNCTION EVALUATION

For defense in depth, the containment function is important, as well as core damage frequency. Because a low fraction of postulated core damage events lead to containment failure, a simplified method of assessing the impact of Thermolag failure was employed. Three functions that support containment integrity were analyzed independently. These functions are isolation, heat removal, and hydrogen control. The reliability of these functions was compared with the Thermolag failed and with the Thermolag assumed capable of performing as designed.

Examples of the various batch files and SETS user programs to perform this analysis are included in attachment PRA-5.

RESULTS

The CCDP calculated both with and without Thermolag was 1.0. This result shows that Thermolag provides no quantifiable benefit in preventing core damage in zone C-2. Additionally, no difference in failure probability was found between the two analyzed cases relating to containment isolation, heat removal or hydrogen control capabilities in zone C-2.

Prepared: Maria O'Flaherty Date: 10/25/94
Reviewed: [signature] Date: 10/25/94

94-0070

Attachment PRA-3
Fire Ignition Frequencies
for Thermolag Areas

Following calculation of the conditional core damage probabilities (CCDPs), the results were reviewed and all fire zones with CCDPs greater than 1.0E-07 were identified. Fire zones with lower CCDPs were screened without additional analysis. In this zone, even though the CCDP is greater than 1.0E-07, calculation of the ignition frequency is not necessary since the CCDP calculated for the two cases is identical.

Attachment PRA-4
Basic Events and Initiators
Used In Analysis

BASIC EVENT LIST FOR ALL MODELED CABLES IN ZONE C-2

Basic Event	Description
C1H2IG5SYZ	FAILURE OF >5 DIV 1 H2 IGNITERS
C2H2IG5SYZ	FAILURE OF >5 DIV 2 H2 IGNITERS
ERHFLOWXVC	RH DIVERSION FLOW VALVE FAILS TO CLOSE
GIA013AMVO	DIV 2 ADS CONTAINMENT OUTBOARD ISOL VLV FAILS TO OPEN
HPXC001MPR	HPCS PUMP FAILS TO RUN FOLLOWING A START
HPXC001MPS	HPCS PUMP FAILS TO START
HPXF004MVO	INJECTION VALVE F004 FAILS TO OPEN
HPXF010MVT	1st TEST VLV TO SUPP POOL IMPROPERLY OPENS
HPXF011MVT	2nd TEST VLV TO SUPP POOL IMPROPERLY OPENS
HPXF023MVT	TEST VLV TO SUPPRESSION POOL F023 OPEN
IRIF031MVO	RCIC SUCT VLV FAILS TO OPEN
IRIF063MVT	MOV F063 IMPROPERLY SHUTS
IRIF064MVT	MOV F064 IMPROPERLY SHUTS
KVR006BAVC	VR CONT INBD ISOL VLV FAILS TO CLOSE
KVR007BAVC	VR CONT EXHAUST/PURGE INBD ISOL VLV FAILS TO CLOSE
KXCY017MVC	CY CONT INBD ISOL VLV FAILS TO CLOSE
KXF022AAVC	INBOARD MSIV A FAILS TO CLOSE
KXF022BAVC	INBOARD MSIV B FAILS TO CLOSE
KXF022CAVC	INBOARD MSIV C FAILS TO CLOSE
KXF022DAVC	INBOARD MSIV D FAILS TO CLOSE
KXFC007MVC	FC CONT OUTLET INBD ISOL VLV FAILS TO CLOSE
KXFC037MVC	FC SUPPLY CONT INBD ISOL VLV FAILS TO CLOSE
KXIA006AVC	IA CONT INBD ISOL VLV 006 FAILS TO CLOSE
KXN084AFSZ	RCIC/RHR LINE HI STEAM FLOW N084A TRANS FAILS TO ACTUA
KXN084BFSZ	RCIC/RHR LINE HI STEAM FLOW N084B TRANS FAILS TO ACTUA
KXN085APSZ	DIV 1 LOW STEAM SUPPLY PRESS N085A TRANS FAILS TO ACTU
KXN085BPSZ	DIV 2 LOW STEAM SUPPLY PRESS N085B TRANS FAILS TO ACTU
KXRE021SVC	CONT EQUIP DRN SUMP DISCH INBD ISOL VLV FAILS TO CLOSE
KXXF016MVC	MAIN DRN & MSIV BYPASS INBD ISOL VLV FAILS TO CLOSE
KXXF063MVC	RHR & RCIC STEAM SUPPLY INBD ISOL VLV FAILS TO CLOSE
KXXF064MVC	RHR & RCIC STEAM SUPPLY OUTBD ISOL VLV FAILS TO CLOSE
KZRF021SVC	CONT FLOOR DRN SUMP DISCH INBD ISOL VLV FAILS TO CLOSE
MXF022AAVT	MAIN STEAM LINE A INBOARD MSIV FAILS SHUT
MXF022BAVT	MAIN STEAM LINE B INBOARD MSIV FAILS SHUT
MXF022CAVT	MAIN STEAM LINE C INBOARD MSIV FAILS SHUT
MXF022DAVT	MAIN STEAM LINE D INBOARD MSIV FAILS SHUT
MXIA006AVT	IA CONTAINMENT INBOARD ISOL VLV FAILS TO REMAIN OPEN
MXIA007AVT	IA DRYWELL OUTBOARD ISOL VLV FAILS TO REMAIN OPEN
MXIA008AVT	IA DRYWELL INBOARD ISOL VLV FAILS TO REMAIN OPEN
MXN091ALSZ	RX LEVEL TRANS 1B21-N091A FAILS LOW
MXN091BLSZ	RX LEVEL TRANS 1B21-N091B FAILS LOW
MXN091ELSZ	RX LEVEL TRANS 1B21-N091E FAILS LOW
MXN091FLSZ	RX LEVEL TRANS 1B21-N091F FAILS LOW
PCN081ALSX	OB LEVEL TRANS A FAILS
PCN081BLSX	IB LEVEL TRANS B FAILS
PCN081CLSX	IB LEVEL TRANS C FAILS
PCN081DLSX	OB LEVEL TRANS D FAILS
PXN067CPSX	PRESS TRANS 67C SIGNAL FAILS
PXN067DPSX	PRESS TRANS 67D SIGNAL FAILS
PXN067GPSX	PRESS TRANS 67G SIGNAL FAILS
PXN067HPSX	PRESS TRANS 67H SIGNAL FAILS

BASIC EVENT LIST FOR ALL MODELED CABLES IN ZONE C-2

Basic Event	Description
PXN073CLSX	LVL TRANS 73C SIGNAL FAILS
PXN073DLSX	LVL TRANS 73D SIGNAL FAILS
PXN073GLSX	LVL TRANS 73G SIGNAL FAILS
PXN073HLSX	LVL TRANS 73H SIGNAL FAILS
PXN091ALSX	LVL TRANS 91A SIGNAL FAILS
PXN091BLSX	LVL TRANS 91B SIGNAL FAILS
PXN091ELSX	LVL TRANS 91E SIGNAL FAILS
PXN091FLSX	LVL TRANS 91F SIGNAL FAILS
PXN094APSX	PRESS TRANS 94A SIGNAL FAILS
PXN094BPSX	PRESS TRANS 94B SIGNAL FAILS
PXN094EPSX	PRESS TRANS 94E SIGNAL FAILS
PXN094FPSX	PRESS TRANS 94F SIGNAL FAILS
PXN400ALSX	SYS 1 LVL TRANS A SIGNAL FAILS
PXN400BLSX	SYS 2 LVL TRANS B SIGNAL FAILS
PXN400ELSX	SYS 1 LVL TRANS E SIGNAL FAILS
PXN400FLSX	SYS 2 LVL TRANS F SIGNAL FAILS
PXN401APSX	SYS 1 PRESS TRANS A SIGNAL FAILS
PXN401BPSX	SYS 2 PRESS TRANS B SIGNAL FAILS
PXN401EPSX	SYS 1 PRESS TRANS E SIGNAL FAILS
PXN401FPSX	SYS 2 PRESS TRANS F SIGNAL FAILS
Q1FC007MVO	Motor Operated Valve FC007 Won't Open
QVR04YXDMO	Damper 1VR04Y Fails to Open
QXIA006AVO	IA Vlv IA006 Fails to Open
R12F008MVO	SUCTION MOV FROM RR FAILS TO OPEN
R12F009MVO	SUCTION MOV FROM RR FAILS TO OPEN
R1C002AMPR	PUMP A FAILS TO RUN
R1C002AMPS	PUMP A FAILS TO START
R1F027AMVO	Transfer From RH System, F027A Fails to Open
R1F027AMVT	INJECTION LINE OB CIV A FAILS TO REMAIN OPEN
R1F028AMVO	Transfer From RH System, F028A Fails to Open
R1F028AMVT	FAILURE OF CNMT SPRAY MOV A TO REMAIN CLOSED
R1F037AMVT	FAILURE OF FC LINE MOV A TO REMAIN CLOSED
R1F042AMVO	INJECTION LINE MOV A FAILS TO OPEN
R1F042AMVT	INJECTION LINE MOV A FAILS TO REMAIN CLOSED
R1F053AMVO	RHR TO FW A MOV FAILS TO OPEN
R1F053AMVT	RHR TO FW A MOV FAILS TO REMAIN CLOSED
R2C002BMPR	PUMP B FAILS TO RUN
R2C002BMPS	PUMP B FAILS TO START
R2F023OMVT	FAILURE OF RCIC HEAD SPRAY MOV TO REMAIN CLOSED
R2F027BMVT	INJECTION LINE OB CIV B FAILS TO REMAIN OPEN
R2F028BMVO	CNMT SPRAY MOV B FAILS TO OPEN
R2F028BMVT	FAILURE OF CNMT SPRAY MOV B TO REMAIN CLOSED
R2F037BMVT	FAILURE OF FC LINE MOV B TO REMAIN CLOSED
R2F042BMVO	RHR B INJ MOV FAILS TO OPEN
R2F042BMVT	INJECTION LINE MOV B FAILS TO REMAIN CLOSED
R2F053BMVO	RHR TO FW B MOV FAILS TO OPEN
R2F053BMVT	RHR TO FW B MOV FAILS TO REMAIN CLOSED
SCC001AMPR	SLC PUMP A FAILS TO RUN
SCC001AMPS	SLC PUMP A FAILS TO START
SCC001BMPR	SLC PUMP B FAILS TO RUN
SCC001BMPS	SLC PUMP B FAILS TO START

BASIC EVENT LIST FOR ALL MODELED CABLES IN ZONE C-2

Basic Event	Description
SCF001AMVO	SUCTION VALVE A FAILS TO OPEN
SCF001BMVO	SUCTION VALVE B FAILS TO OPEN
SCF004AEVO	EXPLOSIVE VALVE A FAILS TO OPEN
SCF004BEVO	EXPLOSIVE VALVE B FAILS TO OPEN
SCF029ARVC	PUMP A DISCHARGE RELIEF VALVE FAILS OPEN
SCF029BRVC	PUMP B DISCHARGE RELIEF VALVE FAILS OPEN
XSX01PAMPR	PUMP 1SX01PA FAILS TO RUN
XSX01PAMPS	PUMP 1SX01PA FAILS TO START
XSX01PBMPR	PUMP 1SX01PB FAILS TO RUN
XSX01PBMPS	PUMP 1SX01PB FAILS TO START
XSX089AMVT	CONT ISO VALVE 1SX089A INADVERT CLOSES
XSX089BMVT	CONT ISO VALVE 1SX089B INADVERT CLOSES
XSX095AMVO	DISCHARGE VALVE 1SX095A FAILS TO OPEN
XSX095BMVO	DISCHARGE VALVE 1SX095B FAILS TO OPEN
XSX096AMVT	CONT ISO VALVE 1SX096A INADVERT CLOSES
XSX096BMVT	CONT ISO VALVE 1SX096B INADVERT CLOSES
YLOSSIATRX	LOSS OF INTRUMENT AIR INITIATOR
YTRANISTRX	TRANSIENT WITH ISOLATION INITIATOR

Attachment PRA-5
Analysis of Conditional Core Damage
Frequencies and Containment Degradation
For Thermolag Firezones

ANALYSIS OF CONDITIONAL CORE DAMAGE FREQUENCIES AND CONTAINMENT DEGRADATION FOR THERMOLAG FIRE ZONES

This attachment describes the method used for determining the likelihood of core damage, given that a fire has destroyed all essential equipment in a specified fire area. Basically, the method fails all components in a given area in the appropriate fault trees, and then re-solves the entire PRA model. This method was used rather than failing events in the core damage results from the PRA, because many components that do not appear in the core damage cutsets because they are inherently reliable may be failed by a fire. Therefore just starting with the core damage cutsets would not yield a true picture of the possible consequences from a fire in a given area. This method was used for the 94 fire areas of interest for the fire PRA.

INPUTS

The method starts with three inputs: the linked CAFTA fault tree models for the plant, the SETS user programs for solving the system and sequences for the level 1 PRA, and a list for each fire area of the basic events that are assumed failed and the initiating events that could result from a fire in a given area.

The linked CAFTA fault trees are in ZCNMT.CAF.

The SETS user programs for the PRA are as listed in appendix F of the PRA update report.

The lists of basic events and initiators are of the following example format.

<u>Example text input file (Area CB3B)</u>

```
D164A16CBD
D174A18CBD
D1DC03EBYD
D1DC04EBYD
D1DC08EBCD
D1RP04ETFZ
DBUSNXCSWH
DC164A1CBD
DC174A1CBD
DC71S1DSSO
DC71S1DSSX
DCC71SABCD
DCC71SBBCD
DCS001DIVD
DCS004AIVD
DCS004BIVD
DCUPS1AIVD
DCUPS1ASSO
DCUPS1ASSX
DCUPS1BIVD
```

94-0076

DCUPS1BSSO
DCUPS1BSSX
DD16E17CBD
DD17E19CBD
DDC1D1ACBD
DDC1D1BCBD
DDC1D1CCBD
DDC1E1ACBD
DDC1E3BCBD
DDC1E6BCBD
DDC1E7ACBD
DDC1F1ACBD
DDC1F3BCBD
DDC1F7ACBD
DDC1F8ACBD
DXVX14CFNR
DXVX14CFNS
ESXFLOWXVC
X1SX189AVO
X1VX14SHXP
YLOSSDCTRX
YTRANISTRX

IMPORTING FAULT TREES

The first step in solving the PRA model is to read the CAFTA fault tree files into SETS, simplify them, and form independent subtrees (IST) and stem equations. Two steps are taken before the doing this in order to ensure that top events necessary for the sequence solutions are not unintentionally included in the ISTs. The first step is identical to that taken for the base PRA solution; to construct an additional fault tree containing all the events that we wanted to keep out of ISTs and then combine this with ZCNMT (the combined IPE fault tree model). The second step was similar, but necessary for this analysis and not the base PRA solution, because in the process of simplifying fault trees with many failed events, some top event equations are dropped if they evaluate to OMEGA (failed). A second auxiliary fault tree was constructed with all the top events that are necessary for the event tree sequence solutions. When this was combined with the ZCNMT, few top events vanished in the reformatting process.

INDEPENDENT SUBTREES

The reformatting process is implemented with the FRMNEWFT procedure in SETS. The user program for this procedure is produced by a BASIC program (ISTPREP) that reads the failure event text file and sets all the included events to OMEGA (true, ie. failed) and then continues to write a SETS program to set all initiators to 0.0 except those included in the failure event text file which are set to 1.0.

An example program to produce ISTs is shown here.

<u>Example SETS user program for form ISTS (CB3BIST.IN)</u>

```
PROGRAM$FORMIST.
COMMENT$ REFORM CAFTA FAULT TREE USING INDEPENDENT SUBTREES$
                  DLTBLK(CPS-STEM,CPS-IST,CPS-STEM1,CPS-IST1,CPS-STEM2).
FRMNEWFT(FORM1$ SETSIN / CPS-TEMP *NAME$
YFIRE= XYFIRE ,
YIETP= XYIETP ,
YIET3= XYIET3 ,
```

94-0076

```
YIES1= XYIES1 ,
YIEA= XYIEA ,
YIEIA= XYIEIA ,
YIET2= XYIET2 ,
YIET4= XYIET4 ,
YIET5= XYIET5 ,
YIES2= XYIES2 ,
YIET9= XYIET9 ,
YIESW= XYIESW ,
YIEDC= XYIEDC ,
YC2= XYC2 ,
YC2A= XYC2A ,
YU1= XYU1 ,
YC8= XYC8 ,
YW= XYW ,
YDG= XYDG ,
YQ= XYQ ,
YQ1= XYQ1 ,
YQ2= XYQ2 ,
YX1= XYX1 ,
YU2= XYU2 ,
YC1= XYC1 ,
YC3= XYC3 ,
YC= XYC ,
YC4= XYC4 ,
YC5= XYC5 ,
YC6= XYC6 ,
YC7= XYC7 ,
YC9= XYC9 ,
YDG1= XYDG1 ,
YDG2= XYDG2 ,
YL1= XYL1 ,
YL4= XYL4 ,
YL6= XYL6 ,
YU= XYU ,
YDIES1= XYDIES1 ,
YDIES2= XYDIES2 ,
YM1= XYM1 ,
YP1= XYP1 ,
YX2= XYX2 ,
YH1= XYH1 ,
YIET9B= XYIET9B ,
YIET9C= XYIET9C ,
YIET9D= XYIET9D ,
YM= XYM ,
YP= XYP ,
YW1= XYW1 ,
YX= XYX ,
YU3= XYU3 ,
YW2= XYW2 ,
YRHALONG= XYRHALONG ,
YRHBLONG= XYRHBLONG ,
YRHCLONG= XYRHCLONG ,
YHPLONG= XYHPLONG ,
YLPLONG= XYLPLONG ,
YCRD= XYCRD ,
YCDCBSUM= XYCDCBSUM ,
R1LPCIAX= XR1LPCIAX ,
R2LPCIBX= XR2LPCIBX ,
R3LPCICX= XR3LPCICX ,
YLPCS= XYLPCS).

FRMNEWPT(FORM3$ CPS-TEMP,NONMOD,FIRETOPS / CPS-STEM1,CPS-IST *OMEGA$
D164A16CBD,
D174A18CBD,
D1DC03EBYD,
D1DC04EBYD,
D1DC08EBCD,
D1RP04ETFZ,
DBUSNXCSWH,
DC164A1CBD,
DC174A1CBD,
DC71S1DSSO,
DC71S1DSSX,
DCC71SABCD,
DCC71SBBCD,
DCS001DIVD,
DCS004AIVD,
DCS004BIVD,
DCUPS1AIVD,
DCUPS1ASSO,
DCUPS1ASSX,
DCUPS1BIVD,
DCUPS1BSSO,
DCUPS1BSSX,
DD16E17CBD,
DD17E19CBD,
```

94-0076

```
DDC1D1ACBD,
DDC1D1BCBD,
DDC1D1CCBD,
DDC1E1ACBD,
DDC1E3BCBD,
DDC1E6BCBD,
DDC1E7ACBD,
DDC1F1ACBD,
DDC1F3BCBD,
DDC1F7ACBD,
DDC1F8ACBD,
DXVX14CFNR,
DXVX14CFNS,
ESXFLOWXVC,
X1SX189AVO,
X1VX14SHXP).

FRMNEWFT(FORM1$ CPS-STEM1 / CPS-STEM *TRIM$ GATE01).
DLTBLK(CPS-TEMP,CPS-STEM1).
BLKSTAT.
```

The first call to FRMNEWFT (Form1) renames all the top events required for the event tree sequence solution to correspond the auxiliary fault tree. The second call (Form3) is the procedure call that OMEGAs the appropriate basic events and forms the ISTs and STEM. Finally the third call removes the logic for the first auxiliary fault tree, so that no time is wasted in solving it.

INITIATOR FREQUENCY CORRECTION

Before the fault trees are solved, the initiators are adjusted using the other program that is produced by the BASIC program ISTPREP.

<u>Example SETS user program to adjust initiator frequencies (CB3BDATA.IN)</u>

```
PROGRAM$FIREDATA.
COMMENT$ READS IN FIRE PRA-SPCIFIC SCENARIO INITIATORS $
RDVALBLK(CPSBEDAT).
\
VALUE BLOCK$ CPSBEDAT.

COMMENT$ INITIATOR ADJUSTMENTS FOR FIRE AREA $
 0.00    $ YLOSSFWTRX  $
 0.00    $ YTRANSYTRX  $
 1.00    $ YTRANISTRX  $
 0.00    $ YIORVXXTRX  $
 0.00    $ YLLOCAXTRX  $
 0.00    $ YMEDLOCTRX  $
 0.00    $ YSBLOCATRX  $
 0.00    $ YLOOPXXTRX  $
 1.00    $ YLOSSDCTRX  $
 0.00    $ YLOSSIATRX  $
 0.00    $ YLOSSSWTRX  $
 0.00    $ YISLOCATRA  $
 0.00    $ YISLOCBTRX  $
 0.00    $ YISLOCCTRX  $
 0.00    $ YISLOCDTRX  $
\
```

EVENT TREE HEADING SOLUTION

After these two programs are run, then the ISTs and the STEM equations are solved. This is done with straight-forward applications of the GENFTEQN procedure, using the SOLVIST and SOLVE

SETS user programs. These programs are edited to set the truncation level at 1E-7.

After these solutions, it is necessary to form an equation block with only the top events which are needed for the event tree sequence solutions. This is done with another SETS user program, but it must be unique for each fire area. As mentioned above, when a top event is evaluated as OMEGA, the equation is lost. Therefore when that top event subsequently appears in a sequence equation, the sequence equation cannot be solved. In order to avoid the need to rewrite the sequence solutions for each fire area, the top events that are lost need to be re-defined. In addition, combination events are sometimes lost, as well. For example, high pressure injection (YU) is a combination of high pressure core spray (YU1) and feedwater (YQ1). If one of these is evaluated as OMEGA, then YU should equal the other input. SETS doesn't handle this correctly. To accommodate these two shortcomings, another BASIC program (SUPREP) was developed to read the output of the FRMNEWFT procedure and make the proper equation adjustments. An example SETS user program resulting from the BASIC program follows.

<u>Example SETS user program to form top event equation block (CB3BSU.IN)</u>

```
PROGRAM$SQSETUP.
COMMENT$ SET UP BLOCK WITH EVENT TREE HEADINGS $
LDBLK(CPS-STEM-EQN).

YQ = OMEGA.
SUBINEQN(YQ,YQ).
YQ2 = OMEGA.
SUBINEQN(YQ2,YQ2).
YCDCBSUM = OMEGA.
SUBINEQN(YCDCBSUM,YCDCBSUM).
YQ1 = OMEGA.
SUBINEQN(YQ1,YQ1).
YCRD = OMEGA.
SUBINEQN(YCRD,YCRD).
YIEA = /OMEGA.
SUBINEQN(YIEA,YIEA).
YX = GGATE01.
SUBINEQN(YX,YX).
YX1 = GGATE01.
SUBINEQN(YX1,YX1).
YU = YU1.
SUBINEQN(YU,YU).

DLTBLK(CPS-TOPS).
FRMBLK(CPS-TOPS* ONLY$ YFIRE, YIETP,YIET3,YIES1,YIEA,YIEIA,YIET2,
      YIET4,YIET5,YIES2,YIET9,YIESW,YIEDC,YC2,YC2A,YU1,YC8,YW,
      YDG,YQ,YQ1,YQ2,YX1,YU2,YC1,YC3,YC,YC4,YC5,YC6,YC7,YC9,
      YDG1,YDG2,YL1,YL4,YL6,YU,YDIES1,YDIES2,YM1,YP1,
      YX2,YH1,YIET9B,YIET9C,YIET9D,YM,YP,YW1,YX,YU3,YW2,YRHALONG,
      YRHBLONG,YRHCLONG,YHPLONG,YLPLONG,YCRD,YCDCBSUM,R1LPCIAX,
      R2LPCIBX,R3LPCICX,YLPCS).

BLKSTAT.
```

EVENT TREE SEQUENCE SOLUTIONS

After these mechanizations, the sequence equations are used to solve all the event tree sequences. The SETS user programs were adjusted to analyze all sequences to a truncation level of 1.0E-7. The final result cutsets are truncated at 2.0E-7. One other modification to the sequence solution was made to eliminate the

analysis for dependent human failures. Because so many headings turned out to be OMEGA, the dependent HRA analysis would have to be customized for each fire case, and the work necessary for that was judged to be excessive for the benefit that could be gained. One change was made to SEQTRAN.IN to avoid formation of an empty block when all transient initiators become ISTs.

THERMOLAG BENEFIT

For areas in which Thermolag is employed as a fire barrier, the above analysis was repeated. The first analysis was with all basic events in the area failed, as though Thermolag provides no benefit. The second analysis assumed that Thermolag was effective, and the protected basic events were not failed.

CONTAINMENT FUNCTIONS

In order to be thorough in evaluating the Thermolag importance, the benefit of Thermolag to containment function, in addition to core damage potential, needed to be evaluated. Running the entire suit of containment sequence solution SETS user programs for all Thermolag applications would be very time consuming. It would also be very difficult, with unique programs required for each area because of the loss of terms that evaluate to OMEGA, as described above. Consequently a simplified method was used. Three containment functions were evaluated as follows: containment heat removal, containment isolation, and hydrogen control. These functions were evaluated independently, rather than through containment event tree sequences.

Containment heat removal capability was modeled as possible by the RHR fault tree, containment spray (YCNMSA, YCNMTSB) and suppression pool cooling (YSPCA, YSPCB) modes. Containment isolation was evaluated with the containment isolation fault tree (KGATE01), and hydrogen control was modeled with its fault tree (CGATE101). The first comparison was for which of these headings were OMEGAd in the Form New Fault Tree procedure call as discussed above under the EVENT TREE HEADINGS heading. If the same events were OMEGAd for both the Thermolag failure and Thermolag success cases, no further action was required, as Thermolag provided no benefit to the model. For cases in which there were differences in the headings that were OMEGAd (This happened for only CNMT heat removal in two areas.), a user program was developed to evaluate the combination of YCNMTSA, YCNMTSB, YSPCA, and YSPCB with the appropriate events OMEGAd. The difference in results between the Thermolag failure and Thermolag success in this analysis is the importance of Thermolag in the area to protecting the containment heat removal function.

BATCH FILE AUTOMATION

The entire process described above, except for the final CNMT heat removal analysis, is implemented by using batch files. The complete solution for a list of areas can be performed by calling

TLSOLN with a list of areas as command line parameters. TLSOLN in turn calls other batch files. The first one called is TLPREP, which runs the BASIC programs to produce the input files. The second call is to TLSYS, which solves the system and event tree heading equations and prepares the equation block with all the necessary headings for the event tree solutions. The third is TLSEQ, which solves the individual event tree sequences, does all recoveries, combines the sequences into final results, and then processes and prints the final results. TLSOLN then calls TLSIFT to identify the containment functions that are failed for each case. The programs and data to complete this process are listed below.

TABLE OF CALLED PROGRAMS AND PROCEDURES

(Note: AREA is used as a generic term to be replaced by each area designation.)

PROGRAM	DESCRIPTION	CALLS	DATA
TLSOLN.BAT	Does entire solution for listed areas	TLPREP.BAT TLSYS.BAT TLSEQ.BAT TLSIFT.BAT	
TLPREP.BAT	Prepares SETS inputs for specified area INPUTBLK.FIR	KEY-FAKE.COM ISTPREP.BAS SUPREP.BAS	
KEY-FAKE.COM	Public Domain utility for command line BASIC parameters		
ISTPREP.BAS	Prepares input to form ISTs and adjust initiators AREA.TXT Writes AREAIST.IN and AREADATA.IN TEMPIST.TXT		
AREA.TXT	Text files containing BE's to be failed and intiators to occur		
SUPREP.BAS	Prepares SETS input for setting up ET top events AREAIST.OUT Writes AREASU.IN		
INPUTBLK.FIR	SETS block file containing only the fault trees from CAFTA		
TLSYS.BAT	Solves for event tree headings	READTL.IN AREAIST.IN AREADATA.IN SOLVIST.IN SOLVE.IN AREASU.IN BLOCKSTA.IN WRITETOP.IN READBLKS.BAS PURGE.COM DO.BAT	
READFIRE.IN	Prepared from CAFTA files for ZCNMT, ZNONMOD, and ZTL. Makes initial SETS block for remainder of programs.		
SOLVIST.IN	Uses SETS procedure GENFTEQN with the SAVE option for ISTs		
SOLVE.IN	Uses SETS procedure GENFTEQN to solve all stem equations. Prepared by using the GENFTEQN with the WRITE option on the		

94-0076

original models with no events OMEGAd in order to solve and save all ET headings.

BLOCKSTA.IN Uses SETS procedure BLKSTAT to check status of equation block

WRITETOP.IN Uses SETS procedures WRTBLK and WRTVALBLK to prepare switch file (SWFL) to form a new block file with only ET headings

READBLKS.BAS Prepares SETS input file READTEMP.IN to form a new block file READBLKS.IN

PURGE.EXE Utility file to remove excessive line and form feeds from SETS output

DO.BAT Utility to print text in small font with small line spacing

TLSEQ.BAT Calls all sequence SETS user programs in sequence to solve multiple sequences, including recoveries CUTVAL.BAS

CUTVAL.BAS Reads output from SETS COMTRMVAL and lists the results in CUTVAL.OUT

TLSIFT.BAT Prepares lists of CNMT function headings that have been set to OMEGA. ISTSIFT.BAS

ISTSIFT.BAS Picks out CNMT function headings that have been set to OMEGA by the AREALIST SETS user program.

94-0076

PROGRAM LISTINGS

TLSOLN.BAT

```
:START
IF %1A==A GOTO END
ECHO %1
CALL TLPREP.BAT %1
CALL TLSYS.BAT %1
CALL TLSEQ.BAT %1
REM CALL TLIMP.BAT %1
PKZIP -A D:\FIRE\%1RES \PCS\FIRE\SEQ\CUTCOMB.OUT
PKZIP -A D:\FIRE\%1RES \SETSBU\SEQCOMB.FIR
COPY \SETSBU\SEQCOMB.FIR %1COMB.RES
REM DEL \SETSBU\%1*.FIR
CALL TLSIFT.BAT %1
SHIFT
GOTO START
:END
```

TLPREP.BAT

```
CD INPUT
DEL PREPBAT.DAT
:START
IF %1A==A GOTO END
REM ****************** PREPARE IST AND DATA FILES
ECHO %1
KEY-FAKE "%1" 013
E:\SY\BASIC\GWBASIC \PCS\TL\INPUT\ISTPREP >> PREPBAT.DAT
REM
COPY \SETSBU\INPUTBLK.FIR BKFL
REM **************   FORM ISTS
COPY %1IST.IN INFL
E:\SY\PCSETS\PCSETS > %1IST.OUT
FIND "ERROR" %1IST.OUT
FIND "ERROR" %1IST.OUT >> PREPBAT.DAT
REM **********************   PREPARE SETUP PROGRAM
KEY-FAKE "%1" 013
E:\SY\BASIC\GWBASIC \PCS\TL\INPUT\SUPREP
REM **************** RECYCLE AND START OVER
SHIFT
GOTO START
:END
CD..
ECHO R
```

TLSYS.BAT

```
:START
IF %1A==A GOTO END
F:
CD\PCS\TL\SYS
DEL SYSBAT.DAT
REM GOTO JUMP
DEL BKFL
COPY F:\SETSBU\READFIRE.IN D:\SCRATCH\READCAF.IN
COPY D:\SCRATCH\READCAF.IN INFL
E:\SY\PCSETS\PCSETS > D:\SCRATCH\READCAF.OUT
FIND "ERROR" D:\SCRATCH\READCAF.OUT > SYSBAT.DAT
FIND "ERROR" D:\SCRATCH\READCAF.OUT
REM DEL READCAF.OUT
REM **************   FORM ISTS
COPY \PCS\TL\INPUT\%1IST.IN INFL
E:\SY\PCSETS\PCSETS > %1IST.OUT
FIND "ERROR" %1IST.OUT
FIND "ERROR" %1IST.OUT >> SYSBAT.DAT
REM ####### READ AREA DATA ###########
COPY \PCS\TL\INPUT\%1DATA.IN INFL
E:\SY\PCSETS\PCSETS > %1DATA.OUT
FIND "ERROR" %1DATA.OUT
FIND "ERROR" %1DATA.OUT >> SYSBAT.DAT
REM **************   ISTS
COPY SOLVIST.IN INFL
E:\SY\PCSETS\PCSETS > SOLVIST.OUT
FIND "ERROR" SOLVIST.OUT
FIND "ERROR" SOLVIST.OUT >> SYSBAT.DAT
FIND "NO EQUATION" SOLVIST.OUT >> SYSBAT.DAT
COPY BKFL F:\SETSBU\%1IST.FIR
GOTO SKIPSTEM
```

94-0076

```
REM ***************    STEMS
DCOPY SOLVSTEM.IN INFL
E:\SY\PCSETS\PCSETS > SOLVSTEM.OUT
FIND "ERROR" SOLVSTEM.OUT
FIND "ERROR" SOLVSTEM.OUT >> SYSBAT.DAT
FIND "NO EQUATION" SOLVSTEM.OUT >> SYSBAT.DAT
COPY BKFL F:\SETSBU\%1STEM.FIR
:SKIPSTEM
REM ***************    STEMS
COPY SOLVE.IN INFL
E:\SY\PCSETS\PCSETS > SOLVE.OUT
FIND "ERROR" SOLVE.OUT
FIND "ERROR" SOLVE.OUT >> SYSBAT.DAT
REM FIND "NO EQUATION" SOLVE.OUT >> SYSBAT.DAT
COPY BKFL F:\SETSBU\%1STEM.FIR
GOTO SKIPEQN
REM ***************
REM COPY GENFTUPG.IN INFL
REM E:\SY\PCSETS\PCSETS > GENFTUPG.OUT
REM CALL DO HP SGFL.SUP CO
REM ******************
:SKIPEQN
REM SEQ SET UP ***************************
COPY \PCS\TL\INPUT\%1SU.IN INFL
E:\SY\PCSETS\PCSETS > %1SU.OUT
FIND "****" %1SU.OUT >> SYSBAT.DAT
FIND "NO EQUATION" %1SU.OUT >> SYSBAT.DAT
FIND "ERROR" %1SU.OUT >> SYSBAT.DAT
COPY BKFL F:\SETSBU\%1HDG.FIR
COPY \PCS\BLOCKSTA.IN INFL
E:\SY\PCSETS\PCSETS > BLOCKSTA.OUT
REM MAKE ET SWFL ***********************
ECHO Y | DEL D:\SCRATCH\*.*
DEL SWFL
COPY WRITETOP.IN INFL
E:\SY\PCSETS\PCSETS > WRITETOP.OUT
FIND "****" WRITETOP.OUT >> SYSBAT.DAT
FIND "NO EQUATION" WRITETOP.OUT >> SYSBAT.DAT
FIND "ERROR" WRITETOP.OUT >> SYSBAT.DAT
E:\SY\BASIC\GWBASIC F:\PCS\READBLKS >> SYSBAT.DAT
DEL BKFL
COPY D:\SCRATCH\READTEMP.IN INFL
E:\SY\PCSETS\PCSETS > D:\SCRATCH\READTEMP.OUT
FIND "****" D:\SCRATCH\READTEMP.OUT >> SYSBAT.DAT
FIND "NO EQUATION" D:\SCRATCH\READTEMP.OUT >> SYSBAT.DAT
FIND "ERROR" D:\SCRATCH\READTEMP.OUT >> SYSBAT.DAT
COPY BKFL \SETSBU\%1TOPS.FIR
REM **************** OUTPUTS
DIR F:\SETSBU\%1*.FIR >> SYSBAT.DAT
DIR %1*.OUT >> SYSBAT.DAT
REM COPY BLOCKSTA.OUT SETS.OUT
REM E:\SY\PCSETS\PURGE
REM TYPE TEMP.DOC >> SYSBAT.DAT
CALL DO HP SYSBAT.DAT CO
rem COPY %1.OUT SETS.OUT
REM E:\SY\PCSETS\PURGE
REM CALL DO HP TEMP.DOC CO
CD ..
SHIFT
GOTO START
:END
ECHO R R
ECHO DONE
ECHO RR
```

TLSEQ.BAT

```
:START
IF %1A==A GOTO FINISH
F:
CD \PCS\TL\SEQ
REM  ASSUMES THAT THE LATEST BLOCKFILE ETTOPS.FIR IS IN \SETSBU
REM  AND THAT THE LATEST FIRE SOLUTION ISTSOLN.FIR IS IN \SETSBU
DEL SEQBAT.DAT
REM GOTO JUMP
REM ******* FORMAT AND READ IN IST EQUATIONS **********
DEL BKFL
COPY \SETSBU\%1IST.FIR BKFL
DEL SWFL
COPY WRITISTS.IN INFL
E:\SY\PCSETS\PCSETS > WRITISTS.OUT
FIND "****" WRITISTS.OUT >>  SEQBAT.DAT
FIND "NO EQUATION" WRITISTS.OUT >>  SEQBAT.DAT
REM FIND "ERROR" WRITISTS.OUT >>  SEQBAT.DAT
E:\SY\BASIC\GWBASIC F:\PCS\READISTS >> SEQBAT.DAT
```

94-0076

Evaluation of Ampacity Derating for Thermo-Lag Installation

Topic:

Consideration of the existing cable ampacities in this area with respect to the NRC concerns (IEIN 94-22) over the ampacity derating needed for Thermo-lag installations.

Design statement:

Clinton Power Station project ampacities for cables in tray were established in calculation 19-G-01. These values are conservative in magnitude and were used during the design process as one of the parameters for selecting the size and type of cable for a specific circuit. A separate calculation (19-AI-8) was performed to determine the amount of ampacity derating needed to account for the increased heat retention (due to the Thermo-lag installation) in the tray. Derating values are viewed as suspect in the IEIN, but no new values are established.

The Thermo-lag installation in fire zone C2 consists of a one hour wrap on tray and conduits. The power cables enclosed in tray or conduits were reviewed (see attachment one) and the review demonstrates that not only were none of these cables thermally overloaded by the currents passing through them but that they could be subjected to an ampacity derating requirement of over 50% without being impacted.

The largest ampacity derating mentioned in the IEIN was 46.4% for a #8 AWG conductor in a tray with a three hour wrap of Thermo-lag applied. It was necessary to examine whether this would represent an impact to our design. Phone calls to the NRC have provided additional information (specifically the diameters of the tested conductors) which allows a comparative evaluation of the test results. On attachment two, the cables tested by Sandia lab for the NRC are examined with respect to the methodology developed by Stolpe (IEEE Transaction Paper 70 TP 557 PWR *Ampacities for cables in Randomly Filled Cable Trays* by J. Stolpe). For this evaluation, tray fill was determined per step 2.2 of ICEA P-54-440 which uses diameter squared for area without the pi/4 component. This resulted in a tray fill depth of 1.41" and the P-54-440 tabulated values for 1.5" fill were utilized in the comparison of data. All heat intensities were calculated using the actual cross-sectional area of the cable. Since the same numbers were used for each section of the evaluation, the heat intensities can be directly compared.

The first set of numbers translates the ampacities reported in 94-22 into heat intensities for open (unwrapped) and Thermo-lag wrapped trays. The NEMA numbers show the heat intensities that would be produced if the ampacity values from table 3-1 of P-54-440 were utilized for the cables tested by the NRC. The CPS numbers show the heat intensities

that would be produced if the methodology used for determining ampacity limits at CPS (Calc 19-G-1) were applied to these conductors, but using a 1.5" fill rather than the nominal 2" fill of CPS design. Tlag ampacity values for the NEMA and CPS tables were calculated based on the 32% derate factor derived in Calc 19-AI-8.

Comparison of the results shows that the NEMA values produce lower heat intensities (and therefore lower overall heat in the tray) than the NRC values. The CPS values are even more conservative with resultant lower intensities. Even though the derate factor for the NEMA and CPS sections is smaller than the NRC values (32% vs. 46.4%, 36%, and 35.3%), the Tlag heat intensities continue to demonstrate that the NEMA-based values produce more conservative results. The reasons for this are found in Stolpe's methodology.

In his paper, Stolpe describes a general method for calculating allowable cable ampacities. By determining the amount of heat that can be dissipated from the tray and distributing that heat through all the cables in the tray, Stolpe defines a conservative upper limit for cable ampacities. The method requires that the allowable depth of fill for the tray be known at the start of the design process so that the ampacity values can be determined before cable selection and installation. At CPS the initial design consideration was to select two inches as the nominal fill depth for power tray and determine the allowable cable ampacities accordingly.

In contrast, the test method used in 94-22 will produce very specific ampacity limits but it will be based on very specific configurations. Due to the limited data available at this time concerning the orientation and distribution of the reported conductors in the test tray, it is unclear just how configuration dependent these test results are. However, given the uneven heat production of the tested conductors it seems likely that relocating the conductors within the confines of the test tray would impact the heat distribution and could affect the reported results. This could mean that in order to use the ampacity values provided by this type of testing, there would have to be tests run for every type of cable singly, in multiples, and in combination with single and multiple specimens of every other type of cable. Whether the same combinations of cables would have to be tested in various sizes and configurations of tray would be a subject for debate. Just determining the various configurations to be tested would require a significant amount of review and evaluation.

The installation in fire zone C2 includes power cables in conduits. Cables in conduits are normally assigned a higher allowable ampacity than cables in trays. However for the purpose of this evaluation the more restrictive ampacity limits of cables in trays were used for conservatism since the conduits contain multiple cables rather than a single cable.

To demonstrate the conservatism of the cable selection employed, the heaviest loaded cables in area CB-1e were added to the attachment two table. As shown, the present loading of the cables (48.8 and 7.2 Amps respectively) results in heat intensities lower than the lowest values shown in the right hand column. Therefore these cables will not be impacted by the concerns expressed in IEIN 94-22 and since they are acceptable, the rest of the cables in fire zone C2 are also acceptable.

Prepared Mark M. Monanan 11/9/94

Reviewed Kevin M Forrest 11/14/94

References

ICEA P-54-440 (NEMA WC 51-1986)
IEEE Transaction paper 70 TP 557 PWR *Ampacities for Cables in Randomly Filled Cable Trays* by J. Stolpe
EPRI Power Plant Elec. Ref. Series Vol.4 *Wire and Cable*
IEIN 94-22
Calc 19-G-01 R/1
Calc 19-AI-8 R/0
K-2982 Power Cable Purchase Spec. Proposal Data
SLICE version 7.3
ROC Y-104156, dated 8/10/94

FIRE ZONE C2 POWER TRAY CABLE AMPACITIES VS. PROJECT AMPACITIES

CABLE	TYPE	PROJECT AMPACITY	LOAD AMPERES	LOAD_%_OF AMPACITY	ALLOWABLE DERATING
1CC16J	3/C,#19/22 AWG,1KV	16	0.8	5.00%	OVER 50%
1CC16S	3/C,#19/22 AWG,1KV	16	0.8	5.00%	OVER 50%
1CY06G	3/C,#19/22 AWG,1KV	16	0.8	5.00%	OVER 50%
1FC05B	3/C,#19/22 AWG,1KV	16	0.8	5.00%	OVER 50%
1FC20B	3/C,#19/22 AWG,1KV	16	0.8	5.00%	OVER 50%
1FP62C	3/C,#19/22 AWG,1KV	16	0.8	5.00%	OVER 50%
1FP65C	3/C,#19/22 AWG,1KV	16	0.8	5.00%	OVER 50%
1HG20A	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
1HG20B	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
1HG20C	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
1HG20J	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
1HG21H	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
1HG21M	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
1HG21N	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
1HG21P	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
1HG22D	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
1HG22E	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
1HG22F	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
1HG22P	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
1HG23E	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
1HG23F	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
1HG23G	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
1HG25K	3/C,#19/22 AWG,1KV	16	6.0	37.50%	OVER 50%
1MC03B	3/C,#19/22 AWG,1KV	16	0.8	5.00%	OVER 50%
1SC02B	3/C,#2 AWG,1KV	64	48.8	76.25%	SEE NOTE 1
1SC06B	3/C,#19/22 AWG,1KV	16	0.8	5.00%	OVER 50%
1VQ24B	3/C,#19/22 AWG,1KV	16	0.8	5.00%	OVER 50%
1VR09B	3/C,#19/22 AWG,1KV	16	0.8	5.00%	OVER 50%
1WO14B	3/C,#19/22 AWG,1KV	16	0.8	5.00%	OVER 50%
1WO16B	3/C,#19/22 AWG,1KV	16	0.8	5.00%	OVER 50%

Note 1) Cable ampacities are only a concern with continuously loaded cables. 1SC02B is only energized intermittently since it feeds the motor for the 1C41-P001B pump (Standby Liquid Control). During normal plant operations, this pump is only run for short periods to perform surveillances. In an accident scenario that required the pump to inject into the vessel, the maximum run time would be less than two hours. Therefore this cable is not impacted by derating.

FIRE ZONE C2 POWER CONDUIT CABLE AMPACITIES VS. PROJECT AMPACITIES

CONDUIT	CABLES	TYPE	PROJECT AMPACITY	LOAD AMPERES	LOAD_%_OF AMPACITY	ALLOWABLE DERATING
C74240	1HG21A	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG21C	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG21D	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG21H	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG21J	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG21K	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG21L	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG21M	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG21N	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG21P	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG25L	3/C,#19/22 AWG,1KV	16	6.0	37.50%	OVER 50%
C74241	1HG22D	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG22E	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG22F	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG22G	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG22H	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG22J	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG22K	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG22L	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG22M	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG22N	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG22P	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG25M	3/C,#19/22 AWG,1KV	16	6.6	41.25%	OVER 50%
C74242	1HG23A	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG23B	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG23C	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG23D	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG23E	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG23F	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG23G	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG23L	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG23M	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG23N	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG23P	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG25N	3/C,#19/22 AWG,1KV	16	6.6	41.25%	OVER 50%
C74243	1HG25P	3/C,#19/22 AWG,1KV	16	7.2	45.00%	OVER 50%
	1HG27A	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG27B	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG27C	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG27D	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG27E	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG27F	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG27G	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG27H	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG27J	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG27K	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG27L	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
	1HG27M	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%
C74123	1HG14L	2/C,#19/25 AWG,600V	10	0.6	6.00%	OVER 50%

Tray ampacity limits used for conservatism.

NRC CABLE AMPACITIES (BASED ON TESTING) VS. NEMA AND CPS AMPACITIES (BASED ON STOLPE METHODOLOGY) AND THE RESULTANT HEAT INTENSITIES OF EACH

Cable	Diameter	Area	90C Resist	Open Amps	Watts/ft	Ht Intensity	Tiag Amps	Watts/ft	Ht Intensity
NRC #8	0.23	0.04154766	0.0008	23.7	0.449352	10.81533834	12.7	0.129032	3.1056382
NRC #4	0.33	0.08553006	0.0003226	37.8	0.460943784	5.389260618	24.2	0.188927464	2.208901338
NRC #2/0	0.52	0.21237216	0.0001013	113.6	1.307272448	6.155573537	73.5	0.547247925	2.576834577
NEMA #8	0.23	0.04154766	0.0008	15.3	0.187272	4.507401861	10.4	0.086528	2.082620297
NEMA #4	0.33	0.08553006	0.0003226	34	0.3729256	4.36016998	23.12	0.172440797	2.016142599
NEMA #2/0	0.52	0.21237216	0.0001013	95.3	0.920015717	4.332091914	64.8	0.425362752	2.00291202
CPS #8	0.23	0.04154766	0.0008	13.1	0.137288	3.304349752	8.9	0.063368	1.525188181
CPS #4	0.33	0.08553006	0.0003226	29.1	0.273180906	3.193975381	19.8	0.126472104	1.47868602
CPS #2/0	0.52	0.21237216	0.0001013	81.5	0.672859925	3.1683057	55.4	0.310905908	1.463967349
3C,#2 ,1KV	1.208	1.146105946	0.000211	64	2.592768	2.262241122			
1SC02B load	1.208	1.146105946	0.000211	48.8	1.50745152	1.315281127			
3C/#19/22,1KV	0.723	0.410551357	0.001178	16	0.904704	2.203631739			
1HG25P load	0.723	0.410551357	0.001178	7.2	0.12213504	0.297490285			

Enclosure 4
Page 6 of 6
94-0076

8A.100
L34-94(11-22)-6
Y- 104475
November 22, 1994

TO: Director - Licensing

FROM: J. R. Langley [signature], 11/15/94
NSED - Director Date

SUBJECT: Proposed Amendment to CPS SAR.

SAR Sections Affected: Appendix F 3.2.2.3, 4.1.2.1

Safety Evaluation or Screening Form attached: ✓ YES ___ NO

SAR Section 1.8 impacted: ___ YES ✓ NO

If yes, identify Section 1.8 impact and affected sections.

Justification of Change: The attached safety evaluation provides the detailed justification for this USAR change. It concludes that the change, deleting the reference to the 1-hour fire rating for the cable tray fire break in Containment, has no adverse impact on the safe shutdown capability of the plant, due to the existing defense-in-depth provided.

Originator: [signature], 11/14/94

Concurrence: N/A, ___
Division of Responsibility

Supervisor: [signature], 11/15/94

NF-139 (4/94)

Attachments: Affected SAR Pages
Safety Evaluation/Screening, LIC Log No. 94-0076
(if applicable)

cc: K A Leffel, V-922
M McMenamin
M O'Flaherty
R P Bhat
C Smail
S Wilson

then propagating down the tray and damaging Division 2 safe shutdown cable. This will be prevented by placing a fire break in the Division 2 trays (see Subsection 3.2.2.3).

At elevation 737 feet there are the Division 2 cables serving temperature elements 1TE-CM004, 1TE-CM006, and 1TE-CM008 (cables 1CM80K, 1CM80L, and 1CM80M). These cables feed indicators in the main control room. These cables are located on the Division 1 side of the containment annulus. A fire would not disable these cables since they are routed in conduit only 2 feet above the normal suppression pool level (elevation 731 feet 0 inches) and below the lowest floor, which is at elevation 737 feet 0 inch.

Even though the Division 1 and 2 cables are separated, operation of some Division 2 valves (1E12-F009, 1E51-F063, and 1E12-F076) is required by Division 1 shutdown systems. Valve 1E12-F009 must be opened to proceed from hot to cold shutdown using RHR in the shutdown cooling mode, or an alternate method can be used (see Figure 1.8-4 or 1.8-7). Valve 1E51-F063 is the RCIC steam supply line isolation inboard valve and thus is required to remain open until the cold shutdown systems are brought into operation. The valve is normally open; therefore damage to power cable 1R102C will not prevent shutdown. Cable 1R102D is connected to a limit switch. A hot short of a limit switch will not close the valve since the control switch contacts are open. Finally, valve 1E51-F076, the RCIC steam line warmup line, will not disable the RCIC system if it spuriously operates.

Method 3 is also available for safe shutdown. The cables associated with HPCS will not prevent manual control room operations to provide high-pressure reactor coolant makeup.

Based on the above discussion and with the installation of the fire break, a fire in this area could only damage one division of safe shutdown cables and equipment.

The performance goals for safe shutdown functions are assured by Method 1, 2, or 3.

3.2.2.3 Modifications in the Fire Area DELETE

- A fire break, consisting of ~~a 1-hour~~ fire-rated material for 20 feet and sealed at each end, will be added to the three Division 2 Class 1E cable trays that are routed around the south end of the containment building above elevation 803 feet.
- Linear thermal detectors will be provided in safety-related cable trays with a design index of approximately 40 from elevation 803 feet to 766 feet.

3.2.2.4 Deviations

- Air lock doors (hatches) provided in the containment and drywell boundaries are not tested or labeled as 3-hour fire doors (see Subsection 4.2.2.14.1).

94-0076

4.0 MODIFICATIONS AND DEVIATIONS

4.1 MODIFICATIONS

4.1.1 AUXILIARY BUILDING

4.1.1.1 Fire Area A-1

4.1.1.1.1 Fire Zone A-1a

- Division 2 power and control cable trays in Fire Zone A-1a will be protected by a 1-hour fire rated material from column 124 to column 110. Division 2 instrumentation cable tray will be protected by a 1-hour fire rated material for 20 feet, to act as a fire break between the Division 1 and 2 safe shutdown cables.

- The entire corridor in Fire Zone A-1a will be protected by an automatic wet-pipe sprinkler system.

4.1.1.1.2 Fire Zone A-1b

- An automatic wet-pipe sprinkler system from column 114 to column 124 providing for partial zone coverage will be installed in the corridor in Fire Zone A-1b.

4.1.2 CONTAINMENT BUILDING

4.1.2.1 Fire Area C-2

DELETE

- A fire break, consisting of ~~a 1-hr~~ fire rated material for 20 feet and sealed at each end, will be added to the three Division 2 Class 1E cable trays that are routed around the south end of the containment building above elevation 803 feet.

- Linear thermal detectors will be provided in safety-related cable trays with a design index of approximately 40 from elevation 803 feet to 766 feet.

4.1.3 CONTROL BUILDING

4.1.3.1 Fire Area CB-1

4.1.3.1.1 Zone CB-1c

- Area detection will be installed in this fire zone.

- An automatic wet-pipe sprinkler system will be installed around the west pipe hatch to prevent hot gases from propagating to elevation 737 feet 0 inch (Zone CB-1e).

SAFETY EVALUATION FORM

Document Evaluated: 1.1 L&S Log # 94-0074

1.2 Number: USAR Appendix F 1.3 Revision: N/A

1.4 Title: EVALUATION OF THERMO-LAG IN FIRE ZONE CB-1e

USAR Appendix F Revision

1.5 References:

See page 6.

BLOCK A - DESCRIPTION OF CHANGE

(Use additional pages if required)

A.1 Describe the basic document or system and the changes being made. Discuss how the change affects the SAR description. Discuss the reason for change.

CPS USAR Appendix F, subsection 3.3.1.2 discusses the provision of 1-hour rated cable fire wrap material to protect Division 2 power, control and instrumentation cables in fire zone CB-1e, which is a general access corridor at elevation 737 feet and a secondary floor at 751 feet. The purpose of this evaluation is to accept the fire wrap as-is even though the fire wrap material used in CB-1e, Thermo-Lag 330-1, does not provide the 1-hour rating. The proposed USAR change will delete the reference to the 1-hour rating of the fire barrier. In addition, this deviation from Appendix R requirement for 1-hour rated fire barrier will be included in USAR Appendix F, Section 4.2. Also, some cables that are listed in the USAR as being safe shutdown cables are being removed because they do not perform safe shutdown functions (Refer to Enclosures 5 and 6).

(Continued on page 8)

NF-002-1 (2/94)

A.2 Identify the equipment, systems and parameters that may be affected by the change:

Fire Zones affected: Fire Zone CB-1e, general access corridor at elevation 737 feet and a secondary floor at 751 feet (USAR Appendix E, Figures FP-10a, 10b, 11a, 11b, cable tray Figure 9, and USAR Appendix F, Deviation Figures 4.2.4.5-2 and 4.2.4.5-3).

Description of Safe shutdown Equipment and/or cables: The systems affected include Division 1 and 2 electrical cables, diesel generator motor control centers, Division 1 and 2 cable trays, Division 1 and 2 diesel generator HVAC, diesel generator fuel oil, auxiliary power, instrument power, RCIC, shutdown service water, control room HVAC, and the Division 1 hydrogen recombiner control panel are located in this zone.

(Continued on page 10)

94-0074

BLOCK B - RADWASTE TREATMENT SYSTEMS

B.1 The proposed activity involves a modification to a radioactive waste treatment system or the way in which it is operated as described in Chapter 11 of the SAR.

Yes ____
No __X__

B.2 Because: The proposed USAR changes affect only the fire protection and safe shutdown analyses contained in the USAR. They do not impact the radwaste system or its operation.

If B.1 is yes, complete form NF-003.

BLOCK C - TECHNICAL SPECIFICATION IMPACT

C.1 The proposed activity requires a change to any part of the Technical Specifications.

Yes ____
No __X__

C.2 Justification if "NO", Technical Specification change package identification number if "YES".

The CPS Technical Specification does not contain any operability requirements for the fire protection features, other than containment isolation. This revision shows that the Safe Shutdown Analysis is unaffected by the proposed change. This change does not impact the CPS Fire Protection Program discussed in Technical Specification 6.8.4.e.

BLOCK D - UNREVIEWED SAFETY QUESTION DETERMINATION

(Attach additional pages with the responses to the block D questions. Identify your answers to Parts I, II, III, and IV.)

Part I - Impact on equipment malfunctions evaluated as the design basis.

1. For the equipment and systems identified in A.1 and A.2, identify any failures evaluated in the SAR.
   See page 21.

2. Discuss the impact of the change on the performance of the equipment and systems identified in A.1 and A.2.
   See page 21.

3. Identify what new failure modes could be introduced by the change.
   See page 21.

4. Identify any impact of the change on the consequences of the failures evaluated in the SAR.
   See page 21.

5. Identify any impact of the change on the probabilities of the failures evaluated in the SAR.
   See page 21.

94-0074

SAFETY EVALUATION FORM

BLOCK D - UNREVIEWED SAFETY QUESTION DETERMINATION

SUMMARY

Based on item 4, are the consequences of any malfunction of equipment evaluated in the SAR increased?	YES ____ NO __X__
Based on item 5, is the probability of a malfunction of equipment evaluated in the SAR increased?	YES ____ NO __X__

If the answer to any of the above questions is yes, the change is an unreviewed safety question.

Part II - Impact on the accidents evaluated as the design basis See page 22.

1. Identify the accidents evaluated in the SAR which could be affected by the change.
2. Discuss how the change impacts the consequences of these accidents.
3. Discuss how the change impacts the probability of these accidents.

SUMMARY

Based on item 2, are the consequences of an accident evaluated in the SAR increased?	YES ____ NO __X__
Based on item 3, is the probability of an accident evaluated in the SAR increased?	YES ____ NO __X__

If the answer to any of the above questions is answered yes, the change is an unreviewed safety question.

Part III - Potential for Creation of a New Unanalyzed Event See page 22.

1. Based on Part I, items 1 and 3, could this change initiate a new type of accident or equipment malfunction? Discuss the basis for this determination.

2. Determine if the new accident or malfunction identified above has sufficient probability or consequences to be considered in the Licensing basis. Discuss the bases for this determination.

94-0074

SAFETY EVALUATION FORM

BLOCK D - UNREVIEWED SAFETY QUESTION DETERMINATION

SUMMARY

Based on item 2, does the change create the possibility for an equipment malfunction or accident of a different type than previously evaluated in the SAR?

YES ______
NO ___X___

If the answer is yes, the change represents an unreviewed safety question.

Part IV - Impact on the Margin of Safety See page 22.

1. Identify how any of the protective barriers are directly affected by the change.
2. Discuss the impact of the change on the approach to the acceptance limits for any of the protective barriers.
3. Discuss the impact of the change on the bases of the Technical Specifications.

SUMMARY

Based on item 2, is any parameter in chapter 7 of the Safety Evaluation Manual exceeded?

YES ______
NO ___X___

Based on items 2 and 3, does the change reduce the margin of safety provided for the protective barriers?

YES ______
NO ___X___

If the first of these two questions is answered yes, the change may be unsafe and requires further justification. If the first question is answered no and the second is answered yes, the change is safe to implement but is an unreviewed safety question and requires prior NRC approval.

94-0074

SAFETY EVALUATION FORM

BLOCK E - SUMMARY

Based on the evaluation in Block C and Block D, the change

_X_ is safe and is not an unreviewed safety question and requires no Technical Specification change. This change may be implemented in accordance with applicable procedures.

_____ is safe but is an unreviewed safety question or requires a Technical Specification change. The change requires NRC approval, prior to implementation.

_____ is unsafe and cannot be implemented.

MRM CRS KAL, SRW. MEO BTF

	printed name	signature	date
Preparer	R. P. Bhat	Ram P. Bhat	11/14/94
Director	J. R. Langley	J R Langley	11/14/94
Manager, NSED	N. A.		
Manager, L&S	R. F. Phares	[signature]	11-15-94
FRG	K. S. Moore	K S Moore	11-17-94

EVIDENCE OF NRC APPROVAL, IF REQUIRED:

License Ammendment No. ________________

printed name	signature	date
	N/A [initials] 11-15-94	

The department responsible for vaulting the parent document must vault this completed form with the document evaluated.

NF-002-5 (2/94)

1.5 References

1. "Clinton Power Station Updated Safety Analysis Report", Revision 6 Appendix E, Subsection 3.4.1.5, Figures FP-10a, 10b, 11a and 11b. Appendix F, Subsections 3.3.1.2, 3.3.1.3, and 4.2.4.5, Cable Tray Figure 9, Deviation Figure 4.2.4.5-2 and 4.2.4.5-3, Section 9.5-1.

2. "Clinton Power Station Technical Specifications", Amendment 93, Section 6.8.4.e.

3. 10 CFR 50 Appendix R, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979", Section III.G.

4. Generic Letter 86-10, "Implementation of Fire Protection Requirements".

5. Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers".

6. NRC Information Notice IN 94-22, "Fire Endurance and Ampacity Derating Test Results of 3-hour Fire Rated Thermo-Lag 330-1 Fire Barriers".

7. CPS Operating License, License Condition 2-F.

8. NSED Calculation IP-M-0177, "Fire Loads for CPS Fire Zones", Rev. 3.

9. NSED Calculation IP-M-0204, "Evaluation of Thermo-Lag Fire Barrier in Fire Zone CB-1e", Rev. 0.

10. NSED Calculation IP-M-0391, "Detailed Fire Modeling for Fire Zone CB-1e", Rev. 0.

11. EPED Calculation 19-AI-8, "Derating for 3-hour TSI Tray Wrap", Rev. 6.

12. NSED Standard ME-08.00, "Thermo-Lag Combustibility Evaluation Methodology Plant Screening Guide", Rev. 0.

13. NSED Standard ME-09.00, "NEI Application Guide for Evaluation of Thermo-Lag Fire Barrier Systems", Rev. 1.

14. EPRI Final Report TR-100370, dated April 1992 (including Revision 1), "Fire Induced Vulnerability Evaluations (FIVE)".

1.5 References (continued)

15. Condition Report 1-92-07-024, "NRC Bulletin 92-01; Indeterminate Fire Rating of Thermo-Lag", Rev. 0.

16. CPS Procedure 1001.06, "CPS Fire Brigade", Rev. 4.

17. CPS Procedure 1893.02, "Fire Prevention - Control of Ignition Source", Rev. 5.

18. CPS Procedure 1893.03, "Control of Flammable and Combustible Liquids and Combustible Materials", Rev. 7.

19. CPS Procedure 1893.04, "Fire Fighting", Rev. 6.

20. CPS Procedure 1893.04 M320, "737' Control: General Access, Prefire Plan" Rev. 3.

21. CPS Procedure 4200.01, "Loss of A. C. Power", Rev. 8.

22. CPS Procedure 1893.04M330, "751' Control: HVAC Mezzanine Prefire Plan," Rev. 3.

23. Illinois Power Policy Memorandum PM 1.05, "No Smoking Rules, Enforcement of:, Rev. 0.

24. CPS Procedure 1091.01, "Housekeeping", Rev. 10.

25. EPED Calc. 19-G-31, "Ampacity of Control Cables in Completely Filled Trays", Rev. 0.

BLOCK A.1 Continued

Reason for Thermo-Lag in Fire Zone CB-1e
The Thermo-Lag 330-1 cable fire wrap in fire zone CB-1e was originally installed to meet the requirement of 10 CFR 50, Appendix R, Section III.G. The current USAR description in Section 9.5-1 states that deviations from Appendix R requirements will be provided in the Clinton Safe Shutdown Analysis, Section 4.2.

Appendix R Requirement

Appendix R subsections III.G.2.a, III.G.2.b and III.G.2.c address specific requirements for the protection of safe shutdown capability in the event of a fire. Appendix R requires compliance with one of the three alternatives outlined by the three subsections.

Appendix R, III.G.2.a requires:

the separation of cable and equipment and associated non-safety circuits of redundant trains by a fire barrier having a 3-hour rating.

Appendix R, III.G.2.b requires:

1. 20 feet of separation, with no intervening combustibles, between redundant cables, equipment and associated non-safety circuits,
2. fire detectors and
3. automatic fire suppression system.

Appendix R, III.G.2.c requires

1. enclosure of the component of one redundant train in a fire barrier having a 1-hour rating,
2. fire detectors and
3. automatic fire suppression system.

94-0074

CPS Compliance with Appendix R in Fire Zone CB-1e

While the Appendix R requirements refer to fire areas, the CPS fire areas have been further divided into fire zones using natural boundaries. The use of fire zones is consistent with the NRC guidance provided in GL 86-10, Question and Answer Section 3.1.5., and CPS USAR Appendix F, Safe Shutdown Analysis. The impact of the proposed change is limited to fire zone CB-1e, it does not impact the other fire zones in fire area CB-1.

In fire zone CB-1e, the original design utilized the option of 1-hour fire barrier (III.G.2.c) using Thermo-Lag to enclose the trays of Division 2 safe shutdown power, instrumentation and control cables. An ionization fire detection system is provided for the entire fire zone. In addition, automatic wet pipe sprinklers are provided that cover Division 1 and 2 cables in the shared area, as shown in CPS 1893.04M320 and CPS 1893.04M330. This combination of options is consistent with the NRC guidance provided in GL 86-10, Question and Answer Section 3.5.1.

The proposed deviation is from the requirement of 10CFR50, Appendix R, Section III.G for a 1-hour fire barrier. It is proposed that the USAR delete references to the 1-hour rating of the Thermo-Lag fire wrap in fire zone CB-1e.

As discussed in Generic Letter 86-10, Paragraph F, a deviation from a commitment made in the FSAR is governed by the provisions of 10CFR50.59. The CPS Operating License Condition 2-F states, "IP may make changes to the approved fire protection program without prior approval of the commission only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire."

This Thermo-Lag safety evaluation is consistent with Generic Letter 86-10 guidance, the CPS fire protection licensing condition and with the CPS process for revising the fire protection program elements contained in the USAR.

BLOCK A.2 continued

Proposed Deviation

The deviation proposed to be included in the USAR Appendix F, Section 4.2 states, "In fire zone CB-1e, the Thermo-Lag 330-1 material providing a fire barrier function for the Division 2 power, control and instrumentation cables is not qualified as a 1-hour rated installation."

Summary of Justification for Deviation

The Appendix R Subsection III.G requirements concern the ability to achieve and maintain safe shutdown. The deviation from the requirement for a 1-hour rated fire barrier enclosing one division of safe shutdown cables in fire zone CB-1e is justified on the basis that several design and programmatic fire protection features are in place at CPS to *ensure that the safe shutdown capability is maintained.* The following is an outline of the defense-in-depth features.

> NOTE:
> More detailed discussion of each of these features is provided later in this section of the safety evaluation.

1. It is not credible to postulate a fire capable of affecting Safe Shutdown cables in fire zone CB-1e due to the administrative controls and the physical design of fire zone CB-1e.

2. Fire modeling of the fire zone CB-1e has shown that the fixed and transient combustibles, either individually or collectively, present no credible risk of safe shutdown cable damage in fire zone CB-1e.

3. In the event that a fire occurs in fire zone CB-1e, it is not credible to postulate damage to both the redundant divisions of safe shutdown cable trays due to the location of the cable tray stacks (high, horizontal tray runs), and the presence of the wet pipe sprinkler system.

4. Even if no credit is taken for the wet pipe sprinkler system extinguishing the fire, the as-built Thermo-Lag cable wrap will protect the wrapped Division 2 safe shutdown cable trays for a duration sufficient to permit manual fire fighting by the CPS fire brigade.

Justification for Deviation (continued)

5. In the event that the fire is not extinguished by both the sprinkler system or by the fire brigade, the Probabilistic Risk Assessment (PRA) evaluation did not identify any safety benefit, with regard to core damage prevention, containment isolation, containment heat removal or containment hydrogen control provided by the Thermo-Lag installed in fire zone CB-1e.

6. In the unlikely event of a fire in CB-1e that disables both divisions of redundant safe shutdown equipment, it is reasonable to expect that operator training, Emergency Response Organization (ERO) activation, and symptom-based procedures provide a final line of defense to ensure plant safety.

1. Detailed Justification for Deviation

Administrative Controls and Fire Zone Layout

Several CPS administrative controls currently in place and the layout of this fire zone minimize the potential for fire initiation in fire zone CB-1e.

(a) Administrative Control

- CPS procedure 1893.02, "Fire Protection - Control of Ignition Sources", establishes controls for hot work including welding, grinding, flame cutting, brazing and soldering operations. This procedure requires precautions to be taken (such as removing or protecting nearby combustibles and posting of a fire watch) prior to the start of hot work in order to minimize the potential for fire ignition.

- CPS procedure 1893.03, "Control of Flammable and Combustible Liquids and Combustible Materials", governs the handling and limitation of the use of combustible solids and liquids and flammable liquids. This procedure limits the quantities of transient materials that can be introduced into the safety related areas of the plant and prescribes area clean-up, adequate ventilation, access for fire protection equipment, etc., in order to minimize the potential for fire initiation and extent of fire propagation.

- Illinois Power enforces a no smoking policy within the company buildings as outlined in Policy Memorandum PM 1.05, "No Smoking Rules, Enforcement of". Noncompliance with this policy results in disciplinary action up to and including termination. Additionally, smoking is prohibited in this fire zone by CPS procedure 1019.01, "Housekeeping".

1. **Administrative Controls and Physical Layout (continued)**

(b) Physical Layout

- The walls of fire zone CB-1e are either 18-inch minimum reinforced concrete, 15-5/8-inch solid concrete block, or 7-5/8-inch minimum hollow concrete block. The portion of the south wall adjacent to the diesel-generator rooms (Fire Zones D-4a, D-5a, and D-6a) and the north wall adjacent to the radwaste building above elevation 751 feet and the west wall adjacent to the auxiliary building are 3-hour fire rated. The two enclosed stairways and two enclosed elevators are 1.9-hour fire rated. The remaining walls are not fire rated (exterior walls are not fire rated unless there is an exterior exposure hazard). The floor of the general access area is 20-inch minimum reinforced concrete with eleven 4-inch floor drains and one 2-inch drain to a sump in Zone CB-1b. The floor of the secondary level is 8-inch reinforced concrete and has thirteen 4-inch floor drains to a sump in Zone CB-1b. The ceiling is 8-inch minimum reinforced concrete. There are three open areas to the fire zones above and below. These areas consist of a west pipe hatch at column row 125-AC, an east pipe hatch at 135-AC, and an equipment hatch located at column row 132-133, AA-AC. There are two open stair systems to the secondary floor. Although the floors, ceiling, and some walls are fire-rated, the substantial concrete and block construction provides structural separation for this zone from adjacent fire zones. In addition, wherever cable trays pass through floors or ceilings, the openings are sealed with a 3 hour fire rated material.

- Fire zone CB-1e is a relatively open area, providing access to the diesel generator rooms and has a relatively large degree of spatial separation between pieces of equipment which could be sources of ignition.

- Since the cable trays are all located high in this fire zone, it is not credible to postulate safe shutdown cable damage due to a fire originating at the floor.

With these administrative controls and the physical design of this fire zone, it is not credible to postulate a fire capable of affecting safe shutdown cables in fire zone CB-1e.

94-0074

2. **Fire Modeling**

A detailed fire modeling analysis, NSED Calculation IP-M-0391, Revision 0, was performed for fire zone CB-1e. It took into account all potential fixed and transient ignition sources, spatial locations and heat release rates within fire zone CB-1e, the room volume of fire zone CB-1e, and the spatial locations and damage temperatures of all potential targets within fire zone CB-1e. The modeling methodology and assumptions were primarily taken from EPRI Fire Induced Vulnerability Evaluation (FIVE) guide. This fire model was conservative in that no credit was taken for the following:

- the equipment hatch and pipe chase openings in the ceiling to fire zone CB-1f above, which would further prevent formation of a hot gas layer
- the substantial concrete and block construction of the floor, walls, and ceiling, which would absorb more energy than the 70% value used in the fire model
- the installed wet pipe system which further reduces the potential for cable damage
- the solid bottoms on all cable trays in fire zone CB-1e which would minimize the tray-to-tray fire propagation within a cable tray stack and reduce temperature at the cables by acting as heat sinks
- the Thermo-Lag, installed on the Division 2 power, instrumentation and control cables which would reduce the temperatures at the wrapped cables

The fire modeling results show that no significant impact on plant safety would result from a fire involving any potential fixed or transient ignition source. Fire modeling also shows that a hot gas layer can not be formed. This is due to the following factors in fire zone CB-1e:

- the use of conduit for all cables not routed in cable trays
- the high floor-to-ceiling height (24 feet) between AA and AC lines, which is the area where Division 1 and Division 2 safe shutdown cables are routed within 20 feet of each other, and large floor area (18,072 ft^2)
- the large distances between potential ignition sources and targets

2. **Fire Modeling (continued)**

- the use of IEEE-383 qualified EPR - Hypalon cable insulation

- the absence of any credible oil-pool type fire scenarios

The detailed fire modeling shows that even if a fire were to occur in fire zone CB-1e, it would not result in loss of safe shutdown capability.

3. **Fire Protection Design Features**

As shown in Enclosure 1, the Division 1 safe shutdown cable trays enter fire zone CB-1e from the northwest corner, west wall (from the Auxiliary Building) and are routed south until reaching the corridor between the AA and AC lines. At this point the cables turn east to connect to risers feeding the upper elevations of the control building, Division 1 MCC's on the 737 feet elevation, and then pass through the AC line wall to the Division 1 diesel generator room. The Division 2 safe shutdown cables enter the fire zone CB-1e from the north end of the fire area by risers from the 719 feet elevation and are routed south from the S line along column 129. These trays feed the Division 2 MCC's on the 737 feet elevation, the risers to the upper elevations of the control building, and connect to trays that pass through the AC line wall into the Division 2 diesel generator room. In the area between AA and AC lines, on each side of column line 129, the two divisions of tray are separated by less than the 20 feet discussed in Appendix R. The trays are installed at least 15 feet 6 inches above the 737 feet elevation floor (7 feet 6 inches above the mezzanine floor) with the lowest Division 1 tray being at 753 feet 6 inches and the lowest Division 2 tray at 752 feet 6 inches. There is no cross-divisional stacking of the trays; that is, Division 2 trays never pass over Division 1 trays, and vice versa.

Wet pipe sprinklers are provided that cover Division 1 and 2 cables in the shared area, as shown in CPS 1893.04M320 and CPS 1893.04M330. If a fire starts in either the Division 1 or 2 cable trays, or the general area below the cable trays, it would be suppressed by the wet pipe, 165°F rated fusible link sprinkler system.

In summary, in the event that a fire occurs in fire zone CB-1e, it is not credible to postulate damage to both the redundant divisions of safe shutdown cable trays due to the location of the cable tray stacks (high, horizontal tray runs) and the presence of the wet pipe sprinkler system.

4. Thermo-Lag Fire Endurance

NRC's Generic Letter 92-08 identified concerns related to the fire endurance capability of Thermo-Lag 330-1 material and the evaluation and application of fire tests to determine the fire endurance ratings of Thermo-Lag 330-1 fire barriers. Condition Report 1-92-07-024 documents the concerns identified by NRC Bulletin 92-01 with regard to the indeterminate fire rating of Thermo-Lag fire barriers. An engineering calculation, IP-M-0204, was performed to determine the fire endurance capability of the as-built Thermo-Lag installation in fire zone CB-1e with regard to its capability to perform its fire barrier function under ASTM-119 fire conditions.

Three cable trays in fire zone CB-1e are wrapped with Thermo-Lag 330-1 fire barrier material. The fire wraps on Division 2 safe shutdown power, instrumentation, and control cable trays, were intended to be fire rated barriers to meet the Appendix R Section III.G.2.c requirement for a 1-hour rated fire barrier.

Per Enclosure 6, the Division 2 instrumentation tray does not contain any safe shutdown cables. Calculation IP-M-0204 took into account Division 2 safe shutdown power and control trays only.

Calculation IP-M-0204 utilized NSED Standard ME-09.00, "NEI Application Guide for Evaluation of Thermo-Lag Fire Barrier Systems". The guide was issued by the Nuclear Energy Institute (NEI) and provides the industry with the data and the methodology necessary for evaluating Thermo-Lag fire barriers. The information provided by the guide was obtained from NEI and utility fire barrier endurance test programs.

Based on detailed analysis using the NSED Standard ME-09.00 methodology, NSED Calculation IP-M-0204 determined the fire endurance capability of the CPS as-built Thermo-Lag 330-1 fire barrier installation in fire zone CB-1e to be at least 28 minutes. This methodology assumes the fire wrap to be subjected to an ASTM E-119 standard time-temperature curve. These temperatures are much higher than those resulting from any credible fire scenario in this fire zone. The Thermo-Lag would, therefore, have a longer endurance under a realistic fire scenario. Additionally, the cable "failure temperature" used in this methodology (approximately 325°F) is significantly lower than a more realistic cable failure temperature (approximately 700°F).

94-0074

4. Thermo-Lag Fire Endurance (continued)

NSED Calculation IP-M-0177, Rev. 3, shows that the calculated equivalent fire severity in fire zone CB-1e is 29 minutes. NSED Standard ME-06.00, "Guidelines for Determining Fire Loads and Preparing Fireload Calculations", provides the methodology for calculating fire loads and equivalent fire severities in CPS fire zones. This methodology requires all material that is not classified as non-combustible to be included as fire loads. As a result, approximately 80% of the fire load in fire zone CB-1e is due to the cable insulation and 10% of the fire load is due to Thermo-Lag itself. Both the IEEE-383 qualified cable with EPR Hypalon insulation and Thermo-Lag 330-1 have high (greater than 900°F) ignition temperatures. As explained in the fire modeling discussion, it is not credible to postulate a temperature of this magnitude at the elevations of the cables in this fire zone. The realistic equivalent fire severity in this fire zone would therefore be significantly less than the calculated 29 minutes.

In the event of a fire in CB-1e, the main control room will receive annunciation of the sprinkler system actuation and the activation of multiple fire detectors in the fire zone. Manual fire fighting by the fire brigade is facilitated by the location of hose stations and portable extinguishers in this fire zone, in fire zone A-2d west of zone CB-1e at elevation 737 feet Auxiliary Building and fire zone R-1i north of zone CB-1e at 737 feet Radwaste Building. Fire Brigade cages are located at both 737 feet Turbine and 737 feet Radwaste Buildings. Also available at 737 feet Turbine are additional hose stations and portable extinguishers.

The CPS fire brigade is available and onsite at all times, with the Shift Supervisor having the Commander of the Fire Brigade designation. The fire brigade composition, function and fire fighting guidance are provided in CPS procedures 1001.06, "CPS Fire Brigade", 1893.04, "Fire Fighting" and the 1893.04 M320 and 1893.04M330 which provides the detailed pre-fire plan for fire zone CB-1e.

CPS fire drills record the time from the Gaitronics announcement of fire to when the fire brigade is ready to start fire fighting at the scene. No fire drills have been held specifically for CB-1e at this time, but drills held in adjacent zones have shown that CB-1e is easily accessible and attackable from several approaches. The Gaitronics announcement from the control room is expected to be prompt since more than one ionization detector from CB-1e would alarm, and smoke communicating through the ceiling openings would cause alarms from adjacent zones. CB-1e is normally not a high radiation or contaminated area. Also, CB-1e is a high traffic area, raising the probability that any fire or fire hazard would be detected at an early stage. It is therefore concluded that the CPS fire brigade would be able to respond to a fire within the calculated time of Thermo-Lag endurance.

4. Thermo-Lag Fire Endurance (continued)

In summary, even if no credit is taken for the wet pipe sprinkler system extinguishing the fire, the as-built Thermo-Lag cable wrap will protect the Division 2 safe shutdown cable trays for a duration sufficient to permit effective manual fire fighting by the CPS fire brigade.

5. Thermo-Lag Safety Benefit

The Probabilistic Risk Assessment (PRA) evaluation which analyzes the safety significance of potential Thermo-Lag fire barrier failure in fire zone CB-1e is included as Enclosure 3 of this safety evaluation. This analysis, consists of three major parts.

- The first part of the analysis is to identify all modeled components that could be affected by a fire in zone CB-1e and the basic events in the IPE model that represent these components. This list of components contains not only the equipment located within the fire zone, but also the equipment located outside this fire zone that are affected by damage to cables in this fire zone. This part also identifies the basic events (equipment failures) in the IPE model that are protected by Thermo-Lag. Part 1 is described in attachments PRA-1 and PRA-4 of Enclosure 3.

- The second part of the analysis involves calculating the conditional core damage probability (CCDP) for two different situations using the basic events list from Part 1 as an input. The first situation is Thermo-Lag failing to perform adequately as a fire barrier. This is the postulated "worst case" in which a fire occurs and all cables and equipment in the fire zone are damaged. The second situation is Thermo-Lag performing its intended fire barrier function in which all cables not wrapped by Thermo-Lag are damaged by a postulated fire. Attachments PRA-2 and PRA-5 of Enclosure 3 describe the CCDP determination.

  While preventing core damage is an important consideration for plant safety, maintaining containment integrity by protecting containment isolation and heat removal capabilities is also a concern. Additionally, containment analysis in the IPE report identified the loss of containment hydrogen control as a major cause of containment failure. Correspondingly, the effect of a fire in zone CB-1e on these functions was also examined. This analysis is detailed in attachments PRA-2 and PRA-5 of Enclosure 3.

5. **Thermo-Lag Safety Benefit (continued)**

- The third part of the analysis was to determine the fire ignition frequency in zone CB-1e. This calculation utilizes the methodology described in the Fire-Induced Vulnerability Evaluation (FIVE) Guide, EPRI TR-100370 and the Fire Risk Analysis Implementation Guide, EPRI Project 3385-01. Ignition frequency calculation is described on attachments PRA-3 and PRA-6 of Enclosure 3.

  The results of this analysis showed that the CCDP calculated for each of the two situations (Thermo-Lag failing and Thermo-Lag performing its design function) was identical. Additionally no benefit from Thermo-Lag was found to exist for containment isolation, containment heat removal or containment hydrogen control.

  In summary, no safety benefit was identified with regard to core damage prevention, containment isolation, containment heat removal or containment hydrogen control is provided by the Thermo-Lag installed in fire zone CB-1e.

6. **Operator Response to Fires Affecting Safe Shutdown Equipment**

While it is not possible to predict exactly what equipment will be lost or impaired due to any given fire, it is possible to assume "worst-case" for an area of the plant involved in a fire. For the areas involving safe shutdown equipment, the issue becomes knowing what is left for the operator to use for any given fire. The operator is trained to control plant parameters per the Emergency Operating Procedures (EOP's) independent of the cause of the off-normal/emergency conditions. That is, the EOP's are symptom-based and not event-based. In this sense, equipment loss due to multiple failures, sabotage, seismic event, etc., is not different from equipment loss due to fire. The operators are given a list of systems to use, not necessarily in a preferential order (what is used is based on what will work).

94-0074

6. Operator Response to Fires Affecting Safe Shutdown Equipment (continued)

The operating crews receive intense, continuing training on the EOP's with multiple equipment failures and on loss of power events. Procedural guidance exists in CPS Procedure 4200.01, "Loss of AC Power" for a Station Black Out (SBO). These steps guide the operator actions to minimize the impact on plant equipment while preserving the equipment that is left. For fires that affect systems to an extent less than an SBO, portions of the Loss of AC Power procedure will apply. CPS crews have demonstrated the ability to implement these procedures while maintaining the reactor in a safe condition. A loss of offsite power concurrent with a fire in CB-1e resulting in the loss of RCIC, Division 1 and 2 NSPS power, and all Division 1 and 2 equipment was simulated on the CPS simulator and the operator actions resulted in achieving hot shutdown and maintaining stable reactor parameters.

Emergency Plan Procedure EC-02 directs activation of the Emergency Response Organization (ERO) during any significant plant fire. While minimum shift manning will allow for successfully achieving hot shutdown conditions, the additional resources provided by the ERO will be valuable in minimizing the impact of the fire on the plant and assisting with recovery and repairs.

In summary, in the event of a fire in CB-1e that disables both divisions of redundant safe shutdown equipment, it is reasonable to expect that operator training, ERO activation and symptom-based procedures provide the final line of defense to ensure plant safety.

Evaluation of Ampacity Derating Impact of Thermo-Lag

The ampacity derating factors for cables in raceway wrapped by Thermo-Lag has become a concern due to questions raised in Generic Letter 92-08. The NRC questions are related to the original Thermo-Lag manufacturer's recommended ampacity derating factors as well as the wide range of ampacity derating factors applied across the industry. In Information Notice (IN) 94-22, the NRC provided some preliminary information about the results of tests the NRC had conducted to establish ampacity derating factors for cables in conduits and trays wrapped by Thermo-Lag 330-1 fire barrier material.

Evaluation of Ampacity Derating Impact of Thermo-Lag (continued)

Ampacity limits are placed on cables to ensure that the cables will operate within their design parameters and are unrelated to a fire scenario. Without ampacity limitations, the current carried by a cable could generate too much heat and result in the cable operating at a temperature above its design rating, thus causing a reduction in the cable's design life. The cables utilized at CPS are rated for 90°C operation and the ampacity limits selected were based on that value. Since different installation configurations (such as covered trays, or fire stops) can limit the dissipation of the heat generated by the current passing through the cable, derating factors were developed to further restrict the current which the cable will be allowed to carry when these configurations are part of the cable routing.

The CPS design defined the boundary between power, control, and instrumentation circuits based on both voltage and current levels. Separate raceways are provided for the different cables so that instrument cables are isolated from noise that could be generated by the power and control cables and the control cables are separated from the heat and induced voltage that could be generated by the power cables. As shown by NSED Calculation 19-G-31, Rev. 0, the currents passing through control and instrumentation cables do not generate sufficient heat to challenge the cable design ratings.

Enclosure 4 identifies the CPS power cables protected by Thermo-Lag 330-1 fire barrier material and the available ampacity margin for each cable in fire zone CB-1e. A review of this data indicates that the power cables wrapped by Thermo-Lag 330-1 in fire zone CB-1e could be derated by as much as 35% or more without impacting their design functions or design life. The highest ampacity derating identified in IN 94-22 is 46.4% for a #8 AWG conductor in a tray wrapped by a 3-hour rated Thermo-Lag 330-1 fire barrier. The Enclosure 4 ampacity evaluation concludes that the NRC ampacity derating concerns expressed in IN 94-22 will not have adverse impact on the two most heavily loaded power cables (120 and 22 amps respectively) in fire zone CB-1e. This conclusion was reached upon comparing conservatism chosen in the CPS design ampacity limits with the derating methodology used by the NRC in IN 94-22. Since the two most heavily loaded cables will not be impacted by the concerns expressed in NRC's IN 94-22, the rest of the cables in fire zone CB-1e are also acceptable from the ampacity derating view point.

Currently, there exist no conclusive ampacity derating factors for cables wrapped by Thermo-Lag 330-1 fire barriers due to the many outstanding issues with regard to past tests and test results; however, as discussed above, the Thermo-Lag cable tray fire wrap in fire zone CB-1e does not adversely impact the current carrying capability of the cables.

SAFETY EVALUATION FORM

BLOCK D, Part I

1. Failures associated with a design-basis fire in fire zone CB-1e are discussed in USAR Appendix F, Fire Protection Safe Shutdown Analysis (SSA), Subsection 3.3.1.

   Currently, Subsection 3.3.1.2 states "in order to ensure that one shutdown method will be available, the Division 1 and 2 cable trays will be protected as described in section 3.3.1.3.2".

   Currently Subsection 3.3.1.3.2 states, "Division 2 cable trays and risers will be protected by a 1-hour fire rated material that extends 20 feet beyond the closest Division 1 cable tray and riser".

   These Subsections, 3.3.1.2 and 3.3.1.3.2, are proposed to be revised based on a new deviation to be added to Subsection 4.2.2.16. The new deviation will eliminate the reference to the 1-hour fire rating of Thermo-Lag. The justification for this deviation, and for removing the subsections 3.3.1.2 and 3.3.1.3.2 wording which implies that there is a safe shutdown concern if the 1-hour rated fire wrap is not installed, is provided in detail under the Block A.2 discussions.

2. For the reasons provided in the Block A.2 discussion, the performance of the safe shutdown systems in fire zone CB-1e is not adversely impacted by the Thermo-Lag fire rating being changed from 1-hour to no specific rating.

3. Even though the Thermo-Lag fire rating is now considered to be less than 1-hour and the reference to the rating is deleted, this reduced capability of the Thermo-Lag fire wrap does not cause any new failure modes. The justification for the reduced capability being acceptable is provided in the Block A.2 discussion.

4. The USAR Appendix F, Safe Shutdown Analysis, documents the capability of the CPS safe shutdown systems to achieve and maintain cold shutdown condition in the event of a single fire anywhere in the plant with a loss of offsite power. As explained by the Block A.2 discussion, it is not credible to postulate a fire scenario capable of adversely affecting the Safe Shutdown capability in fire zone CB-1e despite the reduced Thermo-Lag capability.

5. The probability of the failures evaluated in the USAR is not impacted as discussed in the Block A.2 discussion.

BLOCK D, Part II

1, 2, and 3. The accidents identified in the USAR are not affected by the proposed change to the Thermo-Lag fire wrap rating in fire zone CB-1e. As explained in the Block A.2 discussion, the plant safe shutdown capability in the event of a fire in CB-1e is not adversely impacted. The consequences or the probability of a fire in CB-1e is not impacted.

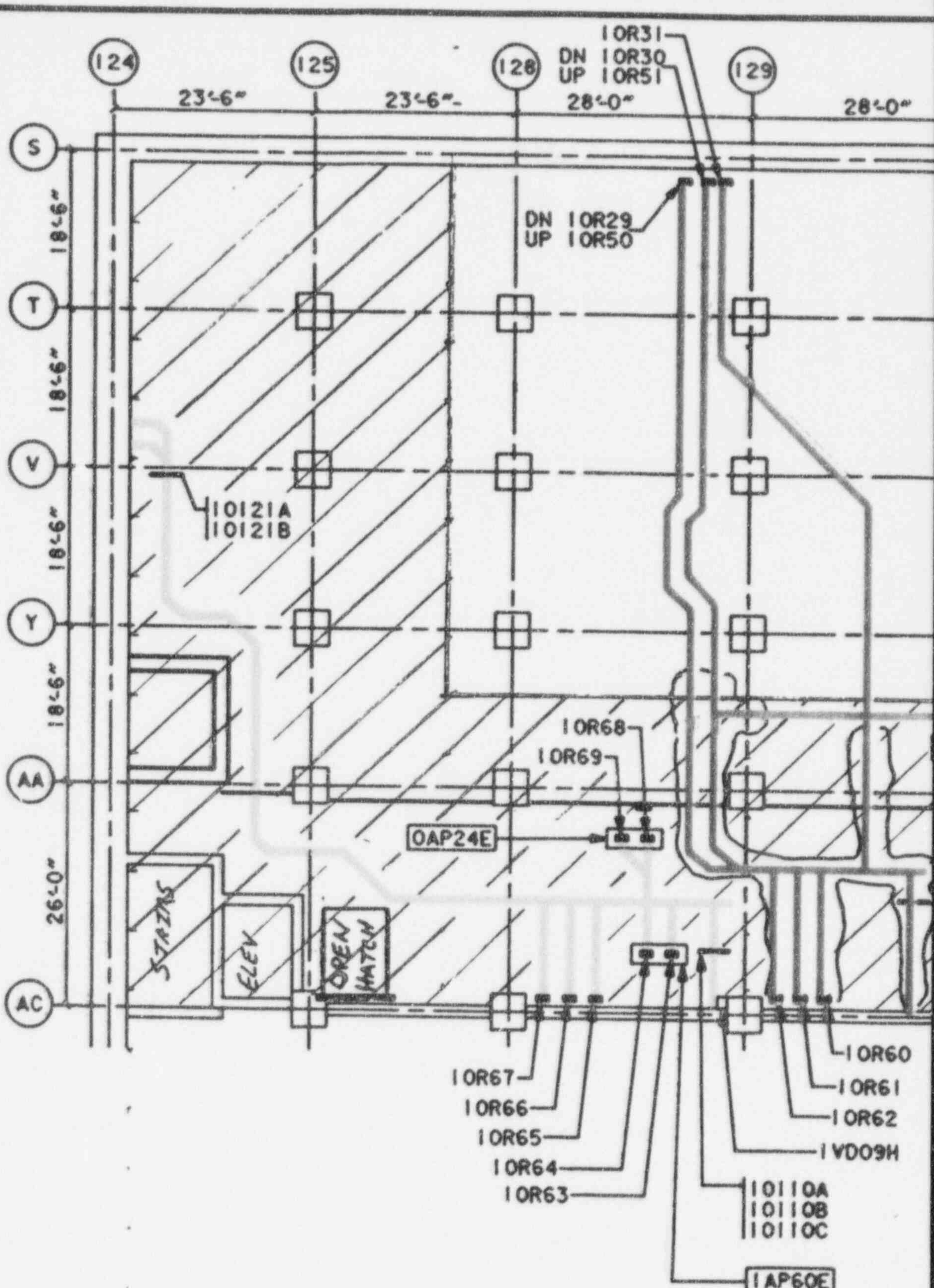
BLOCK D, Part III

1 and 2. As explained in the Block A.2 discussion, the Thermo-Lag combustibility and ampacity derating concerns were evaluated and found to have no impact on fire zone CB-1e safe shutdown capability. No new type of accident or equipment malfunction was identified.

BLOCK D, Part IV

1 and 2. Neither the protective barriers, the approach to the acceptance limits for any of the protective barriers, nor the margin of safety is directly affected by this change. The safe shutdown capability in fire zone CB-1e has been determined to be acceptable after the impact of the change was evaluated as explained in the Block A.2 discussion.

3. The CPS Fire Protection Program as stated in Tech. Spec. 6.8.4.e is unchanged. The bases of the Technical Specifications is not affected by this change.

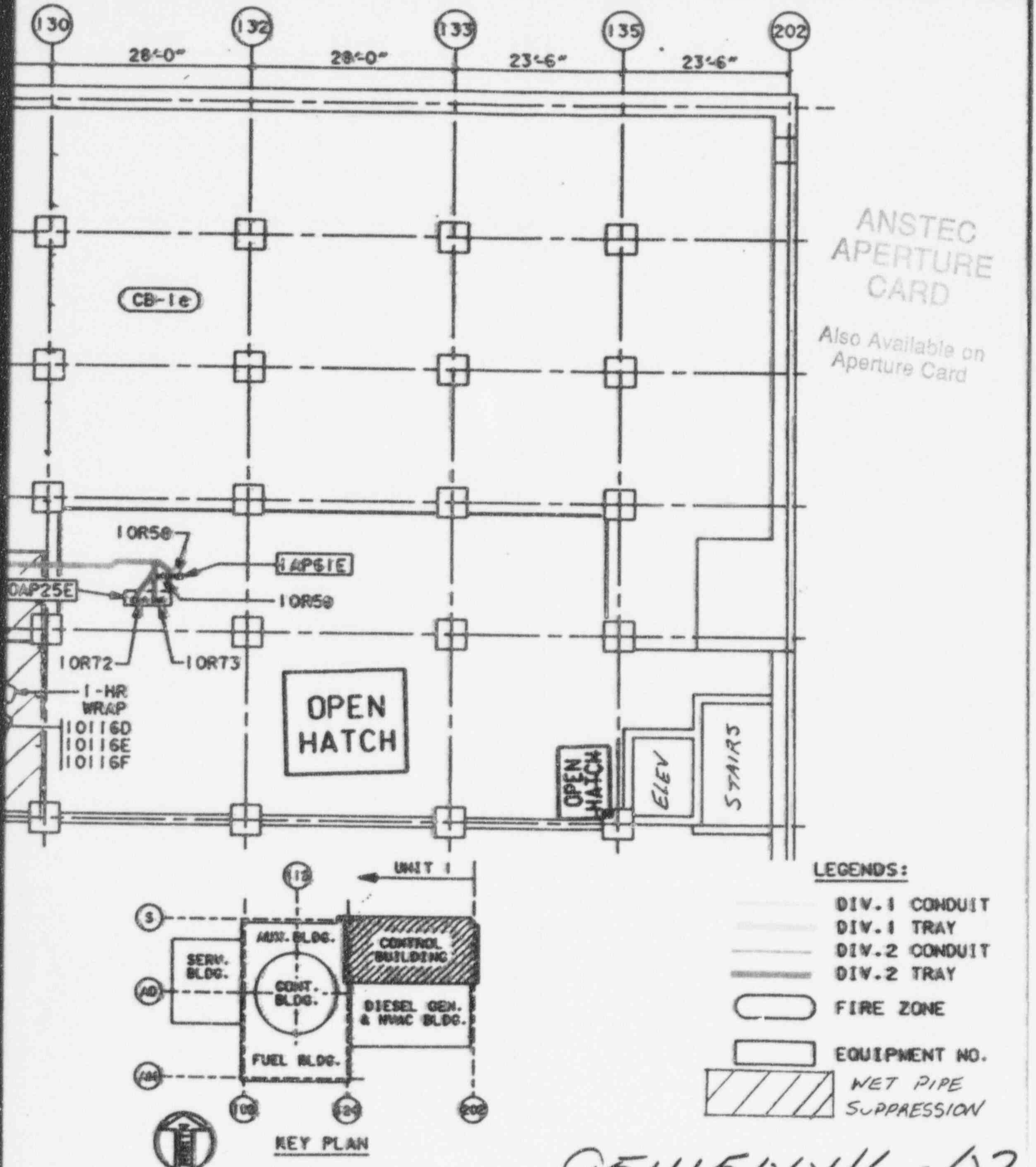


FIRE ZONE CB-1e

Physical Layout and Safe Shutdown Cable Routing

S&L ECAD FILE: CLIET1.4

Enclosure I



9511150046-02

Division II Safe-Shutdown Cables Protected by Thermo-Lag in Fire Zone CB-1e

Raceway	Cable Number	FIREZ. CB-1E	Cable Function
P2R	1RP02C	X	125VDC feed from 1DC14E to 1C71-S001B (Div2 NSPS inverter). Loss of feed causes inverter to transfer to alternate source, 1RP02E.
P2E	1AP29B	X	4KV feed from 1AP09EB to 4160V/480V xfmr of unit sub 0AP06E
P2E	1AP34N	X	125VDC control power main feed from 1DC14E to 0AP06E
P2E	1AP34V	X	125VDC control power reserve feed from 0AP06E to 1AP12E
P2E	1AP34W	X	125VDC control power reseve feed from 1AP12E to 0AP06E
P2E	1AP37D	X	480V feed from 0AP06E to Control bldg MCC 0AP57E. Parallels 1AP37J
P2E	1AP37J	X	480V feed from 0AP06E to Control bldg MCC 0AP57E. Parallels 1AP37D
P2E	1DG21J	X	125VDC control power feed from 1DC14E to Div 2 DG control pnl 1PL12JB
P2E	1DG29A	X	480V feed from DG MCC 1AP61E to air compressor motor 1DG02CA.
P2E	1DG30A	X	480V feed from DG MCC 1AP61E to air compressor motor 1DG02CB.
P2E	1DO02A	X	480V feed from MCC 1AP61E to DG fuel oil transfer pump 1DO01PB
P2E	1SX27A	X	480V feed from 1AP61E to 1SX019B (flow control vlv for 0VC13CB hx). Loss of cable prevents valve operation.
P2E	1SX31A	X	480V feed from 1AP61E to 1SX063B (DG 1B hx outlet valve). Loss of cable will leave valve in last position.
P2E	1SX40A	X	480V feed from 1AP61E to 1SX017B (0VC13CB hx inlet valve). Loss of feed leaves valve in last position.
P2E	1VC25B	X	480V feed from0AP25E to 0FZ-VC103A (damper 0VC21YB operator). Loss prevents damper operation.
P2E	1VC25C	X	480V feed from0AP25E to 0FZ-VC103B (damper 0VC24YB operator). Loss prevents damper operation.
P2E	1VC25D	X	480V feed from0AP25E to 0FZ-VC103C (damper 0VC27YB operator). Loss prevents damper operation.
P2E	1VC26B	X	480V feed from 0AP25E to 0TZ-VC135 (damper 0VC14YB operator). Loss prevents damper operation.
P2E	1VC26C	X	480V feed from 0AP25E to 0TZ-VC134 (damper 0VC13YB operator). Loss prevents damper operation.
P2E	1VC26D	X	480V feed from 0AP25E to 0TZ-VC133 (damper 0VC12YB operator). Loss prevents damper operation.
P2E	1VC27B	X	480V feed from 0AP25E to 0FZ-VC103D (damper 0VC30YB operator). Loss prevents damper operation.
P2E	1VC27C	X	480V feed from 0AP25E to 0FZ-VC103E (damper 0VC33YB operator). Loss prevents damper operation.
P2E	1VC27D	X	480V feed from 0AP25E to 0FZ-VC103F (damper 0VC36YB operator). Loss prevents damper operation.
P2E	1VC28B	X	480V feed from 0AP25E to 0TZ-VC138 (damper 0VC17YB operator). Loss prevents damper operation.
P2E	1VC28C	X	480V feed from 0AP25E to 0TZ-VC137 (damper 0VC16YB operator). Loss prevents damper operation.

Division II Safe-Shutdown Cables Protected by Thermo-Lag in Fire Zone CB-1e

Raceway	Cable Number	FIREZ. CB-1E	Cable Function
P2E	1VC28D	X	480V feed from 0AP25E to 0TZ-VC136 (damper 0VC15YB operator). Loss prevents damper operation.
P2E	1VC28F	X	480V feed from 0AP25E to 0TZ-VC139 (damper 0VC18YB operator). Loss prevents damper operation.
P2E	1VC35B	X	480V feed from 0AP25E to 0FZ-VC112 (damper 0VC03YB operator). Loss prevents damper operation.
P2E	1VC35P	X	480V feed from 0AP25E to 0FZ-VC096 (damper 0VC115YA operator). Loss prevents damper operation.
P2E	1VC50C	X	480V feed from 0AP25E to 0FZ-VC114 (damper 0VC01YB operator). Loss prevents damper operation.
P2E	1VC56B	X	480V feed from 0AP25E to 0FZ-VC103G (damper 0VC39YB operator). Loss prevents damper operation.
P2E	1VC56D	X	480V feed from 0AP25E to 0FZ-VC111 (damper 0VC08YB operator). Loss prevents damper operation.
P2E	1VD02A	X	480V feed from 1AP12E to 1VD01CB (Div2 DG room vent supply fan). Loss of vent fan impacts operation of Div 2 DG.
P2E	1VD05A	X	480V feed from 1AP61E to 1VD02CB (DG 1B oil room exhaust fan). Loss prevents fan operation.
P2E	1VD10A	X	480V feed from 1AP75E (MCC 1B1) to1TZ-VD002A (operator for outside air intake damper 1VD01YB). Damper fails closed .
P2E	1VD10B	X	480V feed from 1AP75E (MCC 1B1) to1TZ-VD002B (operator for return air damper 1VD02YB). Damper fails open .
P2E	1VD10C	X	480V feed from 1AP75E (MCC 1B1) to1TZ-VD002C (operator for exhaust air damper 1VD03YB). Damper fails closed .
C2E	1AP21K	X	Control tie between 1PL12JB (DG cntrl panel) and 1AP09EA (D2 4KV bus RAT feed bkr)
C2E	1AP21L	X	Control tie between 1PL12JB (DG cntrl panel) and 1AP09EA (D2 4KV bus RAT feed bkr)
C2E	1AP23L	X	Control tie between 1PL12JB (DG cntrl panel) and 1AP09EC (D2 4KV ERAT feed bkr)
C2E	1AP23M	X	Control tie between 1PL12JB (DG cntrl panel) and 1AP09EC (D2 4KV ERAT feed bkr)
C2E	1AP29Q	X	Control intertie between 1AP09EB and 0AP06E
C2E	1DG21A	X	Control intertie between 1PL12JB and MCR. Includes LOCA bypass, Auto-start signals, and annunciation.
C2E	1DG21B	X	Control intertie between 1PL12JB and MCR. Includes remote/local control, auto-start, remote start/stop, emergency stop.
C2E	1DG21C	X	Control intertie between 1PL12JB and MCR. Includes voltage and governor adjustments, and local/remote control.
C2E	1DG21D	X	Control intertie between 1PL12JB and MCC 1AP61E. Operates aux relays K18A/B, auto start relay, and lockout relay.
C2E	1DG21F	X	Control intertie between 1PL12JB and MCR. Provides CT output for MCR meters.

Division II Safe-Shutdown Cables Protected by Thermo-Lag in Fire Zone CB-1e

Raceway	Cable Number	FIREZ. CB-1E	Cable Function
C2E	1DG21K	X	Control intertie from brkr closing equalizing timer relay A14 in 1PL82JB to SX pump brkr 1AP09EG. Cable loss prevents start of SX pump 1SX01PB
C2E	1DG21L	X	Control intertie between 1PL12JB and field conditioning relay A13 in 1PL82JB
C2E	1DG21M	X	Control for boost signal from 1AP09EG (SX pump bkr) to 1PL12JB
C2E	1DG24A	X	Control and indication for Engine 1 circulating oil and turbo soak back pumps from 1PL12JB.
C2E	1DG25A	X	Control and indication for Engine 2 circulating oil and turbo soak back pumps from 1PL12JB.
C2E	1DG29B	X	Control and indication for 1DG02CA air compressor from 1PL12JB to MCC 1AP61E
C2E	1DG30B	X	Control and indication for 1DG02CB air compressor from 1PL12JB to MCC 1AP61E
C2E	1DG31C	X	Control, output of CT at 1AP09EH to differential relay in 1PL12J B.
C2E	1DG31D	X	Indication, output of CT at 1AP09EH to wattmeters and ammeters
C2E	1DG31E	X	Indication, output of PT at 1AP09EH to VAR, volt, and wattmeters
C2E	1DG31F	X	Control, output of PT at 1AP09EH to Loss-of -power(240-DG1B), reverse power(232-DG1B), and voltage control(251V-DG1B) relays.
C2E	1DG31K	X	Control, Close permissive(N.C.) and trip signal(N.O.) for bkr 1AP09EH
C2E	1DG31R	X	Control, governor droop control input from "b" contact of bkr 1AP09EH
C2E	1DG31S	X	Control, permissives for loss-of power(240-DG1B) and reverse-power(232-DG1B) relays(from "a" contacts). Trip signal for DG lockout relay from overcurrent aux relay.
C2E	1DG31T	X	Control, idle start circuit and control power for differential(287-DG1B) and loss-of-excitation(240-DG1B) relays
C2E	1DO02B	X	Control and indication for DG fuel oil transfer pump 1DO01PB between MCC 1AP61E and MCR.
C2E	1IP04A	X	120V power from MCC 0AP55EB to MCR for Main Steam Line leak detection devices in Turbine bldg. 1E31-N559B, 558B, 560B, 561B, 562B, and 563B.
C2E	1IP04B	X	120V power from MCC 0AP55EB to MCR 24V DC power supply 1UU-LV851A. Powers many Inst loops, DG fuel oil and day tank levels, sup pool temp and level, drywell and containment air press, SX B strainer outlet press, SGTS B train delta press, ADS air press
C2E	1LV14B	X	120V DISTR PNL CONT

Division II Safe-Shutdown Cables Protected by Thermo-Lag in Fire Zone CB-1e

Raceway	Cable Number	FIREZ. CB-1E	Cable Function
C2E	1LV14D	X	120V DISTR PNL CONT
C2E	1LV14E	X	120V DISTR PNL CONT
C2E	1LV14F	X	120V DISTR PNL CONT
C2E	1LV14G	X	120V DISTR PNL CONT
C2E	1LV14H	X	120V DISTR PNL CONT
C2E	1LV14J	X	120V DISTR PNL CONT
C2E	1LV14K	X	120V DISTR PNL CONT
C2E	1LV14L	X	120V DISTR PNL CONT
C2E	1LV14M	X	120V DISTR PNL CONT
C2E	1SX27B	X	Control from 0PL72JB to 1AP61E to operate 1SX019B when 0VC13CB is energized. Short keeps valve energized continuously, open prevents operation.
C2E	1SX31B	X	Control between 1SX063B limit switches and 1AP61E for operation and position indication. Loss prevents valve operation.
C2E	1SX31C	X	Control between 1AP61E and MCR for operation and indication of 1SX063B. Open prevents valve operation, short causes spurious operation.
C2E	1SX40B	X	Control between 1SX017B limit switches and 1AP61E for operation and position indication. Loss prevents valve operation.
C2E	1SX40C	X	Control between 1AP61E and MCR for operation and indication of 1SX017B. Open prevents valve operation, short causes spurious operation.
C2E	1VC02C	X	120VAC & 125VDC control between 0AP06E and MCR for 0VC03CB (VC B supply fan). Operates fan-heater interlock, ESF amber light, and annunciators.Loss impacts interlock , light, and annunciator.
C2E	1VC04C	X	120VAC & 125VDC annujnciation between 0AP06E and MCR for 0VC04CB (VC B return fan) and 0VC13CB (VC B chilled water chiller) for ESF amber lights and annunciators. Loss impacts annunciation.

Division II Safe-Shutdown Cables Protected by Thermo-Lag in Fire Zone CB-1e

Raceway	Cable Number	FIREZ. CB-1E	Cable Function
C2E	1VC25G	X	Control & annunciation between 0AP25E and 0PL72JB for dampers 0VC21YB, 24YB, and 27YB. Loss of circuit prevents damper operation and impacts ESF amber lights and annunciation.
C2E	1VC25O	X	Control from 0AP25E to 0FZ-VC103A (damper 0VC21YB operator). Loss prevents damper operation.
C2E	1VC25P	X	Control from 0AP25E to 0FZ-VC103B (damper 0VC24YB operator). Loss prevents damper operation.
C2E	1VC25Q	X	Control from 0AP25E to 0FZ-VC103C (damper 0VC27YB operator). Loss prevents damper operation.
C2E	1VC26E	X	Control and alarm intertie between 0AP25E and 0PL72JB for operators 0TZ-VC133, 134, and 135 (dampers 0VC12YB, 13YB, and 14YB). Loss prevents damper operation. Damage prevents (open) or causes (short) alarm or ESF amber light actuation.
C2E	1VC27G	X	Control and alarm intertie between 0AP25E and 0PL72JB for operators 0FZ-VC103D, 103E, and 103F (dampers 0VC30YB, 33YB, and 36YB). Loss prevents damper operation. Damage prevents (open) or causes (short) alarm or ESF amber light actuation.
C2E	1VC27O	X	Control from 0AP25E to 0FZ-VC103D (damper 0VC30YB operator). Loss prevents damper operation.
C2E	1VC27P	X	Control from 0AP25E to 0FZ-VC103E (damper 0VC33YB operator). Loss prevents damper operation.
C2E	1VC27Q	X	Control from 0AP25E to 0FZ-VC103F (damper 0VC36YB operator). Loss prevents damper operation.
C2E	1VC27R	X	120V control feed from 0AP55EB to 0AP25E for various dampers operating circuits on a daisy-chain arrangement. Loss will prevent operation of numerous Div 2 dampers (including 0VC30YB, 33YB, 36YB, etc.).
C2E	1VC28E	X	Control and alarm intertie between 0AP25E and 0PL72JB for operators 0TZ-VC136, 137, 138, and 139 (dampers 0VC15YB, 16YB, 17YB, and 18YB).Loss prevents damper operation. Damage prevents (open) or causes (short) alarm or ESF amber light actuation.
C2E	1VC35T	X	Control from 0AP25E to 0FZ-VC112 (damper 0VC03YB operator). Loss prevents damper operation.
C2E	1VC35U	X	Control from 0AP25E to 0FZ-VC106 (damper 0VC02YB operator). Loss prevents damper operation.
C2E	1VC35W	X	Control from 0AP25E to 0FZ-VC096 (damper 0VC115YA operator). Loss prevents damper operation.
C2E	1VC36R	X	120V control circuit for operators 0FZ-VC117, 116AA, 116AB, 116BA, and 116BB (dampers 0VC10YB, 0VC09YB, and 0VC11YB). Loss prevents damper operation.

Division II Safe-Shutdown Cables Protected by Thermo-Lag in Fire Zone CB-1e

Raceway	Cable Number	FIREZ. CB-1E	Cable Function
C2E	1VC45A	X	120V control and indication circuits from 0PL72JB to MCR for 0VC04CB (Div 2 VC Return fan) and 0VC08PB (Div 2 VC chilled water pump). Loss prevents remote operation of fan (manual) and pump (auto). Local operation at 0PL72JB may be achievable.
C2E	1VC45B	X	Control and alarm circuits from 0PL72JB to MCR for 0VC03CB (Div 2 VC Supply fan). Loss prevents remote operation of fan. Local operation at 0PL72JB may be achievable. Damage prevents (open) or causes (short) alarm and ESF amber light actuation.
C2E	1VC45C	X	Control and alarm circuit from 0PL72JB to MCR, controls operators 0FZ-VC114 (damper 0VC01YB) and 0FZ-VC168 (damper 0VC70Y) and carries various filter and train alarms. Loss prevents damper operation, alarms, and ESF light actuation.
C2E	1VC45D	X	Control between 0PL72JB and MCR for operation of 0VC05CB (MCR HVAC Make-up Air fan B). Loss prevents fan operation and affects various annunciation and red/green lights.
C2E	1VC45F	X	Alarm circuits from 0PL72JB to MCR. Loss prevents (open) or causes (short) alarm and ESF amber light actuation.
C2E	1VC45H	X	Control and alarm circuit from 0PL72JB to MCR for 0FZ-VC096 and 112 (dampers 0VC03YB and 115YA). Loss prevents damper operation and, due to common fuse, may affect 0FZ-VC106, 116BA and BB (dampers 0VC02YB and 11YB). Damage affects alarms and ESF lights.
C2E	1VC46E	X	Indication and alarm circuit between 0PL72JB and MCR for 0FZ-VC111, 124, and 103G (dampers 0VC08YB, 04YB, and 39YB). Loss impacts position indication and, due to common fuse, may cause the dampers to fail closed. Damage impacts alarm and ESF amber lights.
C2E	1VC46F	X	Alarm circuits from 0PL72JB to MCR. Loss prevents (open) or causes (short) alarm and ESF amber light actuation.
C2E	1VC46G	X	Indication and alarm circuit between 0PL72JB and MCR for 0FZ-VC103D, E, and F(dampers 0VC30YB, 33YB, and 36YB). Loss impacts position indication and, due to common fuse, may cause the dampers to fail closed. Damage impacts alarm and ESF amber lights.
C2E	1VC50D	X	Control and alarm circuit between 0AP25E and 0PL72JB for 0FZ-VC114 (damper 0VC01YB) and 0FZ-VC168 (damper 0VC70Y). Damage affects ability to operate valves (fail closed on loss), and prevents (open) or causes (short) annunciation and ESF amber light.
C2E	1VC50K	X	Control from 0AP25E to 0FZ-VC168 (damper 0VC70Y operator). Loss causes damper to fail closed.
C2E	1VC50L	X	Control from 0AP25E to 0FZ-VC114 (damper 0VC01YB operator). Loss causes damper to fail closed.
C2E	1VC50M	X	120V control feed from 0AP55EB to 0AP25E for various dampers operating circuits on a daisy-chain arrangement. Loss will prevent operation and cause numerous Div 2 dampers to fail closed.

Division II Safe-Shutdown Cables Protected by Thermo-Lag in Fire Zone CB-1e

Raceway	Cable Number	FIREZ. CB-1E	Cable Function
C2E	1VC56E	X	Control and alarm intertie between 0AP25E and 0PL72JB for operators 0FZ-VC103G, 111, and 124 (dampers 0VC39YB, 0VC08YB, and 0VC04YB). Loss prevents operation and dampers fail closed. Damage prevents (open) or causes (short) alarm and ESF amber light.
C2E	1VC56N	X	Control from 0AP25E to 0FZ-VC103G (damper 0VC39YB operator). Loss causes damper to fail closed.
C2E	1VC56O	X	Control from 0AP25E to 0FZ-VC124 (damper 0VC04YB operator). Loss causes damper to fail closed.
C2E	1VC56P	X	Control from 0AP25E to 0FZ-VC111 (damper 0VC08YB operator). Loss causes damper to fail closed.
C2E	1VD02E	X	Control between 1AP12E and 1PL54JB. Uses output of 1TIT-VD006 (Div 2 DG rm temp) and 1PDS-VD028 (DG rm 1B exhaust fan diff press) for alarm and to shutdown 1VD01CB (DG rm 1B vent fan) after DG stops. Loss impacts alarm and fan shutdown.
C2E	1VD05B	X	Control intertie between 1AP61E and MCR for operation of 1VD02CB (DG 1B oil room exhaust fan) from MCR. Loss of circuit prevents fan operation.
C2E	1VD05E	X	Alarm circuit between 1PL54JB and 1AP61E to provide annunciation in the MCR. Open circuit prevents annunciation while a short causes it.
C2E	1VD10J	X	Control circuit between 1AP75E (MCC 1B1) and 1TZ-VD002C (operator for exhaust air damper 1VD03YB). Damper fails closed.
C2E	1VD18D	X	120V control power feed from 0AP55EB to 1PL54JB. Loss of feed prevents panel control of VD system and leaves dampers in fail (open or close depending on damper) position.
C2E	1VX25C	X	Alarm signal intertie between 0AP55EA and 1AP75E for MCR annunciation. Loss prevents service not available alarm.
C2E	1VX28F	X	Control and alarm intertie between 0AP55EA and 1PL91J (Inverter room cubicle HVAC panel) for 1VX13CB. Damage can prevent (open) or cause (short) fan operation, alarms, or ESF amber light actuation.
C2E	1VX28N	X	Control intertie between 0AP55EA and 1PL65JB (Div 2 switchgear room 1B HVAC panel) for 1SX193B (Div 2 inverter room cubicle cooler cooling coil inlet valve). Damage opens (open) or closes (short) the valve.

Function of Div 2 LV cables wrapped in Thermo-lag

1LV14B
120V control power from 0AP55EB to MCR for ESF amber lights and overload bypass relays in the HG, IA, SA, SF, and SM systems. Loss prevents testing bypass relays, ESF amber light actuation, and loss of power alarms.

1LV14D
120V control power from 0AP55EB to MCR for: 1) operation of 0RA027 & 028 (Breathing Air valves). Loss isolates valves; 2) Div 2 initiation of MCR HVAC Hi Rad isolation. Loss prevents Div 2 isolation; 3) shutdown of VG fans in the event of charcoal filter deluge. Loss prevents shutdown but sends loss-of-power alarm; 4) trip and alarm of VD fans. Loss prevents trip but sends loss of control power alarm; 5) initiation of VG system from radiation signal and multiplication of LOCA signal. Loss prevents auto initiation and transmission of LOCA signal; 6) LOCA trip of VP chiller. Loss prevents trip; 7)operation of 1VQ001A, 3, and 4B (VQ isolation valves). Loss causes valves to isolate; 8) operation of 1VR001B and LOCA signal seal-in for VR and VQ controls. Loss causes valve isolation but prevents LOCA signal and seal-in; 9)auto open interlock of damper 1VX04YB to fan 1VX03CB. Loss prevents damper operation; and 10) feed to 12V DC power supply 1UU-LV851 which in turn feeds load drivers.

1LV14E
120V control power from 0AP55EB to MCR for: 1) LOCA isolation signals for valves 1CC050,53,60,71,74, and 127; 1CY017, and 20; 1FC007,16B,24B, and 37; 1SF002; 1FP050,52,53, and 79; 1RE019, and 21; 1RF019, and 21. Loss prevents automatic isolation of the valves involved; 2)operation of valves 1IA006, and 7; 1SA030, and 31. Loss results in valve closure and isolation of IA and SA; 3)LOCA signal for closure of valves 1SX020B and 0MC010 and starting the Div 2 SX pump. Loss impacts pump automatic start, valve line-up may require manual action; 4)Containment spray signal for closure of 1SX082B and opening 1E12-F014B. Loss requires manual operation for valve line-up; 5)feed to 15V DC power supply for analog optical isolators

1LV14F
120V control power from 0AP55E to MCR for: 1)leak detection signal on main steam lines. Loss produces isolation signal; 2)LOCA signal to valves 1SM001B, and 2B (Div 2 SM dump valves) and VF fans. Loss prevents auto actions, including Div 2 SM auto dump and VF fan trip;

1LV14F (cont.)
3)operation and LOCA/RAD signals for 1VR006B,7B,35, and 40. Loss causes valves to isolate; 4)operation of valve 1WX019. Loss causes valve to isolate; 5)position indication for valve 1VG057B and temperature indication for Drywell, and containment atmosphere as well as Suppression pool temperature. Loss inops the MCR recorder and computer input.

1LV14G
120V control power from 0AP55E to MCR for ESF amber lights and overload bypass relays in the MC and CY systems. Loss prevents testing bypass relays, ESF amber light actuation, and loss of power alarms.

1LV14H
120V control power from 0AP55E to MCR for ESF amber lights in AP, DG, and DO systems and Div 2 DG fuel oil tank level indication. Loss removes level indication and prevents ESF amber light actuation.

1LV14J
120V control power from 0AP55E to MCR for ESF amber lights and overload bypass relays in the SX system and containment pressure recorder 1PR-CM257. Loss prevents recorder operation, ESF amber light actuation, and testing of bypass relays.

1LV14K
120V control power from 0AP55E to MCR for recorders 1PR-CM064 (Drywell pressure) and 1LR-CM241 (Suppression pool level) and ESF amber lights in the RE system. Loss prevents recorder operation and ESF amber light actuation.

1LV14L
120V control power from 0AP55E to MCR for recorder 0PDR-VC153 (VC train B pre-filter differential) and ESF amber lights the divisional portions of VC, VD, VG, VH, VP, VX, and VY systems. Loss prevents recorder operation and ESF amber light actuation.

1LV14M
120V control power from 0AP55E to MCR for recorders 1LR-CM031 (Containment pressure) and 1LR-SM016 (Suppression pool level). Loss prevents recorder operation.

Div I Safe Shutdown Cables in Fire Zone CB-1E within 20 ft of the Div II Safe Shutdown Thermo-lag wrapped cables

RACEWAY	CABLE #	CABLE FUNCTION
C1E	1AP20K	Speed control permissive from 1AP07EK (RAT feed bkr.) to 1PL12JA.
C1E	1AP20M	Voltage control permissive from 1AP07EK (RAT feed bkr.) to 1PL12JA.
C1E	1AP22J	Speed control permissive from 1AP07EH (ERAT feed bkr.) to 1PL12JA..
C1E	1AP22K	Voltage control permissive from 1AP07EH (ERAT feed bkr.) to 1PL12JA.
P1E	1AP34L	125V DC control power feed from 1DC13E to 0AP05E, 480V unit sub A.
P1E	1AP34T	125V DC backup control power feed from 1AP11E, 480V unit sub 1A, to 0AP05E, 480V unit sub A.
P1E	1AP36A	480V feed from 1AP11E to 1AP60E, DG MCC 1A..
P1E	1AP36N	480V feed from 1AP60E to 0AP24E, Div 1 Damper MCC. Fed from same breaker as 1AP60E.
C1E	1CC05B	Control circuit from 1AP73E to operator of 1CC076A. Damage impacts ability to operate valve.
C1E	1DG01C	Control circuitry between 1PL12JA and 1C61-P001 (Remote shutdown panel) for various functions including LOCA bypass, emergency stop, and remote/local control. Damage would impact remote operation of DG.
C1E	1DG01D	Control circuit from 1PL12JA to MCR to provide CT input to MCR meters. Damage would impact MCR data.
C1E	1DG01G	Control circuit from 1AP60E to 1PL12JA for control power to and output from DG Auto-start, Lockout, and auxiliary relays. Damage would impact auto-start capability and could cause trip and lockout of DG.
C1E	1DG01J	Control circuit from 1C61-P001 to 1PL12JA for start and stop of Div 1 DG from Remote shutdown panel.
C1E	1DG01K	Control circuit from 1C61-P001 to 1PL12JA for remote control of speed and voltage of the DG.
P1E	1DG01M	125V DC control power feed ("NORMAL" or "EMERGENCY") from 1C61-P001 (Remote Shutdown Panel) to 1PL12JA, Div 1 DG control panel.
P1E	1DG01N	125V DC "NORMAL" control power feed from 1DC13E to 1PL12JA.
P1E	1DG01P	125V DC "NORMAL" control power feed for 1PL12JA from 1PL12JA to "NORMAL" contacts in 1C61-P001, Remote Shutdown Panel.
C1E	1DG01R	Control circuit between 1AP07ED (4KV SX pump breaker) and 1PL92JA. This allows the breaker equalizing timer to actuate the 4KV breaker. Cable damage prevents closure of the SX pump breaker.
C1E	1DG01S	Control circuit between 1AP07EE (4KV LPCS pump breaker) and 1PL93JA. This allows the breaker equalizing timer to actuate the 4KV breaker. Cable damage prevents closure of the LPCS pump breaker.
C1E	1DG01T	Control circuit from 1AP07E to 1PL12JA for the diesel boost signal prior to closure of the 4KV breaker.
C1E	1DG04A	Control circuit from 1AP60E to 1PL12JA for circulating oil and turbo soak back pumps on engine 1 of 1DG01KA.
C1E	1DG05A	Control circuit from 1AP60E to 1PL12JA for circulating oil and turbo soak back pumps on engine 2 of 1DG01KA.
P1E	1DG09A	480V feed from 1AP60E to DG air compressor B6 at air start skid.
C1E	1DG09B	Control circuit from 1AP60E to 1PL12JA for DG air compressor B6 at air start skid.
P1E	1DG10A	480V feed from 1AP60E to DG air compressor B2 at air start skid.
C1E	1DG10B	Control circuit from 1AP60E to 1PL12JA for DG air compressor B2 at air start skid.
C1E	1DG11C	Control circuit between 1AP07EC (4KV DG feed breaker) and 1PL12JA carries the CT output from the bus for the differential relays. Damage impacts protective relay operation.
C1E	1DG11D	Control circuit between 1AP07EC (4KV DG feed breaker) and 1PL12JA carries the CT output from the bus for the meters at the panel. Damage impacts meter data for operator.
C1E	1DG11E	Control circuit between 1AP07EC (4KV DG feed breaker) and 1PL12JA carries the PT output from the bus for the meters at the panel. Damage impacts meter data for operator.
C1E	1DG11F	Control circuit between 1AP07EC (4KV DG feed breaker) and 1PL12JA carries the PT output from the bus for the relays at the panel. Damage impacts operation of protective relays.

RACEWAY	CABLE #	CABLE FUNCTION
C1E	1DG11G	Control circuit between 1AP07EC (4KV DG feed breaker) and MCR carries the PT output from the bus for the meters in the MCR. Damage impacts meter data for operator.
C1E	1DG11K	Control permissive from 1AP07EC (4KV DG feed breaker) to the DG auto-start relay in 1AP60E. Damage could impact starting the diesel.
C1E	1DG11R	Control permissive from 1AP07EC (4KV DG feed breaker) to the speed governor droop control in 1PL12JA. Damage impacts diesel control.
C1E	1DG11S	Control permissive from 1AP07EC (4KV DG feed breaker) to the reverse power relay in 1PL12JA and input to the auxiliary lockout relay. Damage impacts diesel operation.
C1E	1DG11T	Control permissive from 1AP07EC (4KV DG feed breaker) to the loss of excitation relay in 1PL12JA and the idle start emergency over ride circuit. Damage impacts diesel operation.
P1E	1DO01A	480V feed from 1AP60E to 1DO01PA, DG fuel oil transfer pump.
C1E	1DO01C	Control circuit between MCR and 1AP60E for operation of 1DO01PA, DG fuel oil transfer pump. Damage impacts pump operability.
C1E	1DO01H	Control circuit between 1C61-P001 and 1AP60E for operation of 1DO01PA, DG fuel oil transfer pump under NORMAL or EMERGENCY line-up. Damage impacts pump operability.
K1E	1DO77A	Carries signal from 1LT-DO001 (DG fuel oil day tank level) to MCR for level indication and auto-start of 1DO01PA. Cable damage prevents one auto-start feature of pump.
K1E	1DO77B	Carries signal from 1LT-DO011 (DG fuel oil tank level) to MCR for indication. Cable damage impacts indication only.
P1E	1RP01C	125V DC feed from1DC13E to 1C71-S001A (Div 1 NSPS inverter). Loss of feed causes inverter to shift to alternate source 1RP01E.
P1E	1SX26A	480V feed from 1AP60E to 1SX019A, VC 1A HX outlet valve .
C1E	1SX26B	Control circuit from 0PL72JA to 1AP60E for opening 1SX019A when 0VC13CA (VC chilled water chiller) is operating. Cable damage prevents valve operation.
P1E	1SX30A	480V feed from 1AP60E to 1SX063A, DG1A HX outlet valve.
C1E	1SX30B	Control circuit between 1AP60E and 1SX063A operator. Cable damage could impact valve operation.
C1E	1SX30E	Control circuit between 1AP60E and 1C61-P001 for operation of 1SX063A from MCR or Remote shutdown panel. Cable damage prevents valve operation.
P1E	1SX39A	480V feed from 1AP60E to 1SX017A, VC 1A HX inlet valve.
C1E	1SX39B	Control circuit between 1AP60E and 1SX017A operator. Cable damage could impact valve operation.
C1E	1SX39C	Control circuit between 1AP60E and MCR for control of valve (no automatic operation). Cable damage prevents changing valve position.
P1E	1VC20B	480V feed from 0AP24E to 0TZ-VC035 (damper 0VC14YA operator).
P1E	1VC20C	480V feed from 0AP24E to 0TZ-VC034 (damper 0VC13YA operator).
P1E	1VC20D	480V feed from 0AP24E to 0TZ-VC033 (damper 0VC12YA operator).
C1E	1VC20E	Control circuit for VC A modulating dampers 0VC12YA, 13YA, and 14YA.
P1E	1VC21B	480V feed from 0AP24E to 0FZ-VC003D (damper 0VC30YA operator).
P1E	1VC21C	480V feed from 0AP24E to 0FZ-VC003E (damper 0VC33YA operator).
P1E	1VC21D	480V feed from 0AP24E to 0FZ-VC003F (damper 0VC36YA operator).
C1E	1VC21G	Control circuit between 0AP24E and 0PL72JA for damper (0VC30YA, 33YA, and 36YA) position indicating lights.
C1E	1VC21O	Control from 0AP24E to 0FZ-VC003D (damper 0VC30YA operator). Loss prevents damper operation.
C1E	1VC21P	Control from 0AP24E to 0FZ-VC003E (damper 0VC33YA operator). Loss prevents damper operation.
C1E	1VC21Q	Control from 0AP24E to 0FZ-VC003F (damper 0VC36YA operator). Loss prevents damper operation.
C1E	1VC21R	120V control power from 0AP54E to 0AP24E for operation of the control circuits of multiple dampers including 0VC15YA, 16YA, 17YA, 21YA, 24YA, 27YA, 30YA, 33YA, and 36YA.
P1E	1VC22B	480V feed from 0AP24E to 0TZ-VC038 (damper 0VC17YA operator).
P1E	1VC22C	480V feed from 0AP24E to 0TZ-VC037 (damper 0VC16YA operator).

RACEWAY	CABLE #	CABLE FUNCTION
P1E	1VC22D	480V feed from 0AP24E to 0TZ-VC036 (damper 0VC15YA operator).
C1E	1VC22E	Alarm and annunciation circuit between 0AP24E and 0PL72JA for dampers 0VC15YA, 16YA, 17YA, and 18YA.
P1E	1VC22F	480V feed from 0AP24E to 0TZ-VC039 (damper 0VC18YA operator).
P1E	1VC33B	480V feed from 0AP24E to 0FZ-VC012 (damper 0VC03YA operator).
C1E	1VC33P	Control from 0AP24E to 0FZ-VC196 (damper 0VC115YB operator). Loss prevents damper operation.
C1E	1VC33U	Control from 0AP24E to 0FZ-VC012 (damper 0VC03YA operator). Loss prevents damper operation.
C1E	1VC33V	Control from 0AP24E to 0FZ-VC006 (damper 0VC02YA operator). Loss prevents damper operation.
P1E	1VC33X	480V feed from 0AP24E to 0FZ-VC196 (damper 0VC115YB operator).
C1E	1VC34R	Control circuit between 0AP24E and 0PL72JA for operation of multiple dampers including 0VC09YA, 10YA, and 11YA. Damage impacts damper operation.
P1E	1VC48B	480V feed from 0AP24E to 0FZ-VC003A (damper 0VC21YA operator).
P1E	1VC48C	480V feed from 0AP24E to 0FZ-VC003B (damper 0VC24YA operator).
P1E	1VC48D	480V feed from 0AP24E to 0FZ-VC003C (damper 0VC27YA operator).
C1E	1VC48E	Control circuit between 0AP24E and 0PL72JA for control of dampers 0VC21YA, 24YA, and 27YA. Includes ESF amber light indication and MCR annunciation. Damage impacts damper operation and MCR indication.
C1E	1VC48N	Control from 0AP24E to 0FZ-VC003A (damper 0VC21YA operator. Loss prevents damper operation.
C1E	1VC48O	Control from 0AP24E to 0FZ-VC003B (damper 0VC24YA operator. Loss prevents damper operation.
C1E	1VC48P	Control from 0AP24E to 0FZ-VC003C (damper 0VC27YA operator. Loss prevents damper operation.
P1E	1VC49B	480V feed from 0AP24E to 0FZ-VC068 (damper 0VC69YA operator).
P1E	1VC49C	480V feed from 0AP24E to 0FZ-VC014 (damper 0VC01YA operator).
C1E	1VC49D	Control circuit between 0AP24E and 0PL72JA for control of dampers 0VC01YA and 69YA. Includes ESF amber light indication and MCR annunciation. Damage impacts damper operation and MCR indication.
C1E	1VC49K	Control from 0AP24E to 0FZ-VC068 (damper 0VC69Y operator. Loss prevents damper operation.
C1E	1VC49L	Control from 0AP24E to 0FZ-VC014 (damper 0VC01YA operator. Loss prevents damper operation.
C1E	1VC49M	120V control power from 0AP54E to 0AP24E for operation of multiple dampers including 0VC01YA, 02YA, 03YA, 04YA, 05YA, 05YB, 06YA, 08YA, 09YA, 10YA, 11YA, 39YA, 49YA, 49YB, 69YA, 114YA, and115YB. Damage prevents valve operation.
P1E	1VC55B	480V feed from 0AP24E to 0FZ-VC003G (damper 0VC39YA operator).
P1E	1VC55D	480V feed from 0AP24E to 0FZ-VC011 (damper 0VC08YA operator).
C1E	1VC55E	Control circuit between 0AP24E and 0PL72JA for control of dampers 0VC04YA, 08YA, and 39YA. Includes ESF amber light indication and MCR annunciation. Damage impacts damper operation and MCR indication.
C1E	1VC55N	Control from 0AP24E to 0FZ-VC003G (damper 0VC39YA operator). Loss prevents damper operation.
C1E	1VC55O	Control from 0AP24E to 0FZ-VC24 (damper 0VC04YA operator). Loss prevents damper operation.
C1E	1VC55P	Control from 0AP24E to 0FZ-VC011 (damper 0VC08YA operator). Loss prevents damper operation.
P1E	1VD01A	480V feed from 1AP11E to 1VD01CA, DG room 1A ventilation fan.
C1E	1VD01E	Control interlock between 1PL54JA (Div 1 DG room ventilation panel) and MCR for operation of 1VD01CA.

RACEWAY	CABLE #	CABLE FUNCTION
C1E	1VD01J	Control interlock for use from 1C61-P001 to start or trip 1VD01CA (DG room 1A ventilation fan) when the remote shutdown hand switches are set to "EMERGENCY". Damage impacts operations from the remote shutdown panel.
P1E	1VD04A	480V feed from 1AP60E to 1VD02CA, DG fuel oil room exhaust fan.
C1E	1VD04E	Alarm and annunciation circuit between 1PL54JA and 1AP60E for 1VD02CA, DG oil room exhaust fan.
C1E	1VD04F	Control circuit between 1AP60E and 1C61-P001 which carries control signals for 1VD02CA (DG oil room exhaust fan) {whether in NORMAL or EMERGENCY}. Damage impacts fan operation.
P1E	1VD09A	480V feed from 1AP72E to 1TZ-VD001A (damper 1VD01YA operator).
P1E	1VD09B	480V feed from 1AP72E to 1TZ-VD001B (damper 1VD02YA operator).
P1E	1VD09C	480V feed from 1AP72E to 1TZ-VD001C (damper 1VD03YA operator).
C1E	1VD09J	Control from 1AP72E to 1TZ-VD001C (damper 1VD03YA operator). Loss prevents damper operation.
C1E	1VD18B	120V control power feed from 0AP54E to 1PL54JA (Div 1 DG room ventilation panel).
P1E	1VX24A	480V feed from 1AP72E to 1VX12CA, switchgear heat removal return fan.

PRA EVALUATION OF SAFETY SIGNIFICANCE OF POTENTIAL THERMOLAG FIRE BARRIER FAILURE IN FIRE ZONE CB-1e

This evaluation is intended for use as supporting documentation in the safety analysis of Thermo-Lag 330-1 cable wrap material in fire zone CB-1e. This study used the IPE model and fire PRA databases as they stood on 10/05/94 as inputs. Subsequent changes to the IPE model and/or fire PRA databases could significantly affect the results of this evaluation. Careful attention to the method used in this evaluation is important in the correct interpretation and application of the final results. Use of the material presented here in any other context could be inappropriate and potentially misleading or erroneous.

METHOD

This analysis is composed of three major parts. The first part of the analysis is to identify all modeled components that could be affected by a fire in zone CB-1e (elevations 737'and 751', Control Building Hallway and Mezzanine) and the basic events in the IPE model that represent these components. This list of components contains not only the equipment itself, but also any cables required for a piece of equipment to perform it's modeled function. This part also includes identifying the basic events in the CPS model that are protected by Thermolag. Part 1 is described in attachments PRA-1 and PRA-4.

Using the basic events list from part 1 as an input, the second part of the analysis involves calculating the conditional core damage probability (CCDP) for two different situations. The first situation is the case in which a fire occurs and all cables and equipment in a fire zone are damaged. This situation models Thermolag failing to perform adequately as a fire barrier. The second situation is the case in which only cables not wrapped by Thermolag are damaged by a postulated fire. This situation models Thermolag performing per design. Attachments PRA-2 and PRA-5 describe the CCDP determination.

While the prevention of core damage is an important feature of Thermolag, it is not Thermolag's sole intended function. Maintaining containment integrity by protecting containment isolation and heat removal capabilities is also required by 10CFR50, Appendix R. Additionally, containment analysis in the IPE report identified the loss of containment hydrogen control as a major cause of containment failure. Correspondingly, the effect of a fire in zone CB-1e on these functions was also examined. This analysis is detailed in attachments PRA-2 and PRA-5.

The third part of the analysis was to determine the fire ignition frequency in zone CB-1e. This calculation utilizes the methodology described in the Fire-Induced Vulnerability

Evaluation (FIVE) Guide, EPRI TR-100370 and the Fire Risk Analysis Implementation Guide, EPRI Project 3385-01. Ignition frequency calculation is described on attachments PRA-3 and PRA-6.

CONCLUSION

This results of this analysis showed that the CCDP calculated for each situation was identical, which means that the Thermolag installed in fire zone CB-1e provided no quantifiable benefit in preventing core damage. Additionally, no impact or benefit from Thermolag was found to exist relating to containment isolation capability, containment heat removal or containment hydrogen control.

Attachment PRA-1
Fire Database Development
and Fire Susceptible Events for
Thermolag Installations

The purpose of the fire PRA databases is to provide location specific information for the PRA model. This information includes the location of all PRA modeled equipment and supporting cables, the basic events (BE)s associated with said equipment, and the PRA initiators that could result from a fire in any fire zone. A major resource for this task was the SLICE database system maintained by the NSED electrical design group. Database development covered all firezones in the plant instead of being specific to individual firezones.

How Database Was Developed

Database development was performed by completion of the following steps:

1. Identification of all basic events included in the PRA model. This task was performed by creating a BE report from the PROJECT.BE file using the CAFTA code.

2. Determine which basic events apply to each piece of modeled equipment. This task was performed by separating the BEs from task 1 by system and having each system analyst identify the equipment associated with each basic event. Some basic events, such as certain flow diversion events, had more than one piece of equipment associated with it. Human errors and maintenance unavailabilities were excluded from this task since these BEs would occur prior to a fire. This task generated database ELDB2.DBF.

3. Identify all power, control and instrumentation cables associated with each piece of modeled equipment. The SLICE database CABLE.DBF was used for this task. All equipment identified in task 2 were compared with the FR_EQUIPMT AND TO_EQUIPMT fields in the CABLE.DBF database. The resulting cables were then traced until either the 4.16KV/6.9KV or main control room cable risers/termination cabinets were reached. Tracing the cables involved not only the CABLE.DBF database, but also plant E02 and E03 drawings. The CPS safe shutdown analysis contained in USAR Appendix F was also reviewed to ensure all cables in that analysis associated with modeled equipment were included in the fire database. Cables to modeled equipment that would not disable the equipment if lost, such as position indication on non-interlocked valves, were not included in the database. Cables to the RAT and ERAT, though not explicitly modeled in the PRA, were included as a means of identifying zones where a fire could result in the loss of offsite power.

4. Identify the routing points associated with all identified cables. Routing points are intermediate locations on a cable tray or conduit. Using SLICE data, the trays containing each cable were identified, as well as all intermediate routing points.

5. Identify fire zone associated with each routing point. Using a SLICE system cross-index of routing point to fire zone, the location of cables contained in cable trays was identified.

6. Identify fire zones associated with each piece of modeled equipment. This task was performed by a combination of plant general arrangement review and plant walkdown.

7. Identify fire zones associated with conduits and open cables. Since the SLICE database does not contain location information on conduit or open cables, this task was performed by a combination of plant general arrangement review and plant walkdown.

8. Identify equipment susceptible to spurious actuation from fire. This information was taken directly from the safe shutdown analysis contained in USAR Appendix F.

9. Identify internal events initiators that could occur due to a fire in a fire zone. Using information gathered in previous tasks, all equipment and cables in this zone were identified. This list was reviewed and a list of initiators resulting from the loss of all equipment and cables in zone CB-1e was compiled. This list was reviewed by an IPE analyst and a SRO and a final initiator list was developed.

Utilizing the information gathered in the previous steps, the fire location database ELDB1.DBF was completed.

Selection of Fire Susceptible BEs in Thermolag Areas

The structure of ELDB1 was set up so that for each piece of equipment, cables were identified up to the 4.16KV/6.9KV busses and/or the main control room termination cabinets. This resulted in listing some cables, particularly power cables, several times for different pieces of equipment. This approach allowed a database sort on fire zone without losing control, power or instrumentation dependencies. Once the equipment and cables contained in a zone were identified, the associated BEs were also determined. This list of BEs was reviewed and BEs that would not be affected by a fire were removed from the list of fire susceptible BEs. Examples of the type of BEs removed include the following: manual valve plugging, check valves failing to open, orifices plugging, all pre-event human errors and all maintenance

unavailabilities. Attachment PRA-4 contains the lists of BEs and initiators generated from database ELDB1.DBF.

Prepared: Mark D. Flaherty Date: 10/5/94
Reviewed: Peter E Walberg Date: 10/5/94

Attachment PRA-2

CONDITIONAL CORE DAMAGE FREQUENCY
AND CONTAINMENT IMPACT
FOR THERMOLAG INSTALLATIONS

For fire zone CB-1e, all the basic events in the PRA that could be affected by a fire in the area were identified using the databases that were prepared for the fire PRA. For a basic event to be affected by a fire, either a fire susceptible component or associated power, control, or important instrumentation cable had to be located in fire zone CB-1e. These basic events are called fire-susceptible basic events. The development of the data bases and the lists of fire susceptible basic events are described in attachment PRA-1.

CORE DAMAGE PROBABILITY

After the appropriate basic events were identified, two analyses were performed. First, all the fire-susceptible basic events involving that area were set to TRUE (meaning failed) in the original models, the model was requantified and the resulting core damage probability was determined. This represents the case in which Thermolag is ineffective. Secondly, all the fire-susceptible basic events involving that area, except those which are protected with Thermolag, were set to TRUE in the models, and the resulting core damage probability was determined. This represents the case in which there is an effective Thermolag fire barrier. The difference between the two results represents the importance of the fire barrier. The bigger difference there is between the two numbers, the more important is the Thermolag installation in that area. For fire zone CB-1e, the list of basic events for both cases was found to be identical. This result is explained by the fact that most of the cables protected by Thermo-Lag are only protected for a portion of their length and are therefore susceptible to damage from a whole zone fire scenario. Attachment PRA-4 contains the list of basic events used in zone CB-1e.

For thoroughness, it is important to go back to the original models to fail the appropriate components, because in the normal process of quantifying a PRA, many combinations of events that are unlikely without a fire are truncated out of the solution because they contribute very little to the overall core damage frequency result. Subsequent results when trying to fail these components will be inaccurate if their failure could contribute significantly to the probability of core damage. By failing them before truncation, no significant contributor can be lost.

The analysis of this area included failure of affected components as described above, plus the certain occurrence of the initiating events that would be precipitated by a fire in each area. All other initiators were trimmed out by setting them to FALSE.

CONTAINMENT FUNCTION EVALUATION

For defense in depth, the containment function is important, as well as core damage frequency. Because a low fraction of postulated core damage events lead to containment failure, a simplified method of assessing the impact of Thermolag failure was employed. Three functions that support containment integrity were analyzed independently. These functions are isolation, heat removal, and hydrogen control. The reliability of these functions was compared with the Thermolag failed and with the Thermolag assumed capable of performing as designed.

Examples of the various batch files and SETS user programs to perform this analysis are included in attachment PRA-5.

RESULTS

The CCDP calculated both with and without Thermolag was 1.10E-01. This result shows that Thermolag provides no quantifiable benefit in preventing core damage in zone CB-1e. Additionally, no difference in failure probability was found between the two analyzed cases relating to containment isolation, heat removal or hydrogen control capabilities in zone CB-1e.

Prepared: M. E. D. Flaherty Date: 10/5/94
Reviewed: Peter E. Wilberg Date: 10/5/94

Attachment PRA-3
Fire Ignition Frequencies
for Thermolag Areas

Following calculation of the conditional core damage probabilities (CCDPs), the results were reviewed and all fire zones with CCDPs greater than 1.0E-07 were identified. Fire zones with lower CCDPs were screened without additional analysis. In this zone, even though the CCDP is greater than 1.0E-07, calculation of the ignition frequency is not necessary since the CCDP calculated for the two cases is identical. However, the ignition frequency calculation for zone CB-1e is presented here as additional information.

Development of Ignition Frequencies

The ignition frequency was calculated in accordance with the EPRI Fire PRA Implementation guide and the Fire-Induced Vulnerability Evaluation (FIVE) manual (EPRI TP-100370). The contractor for the fire PRA tailored collaboration, Scientific Applications International Corp. (SAIC), supplied EXCEL spreadsheets that duplicate the printed ignition frequency worksheets from the implementation manual. Generic fire frequencies were taken directly from the "Fire Events Database, Final Draft Report", dated 12/30/91, that was prepared by SAIC for Nuclear Safety Analysis Center (NSAC). Location weighting factors and ignition source weighting factor methods are specified by the implementation guide.

The major difficulty in the ignition frequency calculation methodology was the determination of the number and location of the plant ignition sources for both zone CB-1e and the plant as a whole. The implementation guide described the types of ignition sources that must be considered. Using the SLICE system EQUIPMEN.DBF database, all equipment matching the component type guidelines were identified. The SLICE system is maintained by the NSED electrical design group. Significant judgment was required in determining which components to include as sources. The bases for component selection were supplied by SAIC. For example, pumps of less than or equal to 5 HP were eliminated as ignition sources. Cables and junction boxes were eliminated as possible ignition sources since essentially all cable in the plant is IEEE-383 rated cable. Using the ignition source list developed from the SLICE system as a guide, zone CB-1e was then walked down and any additional ignition sources were added to the list. Selected system dumps from the MEL system were also reviewed. This was particularly important for the electrical cabinet categories since each individual breaker cubicle is counted as an individual cabinet.

Following the identification of the zone CB-1e ignition sources, the plant wide ignition sources were identified and fire zones associated with these sources were determined by comparing the column and row information from SLICE and MEL with the plant general arrangements. Selected areas were also reviewed from plant elevation drawings (E2X series). Walkdowns in approximately 10% of the plant fire zones were also performed as a check of the accuracy of the documentation review. It should be noted that the implementation guide allows equipment numbers and locations to be estimated by engineering judgment alone. Once locations were identified, the number of plant-wide components for each category were determined both plant-wide and by location type. Fire zones are characterized as belonging to different location types. Some location types were obvious, such as the main control room or turbine building. Others, such as switchgear rooms and reactor building locations were less apparent. Switchgear rooms were selected based on the existence of either 4.16 KV or 6.9 KV switchgear. The reactor building category was based on Mark I and Mark II containment layouts and encompassed zones in the Fuel, Auxiliary, Control and Diesel Generator buildings that were not included in other specific location types.

With the plant wide and location type component tabulations complete, the fixed ignition sources contributing to the ignition frequency in zone CB-1e were determined and entered onto the worksheets. In addition to fixed ignition sources, transient ignition sources were also examined. Transient ignition weighting factors were identified using the implementation guide. Specifically, contribution from smoking and candles were eliminated from consideration. The hot pipe contribution was also excluded for those zones without high energy piping. Once all component location information was entered, the zone ignition frequency was calculated. The zone CB-1e ignition frequency is 9.6E-03 per year. For additional information, Attachment PRA-6 contains the zone CB-1e ignition frequency worksheet.

Prepared: M. E. O'Flaherty Date: 10/5/94

Reviewed: Peter E. Wilberg Date: 10/5/94

Attachment PRA-4
Basic Events and Initiators
Used In Analysis

BASIC EVENT LIST FOR FIRE ZONE CB-1e
(SAME LIST FOR PROTECTED AND UNPROTECTED CABLES)

BASIC EVENT	DESCRIPTION
A05EX4CCBD	FAILURE OF CIRCUIT BREAKER 0AP05E CUB 4C OPEN
A06EX4BCBD	FAILURE OF CIRCUIT BREAKER 0AP06E CUB 4B OPEN
A06EX4CCBD	FAILURE OF CIRCUIT BREAKER 0AP06E CUB 4C OPEN
A22E3ALCBD	FAILURE OF CIRCUIT BREAKER 0AP22E CUB 3AL OPEN
A23E3ALCBD	FAILURE OF CIRCUIT BREAKER 0AP23E CUB 3AL OPEN
AAT1F1JCBD	FAILURE OF CIRCUIT BREAKER AT1F1J OPEN (CUB H)
ADG01KADGR	FAILURE OF DIESEL GENERATOR DG01KA TO RUN
ADG01KADGS	FAILURE OF DIESEL GENERATOR DG01KA TO START
ADG01KALMX	FAILURE DG01KA INITIATION LOGIC CIRCUITS TO WORK
ADG01KBDGR	FAILURE OF DIESEL GENERATOR 01KB TO RUN
ADG01KBDGS	FAILURE OF DIESEL GENERATOR 01KB TO START
ADG01KBLMX	FAILURE OF DG01KB INITIATION CIRCUITS
ADO01PAMPR	FAILURE OF PUMP DO01PA TO RUN GIVEN START
ADO01PAMPS	FAILURE OF PUMP DO01PA TO START
ADO01PBMPR	FAILURE OF PUMP DO01PB TO RUN GIVEN START
ADO01PBMPS	FAILURE OF PUMP DO01PB TO START
AP552ALCBD	FAILURE OF CIRCUIT BREAKER 0AP55EB CUB 2AL OPEN
AP91E4CCBD	FAILURE OF CIRCUIT BREAKER 0AP91E CUB 4C OPEN
AP91E4DCBD	FAILURE OF CIRCUIT BREAKER 0AP91E CUB 4D OPEN
AP92E4DCBD	FAILURE OF CIRCUIT BREAKER 0AP92E CUB 4D OPEN
PX400BCBD	FAILURE OF CIRCUIT BREAKER 400B1 OPEN
PX400OCBD	FAILURE OF CIRCUIT BREAKER 400O OPEN
APX400PCBD	FAILURE OF CIRCUIT BREAKER 400P OPEN
APX401FCBD	FAILURE OF CIRCUIT BREAKER 401F OPEN (CUB 3B)
APX401GCBD	FAILURE OF CIRCUIT BREAKER 401G OPEN (CUB 3B)
AVD01CAFNR	FAILURE OF FAN VD01CA TO RUN
AVD01CAFNS	FAILURE OF FAN VD01CA TO START
AVD01CBFNR	FAILURE OF FAN VD01CB TO RUN
AVD01CBFNS	FAILURE OF FAN VD01CB TO START
AVD01YADMO	FAILURE OF DAMPER VD01YA TO OPEN
AVD01YBDMO	FAILURE OF DAMPER VD01YB TO OPEN
D174A18CBD	FAILURE OF CIRCUIT BREAKER 1DC17E CUB 4A #18 OPEN
D1DC26EBCD	FAILURE OF BATTERY CHARGER 1DC26E OUTPUT
D1RP02ETFZ	TRANSFORMER 1RP02E FAILS TO PROVIDE POWER
D1UPS1ATFZ	SOLATRON REGULATOR UPS1A FAILS TO PROVIDE POWER
D1UPS1BTFZ	SOLATRON REGULATOR UPS1B FAILS TO PROVIDE POWER
D20E4ELCBD	FAILURE OF CIRCUIT BREAKER 0AP20E CUB 4EL OPEN
D20E4ERCBD	FAILURE OF CIRCUIT BREAKER 0AP20E CUB 4ER OPEN
D23E4DLCBD	FAILURE OF CIRCUIT BREAKER 0AP23E CUB 4DL OPEN
D23E4DRCBD	FAILURE OF CIRCUIT BREAKER 0AP23E CUB 4DR OPEN
DAF24ARCBD	FAILURE OF CIRCUIT BREAKER MCC F2 CUB 4AR OPEN
DBUSNXCSWH	DC BUSES 1E AND 1F ARE NOT CROSS CONNECTED
DC174A1CBD	FAILURE OF CIRCUIT BREAKER 1DC17E CUB 4A CKT 1 OPEN
DC71S1ASSO	STATIC XFER SWITCH C71S001A FAILS OPEN
DC71S1ASSX	STATIC XFER SWITCH C71S001A IMPROPER XFER
DC71S1BSSO	STATIC XFER SWITCH C71S001B FAILS OPEN
C71S1BSSX	STATIC XFER SWITCH C71S001B IMPROPER XFER
CC71SABCD	FAILURE OF BATTERY CHARGER C71S004A OUTPUT
DCC71SBBCD	FAILURE OF BATTERY CHARGER C71S004B OUTPUT
DCS001AIVD	FAILURE OF OUTPUT FROM INVERTER S001A

BASIC EVENT LIST FOR FIRE ZONE CB-1e
(SAME LIST FOR PROTECTED AND UNPROTECTED CABLES)

BASIC EVENT	DESCRIPTION
DCS001BIVD	FAILURE OF OUTPUT FROM INVERTER S001B
DCS004AIVD	FAILURE OF OUTPUT FROM INVERTER 1C71S004A
DCS004BIVD	FAILURE OF OUTPUT FROM INVERTER 1C71S004B
DCS005ATFZ	TRANSFORMER S005A FAILS TO PROVIDE POWER
DCS005BTFZ	TRANSFORMER S005B FAILS TO PROVIDE POWER
DCUPS1AIVD	FAILURE OF OUTPUT FROM INVERTER UPS1A
DCUPS1ASSO	STATIC XFER SWITCH UPS1A FAILS OPEN
DCUPS1ASSX	STATIC XFER SWITCH UPS1A IMPROPER XFER
DCUPS1BIVD	FAILURE OF OUTPUT FROM INVERTER UPS1B
DCUPS1BSSO	STATIC XFER SWITCH UPS1B FAILS OPEN
DCUPS1BSSX	STATIC XFER SWITCH UPS1B IMPROPER XFER
DD17E19CBD	FAILURE OF CIRCUIT BREAKER DC MCC 17E CUB 19 OPEN
DDC1F1ACBD	FAILURE OF CIRCUIT BREAKER DC MCC 1F CUB 1A OPEN
DDC1F3BCBD	FAILURE OF CIRCUIT BREAKER DC MCC 1F CUB 3B OPEN
DDC1F7ACBD	FAILURE OF CIRCUIT BREAKER DC MCC 1F CUB 7A OPEN
DDC1F8ACBD	FAILURE OF CIRCUIT BREAKER DC MCC 1F CUB 8A OPEN
DVX13CBFNR	FAILURE OF FAN VX13CB TO RUN
DVX13CBFNS	FAILURE OF FAN VX13CB TO START
DX1D2ALCBD	FAILURE OF CIRCUIT BREAKER MCC 1D CUB 2AL OPEN
DXVX14CFNR	FAILURE OF FAN VX14C TO RUN
XVX14CFNS	FAILURE OF FAN VX14C TO START
RHFLOWXVC	RH DIVERSION FLOW VALVE FAILS TO CLOSE
ESXFLOWXVC	SX DIVERSION FLOW VALVE FAILS TO CLOSE
FTOFAILSYZ	TURB OIL FAILS TO SUPPORT FW OPER (HARDWARE)
IRIF063MVT	MOV F063 IMPROPERLY SHUTS
J0SA01CCPR	FAILURE OF COMPRESSOR 0 TO RUN GIVEN START
J0SA01CCPS	FAILURE OF COMPRESSOR 0 TO START
KXCY016MVC	CY CONT OUTBD ISOL VLV FAILS TO CLOSE
KXCY017MVC	CY CONT INBD ISOL VLV FAILS TO CLOSE
KXFC007MVC	FC CONT OUTLET INBD ISOL VLV FAILS TO CLOSE
KXFC037MVC	FC SUPPLY CONT INBD ISOL VLV FAILS TO CLOSE
KXIA006AVC	IA CONT INBD ISOL VLV 006 FAILS TO CLOSE
KXN004BTSZ	RCIC HI ROOM TEMP N004B TRANS FAILS TO ACTUATE
KXN005BTSZ	RCIC ROOM HI DELTA TEMP N005B TRANS FAILS HIGH
KXN006BTSZ	RCIC ROOM HI DELTA TEMP N006B TRANS FAILS LOW
KXRE021SVC	CONT EQUIP DRN SUMP DISCH INBD ISOL VLV FAILS TO CLOSE
KXXF063MVC	RHR & RCIC STEAM SUPPLY INBD ISOL VLV FAILS TO CLOSE
KZRF021SVC	CONT FLOOR DRN SUMP DISCH INBD ISOL VLV FAILS TO CLOSE
LP0C001MPR	FAILURE OF PUMP 0C001 TO RUN GIVEN START
LP0C001MPS	FAILURE OF PUMP 0C001 TO START
MXIA006AVT	IA CONTAINMENT INBOARD ISOL VLV FAILS TO REMAIN OPEN
Q1FC007MVO	Motor Operated Valve FC007 Won't Open
QXIA006AVO	IA Vlv IA006 Fails to Open
R12F009MVO	SUCTION MOV FROM RR FAILS TO OPEN
R2F037BMVT	FAILURE OF FC LINE MOV B TO REMAIN CLOSED
WCC01PBMPR	FAILURE OF PUMP 1CC01PB TO PROVIDE FLOW
CC01PCMPR	FAILURE OF PUMP 1CC01PC TO PROVIDE FLOW
WO23AXTRX	HARDWARE FAILURE OF CHILLER TRAIN A
WWO23BXTRX	HARDWARE FAILURE OF CHILLER TRAIN B
WWO23CXTRX	HARDWARE FAILURE OF CHILLER TRAIN C

BASIC EVENT LIST FOR FIRE ZONE CB-1e
(SAME LIST FOR PROTECTED AND UNPROTECTED CABLES)

BASIC EVENT	DESCRIPTION
WWO23DXTRX	HARDWARE FAILURE OF CHILLER TRAIN D
WWO23EXTRX	HARDWARE FAILURE OF CHILLER TRAIN E
X1SX189AVO	DISCHARGE VALVE 1SX189 FAILS TO OPEN
XRF014BMVO	INLET VALVE 1E12F014B FAILS TO OPEN
XSX01PAMPR	PUMP 1SX01PA FAILS TO RUN
XSX01PAMPS	PUMP 1SX01PA FAILS TO START
XSX01PBMPR	PUMP 1SX01PB FAILS TO RUN
XSX01PBMPS	PUMP 1SX01PB FAILS TO START
XSX063AMVO	DISCHARGE VALVE 1SX063A FAILS TO OPEN
XSX063BMVO	DISCHARGE VALVE 1SX063B FAILS TO OPEN
XSX181AAVO	DISCHARGE VALVE 1SX181A FAILS TO OPEN
XSX181BAVO	DISCHARGE VALVE 1SX181B FAILS TO OPEN
XSX185AAVO	DISCHARGE VALVE 1SX185A FAILS TO OPEN
XSX185BAVO	DISCHARGE VALVE 1SX185B FAILS TO OPEN
XSX193BAVO	DISCHARGE VALVE 1SX193B FAILS TO OPEN
YLOSSDCTRX	LOSS OF NON-SAFETY DC BUS INITIATOR
YTRANISTRX	TRANSIENT WITH ISOLATION INITIATOR

Attachment PRA-5
Analysis of Conditional Core Damage
Frequencies and Containment Degradation
For Thermolag Fire Areas

ANALYSIS OF CONDITIONAL CORE DAMAGE FREQUENCIES

AND CONTAINMENT DEGRADATION FOR

THERMOLAG FIRE AREAS

This attachment describes the method used for determining the likelihood of core damage, given that a fire has destroyed all essential equipment in a specified fire area. Basically, the method fails all components in a given area in the appropriate fault trees, and then re-solves the entire PRA model. This method was used rather than failing events in the core damage results from the PRA, because many components that do not appear in the core damage cutsets because they are inherently reliable may be failed by a fire. Therefore just starting with the core damage cutsets would not yield a true picture of the possible consequences from a fire in a given area. This method was used for the 94 fire areas of interest for the fire PRA.

INPUTS

The method starts with three inputs: the linked CAFTA fault tree models for the plant, the SETS user programs for solving the system and sequences for the level 1 PRA, and a list for each fire area of the basic events that are assumed failed and the initiating events that could result from a fire in a given area.

The linked CAFTA fault trees are in ZCNMT.CAF.

The SETS user programs for the PRA are as listed in appendix F of the PRA update report.

The lists of basic events and initiators are of the following example format.

<u>Example text input file</u>

```
D164A16CBD
D174A18CBD
D1DC03EBTD
D1DC04EBTD
D1DC08EBCD
D1RP04ETFZ
DBUSXXCSMM
DC164A1CBD
DC174A1CBD
DC71S1DSSO
DC71S1DSSX
DCC71SABCD
DCC71SBBCD
DCS001DIVD
DCS004AIVD
DCS004BIVD
DCUPS1AIVD
DCUPS1ASSO
DCUPS1ASSX
DCUPS1BIVD
```

```
DCUPS18SSO
DCUPS18SSX
DD16E17CBD
DD17E19CBD
DDC1D1ACBD
DDC1D1BCBD
DDC1D1CCBD
DDC1E1ACBD
DDC1E3BCBD
DDC1E6BCBD
DDC1E7ACBD
DDC1F1ACBD
DDC1F3BCBD
DDC1F7ACBD
DDC1F8ACBD
DXVX14CFNR
DXVX14CFNS
ESXFLOWXVC
X1SX189AVO
X1VX14SHXP
YLOSSDCTRX
YTRANISTRX
```

IMPORTING FAULT TREES

The first step in solving the PRA model is to read the CAFTA fault tree files into SETS and simplify them and form independent subtrees (IST) and the stem equations. Two steps are taken before the procedure call to do this in order to ensure that top events necessary for the sequence solutions are not unintentionally modularized. The first step is identical to that taken for the base PRA solution; to construct an additional fault tree containing all the events that we wanted to keep out of ISTs and then combine this with ZCNMT. The second step was analogous, but was necessary for this analysis and not the base PRA solution, because in the process of simplifying the fault trees with many failed events, some top event equations are dropped if they evaluate to OMEGA (failed). A second auxiliary fault tree was constructed with all the top events that are necessary for the event tree sequence solutions. When this was combined with the ZCNMT, few top events vanished in the reformatting process.

INDEPENDENT SUBTREES

The reformatting process is implemented with the FRMNEWFT procedure in SETS. The user program for this procedure is produced by a BASIC program (ISTPREP) that reads the failure event text file and sets all the included events to OMEGA (true, ie. failed) and then continues to write a SETS program to set all initiators to 0.0 except those included in the failure event text file which are set to 1.0.

An example program to produce ISTs is shown here.

<u>Example SETS user program for form ISTS (CB3BIST.IN)</u>

```
PROGRAM$FORMIST.
COMMENTS REFORM CAFTA FAULT TREE USING INDEPENDENT SUBTREES$
DLTBLK(CPS-STEM,CPS-IST,CPS-STEM1,CPS-IST1,CPS-STEM2).
FRMNEWFT(FORM1$ SETSIN / CPS-TEMP *NAMES
YFIRE= XYFIRE ,
YIETP= XYIETP ,
YIET3= XYIET3 ,
```

```
YIES1= XYIES1 ,
YIEA= XYIEA ,
YIEIA= XYIEIA ,
YIET2= XYIET2 ,
YIET4= XYIET4 ,
YIET5= XYIET5 ,
YIES2= XYIES2 ,
YIET9= XYIET9 ,
YIESW= XYIESW ,
YIEDC= XYIEDC ,
YC2= XYC2 ,
YC2A= XYC2A ,
YU1= XYU1 ,
YC8= XYC8 ,
YW= XYW ,
YDG= XYDG ,
YQ= XYQ ,
YQ1= XYQ1 ,
YQ2= XYQ2 ,
YX1= XYX1 ,
YU2= XYU2 ,
YC1= XYC1 ,
YC3= XYC3 ,
YC= XYC ,
YC4= XYC4 ,
YC5= XYC5 ,
YC6= XYC6 ,
YC7= XYC7 ,
YC9= XYC9 ,
YDG1= XYDG1 ,
YDG2= XYDG2 ,
YL1= XYL1 ,
YL4= XYL4 ,
YL6= XYL6 ,
YU= XYU ,
YDIES1= XYDIES1 ,
YDIES2= XYDIES2 ,
YM1= XYM1 ,
YP1= XYP1 ,
YX2= XYX2 ,
YK1= XYK1 ,
YIET9B= XYIET9B ,
YIET9C= XYIET9C ,
YIET9D= XYIET9D ,
YM= XYM ,
YP= XYP ,
YW1= XYW1 ,
YX= XYX ,
YU3= XYU3 ,
YW2= XYW2 ,
YRHALONG= XYRHALONG ,
YRHBLONG= XYRHBLONG ,
YRHCLONG= XYRHCLONG ,
YHPLONG= XYHPLONG ,
YLPLONG= XYLPLONG ,
YCRD= XYCRD ,
YCDCBSUM= XYCDCBSUM ,
R1LPCIAX= XR1LPCIAX ,
R2LPCIBX= XR2LPCIBX ,
R3LPCICX= XR3LPCICX ,
YLPCS= XYLPCS).

FRMKEWFT(FORM3$ CPS-TEMP,MONMOD,FIRETOPS / CPS-STEM1,CPS-IST *OMEGA$
D164A16CBD,
D174A18CBD,
D1DC03EBYD,
D1DC04EBYD,
D1DC08EBCD,
D1RP04ETFZ,
DBUSXXCSUM,
DC164A1CBD,
DC174A1CBD,
DC71S10SSO,
DC71S10SSX,
DCC71SABCD,
DCC71SBBCD,
DCS001DIVD,
DCS004AIVD,
DCS004BIVD,
DCUPS1AIVD,
DCUPS1ASSO,
DCUPS1ASSX,
DCUPS1BIVD,
```

```
DCUPS1BSSO,
DCUPS1BSSX,
DO16E17CBO,
DO17E19CBO,
DOC1D1ACBO,
DOC1D1BCBO,
DOC1D1CCBO,
DOC1E1ACBO,
DOC1E3BCBO,
DOC1E6BCBO,
DOC1E7ACBO,
DOC1F1ACBO,
DOC1F3BCBO,
DOC1F7ACBO,
DOC1F8ACBO,
DXVX14CFHR,
DXVX14CFHS,
ESXFLOWXVC,
X1SX189AVO,
X1VX14SHXP).

FRMNEWFT(FORM1$ CPS-STEM1 / CPS-STEM *TRIMS GATE01).
DLTBLK(CPS-TEMP,CPS-STEM1).
BLKSTAT.
```

The first call to FRMNEWFT (Form1) renames all the top events required for the event tree sequence solution to correspond the auxiliary fault tree. The second call (Form3) is the procedure call that OMEGAs the appropriate basic events and forms the ISTs and STEM. Finally the third call removes the logic for the first auxiliary fault tree, so that no time is wasted in solving it.

INITIATOR FREQUENCY CORRECTION

Before the fault trees are solved, the initiators are adjusted using the other program that is produced by the BASIC program ISTPREP.

<u>Example SETS user program to adjust initiator frequencies (CB3BDATA.IN)</u>

```
PROGRAM$FIREDATA.
COMMENTS READS IN FIRE PRA SPCIFIC SCENARIO INITIATORS $
RDVALBLK(CPSBEDAT).
\
VALUE BLOCKS CPSBEDAT.

COMMENTS INITIATOR ADJUSTMENTS FOR FIRE AREA $
 0.00   $ YLOSSFWTRX  $
 0.00   $ YTRANSYTRX  $
 1.00   $ YTRANISTRX  $
 0.00   $ YIORVXXTRX  $
 0.00   $ YLLOCAXTRX  $
 0.00   $ YMEDLOCTRX  $
 0.00   $ YSBLOCATRX  $
 0.00   $ YLOOPXXTRX  $
 1.00   $ YLOSSDCTRX  $
 0.00   $ YLOSSIATRX  $
 0.00   $ YLOSSSWTRX  $
 0.00   $ YISLOCATRA  $
 0.00   $ YISLOCBTRX  $
 0.00   $ YISLOCCTRX  $
 0.00   $ YISLOCDTRX  $
\
```

EVENT TREE HEADING SOLUTION

After these two programs are run, then the ISTs and the STEM equations are solved. This is done with straight-forward applications of the GENFTEQN procedure, using the SOLVIST and SOLVE

SETS user programs. These programs are edited to set the truncation level at 1E-7.

After these solutions, it is necessary to form an equation block with only the top events which are needed for the event tree sequence solutions. This is done with another SETS user program, but it must be unique for each fire area. As mentioned above, when a top event is evaluated as OMEGA, the equation is lost. Therefore when that top event subsequently appears in a sequence equation, the sequence equation cannot be solved. In order to avoid the need to rewrite the sequence solutions for each fire area, the top events that are lost need to be re-defined. In addition, combination events are sometimes lost, as well. For example, high pressure injection (YU) is a combination of high pressure core spray (YU1) and feedwater (YQ1). If one of these is evaluated as OMEGA, then YU should equal the other input. SETS doesn't handle this correctly. To accommodate these two shortcomings, another BASIC program (SUPREP) was developed to read the output of the FRMNEWFT procedure and make the proper equation adjustments. An example SETS user program resulting from the BASIC program follows.

<u>Example SETS user program to form top event equation block (CB3BSU.IN)</u>

```
PROGRAM$SQSETUP.
COMMENTS SET UP BLOCK WITH EVENT TREE HEADINGS $
LDBLK(CPS-STEM-EQN).

YQ = OMEGA.
SUBINEQN(YQ,YQ).
YQ2 = OMEGA.
SUBINEQN(YQ2,YQ2).
YCDCBSUM = OMEGA.
SUBINEQN(YCDCBSUM,YCDCBSUM).
YQ1 = OMEGA.
SUBINEQN(YQ1,YQ1).
YCRD = OMEGA.
SUBINEQN(YCRD,YCRD).
YIEA = /OMEGA.
SUBINEQN(YIEA,YIEA).
YX = GGATE01.
SUBINEQN(YX,YX).
YX1 = GGATE01.
SUBINEQN(YX1,YX1).
YU = YU1.
SUBINEQN(YU,YU).

DLTBLK(CPS-TOPS).
FRMBLK(CPS-TOPS* ONLY$ YFIRE, YIETP,YIET3,YIES1,YIEA,YIEIA,YIET2,
      YIET4,YIET5,YIES2,YIET9,YIESW,YIEDC,YC2,YC2A,YU1,YC8,YW,
      YDG,YQ,YQ1,YQ2,YX1,YU2,YC1,YC3,YC,YC4,YC5,YC6,YC7,YC9,
      YDG1,YDG2,YL1,YL4,YL6,YU,YDIES1,YDIES2,YM1,YP1,
      YX2,YN1,YIET9B,YIET9C,YIET9D,YM,YP,YW1,YX,YU3,YW2,YRHALONG,
      YRHBLONG,YRHCLONG,YHPLONG,YLPLONG,YCRD,YCDCBSUM,R1LPCIAX,
      R2LPCIBX,R3LPCICX,YLPCS).

BLKSTAT.
```

EVENT TREE SEQUENCE SOLUTIONS

After these mechanizations, the sequence equations are used to solve all the event tree sequences. The SETS user programs were adjusted to analyze all sequences to a truncation level of 1.0E-

7. The final result cutsets are truncated at 2.0E-7. One other modification to the sequence solution was made to eliminate the analysis for dependent human failures. Because so many headings turned out to be OMEGA, the dependent HRA analysis would have to be customized for each fire case, and the work necessary for that was judged to be excessive for the benefit that could be gained. One change was made to SEQTRAN.IN to avoid formation of an empty block when all transient initiators become ISTs.

THERMOLAG BENEFIT

For areas in which Thermolag is employed as a fire barrier, the above analysis was repeated. The first analysis was with all basic events in the area failed, as though Thermolag provides no benefit. The second analysis assumed that Thermolag was effective, and the protected basic events were not failed.

CONTAINMENT FUNCTIONS

In order to be thorough in evaluating the Thermolag importance, the benefit of Thermolag to containment function, in addition to core damage potential, needed to be evaluated. Running the entire suit of containment sequence solution SETS user programs for all Thermolag applications would be very time consuming. It would also be very difficult, with unique programs required for each area because of the loss of terms that evaluate to OMEGA, as described above. Consequently a simplified method was used. Three containment functions were evaluated as follows: containment heat removal, containment isolation, and hydrogen control. These functions were evaluated independently, rather than through containment event tree sequences.

Containment heat removal capability was modeled as possible by the RHR fault tree, containment spray (YCNMSA, YCNMTSB) and suppression pool cooling (YSPCA, YSPCB) modes. Containment isolation was evaluated with the containment isolation fault tree (KGATE01), and hydrogen control was modeled with its fault tree (CGATE101). The first comparison was for which of these headings were OMEGAd in the Form New Fault Tree procedure call as discussed above under the EVENT TREE HEADINGS heading. If the same events were OMEGAd for both the Thermolag failure and Thermolag success cases, no further action was required, as Thermolag provided no benefit to the model. For cases in which there were differences in the headings that were OMEGAd (This happened for only CNMT heat removal in two areas.), a user program was developed to evaluate the combination of YCNMTSA, YCNMTSB, YSPCA, and YSPCB with the appropriate events OMEGAd. The difference in results between the Thermolag failure and Thermolag success in this analysis is the importance of Thermolag in the area to protecting the containment heat removal function.

BATCH FILE AUTOMATION

The entire process described above, except for the final CNMT heat removal analysis, is implemented by using batch files. The complete solution for a list of areas can be performed by calling TLSOLN with a list of areas as command line parameters. TLSOLN in turn calls other batch files. The first one called is TLPREP, which runs the BASIC programs to produce the input files. The second call is to TLSYS, which solves the system and event tree heading equations and prepares the equation block with all the necessary headings for the event tree solutions. The third is TLSEQ, which solves the individual event tree sequences, does all recoveries, combines the sequences into final results, and then processes and prints the final results. TLSOLN then calls TLSIFT to identify the containment functions that are failed for each case. The programs and data to complete this process are listed below.

TABLE OF CALLED PROGRAMS AND PROCEDURES

(Note: AREA is used as a generic term to be replaced by each area designation.)

PROGRAM	DESCRIPTION	CALLS	DATA
TLSOLN.BAT	Does entire solution for listed areas	TLPREP.BAT TLSYS.BAT TLSEQ.BAT TLSIFT.BAT	
TLPREP.BAT	Prepares SETS inputs for specified area	KEY-FAKE.COM ISTPREP.BAS SUPREP.BAS	INPUTBLK.FIR
KEY-FAKE.COM	Public Domain utility for command line BASIC parameters		
ISTPREP.BAS	Prepares input to form ISTs and adjust initiators Writes AREAIST.IN and AREADATA.IN		AREA.TXT TEMPIST.TXT
AREA.TXT	Text files containing BE's to be failed and intiators to occur		
SUPREP.BAS	Prepares SETS input for setting up ET top events Writes AREASU.IN		AREAIST.OUT
INPUTBLK.FIR	SETS block file containing only the fault trees from CAFTA		
TLSYS.BAT	Solves for event tree headings	READTL.IN AREAIST.IN AREADATA.IN SOLVIST.IN SOLVE.IN AREASU.IN BLOCKSTA.IN WRITETOP.IN READBLKS.BAS PURGE.COM DO.BAT	
READFIRE.IN	Prepared from CAFTA files for ZCNMT, ZNONMOD, and ZTL. Makes initial SETS block for remainder of programs.		

SOLVIST.IN	Uses SETS procedure GENFTEQN with the SAVE option for ISTs	
SOLVE.IN	Uses SETS procedure GENFTEQN to solve all stem equations. Prepared by using the GENFTEQN with the WRITE option on the original models with no events OMEGAd in order to solve and save all ET headings.	
BLOCKSTA.IN	Uses SETS procedure BLKSTAT to check status of equation block	
WRITETOP.IN	Uses SETS procedures WRTBLK and WRTVALBLK to prepare switch file (SWFL) to form a new block file with only ET headings	
READBLKS.BAS	Prepares SETS input file READTEMP.IN to form a new block file	READBLKS.IN
PURGE.EXE	Utility file to remove excessive line and form feeds from SETS output	
DO.BAT	Utility to print text in small font with small line spacing	
TLSEQ.BAT	Calls all sequence SETS user programs in sequence to solve multiple sequences, including recoveries CUTVAL.BAS	
CUTVAL.BAS	Reads output from SETS CONTRMVAL and lists the results in CUTVAL.OUT	
TLSIFT.BAT	Prepares lists of CNMT function headings that have been set to OMEGA.	ISTSIFT.BAS
ISTSIFT.BAS	Picks out CNMT function headings that have been set to OMEGA by the AREAIST SETS user program.	

PROGRAM LISTINGS

TLSOLN.BAT

```
:START
IF %1A==A GOTO END
ECHO %1
CALL TLPREP.BAT %1
CALL TLSYS.BAT %1
CALL TLSEQ.BAT %1
REM CALL TLIMP.BAT %1
PKZIP -A D:\FIRE\%1RES \PCS\FIRE\SEQ\CUTCOMB.OUT
PKZIP -A D:\FIRE\%1RES \SETSBU\SEQCOMB.FIR
COPY \SETSBU\SEQCOMB.FIR %1COMB.RES
REM DEL \SETSBU\%1*.FIR
CALL TLSIFT.BAT %1
SHIFT
GOTO START
:END
```

TLPREP.BAT

```
CD INPUT
DEL PREPBAT.DAT
:START
IF %1A==A GOTO END
REM ****************** PREPARE IST AND DATA FILES
ECHO %1
KEY-FAKE "%1" 013
E:\SY\BASIC\GWBASIC \PCS\TL\INPUT\ISTPREP >> PREPBAT.DAT
REM
COPY \SETSBU\INPUTBLK.FIR BKFL
REM ************** FORM ISTS
COPY %1IST.IN INFL
E:\SY\PCSETS\PCSETS > %1IST.OUT
FIND "ERROR" %1IST.OUT
FIND "ERROR" %1IST.OUT >> PREPBAT.DAT
REM ********************** PREPARE SETUP PROGRAM
KEY-FAKE "%1" 013
E:\SY\BASIC\GWBASIC \PCS\TL\INPUT\SUPREP
REM **************** RECYCLE AND START OVER
SHIFT
GOTO START
:END
CD..
ECHO
```

TLSYS.BAT

```
:START
IF %1A==A GOTO END
F:
CD\PCS\TL\SYS
DEL SYSBAT.DAT
REM GOTO JUMP
DEL BKFL
COPY F:\SETSBU\READFIRE.IN D:\SCRATCH\READCAF.IN
COPY D:\SCRATCH\READCAF.IN INFL
E:\SY\PCSETS\PCSETS > D:\SCRATCH\READCAF.OUT
FIND "ERROR" D:\SCRATCH\READCAF.OUT > SYSBAT.DAT
FIND "ERROR" D:\SCRATCH\READCAF.OUT
REM DEL READCAF.OUT
REM ************** FORM ISTS
COPY \PCS\TL\INPUT\%1IST.IN INFL
E:\SY\PCSETS\PCSEYS > %1IST.OUT
FIND "ERROR" %1IST.OUT
FIND "ERROR" %1IST.OUT >> SYSBAT.DAT
REM ####### READ AREA DATA ###########
COPY \PCS\TL\INPUT\%1DATA.IN INFL
E:\SY\PCSETS\PCSETS > %1DATA.OUT
FIND "ERROR" %1DATA.OUT
FIND "ERROR" %1DATA.OUT >> SYSBAT.DAT
REM ************** ISTS
COPY SOLVIST.IN INFL
E:\SY\PCSETS\PCSETS > SOLVIST.OUT
FIND "ERROR" SOLVIST.OUT
FIND "ERROR" SOLVIST.OUT >> SYSBAT.DAT
FIND "NO EQUATION" SOLVIST.OUT >> SYSBAT.DAT
COPY BKFL F:\SETSBU\%1IST.FIR
GOTO SKIPSTEM
```

Attachment PRA-6
Ignition Frequency Worksheet

PLANT - CLINTON
COMPARTMENT CB-1e

Reference Area:
Reactor Building (BWR)

Transients allowed in this zone
Welding, Ext. cords, Heaters, Open flame, Hosting of combustibles
Flammable liquid or gas tanks/piping in this zone: Yes X No

Components	Generic Fire Frequency (G (1))	Location Weighting Factor (WL) (2)	IS (3)	Ignition Source Weighting Factor WI			Compartment Fire Frequency
Rx BLDG COMPONENTS				Number of these ignition sources in the compartment	Total number of these ignition sources in the Reactor Building		
Electrical Cabinets	8.0E-02	1.0E+00	B	138	770	1.8E-01	9.0E-03
Pumps	2.6E-02	1.0E+00	B	0	59	0.0E+00	0.0E+00
PLANT-WIDE COMPONENTS				Weight (or Btus) of cable insulation in this compartment	Weight (or Btus) of cable insulation in Appendix R areas, excluding radwaste or containment		
Non-qualified cable run	8.3E-03	1.0E+00	E	0	0	0.0E+00	0.0E+00
Junction box/splice in NQ cable	1.8E-03	1.0E+00	E	0	0	0.0E+00	0.0E+00
Junction box in Q cable	1.8E-03	1.0E+00	E	0	0	0.0E+00	0.0E+00
				Number of these ignition sources in the compartment	Total number of these ignition sources in all locations listed in Table 1-3		
Fire Protection Panels	2.4E-03	1.0E+00	F	6	114	5.3E-02	1.3E-04
RPS MG sets	6.5E-03	1.0E+00	F	0	2	0.0E+00	0.0E+00
Transformers	7.8E-03	1.0E+00	F	[illegible]	189	3.0E-02	2.3E-04
Battery Chargers	4.0E-03	1.0E+00	F	0	6	0.0E+00	0.0E+00
Air compressors	4.7E-03	1.0E+00	F	0	11	0.0E+00	0.0E+00
Ventilation Subsystems	9.5E-03	1.0E+00	F	5	630	7.9E-03	7.5E-05
Elevator motors	8.3E-03	1.0E+00	F	0	6	0.0E+00	0.0E+00
Dryers	8.7E-03	1.0E+00	F	0	3	0.0E+00	0.0E+00
				Number of these ignition sources in the compartment	Total number of these ignition sources in all plant locations (including those not specified in Table 1-3)		
Off-gas/H2 recombiner	8.8E-02	1.0E+00	G	0	4	0.0E+00	0.0E+00
Hydrogen Tanks	3.2E-03	1.0E+00	G	0	0	0.0E+00	0.0E+00
Gas turbines	3.1E-02	1.0E+00	G	0	0	0.0E+00	0.0E+00
				Enter 1 if these fires could occur, enter 0 they can not occur.	Total number of compartments where misc. other hydrogen fires could be present		
Miscellaneous hydrogen fires	3.2E-03	1.0E+00	C	0	3	0.0E+00	0.0E+00
TRANSIENTS					Total number of compartments in Table 1-3 plant locations		
Cable fires - welding	5.1E-03	1.0E+00	C	1	121	8.3E-03	4.2E-05
Transient fires - welding	3.1E-02	1.0E+00	C	1	121	8.3E-03	2.6E-04
				Sum of ignition source weighting factors for transients	Total number of zones in Table 1-3 plant locations		
Transients-other	1.3E-03	1.0E+00	D	9	121	7.4E-02	9.7E-05
						TOTAL	9.8E-03

(1) From FEDB Report Table 1-3
(2) See FIVE Reference Table 1.1 for guidance
(3) Ignition source weighting factor method. See FEDB Table 1-3 for guidance.

Note: Walkdown on 3/17/94

Evaluation of Ampacity Derating for Thermo-Lag Installation

Topic:

Consideration of the existing cable ampacities in this area with respect to the NRC concerns (IEIN 94-22) over the ampacity derating needed for Thermo-lag installations.

Design statement:

Clinton Power Station project ampacities for cables in tray were established in calculation 19-G-01. These values are conservative in magnitude and were used during the design process as one of the parameters for selecting the size and type of cable for a specific circuit. A separate calculation (19-AI-8) was performed to determine the amount of ampacity derating needed to account for the increased heat retention (due to the Thermo-lag installation) in the tray. Derating values are viewed as suspect in the IEIN, but no new values are established.

The Thermo-lag installation in fire zone CB-1e consists of a one hour wrap. The power cables so enclosed were reviewed (see attachment one) and the review demonstrates that not only were none of these cables thermally overloaded by the currents passing through them but that they could be subjected to as much as a 35% ampacity derating requirement without being impacted.

The largest ampacity derating mentioned in the IEIN was 46.4% for a #8 AWG conductor in a tray with a three hour wrap of Thermo-lag applied. On first examination, this would seem to represent a potential impact to our design. However phone calls to the NRC have provided additional information (specifically the diameters of the tested conductors) which allows a comparative evaluation of the test results. On attachment two, the cables tested by Sandia lab for the NRC are examined with respect to the methodology developed by Stolpe (IEEE Transaction Paper 70 TP 557 PWR *Ampacities for cables in Randomly Filled Cable Trays* by J. Stolpe). For this evaluation, tray fill was determined per step 2.2 of ICEA P-54-440 which uses diameter squared for area without the pi/4 component. This resulted in a tray fill depth of 1.41" and the P-54-440 tabulated values for 1.5" fill were utilized in the comparison of data. All heat intensities were calculated using the actual cross-sectional area of the cable. Since the same numbers were used for each section of the evaluation, the heat intensities can be directly compared.

The first set of numbers translates the ampacities reported in 94-22 into heat intensities for open (unwrapped) and Thermo-lag wrapped trays. The NEMA numbers show the heat intensities that would be produced if the ampacity values from table 3-1 of P-54-440 were utilized for the cables tested by the NRC. The CPS numbers show the heat intensities

that would be produced if the methodology used for determining ampacity limits at CPS (Calc 19-G-1) were applied to these conductors, but using a 1.5" fill rather than the nominal 2" fill of CPS design. Tlag ampacity values for the NEMA and CPS tables were calculated based on the 32% derate factor derived in Calc 19-AI-8.

Comparison of the results shows that the NEMA values produce lower heat intensities (and therefore lower overall heat in the tray) than the NRC values. The CPS values are even more conservative with resultant lower intensities. Even though the derate factor for the NEMA and CPS sections is smaller than the NRC values (32% vs. 46.4%, 36%, and 35.3%), the Tlag heat intensities continue to demonstrate that the NEMA-based values produce more conservative results. The reasons for this are found in Stolpe's methodology.

In his paper, Stolpe describes a general method for calculating allowable cable ampacities. By determining the amount of heat that can be dissipated from the tray and distributing that heat through all the cables in the tray, Stolpe defines a conservative upper limit for cable ampacities. The method requires that the allowable depth of fill for the tray be known at the start of the design process so that the ampacity values can be determined before cable selection and installation. At CPS the initial design consideration was to select two inches as the nominal fill depth for power tray and determine the allowable cable ampacities accordingly.

In contrast, the test method used in 94-22 will produce very specific ampacity limits but it will be based on very specific configurations. Due to the limited data available at this time concerning the orientation and distribution of the reported conductors in the test tray, it is unclear just how configuration dependent these test results are. However, given the uneven heat production of the tested conductors it seems likely that relocating the conductors within the confines of the test tray would impact the heat distribution and could affect the reported results. This could mean that in order to use the ampacity values provided by this type of testing, there would have to be tests run for every type of cable singly, in multiples, and in combination with single and multiple specimens of every other type of cable. Whether the same combinations of cables would have to be tested in various sizes and configurations of tray would be a subject for debate. Just determining the various configurations to be tested would require a significant amount of review and evaluation.

To demonstrate the conservatism of the cable selection employed, the heaviest loaded cables in area CB-1e were added to the attachment two table. As shown, the present loading of the cables (120 and 22 Amps respectively) results in heat intensities lower than the lowest values shown in the right hand column. Therefore these cables will not be impacted by the concerns expressed in IEIN 94-22 and since they are acceptable, the rest of the cables in fire zone CB-1e are also acceptable.

Prepared Mark McMenamin 10/11/94

Reviewed K M Forest 10-12-94

References

ICEA P-54-440 (NEMA WC 51-1986)
IEEE Transaction paper 70 TP 557 PWR *Ampacities for Cables in Randomly Filled Cable Trays* by J. Stolpe
EPRI Power Plant Elec. Ref. Series Vol.4 *Wire and Cable*
IEIN 94-22
Calc 19-G-01 R/1
Calc 19-AI-8 R/0
Calc 19-AK-6 R/0
Calc 19-AN-4 R/11
Calc 19-D-24 R/4
Calc 19-D-29 R/11
K-2982 Power Cable Purchase Spec. Proposal Data
SLICE version 7.3
Drwg E02-1RD99-001 R/M
ROC Y-104156, dated 8/10/94

FIRE ZONE CB-1E POWER TRAY CABLE AMPACITIES VS. PROJECT AMPACITIES

CABLE	TYPE	PROJECT AMPACITY	LOAD AMPERES	LOAD % OF AMPACITY		ALLOWABLE DERATING
1AP29B	3/C,350 MCM,5KV	286	104.0	36%		OVER 50%
1AP34G	2/C,#19/22 AWG,600V	10	0.1	1%		OVER 50%
1AP34H	2/C,#19/22 AWG,600V	10	0.1	1%		OVER 50%
1AP34N	4/C,#2/0 AWG,1KV	117	2.0	2%		OVER 50%
1AP34V	3/C,#1/0 AWG,1KV	97	0.9	1%		OVER 50%
1AP34W	3/C,#1/0 AWG,1KV	97	1.1	1%		OVER 50%
1AP37D	3/C,350 MCM,1KV	269	76.0	28%		OVER 50%
1AP37J	3/C,350 MCM,1KV	269	76.0	28%		OVER 50%
1CM09H	3/C,#6 AWG,1KV	32	16.0	50%		OVER 50%
1CM09K	3/C,#6 AWG,1KV	32	22.0	69%		SEE NOTE 1
1DG21J	3/C,#1/0 AWG,1KV	97	40.0	41%		OVER 50%
1DG24B	3/C,#19/22 AWG,1KV	16	3.2	20%		OVER 50%
1DG25B	3/C,#19/22 AWG,1KV	16	3.2	20%		OVER 50%
1DG26B	3/C,#6 AWG,1KV	32	18.8	59%		41%
1DG27B	3/C,#6 AWG,1KV	32	18.8	59%		41%
1DG28B	3/C,#19/22 AWG,1KV	16	2.5	16%		OVER 50%
1DG29A	3/C,#6 AWG,1KV	32	27.0	84%		SEE NOTE 2
1DG30A	3/C,#6 AWG,1KV	32	27.0	84%		SEE NOTE 2
1DO02A	3/C,#19/22 AWG,1KV	16	2.0	13%		OVER 50%
1RD31H	3/C,#2 AWG,1KV	64	25.0	39%		OVER 50%
1RP02C	4/C,#2/0 AWG,1KV	117	40/cond	34%		OVER 50%
1SX27A	3/C,#19/22 AWG,1KV	16	0.4	2%		OVER 50%
1SX31A	3/C,#19/22 AWG,1KV	16	1.1	7%		OVER 50%
1SX40A	3/C,#19/22 AWG,1KV	16	0.5	3%		OVER 50%
1SX51A	3/C,#19/22 AWG,1KV	16	0.3	2%		OVER 50%
1SX51D	3/C,#19/22 AWG,1KV	16	0.3	2%		OVER 50%
1SX51G	3/C,#19/22 AWG,1KV	16	0.0	0%		OVER 50%
1VC25B	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC25C	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC25D	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC26B	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC26C	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC26D	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC27B	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC27C	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC27D	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC28B	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC28C	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC28D	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC28F	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC35B	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC35C	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC35D	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC35P	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC35S	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC36B	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC36C	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%

FIRE ZONE CB-1E POWER TRAY CABLE AMPACITIES VS. PROJECT AMPACITIES

1VC36D	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC36P	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC36Q	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC50B	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC50C	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC51B	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC51C	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC51D	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC51E	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC56B	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC56C	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VC56D	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VD02A	3/C,#4/0 AWG,1KV	175	120.0	69%		SEE NOTE 3
1VD05A	3/C,#19/22 AWG,1KV	16	6.5	41%		OVER 50%
1VD10A	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VD10B	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VD10C	3/C,#19/22 AWG,1KV	16	0.2	1%		OVER 50%
1VD10D	3/C,#19/22 AWG,1KV	16	0.0	0%		OVER 50%
1VG38A	3/C,#19/22 AWG,1KV	16	7.0	44%		OVER 50%
1VG40A	3/C,#19/22 AWG,1KV	16	7.0	44%		OVER 50%
1VQ05A	3/C,#19/22 AWG,1KV	16	1.7	11%		OVER 50%
1VQ14A	3/C,#19/22 AWG,1KV	16	2.4	15%		OVER 50%

Note 1) The project ampacities are based on all conductors of a 3/C cable being energized, but 1CM09K is carrying a 120V 1ϕ circuit so only two conductors are energized. From section 2.5 of ICEA P-54-440, when only two conductors are energized the allowable ampacity would be increased by $\sqrt{(3/2)}$ or 1.224, or from 32 to 39 amps. Thus the cable is only loaded to 56.4% of allowable and could accept up to a 43.6% derate with out being affected.

Note 2) Cable ampacities are only a concern with continuously loaded cables. 1DG29A and 1DG30A are only energized intermittently since they feed the air compressor motors for the Div 2 DG air start skid. These motors are only run to bring the air tanks up to their normal operating pressure. Therefore these cables are not impacted by derating.

Note 3) The project ampacity is based on a two inch depth of fill in the trays. In fire zone CB-1e, cable 1VD02A passes through three tray routing points which are wrapped in Thermo-lag. Based on the greatest depth of fill in its wrapped routing points in CB-1e, the ampacity of 1VD02A (a 3/C,4/0 cable) could be increased to 185 amps. (Per S&L calc ESI150-3, heat intensity (HI) for depth of fill (DOF) from 1.5-1.99 inches is 6.91 x (DOF) to -1.299 power.) Thus cable 1VD02A is loaded to only 65% of its capability and could accept up to a 35% derate without being affected. Additional cables can only be installed through the design process which would include analysis of the tray thermal ampacity prior to design approval.

NRC CA[illegible] AMPACITIES (BASED ON TESTING) VS. NEMA AND CPS AMPACITIES (BASED ON [illegible]LPE METHODOLOGY) AND THE RESULTANT HEAT INTENSITIES OF EACH

Cable	Diameter	Area	90C Resist	Open Amps	Watts/ft	Ht Intensity	Tlag Amps	Watts/ft	Ht Intensity
NRC #8	0.23	0.04154766	0.0008	23.7	0.449352	10.81533834	12.7	0.129032	3.1056382
NRC #4	0.33	0.08553006	0.0003226	37.8	0.460943784	5.389260618	24.2	0.188927464	2.208901338
NRC #2/0	0.52	0.21237216	0.0001013	113.6	1.307272448	6.155573537	73.5	0.547247925	2.57683[illegible]4577
NEMA #8	0.23	0.04154766	0.0008	15.3	0.187272	4.507401861	10.4	0.086528	2.082620297
NEMA #4	0.33	0.08553006	0.0003226	34	0.3729256	4.36016998	23.12	0.172440797	2.016142599
NEMA #2/0	0.52	0.21237216	0.0001013	95.3	0.920015717	4.332091914	64.8	0.425362752	2.00291202
CPS #8	0.23	0.04164768	0.0008	13.1	0.137288	3.304349752	8.9	0.063368	1.525189181
CPS #4	0.33	0.08553006	0.0003226	29.1	0.273180906	3.193975381	19.8	0.126472104	1.47868602
CPS #2/0	0.52	0.21237216	0.0001013	81.5	0.672859925	3.1683057	55.4	0.310905908	1.463967349
3C,4/0,1KV	1.838	2.653272838	0.0000655	175	6.0178125	2.268071498			
1VD02A load	1.838	2.653272838	0.0000655	120	2.8296	1.066456476			
3C/#6,1KV	0.949	0.707332025	0.000534	32	1.640448	2.319205042			
1CM09K load	0.949	0.707332025	0.000534	22	0.516912	0.730781172			

EVALUATION of Function for BOP Cable 1VD07D

This non-divisional cable carries a trip signal from the CO2 panels on 737 Control building to the main control room for the DG room vent fans (1VD01CA, B,C). The USAR list of safe shutdown cables includes 1VD07D. Fire damage could short the conductors and lock in the CO2 dump signal input. This evaluation reviews the impact of such a condition and its effect on the ability to bring the plant to safe shutdown.

Scenario 1, Fan not running (Fan A [Div 1] discussed, fan B [Div2] logic similar)
The trip signal attempts to produce two trip signals, through relays 1UAY-VD507C and 1KY- VD092A and B. The 507C signal is blocked by contacts of the sealed-in relay 1UAY-VD507D. The signal from VD092A is sent to the breaker trip coil but since the breaker is not closed nothing happens. VD092B times out in 3 seconds. After timing out, the VD092A signal is blocked by an open contact of VD092B. The sealed in VD507D relay blocks auto-start of the fan, but manual start (via MCR handswitch) is possible.

Scenario 2. Fan running, DG not running
The VD507C trip signal is blocked as in scenario 1 above. The contact of VD092A will trip the motor breaker. After VD092B times out, the fan auto-start will be blocked, but manual start will be possible.

Scenario 3. Fan and DG running
The contacts of VD092A and B will work as in 2 above. The VD507C trip signal is not blocked and will also trip the fan motor breaker (relay race between these contacts is of no consequence). After trip, the fan breaker "b" contact closes and VD507D is picked up and sealed-in by the locked in CO2 dump signal (through a contact of 1UAY-VD507B). This removes and blocks the 507C trip signal. As in 1 above, auto-start of the fan is blocked, but manual start will be possible.

The fan breaker logics are similar except that the remote shutdown panel can isolate the A fan from the trip signals.

In summary, cable damage to 1VD07D can trip running fans and prevent auto-start but operators can start fans from MCR. Therefore while certain automatic actions are impacted, the fans are not damaged and the equipment needed for safe shutdown can still be operated. Accordingly cable 1VD07D does not need to be classified as safe shutdown and may be removed from the USAR list.

ref. E02-1VD99 sht 1, 2, 3, 7, 8, and 9
E02-1DG99 sht 8

Prepared by Mark McMenemen 11/4/94
Reviewed by [signature] 11/9/94

Evaluation of Thermo-laged Div 2 Instrumentation Cables in Fire Zone CB-1E Which are Listed as Safe Shutdown

Seven Division 2 instrumentation cables were listed as being Safe Shutdown cables in fire zone CB-1e tray wrapped in Thermo-lag. Individual examination indicates that this is not accurate

1) Two of the cables, 1DG76A and 1DG76B, are routed in tray section 10116F. However while this is one of the tray points wrapped in Thermo-lag in fire zone CB-1e, the cables actually exit the tray before passing through the AC-line wall from the Diesel-Gen bldg. to the Control bldg. Therefore these two cables are not in fire zone CB-1e, are not inside the Thermo-lag wrapping, and should be removed from the fire zone CB-1e list of cables.

2) Cable 1DO78A provides an auto operation signal for the fuel oil transfer pump, but the pump also receives start signals from the Div 2 diesel and a MCR handswitch. Therefore the operation of the pump when needed (when the diesel engine is running) is not dependent on this cable and this cable is not required for the safe shutdown of the plant. Accordingly this cable does not belong on the list of safe shutdown cables in the USAR. By extension, the associated level indicating device should not be on the list of safe shutdown equipment.

3) Cable 1VD10P carries a signal that places the dampers of the Div 2 VD system into position for purge mode operation. A fire in CB-1e would not require purging of the Div 2 diesel bay. The diesel can operate with the dampers in purge or normal position. Therefore this cable is not required for the safe shutdown of the plant following a fire in fire zone CB-1e. Accordingly this cable does not belong on the list of safe shutdown cables in the USAR. By extension, the handswitch associated with this cable should not be on the list of safe shutdown equipment.

4) The remaining three cables, 1DO78B, 1VC91Q, and 1VC95F, provide indication to the MCR. The DO cable provides level indication for the Div 2 fuel oil tank. The VC cables provide pressure, flow, temperature, and humidity data on the Div 2 train of VC for display in the MCR. None of these signals affect system operation and therefore are not needed for the safe shutdown of the plant. Accordingly these cables do not belong on the list of safe shutdown cables in the USAR. As above, the instruments associated with these cables shoul not be on the list of safe shutdown equipment.

This evaluation indicates that there are no cables in the Thermo-laged Div 2 instrumentation tray in fire zone CB-1e which are required for safe shutdown of the plant.

Based on the information gathered, it would appear that the initial determination of what cables should be classified as safe shutdown was made with a very conservative criteria. This same conservative approach was utilized in the selection of the Div 1 safe shutdown cables as well, so that Div 1 cables 1DO77A and 1DO77B are listed in the USAR while performing the same non-essential functions as their Div 2 counterparts (1DO78A and B). These cables should also be removed from the USAR. Similarly the Div 3 cables (1DO79A and B) which perform these functions would not be required for safe shutdown. As with the evaluation of the Div 2 cables above, the instruments which are associated with these cables are non-essential and should also be removed from the USAR list of safe shutdown equipment if their only output is through the cable reviewed.

Ref. E02-1DO99 sht 1,2
E02-1VD99 sht 11
E02- 0VC98 sht 10,12
E29-1001-02A-EI
CCT - 059828 MJM 11/14/94
KAL 11/15/94

Prepared by Mark McMenamin 11/4/94
Reviewed by [signature] 11/9/94

TO: Director - Licensing

FROM: J. R. Langley [signature] 11/14/94
NSED - Director Date

SUBJECT: Proposed Amendment to CPS SAR.

SAR Sections Affected: Appendix F Table 1.8-3, Table 4.2.3.3-1, Table 4.2.4.3-1, Table 4.2.4.5-1, Table 4.2.4.5-2, Table 4.2.4.5-3, Table 4.2.4.5-4, Table 4.2.4.5-5, Table 4.2.4.5-6, Table 4.2.4.6-1; Appendix F 3.3.1.2, 4.2.4.5, 4.2.2.10; Appendix F Figure 4.2.4.5-1, Figure 4.2.4.5-2, Figure 4.2.4.5-3

Safety Evaluation or Screening Form attached: ✓ YES ___ NO

SAR Section 1.8 impacted: ___ YES ✓ NO

If yes, identify Section 1.8 impact and affected sections.

Justification of Change: Enclosures 5 and 6 in the attached safety evaluation provide the detailed justification for deleting these instrumentation cables and instruments from applicable safe shutdown sections of the USAR. In summary, two trip cables (1DG76A,1DG76B) are in fact not routed through firezone CB-1e and the remaining cables (1DO77A,1DO77B,1DO78A,~~1DO79A~~ 1DO78B,1VC91Q,1VC95F,1VD07D,1VD10P) and their related instruments have no safe shutdown fuction.

Originator: [signature] / 11-7-94

Concurrence: N/A /
Division of Responsibility

Supervisor: [signature] / 11/14/94

Attachments: Affected SAR Pages
Safety Evaluation/Screening, LIC Log No. 94-0074
(if applicable)

cc: K A Leffel, V-922 R P Bhat
M G MeMenamin C R Smail
M E O'Flaherty S R Wilson

NF-139 (4/94)

TABLE 1.8-3 (Cont.)

TIME DELAY RELAY	0KY-VC003	0PL72JA	825' 0"	AA/135	1	CB-1				CTA. RM TRAIN ISO. DMPR
CONTROL SWITCH	0HS-VC007	0PL72JA	825' 0"	AA/135	1	CB-1				CHILLED WATER PUMP
TIME DELAY RELAY	1KY-VD080	1PL54JA	762' 0"	AF/128	1	D-8	CONTROL SWITCH	1HS-VD001	1H13-P801-66B	DG RM 1A HVAC SYSTEM
RTD	1TE-VD001	LR	753' 0"	AG/128	1	D-5	CONTROL SWITCH	1HS-VD010	1H13-P801-66B	DG RM 1A HVAC SYSTEM
TEMP IND CTRLR	1TIC-VD001	1PL54JA	762' 0"	AG/128	1	D-8	TRANSFER SWITCH	1HS-1C61-HS308	1C61-P001	DG RM 1A HVAC SYSTEM
RTD	1TE-VD007	LR	742' 0"	AE/128	1	D-5				DG RM 1A HVAC SYSTEM
TEMP IND TRNMTR	1TIT-VD007	1PL54JA	762' 0"	AF/128	1	D-8				DG RM 1A HVAC SYSTEM
TEMP RELAY	1TY-VD007A	1PL54JA	762' 0"	AF/128	1	D-8				DG RM 1A HVAC SYSTEM
TEMP RELAY	1TY-VD007B	1PL54JA	762' 0"	AF/128	1	D-8				DG RM 1A HVAC SYSTEM
DAMPER POSITIONER	1TZ-VD001A	LR	762' 0"	AG/128	1	D-8				DG RM 1A HVAC SYSTEM
DAMPER POSITIONER	1TZ-VD001B	LR	762' 0"	AE/128	1	D-10				DG RM 1A HVAC SYSTEM
DAMPER POSITIONER	1TZ-VD004	LR	744' 0"	AF/128	1	D-5				DG RM 1A HVAC SYSTEM
~~LEVEL TRANSMITTER~~	~~0LT-DO011~~	~~LCL RT~~	~~715' 0"~~	~~100-120/AE-AF~~	~~1~~	~~D-8~~	~~LEVEL RELAY~~	~~0LY-DO011~~	~~1H13-P868~~	~~DIESEL GENERATOR FUEL OIL~~
							~~LEVEL INDICATOR~~	~~0LI-DO011~~	~~1H13-P877~~	~~DIESEL GENERATOR FUEL OIL~~
LEVEL INDICATOR	0LI-DO020	LCL RT	737' 0"	120/AG-AJ	1	D-5				DSL/GEN FUEL OIL STRG TNK LVL
LEVEL TRANSMITTER	1C61-N505	LCL RT	737' 0"	AK-AL/121-124	1	F-1	LEVEL INDICATOR	1C61-R505	1C61-P001	RCIC STORAGE TANK LEVEL
LEVEL TRANSMITTER	1C61-N506	LCL RT	723' 0"	116-121/AF-AH	1	F-1	LEVEL INDICATOR	1C61-R504	1C61-P001	SUPP POOL LEVEL
LEVEL TRANSMITTER	1E51-N035A	LCL RT	737' 0"	AK-AL/121-124	1	F-1	LEVEL RELAY	1E51-N635A	1H13-P661	RCIC STORAGE TANK LEVEL
LEVEL TRANSMITTER	1E51-N035E	LCL RT	737' 0"	AK-AL/121-124	1	F-1	LEVEL RELAY	1E51-N635E	1H13-P661	RCIC STORAGE TANK LEVEL
PRESS TRANSMITTER	1C61-N503	LCL RT	703' 0"	E-1/C	1	A-1	PRESS INDICATOR	1C61-R503	1C61-P001	SSWS STRAINER
PRESS DIFF SWITCH	1PDS-SX022	1SX11J	699' 0"	E-1/C	1	A-1	ANNUNCIATOR		1H13-P601	SSWS STRAINER
PRESS TRANSMITTER	1PT-SX028	LCL RT	703' 0"	[illegible]	1	A-1	INDICATING LIGHT	1C61DS301	1C61-P001	SSWS STRAINER
							PRESS INDICATOR	1PI-SX028	1H13-P601	SSWS STRAINER
RTD	1TE-VH001	LR	699' 0"	C/1	1	A-1	CONTROL SWITCH	1HS-VH001	1H13-P801-66B	SSW PUMP RM "A" SPLY FAN
TEMP IND TRNSMTR	1TIT-VH001	1PL53JA	699' 0"	C/1	1	A-1	TRANSFER SWITCH	1HS-1C61-HS302	1C61-P001	SSW PUMP RM "A" SPLY FAN
CURRENT RELAY	1TY-VH001	1PL53JA	699' 0"	C/1	1	A-1				SSW PUMP RM "A" SPLY FAN
DAMPER POSITIONER	1TZ-VD001C	LR	785' 0"	AC/128	1					DG RM 1A HVAC SYSTEM

DELETE

TABLE 1.8-3 (Cont.)

IND LIGHT	0GL-VC103OA	DPL72JB	825' 0"	AA/125	2	CB-1				CTRL RM ISOL DAMPER
CONTROL SWITCH	0HS-VC107	DPL72JB	825' 0"	AA/125	2	CB-1				CTRL RM ISOL DAMPER
CONTROL SWITCH	0HS-VC102	DPL72JB	825' 0"	AA/125	2	CB-1				CTRL RM HVAC SPLY FAN
CONTROL SWITCH	0HS-VC110	DPL72JB	825' 0"	AA/125	2	CB-1	CONTROL SWITCH	0HS-VC101		CTRL RM HVAC SPLY FAN
TIME DELAY RELAY	0KY-VC101	DPL72JB	825' 0"	AA/125	2	CB-1				CTRL RM HVAC SPLY FAN
CONTROL SWITCH	0HS-VC103A	DPL72JB	825' 0"	AA/125	2	CB-1				CTRL RM TRAIN ISOL DMPR
TIME DELAY RELAY	0KY-VC103	DPL72JB	825' 0"	AA/125	2	CB-1				CTRL RM TRAIN ISOL DMPR
TIME DELAY RELAY	0KY-VC361	DPL72JB	825' 0"	AA/125	2	CB-1				CHILLED WATER FLOW
FLOW IND SWITCH	0FIS-VC108	LR	825' 0"	AC/128	2	CB-1				CHILLED WATER FLOW
FLOW ALRM LOW		DPL72JB	825' 0"	AA/125	2	CB-1				CHILLED WATER FLOW
PRESS DIFF SWITCH	1PDS-VD031	1PL54JB	762' 0"	AF/129	2	D-9	TIME DELAY RELAY	1KY-VD508F	1H13-P851	DG RM 1B EXCH FAN
							PRES DIFF ALRM LOW		1H13-P801	DG RM 1B EXCH FAN
RTD	1TE-VD002	LR	764' 0"	AF/129	2	D-9	CONTROL SWITCH	1HS-VD011	1H13-P801-678	DG RM 1B HVAC SYSTEM
TIME DELAY RELAY	1KY-VD081	1PL54JB	762' 0"	AF/129	2	D-9	CONTROL SWITCH	1HS-VD002	1H13-P801-678	DG RM 1B HVAC SYSTEM
TEMP IND CTRLR	1TIC-VD002	1PL54JB	762' 0"	AF/129	2	D-9				DG RM 1B HVAC SYSTEM
RTD	1TE-VD008	LR	742' 0"	AE/130	2	D-6				DG RM 1B HVAC SYSTEM
TEMP IND TRSMTR	1TIT-VD008	1PL54JB	762' 0"	AF/129	2	D-9				DG RM 1B HVAC SYSTEM
TEMP RELAY	1TY-VD008A	1PL54JB	762' 0"	AF/129	2	D-9				DG RM 1B HVAC SYSTEM
TEMP RELAY	1TY-VD008B	1PL54JB	762' 0"	AF/129	2	D-9				DG RM 1B HVAC SYSTEM
~~CONTROL SWITCH~~	~~1HS-VD071~~	~~LR~~	~~737' 0"~~	~~AE/129~~	~~2~~	~~[illegible]~~				~~DG RM 1B HVAC SYSTEM~~
DAMPER POSITIONER	1TZ-VD002A	LR	762' 0"	AE/130	2	D-9				DG RM 1B HVAC SYSTEM
DAMPER POSITIONER	1TZ-VD002B	LR	762' 0"	AE/130	2	D-10				DG RM 1B HVAC SYSTEM
DAMPER POSITIONER	1FZ-VD005	LR	745' 0"	AF/130	2	D-6				DG RM 1B HVAC SYSTEM
~~LEVEL TRANSMITTER~~	~~1LT-DO012~~	~~LCL RT~~	~~745' 0"~~	~~AE-AF/129-130~~	~~2~~	~~D-3~~	~~LEVEL RELAY~~	~~1LY-DO012~~	~~1H13-P862~~	~~DIESEL GENERATOR FUEL OIL~~
							~~LEVEL INDICATOR~~	~~1LY-DO012~~	~~1H13-P877~~	~~DIESEL GENERATOR FUEL OIL~~
LEVEL TRANSMITTER	1LT-CM031	LCL RT	721' 0"	AD-AE/103	2	F-1	LEVEL RELAY	1LY-CM031	1H13-P852	SUPP POOL WTR LEVEL
							LEVEL RECORDER	1LR-CM241	1H13-P601	SUPP POOL WTR LEVEL
PRESS TRANSMITTER	1PT-SX030	LCL RT	703' 0"	2-1/C	2	M-2	PRESS INDICATOR	1PI-SX030	1H13-P601	SSWS STRAINER
PRESS DIFFER SWTCH	1PDS-SX024	1SX12J	697' 0"	2-1/C	2	M-2	ANNUNCIATOR		1H13-P601	SSWS STRAINER

DELETE

TABLE 1.8-3 (Cont.)

RTD	1TE-VH002	LR	699' 0"	C/2	2	H-2				SSW PUMP RM "B" SPLY FAN
TEMP IND TRNSMTR	1TIT-VH002	1PL53JB	699' 0"	C/2	2	H-2	CONTROL SWITCH	1HS-VH002	1H13-P801-668	SSW PUMP RM "B" SPLY FAN
CURRENT RELAY	1TY-VH002	1PL53JB	699' 0"	C/2	2	H-2				SSW PUMP RM "B" SPLY FAN
DAMPER POSITIONER	1TE-VD002C	LR	786' 0"	AC/130	2					DG RM 1B HVAC SYSTEM
RTD	0TE-VC137	LR	816' 0"	T/133	2					PANEL RM DAMPER
TEMP IND RELAY	0TIY-VC137	0PL78JB	825' 0"	AA/125	2	CB-1				PANEL RM DAMPER
TEMP IND CTRLR	0TTC-VC137	0PL78JB	825' 0"	AA/125	2	CB-1				PANEL RM DAMPER
DAMPER POSITIONER	0TZ-VC137	LR	825' 0"	V-Y/125-129	2	CB-1				PANEL RM DAMPER
FLOW TRANSMITTER	1E22-N005	1H22-P024	712' 0"	AH/104	3	F-1	FLOW INDICATOR	1E22-R603	1H13-P601	HPCS FLOW-DIV 3
~~LEVEL TRANSMITTER~~	~~1LT-DO012~~	~~1DPS-047~~	~~[illegible]~~	~~AE/104~~	~~3~~	~~D-1~~	~~LEVEL INDICATOR~~	~~1LI-DO012~~	~~1H13-P677~~	~~D/G FO DAYTANK RM LVL~~
							~~LEVEL RELAY~~	~~1LY-DO012~~	~~1H13-P620~~	~~DIV 3~~
PRESSURE TRANSMITTER	1PT-SX032	1SPS-007	703' 0"	C/1	3	H-2	PRESS INDICATOR	1PI-SX032	1H13-P601	SSW PUMP 1C DISCH PRESS
RTD	1TE-VY008	LR-WALL	717' 0"	AE/103	3	F-1				HPCS PUMP ROOM COOLER 1VY08SA
TEMP IND TRNSMTR	1TIT-VY008	1PL64J	712' 0"	AF/106	3	F-1				HPCS PUMP ROOM COOLER 1VY08SA
TEMPERATURE RELAY	1TY-VY008	1PL64J	712' 0"	AF/106	3	F-1				HPCS PUMP ROOM COOLER 1VY08SA
RTD	1TE-VX003	LR-WALL	786' 0"	AA/128	3	CB-10				SW GEAR RM SUPPLY FAN 1VX03CC
TEMP IND TRNSMTR	1TIT-VX003	1PL63JC	781' 0"	AC/130	3	CB-10				SW GEAR RM SUPPLY FAN 1VX03CC
TEMPERATURE RELAY	1TY-VX003	1PL63JC	781' 0"	AC/130	3	CB-10				SW GEAR RM SUPPLY FAN 1VX03CC
PRESS DIFF SWITCH	1PDS-VX018	1PL63JC	781' 0"	AC/130	3	CB-10				SW GEAR RM SUPPLY FAN 1VX03CC
TIME DELAY RELAY	1KY-VX018	1PL63JC	781' 0"	AC/130	3	CB-10				SW GEAR RM SUPPLY FAN 1VX03CC
DAMPER ACTUATOR	1FZ-VX003	LR	781' 0"	AC/129	3	CB-10				FAN 1VX03CC DISC DMPR 1VX03YC
INDICATING LIGHT	1ZL-VX012	1PL63JC	781' 0"	AC/130	3	CB-10	INDICATING LIGHT	1ZL-VX003C	1H13-P800-64B	FAN 1VX03CC DISC DMPR 1VX03YC
LIMIT SWITCH	1ZS-VX012A	LR	781' 0"	AC/129	3	CB-10				DMPR 1VX03YC W/INTR TO 1VX06CC
LIMIT SWITCH	1ZS-VX012B	LR	781' 0"	AC/129	3	CB-10				DMPR 1VX03YC W/INTR TO 1VX06CC
TRANSFER SWITCH	1HS-VX115B	LR-DM COND	781' 0"	AC/130	3	CB-10				SW GEAR RM COND UNIT 1VX06CC
CONTROL SWITCH	1HS-VX115C	LR-DM COND	781' 0"	AC/128	3	CB-10				SW GEAR RM COND UNIT 1VX06CC
PRESSURE CONTROLLER	1PC-VX116	1PL48JC	781' 0"	AC/128	3	CB-10				SW GEAR RM COND UNIT 1VX06CC
PRESSURE TRANSMITTER	1PT-VX116	1PL48JC	781' 0"	AC/128	3	CB-10				SW GEAR RM COND UNIT 1VX06CC
DAMPER ACTUATOR	1FZ-VX006	LR	781' 0"	AC/128	3	CB-10				FAN 1VX04CC DISC DMPR 1VX04YC

DELETE

3.3 CONTROL BUILDING

3.3.1 FIRE AREA CB-1 (FIRE ZONES CB-1a THROUGH CB-1i)

3.3.1.1 Description

This fire area consists of nine fire zones (CB-1a through CB-1i) and is located in the control building at various elevations (see Figures FP-8 through FP-15). The description and location of the individual zones are listed in the Clinton FPER and in Table 3.3-1 of this report.

3.3.1.2 Shutdown Analysis

CB-1a, REVISE DELETE

In this area, Fire Zones CB-1b, and CB-1h contain no safe shutdown cables or equipment (see Cable Tray Figures 7 through 13).

The only cable associated with safe shutdown (1D078B) belongs to the Division 2 fuel oil storage tank level indication. This cable is separated from its redundant counterpart, the Division 1 fuel oil storage tank level indication, by a 3-hour fire barrier (Fire Area D-2).

Fire Zone CB-1c contains safe shutdown equipment and cables belonging to Method 1 and 2. Cables associated with each method of safe shutdown have been evaluated. These cables and equipment are part of the shutdown service water, auxiliary power, safety parameter display, and the diesel fuel oil systems. There are no Method 3 safe shutdown cables in this fire zone.

DELETE Zone

Disabling the Division 2 safe shutdown equipment and cables in Fire ~~Zones CB-1a and~~ CB-1c will not prevent achieving a safe shutdown condition using Method 3 from the Control Room.

REVISE

In order to limit the potential damage of a fire spreading to Division 1 cables on the elevations above (i.e, to Zone CB-1e) from Zone CB-1c, modifications will be made (see Subsection 3.3.1.3.1).

In Fire Zone CB-1d, elevation 737 feet 0 inch, a Division 2 cable tray risers pass through the zone on the north wall. The nearest Method 3 safe shutdown cables or equipment (in Fire Zone CB-1e) are located over 50 feet from the Division 2 safe shutdown cable, and the Division 1 cables will be protected by a ceiling automatic wet-pipe sprinkler system. A fire in Zone CB-1d will not disable Method 3 safe shutdown systems.

In Fire Zone CB-1e, elevation 737 feet 0 inch (see Figure FP-10a) and above the intermediate roof at elevation 751 feet 0 inch (see Figure FP-11a), Division 1 and 2 electrical cables that belong to the diesel generator, diesel generator HVAC, auxiliary power, shutdown service water, control room HVAC, and the diesel generator fuel oil systems are routed in cable trays within a distance of less than 20 feet (see Cable Tray Figure 9). Also, located in this fire zone are diesel generator building MCCs 1A and IB. In order to ensure that one shutdown method will be available, the Division 1 and 2 cable trays will be protected as described in Subsection 3.3.1.3.2.

Fire Zone CB-1h is a stairwell tower enclosed by 1.9-hour fire rated walls and does not contain any safety-related or safe shutdown systems. It is not mentioned in the following discussion.

Engineering Justification

Rated fire floors are not utilized throughout Fire Area CB-1 to separate safe shutdown systems. A combination of partial suppression systems, partial fire detection, and firerated barriers are used to provide an equivalent level of protection to Appendix R requirements. The fire protection provided ensures that a fire cannot propagate horizontally or vertically upward sufficiently to damage redundant safe shutdown trains. This deviation is discussed by starting at the lowest elevation of Fire Area CB-1 and progressing upward. Because it is not likely that a fire will propagate downward since all cable risers are sealed at floor penetrations and there is no other continuity of combustibles, that situation was not analyzed.

Elevation 702 Feet 0 Inch - Fire Zones CB-1a and CB-1b

All cable tray risers are sealed at the ceiling with a 3-hour fire rated penetration seal.

The walls of Fire Zone CB-1a are 12-inch-minimum reinforced concrete. The west wall and the south corridor wall, common to Fire Areas D-1, D-2, and D-3, are 3-hour fire rated. The remaining walls are not fire rated. The ceiling (the floor of elevation 762 feet 0 inch) is 12-inch-minimum reinforced concrete and is 3-hour fire rated. Manual hose stations and portable extinguishers are provided throughout this zone. Fire Zone CB-1a has a low fire loading.

The walls of Fire-Zone CB-1b are at least 12-inch reinforced concrete or 11-5/8-inch solid concrete block or 7-5/8-inch hollow concrete block. The north and west walls are 3-hour fire rated. The ceiling is at least 12-inch reinforced concrete and is not fire rated. Manual hose stations and portable extinguishers are provided throughout this zone. Fire Zone CB-1b has a low fire loading.

no REVISE would

If a fire were to start at elevation 702 feet 0 inch, ~~the only~~ safe shutdown equipment ~~that could~~ be affected is a safe shutdown cable (in conduit) that is associated with the Division 2 fuel oil storage tank level indication in Fire Zone CB-1a. This cable is horizontally separated from its redundant counterpart, the Division 1 fuel oil storage tank level indication in Fire Area D-2, by a 3-hour fire barrier. Because of the low fire loading in Fire Zone CB-1a, it is not credible that a fire started in this zone will propagate. A fire starting in Fire Zone CB-1b would be prevented from spreading upward because of the sealing of the cable risers at the ceiling and the substantial construction of the ceiling.

DELETE

Elevation 719 Feet 0 Inch - Fire Zone CB-1c

All cable tray risers have 3-hour fire rated penetration seals installed in the floor and ceiling.

Fire Zones CB-1a and CB-1b contain no safe shutdown cables or equipment. ADD

TABLE 4.2.3.3-1

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
1DG75C	19108C	D-8	K1E	1DG01KA
1DG75D	19108C	D-8	K1E	1DG01KA
~~1DO77A~~	~~19108C~~	~~D-8~~	~~K1E~~	~~1DO01PA~~
~~1DO77B~~	~~19108C~~	~~D-8~~	~~K1E~~	~~1LT-DO011~~
1VD09H	19108C	D-8	K1E	1HS-VD070*
1VD78A	19108C	D-8	K1E	1TE-VD007
1VD78A	C91257	D-8	K1E	1TE-VD007
1VD01A	C92109	D-8	P1E	1VD01CA
1DG31A	C92118	D-8	P2E	1DG01KB
1DG31B	C92120	D-8	P2E	1DG01KB
1VD01E	C92124	D-8	C1E	1KY-VD080*
1VD04E	C92124	D-8	C1E	1PDS-VD030
1VD18B	C92124	D-8	C1E	1TIT-VD007*
1VD75A	C92137	D-8	K1E	1TE-VD001,1TIC-VD001
1VD75C	C92144	D-8	K1E	1TIC-VD001*

DELETE

Elevation 702 Feet 0 Inch - Fire Zones CB-la and CB-lb

All cable tray risers are sealed at the ceiling with a 3-hour fire rated penetration seal.

The walls of Fire Zone CB-la are 12-inch-minimum reinforced concrete. The west wall and the south corridor wall, common to Fire Areas D-l, D-2, and D-3, are 3-hour fire rated. The remaining walls are not fire rated. The ceiling (the floor of elevation 762 feet 0 inch) is 12-inch-minimum reinforced concrete and is 3-hour fire rated. Manual hose stations and portable extinguishers are provided throughout this zone. Fire Zone CB-la has a low fire loading.

The walls of Fire Zone CB-lb are at least 12-inch reinforced concrete, 11-5/8-inch solid concrete block or 7-5/8-inch hollow concrete block. The north and west walls are 3-hour fire rated. The ceiling is at least 12-inch reinforced concrete and is not fire rated. Manual hose stations and portable extinguishers are provided throughout this zone. Fire Zone CB-lb has an approximately uniform low fire loading.

no ← REVISE → would

If a fire were to start at elevation 702 feet 0 inch, ~~the only~~ safe shutdown equipment ~~that could~~ be affected is a safe shutdown cable (in conduit) that is associated with the Division 2 fuel oil storage tank level indication in Fire Zone CB-la. This cable is horizontally separated from its redundant counterpart, the Division 1 fuel oil storage tank level indication in Fire Area D-2, by a 3-hour fire barrier. Because of the negligible fire loading in Fire Zone CB-la, it is not credible that a fire started in this zone will propagate upward. A fire starting in Fire Zone CB-lb would be prevented from spreading upward because of the sealing of the cable risers at the ceiling and the substantial construction of the ceiling.

DELETE

Elevation 719 Feet 0 Inch - Fire Zone CB-lc

All cable tray risers have 3-hour fire rated penetration seals installed in the floor and ceiling.

This zone is a general access area and a heating, ventilation, and air-conditioning equipment area. Also, the standby gas treatment Systems A and B are located in the zone. The fire load in Fire Zone CB-lc is low.

The walls of Fire Zone CB-lc are 36-inch reinforced concrete, 15-5/8-inch solid concrete block, or 11-5/8-inch hollow concrete block. The north and west walls are 3-hour fire rated, and the remaining walls are not fire rated. The ceiling is 20-inch reinforced concrete and is 3-hour fire rated from columns/rows AC-AE and 124-130. The remainder of the ceiling is unrated. There are four stairways in this zone: two are open and two are enclosed in 1.9-hour fire rated walls. There are two elevators enclosed in 1.9-hour fire rated wall. Area fire detection and manual hose stations and extinguishers are provided in this zone.

If a fire were to start in Fire Zone CB-lc, Method 1 and 2 safe shutdown systems could be affected (see Table 4.2.4.5-1 and Figures 4.2.4.5-1). Division 1/Method 3 safe shutdown systems would be free of damage. As a result of the low fire loading, it is unlikely that a fire will propagate up to elevation 737 feet 0 inch.

Fire Zones CB-1a and CB-1b contain no safe shutdown cables or equipment.

ADD

TABLE 4.2.4.3-1

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
1DG75C	19108C	D-8	K1E	1DG01KA
1DG75D	19108C	D-8	K1E	1DG01KA
~~1DO77A~~	~~19108C~~	~~D-8~~	~~K1E~~	~~1DO01PA~~
~~1DO77B~~	~~19108C~~	~~D-8~~	~~K1E~~	~~1LT-DO011~~
1VD09H	19108C	D-8	K1E	1HS-VD070*
1VD78A	19108C	D-8	K1E	1TE-VD007
1VD78A	C91257	D-8	K1E	1TE-VD007
1VD01A	C92109	D-8	P1E	1VD01CA
1DG31A	C92118	D-8	P2E	1DG01KB
1DG31B	C92120	D-8	P2E	1DG01KB
1VD01E	C92124	D-8	C1E	1KY-VD080*
1VD04E	C92124	D-8	C1E	1PDS-VD030
1VD18B	C92124	D-8	C1E	1TIT-VD007*
1VD75A	C92137	D-8	K1E	1TE-VD001,1TIC-VD001
1VD75C	C92144	D-8	K1E	1TIC-VD001*

DELETE

TABLE 4.2.4.5-1

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
1AP29B	1066D	CB-1c	P2E	1AP09EB
1AP34N	1066D	CB-1c	P2E	0VC13CB,1AP12E
1AP34V	1066D	CB-1c	P2E	0VC13CB,1AP12E
1AP34W	1066D	CB-1c	P2E	0VC13CB,1AP12E
1AP36E	1066D	CB-1c	P2E	1AP61E
1DG21J	1066D	CB-1c	P2E	1DG01KB,1DO01PB
1RP02C	1066D	CB-1c	P2R	1C71-S001B
1VD02A	1066D	CB-1c	P2E	1VD01CB
1VD10A	1066D	CB-1c	P2E	1TZ-VD002A,1VD01YB
1VD10B	1066D	CB-1c	P2E	1TZ-VD002B,1VD02YB
1VD10C	1066D	CB-1c	P2E	1TZ-VD002C
1VD10D	1066D	CB-1c	P2E	1FZ-VD005,1V12YB
1RI19C	1066E	CB-1c	C2E	1E51-F004,1E51-F025
1VD10J	1066E	CB-1c	C2E	1TZ-VD002C
1VD10K	1066E	CB-1c	C2E	1FZ-VD005,1VD12YB
1AP37J	10R27	CB-1c	P2E	0AP57E
1AP37D	10R27	CB-1c	P2E	0AP25E,0AP57E
1AP37H	10R27	CB-1c	P2E	0AP25E
1CM07L	10R28	CB-1c	C2E	1TE-CM006.1TE-CM012*
1CM07L	10R30	CB-1c	C2E	1TE-CM006.1TE-CM012*
1RI19C	10R30	CB-1c	C2E	1E51-F004.1351-F025
1VD10J	10R30	CB-1c	C2E	1TZ-VD002C
1VD10K	10R30	CB-1c	C2E	1FZ-VD005.1VD12YB
1AP29B	10R31	CB-1c	P2E	1AP09EB
1AP34N	10R31	CB-1c	P2E	0VC13CB,1AP12E
1AP34V	10R31	CB-1c	P2E	0VC13CB,1AP12E
1AP34W	10R31	CB-1c	P2E	0VC13CB,1AP12E
1AP36E	10R31	CB-1c	P2E	1AP61E
1AP37D	10R31	CB-1c	P2E	0AP25E,0AP57E
1AP37H	10R31	CB-1c	P2E	0AP25E
1DG21J	10R31	CB-1c	P2E	1DG01KB,1DO01PB
1RP02C	10R31	CB-1c	P2R	1VD01CB
1VD02A	10R31	CB-1c	P2E	1TZ-VD002A,1VD01YB
1VD10A	10R31	CB-1c	P2E	1TZ-VD002B,1VD02YB
1VD10B	10R31	CB-1c	P2E	1TZ-VD002C
1VD10C	10R31	CB-1c	P2E	1FZ-VD005,1VD12YB
1VD10D	10R31	CB-1c	P2E	1LT-DO012
~~1DO70B~~	~~C9104~~	~~CB-1c~~	~~K2E~~	~~1LT-DO012~~
~~1DO70B~~	~~C9710~~	~~CB-1c~~	~~K2E~~	~~1LT-DO012~~

DELETE

TABLE 4.2.4.5-2 (Cont'd)

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
1VC56E	10R61	CB-1e	C2E	0VC39YB
1VC56N	10R61	CB-1e	C2E	0VC39YB
1VD18D	10R61	CB-1e	C2E	1TIT-VD008*
1VX28N	10R61	CB-1e	C2E	1SX193B
1VC91L	10R62	CB-1e	K2E	0TE-VC138,0VC17YB
~~1VC91Q~~	~~10R62~~	~~CB-1e~~	~~K2E~~	~~0PDR-VC153~~
1VC95D	10R62	CB-1e	K2E	0PDT-VC121A*
1VC95E	10R62	CB-1e	K2E	0PDT-VC121B*
~~1VC95F~~	~~10R62~~	~~CB-1e~~	~~K2E~~	~~0PDY-VC121~~
1AP36A	10R63	CB-1e	P1E	1AP60E
1AP36N	10R63	CB-1e	P1E	0AP24E
1DG09A	10R63	CB-1e	P1E	1DG06SA
1DG10A	10R63	CB-1e	P1E	1DG06SA
1DO01A	10R63	CB-1e	P1E	1DO01PA
1SX26A	10R63	CB-1e	P1E	1SX019A
1SX30A	10R63	CB-1e	P1E	1SX063A
1SX39A	10R63	CB-1e	P1E	1SX017A
1VD04A	10R63	CB-1e	P1E	1VD02CA
1DG01G	10R64	CB-1e	C1E	1DG01KA,1DO01PA*
1DG04A	10R64	CB-1e	C1E	1DG01KA
1DG05A	10R64	CB-1e	C1E	1DG01KA
1DG09B	10R64	CB-1e	C1E	1DG06SA
1DG10B	10R64	CB-1e	C1E	1DG06SA
1DG11K	10R64	CB-1e	C1E	1DG01KA
1DO01C	10R64	CB-1e	C1E	1DO01PA
1DO01H	10R64	CB-1e	C1E	1DO01PA
1SX26B	10R64	CB-1e	C1E	1SX019A
1SX30B	10R64	CB-1e	C1E	1SX063A
1SX30E	10R64	CB-1e	C1E	1SX063A
1SX39B	10R64	CB-1e	C1E	1SX017A
1SX39C	10R64	CB-1e	C1E	1SX017A
1VD01J	10R64	CB-1e	C1E	1VD01CA
1VD04E	10R64	CB-1e	C1E	1PDS-VD030
1VD04F	10R64	CB-1e	C1E	1VD02CA
1AP34L	10R65	CB-1e	P1E	0AP05E,0VC13CA,1AP11
1AP34T	10R65	CB-1e	P1E	0AP05E,1AP11E
1RP01C	10R65	CB-1e	P1R	1C71-S001A
1RP01H	10R65	CB-1e	P1R	1C71-S001A
1SX26A	10R65	CB-1e	P1E	1SX019A
1SX39A	10R65	CB-1e	P1E	1SX017A
1VC20B	10R65	CB-1e	P1E	0VC14YA
1VC20C	10R65	CB-1e	P1E	0VC13YA
1VC20D	10R65	CB-1e	P1E	0VC12YA
1VC21B	10R65	CB-1e	P1E	0VC30YA
1VC21C	10R65	CB-1e	P1E	0VC33YA
1VC21D	10R65	CB-1e	P1E	0VC36YA
1VC22B	10R65	CB-1e	P1E	0VC17YA
1VC22C	10R65	CB-1e	P1E	0VC16YA
1VC22D	10R65	CB-1e	P1E	0VC15YA

DELETE

TABLE 4.2.4.5-2 (Cont'd)

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
1VC22F	10R65	CB-1e	P1E	0VC18YA
1VC48B	10R65	CB-1e	P1E	0VC21YA
1VC48C	10R65	CB-1e	P1E	0VC24YA
1VC48D	10R65	CB-1e	P1E	0VC27YA
1VC55B	10R65	CB-1e	P1E	0FZ-VC003G,0VC39YA
1CC05B	10R66	CB-1e	C1E	1SX012A,1SX062A
1DG01C	10R66	CB-1e	C1E	1DG01KA
1DG01K	10R66	CB-1e	C1E	1DG01KA
1DG11T	10R66	CB-1e	C1E	1DG01KA
1DO01C	10R66	CB-1e	C1E	1DO01PA
1RI13F	10R66	CB-1e	C1E	1E51-F068
1SX25E	10R66	CB-1e	C1E	1SX073A
1SX26B	10R66	CB-1e	C1E	1SX019A
1SX39B	10R66	CB-1e	C1E	1SX017A
1SX39C	10R66	CB-1e	C1E	1SX017A
1VC20E	10R66	CB-1e	C1E	0VC14YA
1VC21O	10R66	CB-1e	C1E	0VC30YA
1VC21P	10R66	CB-1e	C1E	0VC33YA
1VC21Q	10R66	CB-1e	C1E	0VC36YA
1VC21R	10R66	CB-1e	C1E	0VC14YA*
1VC22E	10R66	CB-1e	C1E	0VC15YA*
1VC48N	10R66	CB-1e	C1E	0VC21YA
1VC48O	10R66	CB-1e	C1E	0VC24YA
1VC48P	10R66	CB-1e	C1E	0VC27YA
1VC49M	10R66	CB-1e	C1E	0VC39YA
1VC55E	10R66	CB-1e	C1E	0VC39YA
1VC55N	10R66	CB-1e	C1E	0VC39YA
1VC55O	10R66	CB-1e	C1E	0VC39YA
1VC55P	10R66	CB-1e	C1E	0VC39YA
1VD01E	10R66	CB-1e	C1E	1KY-VD080*
1VD09J	10R66	CB-1e	C1E	1TZ-VD001C,1VD03YA
1VD18B	10R66	CB-1e	C1E	1TIT-VD007*
1VG31H	10R66	CB-1e	C1E	1SX073A
~~1D077A~~	~~10R67~~	~~CB-1e~~	~~K1E~~	~~1D001PA,1D001PA~~
~~1D077B~~	~~10R67~~	~~CB-1e~~	~~K1E~~	~~1LT-D0011~~
1AP36N	10R68	CB-1e	P1E	0AP24E
1VC20B	10R68	CB-1e	P1E	0VC14YA
1VC20C	10R68	CB-1e	P1E	0VC13YA
1VC20D	10R68	CB-1e	P1E	0VC12YA
1VC21B	10R68	CB-1e	P1E	0VC30YA
1VC21C	10R68	CB-1e	P1E	0VC33YA
1VC21D	10R68	CB-1e	P1E	0VC36YA
1VC22B	10R68	CB-1e	P1E	0VC17YA
1VC22C	10R68	CB-1e	P1E	0VC16YA
1VC22D	10R68	CB-1e	P1E	0VC15YA
1VC22F	10R68	CB-1e	P1E	0VC18YA
1VC48B	10R68	CB-1e	P1E	0VC21YA
1VC48C	10R68	CB-1e	P1E	0VC24YA
1VC48D	10R68	CB-1e	P1E	0VC27YA

DELETE

TABLE 4.2.4.5-3

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
1DG01M	10110A	CB-1e	P1E	1DG01KA,1DO01PA*
1DG01N	10110A	CB-1e	P1E	1DG01KA,1DO01PA*
1DG01P	10110A	CB-1e	P1E	1DG01KA,1DO01PA*
1DG09A	10110A	CB-1e	P1E	1DG065A
1DG10A	10110A	CB-1e	P1E	1DG065A
1DO01A	10110A	CB-1e	P1E	1DO01PA
1SX30A	10110A	CB-1e	P1E	1SX063A
1VD01A	10110A	CB-1e	P1E	1VD01CA
1VD04A	10110A	CB-1e	P1E	1VD02CA
1VD09A	10110A	CB-1e	P1E	1TZ-VD001A
1VD09B	10110A	CB-1e	P1E	1TZ-VD001B,1VD02YA
1VD09D	10110A	CB-1e	P1E	1FZ-VD004,1VD12YA
1AP20K	10110B	CB-1e	C1E	1AP07EK,1DG01KA
1AP20M	10110B	CB-1e	C1E	1AP07EK,1DG01KA
1AP22J	10110B	CB-1e	C1E	1AP07EH,1DG01KA
1AP22K	10110B	CB-1e	C1E	1AP07EH,1DG01KA
1DG01C	10110B	CB-1e	C1E	1DG01KA
1DG01D	10110B	CB-1e	C1E	1DG01KA
1DG01G	10110B	CB-1e	C1E	1DG01KA,1DO01PA*
1DG01J	10110B	CB-1e	C1E	1DG01KA
1DG01K	10110B	CB-1e	C1E	1DG01KA
1DG01Q	10110B	CB-1e	C1E	1DG01KA
1DG01R	10110B	CB-1e	C1E	1DG01KA,1SX01PA
1DG01S	10110B	CB-1e	C1E	1DG01KA
1DG04A	10110B	CB-1e	C1E	1DG01KA
1DG05A	10110B	CB-1e	C1E	1DG01KA
1DG09B	10110B	CB-1e	C1E	1DG06SA
1DG10B	10110B	CB-1e	C1E	1DG06SA
1DG11C	10110B	CB-1e	C1E	1DG01KA
1DG11D	10110B	CB-1e	C1E	1DG01KA
1DG11E	10110B	CB-1e	C1E	1DG01KA
1DG11F	10110B	CB-1e	C1E	1DG01KA
1DG11R	10110B	CB-1e	C1E	1DG01KA
~~1VD07D~~	~~10110B~~	~~CB-1e~~	~~C1E~~	~~1VD01CA,1VD01CB~~

DELETE

TABLE 4.2.4.5-3

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
1DG11S	10110B	CB-1e	C1E	1DG01KA
1DG11T	10110B	CB-1e	C1E	1DG01KA
1SX30B	10110B	CB-1e	C1E	1SX063A
1VD01E	10110B	CB-1e	C1E	1KY-VD080*
1VD04E	10110B	CB-1e	C1E	1PDS-VD030
1VD09K	10110B	CB-1e	C1E	1FZ-VD004,1VD12YA
1VD18B	10110B	CB-1e	C1E	1TIT-VD007*
~~1DO77A~~	~~10110C~~	~~CB-1e~~	~~K1E~~	~~1DO01PA,1DO01PA~~
~~1DO77B~~	~~10110C~~	~~CB-1e~~	~~K1E~~	~~1LT-DO011~~
1DG21J	10116D	CB-1e	P2E	1DG01KB,1DO01PB
1DG29A	10116D	CB-1e	P2E	1DG06SB
1DG30A	10116D	CB-1e	P2E	1DG06SB
1DO02A	10116D	CB-1e	P2E	1DO01PB
1SX31A	10116D	CB-1e	P2E	1SX063B
1VD02A	10116D	CB-1e	P2E	1VD01CB
1VD05A	10116D	CB-1e	P2E	1VD02CB
1VD10A	10116D	CB-1e	P2E	1TZ-VD002A,1VD01YB
1VD10B	10116D	CB-1e	P2E	1TZ-VD002B,1VD02YB
1VD10C	10116D	CB-1e	P2E	1TZ-VD002C
1VD10D	10116D	CB-1e	P2E	1FZ-VD005,1VD12YB
1AP21K	10116E	CB-1e	C2E	1AP09EA,1DG01KB
1AP21L	10116E	CB-1e	C2E	1AP09EA,1DG01KB
1AP23L	10116E	CB-1e	C2E	1AP09EC,1DG01KB
1AP23M	10116E	CB-1e	C2E	1AP09EC,1DG01KB
1DG21A	10116E	CB-1e	C2E	1DG01KB
1DG21B	10116E	CB-1e	C2E	1DG01KB
1DG21C	10116E	CB-1e	C2E	1DG01KB
1DG21D	10116E	CB-1e	C2E	1DG01KB,1DO01PB
1DG21F	10116E	CB-1e	C2E	1DG01KB
1DG21K	10116E	CB-1e	C2E	1SX01PB
1DG21L	10116E	CB-1e	C2E	1DG01KB
1DG21M	10116E	CB-1e	C2E	1DG01KB,1SX01PB

DELETE

TABLE 4.2.4.5-3

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
1DG24A	10116E	CB-1e	C2E	1DG01KB
1DG25A	10116E	CB-1e	C2E	1DG01KB
1DG29B	10116E	CB-1e	C2E	1DG06SB
1DG30B	10116E	CB-1e	C2E	1DG06SB
1DG31C	10116E	CB-1e	C2E	1DG01KB
1DG31D	10116E	CB-1e	C2E	1DG01KB
1DG31E	10116E	CB-1e	C2E	1DG01KB
1DG31F	10116E	CB-1e	C2E	1DG01KB
1DG31R	10116E	CB-1e	C2E	1DG01KB
1DG31S	10116E	CB-1e	C2E	1DG01KB
1DG31T	10116E	CB-1e	C2E	1DG01KB
1SX31B	10116E	CB-1e	C2E	1SX063B
1VD02E	10116E	CB-1e	C2E	1KY-VD081*
1VD05E	10116E	CB-1e	C2E	1PDS-VD031
1VD10J	10116E	CB-1e	C2E	1TZ-VD002C
1VD10K	10116E	CB-1e	C2E	1FZ-VD005,1VD12YB
1VD18D	10116E	CB-1e	C2E	1TIT-VD008*
~~1DG76A~~	~~10116F~~	~~CB-1e~~	~~K2E~~	~~1DG01KB~~
~~1DG76B~~	~~10116F~~	~~CB-1e~~	~~K2E~~	~~1DG01KB~~
~~1DO70A~~	~~10116F~~	~~CB-1e~~	~~K2E~~	~~1DO01PB~~
~~1DO78B~~	~~10116F~~	~~CB-1e~~	~~K2E~~	~~1LT-DO012~~
~~1VD10P~~	~~10116F~~	~~CB-1e~~	~~K2E~~	~~1HS-VD071,1VD02YB~~
1AP34L	10121A	CB-1e	P1E	OVC13CA,1AP11E
1AP34T	10121A	CB-1e	P1E	OAP05E,1AP11E
1AP36A	10121A	CB-1e	P1E	1AP60E
1DG01M	10121A	CB-1e	P1E	1DG01KA,1DO01PA*
1DG01N	10121A	CB-1e	P1E	1DG01KA,1DO01PA*
1DG01P	10121A	CB-1e	P1E	1DG01KA,1DO01PA*
1RP01C	10121A	CB-1e	P1E	1C71-S001A
1VD01A	10121A	CB-1e	P1E	1VD01CA
1VD09A	10121A	CB-1e	P1E	1TZ-VD001A,1VD01YA
1VD09B	10121A	CB-1e	P1E	1TZ-VD001B,1VD02YA
1VD09C	10121A	CB-1e	P1E	1TZ-VD001C,1VD03YA

DELETE

TABLE 4.2.4.5-3

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
~~1VC91Q~~	~~10R62~~	~~CB-1e~~	~~K2E~~	~~OPDR-VC153~~
1VC95D	10R62	CB-1e	K2E	OPDT-VC121A*
1VC95E	10R62	CB-1e	K2E	OPDT-VC121B*
~~1VC95F~~	~~10R62~~	~~CB-1e~~	~~K2E~~	~~OPDY-VC121~~
1AP36A	10R63	CB-1e	P1E	1AP60E
1AP36N	10R63	CB-1e	P1E	0AP24E
1DG09A	10R63	CB-1e	P1E	1DG06SA
1DG10A	10R63	CB-1e	P1E	1DG06SA
1DO01A	10R63	CB-1e	P1E	1DO01PA
1SX26A	10R63	CB-1e	P1E	1SX019A
1SX30A	10R63	CB-1e	P1E	1SX063A
1SX39A	10R63	CB-1e	P1E	1SX017A
1VD04A	10R63	CB-1e	P1E	1VD02CA
1DG01G	10R64	CB-1e	C1E	1DG01KA,1DO01PA*
1DG04A	10R64	CB-1e	C1E	1DG01KA
1DG05A	10R64	CB-1e	C1E	1DG01KA
1DG09B	10R64	CB-1e	C1E	1DG06SA
1DG10B	10R64	CB-1e	C1E	1DG06SA
1DG11K	10R64	CB-1e	C1E	1DG01KA
1DO01C	10R64	CB-1e	C1E	1DO01PA
1DO01H	10R64	CB-1e	C1E	1DO01PA
1SX26B	10R64	CB-1e	C1E	1SX019A
1SX30B	10R64	CB-1e	C1E	1SX063A
1SX30E	10R64	CB-1e	C1E	1SX063A
1SX39B	10R64	CB-1e	C1E	1SX017A
1SX39C	10R64	CB-1e	C1E	1SX017A
1VD01J	10R64	CB-1e	C1E	1VD01CA
1VD04E	10R64	CB-1e	C1E	1PDS-VD030
1VD04F	10R64	CB-1e	C1E	1VD02CA
1AP34L	10R65	CB-1e	P1E	0AP05E,0AP05P 1AP11
1AP34T	10R65	CB-1e	P1E	0AP05E,1AP11E
1RP01C	10R65	CB-1e	P1R	1C71-S001A
1RP01H	10R65	CB-1e	P1R	1C71-S001A
1VC33B	10R65	CB-1e	P1E	0VC03YA
1VC33X	10R65	CB-1e	P1E	0VC115YB
1VC49C	10R65	CB-1e	P1E	0VC01YA
1VC55D	10R65	CB-1e	P1E	0VC08YA

DELETE

TABLE 4.2.4.5-3

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
1VC48P	10R66	CB-1e	C1E	0VC27YA
1VC49M	10R66	CB-1e	C1E	0VC39YA
1VC55E	10R66	CB-1e	C1E	0VC39YA
1VC55N	10R66	CB-1e	C1E	0VC39YA
1VC55O	10R66	CB-1e	C1E	0VC39YA
1VC55P	10R66	CB-1e	C1E	0VC39YA
1VD01E	10R66	CB-1e	C1E	1KY-VD080*
1VD09J	10R66	CB-1e	C1E	1TZ-VD001C,1VD03YA
1VD18B	10R66	CB-1e	C1E	1TIT-VD007*
~~1D077A~~	~~10R67~~	~~CB-1e~~	~~K1E~~	~~1D001PA,1D001PA~~
~~1D077B~~	~~10R67~~	~~CB-1e~~	~~K1E~~	~~1LT-D0011~~
1AP36N	10R68	CB-1e	P1E	0AP24E
1VC20B	10R68	CB-1e	P1E	0VC14YA
1VC20C	10R68	CB-1e	P1E	0VC13YA
1VC20D	10R68	CB-1e	P1E	0VC12YA
1VC21B	10R68	CB-1e	P1E	0VC30YA
1VC21C	10R68	CB-1e	P1E	0VC33YA
1VC21D	10R68	CB-1e	P1E	0VC36YA
1VC22B	10R68	CB-1e	P1E	0VC17YA
1VC22C	10R68	CB-1e	P1E	0VC16YA
1VC22D	10R68	CB-1e	P1E	0VC15YA
1VC22F	10R68	CB-1e	P1E	0VC18YA
1VC48B	10R68	CB-1e	P1E	0VC21YA
1VC48C	10R68	CB-1e	P1E	0VC24YA
1VC48D	10R68	CB-1e	P1E	0VC27YA
1VC55B	10R68	CB-1e	P1E	0FZ-VC003G,0VC39YA
1VC20E	10R69	CB-1e	C1E	0VC14YA
1VC21G	10R69	CB-1e	C1E	0VC30YA,33YA,36YA
1VC21O	10R69	CB-1e	C1E	0VC30YA
1VC21P	10R69	CB-1e	C1E	0VC33YA
1VC21Q	10R69	CB-1e	C1E	0VC36YA
1VC21R	10R69	CB-1e	C1E	0VC14YA*
1VC22E	10R69	CB-1e	C1E	0VC15YA*
1VC33B	10R69	CB-1e	P1E	0VC03YA
1VC33X	10R69	CB-1e	P1E	0VC115YB
1VC49C	10R69	CB-1e	P1E	0VC01YA
1VC33P	10R69	CB-1e	C1E	0VC03YA,0VC115YB
1VC33U	10R69	CB-1e	C1E	0VC03YA,0VC115YB
1VC33V	10R69	CB-1e	C1E	0VC03YA,0VC115YB
1VC34R	10R69	CB-1e	C1E	0VC03YA,0VC115YB
1VC49D	10R69	CB-1e	C1E	0VC01YA
1VC49K	10R69	CB-1e	C1E	0VC01YA
1VC49L	10R69	CB-1e	C1E	0VC01YA

DELETE

TABLE 4.2.4.5-4

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
1VC09J	10R124	CB-1F	C1E	0VC13CA,1SX019A
1VC21G	10R124	CB-1F	C1E	0VC30YA,0VC33YA, 0VC36YA
1VC42A	10R124	CB-1F	C1E	0HS-VC007,0VC08PA
1VC42B	10R124	CB-1F	C1E	0VC03CA,0VC21YA, 0VC24YA*
1VC42C	10R124	CB-1F	C1E	0VC39YA
1VC42D	10R124	CB-1F	C1E	0HS-VC003B,0VC21YA*
1VC42F	10R124	CB-1F	C1E	0HS-VC003A, 0ZL-VC003AA
1VC43E	10R124	CB-1F	C1E	0VC30YA,0VC33YA, 0VC36YA
1VC48E	10R124	CB-1F	C1E	0VC21YA,0VC24YA, 0VC27YA
1VD01E	10R124	CB-1F	C1E	1KY-VD080, 1PDS-VD027*
~~1D077A~~	~~10R125~~	~~CB-1F~~	~~K1E~~	~~1D001PA,1D001PA~~
~~1D077B~~	~~10R125~~	~~CB-1F~~	~~K1E~~	~~1LT-DO011~~
1NB66C	10R125	CB-1F	K1E	1B21-N081A*
1RP75C	10R125	CB-1F	K1E	1B21-N078A*
1VC81B	10R125	CB-1F	K1E	0TTC-VC036,0VC15YA
1VC82G	10R125	CB-1F	K1E	0PDR-VC053, 0TTC-VC037*
1VC95C	10R125	CB-1F	K1E	0PDY-VC021
~~1D078A~~	~~10R137~~	~~CB-1F~~	~~K2E~~	~~1D001PB~~
~~1D078B~~	~~10R137~~	~~CB-1F~~	~~K2E~~	~~1LT-DO012~~
1LD26E	10R137	CB-1F	K2E	1E51-F063,1E51-F076
1LD26F	10R137	CB-1F	K2E	1E51-F063,1E51-F076
1LD26G	10R137	CB-1F	K2E	1E51-F063,1E51-F076
1LD28A	10R137	CB-1F	K2E	1E12-F009*
1LD28B	10R137	CB-1F	K2E	1E12-F009*
1LD28C	10R137	CB-1F	K2E	1E12-F009*
1LD28D	10R137	CB-1F	K2E	1E12-F009*
~~1VC91Q~~	~~10R137~~	~~CB-1F~~	~~K2E~~	~~0PDR-VC153~~
~~1VC95F~~	~~10R137~~	~~CB-1F~~	~~K2E~~	~~0PDY-VC121~~
1AP21K	10R138	CB-1F	C2E	1AP09EA,1DG01KB
1AP21L	10R138	CB-1F	C2E	1AP09EA,1DG01KB
1AP23L	10R138	CB-1F	C2E	1AP09EC,1DG01KB
1AP23M	10R138	CB-1F	C2E	1AP09EC,1DG01KB
1AP29Q	10R138	CB-1F	C2E	1AP09EB

DELETE

TABLE 4.2.4.5-4

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
1VC45A	10R138	CB-1F	C2E	0VC08PB
1VC45B	10R138	CB-1F	C2E	0VC03CB*
1VC45F	10R138	CB-1F	C2E	0KY-VC103
1VC46C	10R138	CB-1F	C2E	1SX076B,1SX107B
1VC46E	10R138	CB-1F	C2E	0VC39YB
1VC46F	10R138	CB-1F	C2E	0VC21YB,24YB,27YB
1VC46G	10R138	CB-1F	C2E	0VC30YB,33YB,36YB
1VD02E	10R138	CB-1F	C2E	1KY-VD081*
1VD05B	10R138	CB-1F	C2E	1VD02CB
1VX28N	10R138	CB-1F	C2E	1SX193B
1VC02C	10R138	CB-1F	C2E	0VC03CB
~~1DO78A~~	~~10R50~~	~~CB-1F~~	~~K2E~~	~~1DO01PB~~
~~1DO78B~~	~~10R50~~	~~CB-1F~~	~~K2E~~	~~1LT-DO012~~
1LD26E	10R50	CB-1F	K2E	1E51-F063,1E51-F076
1LD26F	10R50	CB-1F	K2E	1E51-F063,1E51-F076
1LD26G	10R50	CB-1F	K2E	1E51-F063,1E51-F076
1LD28A	10R50	CB-1F	K2E	1E12-F009, 1E12-F037B*
1LD28B	10R50	CB-1F	K2E	1E12-F009, 1E12-F037B*
1LD28C	10R50	CB-1F	K2E	1E12-F009, 1E12-F037B*
1LD28D	10R50	CB-1F	K2E	1E12-F009, 1E12-F037B*
~~1VC91Q~~	~~10R50~~	~~CB-1F~~	~~K2E~~	~~0PDR-VC153~~
~~1VC95F~~	~~10R50~~	~~CB-1F~~	~~K2E~~	~~0PDY-VC121~~
1AP21K	10R51	CB-1F	C2E	1AP09EA,1DG01KB
1AP21L	10R51	CB-1F	C2E	1AP09EA,1DG01KB
1AP23L	10R51	CB-1F	C2E	1AP09EC,1DG01KB
1AP23M	10R51	CB-1F	C2E	1AP09EC,1DG01KB
1AP29Q	10R51	CB-1F	C2E	1AP09EB
1CM07L	10R51	CB-1F	C2E	1TE-CM006*
1DG21A	10R51	CB-1F	C2E	1DG01KB
1DG21B	10R51	CB-1F	C2E	1DG01KB
1DG21C	10R51	CB-1F	C2E	1DG01KB
1DG21F	10R51	CB-1F	C2E	1DG01KB

DELETE

TABLE 4.2.4.5-4

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
1LV14B	10R61	CB-1F	C2E	1H13-P732A
1VC04C	10R61	CB-1F	C2E	0VC04CB
1VC35T	10R61	CB-1F	C2E	0VC03YB,0VC115YA
1VC35U	10R61	CB-1F	C2E	0VC03YB,0VC115YA
1VC35W	10R61	CB-1F	C2E	0VC03YB,0VC115YA
1VC36R	10R61	CB-1F	C2E	0VC03YB,0VC115YA
1VC45C	10R61	CB-1F	C2E	0VC01YB
1VC45D	10R61	CB-1F	C2E	0VC01YB
1VC45H	10R61	CB-1F	C2E	0VC03YB,0VC115YA
1VC50D	10R61	CB-1F	C2E	0VC01YB
1VC50K	10R61	CB-1F	C2E	0VC01YB
1VC50L	10R61	CB-1F	C2E	0VC01YB
1VC56O	10R61	CB-1F	C2E	0VC08YB
1VC56P	10R61	CB-1F	C2E	0VC08YB
1VX25C	10R61	CB-1F	C2E	1VX13CB
1VX28F	10R61	CB-1F	C2E	1TIS-VX122,1VX13CB
1VC46G	10R61	CB-1F	C2E	0VC30YB,0VC33YB, 0VC36YB
1VC50M	10R61	CB-1F	C2E	0VC39YB
1VC56E	10R61	CB-1F	C2E	0VC39YB
1VC56N	10R61	CB-1F	C2E	0VC39YB
1VD18D	10R61	CB-1F	C2E	1TIT-VD008, 1TY-VD008A*
1VX28N	10R61	CB-1F	C2E	1SX193B
1VC91L	10R62	CB-1F	K2E	0TE-VC138,0VC17YB
~~1VC91Q~~	~~10R62~~	~~CB-1F~~	~~K2E~~	~~0PDR-VC153~~
1VC95D	10R62	CB-1F	K2E	0PDT-VC121A, 0PDY-VC121
1VC95E	10R62	CB-1F	K2E	0PDT-VC121B, 0PDY-VC121
~~1VC95F~~	~~10R62~~	~~CB-1F~~	~~K2E~~	~~0PDY-VC121~~
1AP34L	10R65	CB-1F	P1E	0AP05E,0VC13CA, 1AP11E
1AP34T	10R65	CB-1F	P1E	0AP05E,1AP11E
1RP01C	10R65	CB-1F	P1R	1C71-S001A
1RP01H	10R65	CB-1F	P1R	1C71-S001A
1SX26A	10R65	CB-1F	P1E	1SX019A
1SX39A	10R65	CB-1F	P1E	1SX017A
1VC20B	10R65	CB-1F	P1E	0VC14YA
1VC20C	10R65	CB-1F	P1E	0VC13CA
1VC20D	10R65	CB-1F	P1E	0VC12YA
1VC21B	10R65	CB-1F	P1E	0VC30YA
1VC21C	10R65	CB-1F	P1E	0VC33YA

DELETE

TABLE 4.2.4.5-4

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
1VC21D	10R65	CB-1F	P1E	0VC36YA
1VC22B	10R65	CB-1F	P1E	0VC17YA
1VC22C	10R65	CB-1F	P1E	0VC16YA
1VC22D	10R65	CB-1F	P1E	0VC15YA
1VC22F	10R65	CB-1F	P1E	0VC18YA
1VC48B	10R65	CB-1F	P1E	0VC21YA
1VC48C	10R65	CB-1F	P1E	0VC24YA
1VC48D	10R65	CB-1F	P1E	0VC27YA
1VC55B	10R65	CB-1F	P1E	0FZ-VC003G,0VC39YA
1CC05B	10R66	CB-1F	C1E	1SX012A,1SX062A
1DG01C	10R66	CB-1F	C1E	1DG01KA
1VC33B	10R65	CB-1F	P1E	0VC03YA
1VC33X	10R65	CB-1F	P1E	0VC115YB
1VC49C	10R65	CB-1F	P1E	0VC01YA
1VC55D	10R65	CB-1F	P1E	0VC08YA
1DG01K	10R66	CB-1F	C1E	1DG01KA
1DG11T	10R66	CB-1F	C1E	1DG01KA
1DO01C	10R66	CB-1F	C1E	1DO01PA
1RI13F	10R66	CB-1F	C1E	1E51-F068
1SX26B	10R66	CB-1F	C1E	1SX019A
1SX39B	10R66	CB-1F	C1E	1SX017A
1SX39C	10R66	CB-1F	C1E	1SX017A
1VC20E	10R66	CB-1F	C1E	0VC14YA
1VC21O	10R66	CB-1F	C1E	0VC30YA
1VC21P	10R66	CB-1F	C1E	0VC33YA
1VC21Q	10R66	CB-1F	C1E	0VC36YA
1VC21R	10R66	CB-1F	C1E	0VC14YA*
1VC22E	10R66	CB-1F	C1E	0VC15YA
1VC48N	10R66	CB-1F	C1E	0VC21YA
1VC48O	10R66	CB-1F	C1E	0VC24YA
1VC48P	10R66	CB-1F	C1E	0VC27YA
1VC49M	10R66	CB-1F	C1E	0VC39YA
1VC55E	10R66	CB-1F	C1E	0VC39YA
1VC55N	10R66	CB-1F	C1E	0VC39YA
1VC55O	10R66	CB-1F	C1E	0VC39YA
1VC55P	10R66	CB-1F	C1E	0VC39YA
1VD01E	10R66	CB-1F	C1E	1KY-VD080*
1VD09J	10R66	CB-1F	C1E	1TZ-VD001C,1VD03YA
1VD18B	10R66	CB-1F	C1E	1TIT-VD007*
~~1DO77A~~	~~10R67~~	~~CB-1F~~	~~K1E~~	~~1DO01PA,1DO01PA~~
~~1DO77B~~	~~10R67~~	~~CB-1F~~	~~K1E~~	~~1LT-DO011~~
1NB66C	10R97	CB-1F	K1E	1B21-N081A*
1RP75C	10R97	CB-1F	K1E	1B21-N078A*

DELETE

TABLE 4.2.4.5-5

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
1LV14M	10R61	CB-5c	C2E	1H13-P702A
1SX27B	10R61	CB-5c	C2E	1SX019B
1SX40B	10R61	CB-5c	C2E	1SX017B
1VC02C	10R61	CB-5c	C2E	0VC03CB
1VC25G	10R61	CB-5c	C2E	0VC21YB,24YB,27YB
1VC25O	10R61	CB-5c	C2E	0VC21YB
1VC25P	10R61	CB-5c	C2E	0VC24YB
1VC25Q	10R61	CB-5c	C2E	0VC27YB
1VC26E	10R61	CB-5c	C2E	0VC12YB,13YB,14YB
1VC27G	10R61	CB-5c	C2E	0VC30YB,33YB,36YB
1VC27O	10R61	CB-5c	C2E	0VC30YB
1VC27P	10R61	CB-5c	C2E	0VC33YB
1VC27Q	10R61	CB-5c	C2E	0VC36YB
1VC27R	10R61	CB-5c	C2E	0VC12YB*
1VC28E	10R61	CB-5c	C2E	0VC15YB*
1VC45A	10R61	CB-5c	C2E	0VC08PB
1VC45B	10R61	CB-5c	C2E	0VC03CB*
1VC45F	10R61	CB-5c	C2E	0KY-VC103
1VC46C	10R61	CB-5c	C2E	1SX076B,1SX107B
1VC46E	10R61	CB-5c	C2E	0VC39YB
1LV14B	10R61	CB-5c	C2E	1H13-P732A
1VC04C	10R61	CB-5c	C2E	0VC04CB
1VC35T	10R61	CB-5c	C2E	0VC03YB,0VC115YA
1VC35U	10R61	CB-5c	C2E	0VC03YB,0VC115YA
1VC35W	10R61	CB-5c	C2E	0VC03YB,0VC115YA
1VC36R	10R61	CB-5c	C2E	0VC03YB,0VC115YA
1VC45C	10R61	CB-5c	C2E	0VC01YB
1VC45D	10R61	CB-5c	C2E	0VC01YB
1VC45H	10R61	CB-5c	C2E	0VC03YB,0VC115YA
1VC50D	10R61	CB-5c	C2E	0VC01YB
1VC50K	10R61	CB-5c	C2E	0VC01YB
1VC50L	10R61	CB-5c	C2E	0VC01YB
1VC56O	10R61	CB-5c	C2E	0VC08YA
1VC56P	10R61	CB-5c	C2E	0VC08YA
1VX25C	10R61	CB-5c	C2E	1VX13CB
1VX28F	10R61	CB-5c	C2E	1TIS-VX122,1VX13CB
1VC46F	10R61	CB-5c	C2E	0VC21YB,24YB,27YB
1VC46G	10R61	CB-5c	C2E	0VC30YB,33YB,36YB
1VC50M	10R61	CB-5c	C2E	0VC39YB
1VC56E	10R61	CB-5c	C2E	0VC39YB
1VC56N	10R61	CB-5c	C2E	0VC39YB
1VD18D	10R61	CB-5c	C2E	1TIT-VD008*
1VX28N	10R61	CB-5c	C2E	1SX193B
1VC91L	10R62	CB-5c	K2E	0TE-VC138,0VC17YB
~~1VC91Q~~	~~10R62~~	~~CB-5c~~	~~K2E~~	~~0PDR-VC153~~
1VC95E	10R62	CB-5c	K2E	0PDT-VC121B*

DELETE

TABLE 4.2.4.5-5

DELETE

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
~~1VC95F~~	~~10R62~~	~~CB-5c~~	~~K2E~~	~~0PDV-VC121~~
1VC96D	10R62	CB-5c	K2E	0PDT-VC121A*
1AP34L	10R65	CB-5c	P1E	0AP05E,0VC13CA, 1AP11
1AP34T	10R65	CB-5c	P1E	0AP05E,1AP11E
1RP01C	10R65	CB-5c	P1R	1C71-S001A
1RP01H	10R65	CB-5c	P1R	1C71-S001A
1SX26A	10R65	CB-5c	P1E	1SX019A
1SX39A	10R65	CB-5c	P1E	1SX017A
1VC20B	10R65	CB-5c	P1E	0VC14YA
1VC20C	10R65	CB-5c	P1E	0VC13YA
1VC20D	10R65	CB-5c	P1E	0VC12YA
1VC21B	10R65	CB-5c	P1E	0VC30YA
1VC21C	10R65	CB-5c	P1E	0VC33YA
1VC21D	10R65	CB-5c	P1E	0VC36YA
1VC22B	10R65	CB-5c	P1E	0VC17YA
1VC22C	10R65	CB-5c	P1E	0VC16YA
1VC22D	10R65	CB-5c	P1E	0VC15YA
1VC22F	10R65	CB-5c	P1E	0VC18YA
1VC48B	10R65	CB-5c	P1E	0VC21YA
1VC48C	10R65	CB-5c	P1E	0VC24YA
1VC48D	10R65	CB-5c	P1E	0VC27YA
1VC55B	10R65	CB-5c	P1E	0FZ-VC003G,0VC39YA
1AP34I	1C03001	CB-1g	P1E	0AP05E
1VC33B	10R65	CB-1g	P1E	0VC03YA
1VC33X	10R65	CB-1g	P1E	0VC115YB
1VC49C	10R65	CB-1g	P1E	0VC01YA
1VC55D	10R65	CB-1g	P1E	0VC08YA
1AP28U	1C03002	CB-1g	C1E	0AP05E
1AP28T	C02999	CB-1g	C1E	0AP05E
1RP02C	C0739	CB-3a,e,f CB-4 CB-5a,c	P2R	1C71-S001B
1RP01C	C0734	CB-3a,e,f CB-4 CB-5a,c	P1R	1C71-S001A
1RP01H	C0735	CB-3a,e,f CB-4 CB-5a,c	P1R	1C71-S001A
1RP02H	C0741	CB-3a,e,f CB-4 CB-5a,c	P2R	1C71-S001B
1VX28E	C0741		P2E	1VX13CB

TABLE 4.2.4.5-6

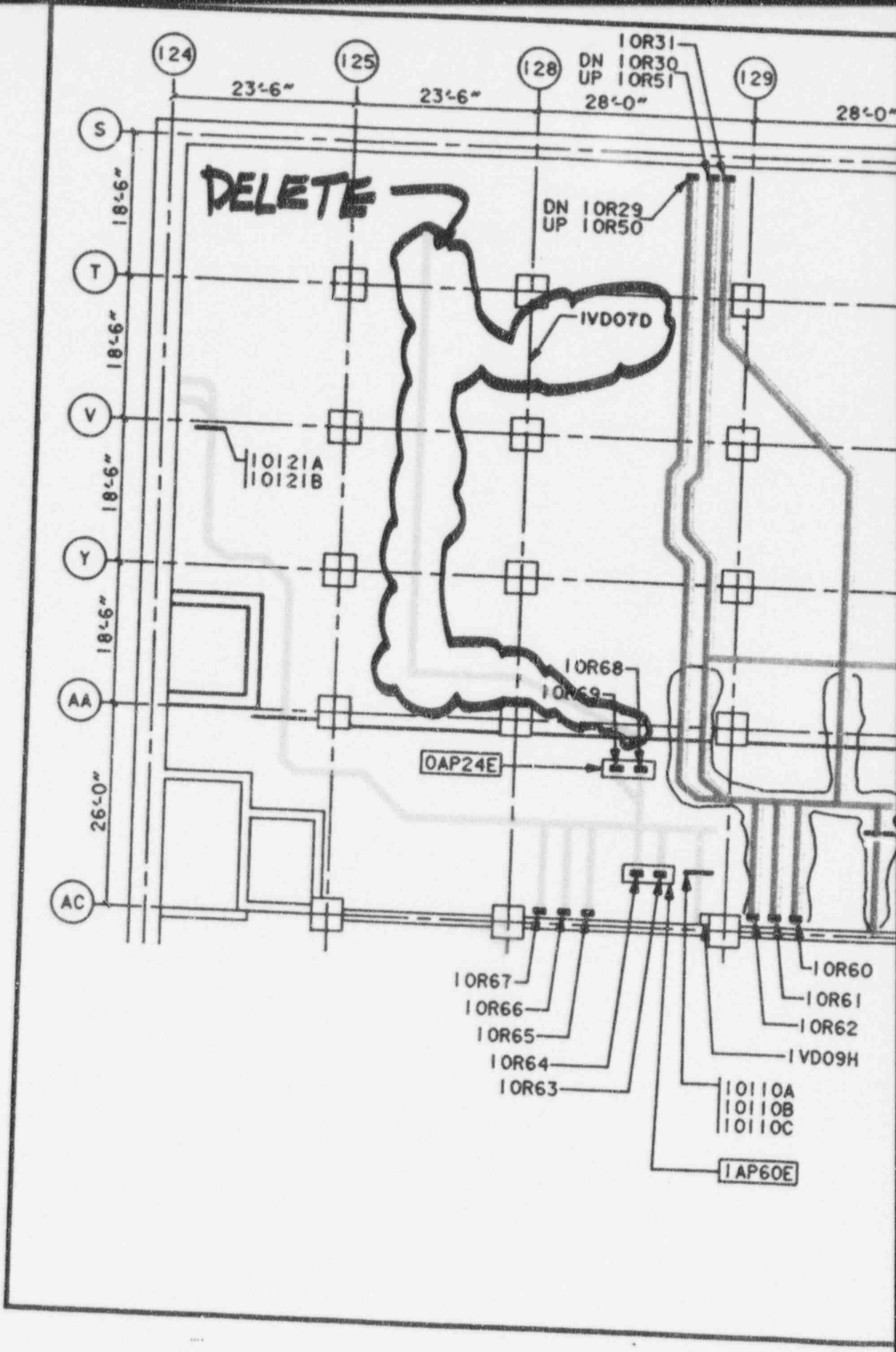
DELETE

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
1VC27P	10R61	CB-1i	C2E	0VC33YB
1VC27Q	10R61	CB-1i	C2E	0VC36YB
1VC27R	10R61	CB-1i	C2E	0VC12YB*
1VC28E	10R61	CB-1i	C2E	0VC15YB*
1VC45A	10R61	CB-1i	C2E	0VC08PB
1VC45B	10R61	CB-1i	C2E	0VC03CB*
1VC45F	10R61	CB-1i	C2E	0VC21YB,24YB,27YB
1VC46C	10R61	CB-1i	C2E	1SX076B,1SX107B
1VC46E	10R61	CB-1i	C2E	0VC39YB
1VC46F	10R61	CB-1i	C2E	0VC21YB,24YB,27YB
1VC46G	10R61	CB-1i	C2E	0VC30YB,33YB,36YB
1VC50M	10R61	CB-1i	C2E	0VC39YB
1VC56E	10R61	CB-1i	C2E	0VC39YB
1VC56N	10R61	CB-1i	C2E	0VC39YB
1VD18D	10R61	CB-1i	C2E	1TIT-VD008*
1VX28N	10R61	CB-1i	C2E	1SX193B
1VC91L	10R62	CB-1i	K2E	0TE-VC138,0VC17YB
1VC91Q	10R62	CB-1i	K2E	0PDR-VC153
1VC95D	10R62	CB-1i	K2E	0PDT-VC121A*
1VC95E	10R62	CB-1i	K2E	0PDT-VC121B*
1VC95F	10R62	CB-1i	K2E	0PDY-VC121
1AP34L	10R65	CB-1i	P1E	0AP05E,0VC13CA*
1AP34T	10R65	CB-1i	P1E	0AP05E,1AP11E
1RP01C	10R65	CB-1i	P1R	1C71-S001A
1RP01H	10R65	CB-1i	P1E	1C71-S001A
1VC33B	10R65	CB-1i	P1E	0VC03YA
1VC33X	10R65	CB-1i	P1E	0VC115YB
1VC49C	10R65	CB-1i	P1E	0VC01YA
1VC55D	10R65	CB-1i	P1E	0VC08YA
1SX26A	10R65	CB-1i	P1E	1SX019A
1SX39A	10R65	CB-1i	P1E	1SX017A
1VC20B	10R65	CB-1i	P1E	0VC14YA
1VC20C	10R65	CB-1i	P1E	0VC13YA
1VC20D	10R65	CB-1i	P1E	0VC12YA
1VC21B	10R65	CB-1i	P1E	0VC30YA
1VC21C	10R65	CB-1i	P1E	0VC33YA
1VC21D	10R65	CB-1i	P1E	0VC36YA
1VC22B	10R65	CB-1i	P1E	0VC17YA
1VC22C	10R65	CB-1i	P1E	0VC16YA
1VC22D	10R65	CB-1i	P1E	0VC15YA
1VC22F	10R65	CB-1i	P1E	0VC18YA
1VC48B	10R65	CB-1i	P1E	0VC21YA
1VC48C	10R65	CB-1i	P1E	0VC24YA

TABLE 4.2.4.6-1 (Cont'd)

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
1VC35P	10R600	CB-5c	P2E	0VC115YA
1VC50C	10R600	CB-5c	P2E	0VC01YB
1VC56D	10R600	CB-5c	P2E	0VC08YB
1VX28E	10R600	CB-5c	P2E	1VX13CB
1VC46C	10R61	CB-5c	C2E	1SX076B,1SX107B
1VC46E	10R61	CB-5c	C2E	0VC39YB
1LV14B	10R61	CB-5c	C2E	1H13-P732A
1VC04C	10R61	CB-5c	C2E	0VC04CB
1VC35T	10R61	CB-5c	C2E	0VC03YB,0VC115YA
1VC35U	10R61	CB-5c	C2E	0VC03YB,0VC115YA
1VC35W	10R61	CB-5c	C2E	0VC03YB,0VC115YA
1VC36R	10R61	CB-5c	C2E	0VC03YB,0VC115YA
1VC45C	10R61	CB-5c	C2E	0VC01YB
1VC45D	10R61	CB-5c	C2E	0VC01YB
1VC45H	10R61	CB-5c	C2E	0VC03YB,0VC115YA
1VC50D	10R61	CB-5c	C2E	0VC08YB
1VC50K	10R61	CB-5c	C2E	0VC08YB
1VC50L	10R61	CB-5c	C2E	0VC08YB
1VC56O	10R61	CB-5c	C2E	0VC08YA
1VC56P	10R61	CB-5c	C2E	0VC08YA
1VX25C	10R61	CB-5c	C2E	1VX13CB
1VX28F	10R61	CB-5c	C2E	1TIS-VX122,1VX13CB
1VC46F	10R61	CB-5c	C2E	0VC21YB,24YB,27YB
1VC46G	10R61	CB-5c	C2E	0VC30YB,33YB,36YB
1VC50M	10R61	CB-5c	C2E	0VC39YB
1VC56E	10R61	CB-5c	C2E	0VC39YB
1VC56N	10R61	CB-5c	C2E	0VC39YB
1VD18D	10R61	CB-5c	C2E	1TIT-VD008*
1VX28N	10R61	CB-5c	C2E	1SX193B
1VC91L	10R62	CB-5c	K2E	0TE-VC138,0VC17YB
~~1VC91Q~~	~~10R62~~	~~CB-5c~~	~~K2E~~	~~0PDR-VC153~~
1VC95E	10R62	CB-5c	K2E	0PDT-VC121B*
~~1VC96F~~	~~10R62~~	~~CB-5c~~	~~K2E~~	~~0PDY-VC121~~
1VC96D	10R62	CB-5c	K2E	0PDT-VC121A*
1AP34L	10R65	CB-5c	P1E	0AP05E,0VC13CA,1AP11
1AP34T	10R65	CB-5c	P1E	0AP05E,1AP11E
1RP01C	10R65	CB-5c	P1R	1C71-S001A
1RP01H	10R65	CB-5c	P1R	1C71-S001A
1SX26A	10R65	CB-5c	P1E	1SX019A
1SX39A	10R65	CB-5c	P1E	1SX017A
1VC20B	10R65	CB-5c	P1E	0VC14YA
1VC20C	10R65	CB-5c	P1E	0VC13YA
1VC20D	10R65	CB-5c	P1E	0VC12YA
1VC21B	10R65	CB-5c	P1E	0VC30YA
1VC21C	10R65	CB-5c	P1E	0VC33YA
1VC21D	10R65	CB-5c	P1E	0VC36YA
1VC22B	10R65	CB-5c	P1E	0VC17YA

DELETE



S&L ECAD FILE: CLIET1.4

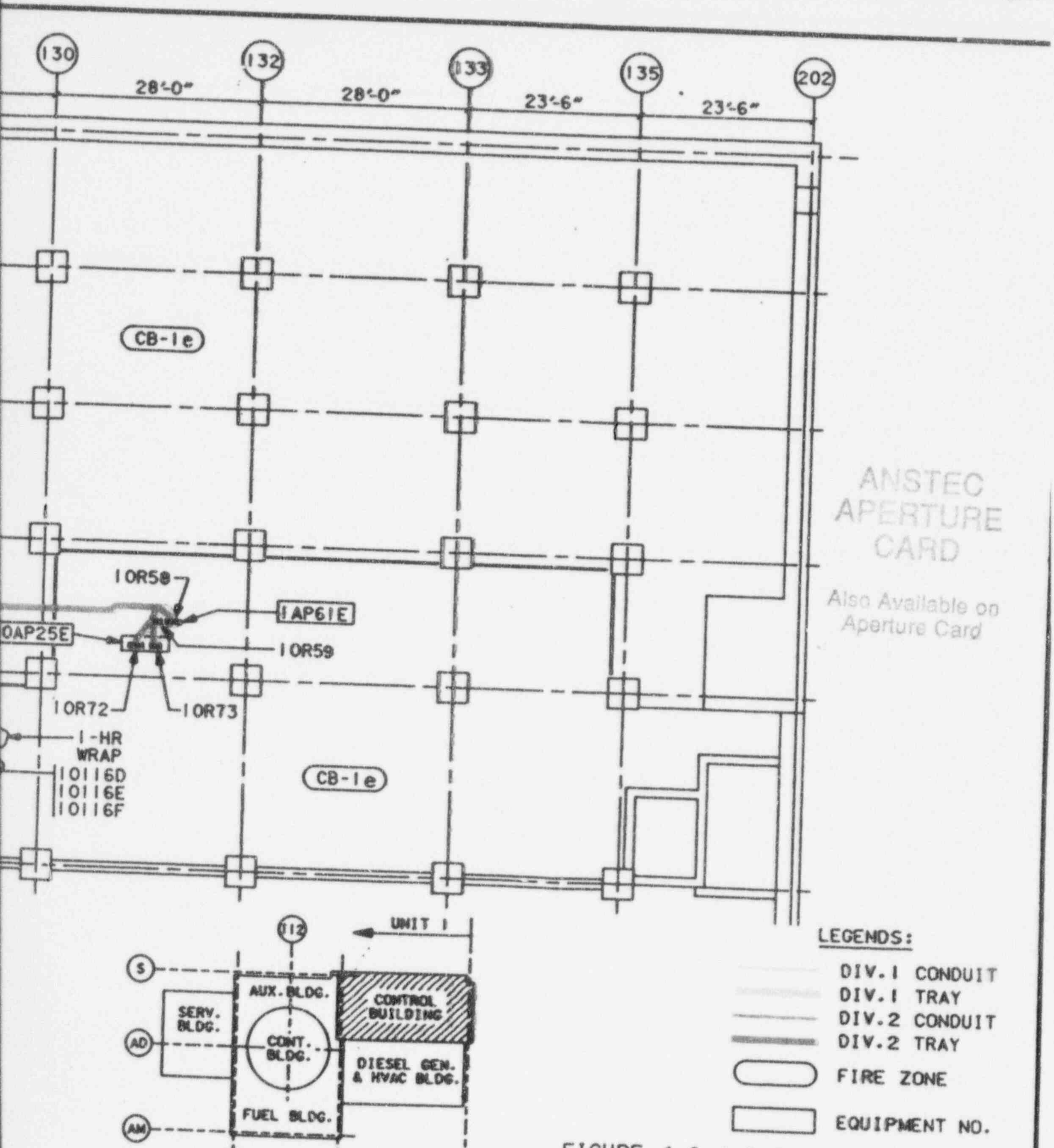
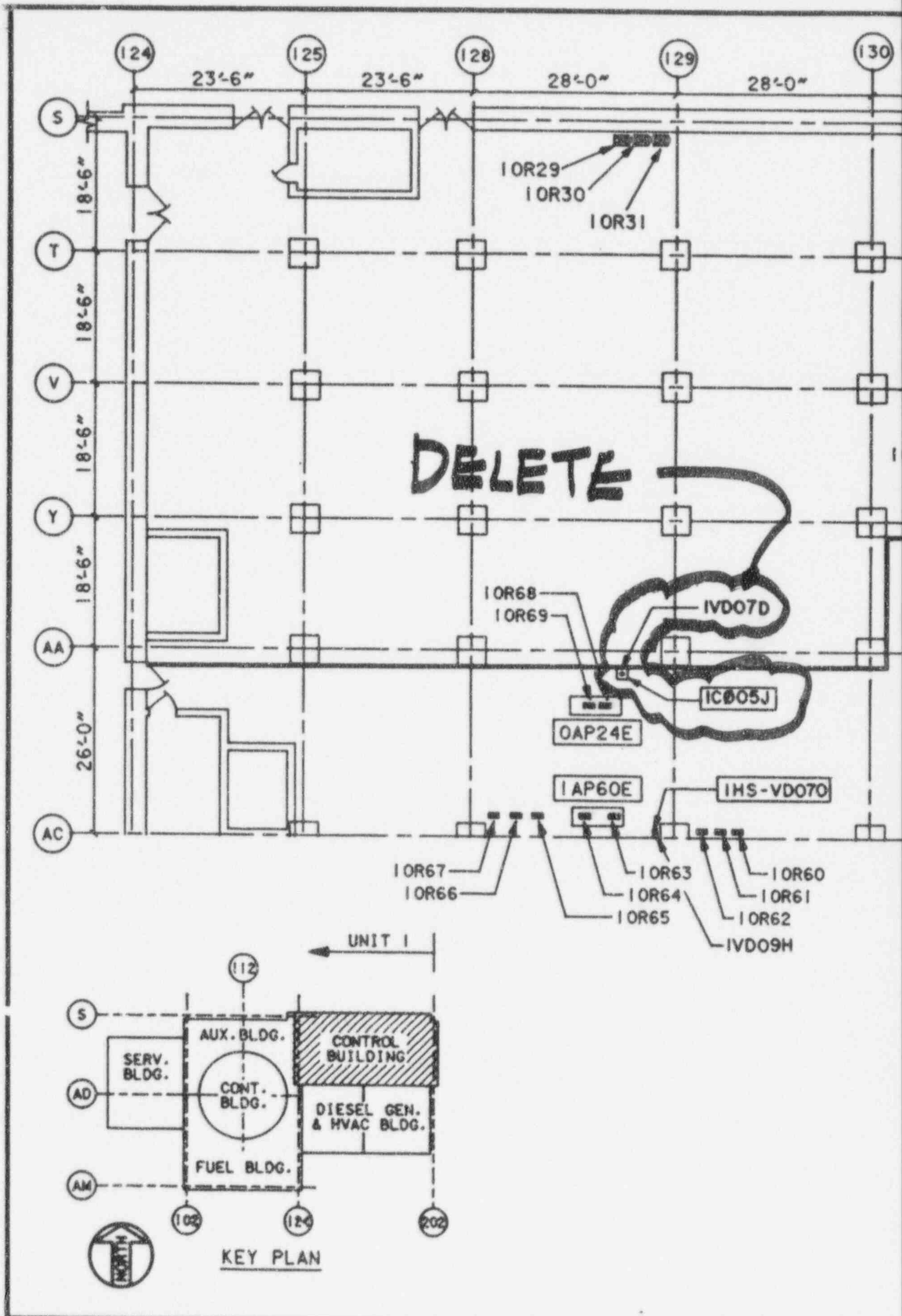


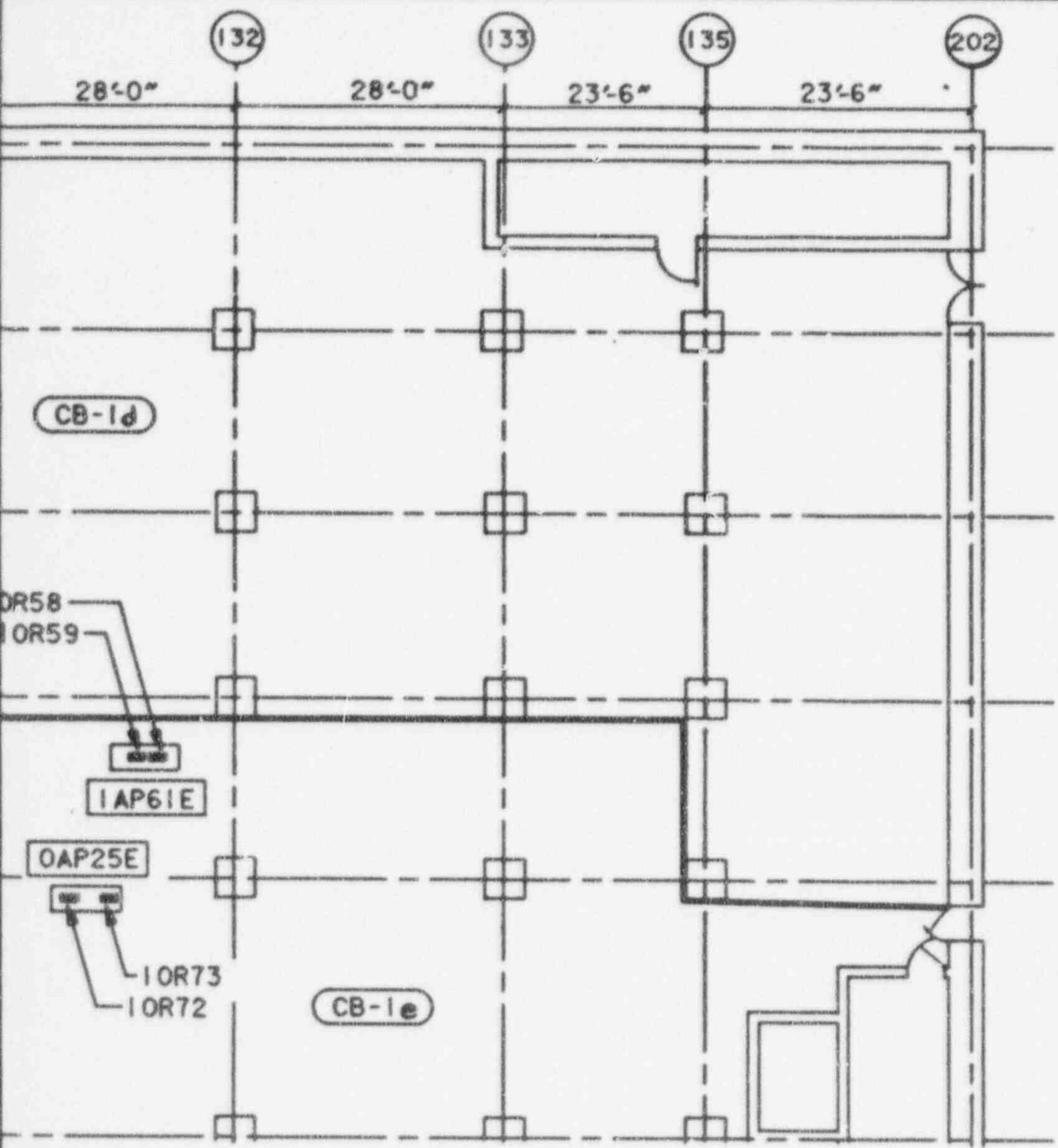
FIGURE 4.2.4.5-3

FIRE PROTECTION DEVIATION
CONTROL BLDG. INTERMEDIATE
ROOF PLAN EL. 751'-0"
FIRE AREA CB-1

9511150046-03



S&L ECAD FILE: CLIETI.6



LEGENDS:

DIV.1 CONDUIT

DIV.1 TRAY

DIV.2 CONDUIT

DIV.2 TRAY

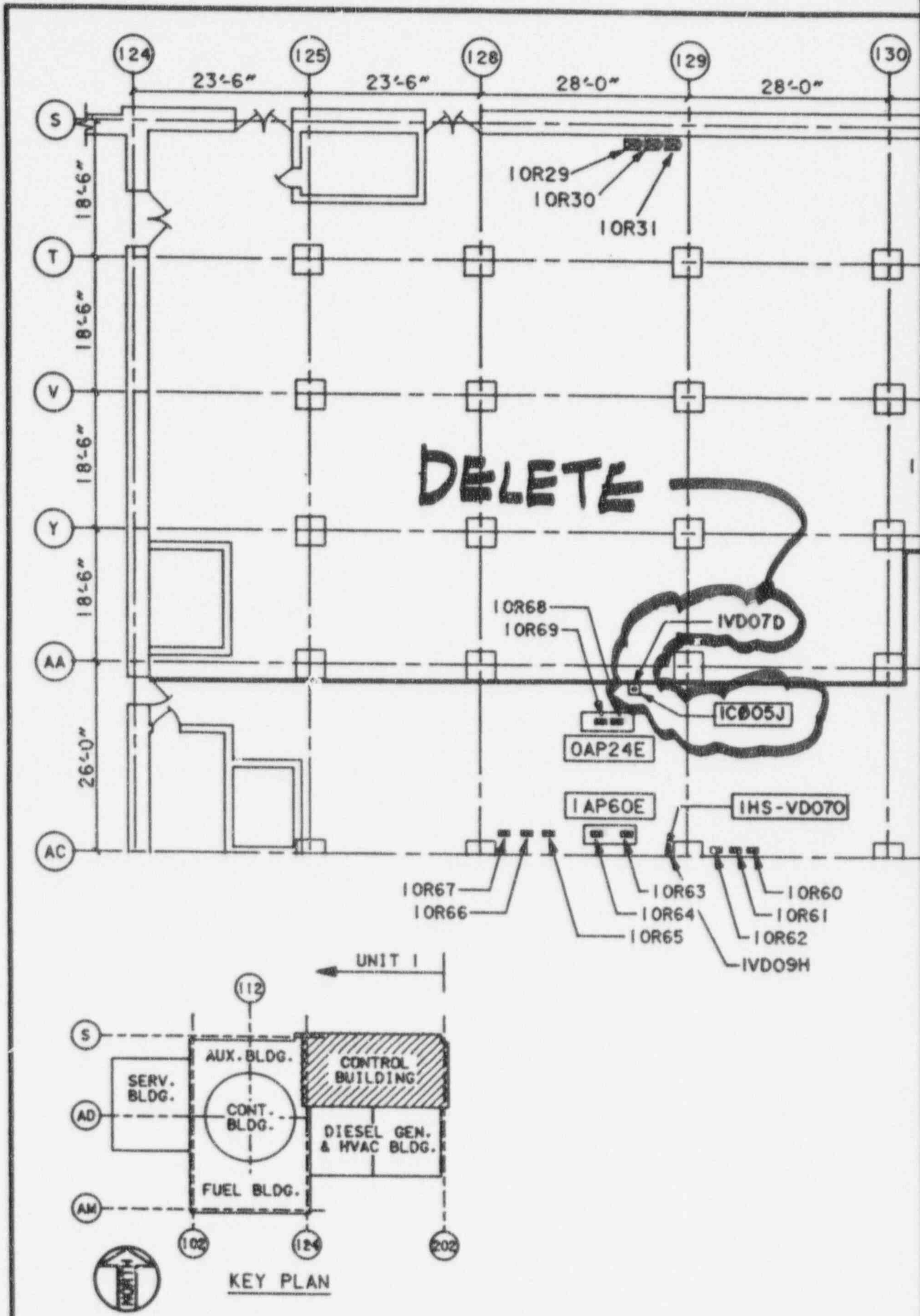
FIRE ZONE

EQUIPMENT NO.

FIGURE 4.2.4.5-2

FIRE PROTECTION DEVIATION
CONTROL & DIESEL GENERATOR BLDG.
GRADE FLOOR PLAN EL.737'-0"
FIRE AREA CB-1

9511150046-04



S&L ECAD FILE: CLIETI.6

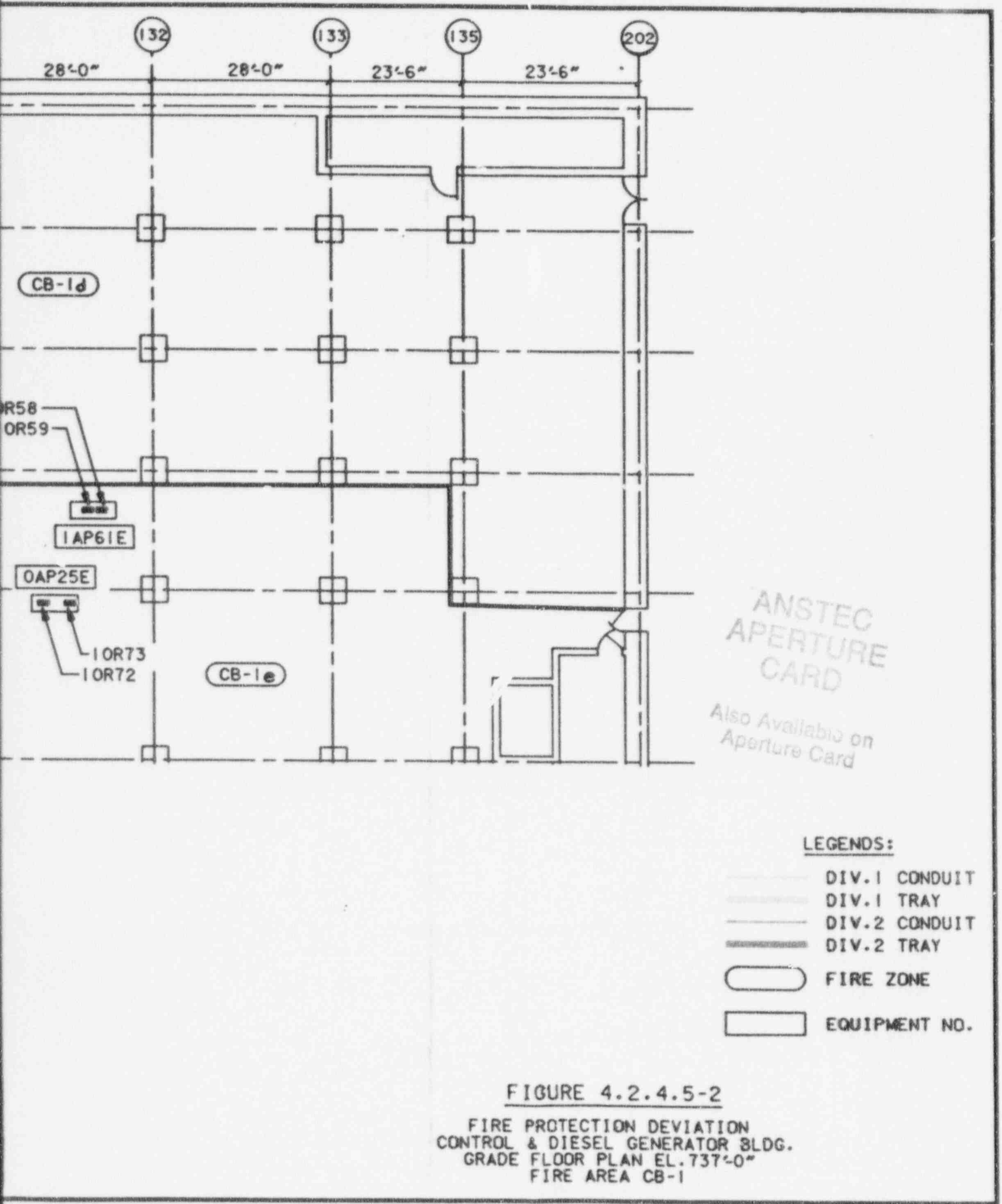


FIGURE 4.2.4.5-2

FIRE PROTECTION DEVIATION
CONTROL & DIESEL GENERATOR BLDG.
GRADE FLOOR PLAN EL.737'-0"
FIRE AREA CB-1

9511150046-05

SAFETY EVALUATION FORM

Document Evaluated: 1.1 L&S Log # 94-0079

1.2 Number: USAR Appendix F 1.3 Revision: N/A

1.4 Title: EVALUATION OF THERMO-LAG IN FIRE ZONE CB-1f
USAR Appendix F Revision

1.5 References:
See page 6

BLOCK A - DESCRIPTION OF CHANGE
(Use additional pages if required)

A.1 Describe the basic document or system and the changes being made. Discuss how the change affects the SAR description. Discuss the reason for change.

CPS USAR Appendix F, Subsection 3.3.1.2 discusses the provision of 3-hour rated cable fire wrap material to protect Division 2 power, control and instrumentation cables in fire zone CB-1f, which is a general access and equipment area at elevation 762 feet in the control building. The purpose of this evaluation is to accept the fire wrap "as-is" even though the fire wrap material used in CB-1f, Thermo-Lag 330-1, does not provide the 3-hour rating. The proposed USAR change will delete the reference to the 3-hour rating of the fire barrier. This deviation from Appendix R requirement for 3-hour rated fire barrier will be included in USAR Appendix F, Section 4.2.

In addition, USAR Appendix E, Subsection 3.4.1.6, is being revised to reflect the fireload as a "moderate" fireload per CR 1-93-12-034 and NSED Standard ME-06.00.

(Continued on page 8)

A.2 Identify the equipment, systems and parameters that may be affected by the change:

Fire Zones affected: Fire Zone CB-1f, general access and equipment area at elevation 762 feet in the control building (USAR Appendix E, Figures FP-12a, cable tray Figure 10, and USAR Appendix F, Deviation Figure 4.2.4.5-4).

Description of Safe Shutdown Equipment and/or cables: The systems affected include Division 1 and 2 diesel generator cables, Division 1 and 2 diesel generator HVAC and diesel oil system cables, Division 1 and 2 control room HVAC cables, Division 1 and 2 NSPS, Division 1 Shutdown Service Water system cables and RCIC cables which are located in this fire zone.

(Continued on page 10)

NF-002-1 (2/94)

94-0079

BLOCK B - RADWASTE TREATMENT SYSTEMS

B.1 The proposed activity involves a modification to a radioactive waste treatment system or the way in which it is operated as described in Chapter 11 of the SAR.

Yes ____
No __X__

B.2 Because: The proposed USAR changes affect only the fire protection and safe shutdown analysis contained in the USAR. They do not impact the radwaste system or its operation.

If B.1 is yes, complete form NF-003.

BLOCK C - TECHNICAL SPECIFICATION IMPACT

C.1 The proposed activity requires a change to any part of the Technical Specifications.

Yes ____
No __X__

C.2 Justification if "NO", Technical Specification change package identification number if "YES".

The CPS Technical Specification does not contain any operability requirements for the fire protection features, other than containment isolation. This revision shows that the Safe Shutdown Analysis is unaffected by the proposed change. This change does not impact the CPS Fire Protection Program discussed in technical Specification 6.8.4.e.

BLOCK D - UNREVIEWED SAFETY QUESTION DETERMINATION

(Attach additional pages with the responses to the block D questions. Identify your answers to Parts I, II, III, and IV.)

Part I - Impact on equipment malfunctions evaluated as the design basis.

1. For the equipment and systems identified in A.1 and A.2, identify any failures evaluated in the SAR.
   See page 21.
2. Discuss the impact of the change on the performance of the equipment and systems identified in A.1 and A.2.
   See page 21.
3. Identify what new failure modes could be introduced by the change.
   See page 21.
4. Identify any impact of the change on the consequences of the failures evaluated in the SAR.
   See page 21.
5. Identify any impact of the change on the probabilities of the failures evaluated in the SAR.
   See page 21.

94-0079

SAFETY EVALUATION FORM

BLOCK D - UNREVIEWED SAFETY QUESTION DETERMINATION

SUMMARY

Based on item 4, are the consequences of any malfunction of equipment evaluated in the SAR increased?	YES	
	NO	X
Based on item 5, is the probability of a malfunction of equipment evaluated in the SAR increased?	YES	
	NO	X

If the answer to any of the above questions is yes, the change is an unreviewed safety question.

Part II - Impact on the accidents evaluated as the design basis See page 22

1. Identify the accidents evaluated in the SAR which could be affected by the change.
2. Discuss how the change impacts the consequences of these accidents.
3. Discuss how the change impacts the probability of these accidents.

SUMMARY

Based on item 2, are the consequences of an accident evaluated in the SAR increased?	YES	
	NO	X
Based on item 3, is the probability of an accident evaluated in the SAR increased?	YES	
	NO	X

If the answer to any of the above questions is answered yes, the change is an unreviewed safety question.

Part III - Potential for Creation of a New Unanalyzed Event See page 22

1. Based on Part I, items 1 and 3, could this change initiate a new type of accident or equipment malfunction? Discuss the basis for this determination.

2. Determine if the new accident or malfunction identified above has sufficient probability or consequences to be considered in the Licensing basis. Discuss the bases for this determination.

SAFETY EVALUATION FORM

BLOCK D - UNREVIEWED SAFETY QUESTION DETERMINATION

SUMMARY

Based on item 2, does the change create the possibility for an equipment malfunction or accident of a different type than previously evaluated in the SAR?

YES ________
NO ___X___

If the answer is yes, the change represents an unreviewed safety question.

Part IV - Impact on the Margin of Safety See page 22

1. Identify how any of the protective barriers are directly affected by the change.
2. Discuss the impact of the change on the approach to the acceptance limits for any of the protective barriers.
3. Discuss the impact of the change on the bases of the Technical Specifications.

SUMMARY

Based on item 2, is any parameter in chapter 7 of the Safety Evaluation Manual exceeded?

YES ________
NO ___X___

Based on items 2 and 3, does the change reduce the margin of safety provided for the protective barriers?

YES ________
NO ___X___

If the first of these two questions is answered yes, the change may be unsafe and requires further justification. If the first question is answered no and the second is answered yes, the change is safe to implement but is an unreviewed safety question and requires prior NRC approval.

94-0079

SAFETY EVALUATION FORM

BLOCK E - SUMMARY

Based on the evaluation in Block C and Block D, the change

_X_ is safe and is not an unreviewed safety question and requires no Technical Specification change. This change may be implemented in accordance with applicable procedures.

____ is safe but is an unreviewed safety question or requires a Technical Specification change. The change requires NRC approval, prior to implementation.

____ is unsafe and cannot be implemented.

CRS, SAW, BTH, MCO, KAL

	printed name	signature	date
Preparer	R.P. Bhat	Ram P. Bhat	11/28/94
Director	R.L. Webb for J.R. Langley	[signature] for J. R. Langley	11/28/94
Manager, NSED	N/A		
Manager, L&S	J.L. Peterson for R.F. Phares	J.L. Peterson	11-29-94
FRG	L.E. Everman	[signature]	12-1-94

EVIDENCE OF NRC APPROVAL, IF REQUIRED:

License Ammendment No. ____________

printed name	signature	date
N/A	[initials] 11-29-94	

The department responsible for vaulting the parent document must vault this completed form with the document evaluated.

NF-002-5 (2/94)

F131

94-0079

1.5 References

1. "Clinton Power Station Updated Safety Analysis Report", Revision 6 Appendix E, Subsection 3.4.1.6, Figures FP-12a, and 12b. Appendix F, Subsections 3.3.1.2, 3.3.1.3, 4.1.3.1.3, 4.2.2.10, and 4.2.4.5, Appendix F Table 4.2.2.15-1, Cable Tray Figure 10, Deviation Figure 4.2.4.5-4 and Section 9.5-1.

2. "Clinton Power Station Technical Specifications", Amendment 93, Section 6.8.4.e.

3. 10 CFR 50 Appendix R, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979", Section III.G.

4. Generic Letter 86-10, "Implementation of Fire Protection Requirements".

5. Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers".

6. NRC Information Notice IN 94-22, "Fire Endurance and Ampacity Derating Test Results of 3-hour Fire Rated Thermo-Lag 330-1 Fire Barriers".

7. CPS Operating License, License Condition 2-F.

8. NSED Calculation IP-M-0177, "Fire Loads for CPS Fire Zones", Rev. 3.

9. NSED Calculation IP-M-0340, "Evaluation of Thermo-Lag Fire Barrier in Fire Zone CB-1f", Rev. 0.

10. NSED Calculation IP-M-0392, "Detailed Fire Modeling for Fire Zone CB-1f", Rev. 0.

11. EPED Calculation 19-AI-8, "Derating for 3-hour TSI Tray Wrap", Rev. 6.

12. NSED Standard ME-08.00, "Thermo-Lag Combustibility Evaluation Methodology Plant Screening Guide", Rev. 0.

13. NSED Standard ME-09.00, "NEI Application Guide for Evaluation of Thermo-Lag Fire Barrier Systems", Rev. 1.

14. EPRI Final Report TR-100370, dated April 1992 (including Revision 1), "Fire Induced Vulnerability Evaluations (FIVE)".

15. Condition Report 1-92-07-024, "NRC Bulletin 92-01; Indeterminate Fire Rating of Thermo-Lag", Rev. 0.

94-0079

1.5 References (continued)

16. CPS Procedure 1001.06, "CPS Fire Brigade", Rev. 4.

17. CPS Procedure 1893.02, "Fire Prevention - Control of Ignition Source", Rev. 5.

18. CPS Procedure 1893.03, "Control of Flammable and Combustible Liquids and Combustible Materials", Rev. 7.

19. CPS Procedure 1893.04, "Fire Fighting", Rev. 6.

20. CPS Procedure 1893.04 M340, "762' Control: General Area, Prefire Plan," Rev. 3.

21. CPS Procedure 4200.01, "Loss of A. C. Power", Rev. 8.

22. Illinois Power Policy Memorandum PM 1.05, "No Smoking Rules, Enforcement of:, Rev. 0.

23. CPS Procedure 1019.01, "Housekeeping", Rev. 10.

24. EPED Calc. 19-G-31, "Ampacity of Control Cables in Completely Filled Trays", Rev. 0.

25. Condition Report 1-93-12-034, "Potential Impact of New Fireload Calcs on Appendix R Deviations", Rev. 0.

26. Sandia Report SAND94-0146, "An Evaluation of the Fire Barrier System Thermo-Lag 330-1", printed September 1994.

27. NSED Standard ME-06.00, "Guidelines for Determining Fire Loads and Preparing Fire Load Calculations", Rev. 2.

BLOCK A.1 Continued

Reason for Thermo-Lag in Fire Zone CB-1f
The Thermo-Lag 330-1 cable fire wrap in fire zone CB-1f was originally installed to meet the requirement of 10 CFR 50, Appendix R, Section III.G. The current USAR description in Section 9.5-1 states that deviations from Appendix R requirements will be provided in the Clinton Safe Shutdown Analysis, Section 4.2.

Appendix R Requirement

Appendix R subsections III.G.2.a, III.G.2.b and III.G.2.c address specific requirements for the protection of safe shutdown capability in the event of a fire. Appendix R requires compliance with one of the three alternatives outlined by the three subsections.

Appendix R, III.G.2.a requires:

the separation of cable and equipment and associated non-safety circuits of redundant trains by a fire barrier having a 3-hour rating.

Appendix R, III.G.2.b requires:

1. 20 feet of separation, with no intervening combustibles, between redundant cables, equipment and associated non-safety circuits,
2. fire detectors and
3. automatic fire suppression system.

Appendix R, III.G.2.c requires

1. enclosure of the component of one redundant train in a fire barrier having a 1-hour rating,
2. fire detectors and
3. automatic fire suppression system.

94-0079

CPS Compliance with Appendix R in Fire Zone CB-1f

While the Appendix R requirements refer to fire areas, the CPS fire areas have been further divided into fire zones using natural boundaries. The use of fire zones is consistent with the NRC guidance provided in GL 86-10, Question and Answer Section 3.1.5., and CPS USAR Appendix F, Safe Shutdown Analysis. The impact of the proposed change is limited to fire zone CB-1f, it does not impact the other fire zones in fire area CB-1.

In fire zone CB-1f, the original design utilized the option of 3-hour fire barrier (III.G.2.a) using Thermo-Lag to enclose the trays of Division 2 safe shutdown power, instrumentation and control cables. An ionization fire detection system is provided for the entire fire zone.

The proposed deviation is from the requirement of 10CFR50, Appendix R, Section III.G for a 3-hour fire barrier. It is proposed that the USAR delete references to the 3-hour rating of the Thermo-Lag fire wrap in fire zone CB-1f.

As discussed in Generic Letter 86-10, Paragraph F, a deviation from a commitment made in the FSAR is governed by the provisions of 10CFR50.59. The CPS Operating License Condition 2-F states, "IP may make changes to the approved fire protection program without prior approval of the commission only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire."

This Thermo-Lag safety evaluation is consistent with Generic Letter 86-10 guidance, the CPS fire protection licensing condition and with the CPS process for revising the fire protection program elements contained in the USAR.

BLOCK A.2 continued

Proposed Deviation

The deviation proposed to be included in the USAR Appendix F, Section 4.2 states, "In fire zone CB-1f, the Thermo-Lag 330-1 material providing a fire barrier function for the Division 2 power, control and instrumentation cables is not qualified as a 3-hour rated installation."

Summary of Justification for Deviation

The Appendix R Subsection III.G requirements concern the ability to achieve and maintain safe shutdown. The deviation from the requirement for a 3-hour rated fire barrier enclosing one division of safe shutdown cables in fire zone CB-1f is justified on the basis that several design and programmatic fire protection features are in place at CPS to *ensure that the safe shutdown capability is maintained.* The following is an outline of the defense-in-depth features.

> NOTE:
> More detailed discussion of each of these features is provided later in this section of the safety evaluation.

1. It is unlikely for a fire to occur which is capable of affecting safe shutdown cables in fire zone CB-1f due to the administrative controls and the physical design of fire zone CB-1f.

2. Fire modeling of the fire zone CB-1f has shown that the fixed and transient combustibles, either individually or collectively, present no credible risk to safe shutdown capability.

3. In the event that a fire occurs in fire zone CB-1f, it is unlikely that both the redundant divisions of safe shutdown cables would be damaged.

4. In the event that a fire occurs in fire zone CB-1f, the as-built Thermo-Lag cable wrap will protect the wrapped Division 2 safe shutdown cable trays for a duration sufficient to permit manual fire fighting by the CPS fire brigade.

5. In the event that the fire is not extinguished by the fire brigade, the Probabilistic Risk Assessment (PRA) evaluation did not identify any significant safety benefit, with regard to core damage prevention, containment isolation, containment heat removal or containment hydrogen control, provided by the Thermo-Lag installed in fire zone CB-1f.

6. In the unlikely event of a fire in CB-1f that disables both divisions of redundant safe shutdown equipment, it is reasonable to expect that operator training,

Justification for Deviation (continued)

Emergency Response Organization (ERO) activation, and symptom-based procedures provide a final line of defense to ensure plant safety.

1. Detailed Justification for Deviation

Administrative Controls and Fire Zone Layout

Several CPS administrative controls currently in place and the layout of this fire zone minimize the potential for fire initiation in fire zone CB-1f.

(a) Administrative Control

- CPS procedure 1893.02, "Fire Protection - Control of Ignition Sources", establishes controls for hot work including welding, grinding, flame cutting, brazing and soldering operations. This procedure requires precautions to be taken (such as removing or protecting nearby combustibles and posting of a fire watch) prior to the start of hot work in order to minimize the potential for fire ignition.

- CPS procedure 1893.03, "Control of Flammable and Combustible Liquids and Combustible Materials", governs the handling and limitation of the use of combustible solids and liquids and flammable liquids. This procedure limits the quantities of transient materials that can be introduced into the safety related areas of the plant and prescribes area clean-up, adequate ventilation, access for fire protection equipment, etc., in order to minimize the potential for fire initiation and extent of fire propagation.

- Illinois Power enforces a no smoking policy within the company buildings as outlined in Policy Memorandum PM 1.05, "No Smoking Rules, Enforcement of". Noncompliance with this policy results in disciplinary action up to and including termination. Additionally, smoking is prohibited in this fire zone by CPS procedure 1019.01, "Housekeeping".

94-0079

1. **Administrative Controls and Physical Layout (continued)**

(b) Physical Layout

- The walls of fire zone CB-1f are 24-inch minimum reinforced concrete and are 3-hour fire rated except for the east exterior wall (exterior walls are not fire rated unless there is an exterior fire hazard). The two enclosed stairways and two enclosed elevators are 1.9-hour fire rated. The floor of the general access area is 12-inch minimum reinforced concrete with twenty-three 4-inch floor drains and is not fire-rated. The ceiling is 12-inch minimum reinforced concrete and is fire-rated only between column-rows 124-130 and column lines S-AC (See Enclosure 1). There are three openings to the fire zones both above and below. These openings consist of a west pipe hatch at column row 125-AC, an east pipe hatch at 135-AC, and an equipment hatch to the zone below at column row 132-133, AA-AC and to the zone below at column row 135-202, Y-AA. Although the floors, ceiling, and some walls are not fire-rated, the substantial concrete and block construction provides structural separation for this zone from adjacent fire zones. In addition, cable tray penetration openings are sealed with a 3-hour fire rated penetration seal material.

- Fire zone CB-1f is a relatively open area, providing access to the HVAC equipment in the diesel building and has a relatively large degree of spatial separation between pieces of equipment which could be sources of ignition.

With these administrative controls and the physical layout of this fire zone, it is unlikely for a fire to occur, which is capable of affecting safe shutdown cables in fire zone CB-1f.

2. Fire Modeling

A detailed fire modeling analysis, NSED Calculation IP-M-0392, Revision 0, was performed for fire zone CB-1f. It took into account all potential fixed and transient ignition sources, spatial locations and heat release rates within fire zone CB-1f, the room volume of fire zone CB-1f, and the spatial locations and damage temperatures of all potential targets within fire zone CB-1f. The modeling methodology and assumptions were primarily taken from EPRI Fire Induced Vulnerability Evaluation (FIVE) guide. This fire model was conservative in that no credit was taken for the following:

- the substantial concrete and block construction of the floor, walls, and ceiling, which would absorb more energy than the 70% value used in the fire model
- the solid bottoms on all cable trays and tray covers for the first 12 feet of tray risers in fire zone CB-1f which would reduce temperature at the cables by acting as heat sinks
- the Thermo-Lag, installed on the Division 2 power, instrumentation and control cables which would reduce the temperatures at the wrapped cables

Fire modeling shows that a hot gas layer can not be formed due to any fixed or transient ignition source. This is due to the following factors in fire zone CB-1f:

- the openings in the ceiling to fire zones CB-1g and CB-1i above
- the use of conduit for all cables not routed in cable trays
- the high floor-to-ceiling height (18 feet)
- the large distances between most of the potential ignition sources and targets
- the use of IEEE-383 qualified EPR - Hypalon cable insulation

The detailed fire modeling shows that even if a fire were to occur in fire zone CB-1f, it would not result in loss of safe shutdown capability.

3. Fire Protection Design Features

As shown in Enclosure 1, the Division 1 power, control , and instrumentation safe shutdown cable trays are located as floor-to-ceiling risers along column line AC in this fire zone. From this location, the control and instrumentation trays are routed north and east within the fire zone. The Division 2 safe shutdown cable trays are located in the two ends of this fire zone. Ir he north side, the control and instrumentation trays are located as risers entering from the floor below along column line S and routed below the ceiling between column lines S and T. In the south side, the power, control and instrumentation trays are in floor-to-ceiling risers along column line AC, 19 feet from the Division 1 risers. There is no cross-divisional stacking of the trays; that is, Division 1 trays never pass over Division 2 trays and vice-versa.

Wet pipe sprinkler systems protect the west pipe hatch and the equipment hatch at the ceiling level of the fire zone CB-1e below to cool hot gases entering from CB-1e to CB-1f.

In summary, in the event that a fire occurs in fire zone CB-1f, it is unlikely that both the redundant divisions of safe shutdown cable trays would be damaged.

94-0079

4. **Thermo-Lag Fire Endurance**

NRC's Generic Letter 92-08 identified concerns related to the fire endurance capability of Thermo-Lag 330-1 material and the evaluation and application of fire tests to determine the fire endurance ratings of Thermo-Lag 330-1 fire barriers. Condition Report 1-92-07-024 documents the concerns identified by NRC Bulletin 92-01 with regard to the indeterminate fire rating of Thermo-Lag fire barriers. An engineering calculation, IP-M-0340 was performed to determine the fire endurance capability of the as-built Thermo-Lag installation in fire zone CB-1f with regard to its capability to perform its fire barrier function under ASTM-119 fire conditions.

Five cable trays in fire zone CB-1f are wrapped with Thermo-Lag 330-1 fire barrier material. The fire wraps on Division 2 safe shutdown power, instrumentation, and control cable trays were intended to be fire rated barriers to meet the Appendix R Section III.G.2.a requirement for a 3-hour rated fire barrier.

NSED Calculation IP-M-0340 utilized NSED Standard ME-09.00, "NEI Application Guide for Evaluation of Thermo-Lag Fire Barrier Systems". The guide was issued by the Nuclear Energy Institute (NEI) and provides the industry with the data and the methodology necessary for evaluating Thermo-Lag fire barriers. The information provided by the guide was obtained from NEI and utility fire barrier endurance test programs. Additionally, the results of testing of Thermo-Lag 3-hour fire barriers, conducted by Sandia Laboratories for the NRC, were reviewed and incorporated into NSED Calculation IP-M-0340.

Based on detailed analysis using the NSED Standard ME-09.00 methodology, NSED Calculation IP-M-0340 determined the fire endurance capability of the CPS as-built Thermo-Lag 330-1 fire barrier installation in fire zone CB-1f to be at least 85 minutes. The cable "failure temperature" used in this methodology (approximately 325°F) is significantly lower than a more realistic cable failure temperature (approximately 700°F). The Thermo-Lag would, therefore, have a longer endurance under a realistic fire scenario.

4. **Thermo-Lag Fire Endurance (continued)**

NSED Calculation IP-M-0177, Rev. 3, shows that the calculated equivalent fire severity in fire zone CB-1f is 38 minutes. This equates to a "moderate" fire load as defined by NSED Standard ME-06.00, "Guidelines for Determining Fire Loads and Preparing Fireload Calculations", which provides the methodology for calculating fire loads and equivalent fire severities in CPS fire zones. The USAR (Appendix E) is being revised to reflect the result of NSED Calculation IP-M-0177, Rev. 3. The NSED Standard MD-06.00 methodology requires all material that is not classified as non-combustible to be included as fire loads. As a result, approximately 85% of the fire load in fire zone CB-1f is due to the cable insulation and 5% of the fire load is due to Thermo-Lag itself. Both the IEEE-383 qualified cable with EPR Hypalon insulation and Thermo-Lag 330-1 have high (greater than 900°F) ignition temperatures. The realistic equivalent fire severity in this fire zone would therefore be significantly less than the calculated 38 minutes.

In the event of a fire in CB-1f, the main control room will receive annunciation of multiple fire detectors in this fire zone and in the fire zones above. Manual fire fighting by the fire brigade is facilitated by the location of hose stations and portable extinguishers in this fire zone and in fire zone R-1p north of CB-1f at 762 feet Radwaste Building. Fire Brigade cages are located at 737 feet Turbine and 737 feet Radwaste and 800 feet Control Buildings.

The CPS fire brigade is available and onsite at all times, with the Shift Supervisor having the Commander of the Fire Brigade designation. The fire brigade composition, function and fire fighting guidance are provided in CPS procedures 1001.06, "CPS Fire Brigade", 1893.04, "Fire Fighting". The detailed pre-fire plan for CB-1f is contained in CPS procedure 1893.04M340.

CPS fire drills record the time from the Gaitronics announcement of fire to when the fire brigade is ready to start fire fighting at the scene. Fire drills held for CB-1f and adjacent zones have shown this time to be 12 minutes or less. CB-1f is easily accessible and attackable from several approaches. Simulator excercise demonstrated the knowledge of fire brigade members with regard to minimizing the fire spread to safety-related buildings; the fire brigade attacked the CB-1f fire from the non-safety related Radwaste Building side. The Gaitronics announcement from the control room is expected to be prompt since more than one ionization detector from CB-1f would alarm, and smoke communicating through the ceiling openings would cause alarms from adjacent zones. CB-1f is not a radiation or contaminated area. Also, CB-1f is a high traffic area, raising the probability that any fire or fire hazard would be detected at an early stage. It is therefore concluded that the CPS fire brigade would be able to respond to a fire within the calculated time of Thermo-Lag endurance.

4. Thermo-Lag Fire Endurance (continued)

In summary, the as-built Thermo-Lag fire wrap will protect the Division 2 safe shutdown cable trays for a duration sufficient to permit effective manual fire fighting by the CPS fire brigade.

5. Thermo-Lag Safety Benefit

The Probabilistic Risk Assessment (PRA) evaluation which analyzes the safety significance of potential Thermo-Lag fire barrier failure in fire zone CB-1f is included as Enclosure 3 of this safety evaluation. This analysis, consists of three major parts.

- The first part of the analysis is to identify all modeled components that could be affected by a fire in zone CB-1f and the basic events in the IPE model that represent these components. This list of components contains not only the equipment located within the fire zone, but also the equipment located outside this fire zone that are affected by damage to cables in this fire zone. This part also identifies the basic events (equipment failures) in the IPE model that are protected by Thermo-Lag. Part 1 is described in attachments PRA-1 and PRA-4 of Enclosure 3.

- The second part of the analysis involves calculating the conditional core damage probability (CCDP) for two different situations using the basic events list from Part 1 as an input. The first situation is Thermo-Lag failing to perform adequately as a fire barrier. This is the postulated "worst case" in which a fire occurs and all cables and equipment in the fire zone are damaged. The second situation is Thermo-Lag performing its intended fire barrier function in which all cables not wrapped by Thermo-Lag are damaged by a postulated fire. Attachments PRA-2 and PRA-5 of Enclosure 3 describe the CCDP determination.

  While preventing core damage is an important consideration for plant safety, maintaining containment integrity by protecting containment isolation and heat removal capabilities is also a concern. Additionally, containment analysis in the IPE report identified the loss of containment hydrogen control as a major cause of containment failure. Correspondingly, the effect of a fire in zone CB-1f on these functions was also examined. This analysis is detailed in attachments PRA-2 and PRA-5 of Enclosure 3.

5. Thermo-Lag Safety Benefit (continued)

- The third part of the analysis was to determine the fire ignition frequency in zone CB-1f. This calculation utilizes the methodology described in the Fire-Induced Vulnerability Evaluation (FIVE) Guide, EPRI TR-100370 and the Fire Risk Analysis Implementation Guide, EPRI Project 3385-01. Ignition frequency calculation is described on attachments PRA-3 and PRA-6 of Enclosure 3.

The results of this analysis showed that the product of the difference in the CCDP between the two cases (Thermo-Lag failing and Thermo-Lag performing its design function) and the ignition frequency was below the significance threshold of 1.0E-06. Additionally, no significant impact was found to exist for containment isolation, containment heat removal or containment hydrogen control.

In summary, no significant safety benefit, with regard to core damage prevention, containment isolation, containment heat removal or containment hydrogen control, is provided by the Thermo-Lag installed in fire zone CB-1f.

6. Operator Response to Fires Affecting Safe Shutdown Equipment

While it is not possible to predict exactly what equipment will be lost or impaired due to any given fire, it is possible to assume "worst-case" for an area of the plant involved in a fire. For the areas involving safe shutdown equipment, the issue becomes knowing what is left for the operator to use for any given fire. The operator is trained to control plant parameters per the Emergency Operating Procedures (EOP's) independent of the cause of the off-normal/emergency conditions. That is, the EOP's are symptom-based and not event-based. In this sense, equipment loss due to multiple failures, sabotage, seismic event, etc., is not different from equipment loss due to fire. The operators are given a list of systems to use, not necessarily in a preferential order (what is used is based on what will work).

94-0079

6. Operator Response to Fires Affecting Safe Shutdown Equipment (continued)

The operating crews receive intense, continuing training on the EOP's with multiple equipment failures and on loss of power events. Procedural guidance exists in CPS Procedure 4200.01, "Loss of AC Power" for a Station Black Out (SBO). These steps guide the operator actions to minimize the impact on plant equipment while preserving the equipment that is left. For fires that affect systems to an extent less than an SBO, portions of the Loss of AC Power procedure will apply. CPS crews have demonstrated the ability to implement these procedures while maintaining the reactor in a safe condition. A loss of offsite power concurrent with a fire in CB-1f resulting in the loss of RCIC, Division 1 NSPS power, and all Division 1 and 2 equipment was simulated on the CPS simulator and the operator actions resulted in achieving hot shutdown and maintaining stable reactor parameters.

Emergency Plan Procedure EC-02 directs activation of the Emergency Response Organization (ERO) during any significant plant fire. While minimum shift manning will allow for successfully achieving hot shutdown conditions, the additional resources provided by the ERO will be valuable in minimizing the impact of the fire on the plant and assisting with recovery and repairs.

In summary, in the event of a fire in CB-1f that disables both divisions of redundant safe shutdown equipment, it is reasonable to expect that operator training, ERO activation and symptom-based procedures provide the final line of defense to ensure plant safety.

Evaluation of Ampacity Derating Impact of Thermo-Lag

The ampacity derating factors for cables in raceway wrapped by Thermo-Lag has become a concern due to questions raised in Generic Letter 92-08. The NRC questions are related to the original Thermo-Lag manufacturer's recommended ampacity derating factors as well as the wide range of ampacity derating factors applied across the industry. In Information Notice (IN) 94-22, the NRC provided some preliminary information (subsequently issued in Sandia Report SAND94-0146, September 1994) about the results of tests the NRC had conducted to establish ampacity derating factors for cables in trays wrapped by Thermo-Lag 330-1 fire barrier material.

Evaluation of Ampacity Derating Impact of Thermo-Lag (continued)

Ampacity limits are placed on cables to ensure that the cables will operate within their design parameters and are unrelated to a fire scenario. Without ampacity limitations, the current carried by a cable could generate too much heat and result in the cable operating at a temperature above its design rating, thus causing a reduction in the cable's design life. The cables utilized at CPS are rated for 90°C operation and the ampacity limits selected were based on that value. Since different installation configurations (such as covered trays, or fire stops) can limit the dissipation of the heat generated by the current passing through the cable, derating factors were developed to further restrict the current which the cable will be allowed to carry when these configurations are part of the cable routing.

The CPS design defined the boundary between power, control, and instrumentation circuits based on both voltage and current levels. Separate raceways are provided for the different cables so that instrument cables are isolated from noise that could be generated by the power and control cables and the control cables are separated from the heat and induced voltage that could be generated by the power cables. As shown by NSED Calculation 19-G-31, Rev. 0, the currents passing through control and instrumentation cables do not generate sufficient heat to challenge the cable design ratings.

Enclosure 4 identifies the CPS power cables protected by Thermo-Lag 330-1 fire barrier material and the available ampacity margin for each cable in fire zone CB-1f. A review of this data indicates that the power cables wrapped by Thermo-Lag 330-1 in fire zone CB-1f could be derated by as much as 37% or more without impacting their design functions or design life. The highest ampacity derating identified in IN 94-22 is 46.4% for a #8 AWG conductor in a tray wrapped by a 3-hour rated Thermo-Lag 330-1 fire barrier. The Enclosure 4 ampacity evaluation concludes that the NRC ampacity derating concerns expressed in IN 94-22 will not have adverse impact on the four most heavily loaded power cables (22, 12, 109, and 207.9 amps respectively) in fire zone CB-1f. This conclusion was reached upon comparing conservatism chosen in the CPS design ampacity limits with the derating methodology used by the NRC in IN 94-22. Since the four most heavily loaded cables will not be impacted by the concerns expressed in NRC's IN 94-22, the rest of the cables in fire zone CB-1f are also acceptable from the ampacity derating view point.

Currently, there exist no conclusive ampacity derating factors for cables wrapped by Thermo-Lag 330-1 fire barriers due to the many outstanding issues with regard to past tests and test results; however, as discussed above, the Thermo-Lag cable tray fire wrap in fire zone CB-1f does not adversely impact the current carrying capability of the cables.

94-0079

SAFETY EVALUATION FORM

BLOCK D, Part I

1. Failures associated with a design-basis fire in fire zone CB-1f are discussed in USAR Appendix F, Fire Protection Safe Shutdown Analysis (SSA), Subsection 3.3.1.

   Currently, Subsection 3.3.1.2 states "...to separate the Division 1 shutdown cables from those of Division 2. Division 2 cable trays will be protected with a material that has a 3-hour fire rating (see Subsection 3.3.1.3.3)."

   Currently Subsection 3.3.1.3.3 states, "In order to preclude the possibility of a fire destroying both Division 1 and 2 cables that serve safe shutdown equipment, the Division 2 cable trays will be protected with a material that has a 3-hour fire rating."

   These Subsections, 3.3.1.2 and 3.3.1.3.3, are proposed to be revised based on a new deviation to be added to Subsection 4.2.2.17. The new deviation will eliminate the reference to the 3-hour fire rating of Thermo-Lag. The justification for this deviation, and for removing the subsections 3.3.1.2 and 3.3.1.3.3 wording which implies that there is a safe shutdown concern if the 3-hour rated fire wrap is not installed, is provided in detail under the Block A.2 discussions.

2. For the reasons provided in the Block A.2 discussion, the performance of the safe shutdown systems in fire zone CB-1f is not adversely impacted by the Thermo-Lag fire rating being changed from 3-hour to no specific rating.

3. Even though the Thermo-Lag fire rating is now considered to be less than 3-hour and the reference to the rating is deleted, this reduced capability of the Thermo-Lag fire wrap does not cause any new failure modes. The justification for the reduced capability being acceptable is provided in the Block A.2 discussion.

4. The USAR Appendix F, Safe Shutdown Analysis, documents the capability of the CPS safe shutdown systems to achieve and maintain cold shutdown condition in the event of a single fire anywhere in the plant with a loss of offsite power. As explained by the Block A.2 discussion, it is not credible to postulate a fire scenario capable of adversely affecting the safe shutdown capability in fire zone CB-1f despite the reduced Thermo-Lag capability.

5. The probability of the failures evaluated in the USAR is not impacted as discussed in the Block A.2 discussion.

BLOCK D, Part II

1, 2, and 3. The accidents identified in the USAR are not affected by the proposed change to the Thermo-Lag fire wrap rating in fire zone CB-1f. As explained in the Block A.2 discussion, the plant safe shutdown capability in the event of a fire in CB-1f is not adversely impacted. Although it could be postulated that a certain fire scenario could result in a higher core damage probability without an effective 3-hour barrier, the potential for such a scenario is so remote that the impact on overall core damage frequency is negligible.

BLOCK D, Part III

1 and 2. As explained in the Block A.2 discussion, the Thermo-Lag combustibility and ampacity derating concerns were evaluated and found to have no impact on fire zone CB-1f safe shutdown capability. No new type of accident or equipment malfunction was identified.

BLOCK D, Part IV

1 and 2. Neither the protective barriers, the approach to the acceptance limits for any of the protective barriers, nor the margin of safety is directly affected by this change. The safe shutdown capability in fire zone CB-1f has been determined to be acceptable after the impact of the change was evaluated as explained in the Block A.2 discussion.

3. The CPS Fire Protection Program as stated in Tech. Spec. 6.8.4.e is unchanged. The bases of the Technical Specifications is not affected by this change.

Division II Safe Shutdown Cables Protected by Thermo-Lag in Fire Zone CB-1f

Raceway	Cable Number	FIREZ. CB-1F	Cable Function
P2E	1VC35B	X	480V feed from 0AP25E to 0FZ-VC112 (damper 0VC03YB operator). Loss prevents damper operation.
P2E	1VC56D	X	480V feed from 0AP25E to 0FZ-VC111 (damper 0VC08YB operator). Loss prevents damper operation.
C2E	1AP21K	X	Control tie between 1PL12JB (DG cntrl panel) and 1AP09EA (D2 4KV bus RAT feed bkr)
C2E	1AP21L	X	Control tie between 1PL12JB (DG cntrl panel) and 1AP09EA (D2 4KV bus RAT feed bkr)
C2E	1AP23L	X	Control tie between 1PL12JB (DG cntrl panel) and 1AP09EC (D2 4KV ERAT feed bkr)
C2E	1AP23M	X	Control tie between 1PL12JB (DG cntrl panel) and 1AP09EC (D2 4KV ERAT feed bkr)
C2E	1AP29Q	X	Control intertie between 1AP09EB and 0AP06E
C2E	1CM07L	X	120VAC Control power from 0AP57E to 1H13-P639 for valves 1CM022,023,025,026, and gamma monitors 1RIX-CM060,062, and 1RU-CM060,062
C2E	1DG21A	X	Control intertie between 1PL12JB and MCR. Includes LOCA bypass, Auto-start signals, and annunciation.
C2E	1DG21B	X	Control intertie between 1PL12JB and MCR. Includes remote/local control, auto-start, remote start/stop, emergency stop.
C2E	1DG21C	X	Control intertie between 1PL12JB and MCR. Includes voltage and governor adjustments, and local/remote control.
C2E	1DG21F	X	Control intertie between 1PL12JB and MCR. Provides CT output for MCR meters.
C2E	1DG21K	X	Control intertie from brkr closing equalizing timer relay A14 in 1PL92JB to SX pump brkr 1AP09EG. Cable loss prevents start of SX pump 1SX01PB
C2E	1DG21M	X	Control for boost signal from 1AP09EG (SX pump bkr) to 1PL12JB
C2E	1DG31C	X	Control, output of CT at 1AP09EH to differential relay in 1PL12J B.
C2E	1DG31D	X	Indication, output of CT at 1AP09EH to wattmeters and ammeters
C2E	1DG31E	X	Indication, output of PT at 1AP09EH to VAR, volt, and wattmeters
C2E	1DG31F	X	Control, output of PT at 1AP09EH to Loss-of -power(240-DG1B), reverse power(232-DG1B), and voltage control(251V-DG1B) relays.
C2E	1DG31K	X	Control, Close permissive(N.C.) and trip signal(N.O.) for bkr 1AP09EH
C2E	1DG31R	X	Control, governor droop control input from "b" contact of bkr 1AP09EH
C2E	1DG31S	X	Control, permissives for loss-of power(240-DG1B) and reverse-power(232-DG1B) relays(from "a" contacts). Trip signal for DG lockout relay from overcurrent aux relay.
C2E	1DG31T	X	Control, idle start circuit and control power for differential(287-DG1B) and loss-of-excitation(240-DG1B) relays
C2E	1DO02B	X	Control and indication for DG fuel oil transfer pump 1DO01PB between MCC 1AP61E and MCR.

94-0079

Division II Safe Shutdown Cables Protected by Thermo-Lag in Fire Zone CB-1f

Raceway	Cable Number	FIREZ. CB-1F	Cable Function
C2E	1DO02C	X	Control and annunciation for DG fuel oil transfer pump 1DO01PB and shunt trip signal for Div 2 DG air start skid compressors between MCC 1AP61E and MCR.
C2E	1IP04A	X	120V power from MCC 0AP55EB to MCR for Main Steam Line leak detection devices in Turbine bldg. 1E31-N559B, 558B, 560B, 561B, 562B, and 563B.
C2E	1IP04B	X	120V power from MCC 0AP55EB to MCR 24V DC power supply 1UU-LV851A. Powers many inst loops, DG fuel oil and day tank levels, sup pool temp and level, drywell and containment air press, SX B strainer outlet press, SGTS B train delta press, ADS air press
C2E	1LV14B	X	120V DISTR PNL CONT
C2E	1LV14D	X	120V DISTR PNL CONT
C2E	1LV14E	X	120V DISTR PNL CONT
C2E	1LV14F	X	120V DISTR PNL CONT
C2E	1LV14G	X	120V DISTR PNL CONT
C2E	1LV14H	X	120V DISTR PNL CONT
C2E	1LV14J	X	120V DISTR PNL CONT
C2E	1LV14K	X	120V DISTR PNL CONT
C2E	1LV14L	X	120V DISTR PNL CONT
C2E	1LV14M	X	120V DISTR PNL CONT
C2E	1RI19C	X	125VDC control for air sol vlvs 1E51-F004 and F025 (RCIC turb exh drain line isolation vlvs), vlvs isolate/close on loss of power.
C2E	1SX31C	X	Control between 1AP61E and MCR for operation and indication of 1SX063B. Open prevents valve operation, short causes spurious operation.
C2E	1SX40C	X	Control between 1AP61E and MCR for operation and indication of 1SX017B. Open prevents valve operation, short causes spurious operation.
C2E	1VC02C	X	120VAC & 125VDC control between 0AP06E and MCR for 0VC03CB (VC B supply fan). Operates fan-heater interlock, ESF amber light, and annunciators.Loss impacts interlock , light, and annunciator.
C2E	1VC04C	X	120VAC & 125VDC annujnciation between 0AP06E and MCR for 0VC04CB (VC B return fan) and 0VC13CB (VC B chilled water chiller) for ESF amber lights and annunciators. Loss impacts annunciation.

9410079

Division II Safe Shutdown Cables Protected by Thermo-Lag in Fire Zone CB-1f

Raceway	Cable Number	FIREZ. CB-1F	Cable Function
C2E	1VC45A	X	120V control and indication circuits from 0PL72JB to MCR for 0VC04CB (Div 2 VC Return fan) and 0VC08PB (Div 2 VC chilled water pump). Loss prevents remote operation of fan (manual) and pump (auto). Local operation at 0PL72JB may be achievable.
C2E	1VC45B	X	Control and alarm circuits from 0PL72JB to MCR for 0VC03CB (Div 2 VC Supply fan). Loss prevents remote operation of fan. Local operation at 0PL72JB may be achievable. Damage prevents (open) or causes (short) alarm and ESF amber light actuation.
C2E	1VC45C	X	Control and alarm circuit from 0PL72JB to MCR, controls operators 0FZ-VC114 (damper 0VC01YB) and 0FZ-VC168 (damper 0VC70Y) and carries various filter and train alarms. Loss prevents damper operation, alarms, and ESF light actuation.
C2E	1VC45D	X	Control between 0PL72JB and MCR for operation of 0VC05CB (MCR HVAC Make-up Air fan B). Loss prevents fan operation and affects various annunciation and red/green lights.
C2E	1VC45F	X	Alarm circuits from 0PL72JB to MCR. Loss prevents (open) or causes (short) alarm and ESF amber light actuation.
C2E	1VC45H	X	Control and alarm circuit from 0PL72JB to MCR for 0FZ-VC096 and 112 (dampers 0VC03YB and 115YA). Loss prevents damper operation and, due to common fuse, may affect 0FZ-VC106, 116BA and BB (dampers 0VC02YB and 11YB). Damage affects alarms and ESF lights.
C2E	1VC46E	X	Indication and alarm circuit between 0PL72JB and MCR for 0FZ-VC111, 124, and 103G (dampers 0VC08YB, 04YB, and 39YB). Loss impacts position indication and, due to common fuse, may cause the dampers to fail closed. Damage impacts alarm and ESF amber lights.
C2E	1VC46F	X	Alarm circuits from 0PL72JB to MCR. Loss prevents (open) or causes (short) alarm and ESF amber light actuation.
C2E	1VC46G	X	Indication and alarm circuit between 0PL72JB and MCR for 0FZ-VC103D, E, and F(dampers 0VC30YB, 33YB, and 36YB). Loss impacts position indication and, due to common fuse, may cause the dampers to fail closed. Damage impacts alarm and ESF amber lights.
C2E	1VD02E	X	Control between 1AP12E and 1PL54JB. Uses output of 1TIT-VD008 (Div 2 DG rm temp) and 1PDS-VD028 (DG rm 1B exhaust fan diff press) for alarm and to shutdown 1VD01CB (DG rm 1B vent fan) after DG stops. Loss impacts alarm and fan shutdown.
C2E	1VD05B	X	Control intertie between 1AP61E and MCR for operation of 1VD02CB (DG 1B oil room exhaust fan) from MCR. Loss of circuit prevents fan operation.
C2E	1VX25C	X	Alarm signal intertie between 0AP55EA and 1AP75E for MCR annunciation. Loss prevents service not available alarm.

94-0079

Division II Safe Shutdown Cables Protected by Thermo-Lag in Fire Zone CB-1f

Raceway	Cable Number	FIREZ. CB-1F	Cable Function
C2E	1VX28F	X	Control and alarm intertie between 0AP55EA and 1PL91J (Inverter room cubicle HVAC panel) for 1VX13CB. Damage can prevent (open) or cause (short) fan operation, alarms, or ESF amber light actuation.
C2E	1VX28N	X	Control intertie between 0AP55EA and 1PL65JB (Div 2 switchgear room 1B HVAC panel) for 1SX193B (Div 2 inverter room cubicle cooler cooling coil inlet valve). Damage opens (open) or closes (short) the valve.
K2E	1LD26E	X	Signal from 1E31-N005B (RCIC area cooler inlet temp) to MCR delta temp sw. Sw actuation cause RCIC isolation.
K2E	1LD26F	X	Signal from 1E31-N006B (RCIC area cooler outlet temp) to MCR delta temp sw. Sw actuation cause RCIC isolation.
K2E	1LD26G	X	Signal from 1E31-N004B (RCIC area ambient temp) to MCR temp sw. Sw actuation causes RCIC isolation.
K2E	1LD28A	X	Signal from 1E31-N027B (RHR A Ht Ex Rm cooler inlet temp) to MCR delta temp sw. Sw actuation causes RCIC and RHR isolation
K2E	1LD28B	X	Signal from 1E31-N028B (RHR A Ht Ex Rm cooler outlet temp) to MCR delta temp sw. Sw actuation causes RCIC and RHR isolation
K2E	1LD28C	X	Signal from 1E31-N002B (RHR B Ht Ex Rm cooler inlet temp) to MCR delta temp sw. Sw actuation causes RCIC and RHR isolation
K2E	1LD28D	X	Signal from 1E31-N003B (RHR B Ht Ex Rm cooler outlet temp) to MCR delta temp sw. Sw actuation causes RCIC and RHR isolation

94-0079

Function of Div 2 LV cables wrapped in Thermo-lag

1LV14B

120V control power from 0AP55EB to MCR for ESF amber lights and overload bypass relays in the HG, IA, SA, SF, and SM systems. Loss prevents testing bypass relays, ESF amber light actuation, and loss of power alarms.

1LV14D

120V control power from 0AP55EB to MCR for: 1) operation of 0RA027 & 028 (Breathing Air valves). Loss isolates valves; 2) Div 2 initiation of MCR HVAC Hi Rad isolation. Loss prevents Div 2 isolation; 3) shutdown of VG fans in the event of charcoal filter deluge. Loss prevents shutdown but sends loss-of-power alarm; 4) trip and alarm of VD fans. Loss prevents trip but sends loss of control power alarm; 5) initiation of VG system from radiation signal and multiplication of LOCA signal. Loss prevents auto initiation and transmission of LOCA signal; 6) LOCA trip of VP chiller. Loss prevents trip; 7)operation of 1VQ001A, 3, and 4B (VQ isolation valves). Loss causes valves to isolate; 8) operation of 1VR001B and LOCA signal seal-in for VR and VQ controls. Loss causes valve isolation but prevents LOCA signal and seal-in; 9)auto open interlock of damper 1VX04YB to fan 1VX03CB. Loss prevents damper operation; and 10) feed to 12V DC power supply 1UU-LV851 which in turn feeds load drivers.

1LV14E

120V control power from 0AP55EB to MCR for: 1) LOCA isolation signals for valves 1CC050,53,60,71,74, and 127; 1CY017, and 20; 1FC007,16B,24B, and 37; 1SF002; 1FP050,52,53, and 79; 1RE019, and 21; 1RF019, and 21. Loss prevents automatic isolation of the valves involved; 2)operation of valves 1IA006, and 7; 1SA030, and 31. Loss results in valve closure and isolation of IA and SA; 3)LOCA signal for closure of valves 1SX020B and 0MC010 and starting the Div 2 SX pump. Loss impacts pump automatic start, valve line-up may require manual action; 4)Containment spray signal for closure of 1SX082B and opening 1E12-F014B. Loss requires manual operation for valve line-up; 5)feed to 15V DC power supply for analog optical isolators

1LV14F

120V control power from 0AP55E to MCR for: 1)leak detection signal on main steam lines. Loss produces isolation signal; 2)LOCA signal to valves 1SM001B, and 2B (Div 2 SM dump valves) and VF fans. Loss prevents auto actions, including Div 2 SM auto dump and VF fan trip;

1LV14F (cont.)
3)operation and LOCA/RAD signals for 1VR006B,7B,35, and 40. Loss causes valves to isolate; 4)operation of valve 1WX019. Loss causes valve to isolate; 5)position indication for valve 1VG057B and temperature indication for Drywell, and containment atmosphere as well as Suppression pool temperature. Loss inops the MCR recorder and computer input.

1LV14G
120V control power from 0AP55E to MCR for ESF amber lights and overload bypass relays in the MC and CY systems. Loss prevents testing bypass relays, ESF amber light actuation, and loss of power alarms.

1LV14H
120V control power from 0AP55E to MCR for ESF amber lights in AP, DG, and DO systems and Div 2 DG fuel oil tank level indication. Loss removes level indication and prevents ESF amber light actuation.

1LV14J
120V control power from 0AP55E to MCR for ESF amber lights and overload bypass relays in the SX system and containment pressure recorder 1PR-CM257. Loss prevents recorder operation, ESF amber light actuation, and testing of bypass relays.

1LV14K
120V control power from 0AP55E to MCR for recorders 1PR-CM064 (Drywell pressure) and 1LR-CM241 (Suppression pool level) and ESF amber lights in the RE system. Loss prevents recorder operation and ESF amber light actuation.

1LV14L
120V control power from 0AP55E to MCR for recorder 0PDR-VC153 (VC train B pre-filter differential) and ESF amber lights the divisional portions of VC, VD, VG, VH, VP, VX, and VY systems. Loss prevents recorder operation and ESF amber light actuation.

1LV14M
120V control power from 0AP55E to MCR for recorders 1LR-CM031 (Containment pressure) and 1LR-SM016 (Suppression pool level). Loss prevents recorder operation.

Div I Safe Shutdown Cables in Fire Zone CB-1F within 20 ft of the Div II Safe Shutdown Thermo-lag wrapped cables

RACEWAY	CABLE #	CABLE FUNCTION
P1E	1AP34L	125V DC control power feed from 1DC13E to 0AP05E, 480V unit sub A.
P1E	1AP34T	125V DC backup control power feed from 1AP11E, 480V unit sub 1A, to 0AP05E, 480V unit sub A.
C1E	1CC05B	Control circuit from 1AP73E to operator of 1CC076A. Damage impacts ability to operate valve.
C1E	1DG01C	Control circuitry between 1PL12JA and 1C61-P001 (Remote shutdown panel) for various functions including LOCA bypass, emergency stop, and remote/local control. Damage would impact remote operation of DG.
C1E	1DG01K	Control circuit from 1C61-P001 to 1PL12JA for remote control of speed and voltage of the DG.
C1E	1DG01T	Control circuit from 1AP07E to 1PL12JA for the diesel boost signal prior to closure of the 4KV breaker.
C1E	1DG11G	Control circuit between 1AP07EC (4KV DG feed breaker) and MCR carries the PT output from the bus for the meters in the MCR. Damage impacts meter data for operator.
C1E	1DG11T	Control permissive from 1AP07EC (4KV DG feed breaker) to the loss of excitation relay in 1PL12JA and the idle start emergency over ride circuit. Damage impacts diesel operation.
C1E	1DO01C	Control circuit between MCR and 1AP60E for operation of 1DO01PA, DG fuel oil transfer pump. Damage impacts pump operability.
C1E	1IP03A	120V regulated AC from 0AP54EB to MCR panel H13-P861. Provides power for Turbine bldg MS leak detection temperature switches. Damage causes alarm and inputs Div 1 isolation signal into 2-of-4 logic.
C1E	1IP03B	120V regulated AC from 0AP54EB to MCR panel H13-P861. Provides power for signal converter 1TY-CM258 and 24V DC power supply 1UU-LV861A.
C1E	1LV13D	120V AC from 0AP54EB to MCR panel 1H13-P861 for: 1) operation of solenoids for 0RA026 and 029 (Breathing Air valves), 1IA005 and 008 (IA div 1 isolation valves), and 1SA029 and 032 (SA div 1 isolation valves). Loss of power isolates valves; 2) LOCA isolation signals to relays for valves in the CY, FC, FP, SF, SX, MC, RE, and RF systems. Loss of power prevents isolation; 3) LOCA start signal for the 1SX01PA (Div 1 SX pump). Loss prevents auto-start from LOCA.
C1E	1LV13E	120V AC from 0AP54EB to MCR panel 1H13-P861 for: 1) auto-operation logic for SM Div 1 dump valves. Loss prevents automatic opening but manual operation remains possible; 2) isolation and trip logic for VF fans. Loss prevents fan trip; 3) operation of solenoids for 1VR006A and 007A (VR div 1 isolation valves) and 1WX020 (WX div 1 isolation valve). Loss of power isolates valves; 4) Turbine bldg MS leak detection loop. Loss1 causes alarm and inputs Div 1 isolation signal into 2-of-4 logic.
C1E	1LV13F	120V AC from 0AP54EB to MCR panel 1H13-P870 for ESF amber lights and testing overload bypass relays in the CY and MC systems. Loss prevents testing bypass relays, ESF amber light actuation, and loss of power alarms.
C1E	1LV13G	120V AC from 0AP54EB to MCR panel 1H13-P877 for ESF amber lights in the AP, DG, and DO systems. Loss prevents ESF amber light actuation.
C1E	1LV13H	120V AC from 0AP54EB to MCR panel 1H13-P601 for: 1) ESF amber lights in the RE system. Loss prevents ESF amber light actuation; 2) recorders (1PR-CM256, 063, and 240) in the CM system. Loss prevents MCR data collection.
C1E	1LV13J	120V AC from 0AP54EB to MCR panel 1H13-P801 for: 1) ESF amber lights in VC, VD, VG, VH, VP, VX, and VY systems. Loss of power prevents ESF amber light actuation; 2) recorder 0PDR-VC053. Loss impacts MCR data collection.

RACEWAY	CABLE #	CABLE FUNCTION
C1E	1LV13K	120V AC from 0AP54EB to MCR panel 1H13-P861 for: 1) radiation and LOCA isolation signals in the VC, VG, VP, VQ, and VR systems. Loss of power prevents isolation and also blocks the LOCA isolation signals to other systems that originate in VG, VQ, etc; 2) control of solenoids for VQ and VR valves. Loss of power causes valves to close and isolate; 3) auto-control of Div 1 VD fan. Loss of power prevents auto-start but manual control remains intact; 4) auto-open interlock of damper 1VX04YA to fan 1VX03CA. Loss prevents damper operation.
C1E	1LV13L	120V AC from 0AP54EB to MCR panel 1H13-P601 for ESF amber lights and bypass relays in the SX system. Loss prevents ESF amber light actuation.
K1E	1NB66C	Signal from 1B21-N081A (Reactor water level xmtr) to DCS computer. Damage would interrupt signal to MCR and cause Div 1 low reactor water level signal to be input to 2-of-4 logic.
P1E	1RP01C	125V DC feed from 1DC13E to 1C71-S001A (Div 1 NSPS inverter). Loss of feed causes inverter to shift to alternate source 1RP01E.
K1E	1RP75C	Signal from 1B21-N078A (Reactor pressure xmtr) to DCS computer. Damage would interrupt signal to MCR and cause Div 1 reactor pressure signal to be input to 2-of-4 logic.
P1E	1SX26A	480V feed from 1AP60E to 1SX019A, VC 1A HX outlet valve .
C1E	1SX26B	Control circuit from 0PL72JA to 1AP60E for opening 1SX019A when 0VC13CA (VC chilled water chiller) is operating. Cable damage prevents valve operation.
P1E	1SX39A	480V feed from 1AP60E to 1SX017A, VC 1A HX inlet valve.
C1E	1SX39B	Control circuit between 1AP60E and 1SX017A operator. Cable damage could impact valve operation.
C1E	1SX39C	Control circuit between 1AP60E and MCR for control of valve (no automatic operation). Cable damage prevents changing valve position.
C1E	1VC01C	Alarm circuit between 0AP05E and MCR for ESF amber lights and annunciation about 0VC03CA (VC A supply fan). Damage would impact MCR annunciation.
C1E	1VC03C	Alarm circuit between 0AP05E and MCR for ESF amber lights and annunciation about 0VC04CA (VC A return fan) and 0VC13CA (VC A chiller). Damage would impact MCR annunciation.
C1E	1VC09J	120V AC feeds from 1AP72E to 0VC13CA (VC A chiller) to control and energize the heater circuits of the compressor. Damage impacts heater circuits and could impact chiller operation.
P1E	1VC20B	480V feed from 0AP24E to 0TZ-VC035 (damper 0VC14YA operator).
P1E	1VC20C	480V feed from 0AP24E to 0TZ-VC034 (damper 0VC13YA operator).
P1E	1VC20D	480V feed from 0AP24E to 0TZ-VC033 (damper 0VC12YA operator).
C1E	1VC20E	Control circuit for VC A modulating dampers 0VC12YA, 13YA, and 14YA.
P1E	1VC21B	480V feed from 0AP24E to 0FZ-VC003D (damper 0VC30YA operator).
P1E	1VC21C	480V feed from 0AP24E to 0FZ-VC003E (damper 0VC33YA operator).
P1E	1VC21D	480V feed from 0AP24E to 0FZ-VC003F (damper 0VC36YA operator).
C1E	1VC21G	Control circuit between 0AP24E and 0PL72JA for damper (0VC30YA, 33YA, and 36YA) position indicating lights.
C1E	1VC21O	Control from 0AP24E to 0FZ-VC003D (damper 0VC30YA operator). Loss prevents damper operation.
C1E	1VC21P	Control from 0AP24E to 0FZ-VC003E (damper 0VC33YA operator). Loss prevents damper operation.
C1E	1VC21Q	Control from 0AP24E to 0FZ-VC003F (damper 0VC36YA operator). Loss prevents damper operation.
C1E	1VC21R	120V control power from 0AP54E to 0AP24E for operation of the control circuits of multiple dampers including 0VC15YA, 16YA, 17YA, 21YA, 24YA, 27YA, 30YA, 33YA, and 36YA.
P1E	1VC22B	480V feed from 0AP24E to 0TZ-VC038 (damper 0VC17YA operator).
P1E	1VC22C	480V feed from 0AP24E to 0TZ-VC037 (damper 0VC16YA operator).

RACEWAY	CABLE #	CABLE FUNCTION
P1E	1VC22D	480V feed from 0AP24E to 0TZ-VC036 (damper 0VC15YA operator).
C1E	1VC22E	Alarm and annunciation circuit between 0AP24E and 0PL72JA for dampers 0VC15YA, 16YA, 17YA, and 18YA.
P1E	1VC22F	480V feed from 0AP24E to 0TZ-VC039 (damper 0VC18YA operator).
P1E	1VC33B	480V feed from 0AP24E to 0FZ-VC012 (damper 0VC03YA operator).
C1E	1VC33P	Control from 0AP24E to 0FZ-VC196 (damper 0VC115YB operator). Loss prevents damper operation.
C1E	1VC33U	Control from 0AP24E to 0FZ-VC012 (damper 0VC03YA operator). Loss prevents damper operation.
C1E	1VC33V	Control from 0AP24E to 0FZ-VC006 (damper 0VC02YA operator). Loss prevents damper operation.
P1E	1VC33X	480V feed from 0AP24E to 0FZ-VC196 (damper 0VC115YB operator).
C1E	1VC34R	Control circuit between 0AP24E and 0PL72JA for operation of multiple dampers including 0VC09YA, 10YA, and 11YA. Damage impacts damper operation.
C1E	1VC42A	Control circuit between 0PL72JA and MCR for 0VC04CA (VC A return fan) and 0VC08PA (VC A chilled water pump). Circuit provides status lights, control of pump, and manual stop of fan. Cable damage impacts VC A train operation.
C1E	1VC42B	125V DC control circuit between 0PL72JA and MCR for 0VC03CA (VC A supply fan). Circuit provides for remote (MCR) control of fan and status lights, as well as ESF amber lights and annunciation. Cable damage prevents control from MCR and, if double fault occurred, could blow control fuses and prevent fan breaker operation.
C1E	1VC42C	Control circuit between 0PL72JA and MCR for position indication of dampers 0VC114YA, 39YA, 04YA, and 08YA as well as ESF amber lights and annunciation. Cable damage could impact operation of dampers 0VC39YA, 04YA, and 08YA.
C1E	1VC42D	Control circuit between 0PL72JA and MCR for position indication of dampers 0VC27YA, 24YA, and 21YA as well as ESF amber lights and annunciation. Cable damage could impact operation of dampers.
C1E	1VC42F	Alarm circuit between 0PL72JA and MCR for annunciation of isolation dampers position. Damage impacts annunciation.
C1E	1VC43C	Control circuit between 0PL72JA and MCR for control and position indication of dampers 0VC69YA and 01YA as well as ESF amber lights and annunciation. Cable damage would impact control and operation of dampers.
C1E	1VC43E	Control circuit between 0PL72JA and MCR for position indication of dampers 0VC30YA, 33YA, and 36YA as well as ESF amber lights and annunciation. Cable damage could impact operation of dampers.
C1E	1VC43F	Control circuit between 0PL72JA and MCR for position indication of dampers 0VC03YA, 02YA, 11YA, and 115YA plus control of 0VC03YA and 115YA as well as ESF amber lights and annunciation. Cable damage would impact operation of dampers.
P1E	1VC48B	480V feed from 0AP24E to 0FZ-VC003A (damper 0VC21YA operator).
P1E	1VC48C	480V feed from 0AP24E to 0FZ-VC003B (damper 0VC24YA operator).
P1E	1VC48D	480V feed from 0AP24E to 0FZ-VC003C (damper 0VC27YA operator).
C1E	1VC48E	Control circuit between 0AP24E and 0PL72JA for control of dampers 0VC21YA, 24YA, and 27YA. Includes ESF amber light indication and MCR annunciation. Damage impacts damper operation and MCR indication.
C1E	1VC48N	Control from 0AP24E to 0FZ-VC003A (damper 0VC21YA operator. Loss prevents damper operation.
C1E	1VC48O	Control from 0AP24E to 0FZ-VC003B (damper 0VC24YA operator. Loss prevents damper operation.
C1E	1VC48P	Control from 0AP24E to 0FZ-VC003C (damper 0VC27YA operator. Loss prevents damper operation.
P1E	1VC49B	480V feed from 0AP24E to 0FZ-VC068 (damper 0VC69YA operator).
P1E	1VC49C	480V feed from 0AP24E to 0FZ-VC014 (damper 0VC01YA operator).

94-0079

RACEWAY	CABLE #	CABLE FUNCTION
C1E	1VC49D	Control circuit between 0AP24E and 0PL72JA for control of dampers 0VC01YA and 69YA. Includes ESF amber light indication and MCR annunciation. Damage impacts damper operation and MCR indication.
C1E	1VC49K	Control from 0AP24E to 0FZ-VC068 (damper 0VC69Y operator. Loss prevents damper operation.
C1E	1VC49L	Control from 0AP24E to 0FZ-VC014 (damper 0VC01YA operator. Loss prevents damper operation.
C1E	1VC49M	120V control power from 0AP54E to 0AP24E for operation of multiple dampers including 0VC01YA, 02YA, 03YA, 04YA, 05YA, 05YB, 06YA, 08YA, 09YA, 10YA, 11YA, 39YA, 49YA, 49YB, 69YA, 114YA, and115YB. Damage prevents valve operation.
P1E	1VC55B	480V feed from 0AP24E to 0FZ-VC003G (damper 0VC39YA operator).
P1E	1VC55D	480V feed from 0AP24E to 0FZ-VC011 (damper 0VC08YA operator).
C1E	1VC55E	Control circuit between 0AP24E and 0PL72JA for control of dampers 0VC04YA, 08YA, and 39YA. Includes ESF amber light indication and MCR annunciation. Damage impacts damper operation and MCR indication.
C1E	1VC55N	Control from 0AP24E to 0FZ-VC003G (damper 0VC39YA operator). Loss prevents damper operation.
C1E	1VC55O	Control from 0AP24E to 0FZ-VC24 (damper 0VC04YA operator). Loss prevents damper operation.
C1E	1VC55P	Control from 0AP24E to 0FZ-VC011 (damper 0VC08YA operator). Loss prevents damper operation.
K1E	1VC81B	Signal from 0TTC-VC036 at 0PL72JA to MCR recorder 0PDR-VC036 for computer room temperature. Damage impacts MCR data.
K1E	1VC95C	Signal from 0PDY-VC021 at 0PL72JA to MCR meter 0PDI-VC021 for MCR pressure indication. Damage impacts MCR data display.
C1E	1VD01E	Control interlock between 1PL54JA (Div 1 DG room ventilation panel) and MCR for operation of 1VD01CA.
P1E	1VD09C	480V feed from 1AP72E to 1TZ-VD001C (damper 1VD03YA operator).
C1E	1VD09J	Control from 1AP72E to 1TZ-VD001C (damper 1VD03YA operator). Loss prevents damper operation.
C1E	1VD18B	120V control power feed from 0AP54E to 1PL54JA (Div 1 DG room ventilation panel).
P1E	1VX24A	480V feed from 1AP72E to 1VX12CA, switchgear heat removal return fan.

PRA EVALUATION OF SAFETY SIGNIFICANCE OF POTENTIAL

THERMOLAG FIRE BARRIER FAILURE IN FIRE ZONE CB-1f

This evaluation is intended for use as supporting documentation in the safety analysis of Thermo-Lag 330-1 cable wrap material in fire zone CB-1f. This study used the IPE model and fire PRA databases as they stood on 11/18/94 as inputs. Subsequent changes to the IPE model and/or fire PRA databases could significantly affect the results of this evaluation. Careful attention to the method used in this evaluation is important in the correct interpretation and application of the final results. Use of the material presented here in any other context could be inappropriate and potentially misleading or erroneous.

METHOD

This analysis is composed of three major parts. The first part of the analysis is to identify all modeled components that could be affected by a fire in zone CB-1f (762' elevation, Control Building) and the basic events in the IPE model that represent these components. This list of components contains not only the equipment itself, but also any cables required for a piece of equipment to perform its modeled function. This part also includes identifying the basic events in the CPS model that are protected by Thermolag. Part 1 is described in attachments PRA-1 and PRA-4.

Using the basic events list from part 1 as an input, the second part of the analysis involves calculating the conditional core damage probability (CCDP) for two different situations. The first situation is the case in which a fire occurs and all cables and equipment in a fire zone are damaged. This situation models Thermolag failing to perform adequately as a fire barrier. The second situation is the case in which only cables not wrapped by Thermolag are damaged by a postulated fire. This situation models Thermolag performing per design. Attachments PRA-2 and PRA-5 describe the CCDP determination.

While core damage prevention is an important consideration for plant safety, it is not Thermolag's sole intended function. Maintaining containment integrity by protecting containment isolation and heat removal capabilities is also required by 10CFR50, Appendix R. Additionally, containment analysis in the IPE report identified the loss of containment hydrogen control as a major cause of containment failure. Correspondingly, the effect of a fire in zone CB-1f on these functions was also examined. This analysis is detailed in attachments PRA-2 and PRA-5.

The third part of the analysis was to determine the fire ignition frequency in zone CB-1f. This calculation utilizes the methodology described in the Fire-Induced Vulnerability Evaluation (FIVE) Guide, EPRI TR-100370 and the Fire Risk Analysis Implementation Guide, EPRI Project 3385-01. Ignition frequency calculation is described on attachments PRA-3 and PRA-6.

CONCLUSION

This results of this analysis showed that the difference in CCDPs between the two cases multiplied by the ignition frequency was below the significance threshold of 1.0E-06. This result shows that the Thermolag installed in fire zone CB-1f provided no significant benefit in preventing core damage. Additionally, no significant impact or benefit from Thermolag was found to exist relating to containment isolation capability, containment heat removal or containment hydrogen control.

Fire Database Development
and Fire Susceptible Events for
Thermolag Installations

The purpose of the fire PRA databases is to provide location specific information for the PRA model. This information includes the location of all PRA modeled equipment and supporting cables, the basic events (BE)s associated with said equipment, and the PRA initiators that could result from a fire in any fire zone. A major resource for this task was the SLICE database system maintained by the NSED electrical design group. Database development covered all firezones in the plant instead of being specific to individual firezones.

How Database Was Developed

Database development was performed by completion of the following steps:

1. Identification of all basic events included in the PRA model. This task was performed by creating a BE report from the PROJECT.BE file using the CAFTA code.

2. Determine which basic events apply to each piece of modeled equipment. This task was performed by separating the BEs from task 1 by system and having each system analyst identify the equipment associated with each basic event. Some basic events, such as certain flow diversion events, had more than one piece of equipment associated with it. Human errors and maintenance unavailabilities were excluded from this task since these BEs would occur prior to a fire. This task generated database ELDB2.DBF.

3. Identify all power, control and instrumentation cables associated with each piece of modeled equipment. The SLICE database CABLE.DBF was used for this task. All equipment identified in task 2 were compared with the FR_EQUIPMT AND TO_EQUIPMT fields in the CABLE.DBF database. The resulting cables were then traced until either the 4.16KV/6.9KV or main control room cable risers/termination cabinets were reached. Tracing the cables involved not only the CABLE.DBF database, but also plant E02 and E03 drawings. The CPS safe shutdown analysis contained in USAR Appendix F was also reviewed to ensure all cables in that analysis associated with modeled equipment were included in the fire database. Cables to modeled equipment that would not disable the equipment if lost, such as position indication on non-interlocked valves, were not included in the database. Cables to the RAT and ERAT, though not explicitly modeled in the PRA, were included as a means of identifying zones where a fire could result in the loss of offsite power.

4. Identify the routing points associated with all identified cables. Routing points are intermediate locations on a cable tray or conduit. Using SLICE data, the trays containing each cable were identified, as well as all intermediate routing points.

5. Identify fire zone associated with each routing point. Using a SLICE system cross-index of routing point to fire zone, the location of cables contained in cable trays was identified.

6. Identify fire zones associated with each piece of modeled equipment. This task was performed by a combination of plant general arrangement review and plant walkdown.

7. Identify fire zones associated with conduits and open cables. Since the SLICE database does not contain location information on conduit or open cables, this task was performed by a combination of plant general arrangement review and plant walkdown.

8. Identify equipment susceptible to spurious actuation from fire. This information was taken directly from the safe shutdown analysis contained in USAR Appendix F.

9. Identify internal events initiators that could occur due to a fire in a fire zone. Using information gathered in previous tasks, all equipment and cables in this zone were identified. This list was reviewed and a list of initiators resulting from the loss of all equipment and cables in zone CB-1f was compiled. This list was reviewed by an IPE analyst and a SRO and a final initiator list was developed.

Utilizing the information gathered in the previous steps, the fire location database ELDB1.DBF was completed.

Selection of Fire Susceptible BEs in Thermolag Areas

The structure of ELDB1 was set up so that for each piece of equipment, cables were identified up to the 4.16KV/6.9KV busses and/or the main control room termination cabinets. This resulted in listing some cables, particularly power cables, several times for different pieces of equipment. This approach allowed a database sort on fire zone without losing control, power or instrumentation dependencies. Once the equipment and cables contained in a zone were identified, the associated BEs were also determined. This list of BEs was reviewed and BEs that would not be affected by a fire were removed from the list of fire susceptible BEs. Examples of the type of BEs removed include the following: manual valve plugging, check valves failing to open, orifices plugging, all pre-event human errors and all maintenance

unavailabilities. Attachment PRA-4 contains the lists of BEs and initiators generated from database ELDB1.DBF.

Prepared: M. C. O'Flaherty Date: 1/21/94
Reviewed: P. E. Udberg Date: 1/23/94

Attachment PRA-2'

CONDITIONAL CORE DAMAGE FREQUENCY AND CONTAINMENT IMPACT FOR THERMOLAG INSTALLATIONS

For fire zone CB-1f, all the basic events in the PRA that could be affected by a fire in the area were identified using the databases that were prepared for the fire PRA. For a basic event to be affected by a fire, either a fire susceptible component or associated power, control, or important instrumentation cable had to be located in fire zone CB-1f. These basic events are called fire-susceptible basic events. The development of the data bases and the lists of fire susceptible basic events are described in attachment PRA-1.

CONDITIONAL CORE DAMAGE PROBABILITY

After the appropriate basic events were identified, two analyses were performed. First, all the fire-susceptible basic events involving that area were set to TRUE (meaning failed) in the original model, the model was requantified and the resulting conditional core damage probability (CCDP) was determined. This represents the case in which Thermolag is ineffective. Secondly, all the fire-susceptible basic events involving that area, except those which are protected with Thermolag, were set to TRUE in the models, and the resulting CCDP was determined. This represents the case in which there is an effective Thermolag fire barrier. The difference between the two results multiplied by the firezone ignition frequency represents the importance of the fire barrier. The larger the product of the ignition frequency and difference in CCDPs is, the more important is the Thermolag installation in that area. Attachment PRA-4 contains the list of basic events used for both cases in zone CB-1f.

Following the completion of fire modeling it was found that all of the fixed ignition sources identified in firezone CB-1f could be screened using FIVE and Fire PRA methods. Additionally, only transient oil had the potential for a significant fire. Correspondingly, the transient ignition frequency for oil was used in the calculation to determine the safety benefit of installed Thermolag in firezone CB-1f. Attachment PRA-7 details the transient oil ignition frequency calculation.

For thoroughness, it is important to go back to the original models to fail the appropriate components, because in the normal process of quantifying a PRA, many combinations of events that are unlikely without a fire are truncated out of the solution because they contribute very little to the overall core damage frequency result. Subsequent results when trying to fail these components will be inaccurate if their failure could contribute significantly to the probability of core damage. By failing them before truncation, no significant contributor can be lost.

The analysis of this area included failure of affected components as described above, plus the certain occurrence of the initiating events that would be precipitated by a fire in each area. All other initiators were trimmed out by setting them to FALSE.

94-0079

CONTAINMENT FUNCTION EVALUATION

For defense in depth, the containment function is important, as well as core damage frequency. Because a low fraction of postulated core damage events lead to containment failure, a simplified method of assessing the impact of Thermolag failure was employed: Three functions that support containment integrity were analyzed independently. These functions are isolation, heat removal, and hydrogen control. The reliability of these functions was compared with the Thermolag failed and with the Thermolag assumed capable of performing as designed.

Examples of the various batch files and SETS user programs to perform this analysis are included in attachment PRA-5.

RESULTS

The CCDP calculated without crediting Thermolag was 2.30E-01. The CCDP taking credit for Thermolag was 2.21E-01 with a difference between the two cases of 9.0E-03. The ignition frequency for transient oil was calculated to be 1.30E-07 fire/yr. The product of the ignition frequency and the difference in CCDPs was found to be 1.17E-09 which is far below the significance threshold of 1.0E-06. This result shows that Thermolag provides no significant benefit in preventing core damage in zone CB-1f. Additionally, no significant impact or benefit was found between the two analyzed cases relating to containment isolation, heat removal or hydrogen control capabilities in zone CB-1f.

Prepared: M. E. O'Flaherty Date: 11/23/94

Reviewed: P. E. Wolberg Date: 11/23/94

94-0079

Fire Ignition Frequencies
for Thermolag Areas

Following calculation of the conditional core damage probabilities (CCDPs), the results were reviewed and all fire zones with CCDPs greater than 1.0E-07 were identified. Fire zones with lower CCDPs were screened without additional analysis. In this zone the CCDP is greater than 1.0E-07 and the ignition frequency must be calculated.

Development of Ignition Frequencies

The ignition frequency was calculated in accordance with the EPRI Fire PRA Implementation guide and the Fire-Induced Vulnerability Evaluation (FIVE) manual (EPRI TP-100370). The contractor for the fire PRA tailored collaboration, Scientific Applications International Corp. (SAIC), supplied EXCEL spreadsheets that duplicate the printed ignition frequency worksheets from the implementation manual. Generic fire frequencies were taken directly from the "Fire Events Database, Final Draft Report", dated 12/30/91, that was prepared by SAIC for Nuclear Safety Analysis Center (NSAC). Location weighting factors and ignition source weighting factor methods are specified by the implementation guide.

The major difficulty in the ignition frequency calculation methodology was the determination of the number and location of the plant ignition sources for both zone CB-1f and the plant as a whole. The implementation guide described the types of ignition sources that must be considered. Using the SLICE system EQUIPMEN.DBF database, all equipment matching the component type guidelines were identified. The SLICE system is maintained by the NSED electrical design group. Significant judgment was required in determining which components to include as sources. The bases for component selection were supplied by SAIC. For example, pumps of less than or equal to 5 HP were eliminated as ignition sources. Cables and junction boxes were eliminated as possible ignition sources since essentially all cable in the plant is IEEE-383 rated cable. Using the ignition source list developed from the SLICE system as a guide, zone CB-1f was then walked down and any additional ignition sources were added to the list. Selected system dumps from the MEL system were also reviewed. This was particularly important for the electrical cabinet categories since each individual breaker cubicle is counted as an individual cabinet.

Following the identification of the zone CB-1f ignition sources, the plant wide ignition sources were identified and fire zones associated with these sources were determined by comparing the column and row information from SLICE and MEL with the plant general arrangements. Selected areas were also reviewed from plant elevation drawings (E2X series). Walkdowns in approximately 10% of the plant fire zones were also performed as a check of the accuracy of the documentation review. It should be noted that the implementation guide allows equipment numbers and locations to be estimated by engineering judgment alone. Once locations were identified, the number of plant-wide components for each category were determined both plant-wide and by location type. Fire zones are characterized as belonging to different location types. Some location types were obvious, such as the main control room or turbine building. Others, such as switchgear rooms and reactor building locations were less apparent. Switchgear rooms were selected based on the existence of either 4.16 KV or 6.9 KV switchgear. The reactor building category was based on Mark I and Mark II containment layouts and encompassed zones in the Fuel, Auxiliary, Control and Diesel Generator buildings that were not included in other specific location types.

With the plant wide and location type component tabulations complete, the fixed ignition sources contributing to the ignition frequency in zone CB-1f were determined and entered onto the worksheets. In addition to fixed ignition sources, transient ignition sources were also examined. Transient ignition weighting factors were identified using the implementation guide. Specifically, contribution from smoking and candles were eliminated from consideration. The hot pipe contribution was also excluded for those zones without high energy piping. Once all component location information was entered, the zone ignition frequency was calculated. The firezone CB-1f ignition frequency is 7.4E-03 per year. For additional information, Attachment PRA-6 contains the zone CB-1f ignition frequency worksheet.

Prepared: M.E.J. Flaherty Date: 11/21/94
Reviewed: P.E. Walters Date: 11/23/94

BASIC EVENT LIST FOR ALL MODELED CABLES IN ZONE CB-1f

BASIC EVENT	DESCRIPTION
A05EX4CCBD	FAILURE OF CIRCUIT BREAKER 0AP05E CUB 4C OPEN
A06EX4BCBD	FAILURE OF CIRCUIT BREAKER 0AP06E CUB 4B OPEN
A06EX4CCBD	FAILURE OF CIRCUIT BREAKER 0AP06E CUB 4C OPEN
A22E3ALCBD	FAILURE OF CIRCUIT BREAKER 0AP22E CUB 3AL OPEN
A23E3ALCBD	FAILURE OF CIRCUIT BREAKER 0AP23E CUB 3AL OPEN
A45E4ALCBD	FAILURE OF CIRCUIT BREAKER 1AP45E CUB 4AL OPEN
AAP144CCBD	FAILURE OF CIRCUIT BREAKER 1AP14E CUB 4C OPEN
AAP244ACBD	FAILURE OF CIRCUIT BREAKER 1AP24E CUB 4A OPEN
AAP244CCBD	FAILURE OF CIRCUIT BREAKER 1AP24E CUB 4C OPEN
AAP244DCBD	FAILURE OF CIRCUIT BREAKER 1AP24E CUB 4D OPEN
AAPATCOCBD	FAILURE OF CIRCUIT BREAKER ATCO OPEN
AAT1D1LCBD	FAILURE OF CIRCUIT BREAKER AT1D1L OPEN (CUB J)
AAT1F1JCBD	FAILURE OF CIRCUIT BREAKER AT1F1J OPEN (CUB H)
ADG01KADGR	FAILURE OF DIESEL GENERATOR DG01KA TO RUN
ADG01KADGS	FAILURE OF DIESEL GENERATOR DG01KA TO START
ADG01KALMX	FAILURE DG01KA INITIATION LOGIC CIRCUITS TO WORK
ADG01KBDGR	FAILURE OF DIESEL GENERATOR 01KB TO RUN
ADG01KBDGS	FAILURE OF DIESEL GENERATOR 01KB TO START
ADG01KBLMX	FAILURE OF DG01KB INITIATION CIRCUITS
ADO01PAMPR	FAILURE OF PUMP DO01PA TO RUN GIVEN START
ADO01PAMPS	FAILURE OF PUMP DO01PA TO START
ADO01PBMPR	FAILURE OF PUMP DO01PB TO RUN GIVEN START
ADO01PBMPS	FAILURE OF PUMP DO01PB TO START
AP201A1CBD	FAILURE OF CIRCUIT BREAKER 201A1 CLOSED (RAT)
AP201A1CBO	FAILURE OF CIRCUIT BREAKER 201A1 TO OPEN (RAT)
AP221A1CBC	FAILURE OF CIRCUIT BREAKER 221A1 TO CLOSE (ERAT) (CUB
AP221A1CBO	FAILURE OF CIRCUIT BREAKER 221A1 TO OPEN (ERAT)
AP552ALCBD	FAILURE OF CIRCUIT BREAKER 0AP55EB CUB 2AL OPEN
AP91E4CCBD	FAILURE OF CIRCUIT BREAKER 0AP91E CUB 4C OPEN
AP91E4DCBD	FAILURE OF CIRCUIT BREAKER 0AP91E CUB 4D OPEN
APX201ACBO	FAILURE OF CIRCUIT BREAKER 201A TO OPEN (UAT)
APX400BCBD	FAILURE OF CIRCUIT BREAKER 400B1 OPEN
APX400OCBD	FAILURE OF CIRCUIT BREAKER 4000 OPEN
APX401DCBD	FAILURE OF CIRCUIT BREAKER 401D OPEN (CUB 3B)
APX401FCBD	FAILURE OF CIRCUIT BREAKER 401F OPEN (CUB 3B)
APX401JCBD	FAILURE OF CIRCUIT BREAKER 401J OPEN (CUB 3B)
APX401LCBD	FAILURE OF CIRCUIT BREAKER 401L OPEN (CUB 3B)
APX501ACBO	FAILURE OF CIRCUIT BREAKER 501A TO OPEN (UAT)
APX521ACBC	FAILURE OF CIRCUIT BREAKER 521A TO CLOSE (RAT) (CUB F)
AU201A1RDY	UNDERVOLTAGE RELAY 201A1 FAILS TO ACTUATE
AU221A1RDY	UNDERVOLTAGE RELAY 221A1 FAILS TO ACTUATE
AVD01CAFNR	FAILURE OF FAN VD01CA TO RUN
AVD01CAFNS	FAILURE OF FAN VD01CA TO START
AVD01CBFNR	FAILURE OF FAN VD01CB TO RUN
AVD01CBFNS	FAILURE OF FAN VD01CB TO START
VD01YADMO	FAILURE OF DAMPER VD01YA TO OPEN
'D01YBDMO	FAILURE OF DAMPER VD01YB TO OPEN
_164A16CBD	FAILURE OF CIRCUIT BREAKER 1DC16E CUB 4A #16 OPEN
D174A18CBD	FAILURE OF CIRCUIT BREAKER 1DC17E CUB 4A #18 OPEN
D1DC25EBCD	FAILURE OF BATTERY CHARGER 1DC25E OUTPUT
D1DC26EBCD	FAILURE OF BATTERY CHARGER 1DC26E OUTPUT

94-0079

BASIC EVENT LIST FOR ALL MODELED CABLES IN ZONE CB-1f

BASIC EVENT	DESCRIPTION
D1RP02ETFZ	TRANSFORMER 1RP02E FAILS TO PROVIDE POWER
D1UPS1ATFZ	SOLATRON REGULATOR UPS1A FAILS TO PROVIDE POWER
D1UPS1BTFZ	SOLATRON REGULATOR UPS1B FAILS TO PROVIDE POWER
D20E4ELCBD	FAILURE OF CIRCUIT BREAKER 0AP20E CUB 4EL OPEN
D20E4ERCBD	FAILURE OF CIRCUIT BREAKER 0AP20E CUB 4ER OPEN
D23E4DLCBD	FAILURE OF CIRCUIT BREAKER 0AP23E CUB 4DL OPEN
D23E4DRCBD	FAILURE OF CIRCUIT BREAKER 0AP23E CUB 4DR OPEN
DAF24ARCBD	FAILURE OF CIRCUIT BREAKER MCC F2 CUB 4AR OPEN
DBUSNXCSWH	DC BUSES 1E AND 1F ARE NOT CROSS CONNECTED
DC164A1CBD	FAILURE OF CIRCUIT BREAKER 1DC16E CUB 4A CKT 1 OPEN
DC174A1CBD	FAILURE OF CIRCUIT BREAKER 1DC17E CUB 4A CKT 1 OPEN
DC71S1ASSO	STATIC XFER SWITCH C71S001A FAILS OPEN
DC71S1ASSX	STATIC XFER SWITCH C71S001A IMPROPER XFER
DC71S1BSSO	STATIC XFER SWITCH C71S001B FAILS OPEN
DC71S1BSSX	STATIC XFER SWITCH C71S001B IMPROPER XFER
DCC71SABCD	FAILURE OF BATTERY CHARGER C71S004A OUTPUT
DCC71SBBCD	FAILURE OF BATTERY CHARGER C71S004B OUTPUT
DCS001AIVD	FAILURE OF OUTPUT FROM INVERTER S001A
DCS001BIVD	FAILURE OF OUTPUT FROM INVERTER S001B
DCS004AIVD	FAILURE OF OUTPUT FROM INVERTER 1C71S004A
DCS004BIVD	FAILURE OF OUTPUT FROM INVERTER 1C71S004B
DCS005ATFZ	TRANSFORMER S005A FAILS TO PROVIDE POWER
DCS005BTFZ	TRANSFORMER S005B FAILS TO PROVIDE POWER
DCUPS1AIVD	FAILURE OF OUTPUT FROM INVERTER UPS1A
DCUPS1ASSO	STATIC XFER SWITCH UPS1A FAILS OPEN
DCUPS1ASSX	STATIC XFER SWITCH UPS1A IMPROPER XFER
DCUPS1BIVD	FAILURE OF OUTPUT FROM INVERTER UPS1B
DCUPS1BSSO	STATIC XFER SWITCH UPS1B FAILS OPEN
DCUPS1BSSX	STATIC XFER SWITCH UPS1B IMPROPER XFER
DD16E17CBD	FAILURE OF CIRCUIT BREAKER DC MCC 1E CUB 17 OPEN
DD17E19CBD	FAILURE OF CIRCUIT BREAKER DC MCC 17E CUB 19 OPEN
DDC1E1ACBD	FAILURE OF CIRCUIT BREAKER DC MCC 1E CUB 1A OPEN
DDC1E3BCBD	FAILURE OF CIRCUIT BREAKER DC MCC 1E CUB 3B OPEN
DDC1E6BCBD	FAILURE OF CIRCUIT BREAKER DC MCC 1E 6B OPEN
DDC1E7ACBD	FAILURE OF CIRCUIT BREAKER DC MCC 1E CUB 7A OPEN
DDC1F1ACBD	FAILURE OF CIRCUIT BREAKER DC MCC 1F CUB 1A OPEN
DDC1F3BCBD	FAILURE OF CIRCUIT BREAKER DC MCC 1F CUB 3B OPEN
DDC1F7ACBD	FAILURE OF CIRCUIT BREAKER DC MCC 1F CUB 7A OPEN
DDC1F8ACBD	FAILURE OF CIRCUIT BREAKER DC MCC 1F CUB 8A OPEN
DMC1D4BCBD	FAILURE OF CB UNIT S[illegible] CUB 4B OPEN
DVX04CAFNR	FAILURE OF FAN VX04CA TO RUN
DVX13CBFNR	FAILURE OF FAN VX13CB TO RUN
DVX13CBFNS	FAILURE OF FAN VX13CB TO START
DX1C2ALCBD	FAILURE OF CIRCUIT BREAKER MCC 1C CUB 2AL OPEN
DX1D2ALCBD	FAILURE OF CIRCUIT BREAKER MCC 1D CUB 2AL OPEN
DXVX14CFNR	FAILURE OF FAN VX14C TO RUN
DXVX14CFNS	FAILURE OF FAN VX14C TO START
ERHFLOWXVC	RH DIVERSION FLOW VALVE FAILS TO CLOSE
ESXFLOWXVC	SX DIVERSION FLOW VALVE FAILS TO CLOSE
EWSFLOWXVC	WS DIVERSION FLOW VALVE FAILS TO CLOSE
FCB005AMVT	MOV 1CB005A FAILS TO REMAIN OPEN

94-0079

BASIC EVENT LIST FOR ALL MODELED CABLES IN ZONE CB-1f

BASIC EVENT	DESCRIPTION
FCB01PAMPR	PUMP 1CB01PA FAILS TO RUN
FCB01PCMPR	PUMP 1CB01PC FAILS TO RUN
FCB01PCMPS	PUMP 1CB01PC FAILS TO START
FCD01PAMPR	PUMP 1CD01PA FAILS TO RUN
FFW010BAVC	COND FLOW RETURN VALVE 1FW010B FAILS TO CLOSE
FFW010BAVO	MIN FLOW VALVE 1FW010B FAILS TO OPEN
FTOFAILSYZ	TURB OIL FAILS TO SUPPORT FW OPER (HARDWARE)
IRIF063MVT	MOV F063 IMPROPERLY SHUTS
J0SA01CCPR	FAILURE OF COMPRESSOR 0 TO RUN GIVEN START
J0SA01CCPS	FAILURE OF COMPRESSOR 0 TO START
J1IA021AVZ	AUTO ISOL VALVE 1IA021 IMPROPERLY CLOSES
J1IA022AVZ	AUTO ISOL VALVE 1IA022 IMPROPERLY CLOSES
J1IA045AVZ	AUTO ISOL VALVE 1IA045 IMPROPERLY CLOSES
JXIA053PSZ	SWITCH IA053 FAILS CAUSING ISOLATION
KXCY016MVC	CY CONT OUTBD ISOL VLV FAILS TO CLOSE
KXCY017MVC	CY CONT INBD ISOL VLV FAILS TO CLOSE
KXFC007MVC	FC CONT OUTLET INBD ISOL VLV FAILS TO CLOSE
KXFC037MVC	FC SUPPLY CONT INBD ISOL VLV FAILS TO CLOSE
KXIA006AVC	IA CONT INBD ISOL VLV 006 FAILS TO CLOSE
KXN004BTSZ	RCIC HI ROOM TEMP N004B TRANS FAILS TO ACTUATE
KXN005BTSZ	RCIC ROOM HI DELTA TEMP N005B TRANS FAILS HIGH
KXN006BTSZ	RCIC ROOM HI DELTA TEMP N006B TRANS FAILS LOW
KXRE021SVC	CONT EQUIP DRN SUMP DISCH INBD ISOL VLV FAILS TO CLOSE
KXXF063MVC	RHR & RCIC STEAM SUPPLY INBD ISOL VLV FAILS TO CLOSE
KZRF021SVC	CONT FLOOR DRN SUMP DISCH INBD ISOL VLV FAILS TO CLOSE
MCA01PAMPR	VACUUM PUMP A FAILS TO RUN GIVEN START
MCA01PAMPS	VACUUM PUMP A FAILS TO START
MCA01PBMPR	VACUUM PUMP B FAILS TO RUN GIVEN START
MCA01PBMPS	VACUUM PUMP B FAILS TO START
MCA02PAMPR	SEAL WATER PUMP 0CA02PA FAILS TO RUN
MCA02PAMPS	SEAL WATER PUMP 0CA02PA FAILS TO START
MCW001AHVT	CW PUMP A DISCH VLV FAILS TO REMAIN OPEN
MCW001CHVO	CW PUMP 1C DISCHARGE VLV FAILS TO OPEN
MCW01PAMPR	CW PUMP A FAILS TO RUN
MCW01PBMPR	CW PUMP B FAILS TO RUN
MCW01PCMPR	CW PUMP C FAILS TO RUN
MCW01PCMPS	CIRC WATER PUMP C FAILS TO START
MSCREENSYZ	INEFFECTIVE SCREEN SPRAY
MXIA006AVT	IA CONTAINMENT INBOARD ISOL VLV FAILS TO REMAIN OPEN
NC11C1AMPR	CRD PUMP 1C11C001A FAILS TO RUN
PCN081ALSX	OB LEVEL TRANS A FAILS
PXN400ALSX	SYS 1 LVL TRANS A SIGNAL FAILS
PXN400ELSX	SYS 1 LVL TRANS E SIGNAL FAILS
PXN401APSX	SYS 1 PRESS TRANS A SIGNAL FAILS
PXN401EPSX	SYS 1 PRESS TRANS E SIGNAL FAILS
Q1FC007MVO	Motor Operated Valve FC007 Won't Open
QXIA006AVO	IA Vlv IA006 Fails to Open
R12F008MVO	SUCTION MOV FROM RR FAILS TO OPEN
R12F009MVO	SUCTION MOV FROM RR FAILS TO OPEN
R2F037BMVT	FAILURE OF FC LINE MOV B TO REMAIN CLOSED
R3VY07CFNR	RHR C ROOM COOLER FAN FAILS TO RUN

BASIC EVENT LIST FOR ALL MODELED CABLES IN ZONE CB-1f

BASIC EVENT	DESCRIPTION
R3VY07CFNS	RHR C ROOM COOLER FAN FAILS TO START
WOWS1PAMPR	FAILURE OF PUMP 0WS01PA TO PROVIDE SEAL FLOW
WCC01PAMPR	FAILURE OF PUMP 1CC01PA TO PROVIDE FLOW
WCC01PBMPR	FAILURE OF PUMP 1CC01PB TO PROVIDE FLOW
WCC01PCMPR	FAILURE OF PUMP 1CC01PC TO PROVIDE FLOW
WWO23AXTRX	HARDWARE FAILURE OF CHILLER TRAIN A
WWO23BXTRX	HARDWARE FAILURE OF CHILLER TRAIN B
WWO23CXTRX	HARDWARE FAILURE OF CHILLER TRAIN C
WWO23DXTRX	HARDWARE FAILURE OF CHILLER TRAIN D
WWO23EXTRX	HARDWARE FAILURE OF CHILLER TRAIN E
WWS01PCMPR	FAILURE OF PUMP 1WS01PC TO PROVIDE FLOW
WWS1PACMPR	FAILURE OF PUMP 1WS01PA TO PROVIDE FLOW
WWT01PAMPR	FAILURE OF PUMP 1WT01PA TO PROVIDE FLOW
X1SX02SMVO	SLUICE GATE FAILS TO OPEN
X1SX189AVO	DISCHARGE VALVE 1SX189 FAILS TO OPEN
XRF014BMVO	INLET VALVE 1E12F014B FAILS TO OPEN
XSX01PAMPR	PUMP 1SX01PA FAILS TO RUN
XSX01PAMPS	PUMP 1SX01PA FAILS TO START
XSX01PBMPR	PUMP 1SX01PB FAILS TO RUN
XSX01PBMPS	PUMP 1SX01PB FAILS TO START
XSX023BAVO	DISCHARGE VALVE 1SX023B FAILS TO OPEN
XSX027BAVO	DISCHARGE VALVE 1SX027B FAILS TO OPEN
XSX027CAVO	DISCHARGE VALVE 1SX027C FAILS TO OPEN
XSX063AMVO	DISCHARGE VALVE 1SX063A FAILS TO OPEN
XSX063BMVO	DISCHARGE VALVE 1SX063B FAILS TO OPEN
XSX181AAVO	DISCHARGE VALVE 1SX181A FAILS TO OPEN
XSX181BAVO	DISCHARGE VALVE 1SX181B FAILS TO OPEN
XSX185AAVO	DISCHARGE VALVE 1SX185A FAILS TO OPEN
XSX185BAVO	DISCHARGE VALVE 1SX185B FAILS TO OPEN
XSX193BAVO	DISCHARGE VALVE 1SX193B FAILS TO OPEN
YLOSSIATRX	LOSS OF INTRUMENT AIR INITIATOR
YLOSSSWTRX	LOSS OF PLANT SERVICE WATER INITIATOR
YTRANISTRX	TRANSIENT WITH ISOLATION INITIATOR

94-0079

BASIC EVENT LIST FOR ALL NON-THERMOLAG WRAPPED CABLES IN ZONE CB-1f

BASIC EVENT	DESCRIPTION
A05EX4CCBD	FAILURE OF CIRCUIT BREAKER 0AP05E CUB 4C OPEN
A22E3ALCBD	FAILURE OF CIRCUIT BREAKER 0AP22E CUB 3AL OPEN
A23E3ALCBD	FAILURE OF CIRCUIT BREAKER 0AP23E CUB 3AL OPEN
A45E4ALCBD	FAILURE OF CIRCUIT BREAKER 1AP45E CUB 4AL OPEN
AAP144CCBD	FAILURE OF CIRCUIT BREAKER 1AP14E CUB 4C OPEN
AAP244ACBD	FAILURE OF CIRCUIT BREAKER 1AP24E CUB 4A OPEN
AAP244CCBD	FAILURE OF CIRCUIT BREAKER 1AP24E CUB 4C OPEN
AAP244DCBD	FAILURE OF CIRCUIT BREAKER 1AP24E CUB 4D OPEN
AAPATCOCBD	FAILURE OF CIRCUIT BREAKER ATCO OPEN
AAT1D1LCBD	FAILURE OF CIRCUIT BREAKER AT1D1L OPEN (CUB J)
AAT1F1JCBD	FAILURE OF CIRCUIT BREAKER AT1F1J OPEN (CUB H)
ADG01KADGR	FAILURE OF DIESEL GENERATOR DG01KA TO RUN
ADG01KADGS	FAILURE OF DIESEL GENERATOR DG01KA TO START
ADG01KALMX	FAILURE DG01KA INITIATION LOGIC CIRCUITS TO WORK
ADO01PAMPR	FAILURE OF PUMP DO01PA TO RUN GIVEN START
ADO01PAMPS	FAILURE OF PUMP DO01PA TO START
AP201A1CBD	FAILURE OF CIRCUIT BREAKER 201A1 CLOSED (RAT)
AP201A1CBO	FAILURE OF CIRCUIT BREAKER 201A1 TO OPEN (RAT)
AP221A1CBC	FAILURE OF CIRCUIT BREAKER 221A1 TO CLOSE (ERAT) (CUB
AP221A1CBO	FAILURE OF CIRCUIT BREAKER 221A1 TO OPEN (ERAT)
AP91E4CCBD	FAILURE OF CIRCUIT BREAKER 0AP91E CUB 4C OPEN
AP91E4DCBD	FAILURE OF CIRCUIT BREAKER 0AP91E CUB 4D OPEN
APX201ACBO	FAILURE OF CIRCUIT BREAKER 201A TO OPEN (UAT)
APX4000CBD	FAILURE OF CIRCUIT BREAKER 4000 OPEN
APX401DCBD	FAILURE OF CIRCUIT BREAKER 401D OPEN (CUB 3B)
APX401FCBD	FAILURE OF CIRCUIT BREAKER 401F OPEN (CUB 3B)
APX401JCBD	FAILURE OF CIRCUIT BREAKER 401J OPEN (CUB 3B)
APX401LCBD	FAILURE OF CIRCUIT BREAKER 401L OPEN (CUB 3B)
APX501ACBO	FAILURE OF CIRCUIT BREAKER 501A TO OPEN (UAT)
APX521ACBC	FAILURE OF CIRCUIT BREAKER 521A TO CLOSE (RAT) (CUB F)
AU201A1RDY	UNDERVOLTAGE RELAY 201A1 FAILS TO ACTUATE
AU221A1RDY	UNDERVOLTAGE RELAY 221A1 FAILS TO ACTUATE
AVD01CAFNR	FAILURE OF FAN VD01CA TO RUN
AVD01CAFNS	FAILURE OF FAN VD01CA TO START
AVD01YADNO	FAILURE OF DAMPER VD01YA TO OPEN
D164A16CBD	FAILURE OF CIRCUIT BREAKER 1DC16E CUB 4A #16 OPEN
D174A18CBD	FAILURE OF CIRCUIT BREAKER 1DC17E CUB 4A #18 OPEN
D1DC25EBCD	FAILURE OF BATTERY CHARGER 1DC25E OUTPUT
D1DC26EBCD	FAILURE OF BATTERY CHARGER 1DC26E OUTPUT
D1UPS1ATFZ	SOLATRON REGULATOR UPS1A FAILS TO PROVIDE POWER
D1UPS1BTFZ	SOLATRON REGULATOR UPS1B FAILS TO PROVIDE POWER
D20E4ELCBD	FAILURE OF CIRCUIT BREAKER 0AP20E CUB 4EL OPEN
D20E4ERCBD	FAILURE OF CIRCUIT BREAKER 0AP20E CUB 4ER OPEN
D23E4DLCBD	FAILURE OF CIRCUIT BREAKER 0AP23E CUB 4DL OPEN
D23E4DRCBD	FAILURE OF CIRCUIT BREAKER 0AP23E CUB 4DR OPEN
BUSNXCSWH	DC BUSES 1E AND 1F ARE NOT CROSS CONNECTED
DC164A1CBD	FAILURE OF CIRCUIT BREAKER 1DC16E CUB 4A CKT 1 OPEN
DC174A1CBD	FAILURE OF CIRCUIT BREAKER 1DC17E CUB 4A CKT 1 OPEN
DC71S1ASSO	STATIC XFER SWITCH C71S001A FAILS OPEN
DC71S1ASSX	STATIC XFER SWITCH C71S001A IMPROPER XFER

94-0079

BASIC EVENT LIST FOR ALL NON-THERMOLAG WRAPPED CABLES IN ZONE CB-1f

BASIC EVENT	DESCRIPTION
DC71S1BSSO	STATIC XFER SWITCH C71S001B FAILS OPEN
DC71S1BSSX	STATIC XFER SWITCH C71S001B IMPROPER XFER
DCC71SABCD	FAILURE OF BATTERY CHARGER C71S004A OUTPUT
DCC71SBBCD	FAILURE OF BATTERY CHARGER C71S004B OUTPUT
DCS001AIVD	FAILURE OF OUTPUT FROM INVERTER S001A
DCS001BIVD	FAILURE OF OUTPUT FROM INVERTER S001B
DCS004AIVD	FAILURE OF OUTPUT FROM INVERTER 1C71S004A
DCS004BIVD	FAILURE OF OUTPUT FROM INVERTER 1C71S004B
DCS005ATFZ	TRANSFORMER S005A FAILS TO PROVIDE POWER
DCS005BTFZ	TRANSFORMER S005B FAILS TO PROVIDE POWER
DCUPS1AIVD	FAILURE OF OUTPUT FROM INVERTER UPS1A
DCUPS1ASSO	STATIC XFER SWITCH UPS1A FAILS OPEN
DCUPS1ASSX	STATIC XFER SWITCH UPS1A IMPROPER XFER
DCUPS1BIVD	FAILURE OF OUTPUT FROM INVERTER UPS1B
DCUPS1BSSO	STATIC XFER SWITCH UPS1B FAILS OPEN
DCUPS1BSSX	STATIC XFER SWITCH UPS1B IMPROPER XFER
DD16E17CBD	FAILURE OF CIRCUIT BREAKER DC MCC 1E CUB 17 OPEN
DD17E19CBD	FAILURE OF CIRCUIT BREAKER DC MCC 17E CUB 19 OPEN
DDC1E1ACBD	FAILURE OF CIRCUIT BREAKER DC MCC 1E CUB 1A OPEN
DDC1E3BCBD	FAILURE OF CIRCUIT BREAKER DC MCC 1E CUB 3B OPEN
DDC1E6BCBD	FAILURE OF CIRCUIT BREAKER DC MCC 1E 6B OPEN
DDC1E7ACBD	FAILURE OF CIRCUIT BREAKER DC MCC 1E CUB 7A OPEN
DDC1F1ACBD	FAILURE OF CIRCUIT BREAKER DC MCC 1F CUB 1A OPEN
DDC1F3BCBD	FAILURE OF CIRCUIT BREAKER DC MCC 1F CUB 3B OPEN
DDC1F7ACBD	FAILURE OF CIRCUIT BREAKER DC MCC 1F CUB 7A OPEN
DDC1F8ACBD	FAILURE OF CIRCUIT BREAKER DC MCC 1F CUB 8A OPEN
DMC1D4BCBD	FAILURE OF CB UNIT SUB 1D CUB 4B OPEN
DVX04CAFNR	FAILURE OF FAN VX04CA TO RUN
DX1C2ALCBD	FAILURE OF CIRCUIT BREAKER MCC 1C CUB 2AL OPEN
DX1D2ALCBD	FAILURE OF CIRCUIT BREAKER MCC 1D CUB 2AL OPEN
EWSFLOWXVC	WS DIVERSION FLOW VALVE FAILS TO CLOSE
FCB005AMVT	MOV 1CB005A FAILS TO REMAIN OPEN
FCB01PAMPR	PUMP 1CB01PA FAILS TO RUN
FCB01PCMPR	PUMP 1CB01PC FAILS TO RUN
FCB01PCMPS	PUMP 1CB01PC FAILS TO START
FCD01PAMPR	PUMP 1CD01PA FAILS TO RUN
FFW010BAVC	COND FLOW RETURN VALVE 1FW010B FAILS TO CLOSE
FFW010BAVO	MIN FLOW VALVE 1FW010B FAILS TO OPEN
FTOFAILSYZ	TURB OIL FAILS TO SUPPORT FW OPER (HARDWARE)
J0SA01CCPR	FAILURE OF COMPRESSOR 0 TO RUN GIVEN START
J0SA01CCPS	FAILURE OF COMPRESSOR 0 TO START
J1IA021AVZ	AUTO ISOL VALVE 1IA021 IMPROPERLY CLOSES
J1IA022AVZ	AUTO ISOL VALVE 1IA022 IMPROPERLY CLOSES
J1IA045AVZ	AUTO ISOL VALVE 1IA045 IMPROPERLY CLOSES
JXIA053PSZ	SWITCH IA053 FAILS CAUSING ISOLATION
KXCY016MVC	CY CONT OUTBD ISOL VLV FAILS TO CLOSE
MCA01PAMPR	VACUUM PUMP A FAILS TO RUN GIVEN START
MCA01PAMPS	VACUUM PUMP A FAILS TO START
MCA01PBMPR	VACUUM PUMP B FAILS TO RUN GIVEN START
MCA01PBMPS	VACUUM PUMP B FAILS TO START

BASIC EVENT LIST FOR ALL NON-THERMOLAG WRAPPED CABLES IN ZONE CB-1f

BASIC EVENT DESCRIPTION

MCA02PAMPR	SEAL WATER PUMP 0CA02PA FAILS TO RUN
MCA02PAMPS	SEAL WATER PUMP 0CA02PA FAILS TO START
MCW001AHVT	CW PUMP A DISCH VLV FAILS TO REMAIN OPEN
MCW001CHVO	CW PUMP 1C DISCHARGE VLV FAILS TO OPEN
MCW01PAMPR	CW PUMP A FAILS TO RUN
MCW01PBMPR	CW PUMP B FAILS TO RUN
MCW01PCMPR	CW PUMP C FAILS TO RUN
MCW01PCMPS	CIRC WATER PUMP C FAILS TO START
MSCREENSYZ	INEFFECTIVE SCREEN SPRAY
NC11C1AMPR	CRD PUMP 1C11C001A FAILS TO RUN
PCN081ALSX	OB LEVEL TRANS A FAILS
PXN400ALSX	SYS 1 LVL TRANS A SIGNAL FAILS
PXN400ELSX	SYS 1 LVL TRANS E SIGNAL FAILS
PXN401APSX	SYS 1 PRESS TRANS A SIGNAL FAILS
PXN401EPSX	SYS 1 PRESS TRANS E SIGNAL FAILS
R12F008MVO	SUCTION MOV FROM RR FAILS TO OPEN
W0WS1PAMPR	FAILURE OF PUMP 0WS01PA TO PROVIDE SEAL FLOW
WCC01PAMPR	FAILURE OF PUMP 1CC01PA TO PROVIDE FLOW
WCC01PBMPR	FAILURE OF PUMP 1CC01PB TO PROVIDE FLOW
WCC01PCMPR	FAILURE OF PUMP 1CC01PC TO PROVIDE FLOW
WWO23AXTRX	HARDWARE FAILURE OF CHILLER TRAIN A
WWO23BXTRX	HARDWARE FAILURE OF CHILLER TRAIN B
WWO23CXTRX	HARDWARE FAILURE OF CHILLER TRAIN C
WWO23DXTRX	HARDWARE FAILURE OF CHILLER TRAIN D
WWO23EXTRX	HARDWARE FAILURE OF CHILLER TRAIN E
WWS01PCMPR	FAILURE OF PUMP 1WS01PC TO PROVIDE FLOW
WWS1PACMPR	FAILURE OF PUMP 1WS01PA TO PROVIDE FLOW
WWT01PAMPR	FAILURE OF PUMP 1WT01PA TO PROVIDE FLOW
X1SX02SMVO	SLUICE GATE FAILS TO OPEN
XSX01PAMPR	PUMP 1SX01PA FAILS TO RUN
XSX01PAMPS	PUMP 1SX01PA FAILS TO START
XSX063AMVO	DISCHARGE VALVE 1SX063A FAILS TO OPEN
XSX181AAVO	DISCHARGE VALVE 1SX181A FAILS TO OPEN
XSX185AAVO	DISCHARGE VALVE 1SX185A FAILS TO OPEN
YLOSSIATRX	LOSS OF INTRUMENT AIR INITIATOR
YLOSSSWTRX	LOSS OF PLANT SERVICE WATER INITIATOR
YTRANISTRX	TRANSIENT WITH ISOLATION INITIATOR

94-0079

Attachment PRA-5
Analysis of Conditional Core Damage
Frequencies and Containment Degradation
For Thermolag Firezones

94-0079

ANALYSIS OF CONDITIONAL CORE DAMAGE FREQUENCIES

AND CONTAINMENT DEGRADATION FOR

THERMOLAG FIRE ZONES

This attachment describes the method used for determining the likelihood of core damage, given that a fire has destroyed all essential equipment in a specified fire area. Basically, the method fails all components in a given area in the appropriate fault trees, and then re-solves the entire PRA model. This method was used rather than failing events in the core damage results from the PRA, because many components that do not appear in the core damage cutsets because they are inherently reliable may be failed by a fire. Therefore just starting with the core damage cutsets would not yield a true picture of the possible consequences from a fire in a given area. This method was used for the 94 fire areas of interest for the fire PRA.

INPUTS

The method starts with three inputs: the linked CAFTA fault tree models for the plant, the SETS user programs for solving the system and sequences for the level 1 PRA, and a list for each fire area of the basic events that are assumed failed and the initiating events that could result from a fire in a given area.

The linked CAFTA fault trees are in ZCNMT.CAF.

The SETS user programs for the PRA are as listed in appendix F of the PRA update report.

The lists of basic events and initiators are of the following example format.

<u>Example text input file (Area CB3B)</u>

```
D164A16CBD
D174A18CBD
D1DC03EBYD
D1DC04EBYD
D1DC08EBCD
D1RP04ETFZ
DBUSNXCSWH
DC164A1CBD
DC174A1CBD
DC71S1DSSO
DC71S1DSSX
DCC71SABCD
DCC71SBBCD
DCS001DIVD
DCS004AIVD
DCS004BIVD
DCUPS1AIVD
DCUPS1ASSO
DCUPS1ASSX
DCUPS1BIVD
```

94-0079

DCUPS1BSSO
DCUPS1BSSX
DD16E17CBD
DD17E19CBD
DDC1D1ACBD
DDC1D1BCBD
DDC1D1CCBD
DDC1E1ACBD
DDC1E3BCBD
DDC1E6BCBD
DDC1E7ACBD
DDC1F1ACBD
DDC1F3BCBD
DDC1F7ACBD
DDC1F8ACBD
DXVX14CFNR
DXVX14CFNS
ESXFLOWXVC
X1SX189AVO
X1VX14SHXP
YLOSSDCTRX
YTRANISTRX

IMPORTING FAULT TREES

The first step in solving the PRA model is to read the CAFTA fault tree files into SETS, simplify them, and form independent subtrees (IST) and stem equations. Two steps are taken before doing this in order to ensure that top events necessary for the sequence solutions are not unintentionally included in the ISTs. The first step is identical to that taken for the base PRA solution; to construct an additional fault tree containing all the events that we wanted to keep out of ISTs and then combine this with ZCNMT (the combined IPE fault tree model). The second step was similar, but necessary for this analysis and not the base PRA solution, because in the process of simplifying fault trees with many failed events, some top event equations are dropped if they evaluate to OMEGA (failed). A second auxiliary fault tree was constructed with all the top events that are necessary for the event tree sequence solutions. When this was combined with the ZCNMT, few top events vanished in the reformatting process.

INDEPENDENT SUBTREES

The reformatting process is implemented with the FRMNEWFT procedure in SETS. The user program for this procedure is produced by a BASIC program (ISTPREP) that reads the failure event text file and sets all the included events to OMEGA (true, ie. failed) and then continues to write a SETS program to set all initiators to 0.0 except those included in the failure event text file which are set to 1.0.

An example program to produce ISTs is shown here.

<u>Example SETS user program for form ISTS (CB3BIST.IN)</u>

```
PROGRAM$FORMIST.
COMMENT$ REFORM CAFTA FAULT TREE USING INDEPENDENT SUBTREES$
                 DLTBLK(CPS-STEM,CPS-IST,CPS-STEM1,CPS-IST1,CPS-STEM2).
FRMNEWFT(FORM1$ SETSIN / CPS-TEMP *NAME$
YFIRE= XYFIRE ;
YIETP= XYIETP ;
YIET3= XYIET3 ;
```

94-0079

```
YIES1= XYIES1 ,
YIEA= XYIEA ,
YIEIA= XYIEIA ,
YIET2= XYIET2 ,
YIET4= XYIET4 ,
YIET5= XYIET5 ,
YIES2= XYIES2 ,
YIET9= XYIET9 ,
YIESW= XYIESW ,
YIEDC= XYIEDC ,
YC2= XYC2 ,
YC2A= XYC2A ,
YU1= XYU1 ,
YC8= XYC8 ,
YW= XYW ,
YDG= XYDG ,
YO= XYO ,
YO1= XYO1 ,
YO2= XYO2 ,
YX1= XYX1 ,
YU2= XYU2 ,
YC1= XYC1 ,
YC3= XYC3 ,
YC= XYC ,
YC4= XYC4 ,
YC5= XYC5 ,
YC6= XYC6 ,
YC7= XYC7 ,
YC9= XYC9 ,
YDG1= XYDG1 ,
YDG2= XYDG2 ,
YL1= XYL1 ,
YL4= XYL4 ,
YL6= XYL6 ,
YU= XYU ,
YDIES1= XYDIES1 ,
YDIES2= XYDIES2 ,
YM1= XYM1 ,
YP1= XYP1 ,
YX2= XYX2 ,
YH1= XYH1 ,
YIET9B= XYIET9B ,
YIET9C= XYIET9C ,
YIET9D= XYIET9D ,
YM= XYM ,
YP= XYP ,
YW1= XYW1 ,
YX= XYX ,
YU3= XYU3 ,
YW2= XYW2 ,
YRHALONG= XYRHALONG ,
YRHBLONG= XYRHBLONG ,
YRHCLONG= XYRHCLONG ,
YHPLONG= XYHPLONG ,
YLPLONG= XYLPLONG ,
YCRD= XYCRD ,
YCDCBSUM= XYCDCBSUM ,
R1LPCIAX= XR1LPCIAX ,
R2LPCIBX= XR2LPCIBX ,
R3LPCICX= XR3LPCICX ,
YLPCS= XYLPCS).

FRMNEWFT(FORM3$ CPS-TEMP,NONMOD,FIRETOPS / CPS-STEM1,CPS-IST *OMEGA$
D164A16CBD,
D174A18CBD,
D1DC03EBYD,
D1DC04EBYD,
D1DC08EBCD,
D1RP04ETFZ,
DBUSNXCSWH,
DC164A1CBD,
DC174A1CBD,
DC71S1DSSO,
DC71S1DSSX,
DCC71SABCD,
DCC71SBBCD,
DCS001DIVD,
DCS004AIVD,
DCS004BIVD,
DCUPS1AIVD,
DCUPS1ASSO,
DCUPS1ASSX,
DCUPS1BIVD,
DCUPS1BSSO,
DCUPS1BSSX,
DD16E17CBD,
DD17E19CBD,
```

94-0079

```
DDC1D1ACBD,
DDC1D1BCBD,
DDC1D1CCBD,
DDC1E1ACBD,
DDC1E3BCBD,
DDC1E6BCBD,
DDC1E7ACBD,
DDC1F1ACBD,
DDC1F3BCBD,
DDC1F7ACBD,
DDC1F8ACBD,
DXVX14CFNR,
DXVX14CFNS,
ESXFLOWXVC,
X1SX189AVO,
X1VX14SHXP}.

FRMNEWFT(FORM1$ CPS-STEM1 / CPS-STEM *TRIM$ GATE01).
DLTBLK(CPS-TEMP,CPS-STEM1).
BLKSTAT.
```

The first call to FRMNEWFT (Form1) renames all the top events required for the event tree sequence solution to correspond the auxiliary fault tree. The second call (Form3) is the procedure call that OMEGAs the appropriate basic events and forms the ISTs and STEM. Finally the third call removes the logic for the first auxiliary fault tree, so that no time is wasted in solving it.

INITIATOR FREQUENCY CORRECTION

Before the fault trees are solved, the initiators are adjusted using the other program that is produced by the BASIC program ISTPREP.

<u>Example SETS user program to adjust initiator frequencies (CB3BDATA.IN)</u>

```
PROGRAM$FIREDATA.
COMMENT$ READS IN FIRE PRA-SPCIFIC SCENARIO INITIATORS $
RDVALBLK(CPSBEDAT).

VALUE BLOCK$ CPSBEDAT.

COMMENT$ INITIATOR ADJUSTMENTS FOR FIRE AREA $
 0.00    $ YLOSSFWTRX  $
 0.00    $ YTRANSYTRX  $
 1.00    $ YTRANISTRX  $
 0.00    $ YIORVXXTRX  $
 0.00    $ YLLOCAXTRX  $
 0.00    $ YMEDLOCTRX  $
 0.00    $ YSBLOCATRX  $
 0.00    $ YLOOPXXTRX  $
 1.00    $ YLOSSDCTRX  $
 0.00    $ YLOSSIATRX  $
 0.00    $ YLOSSSWTRX  $
 0.00    $ YISLOCATRA  $
 0.00    $ YISLOCBTRX  $
 0.00    $ YISLOCCTRX  $
 0.00    $ YISLOCDTRX  $
```

EVENT TREE HEADING SOLUTION

After these two programs are run, then the ISTs and the STEM equations are solved. This is done with straight-forward applications of the GENFTEQN procedure, using the SOLVIST and SOLVE

SETS user programs. These programs are edited to set the truncation level at 1E-7.

After these solutions, it is necessary to form an equation block with only the top events which are needed for the event tree sequence solutions. This is done with another SETS user program, but it must be unique for each fire area. As mentioned above, when a top event is evaluated as OMEGA, the equation is lost. Therefore when that top event subsequently appears in a sequence equation, the sequence equation cannot be solved. In order to avoid the need to rewrite the sequence solutions for each fire area, the top events that are lost need to be re-defined. In addition, combination events are sometimes lost, as well. For example, high pressure injection (YU) is a combination of high pressure core spray (YU1) and feedwater (YQ1). If one of these is evaluated as OMEGA, then YU should equal the other input. SETS doesn't handle this correctly. To accommodate these two shortcomings, another BASIC program (SUPREP) was developed to read the output of the FRMNEWFT procedure and make the proper equation adjustments. An example SETS user program resulting from the BASIC program follows.

<u>Example SETS user program to form top event equation block (CB3BSU.IN)</u>

```
PROGRAM$SQSETUP.
COMMENTS SET UP BLOCK WITH EVENT TREE HEADINGS $
LDBLK(CPS-STEM-EQN).

YQ = OMEGA.
SUBINEQN(YQ,YQ).
YQ2 = OMEGA.
SUBINEQN(YQ2,YQ2).
YCDCBSUM = OMEGA.
SUBINEQN(YCDCBSUM,YCDCBSUM).
YQ1 = OMEGA.
SUBINEQN(YQ1,YQ1).
YCRD = OMEGA.
SUBINEQN(YCRD,YCRD).
YIEA = /OMEGA.
SUBINEQN(YIEA,YIEA).
YX = GGATE01.
SUBINEQN(YX,YX).
YX1 = GGATE01.
SUBINEQN(YX1,YX1).
YU = YU1.
SUBINEQN(YU,YU).

DLTBLK(CPS-TOPS).
FRMBLK(CPS-TOPS* ONLY$ YFIRE, YIETP,YIET3,YIES1,YIEA,YIEIA,YIET2,
       YIET4,YIET5,YIES2,YIET9,YIESW,YIEDC,YC2,YC2A,YU1,YC8,YW,
       YDG,YQ,YQ1,YQ2,YX1,YU2,YC1,YC3,YC,YC4,YC5,YC6,YC7,YC9,
       YDG1,YDG2,YL1,YL4,YL6,YU,YDIES1,YDIES2,YM1,YP1,
       YX2,YH1,YIET9B,YIET9C,YIET9D,YM,YP,YW1,YX,YU3,YW2,YRHALONG,
       YRHBLONG,YRHCLONG,YHPLONG,YLPLONG,YCRD,YCDCBSUM,R1LPCIAX,
       R2LPCIBX,R3LPCICX,YLPCS).

BLKSTAT.
```

EVENT TREE SEQUENCE SOLUTIONS

After these mechanizations, the sequence equations are used to solve all the event tree sequences. The SETS user programs were adjusted to analyze all sequences to a truncation level of 1.0E-7. The final result cutsets are truncated at 2.0E-7. One other modification to the sequence solution was made to eliminate the

94-0079

analysis for dependent human failures. Because so many headings turned out to be OMEGA, the dependent HRA analysis would have to be customized for each fire case, and the work necessary for that was judged to be excessive for the benefit that could be gained. One change was made to SEQTRAN.IN to avoid formation of an empty block when all transient initiators become ISTs.

THERMOLAG BENEFIT

For areas in which Thermolag is employed as a fire barrier, the above analysis was repeated. The first analysis was with all basic events in the area failed, as though Thermolag provides no benefit. The second analysis assumed that Thermolag was effective, and the protected basic events were not failed.

CONTAINMENT FUNCTIONS

In order to be thorough in evaluating the Thermolag importance, the benefit of Thermolag to containment function, in addition to core damage potential, needed to be evaluated. Running the entire suit of containment sequence solution SETS user programs for all Thermolag applications would be very time consuming. It would also be very difficult, with unique programs required for each area because of the loss of terms that evaluate to OMEGA, as described above. Consequently a simplified method was used. Three containment functions were evaluated as follows: containment heat removal, containment isolation, and hydrogen control. These functions were evaluated independently, rather than through containment event tree sequences.

Containment heat removal capability was modeled as possible by the RHR fault tree, containment spray (YCNMSA, YCNMTSB) and suppression pool cooling (YSPCA, YSPCB) modes. Containment isolation was evaluated with the containment isolation fault tree (KGATE01), and hydrogen control was modeled with its fault tree (CGATE101). The first comparison was for which of these headings were OMEGAd in the Form New Fault Tree procedure call as discussed above under the EVENT TREE HEADINGS heading. If the same events were OMEGAd for both the Thermolag failure and Thermolag success cases, no further action was required, as Thermolag provided no benefit to the model. For cases in which there were differences in the headings that were OMEGAd (This happened for only CNMT heat removal in two areas.), a user program was developed to evaluate the combination of YCNMTSA, YCNMTSB, YSPCA, and YSPCB with the appropriate events OMEGAd. The difference in results between the Thermolag failure and Thermolag success in this analysis is the importance of Thermolag in the area to protecting the containment heat removal function.

BATCH FILE AUTOMATION

The entire process described above, except for the final CNMT heat removal analysis, is implemented by using batch files. The complete solution for a list of areas can be performed by calling

TLSOLN with a list of areas as command line parameters. TLSOLN in turn calls other batch files. The first one called is TLPREP, which runs the BASIC programs to produce the input files. The second call is to TLSYS, which solves the system and event tree heading equations and prepares the equation block with all the necessary headings for the event tree solutions. The third is TLSEQ, which solves the individual event tree sequences, does all recoveries, combines the sequences into final results, and then processes and prints the final results. TLSOLN then calls TLSIFT to identify the containment functions that are failed for each case. The programs and data to complete this process are listed below.

TABLE OF CALLED PROGRAMS AND PROCEDURES

(Note: AREA is used as a generic term to be replaced by each area designation.)

PROGRAM	DESCRIPTION	CALLS	DATA
TLSOLN.BAT	Does entire solution for listed areas	TLPREP.BAT TLSYS.BAT TLSEQ.BAT TLSIFT.BAT	
TLPREP.BAT	Prepares SETS inputs for specified area INPUTBLK.FIR	KEY-FAKE.COM ISTPREP.BAS SUPREP.BAS	
KEY-FAKE.COM	Public Domain utility for command line BASIC parameters		
ISTPREP.BAS	Prepares input to form ISTs and adjust initiators AREA.TXT Writes AREAIST.IN and AREADATA.IN TEMPIST.TXT		
AREA.TXT	Text files containing BE's to be failed and intiators to occur		
SUPREP.BAS	Prepares SETS input for setting up ET top events AREAIST.OUT Writes AREASU.IN		
INPUTBLK.FIR	SETS block file containing only the fault trees from CAFTA		
TLSYS.BAT	Solves for event tree headings	READTL.IN AREAIST.IN AREADATA.IN SOLVIST.IN SOLVE.IN AREASU.IN BLOCKSTA.IN WRITETOP.IN READBLKS.BAS PURGE.COM DO.BAT	
READFIRE.IN	Prepared from CAFTA files for ZCNMT, ZNONMOD, and ZTL. Makes initial SETS block for remainder of programs.		
SOLVIST.IN	Uses SETS procedure GENFTEQN with the SAVE option for ISTs		
SOLVE.IN	Uses SETS procedure GENFTEQN to solve all stem equations. Prepared by using the GENFTEQN with the WRITE option on the		

original models with no events OMEGAd in order to solve and save all ET headings.

BLOCKSTA.IN Uses SETS procedure BLKSTAT to check status of equation block

WRITETOP.IN Uses SETS procedures WRTBLK and WRTVALBLK to prepare switch file (SWFL) to form a new block file with only ET headings

READBLKS.BAS Prepares SETS input file READTEMP.IN to form a new block file READBLKS.IN

PURGE.EXE Utility file to remove excessive line and form feeds from SETS output

DO.BAT Utility to print text in small font with small line spacing

TLSEQ.BAT Calls all sequence SETS user programs in sequence to solve multiple sequences, including recoveries CUTVAL.BAS

CUTVAL.BAS Reads output from SETS COMTRMVAL and lists the results in CUTVAL.OUT

TLSIFT.BAT Prepares lists of CNMT function headings that have been set to OMEGA. ISTSIFT.BAS

ISTSIFT.BAS Picks out CNMT function headings that have been set to OMEGA by the AREAIST SETS user program.

PROGRAM LISTINGS

TLSOLN.BAT

```
:START
IF %1A==A GOTO END
ECHO %1
CALL TLPREP.BAT %1
CALL TLSYS.BAT %1
CALL TLSEQ.BAT %1
REM CALL TLIMP.BAT %1
PKZIP -A D:\FIRE\%1RES \PCS\FIRE\SEQ\CUTCOMB.OUT
PKZIP -A D:\FIRE\%1RES \SETSBU\SEQCOMB.FIR
COPY \SETSBU\SEQCOMB.FIR %1COMB.RES
REM DEL \SETSBU\%1*.FIR
CALL TLSIFT.BAT %1
SHIFT
GOTO START
:END
```

TLPREP.BAT

```
CD INPUT
DEL PREPBAT.DAT
:START
IF %1A==A GOTO END
REM ****************** PREPARE IST AND DATA FILES
ECHO %1
KEY-FAKE "%1" 013
E:\SY\BASIC\GWBASIC \PCS\TL\INPUT\ISTPREP >> PREPBAT.DAT
REM
COPY \SETSBU\INPUTBLK.FIR BKFL
REM **************  FORM ISTS
COPY %1IST.IN INFL
E:\SY\PCSETS\PCSETS > %1IST.OUT
FIND "ERROR" %1IST.OUT
FIND "ERROR" %1IST.OUT >> PREPBAT.DAT
REM **********************  PREPARE SETUP PROGRAM
KEY-FAKE "%1" 013
E:\SY\BASIC\GWBASIC \PCS\TL\INPUT\SUPREP
REM **************** RECYCLE AND START OVER
SHIFT
GOTO START
:END
CD..
ECHO R
```

TLSYS.BAT

```
:START
IF %1A==A GOTO END
F:
CD\PCS\TL\SYS
DEL SYSBAT.DAT
REM GOTO JUMP
DEL BKFL
COPY F:\SETSBU\READFIRE.IN D:\SCRATCH\READCAF.IN
COPY D:\SCRATCH\READCAF.IN INFL
E:\SY\PCSETS\PCSETS > D:\SCRATCH\READCAF.OUT
FIND "ERROR" D:\SCRATCH\READCAF.OUT > SYSBAT.DAT
FIND "ERROR" D:\SCRATCH\READCAF.OUT
REM DEL READCAF.OUT
REM **************  FORM ISTS
COPY \PCS\TL\INPUT\%1IST.IN INFL
E:\SY\PCSETS\PCSETS > %1IST.OUT
FIND "ERROR" %1IST.OUT
FIND "ERROR" %1IST.OUT >> SYSBAT.DAT
REM ####### READ AREA DATA ###########
COPY \PCS\TL\INPUT\%1DATA.IN INFL
E:\SY\PCSETS\PCSETS > %1DATA.OUT
FIND "ERROR" %1DATA.OUT
FIND "ERROR" %1DATA.OUT >> SYSBAT.DAT
REM **************  ISTS
COPY SOLVIST.IN INFL
E:\SY\PCSETS\PCSETS > SOLVIST.OUT
FIND "ERROR" SOLVIST.OUT
FIND "ERROR" SOLVIST.OUT >> SYSBAT.DAT
FIND "NO EQUATION" SOLVIST.OUT >> SYSBAT.DAT
COPY BKFL F:\SETSBU\%1IST.FIR
GOTO SKIPSTEM
```

94-0079

```
REM ***************   STEMS
DCOPY SOLVSTEM.IN INFL
E:\SY\PCSETS\PCSETS > SOLVSTEM.OUT
FIND "ERROR" SOLVSTEM.OUT
FIND "ERROR" SOLVSTEM.OUT >> SYSBAT.DAT
FIND "NO EQUATION" SOLVSTEM.OUT >> SYSBAT.DAT
COPY BKFL F:\SETSBU\%1STEM.FIR
:SKIPSTEM
REM ***************   STEMS
COPY SOLVE.IN INFL
E:\SY\PCSETS\PCSETS > SOLVE.OUT
FIND "ERROR" SOLVE.OUT
FIND "ERROR" SOLVE.OUT >> SYSBAT.DAT
REM FIND "NO EQUATION" SOLVE.OUT >> SYSBAT.DAT
COPY BKFL F:\SETSBU\%1STEM.FIR
GOTO SKIPEQN
REM ***************
REM COPY GENFTUPG.IN INFL
REM E:\SY\PCSETS\PCSETS > GENFTUPG.OUT
REM CALL DO HP SGFL.SUP CO
REM *******************
:SKIPEQN
REM SEQ SET UP ******************************
COPY \PCS\TL\INPUT\%1SU.IN INFL
E:\SY\PCSETS\PCSETS > %1SU.OUT
FIND "****" %1SU.OUT >> SYSBAT.DAT
FIND "NO EQUATION" %1SU.OUT >> SYSBAT.DAT
FIND "ERROR" %1SU.OUT >> SYSBAT.DAT
COPY BKFL F:\SETSBU\%1HDG.FIR
COPY \PCS\BLOCKSTA.IN INFL
E:\SY\PCSETS\PCSETS > BLOCKSTA.OUT
REM MAKE ET SWFL ***********************
ECHO Y | DEL D:\SCRATCH\*.*
DEL SWFL
COPY WRITETOP.IN INFL
E:\SY\PCSETS\PCSETS > WRITETOP.OUT
FIND "****" WRITETOP.OUT >> SYSBAT.DAT
FIND "NO EQUATION" WRITETOP.OUT >> SYSBAT.DAT
FIND "ERROR" WRITETOP.OUT >> SYSBAT.DAT
E:\SY\BASIC\GWBASIC F:\PCS\READBLKS >> SYSBAT.DAT
DEL BKFL
COPY D:\SCRATCH\READTEMP.IN INFL
E:\SY\PCSETS\PCSETS > D:\SCRATCH\READTEMP.OUT
FIND "****" D:\SCRATCH\READTEMP.OUT >> SYSBAT.DAT
FIND "NO EQUATION" D:\SCRATCH\READTEMP.OUT >> SYSBAT.DAT
FIND "ERROR" D:\SCRATCH\READTEMP.OUT >> SYSBAT.DAT
COPY BKFL \SETSBU\%1TOPS.FIR
REM *************** OUTPUTS
DIR F:\SETSBU\%1*.FIR >> SYSBAT.DAT
DIR %1*.OUT >> SYSBAT.DAT
REM COPY BLOCKSTA.OUT SETS.OUT
REM E:\SY\PCSETS\PURGE
REM TYPE TEMP.DOC >> SYSBAT.DAT
CALL DO HP SYSBAT.DAT CO
rem COPY %1.OUT SETS.OUT
REM E:\SY\PCSETS\PURGE
REM CALL DO HP TEMP.DOC CO
CD ..
SHIFT
GOTO START
:END
ECHO R R
ECHO DONE
ECHO RR
```

TLSEQ.BAT

```
:START
IF %1A==A GOTO FINISH
F:
CD \PCS\TL\SEQ
REM  ASSUMES THAT THE LATEST BLOCKFILE ETTOPS.FIR IS IN \SETSBU
REM  AND THAT THE LATEST FIRE SOLUTION ISTSOLN.FIR IS IN \SETSBU
DEL SEQBAT.DAT
REM GOTO JUMP
REM ******* FORMAT AND READ IN IST EQUATIONS ***********
DEL BKFL
COPY \SETSBU\%1IST.FIR BKFL
DEL SWFL
COPY WRITISTS.IN INFL
E:\SY\PCSETS\PCSETS > WRITISTS.OUT
FIND "****" WRITISTS.OUT >>  SEQBAT.DAT
FIND "NO EQUATION" WRITISTS.OUT >>  SEQBAT.DAT
REM FIND "ERROR" WRITISTS.OUT >>  SEQBAT.DAT
E:\SY\BASIC\GWBASIC F:\PCS\READISTS >> SEQBAT.DAT
```

COMPARTMENT FIRE FREQUENCY WORKSHEET

PLANT - CLINTON
COMPARTMENT CB-1f

Reference Area:
Reactor Building (BWR)

Transients allowed in this zone
Welding, Ext. cords, Heaters, Open flame, Heating of combustibles
Flammable liquid or gas tanks/piping in this zone: Yes ___ No X

Components	Generic Fire Frequency (f) (1)	Location Weighting Factor (WL) (2)	M (3)	Ignition Source Weighting Factor WI			Compartment Fire Frequency
Rx BLDG COMPONENTS				Number of these ignition sources in the compartment	Total number of these ignition sources in the Reactor Building		
Electrical Cabinets	5.0E-02	1.0E+00	B	85	795	1.1E-01	5.3E-03
Pumps	2.5E-02	1.0E+00	B	3	59	5.1E-02	1.3E-03
PLANT-WIDE COMPONENTS				Weight (or Btus) of cable insulation in this compartment	Weight (or Btus) of cable insulation in Appendix B areas, excluding radwaste or containment		
Non-qualified cable run	6.3E-03	1.0E+00	E	0	0	0.0E+00	0.0E+00
Junction box/splice in NQ cable	1.6E-03	1.0E+00	E	0	0	0.0E+00	0.0E+00
Junction box in Q cable	1.6E-03	1.0E+00	E	0	0	0.0E+00	0.0E+00
				Number of these ignition sources in the compartment	Total number of these ignition sources in all locations listed in Table 1-3		
Fire Protection Panels	2.4E-03	1.0E+00	F	0	114	0.0E+00	0.0E+00
RPS MG sets	5.5E-03	1.0E+00	F	0	2	0.0E+00	0.0E+00
Transformers	7.9E-03	1.0E+00	F	4	169	2.4E-02	1.9E-04
Battery Chargers	4.0E-03	1.0E+00	F	0	6	0.0E+00	0.0E+00
Air compressors	4.7E-03	1.0E+00	F	0	11	0.0E+00	0.0E+00
Ventilation Subsystems	8.5E-03	1.0E+00	F	14	630	2.2E-02	2.1E-04
Elevator motors	6.3E-03	1.0E+00	F	0	6	0.0E+00	0.0E+00
Dryers	8.7E-03	1.0E+00	F	0	3	0.0E+00	0.0E+00
				Number of these ignition sources in the compartment	Total number of these ignition sources in all plant locations (including those not specified in Table 1-3)		
Off-gas/H2 recombiner	6.6E-02	1.0E+00	G	0	4	0.0E+00	0.0E+00
Hydrogen Tanks	3.2E-03	1.0E+00	G	0	0	0.0E+00	0.0E+00
Gas turbines	3.1E-02	1.0E+00	G	0	0	0.0E+00	0.0E+00
				Enter 1 if these fires could occur, enter 0 they can not occur.	Total number of compartments where misc. other hydrogen fires could be present		
Miscellaneous hydrogen fires	3.2E-03	1.0E+00	C	0	3	0.0E+00	0.0E+00
TRANSIENTS					Total number of compartments in Table 1-3 plant locations		
Cable fires - welding	5.1E-03	1.0E+00	C	1	121	8.3E-03	4.2E-05
Transient fires - welding	3.1E-02	1.0E+00	C	1	121	8.3E-03	2.6E-04
				Sum of ignition source weighting factors for transients	Total number of zones in Table 1-3 plant locations		
Transients-other	1.3E-03	1.0E+00	D	9	121	7.4E-02	9.7E-05
						TOTAL	7.4E-03

(1) From FEDB Report Table 1-3
(2) See FIVE Reference Table 1.1 for guidance
(3) Ignition source weighting factor method. See FEDB Table 1-3 for guidance.

Note: Walkdown on 3/17/94

RESULTS OF MAINTENANCE HISTORY REVIEW FOR OIL

AS A TRANSIENT COMBUSTIBLE IN ZONE CB-1f

In order to determine the significance of oil as a transient combustible in zone CB-1f, maintenance records and surveillance data were reviewed to determine how often oil was present in the fire zone. While the only oil lubricated equipment is located within fire zone CB-1f are the three CC pumps, this zone could be traversed to reach equipment in other fire zones. This review identified oil lubricated equipment located on the 762' elevation of the control and diesel generator buildings since it was felt access to these zones would likely require traversing fire zone CB-1f.

Based on walkdown of fire zone CB-1f, a time per traverse for oil of 15 minutes was conservatively estimated. Additionally, it was assumed that 2 traverses (trav) of zone CB-1f per evolution (evol) were required.

Since the CC pumps are located within firezone CB-1f, it is assumed that each oil change requires more time than 15 minutes per traverse. Additionally, since each evolution involves 2 gallons of oil or less, a time per evolution of 1/2 shift (4 hours) was used in the analysis.

Preventive Maintenance Activities

The first group of maintenance records examined were for preventive maintenance activities (PMs). PMs are performed either at regular time intervals or in response to a specific evert or number of events.

0RA01CA(B) - Change compressor oil every 6 months.

(2 compressors)(2 evol/yr)(2 trav/evol)(15 min/trav) = 120 min/yr

0VA05CA(B) - Grease lubricated.

0VA06CA(B) - Grease lubricated.

0VL02CA(B) - Grease lubricated.

0VL03CA(B) - Grease lubricated.

0VL17CA(B) - Grease lubricated.

0VL18CA(B) - Grease lubricated.

1CC01PA(B,C) - Change motor bearing oil every 6 months, change pump bearing oil every 6 months.

Note: Since no requirement exists that specifies that changing the oil for the motor and pump bearings must be done concurrently, these activities are treated conservatively as occurring separately.

(3 pumps)(2 evol/yr)(240 min/evol) = 1440 min/yr

1VD01CA(B,C) - Grease lubricated.

1VD03CA(B) - Grease lubricated.

1VF03CA(B) - Grease lubricated.

1VF04CA(B) - Grease lubricated.

1VR06CA(B) - Grease lubricated.

1VR07CA(B) - Grease lubricated.

Corrective Maintenance Activities

The remainder of the maintenance records examined were for corrective maintenance activities. Corrective maintenance is performed in response to degradation or failure of a piece of equipment. Only maintenance work requests (MWRs) that specifically included oil replacement in the job steps or listed oil in the materials used section were included.

The following corrective maintenance activities were performed over the period of 6/22/94 - 4/28/86.

0RA01CB - 1 evolution
1CC01PB - 4 evolutions
1CC01PC - 1 evolution

1CC01PB & 1CC01PC

(5 evol/8.15 yr)(240 min/evol) = 147.2 min/yr

0RA01CB

(1 evol/8.15 yr)(2 trav/evol)(15 min/trav) = 3.7 min/yr

Significance Calculation

The sum of all of the oil traverses of fire zone CB-1f is 1710.9 min/yr. The total number of minutes in a year is 525,600. This gives a probability of oil being present in fire zone CB-1f of 1710.9/525600 or 3.26E-03.

3.99E-04 - Transient Combustible Ignition Frequency for Fire Zone CB-1f (Transient Section, Attachment PRA-6).

0.1 - Probability of Oil Being Exposed In Violation of the Fire Protection Program (FIVE manual).

2.30E-01 - Whole Zone CCDP for Fire Zone CB-1f.

(3.26E-03)(3.99E-04)(0.1)(2.30E-01) = 2.99E-08, Not Significant as a transient combustible

(Note: the product of the transient combustible ignition frequency, probability of oil being exposed and the probability of oil being in the zone is also referred to as the ignition frequency for transient oil)

94-0079

Evaluation of Ampacity Derating for Thermo-Lag Installation

Topic:

Consideration of the existing cable ampacities in this area with respect to the NRC concerns (IEIN 94-22) over the ampacity derating needed for Thermo-lag installations.

Design statement:

Clinton Power Station project ampacities for cables in tray were established in calculation 19-G-01. These values are conservative in magnitude and were used during the design process as one of the parameters for selecting the size and type of cable for a specific circuit. A separate calculation (19-AI-8) was performed to determine the amount of ampacity derating needed to account for the increased heat retention (due to the Thermo-lag installation) in the tray. Derating values are viewed as suspect in the IEIN, but no new values are established.

The Thermo-lag installation in fire zone CB-1f consists of a three hour wrap. Power cable trays (Div 2 and BOP) so enclosed were reviewed (see attachments one and two) and the review demonstrates that not only were none of these cables thermally overloaded by the currents passing through them but that they could be subjected to as much as a 43.6% (for Div 2, 37.6% for BOP) ampacity derating requirement without being impacted.

The largest ampacity derating mentioned in the IEIN was 46.4% for a #8 AWG conductor in a tray with a three hour wrap of Thermo-lag applied. On first examination, this would seem to represent a potential impact to our design. However phone calls to the NRC have provided additional information (specifically the diameters of the tested conductors) which allows a comparative evaluation of the test results. On attachment two, the cables tested by Sandia lab for the NRC are examined with respect to the methodology developed by Stolpe (IEEE Transaction Paper 70 TP 557 PWR *Ampacities for cables in Randomly Filled Cable Trays* by J. Stolpe). For this evaluation, tray fill was determined per step 2.2 of ICEA P-54-440 which uses diameter squared for area without the pi/4 component. This resulted in a tray fill depth of 1.41" and the P-54-440 tabulated values for 1.5" fill were utilized in the comparison of data. All heat intensities were calculated using the actual cross-sectional area of the cable. Since the same numbers were used for each section of the evaluation, the heat intensities can be directly compared.

The first set of numbers translates the ampacities reported in 94-22 into heat intensities for open (unwrapped) and Thermo-lag wrapped trays. The NEMA numbers show the heat intensities that would be produced if the ampacity values from table 3-1 of P-54-440 were utilized for the cables tested by the NRC. The CPS numbers show the heat intensities that would be produced if the methodology used for determining ampacity limits at CPS (Calc 19-G-1) were applied to these conductors, but using a 1.5" fill rather than the nominal 2" fill of CPS design. Tlag ampacity values for the NEMA and CPS tables were calculated based on the 32% derate factor derived in Calc 19-AI-8.

Comparison of the results shows that the NEMA values produce lower heat intensities (and therefore lower overall heat in the tray) than the NRC values. The CPS values are even more conservative with resultant lower intensities. Even though the derate factor for the NEMA and CPS sections is smaller than the NRC values (32% vs. 46.4%, 36%, and 35.3%), the Tlag heat intensities continue to demonstrate that the NEMA-based values produce more conservative results. The reasons for this are found in Stolpe's methodology.

In his paper, Stolpe describes a general method for calculating allowable cable ampacities. By determining the amount of heat that can be dissipated from the tray and distributing that heat through all the cables in the tray, Stolpe defines a conservative upper limit for cable ampacities. The method requires that the allowable depth of fill for the tray be known at the start of the design process so that the ampacity values can be determined before cable selection and installation. At CPS the initial design consideration was to select two inches as the nominal fill depth for power tray and determine the allowable cable ampacities accordingly.

In contrast, the test method used in 94-22 will produce very specific ampacity limits but it will be based on very specific configurations. Due to the limited data available at this time concerning the orientation and distribution of the reported conductors in the test tray, it is unclear just how configuration dependent these test results are. However, given the uneven heat production of the tested conductors it seems likely that relocating the conductors within the confines of the test tray would impact the heat distribution and could affect the reported results. This could mean that in order to use the ampacity values provided by this type of testing, there would have to be tests run for every type of cable singly, in multiples, and in combination with single and multiple specimens of every other type of cable. Whether the same combinations of cables would have to be tested in various sizes and configurations of tray would be a subject for debate. Just determining the various configurations to be tested would require a significant amount of review and evaluation.

To demonstrate the conservatism of the cable selection employed, the heaviest loaded cables in area CB-1f were added to the attachment two table. As shown, the present loading of the cables (22, 12, 109, and 207.9 Amps respectively) results in heat intensities lower than the lowest values shown in the right hand column. Therefore these cables will not be impacted by the concerns expressed in IEIN 94-22 and since they are acceptable, the rest of the cables in fire zone CB-1f are also acceptable.

Prepared Mark McMenamen 11/21/94

Reviewed Kevin Forrest 11/21/94

References
ICEA P-54-440 (NEMA WC 51-1986)
IEEE Transaction paper 70 TP 557 PWR *Ampacities for Cables in Randomly Filled Cable Trays* by J. Stolpe
EPRI Power Plant Elec. Ref. Series Vol.4 *Wire and Cable*
IEIN 94-22
Calc 19-G-01 R/1
Calc 19-AI-8 R/0
Calc 19-AK-6 R/0
Calc 19-AN-4 R/11
Calc 19-D-24 R/4
Calc 19-D-29 R/11
K-2982 Power Cable Purchase Spec. Proposal Data
SLICE version 7.3
Drwg E02-1RD99-001 R/M
ROC Y-104156, dated 8/10/94

FIRE ZONE CB-1F DIV 2 POWER TRAY CABLE AMPACITIES VS.PROJECT AMPACITIES

CABLE	TYPE	PROJECT AMPACITY	LOAD AMPERES	LOAD % OF AMPACITY	ALLOWABLE DERATING
1AP29B	3/C,350 MCM,5KV	286	104.0	36%	OVER 50%
1AP34G	2/C,#19/22 AWG,600V	10	0.1	1%	OVER 50%
1AP34H	2/C,#19/22 AWG,600V	10	0.1	1%	OVER 50%
1AP34N	4/C,#2/0 AWG,1KV	117	2.0	2%	OVER 50%
1AP34V	3/C,#1/0 AWG,1KV	97	0.9	1%	OVER 50%
1AP34W	3/C,#1/0 AWG,1KV	97	1.1	1%	OVER 50%
1AP37D	3/C,350 MCM,1KV	269	76.0	28%	OVER 50%
1AP37J	3/C,350 MCM,1KV	269	76.0	28%	OVER 50%
1CM09H	3/C,#6 AWG,1KV	32	16.0	50%	OVER 50%
1CM09K	3/C,#6 AWG,1KV	32	22.0	69%	**SEE NOTE 1**
1RD31H	3/C,#2 AWG,1KV	64	25.0	39%	OVER 50%
1RP02C	4/C,#2/0 AWG,1KV	117	40/cond	34%	OVER 50%
1SX27A	3/C,#19/22 AWG,1KV	16	0.4	2%	OVER 50%
1SX40A	3/C,#19/22 AWG,1KV	16	0.5	3%	OVER 50%
1SX51A	3/C,#19/22 AWG,1KV	16	0.3	2%	OVER 50%
1SX51D	3/C,#19/22 AWG,1KV	16	0.3	2%	OVER 50%
1SX51G	3/C,#19/22 AWG,1KV	16	0.0	0%	OVER 50%
1VC25B	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC25C	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC25D	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC26B	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC26C	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC26D	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC27B	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC27C	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC27D	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC28B	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC28C	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC28D	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC28F	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC35B	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC35C	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC35D	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC35P	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC35S	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC36B	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC36C	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC36D	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC36P	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC36Q	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC50B	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC50C	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC51B	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC51C	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC51D	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC51E	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC56B	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC56C	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%
1VC56D	3/C,#19/22 AWG,1KV	16	0.2	1%	OVER 50%

FIRE ZONE CB-1F DIV 2 POWER TRAY CABLE AMPACITIES VS.PROJECT AMPACITIES

1VG38A	3/C,#19/22 AWG,1KV	16	7.0	44%		OVER 50%
1VG40A	3/C,#19/22 AWG,1KV	16	7.0	44%		OVER 50%
1VQ05A	3/C,#19/22 AWG,1KV	16	1.7	11%		OVER 50%
1VQ14A	3/C,#19/22 AWG,1KV	16	2.4	15%		OVER 50%

Note 1) The project ampacities are based on all conductors of a 3/C cable being energized, but 1CM09K is carrying a 120V 1ϕ circuit so only two conductors are energized. From section 2.5 of ICEA P-54-440, when only two conductors are energized the allowable ampacity would be increased by $\sqrt{(3/2)}$ or 1.224, or from 32 to 39 amps. Thus the cable is only loaded to 56.4% of allowable and could accept up to a 43.6% derate with out being affected.

FIRE ZONE CB-1F BOP POWER TRAY CABLE AMPACITIES VS. PROJECT AMPACITIES

CABLE	TYPE	PROJECT AMPACITY	LOAD AMPERES	LOAD_%_OF AMPACITY	ALLOWABLE DERATING
1AP33T	3/C,#2 AWG,1KV	64	0.6	0.94%	OVER 50%
1AP45F	3/C,#2 AWG,1KV	64	0.2	0.31%	OVER 50%
1AP53F	3/C,#2 AWG,1KV	64	0.2	0.31%	OVER 50%
1AP55U	3/C,#2 AWG,1KV	64	0.2	0.31%	OVER 50%
1AP57T	3/C,#2 AWG,1KV	64	0.2	0.31%	OVER 50%
1AP72C	3/C,#2 AWG,1KV	64	14	21.88%	OVER 50%
1AP72D	3/C,500 MCM,1KV	333	83.9	25.20%	OVER 50%
1AP72K	3/C,500 MCM,1KV	333	68.6	20.60%	OVER 50%
1AP72P	3/C,#2 AWG,1KV	64	14	21.88%	OVER 50%
1AP84H	3/C,#2 AWG,1KV	64	0.3	0.47%	OVER 50%
1DC12A	3/C,#2 AWG,1KV	64	3.9	6.09%	OVER 50%
1DC12B	3/C,#2 AWG,1KV	64	10.1	15.78%	OVER 50%
1DC13A	3/C,#2 AWG,1KV	64	3.3	5.16%	OVER 50%
1EH06B	4/C, #4 AWG, 1KV	44	19.2	43.64%	OVER 50%
1HC15D	3/C, #19/22 AWG,1KV	16	0.2	1.25%	OVER 50%
1LV53D	3/C, #19/22 AWG,1KV	16	12	75.00%	SEE NOTE 1
1TO15A	3/C,500 MCM,1KV	333	143	42.94%	OVER 50%
1VL01A	3/C,500 MCM,1KV	333	207.9	62.43%	37.57%
1VL01B	3/C,500 MCM,1KV	333	170.1	51.08%	48.92%
1VL02A	3/C,350 MCM, 1KV	269	150.8	56.06%	43.94%
1VL02B	3/C,350 MCM, 1KV	269	123.4	45.87%	OVER 50%
1VL04A	3/C,#4/0 AWG, 1KV	175	90.2	51.54%	48.46%
1VL05A	3/C,350 MCM, 1KV	269	78.2	29.07%	OVER 50%
1VW03A	3/C,350 MCM, 1KV	269	134.9	50.15%	49.85%
1WY11A	3/C,#4/0 AWG, 1KV	175	109	62.29%	37.71%
1WY11B	3/C, #6 AWG, 1KV	32	18	56.25%	43.75%

Note 1) The project ampacities are based on all conductors of a cable being energized, but 1LV53D is carrying a 120V circuit so only two conductors are energized. From section 2.5 of ICEA P-54-440, when only two conductors are energized the allowable ampacity would be increased by $\sqrt{(3/2)}$ or 1.224, in this case from 16 to 19.6 amps. Thus the cable is only loaded to 61.3% of allowable and could accept up to a 38.4% derate without being affected.

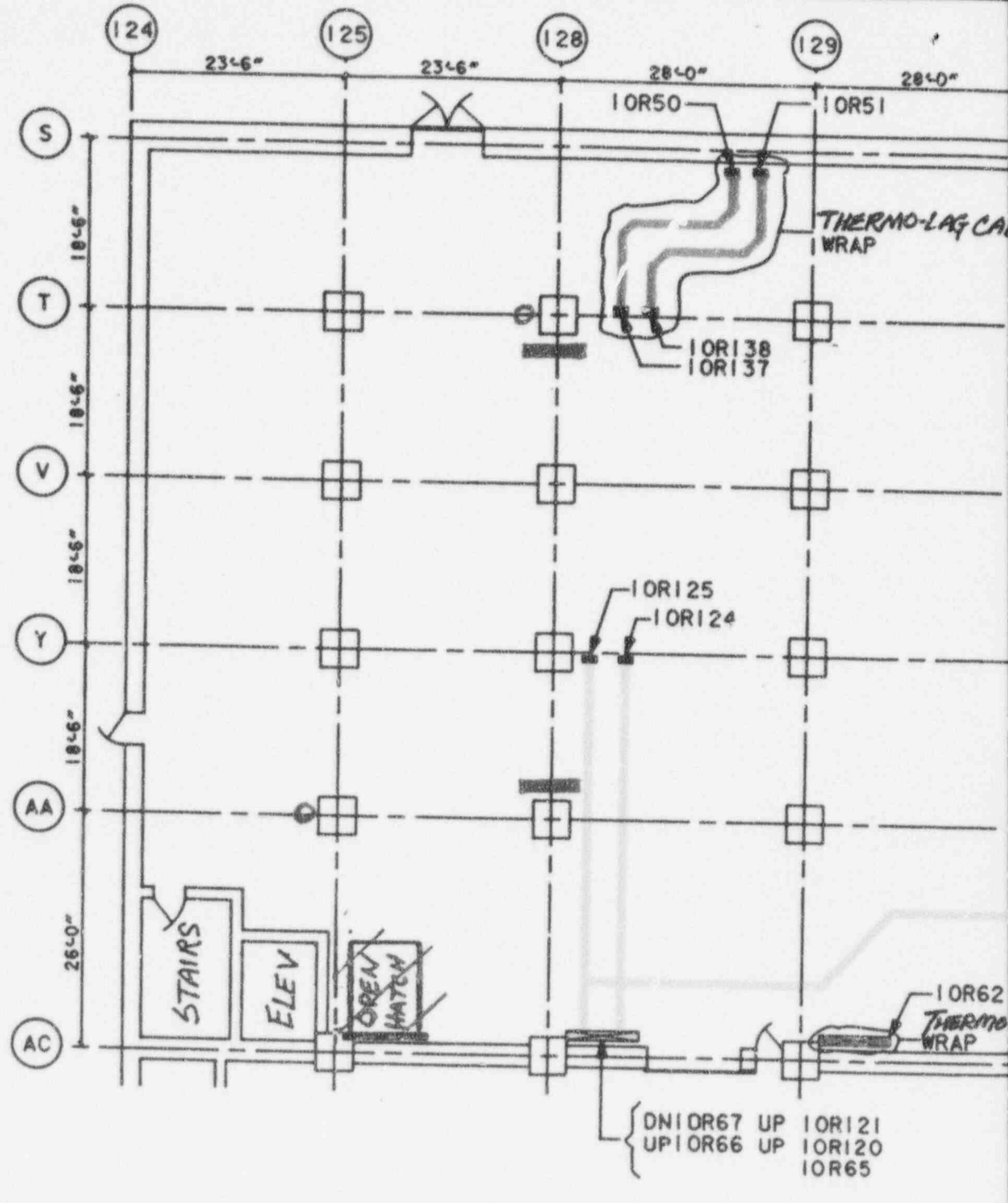
Note 2) Cables 1TO15A, 1VL01A, and 1VL02A are one half of parallel feeds to equipment (paired with 1TO15E, 1VL01B, and 1VL02B respectively). The load amperes shown reflect 55% of the end device's ampere draw which provides a conservative value for analysis since there is unlikely to be a length mismatch of 10% between the paired cables.

NRC CABLE AMPACITIES (BASED ON TESTING) VS. NEMA AND CPS AMPACITIES (BASED ON STOLPE METHODOLOGY) AND THE RESULTANT HEAT INTENSITIES OF EACH

Cable	Diameter	Area	90C Resist	Open Amps	Watts/ft	Ht Intensity	Tlag Amps	Watts/ft	Ht Intensity
NRC #8	0.23	0.04154766	0.0008	23.7	0.449352	10.81533834	12.7	0.129032	3.1056382
NRC #4	0.33	0.08553006	0.0003226	37.8	0.460943784	5.389280618	24.2	0.188927464	2.208901338
NRC #2/0	0.52	0.21237216	0.0001013	113.6	1.307272448	6.155573537	73.5	0.547247925	2.576834577
NEMA #8	0.23	0.04154766	0.0008	15.3	0.187272	4.507401861	10.4	0.086528	2.082620297
NEMA #4	0.33	0.08553006	0.0003226	34	0.3729256	4.36016998	23.12	0.172440797	2.016142599
NEMA #2/0	0.52	0.21237216	0.0001013	95.3	0.920015717	4.332091914	64.8	0.425362752	2.00291202
CPS #8	0.23	0.04154766	0.0008	13.1	0.137288	3.304349752	8.9	0.063368	1.525188181
CPS #4	0.33	0.08553006	0.0003226	29.1	0.273180906	3.193975381	19.8	0.126472104	1.47868602
CPS #2/0	0.52	0.21237216	0.0001013	81.5	0.672859925	3.1683057	55.4	0.310905908	1.463967349
3/C,#6,1KV	0.949	0.707332025	0.000534	32	1.640448	2.319205042			
1CM09K load	0.949	0.707332025	0.000534	22	0.516912	0.730791172			
3/C,#19/22,1KV	0.723	0.410551357	0.001178	18	0.904704	2.203631739			
1LV53D load	0.723	0.410551357	0.001178	12	0.339264	0.826361902			
3/C,500,1KV	2.577	5.215785637	0.000028	333	9.314676	1.785862505			
1VL01A load	2.577	5.215785637	0.000028	207.9	3.63068244	0.696095026			
3/C,4/0,1KV	1.838	2.653272838	0.000066	175	6.06375	2.285385021			
1WY11A load	1.838	2.653272838	0.000066	109	2.352438	0.886617451			

94-0079

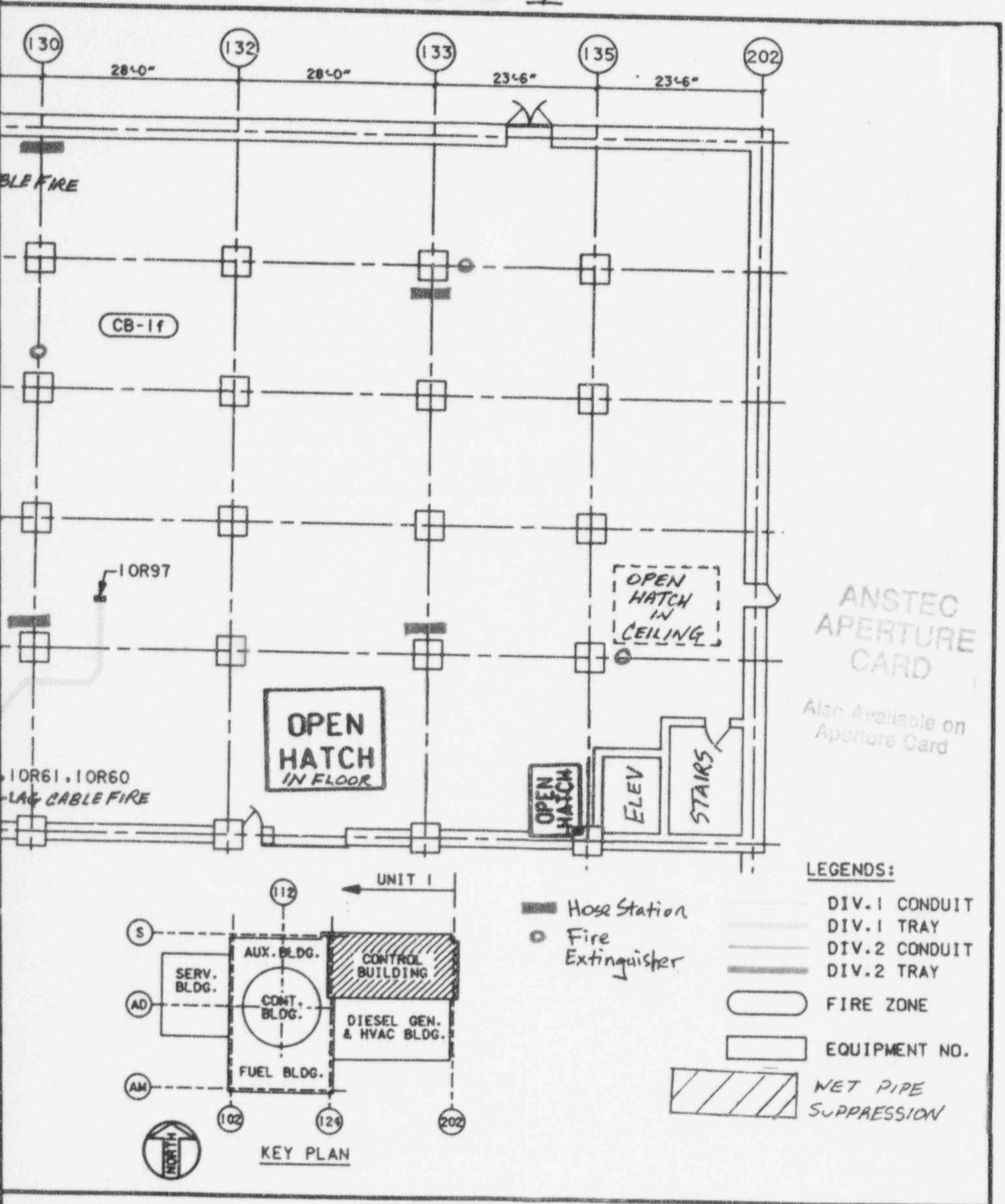
S&L ECAD FILE: CLIETI.1



FIRE ZONE CB-1f

Physical Layout and Safe Shutdown Cable Routing

ENCLOSURE 1



9511150046-06

8A.100
L34 -94(12-02) - L
Y- 104492

TO: Director - Licensing

FROM: J. B. Langley ____ 11/23/94
NSED - Director Date

SUBJECT: Proposed Amendment to CPS SAR.

SAR Sections Affected: Appendix E 3.4.1.6;
Appendix F 3.3.1.2, 3.3.1.3.3, 3.3.1.4.1, 4.1.3.1.3, 4.2.2.10, 4.2.2.17, 4.2.4.5
Table 4.2.2.15-1, Appendix F Figure 4.2.4.5-4

Safety Evaluation or Screening Form attached: ✓ YES ____ NO

SAR Section 1.8 impacted: ____ YES ✓ NO

If yes, identify Section 1.8 impact and affected sections.

Justification of Change: The attached safety evaluation provides the detailed justification for this USAR change. It concludes that the change, deviating from the 10CFR50 App. R requirement for a 3-hour rated fire barrier to protect one division of safe shutdown cables, has no adverse impact on the safe shutdown capability of the plant, due to the existing defense-in-depth provided.

Originator: Brian T. Ford / 11-22-94

Concurrence: N/A / ____
Division of Responsibility

Supervisor: ____ / 11/23/94

Attachments: Affected SAR Pages
Safety Evaluation/Screening, LIC Log No. 94-0079
(if applicable)

cc: K A Leffel, V-922 R P Bhat
M McMenamin C Small
M O'Flaherty S Wilson

NF-139 (4/94)

Safety-Related Equipment

Division 1 and 2 cable trays are routed through the zone.

Combustible Materials

Lubricants
Cable Insulation
HVAC Material
Plastic, Rubber, Cloth and Paper

Fire Load

REVISE

The fire load for the fire zone is ~~29,000 Btu/ft²~~ moderate.

Fire Detection and Protection

There is an ionization fire detection system located in the zone. Portable fire extinguishers and hose stations are provided for manual firefighting as shown on the referenced drawings. The hatch at 125/AC is protected by an automatic wet pipe sprinkler system.

Design-Basis Fire

In the event of a fire in this fire zone, safe shutdown can be achieved as discussed in Subsection 3.3.1 of the Safe Shutdown Analysis.

3.4.1.7 Fire Zone CB-1g; Elevation 781' - 0"
Unit 2 Cable Spreading Rooms

Description

This zone is a general access for the cable spreading rooms and has a floor area of 8790 ft^2.

A plan view of this fire zone is shown on Figure FP-13a. Rated barriers, area detection, suppression systems, and major plant equipment are shown on Figure FP-13b. Safety-related cable trays are shown on cable tray Figure 11.

The floor is 12-inch minimum reinforced concrete with twenty-four 4-inch floor drains and is not fire rated. The walls are 24-inch minimum reinforced concrete or 7-5/8-inch reinforced hollow concrete block. The north and south walls are 3-hour fire rated, and the west wall and stair/elevator enclosure are 1.9-hour fire rated. The remaining walls are not fire rated. The ceiling is 23-inch minimum reinforced concrete and is 3-hour fire rated.

In Fire Zone CB-1f, elevation 762 feet 0 inch (see Cable Tray Figure 10), Division 1 cable trays are located on the southwest side of the zone. Division 2 cable trays are routed along the north wall 39 feet from the Division 1 trays, and Division 2 cable risers are found along the south wall 19 feet from the Division 1 trays. All of these trays contain safe shutdown cables. The problem, therefore, is to separate the Division 1 shutdown cables from those of Division 2. Division 2 cable trays will be protected with a material ~~that has a 3-hour fire rating~~ (see Subsection 3.3.1.3.3). A wet pipe sprinkler system will be installed to prevent hot gases from propogating between Fire Zones CB-1e and CB-1f (see Subsection 3.3.1.3.2) and from the west side of Fire Zone CB-1f to CB-1i (see Subsection 3.3.1.3.3).

REVISE fire-rated DELETE DELETE

The loss or malfunction of the Division 1 safe shutdown equipment will not prevent safe shutdown from being achieved using Method 2 from the control room.

A fire in Zone CB-1g at elevation 781 feet 0 inch (see Figure FP-13 and Cable Tray Figure 11) would disable cables belonging to the Division 1 safe shutdown system. Cables in this zone that belong to Method 2 safe shutdown system will be rerouted in conduit and protected (see Subsection 3.3.1.3.4). Safe shutdown can be accomplished from the control room with Method 2.

Fire Zone CB-1i located at elevation 825 feet 0 inch (see Figure FP-15 and Cable Tray Figure 13) contains cables and equipment belonging to both methods of safe shutdown. In order to ensure a safe plant shutdown, the modifications described in Subsection 3.3.1.3.5 will. be made to adequately separate the two methods of safe shutdown cable and equipment. Since Division 1 and 2 control room ventilation system could be affected by a fire in the west side of Fire Zone CB-1i safe shutdown has been assured from the remote shutdown panel.

In order to limit the potential damage of hot gases spreading to Division 2 cables on elevation 825 feet, west side, from the enclosed pipe hatches on elevations 781 feet and 800 feet (Fire Zones CB-1f to CB-1i), modifications will be made (see Subsection 3.3.1.3.3).

After completion of the modifications, if a fire occurs in any CB-1 fire zone, hot and cold shutdown can be achieved from the appropriate safe shutdown system.

The performance goals for the safe shutdown functions are assured by Method 1, 2, or 3.

3.3.1.3 <u>Modifications in Fire Area</u>

3.3.1.3.1 <u>Zone CB-1c</u>

- Area detection will be installed in this fire zone.
- An automatic wet-pipe sprinkler system will be installed around the west pipe hatch to prevent hot gases from propagating to elevation 737 feet 0 inch (Zone CB-1e).

3.3.1.3.2 <u>Zone CB-1e</u>

- Division 2 cable trays and risers will be protected by a 1-hour fire-rated material that extends 20 feet beyond the closest Division 1 cable tray and riser.

- In the corridor outside the diesel generator rooms an automatic wet pipe sprinkler system will be installed (see Figure FP-11 and Cable Tray Figure 9). This system will protect the west pipe hatch at column-row 125-AC at ceiling level.

- An automatic wet-pipe sprinkler system will be installed at the ceiling to protect the equipment hatch located at column-row 132-133, AA-AC.

3.3.1.3.3 Zone CB-1f

- In order to preclude the possibility of a fire destroying both Division 1 and 2 cables that serve safe shutdown equipment, the Division 2 cable trays will be protected with a fire-rated material ~~that has a 3 hour fire rating~~. DELETE DELETE REVISE

- An automatic wet-pipe sprinkler system will be installed around the west pipe hatch to prevent hot gases from propogating to elevation 825 feet 0 inch (Fire Zone CB-1i).

3.3.1.3.4 Zone CB-1g

- Area detection will be installed in this zone.

- Safe shutdown cables 1NB65C, 1RH79C, and 1RP76C will be transferred from cable trays and rerouted in conduit. These conduits in Zone CB-1g will be protected by a 3-hour fire-rated material.

3.3.1.3.5 Zone CB-1i

- Division 1 safe shutdown cables 1AP28Q, 1AP34X, and 1AP28B will be rerouted from the Division 1 cable tray on the west side of Zone CB-1i to the east side of Zone CB-1i.

- The wall at column 130 from the missile wall (north) to row AC (south) will be upgraded to a 3-hour fire barrier.

- Partial fire detection will be installed in the vicinity of the west pipe hatch (see Subsection 4.2.4.5).

3.3.1.3.6 Zone CB-1d

- The vertical cable chase along the S wall between columns 128.5 and 132 will be enclosed by a minimum 1.9-hour fire rated barrier (see Figure FP-106).

3.3.1.4 Deviations

3.3.1.4.1 Barriers

Engineering justification for the following deviation requests is found in Section 4.2 of this report.

- Fire Area CB-1 is separated from Fire Areas CB-2, CB-4, CB-5, and CB-7 by 8-inch hollow-block walls that are rated at less than 3 hours (see Subsection 4.2.2.6).
- Non-fire-rated reinforced concrete floors of the control building separate redundant safe shutdown electrical divisions of components.
- Ventilation piping that penetrates 3-hour fire rated walls and floors does not have fire dampers (see Subsection 4.2.2.9).
- Bus duct penetrations through fire-rated barriers have not been tested or labeled as 3-hour fire rated penetrations (see Subsection 4.2.2.15).
- The Thermo-Lag 330-1 cable fire wrap installed in fire zone CB-1f is not 3-hour fire-rated (see Subsection 4.2.2.17) ADD

3.3.1.4.2 Detection

- Complete area fire detection is not provided in this fire area (see Subsection 4.2.3.1.5).

3.3.1.4.3 Suppression

- An automatic fire detection system is not provided throughout the fire area (see Subsection 4.2.4.5).

3.3.2 FIRE AREA CB-2

3.3.2.1 Description

This fire area consists of the Division 2 cable spreading room at elevation 781 feet 0 inch (see Figure FP-13).

3.3.2.2 Shutdown Analysis

A fire in this zone would disable the Division 2 safe shutdown systems (see Cable Tray Figure 11). There are no Division 1 cables or equipment necessary for safe shutdown in this fire area.

In this area, however, are Division 2 cables that control valves (1E12-F006B, 1E12-F009, 1E12-F052B, and 1E51-Fxxx) required for the proper operation of Method 1 safe shutdown systems. Valves 1E12-F006B and 1E12-F052B are normally closed and remain closed during the entire shutdown procedure. The concern here is that a hot short could open these valves. For a discussion of how spurious operation of valve 1E12-F052B is prevented, see Section 1.6. Valve 1E12-F006B must be closed only while proceeding from hot to cold shutdown. After achieving hot shutdown, this valve will be verified as being closed. Valve 1E12-F009 must be opened to achieve normal shutdown cooling mode. If a fire destroyed the cables that serve this valve (1RH17F, and G) or associated cables, an alternate shutdown cooldown method can be used to achieve cold shutdown (see Figure 1.8-4).

Valve 1E51-F063 must remain open during hot shutdown to allow steam flow to the RCIC turbine. Control cables (1R102F and 1R102G) for this valve are routed through Area CB-2, thus raising the potential of a hot short closing the valve. Valves associated with RCIC operation, 1E51-Fxxx, could be affected by a fire in

4.1.3.1.2 Zone CB-1e

- Division 2 cable trays and risers will be protected by a 1-hour fire rated material that extends 20 feet beyond the closest Division 1 cable tray and riser.

- In the corridor outside the diesel-generator rooms, an automatic wetpipe sprinkler system will be installed (see Figure FP-11 and Cable Tray Figure 9). This system will protect the west pipe hatch at column row 125-AC at ceiling level.

- An automatic wet-pipe sprinkler system will be installed at the ceiling to protect the equipment hatch located at column row 132-133, AA-AC.

4.1.3.1.3 Zone CB-1f

- In order to preclude the possibility of a fire destroying both Division 1 and 2 cables that serve safe shutdown equipment, the Division 2 cable trays will be protected with a material ~~that has a 3-hour fire rating~~. DELETE DELETE REVISE fire rated

- An automatic wet-pipe sprinkler system will be installed around the west pipe hatch to prevent hot gases from propagating to elevation 825 feet 0 inch (Fire Zone CB-1c).

4.1.3.1.4 Zone CB-1g

- Area detection will be installed in this zone.

- Safe shutdown cables 1NB65C, 1RH79C, and 1RP76C will be transferred from cable trays and rerouted in conduit. These conduits in Zone CB-1g will be protected by a 3-hour fire rated material.

4.1.3.1.5 Zone CB-1i

- Division 1 safe shutdown cables 1AP28Q, 1AP34X, and 1AP28B will be rerouted from the Division 1 cable tray on the west side of Zone CB-1i to the east side of Zone CB-1i.

- The wall, at column 130 from the missile wall (north) to row AC (south), will be upgraded to a 3-hour fire barrier.

- Partial fire detection will be installed in the vicinity of the west pipe hatch (see Subsection 4.2.4.5).

4.1.3.1.6 Zone CB-1d

- The vertical cable chase along the S wall between columns 128.5 and 132 will be enclosed by a 1.9-hour fire rated barrier (see Figure FP-106).

Area fire detection is provided in this fire zone. The fire load in Fire Zone CB-1f is ~~approximately~~ ~~29,000 Btu/ft²~~ moderate REVISE DELETE

If a fire were to start in Fire Zone CB-1f at elevation 762 feet 0 inch, only Division 1 safe shutdown systems could be affected; all Division 2 safe shutdown systems are protected by a ~~3-hour~~ fire-rated material (see Figure 4.2.4.5-4). A safe plant shutdown would be achieved by Method 2 safe shutdown systems. The possibility of upward fire propagation from Fire Zone CB-1f is limited by the automatic sprinkler system that is provided at the ceiling of elevation 762 feet 0 inch around the HVAC shaft at column row 125/AC, the 3-hour fire rated ceiling between column rows 124-130 and column line S-AC, and the sealing or cable risers penetrating the ceiling protect one safe shutdown division. Upward fire propagation can occur through the open hatch at column row 135/AC, which communicates with elevation 825 feet 0 inch (Fire Zone CB-1i). The concern is discussed later.

Elevation 781 Feet 0 Inch - Fire Zone CB-1g

All cable tray risers have 3-hour fire rated penetration seals installed in the floor and ceiling.

This zone is a general access for the cable spreading rooms. This space was originally intended for the Unit 2 cable spreading rooms but is currently the insulators shop. The fire loading in Fire Zone CB-1g is low.

The floor is 12-inch minimum reinforced concrete and is not fire rated. The walls are 24-inch minimum reinforced concrete or 7-5/8-inch hollow concrete block. The north and south walls are 3-hour fire rated, and the west wall and stair/elevator enclosure are 1.9-hour fire rated. The remaining walls are not fire rated. The ceiling is 23-inch minimum reinforced concrete and is 3-hour fire rated. Portable fire extinguishers and manual hose stations are provided as shown on Figure FP-13b. Area fire detection is also provided throughout this fire zone.

If a fire were to start in Fire Zone CB-1g at elevation 781 feet 0 inch, only Division 1 safe shutdown systems could be affected; all Division 2 safe shutdown systems are protected by a 3-hour fire rated material (see Figure 4.2.4.5-5). A safe plant shutdown would be assured by Method 2 safe shutdown systems. A fire cannot propagate upward from Fire Zone CB-1g since the ceiling is 3-hour fire rated. Thus, for a fire in Fire Zone CB-1g at elevation 781 feet 0 inch, the fire would be contained at this elevation and safe shutdown could be achieved.

Elevation 825 Feet 0 Inch - Fire Zone CB-1i

All cable tray risers have 3-hour fire rated penetration seals installed in the floor. The fire loading in Fire Zone CB-1i is low.

This zone contains the air handling equipment for the control room and auxiliary building. The floor is 12-inch-minimum concrete on steel decking and is 3-hour fire rated. The walls are 24-inch reinforced concrete, 11-5/8-inch hollow concrete block, or 7-5/8-inch hollow concrete block. The walls at the stair/elevator enclosures are 1.9-hour fire rated. The remaining walls are not fire rated. The ceiling is 24-inch concrete on steel decking and is not fire rated. The dividing wall at column 130 between the missile wall and row AC has

Table 4.2.2.15-1

Locations of 4.16-kV and 6.9-kV Bus Ducts

Fire Zones	Fire Load Classifications	Detection	Automatic Suppression	Zone Elevation (ft)	Location (row/ column)	Safe Shutdown Concern*	Number of Openings	Number of Bus Ducts	High Fire Load in Area
R-1i/A-1b	low/moderate	N/Y	N/Y	737	S/122	N	1	1	N
CB-1e/A-1b	low/moderate	Y/Y	Y/Y	751/737	S/124	N	1	1	N
T-1f/A-1b	moderate/moderate	N/Y	N/N	737	S/102	N	3	3	N
		N/Y	N/N		S/107	N			N
		N/Y	N/Y		S/117	N			N
A-1b/Exterior Wall	moderate	Y/N	N/N	737	U/102	N	1	3	N
A-1b/A-3d	moderate/moderate	Y/Y	N/N	737 and 762 (floor)	S/102	N	5	5	N
		Y/Y	N/N		U/105	N			N
		Y/Y	N/N		V/105	N			N
		Y/Y	N/N		U/105	N			N
		Y/Y	N/N		U/105	N			N
A-1b/A-2k	moderate/moderate	Y/Y	Y/N	762 (floor)	U/121	N	4	4	N
		Y/Y	Y/N		U/121	N			N
		Y/Y	Y/N		U/121	N			N
		Y/Y	Y/N		U/121	N			N
R-1p/A-2k	moderate/moderate	N/Y	N/N	762	S/122	N	1	1	N
CB-1f/A-2k	moderate ~~29,000 Btu/ft²~~/ moderate REVISE	N/Y	N/N	762	T/124	N	1	1	N

* Redundant safe shutdown components or methods of shutdown are not located in the vicinity (less than 20 feet) of the penetration.

Table 4.2.2.15-1

Locations of 4.16-kV and 6.9-kV Bus Ducts (Cont'd)

Fire Zones	Fire Load Classifications	Detection	Automatic Suppression	Zone Elevation (ft)	Location (row/ column)	Safe Shutdown Concern*	Number of Openings	Number of Bus Ducts	High Fire Load in Area
T-1h/A-3d	moderate/moderate	N/Y	N/N	762	S/102	N	1	1	N
R-1p/CB-1f	moderate/~~29,000 Btu/ft^2~~ moderate	N/N	N/N	762	S/128	N	2	2	N
		N/N	N/N		S/133	N			N

REVISE

* Redundant safe shutdown components or methods of shutdown are not located in the vicinity (less than 20 feet) of the penetration.

The Division 2 safe shutdown systems in Fire Zone CB-1c pass no closer than 14 feet from the hatch, which along with the absence of intervening combustibles, limits the chances of vertical fire propagation. In addition, an automatic suppression system is provided over Division 1 safe shutdown systems at elevation 737 feet 0 inch (see Figures FP-10b and FP-11b and Cable Tray Figure 9), further preventing fire damage to Division 1 safe shutdown systems from exposure fires from all directions. The suppression system would also prevent a fire in Division 1 systems from propagating horizontally or vertically upward. Any Division 2 systems that pass horizontally within 20 feet of Division 1 systems (see Figure 4.2.4.5-3) are also protected by a 1-hour fire rated material. Automatic detection is installed throughout Fire Zone CB-1e. The possibility of upward fire propagation is prevented by automatic sprinkler protection that is provided at the ceiling of elevation 737 feet 0 inch around the HVAC shaft at column row 125/AC and the equipment hatch at column row 132/AA. Upward propagation through the unrated ceiling is prevented by the sealing of the primary propagation path, the cable risers penetrating the ceiling.

Safe shutdown can be achieved by Method 2 or 3.

Elevation 762 Feet 0 Inch - Fire Zone CB-1f

All cable tray risers have 3-hour fire rated penetration seals installed in the floor and ceiling.

The floor is 12-inch reinforced concrete with open areas for piping and equipment removal. The floor is not fire rated.

The zone walls are 24-inch-minimum concrete and are 3-hour fire rated, except for the east wall, which is not fire rated. The two enclosed stairways and the two enclosed elevators are 1.9-hour fire rated. The ceiling is 12-inch-minimum reinforced concrete and is 3-hour fire rated between column rows 124-130 and column lines S-AC. Manual hose stations and portable fire extinguishers are provided as shown on Figure FP-12b.

Area fire detection is provided in this fire zone. The fire load in Fire Zone CB-1f is ~~approximately 29,000 Btu/ft²~~ moderate. REVISE

DELETE

If a fire were to start in Fire Zone CB-1f at elevation 762 feet 0 inch, only Division 1 safe shutdown systems could be affected; all Division 2 safe shutdown systems are protected by a ~~3-hour~~ fire rated material (see Figure 4.2.4.5-4). A safe shutdown would be achieved by Method 2 safe shutdown systems. The possibility of upward fire propagation from Fire Zone CB-1f is limited by the automatic sprinkler system that is provided at the ceiling of elevation 762 feet 0 inch around the HVAC shaft at column row 125/AC, the 3-hour fire rated ceiling between column rows 124-130 and column line SAC, and the sealing or cable risers penetrating the ceiling protect one safe shutdown division. Upward fire propagation can occur through the open hatch at column row 135/AC, which communicates with elevation 825 feet 0 inch (Fire Zone CB-1i). The concern is discussed later.

Elevation 781 Feet 0 Inch - Fire Zone CB-1g

All cable tray risers have 3-hour fire rated penetration seals installed in the floor and ceiling.

4.2.2.17 Thermo-Lag 330-1 Cable Fire Wrap Not 3-hour Fire Rated

Description of Deviation

The Thermo-Lag 330-1 cable fire wraps installed in fire zone CB-1f are not qualified as 3-hour rated installations.

Reference

10 CFR Part 50, Appendix R, Subsection III.G.2.

Fire Zone Involved

The fire zone involved in this deviation is CB-1f.

While the Appendix R requirements refer to fire areas, the CPS fire areas have been further divided into fire zones using natural boundaries. The use of fire zones is consistent with the NRC guidance provided in GL 86-10, Question and Answer Section 3.1.5. The impact of the proposed change is limited to fire zone CB-1f; it does not impact the other fire zones in fire area CB-1.

Description of Safe Shutdown Equipment

Cable Tray Figure 10 shows the locations of Division 1 and 2 cable trays in fire zone CB-1f. Division 1 and 2 diesel generator cables, Division 1 and 2 diesel generator HVAC and diesel oil system cables, Division 1 and 2 control room HVAC cables, Division 1 and 2 NSPS cables, Division 1 Shutdown Service Water system cables and RCIC cables are located in this fire zone.

The original design in fire zone CB-1f utilized the option of 3-hour fire barrier (III.G.2.a) using Thermo-Lag to enclose the trays of Division 2 safe shutdown power, instrumentation and control cables. Figure 4.2.4.5-4 shows the locations of Thermo-Lag in fire zone CB-1f. In addition, as shown on Figure FP-12b, an ionization fire detection system is provided for the entire fire zone.

Engineering Justification

The Appendix R Subsection III.G.2 requirements concern the ability to achieve and maintain safe shutdown. The deviation from the requirement for a 3-hour rated fire barrier enclosing the division of safe shutdown cables in fire zone CB-1f is justified on the basis that several design and programmatic fire protection features are in place at CPS to ensure that the safe shutdown capability is maintained. The following is an outline of the defense-in-depth features.

Engineering Justification (Continued)

1. It is unlikely for a fire to occur which is capable of affecting safe shutdown cables in fore zone CB-1f due to the administrative controls and the physical design features. The administrative controls include control of ignition sources, control of combustible and flammable materials and the "No Smoking" rules. The physical design features of fire zone CB-1f include substantial concrete and block construction providing structural separation for this fire zone from adjacent fire zones, relatively open layout, and the 3-hour fire rated penetration seals for cable tray penetration openings.

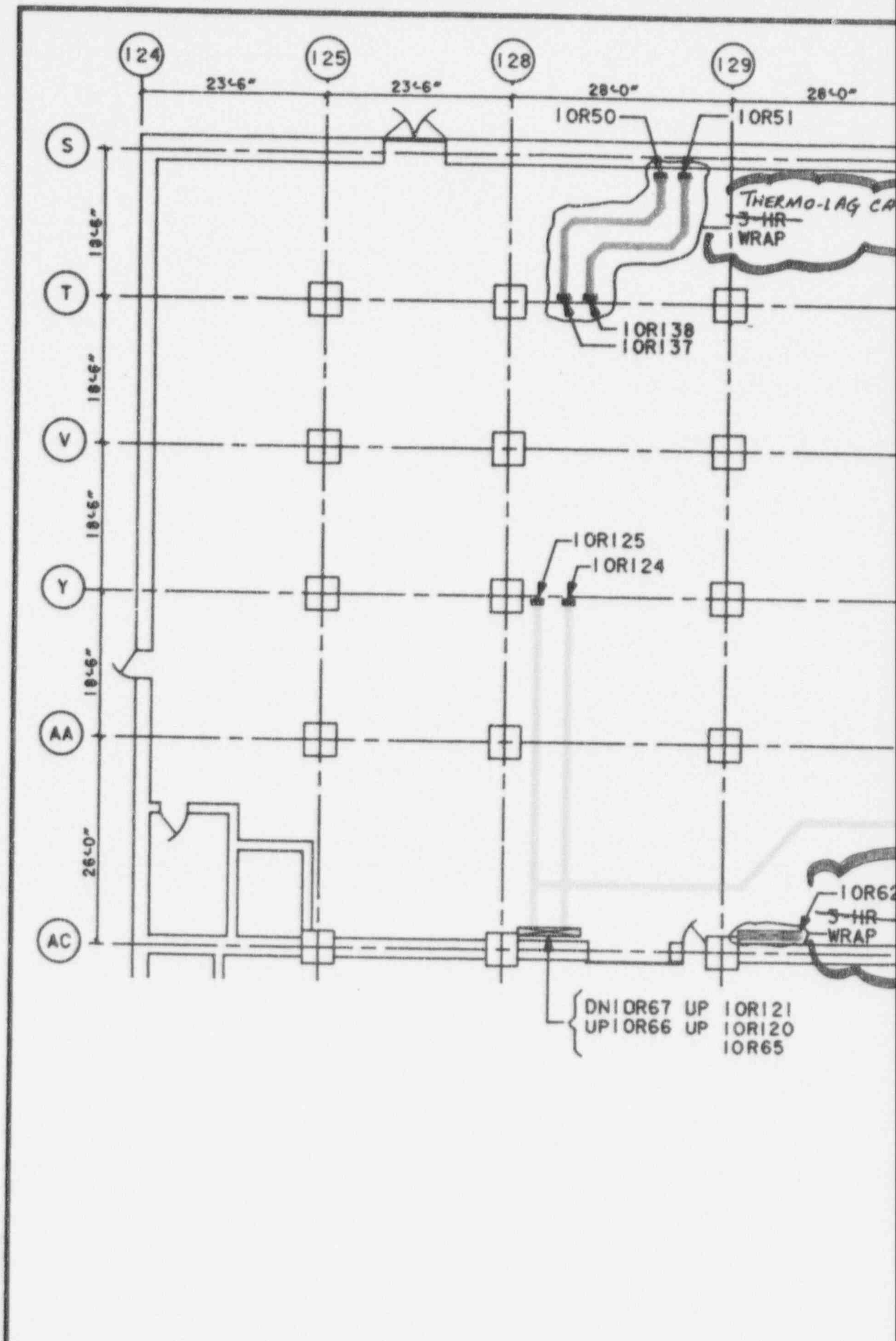
2. Fire modeling of fire zone CB-1f has shown that the fixed and transient combustibles, either individually or collectively, present no credible risk to safe shutdown capability.

3. In the event that a fire occurs in fire zone CB-1f, it is unlikely that it would damage both redundant divisions of safe shutdown cable trays due to the location of the cable tray stacks (Division 1 trays never pass over Division 2 trays and vice-versa) and the provision of wet pipe sprinkler systems protecting the west pipe hatch and the equipment hatch at the ceiling level of fire zone CB-1e below to cool hot gases entering from CB-1e to CB-1f.

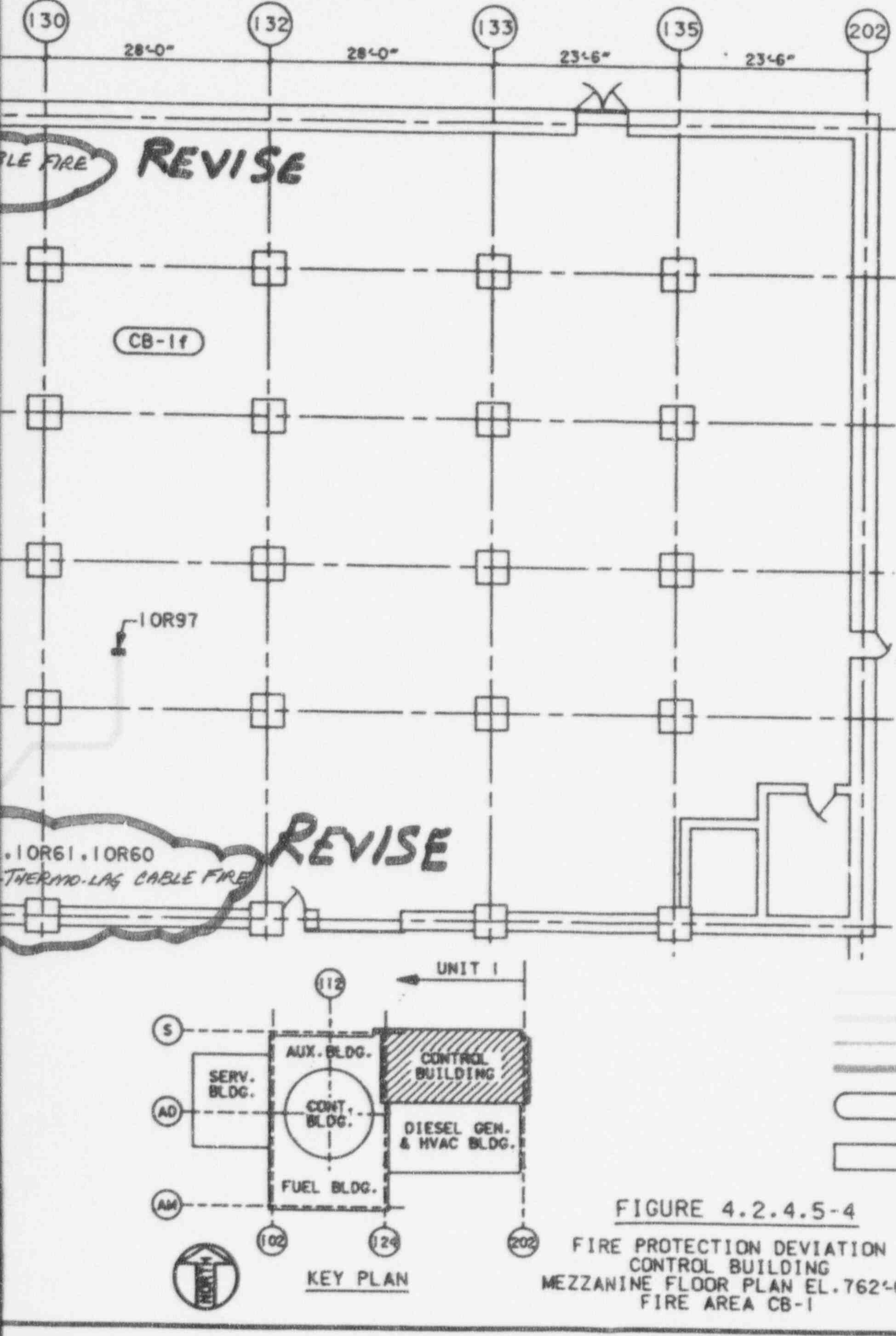
4. In the event that a fire occurs in fire zone CB-1f, the as-built Thermo-Lag cable wrap will protect the wrapped Division 2 safe shutdown cable trays for a duration sufficient to permit manual fire fighting by the CPS fire brigade.

5. In the event that a fire is not extinguished by the fire brigade, the Probabilistic Risk Assessment (PRA) evaluation did not identify any significant safety benefit, with regard to core damage prevention, containment isolation, containment heat removal or containment hydrogen control, provided by the Thermo-Lag installed in fire zone CB-1f.

6. In the unlikely event of a fire in CB-1f that disables both divisions of redundant safe shutdown equipment, it is reasonable to expect that operator training, Emergency Response Organization (ERO) activation, and symptom-based procedures provide a final line of defense to ensure plant safety.



S&L ECAD FILE: CLIETI.1



LEGENDS:

DIV. 1 CONDUIT
DIV. 1 TRAY
DIV. 2 CONDUIT
DIV. 2 TRAY
FIRE ZONE
EQUIPMENT NO.

FIGURE 4.2.4.5-4

FIRE PROTECTION DEVIATION
CONTROL BUILDING
MEZZANINE FLOOR PLAN EL. 762'-0"
FIRE AREA CB-1

9511150046-07

SAFETY EVALUATION FORM

Document Evaluated: 1.1 L&S Log # 94-0083

1.2 Number: USAR Appendix F 1.3 Revision: ______

1.4 Title: EVALUATION OF THERMO-LAG IN FIRE AREA D-8 (DIVISION 1 DIESEL GENERATOR VENT FAN ROOM)

1.5 References:

See page 6

BLOCK A - DESCRIPTION OF CHANGE

(Use additional pages if required)

A.1 Describe the basic document or system and the changes being made. Discuss how the change affects the SAR description. Discuss the reason for change.

CPS USAR Appendix F, subsection 3.4.8.2 discusses the provision of 1-hour rated cable fire wrap material to protect the main power feed cables for the Division 2 diesel generator in fire area D-8, which is the Division 1 diesel generator ventilation fan room and breathing air filter train A, B, C and compressor room at elevation 762 feet in the diesel generator building. The purpose of this evaluation is to accept the fire wrap as-is even though the fire wrap material used in D-8, Thermo-Lag 330-1, does not provide the 1-hour rating. The proposed USAR change will delete the reference to the 1-hour rating of the fire barrier. In addition, this deviation from Appendix R requirement for 1-hour rated fire barrier will be included in USAR Appendix F, Section 4.2. Also, some corrections are being made to the listing and routing of Division 1 safe shutdown cables in fire area D-8 (Refer to Enclosure 5).

(Continued on page 8)

A.2 Identify the equipment, systems and parameters that may be affected by the change:

Fire Area affected: Fire Area D-8, Division 1 diesel generator ventilation fan room and breathing air filter train A, B, C and compressor room at elevation 762 feet in the diesel generator building (USAR Appendix E, Figures FP-12a, FP-12b, and USAR Appendix F, Deviation Figure 4.2.4.3-1).

Description of Safe Shutdown Equipment and/or cables: The systems affected include the Division 1 diesel generator ventilation fan and panel and Division 2 diesel generator power cables.

(Continued on page 9)

94-0083

BLOCK B - RADWASTE TREATMENT SYSTEMS

B.1 The proposed activity involves a modification to a radioactive waste treatment system or the way in which it is operated as described in Chapter 11 of the SAR.

Yes ____
No __X__

B.2 Because: The proposed USAR changes affect only the fire protection and safe shutdown analyses contained in the USAR. They do not impact the radwaste system or its operation.

If B.1 is yes, complete form NF-003.

BLOCK C - TECHNICAL SPECIFICATION IMPACT

C.1 The proposed activity requires a change to any part of the Technical Specifications.

Yes ____
No __X__

C.2 Justification if "NO", Techeical Specification change package identification number if "YES".

The CPS Technical Specification does not contain any operability requirements for the fire protection features. This evaluation shows that the safe shutdown analysis is unaffected by the proposed change. This change does not impact the CPS Fire Protection Program discussed in Technical Specification 6.8.4.e.

BLOCK D - UNREVIEWED SAFETY QUESTION DETERMINATION

(Attach additional pages with the responses to the block D questions. Identify your answers to Parts I, II, III, and IV.)

Part I - Impact on equipment malfunctions evaluated as the design basis.

1. For the equipment and systems identified in A.1 and A.2, identify any failures evaluated in the SAR.
   See page 18
2. Discuss the impact of the change on the performance of the equipment and systems identified in A.1 and A.2.
   See page 18
3. Identify what new failure modes could be introduced by the change.
   See page 18
4. Identify any impact of the change on the consequences of the failures evaluated in the SAR.
   See page 18
5. Identify any impact of the change on the probabilities of the failures evaluated in the SAR.
   See page 18

94-0083

SAFETY EVALUATION FORM

BLOCK D - UNREVIEWED SAFETY QUESTION DETERMINATION

SUMMARY

Based on item 4, are the consequences of any malfunction of equipment evaluated in the SAR increased? YES ______ NO __X__

Based on item 5, is the probability of a malfunction of equipment evaluated in the SAR increased? YES ______ NO __X__

If the answer to any of the above questions is yes, the change is an unreviewed safety question.

Part II - Impact on the accidents evaluated as the design basis **See page 18**

1. Identify the accidents evaluated in the SAR which could be affected by the change.
2. Discuss how the change impacts the consequences of these accidents.
3. Discuss how the change impacts the probability of these accidents.

SUMMARY

Based on item 2, are the consequences of an accident evaluated in the SAR increased? YES ______ NO __X__

Based on item 3, is the probability of an accident evaluated in the SAR increased? YES ______ NO __X__

If the answer to any of the above questions is answered yes, the change is an unreviewed safety question.

Part III - Potential for Creation of a New Unanalyzed Event **See page 19**

1. Based on Part I, items 1 and 3, could this change initiate a new type of accident or equipment malfunction? Discuss the basis for this determination.

2. Determine if the new accident or malfunction identified above has sufficient probability or consequences to be considered in the Licensing basis. Discuss the bases for this determination.

94-0083

SAFETY EVALUATION FORM

BLOCK D - UNREVIEWED SAFETY QUESTION DETERMINATION

SUMMARY

Based on item 2, does the change create the possibility for an equipment malfunction or accident of a different type than previously evaluated in the SAR?

YES ______
NO ___X___

If the answer is yes, the change represents an unreviewed safety question.

. art IV - Impact on the Margin of Safety See page 19

1. Identify how any of the protective barriers are directly affected by the change.
2. Discuss the impact of the change on the approach to the acceptance limits for any of the protective barriers.
3. Discuss the impact of the change on the bases of the Technical Specifications.

SUMMARY

Based on item 2, is any parameter in chapter 7 of the Safety Evaluation Manual exceeded?

YES ______
NO ___X___

Based on items 2 and 3, does the change reduce the margin of safety provided for the protective barriers?

YES ______
NO ___X___

If the first of these two questions is answered yes, the change may be unsafe and requires further justification. If the first question is answered no and the second is answered yes, the change is safe to implement but is an unreviewed safety question and requires prior NRC approval.

94-0083

SAFETY EVALUATION FORM

BLOCK E - SUMMARY

Based on the evaluation in Block C and Block D, the change

_X_ is safe and is not an unreviewed safety question and requires no Technical Specification change. This change may be implemented in accordance with applicable procedures.

____ is safe but is an unreviewed safety question or requires a Technical Specification change. The change requires NRC approval, prior to implementation.

____ is unsafe and cannot be implemented.

MEO KAL M&M BTF CRS SRW

	printed name	signature	date
Preparer	R.P. Bhat	Rama P. Bhat	12/13/94
Director	J.R. Langley	[signature]	~~12/14~~ 12/13/94
Manager, NSED	N.A.		
Manager, L&S	J.L. Peterson for R.F. Phares	[signature]	12-13-94
FRG	K.S. Moore	[signature]	12-15-94

EVIDENCE OF NRC APPROVAL, IF REQUIRED:

License Ammendment No. ________

printed name	signature	date
	N/A [initials] 12-13-94	

The department responsible for vaulting the parent document must vault this completed form with the document evaluated.

NF-002-5 (2/94)

F136

94-0083

1.5 References

1. "Clinton Power Station Updated Safety Analysis Report", Revision 6 Appendix E, Subsection 3.5.8, Figures FP-12a, and 12b, and Cable Tray Figure 10, Appendix F, Subsections 3.4.8.2, 3.4.8.3, 4.1.4.1, 4.2.3.3, and 4.2.4.3, Appendix F, Tables 4.2.3.3-1 and 4.2.4.3-1, Deviation Figures 4.2.3.3-1 and 4.2.4.3-1

2. "Clinton Power Station Technical Specifications", Amendment 93, Section 6.8.4.e.

3. 10 CFR 50 Appendix R, "Fire Protection Program for Nuclear Power Facilities Operating Prior to January 1, 1979", Section III.G.

4. Generic Letter 86-10, "Implementation of Fire Protection Requirements"

5. Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers".

6. NRC Information Notice IN 94-22, "Fire Endurance and Ampacity Derating Test Results of 3-hour Fire Rated Thermo-Lag 330-1 Fire Barriers"

7. CPS Operating License, License Condition 2-F.

8. NSED Calculation IP-M-0177, "Fire loads for CPS Fire Zones", Rev. 3.

9. NSED Calculation IP-M-0343, "Evaluation of Thermo-Lag Fire Barrier in Fire Area D-8", Rev. 0.

10. NSED Calculation IP-M-0393, "Detailed Fire Modeling for Fire Area D-8", Rev. 0.

11. EPED Calculation 19-AI-8, "Derating for 3-hour TSI Tray Wrap", Rev. 6.

12. NSED Standard ME-08.00, "Thermo-Lag Combustibility Evaluation Methodology Plant Screening Guide", Rev. 0.

13. NSED Standard ME-09.00, "NEI Application Guide for Evaluation of Thermo-Lag Fire Barrier Systems", Rev. 1.

14. EPRI Final Report TR-100370, dated April 1992 (including Revision 1), "Fire Induced Vulnerability Evaluations (FIVE)".

15. Condition Report 1-92-07-024, "NRC Bulletin 92-01; Indeterminate Fire Rating of Thermo-Lag", Rev. 0.

16. CPS Procedure 1001.06, "CPS Fire Brigade", Rev. 4.

SAFETY EVALUATION FORM

1.5 References (Continued)

17. CPS Procedure 1893.02, "Fire Prevention - Control of Ignition Source", Rev. 5.

18. CPS Procedure 1893.03, "Control of Flammable and Combustible Liquids and Combustible Materials", Rev. 7.

19. CPS Procedure 1893.04, "Fire Fighting", Rev. 6.

20. CPS Procedure 1893.04 M521, "762' Diesel Generator: Div. 1 Ventilation Room Prefire Plan," Rev. 3.

21. CPS Procedure 4200.01, "Loss of A.C. Power", Rev. 8.

22. Illinois Power Policy Memorandum PM 1.05, "No Smoking Rules, Enforcement of:", Rev. 0.

23. CPS Procedure 1019.01, "Housekeeping", Rev. 10.

24. S&L Field Engineering Change Notice (FECN) 13629, for installation of two thermal detectors in fire area D-8.

BLOCK A.1 **(Continued)**

Reason for Thermo-Lag Fire Area D-8

The Thermo-Lag 330-1 cable fire wrap in fire area D-8 was originally installed to meet the requirement of 10 CFR 50, Appendix R, Section III.G. The current USAR description in Section 9.5.1 states that deviations from Appendix R requirements will be provided in the Clinton Safe Shutdown Analysis, Section 4.2.

Appendix R Requirement

Appendix R subsection III.G.2.a, III.G.2.b, III.G.2.c address specific requirements for the protection of safe shutdown capability in the event of a fire. Appendix R requires compliance with one of the three alternatives outlined in the three subsections.

Appendix R, III.G.2.a requires:

the separation of cable and equipment and associated non-safety circuits of redundant trains by a fire barrier having a 3-hour rating

Appendix R, III.G.2.b requires:

1. 20 feet of separation, with no intervening combustibles between redundant cables, equipment and associated non-safety circuits,
2. fire detectors and
3. automatic fire suppression system.

Appendix R, III.G.2.c requires:

1. enclosure of the component of one redundant train in a fire barrier having a 1-hour rating,
2. fire detectors and
3. automatic fire suppression system.

CPS Compliance with Appendix R in Fire Area D-8

In fire area D-8, the original design provided for thermal detection and 1-hour fire rated barrier (Thermo-Lag) enclosing the Division 2 diesel generator cables. USAR Appendix F, Subsections 4.2.3.3 and 4.2.4.3 identify deviations from Appendix R Section III.G.2.c requirements for the installation of an automatic fire detection and suppression system throughout fire area D-8. As discussed in SSER 5, Subsections 9.5.1.4 and 9.5.5, and SSER 6, Subsections 9.5.1.4 and 9.5.5, the NRC accepted these deviations on the basis of the limited quantities of combustibles, area wide automatic fire detection in the adjacent fire area, enclosure of the conduits of one division in a 1-hour fire rated barrier and the installation of thermal detectors above those conduits.

The new deviation proposed by this USAR change is to delete the reference to the 1-hour rating of the Thermo-Lag fire wrap installed to protect the Division 2 diesel generator cables in fire area D-8.

BLOCK A.1 **(Continued)**

CPS Compliance with Appendix R in Fire Area D-8 (Continued)

As discussed in Generic Letter 86-10, Paragraph F, a deviation from a commitment made in the FSAR is governed by the provisions of 10CFR50.59. The CPS Operating License Condition 2-F states, "IP may make changes to the approved fire protection program without prior approval of the commission only if those changes would not adversely affect the ability to achieve and maintain safe shutdown in the event of a fire."

This Thermo-Lag safety evaluation is consistent with Generic Letter 86-10 guidance, the CPS fire protection licensing condition and with the CPS process for revising the fire protection program elements contained in the USAR.

BLOCK A.2 **(Continued)**

Proposed Deviation

The deviation proposed to be included in the USAR Appendix F, Section 4.2 states, "In fire area D-8, the Thermo-Lag 330-1 material providing a fire barrier function for the Division 2 power cables is not qualified as a 1-hour rated installation."

Summary of Justification for Deviation

The Appendix R Subsection III.G requirements concern the ability to achieve and maintain safe shutdown. The deviation from the requirement for a 1-hour rated fire barrier enclosing one division of safe shutdown cables in fire area D-8 is justified on the basis that several design and programmatic fire protection features are in place at CPS to *ensure that the safe shutdown capability is maintained.* The following is an outline of the defense-in-depth features.

NOTE:
More detailed discussion of each of these features is provided later in this section of the safety evaluation.

1. It is not credible to postulate a fire capable of affecting Safe Shutdown cables in fire area D-8 due to the administrative controls and the physical design of fire area D-8.

2. Fire modeling of the fire area D-8 has shown that the fixed and transient combustibles, either individually or collectively, present no credible risk of safe shutdown cable damage in fire area D-8.

3. In the event that a fire occurs in fire area D-8, it is not credible to postulate damage to both the redundant divisions of safe shutdown equipment due to the Division 2 cables being in conduit on the outside of the existing missile barrier.

BLOCK A.2 (Continued)

4. In the event that a fire occurs in fire area D-8, the as-built Thermo-Lag cable wrap will protect the wrapped Division 2 safe shutdown cables for a duration sufficient to permit manual fire fighting by the CPS fire brigade.

5. In the event that the fire is not extinguished by the fire brigade, the Probabilistic Risk Assessment (PRA) evaluation did not identify any safety benefit, with regard to core damage prevention, containment isolation, containment heat removal or containment hydrogen control provided by the Thermo-Lag installed in fire area D-8.

6. In the unlikely event of a fire in D-8 that disables both divisions of redundant safe shutdown equipment, it is reasonable to expect that operator training, Emergency Response Organization (ERO) activation, and symptom-based procedures provide a final line of defense to ensure plant safety.

1. Detailed Justification for Deviation

Administrative Controls and Fire Area Layout

Several CPS administrative controls currently in place and the layout of this fire area minimize the potential for fire initiation in fire area D-8.

(a) Administrative Control

- CPS procedure 1893.02, "Fire Protection - Control of Ignition Sources", establishes controls for hot work including welding, grinding, flame cutting, brazing and soldering operations. This procedure requires precautions to be taken (such as removing or protecting nearby combustibles and posting of a fire watch) prior to the start of hot work in order to minimize the potential for fire ignition.

- CPS procedure 1893.03, "Control of Flammable and Combustible Liquids and Combustible Materials", governs the handling and limitation of the use of combustible solids and liquids and flammable liquids. This procedure limits the quantities of transient materials that can be introduced into the safety related areas of the plant and prescribes area clean-up, adequate ventilation, access for fire protection equipment, etc., in order to minimize the potential for fire initiation and extent of fire propagation.

- Illinois Power enforces a no smoking policy within the company buildings as outlined in Policy Memorandum PM 1.05, "No Smoking Rules, Enforcement of:". Noncompliance with this policy results in disciplinary action up to and including termination. Additionally, smoking is prohibited in this fire area by CPS procedure 1019.01, "Housekeeping".

BLOCK A.2 (Continued)

(a) Administrative Control (Continued)

- Access to the portion of fire area D-8 outside of the partial concrete wall is restricted, and the Main Control Room is notified before entry into the diesel generator vent fan room. In addition, D-8 is not accessible when the ventilation fan is running.

(b) Physical Layout

- This fire area consists of the Division 1 diesel generator ventilation fan room and air intake located along the south wall of the diesel generator building at elevation 762 feet. Also in the room are breathing air filter trains A, B, C and the breathing air compressors. The floor area is 1268 ft^2. The floor of fire area D-8 is 12-inch minimum reinforced concrete with three 4-inch floor drains. The floor is 3-hour fire rated. The walls are 12-inch minimum reinforced concrete. The walls are 3-hour fire rated except the south wall which is an exterior wall and is not fire rated. The ceiling is 24-inch minimum reinforced concrete and is not fire rated.

- The Division 2 power feed cables, 1DG31A and 1DG31B (as shown on Enclosure 1), that run along the south wall of this fire area are separated from the Division 1 diesel generator ventilation system and other combustibles by a missile shield wall and the partial concrete wall containing a normally closed damper. The north wall is open to the atmosphere through louvers. The Thermo-Lag wrapped conduits are located approximately 17 feet above the floor level. The area below the conduits does not contain any plant equipment.

  Transient combustible storage in this space is highly unlikely since this space is the diesel air intake corridor and the access to this space is restricted.

- The outside air intakes to fire area D-8 are located 25 feet above grade level at this location, therefore, no fire hazard exists due to an external source.

With these administrative controls and the physical layout of this fire area, it is not credible to postulate a fire capable of affecting safe shutdown cables in fire area D-8.

2. Fire Modeling

A detailed fire modeling analysis, NSED Calculation IP-M-0393, Revision 0, was performed for fire area D-8. It took into account all potential fixed and transient ignition sources, spatial locations and heat release rates within fire area D-8, the room volume of fire area D-8, and the spatial locations and damage temperatures of all potential targets within fire area D-8. The modeling methodology and assumptions were primarily taken from EPRI Fire Induced Vulnerability Evaluation (FIVE) guide. This fire model was conservative in that no credit was taken for the following:

BLOCK A.2 (Continued)

2. **Fire Modeling (Continued)**

- the substantial concrete and block construction of the floor, walls, and ceiling, which would absorb more energy that the 70% value used in the fire model
- the Thermo-Lag, installed on the Division 2 power cables which would reduce the temperatures at the wrapped cables

The fire modeling results show that no significant impact on plant safety would result from a fire involving any potential fixed or transient ignition source. Fire modeling also shows that formation of a hot gas layer is not credible. This is due to the following factors in fire area D-8:

- the use of conduit for all cables
- the large distance between potential ignition sources and targets
- the use of IEEE-383 qualified EPR - Hypalon cable insulation
- the absence of any credible oil-pool type fire scenarios

The detailed fire modeling shows that even if a fire were to occur in fire area D-8, it would not result in loss of safe shutdown capability.

3. **Fire Protection Design Features**

As shown in Enclosure 1, the Division 1 safe shutdown cables enter fire area D-8 from the northwest corner, north wall, and are routed south and east to the diesel-generator ventilation panel, the ventilation fan, and down to the 737 feet level. The Division 2 diesel generator power cables enter the fire area from the southeast corner, east wall and travel due west, exiting out of the west in the southwest corner. The Division 2 power feed cables, 1DG31A and 1DG31B (as shown on Enclosure 1), that run along the south wall of this fire area are separated from the Division 1 diesel-generator ventilation system by a missile shield and a partial concrete wall containing a normally shut damper. The Division 2 cables are protected with local thermal detection. The only combustibles in the area are electrical insulation in cabinets, HVAC duct insulation materials, and lubricants, resulting in a low fire loading.

A manual deluge system is provided for the breathing air compressor filter unit. Portable fire extinguishers and hose stations are provided for manual firefighting as shown on Enclosure 1.

In summary, in the event that a fire occurs in fire area D-8, it is not credible to postulate damage to both the redundant divisions of safe shutdown cables due to the location of the

<u>BLOCK A.2</u> **(Continued)**

3. Fire Protection Design Features (Continued)

Division 2 cables (approximately 18 foot above the floor) and the presence of the physical barriers between Division 1 and Division 2..

4. Thermo-Lag Fire Endurance

NRC's Generic Letter 92-08 identified concerns related to the fire endurance capability of Thermo-Lag 330-1 material and the evaluation and application of fire tests to determine the fire endurance ratings of Thermo-Lag 330-1 fire barriers. Condition Report 1-92-07-024 documents the concerns identified by NRC Bulletin 92-01 with regard to the indeterminate fire rating of Thermo-Lag fire barriers. An engineering calculation, IP-M-0343, was performed to determine the fire endurance capability of the as-built Thermo-Lag installation in fire area D-8 with regard to its capability to perform its fire barrier function under ASTM-119 fire conditions.

In fire area D-8 , Division 2 diesel generator power cables are wrapped with Thermo-Lag 330-1 fire barrier material. The fire wraps on Division 2 safe shutdown power cables were intended to be a 1-hour rated fire barrier as discussed on page 8.

Calculation IP-M-0343 utilized NSED Standard ME-09.00, "NEI Application Guide for Evaluation of Thermo-Lag Fire Barrier Systems". The guide was issued by the Nuclear Energy Institute (NEI) and provides the industry with the data and the methodology necessary for evaluating Thermo-Lag fire barriers. The information provided by the guide was obtained from NEI and utility fire barrier endurance test programs.

Based on detailed analysis using the NSED Standard ME-09.00 methodology, NSED Calculation IP-M-0343 determined the fire endurance capability of the CPS as-built Thermo-Lag 330-1 fire barrier installation in fire area D-8 to be at least 46 minutes. This methodology assumes the fire wrap to be subjected to an ASTM E-119 standard time-temperature curve. These temperatures are much higher that those resulting from any credible fire scenario in this fire area. The Thermo-Lag would, therefore, have a longer endurance under a realistic fire scenario. Additionally, the cable "failure temperature" used in this methodology (approximately 325°F) is significantly lower than a more realistic cable failure temperature (approximately 700°F).

NSED Calculation IP-M-0177, Rev. 3, shows that the calculated equivalent fire severity in fire area D-8 is 12 minutes. NSED Standard ME-06.00, "Guidelines for Determining Fire Loads and Preparing Fireload Calculations", provides the methodology for calculating fire loads and equivalent fire severities in CPS fire zones. This methodology requires all material that is not classified as non-combustible to be included as fire loads. As a result, approximately 30% of the fire load in fire area D-8 is due to Thermo-Lag itself. Both the IEEE-383 qualified cable with EPR Hypalon insulation and Thermo-Lag 330-1 have high

<u>BLOCK A.2</u> (Continued)

4. Thermo-Lag Fire Endurance (Continued)

(greater that 900°F) ignition temperatures. As explained in the fire modeling discussion, it is not credible to postulate a temperature of this magnitude at the elevations of the cables in this fire area. The realistic equivalent fire severity in this fire area would therefore be significantly less that the calculated 12 minutes.

In the event of a fire in D-8, the main control room will receive annunciation from thermal detectors in the fire area. Manual fire fighting by the fire brigade is facilitated by the location of hose stations and portable extinguishers in fire area D-10 north of area D-8 at 762 feet Control Building. Fire Brigade cages are located at 737 feet Turbine, 737 feet Radwaste Building and 800 feet Control Building.

The CPS fire brigade is available and on-site at all times, with the Shift Supervisor having the Commander of the Fire Brigade designation. The fire brigade composition, function and fire fighting guidance are provided in CPS procedures 1001.06, "CPS Fire Brigade", 1893.04, "Fire Fighting" and 1893.04M521 which provides the detailed pre-fire plan for fire area D-8.

CPS fire drills record the time from the Gaitronics announcement of fire to when the fire brigade is ready to start fire fighting at the scene. Three fire drills have been held specifically for D-8, the longest response time being 10 minutes. For a fire affecting the portion of D-8 containing Division 2 cables, the Gaitronics announcement from the control room is expected to be prompt since one of the two thermal detectors would alarm. Fire area D-8 is not a high radiation or contaminated area. It is therefore concluded that the CPS fire brigade would be able to respond to a fire within the calculated time of Thermo-Lag endurance.

In summary, the as-built Thermo-Lag cable wrap will protect the Division 2 safe shutdown cables for a duration sufficient to permit effective manual fire fighting by the CPS fire brigade.

5. Thermo-Lag Safety Benefit

The Probabilistic Risk Assessment (PRA) evaluation, which analyzes the safety significance of potential Thermo-Lag fire barrier failure in fire area D-8, is included as Enclosure 3 of this safety evaluation. This analysis, consists of three major parts.

BLOCK A.2 (Continued)

5. Thermo-Lag Safety Benefit (Continued)

- The first part of the analysis is to identify all modeled components that could be affected by a fire in area D-8 and the basic events in the IPE model that represent these components. This list of components contains not only the equipment located within the fire area, but also the equipment located outside this fire area that are affected by damage to cables in this fire area. This part also identifies the basic events (equipment failures) in the IPE model that are protected by Thermo-Lag. Part 1 is described in attachments PRA-1 and PRA-4 of Enclosure 3.

- The second part of the analysis involves calculating the conditional core damage probability (CCDP) for two different situations using the basic events list from Part 1 as an input. The first situation is Thermo-Lag failing to perform adequately as a fire barrier. This is the postulated "worst case" in which a fire occurs and all cables and equipment in the fire area are damaged. The second situation is Thermo-Lag performing its intended fire barrier function in which all cables not wrapped by Thermo-Lag are damaged by a postulated fire. Attachments PRA-2 and PRA-5 of Enclosure 3 describe the CCDP determination.

- While preventing core damage is an important consideration for plant safety, maintaining containment integrity by protecting containment isolation and heat removal capabilities is also a concern. Additionally, containment analysis in the IPE report identified the loss of containment hydrogen control as a major cause of containment failure. Correspondingly, The effect of a fire in area D-8 on these functions was also examined. This analysis is detailed in attachment PRA-2 and PRA-5 of Enclosure 3.

- The third part of the analysis was to determine the fire ignition frequency in area D-8. This calculation utilizes the methodology described in the Fire-Induced Vulnerability Evaluation (FIVE) Guide, EPRI TR-100370 and the Fire Risk Analysis Implementation Guide, EPRI Project 3385-01. Ignition frequency calculation is described on attachments PRA-3 and PRA-6 of Enclosure 3.

  The results of this analysis showed that the CCDP calculated for each of the two situations (Thermo-Lag failing and Thermo-Lag performing its design function) was identical. Additionally no benefit from Thermo-Lag was found to exist for containment isolation, containment heat removal or containment hydrogen control.

In summary, no safety benefit was identified with regard to core damage prevention, containment isolation, containment heat removal or containment hydrogen control is provided by the Thermo-Lag installed in fire area D-8.

BLOCK A.2 (Continued)

6. Operator Response to Fires Affecting Safe Shutdown Equipment

While it is not possible to predict exactly what equipment will be lost or impaired due to any given fire, it is possible to assume "worst case" for an area of the plant involved in a fire. For the areas involving safe shutdown equipment, the issue becomes knowing what is left for the operator to use for any given fire. The operator is trained to control plant parameters per the Emergency Operating Procedures (EOP's) independent of the cause of the off-normal/emergency conditions. That is, the EOP's are symptom-based and not event-based. In this sense, equipment loss due to multiple failures, sabotage, seismic event, etc., is not different from equipment loss due to fire. The operators are given a list of systems to use, not necessarily in a preferential order (what is used is based on what will work).

The operating crews receive intense, continuing training on the EOP's with multiple equipment failures and on loss of power events. Procedural guidance exists in CPS Procedure 4200.01, "Loss of AC Power" for a Station Black Out (SBO). These steps guide the operator actions to minimize the impact on plant equipment while preserving the equipment that is left. For fires that affect systems to an extent less that an SBO, portions of the Loss of AC Power procedure will apply. CPS crews have demonstrated the ability to implement these procedures while maintaining the reactor in a safe condition. A loss of off-site power, concurrent with a failure of Division 1 and 2 diesel generators was simulated on the CPS simulator, resulting in a loss of Division 1 and 2 AC power, and all non-divisional AC power. Operator actions resulted in achieving hot shutdown and maintaining stable reactor parameters.

Emergency Plan Procedure EC-02 directs activation of the Emergency Response Organization (ERO) during any significant plant fire. While minimum shift manning will allow for successfully achieving hot shutdown conditions, the additional resources provided by the ERO will be valuable in minimizing the impact of the fire on the plant and assisting with recovery and repairs.

In summary, in the event of a fire in D-8 that disables both divisions of redundant safe shutdown equipment, it is reasonable to expect that operator training, ERO activation and symptom-based procedures provide the final line of defense to ensure plant safety.

Evaluation of Ampacity Derating Impact of Thermo-Lag

The ampacity derating factors for cables in raceway wrapped by Thermo-Lag has become a concern due to questions raised in Generic Letter 92-08. The NRC questions are related to the original Thermo-Lag manufacturer's recommended ampacity derating factors as well as the wide range of ampacity derating factors applied across the industry. In Information Notice (IN) 94-22, the NRC provided some preliminary information about the results of test the NRC had conducted to establish ampacity derating factors for cables in conduits and trays wrapped by Thermo-Lag 330-1 fire barrier material.

94-0083

BLOCK A.2 (Continued)

Evaluation of Ampacity Derating Impact of Thermo-Lag (Continues)

Ampacity limits are placed on cables to ensure that the cables will operate within their design parameters and are unrelated to a fire scenario. Without ampacity limitations, the current carried by a cable could generate too much heat and result in the cable operating at a temperature above its design rating, thus causing a reduction in the cable's design life. The cables utilized at CPS are rated for 90°C operation and the ampacity limits selected were based on that value. Since different installation configurations (such as covered trays, or fire stops) can limit the dissipation of the heat generated by the current passing through the cable, derating factors were developed to further restrict the current which the cable will be allowed to carry when these configurations are part of the cable routing.

The CPS design defined the boundary between power, control, and instrumentation circuits based on both voltage and current levels. Separate raceways are provided for the different cables so that instrument cables are isolated from noise that could be generated by the power and control cables and the control cables are separated from the heat and induced voltage that could be generated by the power cables. As shown by NSED Calculation 19-G-31, Rev. 0, the currents passing through control and instrumentation cables do not generate sufficient heat to challenge the cable design ratings.

Enclosure 4 identifies the CPS power cables protected by Thermo-Lag 330-1 fire barrier material and the available ampacity margin for each cable in fire area D-8. A review of this data indicates that the power cables wrapped by Thermo-Lag 330-1 in fire area D-8 could be derated by as much as 34% without impacting their design functions or design life. The highest ampacity derating identified in IN-94-22 is 46.4% for a #8 AWG conductor in a tray wrapped by a 3-hour rated Thermo-Lag 330-1 fire barrier. The Enclosure 4 ampacity evaluation concludes that the NRC ampacity derating concerns expressed in IN 94-22 will not have adverse impact on the power cables (each carrying 338.4 amps) in fire area D-8. This conclusion was reached upon comparing conservatism chosen in the CPS design ampacity limits with the derating methodology used by the NRC in IN 94-22.

Currently, there exists no conclusive ampacity derating factors for cables wrapped by Thermo-Lag 330-1 fire barriers due to the many outstanding issues with regard to past tests and test results; however, as discussed above, the Thermo-Lag conduit fire wrap in fire area D-8 does not adversely impact the current carrying capability of the cables.

94-0083

SAFETY EVALUATION FORM

BLOCK D, Part I

1. Failures associated with a design-basis fire in fire area D-8 are discussed in USAR Appendix F, Fire Protection Safe Shutdown Analysis (SSA), Subsection 3.4.8.

   Currently, Subsection 3.4.8.2 states "These conduits will be protected as described in Section 3.4.8.3".

   Currently Subsection 3.4.8.3 states, "Division 2 diesel-generator cables 1DG31A and 1DG31B, in conduits, will be protected by a 1-hour fire rated material".

   These Subsections 3.4.8.2 and 3.4.8.3 are proposed to be revised based on a new deviation to be added to Subsection 4.2.2.16. The new deviation will eliminate the reference to the 1-hour fire rating of Thermo-Lag. The justification for this deviation, and for removing the subsections 3.4.8.2 and 3.4.8.3 wording which implies that there is a safe shutdown concern if the 1-hour rated fire wrap is not installed, is provided in detail under the Block A.2 discussions.

2. For the reasons provided in the Block A.2 discussion, the performance of the safe shutdown systems in fire area D-8 is not adversely impacted by the Thermo-Lag fire rating changed from 1-hour to no specific rating.

3. Even though the Thermo-Lag fire rating is now considered to be less than 1-hour and the reference to the rating is deleted, this reduced capability of the Thermo-Lag fire wrap does not cause any new failure modes. The justification for the reduced capability being acceptable is provided in the Block A.2 discussion.

4. The USAR Appendix F, Safe Shutdown Analysis, documents the capability of the CPS safe shutdown systems to achieve and maintain cold shutdown condition in the event of a single fire anywhere in the plant with a loss of off-site power. As explained by the Block A.2 discussion, it is not credible to postulate a fire scenario capable of adversely affecting the Safe Shutdown capability in fire area D-8 despite the reduced Thermo-Lag capability.

5. The probability of the failures evaluated in the USAR is not impacted as discussed in the Block A.2 discussion.

BLOCK D, Part II

1,2, and 3. The accidents identified in the USAR are not affected by the proposed change to the Thermo-Lag fire wrap rating in fire area D-8. As explained in the Block A.2 discussion, the plant safe shutdown capability in the event of a fire in D-8 is not adversely impacted. The consequences or the probability of a fire in D-8 is not impacted.

SAFETY EVALUATION FORM

BLOCK D, Part III

1 and 2. As explained in the Block A.2 discussion the Thermo-Lag combustibility and ampacity derating concerns were evaluated and found to have no impact on fire area D-8 safe shutdown capability. No new type of accident or equipment malfunction was identified.

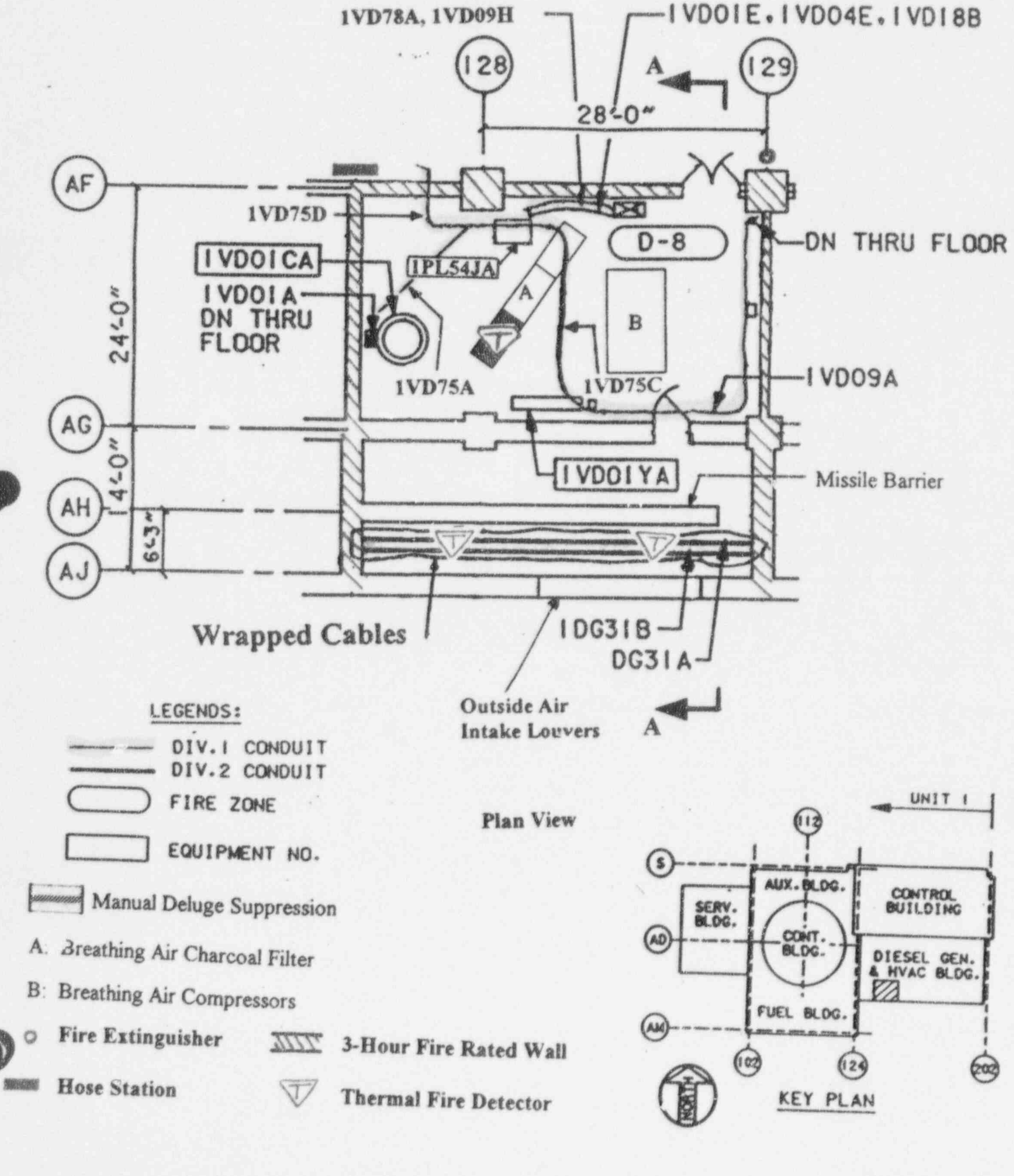
BLOCK D, Part IV

1 and 2. Neither the protective barriers, the approach to the acceptance limits for any of the protective barriers, nor the margin of safety is directly affected by this change. The safe shutdown capability in fire area D-8 has been determined to be acceptable after the impact of the change was evaluated as explained in the Block A.2 discussion.

3. The CPS Fire Protection Program as stated in Tech. Spec. 6.8.4.e is unchanged. The bases of the Technical Specifications are not affected by this change.

FIRE AREA D-8

762' Elevation
Division 1 Diesel-Generator Vent Fan Room

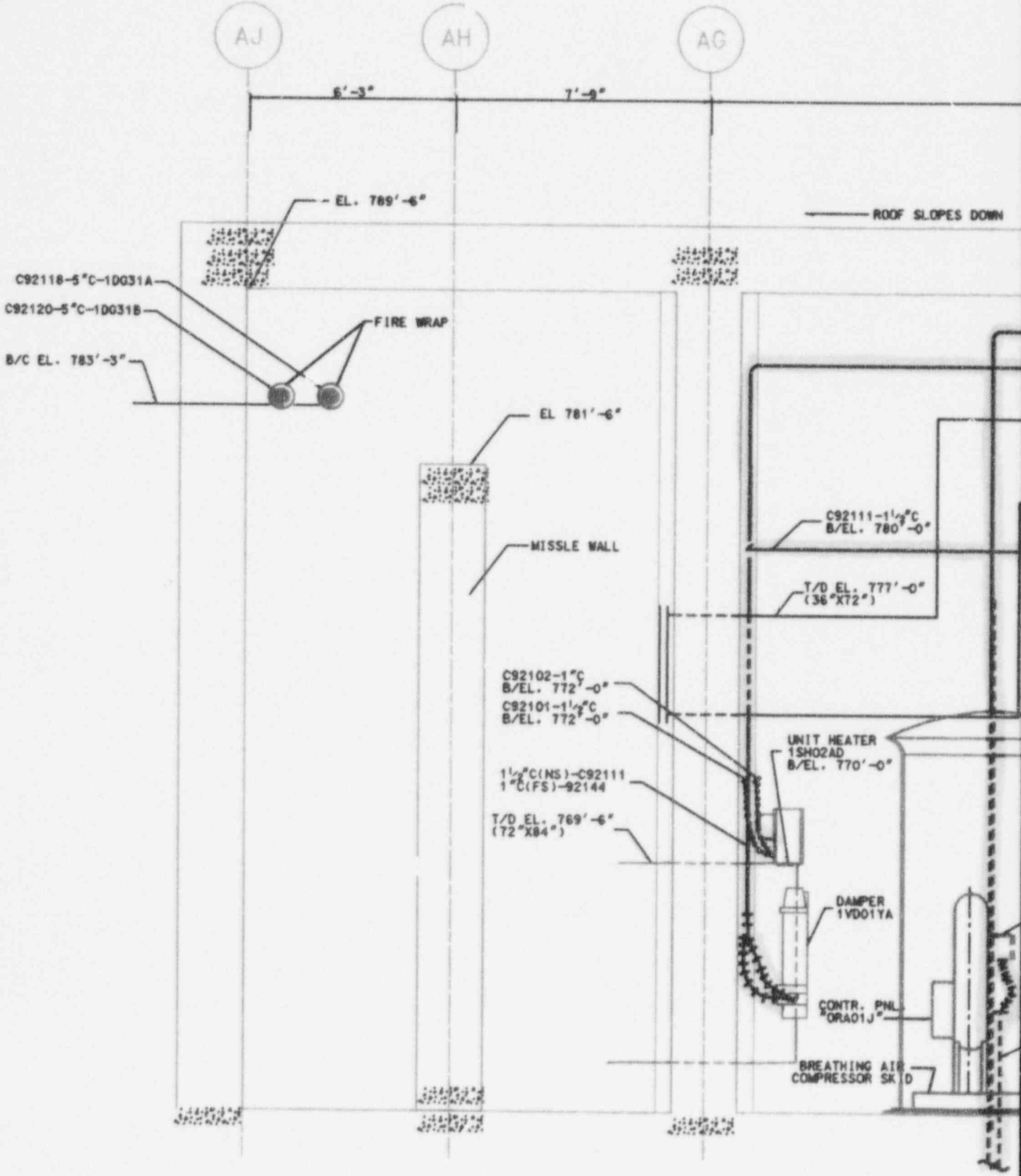


Plan View

FIRE AREA D-8

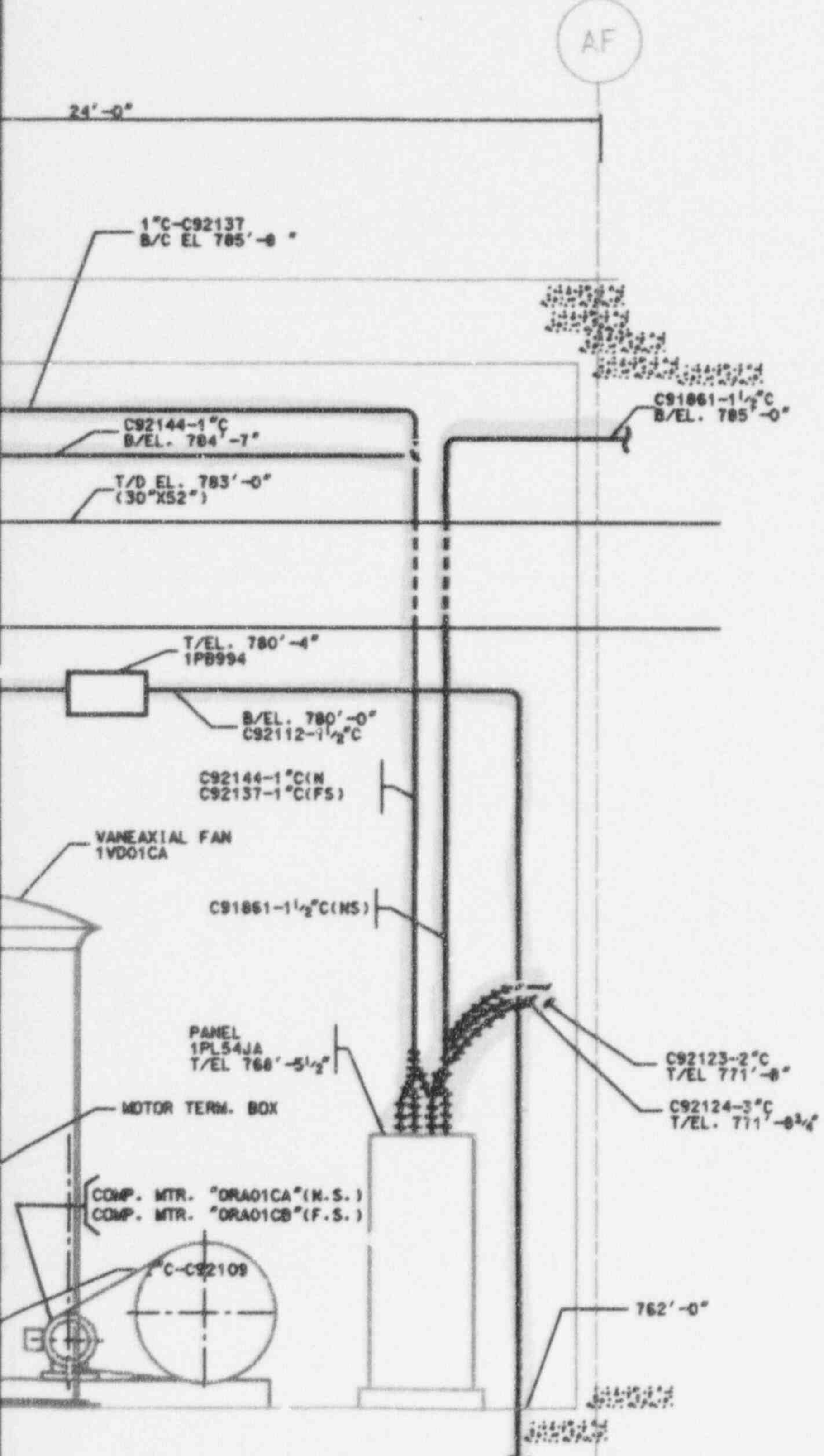
762' ELEVATION

DIV. 1 DIESEL GENERATOR VENT FAN ROO



SECTION A-A

ENCLOSURE 1
PAGE 2 OF 2



9511150046-08

94-0083

Enclosure 2

Div 2 Safe Shutdown Cables in Fire Area D-8

RACEWAY	CABLE #	CABLE FUNCTION
P2E	1DG31A	4KV feed from Div 2 Diesel Generator to Div 2bus feed 1AP09EH. Parallel feed to 1DG31B.
P2E	1DG31B	4KV feed from Div 2 Diesel Generator to Div 2bus feed 1AP09EH. Parallel feed to 1DG31A.

Div 1 Safe Shutdown Cables in Fire Area D-8

RACEWAY	CABLE #	CABLE FUNCTION
P1E	1VD01A	480V feed from 1AP11E to 1VD01CA, DG room 1A ventilation fan.
C1E	1VD01E	Control interlock between 1PL54JA (Div 1 DG room ventilation panel) and MCR for operation of 1VD01CA, DG room supply fan.
C1E	1VD04E	Alarm and annunciation circuit between 1PL54JA and 1AP60E for 1VD02CA, DG oil room exhaust fan.
P1E	1VD09A	480V feed from 1AP72E to 1TZ-VD001A (damper 1VD01YA operator).
K1E	1VD09H	Control signal from 1HS-VD070 to 1PL54JA to place dampers 1VD01YA and 1VD02YA into position for purge mode operation.
C1E	1VD18B	120V control power feed from 0AP54E to 1PL54JA (Div 1 DG room ventilation panel).
K1E	1VD75A	Temperature input signal from 1TE-VD001 to 1PL54JA for use in positioning dampers 1VD01YA and 1VD02YA.
K1E	1VD75C	DC positioning signal from 1PL54JA to 1TZ-VD001A (operator for damper 1VD01YA).
K1E	1VD75D	DC positioning signal from 1PL54JA to 1TZ-VD001B (operator for damper 1VD02YA).
K1E	1VD78A	Temperature input signal from 1TE-VD007 to 1PL54JA for high and low temperature alarms to MCR.

PRA EVALUATION OF SAFETY SIGNIFICANCE OF POTENTIAL THERMOLAG FIRE BARRIER FAILURE IN FIRE AREA D-8

This evaluation is intended for use as supporting documentation in the safety analysis of Thermo-Lag 330-1 cable wrap material in fire area D-8. This study used the IPE model and fire PRA databases as they stood on 12/01/94 as inputs. Subsequent changes to the IPE model and/or fire PRA databases could significantly affect the results of this evaluation. Careful attention to the method used in this evaluation is important in the correct interpretation and application of the final results. Use of the material presented here in any other context could be inappropriate and potentially misleading or erroneous.

METHOD

This analysis is composed of three major parts. The first part of the analysis is to identify all modeled components that could be affected by a fire in zone D-8 (762' elevation, DG 1 ventilation room, Diesel Generator Building) and the basic events in the IPE model that represent these components. This list of components contains not only the equipment itself, but also any cables required for a piece of equipment to perform its modeled function. This part also includes identifying the basic events in the CPS model that are protected by Thermolag. Part 1 is described in attachments PRA-1 and PRA-4.

Using the basic events list from part 1 as an input, the second part of the analysis involves calculating the conditional core damage probability (CCDP) for two different situations. The first situation is the case in which a fire occurs and all cables and equipment in a fire area are damaged. This situation models Thermolag failing to perform adequately as a fire barrier. The second situation is the case in which only cables not wrapped by Thermolag are damaged by a postulated fire. This situation models Thermolag performing per design. Attachments PRA-2 and PRA-5 describe the CCDP determination.

While core damage prevention is an important consideration for plant safety, it is not Thermolag's sole intended function. Maintaining containment integrity by protecting containment isolation and heat removal capabilities is also required by 10CFR50, Appendix R. Additionally, containment analysis in the IPE report identified the loss of containment hydrogen control as a major cause of containment failure. Correspondingly, the effect of a fire in fire area D-8 on these functions was also examined. This analysis is detailed in attachments PRA-2 and PRA-5.

The third part of the analysis was to determine the fire ignition frequency in fire area D-8. This calculation utilizes the methodology described in the Fire-Induced Vulnerability Evaluation (FIVE) Guide, EPRI TR-100370 and the Fire Risk Analysis Implementation Guide, EPRI Project 3385-01. Ignition frequency calculation is described on attachments PRA-3 and PRA-6.

CONCLUSION

This results of this analysis found that no difference in CCDPs existed between the two cases. This result shows that the Thermolag installed in fire area D-8 provided no quantifiable benefit in preventing core damage. Additionally, no impact or benefit from Thermolag was found to exist relating to containment isolation capability, containment heat removal or containment hydrogen control.

Attachment PRA-1
Fire Database Development
and Fire Susceptible Events for
Thermolag Installations

The purpose of the fire PRA databases is to provide location specific information for the PRA model. This information includes the location of all PRA modeled equipment and supporting cables, the basic events (BE)s associated with said equipment, and the PRA initiators that could result from a fire in any fire area. A major resource for this task was the SLICE database system maintained by the NSED electrical design group. Database development covered all fire areas in the plant instead of being specific to individual fire areas.

How Database Was Developed

Database development was performed by completion of the following steps:

1. Identification of all basic events included in the PRA model. This task was performed by creating a BE report from the PROJECT.BE file using the CAFTA code.

2. Determine which basic events apply to each piece of modeled equipment. This task was performed by separating the BEs from task 1 by system and having each system analyst identify the equipment associated with each basic event. Some basic events, such as certain flow diversion events, had more than one piece of equipment associated with it. Human errors and maintenance unavailabilities were excluded from this task since these BEs would occur prior to a fire. This task generated database ELDB2.DBF.

3. Identify all power, control and instrumentation cables associated with each piece of modeled equipment. The SLICE database CABLE.DBF was used for this task. All equipment identified in task 2 were compared with the FR_EQUIPMT AND TO_EQUIPMT fields in the CABLE.DBF database. The resulting cables were then traced until either the 4.16KV/6.9KV or main control room cable risers/termination cabinets were reached. Tracing the cables involved not only the CABLE.DBF database, but also plant E02 and E03 drawings. The CPS safe shutdown analysis contained in USAR Appendix F was also reviewed to ensure all cables in that analysis associated with modeled equipment were included in the fire database. Cables to modeled equipment that would not disable the equipment if lost, such as position indication on non-interlocked valves, were not included in the database. Cables to the RAT and ERAT, though not explicitly modeled in the PRA, were included as a means of identifying fire areas where a fire could result in the loss of offsite power.

4. Identify the routing points associated with all identified cables. Routing points are intermediate locations on a cable tray or conduit. Using SLICE data, the trays containing each cable were identified, as well as all intermediate routing points.

5. Identify fire areas associated with each routing point. Using a SLICE system cross-index of routing point to fire area, the location of cables contained in cable tray was identified.

6. Identify fire areas associated with each piece of modeled equipment. This task was performed by a combination of plant general arrangement review and plant walkdown.

7. Identify fire areas associated with conduits and open cables. Since the SLICE database does not contain location information on conduit or open cables, this task was performed by a combination of plant general arrangement review and plant walkdown.

8. Identify equipment susceptible to spurious actuation from fire. This information was taken directly from the safe shutdown analysis contained in USAR Appendix F.

9. Identify internal events initiators that could occur due to a fire in a fire area. Using information gathered in previous tasks, all equipment and cables in this fire area were identified. This list was reviewed and a list of initiators resulting from the loss of all equipment and cables in fire area D-8 was compiled. This list was reviewed by an IPE analyst and a SRO and a final initiator list was developed.

Utilizing the information gathered in the previous steps, the fire location database ELDB1.DBF was completed.

Selection of Fire Susceptible BEs in Thermolag Areas

The structure of ELDB1 was set up so that for each piece of equipment, cables were identified up to the 4.16KV/6.9KV busses and/or the main control room termination cabinets. This resulted in listing some cables, particularly power cables, several times for different pieces of equipment. This approach allowed a database sort on fire area without losing control, power or instrumentation dependencies. Once the equipment and cables contained in a fire area were identified, the associated BEs were also determined. This list of BEs was reviewed and BEs that would not be affected by a fire were removed from the list of fire susceptible BEs. Examples of the type of BEs removed include the following: manual valve plugging, check valves failing to open, orifices plugging, all pre-event human errors and all maintenance unavailabilities. Attachment PRA-4 contains the lists of BEs and initiators generated from database ELDB1.DBF.

Prepared: M. E. DiFilaberto Date: 12/2/94
Reviewed: R. Weber Date: 12/5/94

94-0083

Attachment PRA-2

CONDITIONAL CORE DAMAGE FREQUENCY
AND CONTAINMENT IMPACT
FOR THERMOLAG INSTALLATIONS

For fire area D-8, all the basic events in the PRA that could be affected by a fire in the area were identified using the databases that were prepared for the fire PRA. For a basic event to be affected by a fire, either a fire susceptible component or associated power, control, or important instrumentation cable had to be located in fire area D-8. These basic events are called fire-susceptible basic events. The development of the data bases and the lists of fire susceptible basic events are described in attachment PRA 1.

CONDITIONAL CORE DAMAGE PROBABILITY

After the appropriate basic events were identified, two analyses were performed. First, all the fire-susceptible basic events involving that area were set to TRUE (meaning failed) in the original model, the model was requantified and the resulting conditional core damage probability (CCDP) was determined. This represents the case in which Thermolag is ineffective. Secondly, all the fire-susceptible basic events involving that area, except those which are protected with Thermolag, were set to TRUE in the models, and the resulting CCDP was determined. This represents the case in which there is an effective Thermolag fire barrier. The difference between the two results multiplied by the fire area ignition frequency represents the importance of the fire barrier. The larger the product of the ignition frequency and difference in CCDPs is, the more important is the Thermolag installation in that area. Attachment PRA-4 contains the list of basic events used for both cases in fire area D-8.

Following the completion of fire modeling it was found that all of the fixed ignition sources identified in fire area D-8 could be screened using FIVE and Fire PRA methods. Additionally, only transient oil had the potential for a significant fire. Correspondingly, the transient ignition frequency for oil was used in the calculation to determine the safety benefit of installed Thermolag in fire area D-8. Attachment PRA-7 details the transient oil ignition frequency calculation.

For thoroughness, it is important to go back to the original models to fail the appropriate components, because in the normal process of quantifying a PRA, many combinations of events that are unlikely without a fire are truncated out of the solution because they contribute very little to the

94-0083

CONTAINMENT FUNCTION EVALUATION

For defense in depth, the containment function is important, as well as core damage frequency. Because a low fraction of postulated core damage events lead to containment failure, a simplified method of assessing the impact of Thermolag failure was employed. Three functions that support containment integrity were analyzed independently. These functions are isolation, heat removal, and hydrogen control. The reliability of these functions was compared with the Thermolag failed and with the Thermolag assumed capable of performing as designed.

Examples of the various batch files and SETS user programs to perform this analysis are included in attachment PRA-5.

RESULTS

The CCDP calculated without crediting Thermolag was <2.0E-07 (2.0E-07 is the truncation limit used in the quantification process). The CCDP taking credit for Thermolag was also <2.0E-07. This result shows that Thermolag provides no quantifiable benefit in preventing core damage in fire area D-8. Additionally, no impact or benefit was found between the two analyzed cases relating to containment isolation, heat removal or hydrogen control capabilities in fire area D-8.

Prepared: M.E.J. Fiefalista Date: 12/5/94
Reviewed: P.E. Dilberg Date: 12/5/94

94-0083

Attachment PRA-3
Fire Ignition Frequencies
for Thermolag Areas

Following calculation of the conditional core damage probabilities (CCDPs), the results were reviewed and all fire areas with CCDPs greater than 1.0E-07 were identified. Fire areas with lower CCDPs were screened without additional analysis. In this fire area, the CCDP was calculated as being less than 2.0E-07 (the SETS quantification truncation limit). Since this value could potentially be slightly greater than the 1.0E-07 threshold, the ignition frequency must be calculated.

Development of Ignition Frequencies

The ignition frequency was calculated in accordance with the EPRI Fir(RA Implementation guide and the Fire-Induced Vulnerabi. .y Evaluation (FIVE) manual (EPRI TP-100370). The contractor for the fire PRA tailored collaboration, Scientific Applications International Corp. (SAIC), supplied EXCEL spreadsheets that duplicate the printed ignition frequency worksheets from the implementation manual. Generic fire frequencies were taken directly from the "Fire Events Database, Final Draft Report", dated 12/30/91, that was prepared by SAIC for Nuclear Safety Analysis Center (NSAC). Location weighting factors and ignition source weighting factor methods are specified by the implementation guide.

The major difficulty in the ignition frequency calculation methodology was the determination of the number and location of the plant ignition sources for both fire area D-8 and the plant as a whole. The implementation guide described the types of ignition sources that must be considered. Using the SLICE system EQUIPMEN.DBF database, all equipment matching the component type guidelines were identified. The SLICE system is maintained by the NSED electrical design group. Significant judgment was required in determining which components to include as sources. The bases for component selection were supplied by SAIC. For example, pumps of less than or equal to 5 HP were eliminated as ignition sources. Cables and junction boxes were eliminated as possible ignition sources since essentially all cable in the plant is IEEE-383 rated cable. Using the ignition source list developed from the SLICE system as a guide, fire area D-8 was then walked down and any additional ignition sources were added to the list. Selected system dumps from the MEL system were also reviewed. This was particularly important for the electrical cabinet categories since each individual breaker cubicle is counted as an individual cabinet.

fire areas associated with these sources were determined by comparing the column and row information from SLICE and MEL with the plant general arrangements. Selected areas were also reviewed from plant elevation drawings (E2X series). Walkdowns in approximately 10% of the plant fire areas were also performed as a check of the accuracy of the documentation review. It should be noted that the implementation guide allows equipment numbers and locations to be estimated by engineering judgment alone. Once locations were identified, the number of plant-wide components for each category were determined both plant-wide and by location type. Fire areas are characterized as belonging to different location types. Some location types were obvious, such as the main control room or turbine building. Others, such as switchgear rooms and reactor building locations were less apparent. Switchgear rooms were selected based on the existence of either 4.16 KV or 6.9 KV switchgear. The reactor building category was based on Mark I and Mark II containment layouts and encompassed fire areas in the Fuel, Auxiliary, Control and Diesel Generator buildings that were not included in other specific location types.

With the plant wide and location type component tabulations complete, the fixed ignition sources contributing to the ignition frequency in fire area D-8 were determined and entered onto the worksheets. In addition to fixed ignition sources, transient ignition sources were also examined. Transient ignition weighting factors were identified using the implementation guide. Specifically, contribution from smoking and candles were eliminated from consideration. The hot pipe contribution was also excluded for those fire areas without high energy piping. Once all component location information was entered, the fire area ignition frequency was calculated. The fire area D-8 ignition frequency is 1.5E-03 per year. For additional information, Attachment PRA-6 contains the fire area D-8 ignition frequency worksheet.

Prepared: M. E. DiLiberto Date: 12/2/94

Reviewed: P. E. Wiberg Date: 12/5/94

BASIC EVENT LIST FOR ALL MODELED CABLES IN AREA D-8

BASIC EVENT	DESCRIPTION
ADG01KBDGR	FAILURE OF DIESEL GENERATOR 01KB TO RUN
ADG01KBDGS	FAILURE OF DIESEL GENERATOR 01KB TO START
ADG01KBLMX	FAILURE OF DG01KB INITIATION CIRCUITS
AVD01CAFNR	FAILURE OF FAN VD01CA TO RUN
AVD01CAFNS	FAILURE OF FAN VD01CA TO START
AVD01YADMO	FAILURE OF DAMPER VD01YA TO OPEN
EWSFLOWXVC	WS DIVERSION FLOW VALVE FAILS TO CLOSE
YTRANSYTRX	TRANSIENT WITHOUT ISOLATION INITIATOR

94-0083

BASIC EVENT LIST FOR ALL NON-THERMOLAG WRAPPED CABLES IN AREA D-8

BASIC EVENT	DESCRIPTION
AVD01CAFNR	FAILURE OF FAN VD01CA TO RUN
AVD01CAFNS	FAILURE OF FAN VD01CA TO START
AVD01YADMO	FAILURE OF DAMPER VD01YA TO OPEN
EWSFLOWXVC	WS DIVERSION FLOW VALVE FAILS TO CLOSE
YTRANSYTRX	TRANSIENT WITHOUT ISOLATION INITIATOR

94-0083

Attachment PRA-5
Analysis of Conditional Core Damage Frequencies and Containment Degradation For Thermolag Fire Areas

94-0083

ANALYSIS OF CONDITIONAL CORE DAMAGE FREQUENCIES AND CONTAINMENT DEGRADATION FOR THERMOLAG FIRE AREAS

This attachment describes the method used for determining the likelihood of core damage, given that a fire has destroyed all essential equipment in a specified fire area. Basically, the method fails all components in a given area in the appropriate fault trees, and then re-solves the entire PRA model. This method was used rather than failing events in the core damage results from the PRA, because many components that do not appear in the core damage cutsets because they are inherently reliable may be failed by a fire. Therefore just starting with the core damage cutsets would not yield a true picture of the possible consequences from a fire in a given area. This method was used for the 94 fire areas of interest for the fire PRA.

INPUTS

The method starts with three inputs: the linked CAFTA fault tree models for the plant, the SETS user programs for solving the system and sequences for the level 1 PRA, and a list for each fire area of the basic events that are assumed failed and the initiating events that could result from a fire in a given area.

The linked CAFTA fault trees are in ZCNMT.CAF.

The SETS user programs for the PRA are as listed in appendix F of the PRA update report.

The lists of basic events and initiators are of the following example format.

<u>Example text input file (Area CB3B)</u>

```
D164A16CBD
D174A18CBD
D1DC03EBYD
D1DC04EBYD
D1DC08EBCD
D1RP04ETFZ
DBUSNXCSWH
DC164A1CBD
DC174A1CBD
DC71S1DSSO
DC71S1DSSX
DCC71SABCD
DCC71SBBCD
DCS001DIVD
DCS004AIVD
DCS004BIVD
DCUPS1AIVD
DCUPS1ASSO
DCUPS1ASSX
DCUPS1BIVD
```

94-0083

DCUPS1BSSO
DCUPS1BSSX
DD16E17CBD
DD17E19CBD
DDC1D1ACBD
DDC1D1BCBD
DDC1D1CCBD
DDC1E1ACBD
DDC1E3BCBD
DDC1E6BCBD
DDC1E7ACBD
DDC1F1ACBD
DDC1F3BCBD
DDC1F7ACBD
DDC1F8ACBD
DXVX14CFNR
DXVX14CFNS
ESXFLOWXVC
X1SX189AVO
X1VX14SHXP
YLOSSDCTRX
YTRANISTRX

IMPORTING FAULT TREES

The first step in solving the PRA model is to read the CAFTA fault tree files into SETS, simplify them, and form independent subtrees (IST) and stem equations. Two steps are taken before doing this in order to ensure that top events necessary for the sequence solutions are not unintentionally included in the ISTs. The first step is identical to that taken for the base PRA solution; to construct an additional fault tree containing all the events that we wanted to keep out of ISTs and then combine this with ZCNMT (the combined IPE fault tree model). The second step was similar, but necessary for this analysis and not the base PRA solution, because in the process of simplifying fault trees with many failed events, some top event equations are dropped if they evaluate to OMEGA (failed). A second auxiliary fault tree was constructed with all the top events that are necessary for the event tree sequence solutions. When this was combined with the ZCNMT, few top events vanished in the reformatting process.

INDEPENDENT SUBTREES

The reformatting process is implemented with the FRMNEWFT procedure in SETS. The user program for this procedure is produced by a BASIC program (ISTPREP) that reads the failure event text file and sets all the included events to OMEGA (true, ie. failed) and then continues to write a SETS program to set all initiators to 0.0 except those included in the failure event text file which are set to 1.0.

An example program to produce ISTs is shown here.

<u>Example SETS user program for form ISTS (CB3BIST.IN)</u>

```
PROGRAM$FORMIST.
COMMENT$ REFORM CAFTA FAULT TREE USING INDEPENDENT SUBTREES$
                  DLTBLK(CPS-STEM,CPS-IST,CPS-STEM1,CPS-IST1,CPS-STEM2).
FRMNEWFT(FORM1$ SETSIN / CPS-TEMP *NAMES$
YFIRE= XYFIRE ;
YIETP= XYIETP ;
YIET3= XYIET3 ;
```

94-0083

```
YIES1= XYIES1 ,
YIEA= XYIEA ,
YIEIA= XYIEIA ,
YIET2= XYIET2 ,
YIET4= XYIET4 ,
YIET5= XYIET5 ,
YIES2= XYIES2 ,
YIET9= XYIET9 ,
YIESW= XYIESW ,
YIEDC= XYIEDC ,
YC2= XYC2 ,
YC2A= XYC2A ,
YU1= XYU1 ,
YC8= XYC8 ,
YW= XYW ,
YDG= XYDG ,
YQ= XYQ ,
YQ1= XYQ1 ,
YQ2= XYQ2 ,
YX1= XYX1 ,
YU2= XYU2 ,
YC1= XYC1 ,
YC3= XYC3 ,
YC= XYC ,
YC4= XYC4 ,
YC5= XYC5 ,
YC6= XYC6 ,
YC7= XYC7 ,
YC9= XYC9 ,
YDG1= XYDG1 ,
YDG2= XYDG2 ,
YL1= XYL1 ,
YL4= XYL4 ,
YL6= XYL6 ,
YU= XYU ,
YDIES1= XYDIES1 ,
YDIES2= XYDIES2 ,
YM1= XYM1 ,
YP1= XYP1 ,
YX2= XYX2 ,
YH1= XYH1 ,
YIET9B= XYIET9B ,
YIET9C= XYIET9C ,
YIET9D= XYIET9D ,
YM= XYM ,
YP= XYP ,
YW1= XYW1 ,
YX= XYX ,
YU3= XYU3 ,
YW2= XYW2 ,
YRHALONG= XYRHALONG ,
YRHBLONG= XYRHBLONG ,
YRHCLONG= XYRHCLONG ,
YHPLONG= XYHPLONG ,
YLPLONG= XYLPLONG ,
YCRD= XYCRD ,
YCDCBSUM= XYCDCBSUM ,
R1LPCIAX= XR1LPCIAX ,
R2LPCIBX= XR2LPCIBX ,
R3LPCICX= XR3LPCICX ,
YLPCS= XYLPCS).

FRMNEWPT(FORM3$ CPS-TEMP,NONMOD,FIRETOPS / CPS-STEM1,CPS-IST *OMEGA$
D164A16CBD,
D174A18CBD,
D1DC03EBYD,
D1DC04EBYD,
D1DC08EBCD,
D1RP04ETFZ,
DBUSNXCSWH,
DC164A1CBD,
DC174A1CBD,
DC71S1DSSO,
DC71S1DSSX,
DCC71SABCD,
DCC71SBBCD,
DCS001DIVD,
DCS004AIVD,
DCS004BIVD,
DCUPS1AIVD,
DCUPS1ASSO,
DCUPS1ASSX,
DCUPS1BIVD,
DCUPS1BSSO,
DCUPS1BSSX,
DD16E17CBD,
DD17E19CBD,
```

94-0083

```
DDC1D1ACBD,
DDC1D1BCBD,
DDC1D1CCBD,
DDC1E1ACBD,
DDC1E3BCBD,
DDC1E6BCBD,
DDC1E7ACBD,
DDC1F1ACBD,
DDC1F3BCBD,
DDC1F7ACBD,
DDC1F8ACBD,
DXVX14CFNR,
DXVX14CFNS,
ESXFLOWXVC,
X1SX189AVO,
X1VX14SHXP).

FRMNEWFT(FORM1$ CPS-STEM1 / CPS-STEM *TRIM$ GATE01).
DLTBLK(CPS-TEMP,CPS-STEM1).
BLKSTAT.
```

The first call to FRMNEWFT (Form1) renames all the top events required for the event tree sequence solution to correspond the auxiliary fault tree. The second call (Form3) is the procedure call that OMEGAs the appropriate basic events and forms the ISTs and STEM. Finally the third call removes the logic for the first auxiliary fault tree, so that no time is wasted in solving it.

INITIATOR FREQUENCY CORRECTION

Before the fault trees are solved, the initiators are adjusted using the other program that is produced by the BASIC program ISTPREP.

Example SETS user program to adjust initiator frequencies (CB3BDATA.IN)

```
PROGRAM$FIREDATA.
COMMENTS$ READS IN FIRE PRA-SPCIFIC SCENARIO INITIATORS $
RDVALBLK(CPSBEDAT).
\
VALUE BLOCK$ CPSBEDAT.

COMMENTS$ INITIATOR ADJUSTMENTS FOR FIRE AREA $
 0.00     $ YLOSSFWTRX   $
 0.00     $ YTRANSYTRX   $
 1.00     $ YTRANISTRX   $
 0.00     $ YIORVXXTRX   $
 0.00     $ YLLOCAXTRX   $
 0.00     $ YMEDLOCTRX   $
 0.00     $ YSBLOCATRX   $
 0.00     $ YLOOPXXTRX   $
 1.00     $ YLOSSDCTRX   $
 0.00     $ YLOSSIATRX   $
 0.00     $ YLOSSSWTRX   $
 0.00     $ YISLOCATRA   $
 0.00     $ YISLOCBTRX   $
 0.00     $ YISLOCCTRX   $
 0.00     $ YISLOCDTRX   $
\
```

EVENT TREE HEADING SOLUTION

After these two programs are run, then the ISTs and the STEM equations are solved. This is done with straight-forward applications of the GENFTEQN procedure, using the SOLVIST and SOLVE

94-0083

SETS user programs. These programs are edited to set the truncation level at 1E-7.

After these solutions, it is necessary to form an equation block with only the top events which are needed for the event tree sequence solutions. This is done with another SETS user program, but it must be unique for each fire area. As mentioned above, when a top event is evaluated as OMEGA, the equation is lost. Therefore when that top event subsequently appears in a sequence equation, the sequence equation cannot be solved. In order to avoid the need to rewrite the sequence solutions for each fire area, the top events that are lost need to be re-defined. In addition, combination events are sometimes lost, as well. For example, high pressure injection (YU) is a combination of high pressure core spray (YU1) and feedwater (YQ1). If one of these is evaluated as OMEGA, then YU should equal the other input. SETS doesn't handle this correctly. To accommodate these two shortcomings, another BASIC program (SUPREP) was developed to read the output of the FRMNEWFT procedure and make the proper equation adjustments. An example SETS user program resulting from the BASIC program follows.

<u>Example SETS user program to form top event equation block (CB3BSU.IN)</u>

```
PROGRAM$SQSETUP.
COMMENT$ SET UP BLOCK WITH EVENT TREE HEADINGS $
LDBLK(CPS-STEM-EQN).

YQ = OMEGA.
SUBINEQN(YQ,YQ).
YQ2 = OMEGA.
SUBINEQN(YQ2,YQ2).
YCDCBSUM = OMEGA.
SUBINEQN(YCDCBSUM,YCDCBSUM).
YQ1 = OMEGA.
SUBINEQN(YQ1,YQ1).
YCRD = OMEGA.
SUBINEQN(YCRD,YCRD)..
YIEA = /OMEGA.
SUBINEQN(YIEA,YIEA).
YX = GGATE01.
SUBINEQN(YX,YX).
YX1 = GGATE01.
SUBINEQN(YX1,YX1).
YU = YU1.
SUBINEQN(YU,YU).

DLTBLK(CPS-TOPS).
FRMBLK(CPS-TOPS* ONLY$ YFIRE, YIETP,YIET3,YIES1,YIEA,YIEIA,YIET2,
        YIET4,YIET5,YIES2,YIET9,YIESW,YIEDC,YC2,YC2A,YU1,YC8,YW,
        YDG,YQ,YQ1,YQ2,YX1,YU2,YC1,YC3,YC,YC4,YC5,YC6,YC7,YC9,
        YDG1,YDG2,YL1,YL4,YL6,YU,YDIES1,YDIES2,YM1,YP1,
        YX2,YH1,YIET9B,YIET9C,YIET9D,YM,YP,YW1,YX,YU3,YW2,YRHALONG,
        YRHBLONG,YRHCLONG,YHPLONG,YLPLONG,YCRD,YCDCBSUM,R1LPCIAX,
        R2LPCIBX,R3LPCICX,YLPCS).

BLKSTAT.
```

EVENT TREE SEQUENCE SOLUTIONS

After these mechanizations, the sequence equations are used to solve all the event tree sequences. The SETS user programs were adjusted to analyze all sequences to a truncation level of 1.0E-7. The final result cutsets are truncated at 2.0E-7. One other modification to the sequence solution was made to eliminate the

analysis for dependent human failures. Because so many headings turned out to be OMEGA, the dependent HRA analysis would have to be customized for each fire case, and the work necessary for that was judged to be excessive for the benefit that could be gained. One change was made to SEQTRAN.IN to avoid formation of an empty block when all transient initiators become ISTs.

THERMOLAG BENEFIT

For areas in which Thermolag is employed as a fire barrier, the above analysis was repeated. The first analysis was with all basic events in the area failed, as though Thermolag provides no benefit. The second analysis assumed that Thermolag was effective, and the protected basic events were not failed.

CONTAINMENT FUNCTIONS

In order to be thorough in evaluating the Thermolag importance, the benefit of Thermolag to containment function, in addition to core damage potential, needed to be evaluated. Running the entire suit of containment sequence solution SETS user programs for all Thermolag applications would be very time consuming. It would also be very difficult, with unique programs required for each area because of the loss of terms that evaluate to OMEGA, as described above. Consequently a simplified method was used. Three containment functions were evaluated as follows: containment heat removal, containment isolation, and hydrogen control. These functions were evaluated independently, rather than through containment event tree sequences.

Containment heat removal capability was modeled as possible by the RHR fault tree, containment spray (YCNMSA, YCNMTSB) and suppression pool cooling (YSPCA, YSPCB) modes. Containment isolation was evaluated with the containment isolation fault tree (KGATE01), and hydrogen control was modeled with its fault tree (CGATE101). The first comparison was for which of these headings were OMEGAd in the Form New Fault Tree procedure call as discussed above under the EVENT TREE HEADINGS heading. If the same events were OMEGAd for both the Thermolag failure and Thermolag success cases, no further action was required, as Thermolag provided no benefit to the model. For cases in which there were differences in the headings that were OMEGAd (This happened for only CNMT heat removal in two areas.), a user program was developed to evaluate the combination of YCNMTSA, YCNMTSB, YSPCA, and YSPCB with the appropriate events OMEGAd. The difference in results between the Thermolag failure and Thermolag success in this analysis is the importance of Thermolag in the area to protecting the containment heat removal function.

BATCH FILE AUTOMATION

The entire process described above, except for the final CNMT heat removal analysis, is implemented by using batch files. The complete solution for a list of areas can be performed by calling

TLSOLN with a list of areas as command line parameters. TLSOLN in turn calls other batch files. The first one called is TLPREP, which runs the BASIC programs to produce the input files. The second call is to TLSYS, which solves the system and event tree heading equations and prepares the equation block with all the necessary headings for the event tree solutions. The third is TLSEQ, which solves the individual event tree sequences, does all recoveries, combines the sequences into final results, and then processes and prints the final results. TLSOLN then calls TLSIFT to identify the containment functions that are failed for each case. The programs and data to complete this process are listed below.

TABLE OF CALLED PROGRAMS AND PROCEDURES

(Note: AREA is used as a generic term to be replaced by each area designation.)

PROGRAM	DESCRIPTION	CALLS	DATA
TLSOLN.BAT	Does entire solution for listed areas	TLPREP.BAT TLSYS.BAT TLSEQ.BAT TLSIFT.BAT	
TLPREP.BAT	Prepares SETS inputs for specified area INPUTBLK.FIR	KEY-FAKE.COM ISTPREP.BAS SUPREP.BAS	
KEY-FAKE.COM	Public Domain utility for command line BASIC parameters		
ISTPREP.BAS	Prepares input to form ISTs and adjust initiators AREA.TXT Writes AREAIST.IN and AREADATA.IN TEMPIST.TXT		
AREA.TXT	Text files containing BE's to be failed and intiators to occur		
SUPREP.BAS	Prepares SETS input for setting up ET top events AREAIST.OUT Writes AREASU.IN		
INPUTBLK.FIR	SETS block file containing only the fault trees from CAFTA		
TLSYS.BAT	Solves for event tree headings	READTL.IN AREAIST.IN AREADATA.IN SOLVIST.IN SOLVE.IN AREASU.IN BLOCKSTA.IN WRITETOP.IN READBLKS.BAS PURGE.COM DO.BAT	
READFIRE.IN	Prepared from CAFTA files for ZCNMT, ZNONMOD, and ZTL. Makes initial SETS block for remainder of programs.		
SOLVIST.IN	Uses SETS procedure GENFTEQN with the SAVE option for ISTs		
SOLVE.IN	Uses SETS procedure GENFTEQN to solve all stem equations. Prepared by using the GENFTEQN with the WRITE option on the		

94-0083

original models with no events OMEGAd in order to solve and save all ET headings.

BLOCKSTA.IN Uses SETS procedure BLKSTAT to check status of equation block

WRITETOP.IN Uses SETS procedures WRTBLK and WRTVALBLK to prepare switch file (SWFL) to form a new block file with only ET headings

READBLKS.BAS Prepares SETS input file READTEMP.IN to form a new block file READBLKS.IN

PURGE.EXE Utility file to remove excessive line and form feeds from SETS output

DO.BAT Utility to print text in small font with small line spacing

TLSEQ.BAT Calls all sequence SETS user programs in sequence to solve multiple sequences, including recoveries CUTVAL.BAS

CUTVAL.BAS Reads output from SETS COMTRMVAL and lists the results in CUTVAL.OUT

TLSIFT.BAT Prepares lists of CNMT function headings that have been set to OMEGA. ISTSIFT.BAS

ISTSIFT.BAS Picks out CNMT function headings that have been set to OMEGA by the AREAIST SETS user program.

94-0083

PROGRAM LISTINGS

TLSOLN.BAT

```
:START
IF %1A==A GOTO END
ECHO %1
CALL TLPREP.BAT %1
CALL TLSYS.BAT %1
CALL TLSEQ.BAT %1
REM CALL TLIMP.BAT %1
PKZIP -A D:\FIRE\%1RES.\PCS\FIRE\SEQ\CUTCOMB.OUT
PKZIP -A D:\FIRE\%1RES \SETSBU\SEQCOMB.FIR
COPY \SETSBU\SEQCOMB.FIR %1COMB.RES
REM DEL \SETSBU\%1*.FIR
CALL TLSIFT.BAT %1
SHIFT
GOTO START
:END
```

TLPREP.BAT

```
CD INPUT
DEL PREPBAT.DAT
:START
IF %1A==A GOTO END
REM ****************** PREPARE IST AND DATA FILES
ECHO %1
KEY-FAKE "%1" 013
E:\SY\BASIC\GWBASIC \PCS\TL\INPUT\ISTPREP >> PREPBAT.DAT
REM
COPY \SETSBU\INPUTBLK.FIR BKFL
REM ************** FORM ISTS
COPY %1IST.IN INFL
E:\SY\PCSETS\PCSETS > %1IST.OUT
FIND "ERROR" %1IST.OUT
FIND "ERROR" %1IST.OUT >> PREPBAT.DAT
REM ********************** PREPARE SETUP PROGRAM
KEY-FAKE "%1" 013
E:\SY\BASIC\GWBASIC \PCS\TL\INPUT\SUPREP
REM **************** RECYCLE AND START OVER
SHIFT
GOTO START
:END
CD..
ECHO R
```

TLSYS.BAT

```
:START
IF %1A==A GOTO END
F:
CD\PCS\TL\SYS
DEL SYSBAT.DAT
REM GOTO JUMP
DEL BKFL
COPY F:\SETSBU\READFIRE.IN D:\SCRATCH\READCAF.IN
COPY D:\SCRATCH\READCAF.IN INFL
E:\SY\PCSETS\PCSETS > D:\SCRATCH\READCAF.OUT
FIND "ERROR" D:\SCRATCH\READCAF.OUT > SYSBAT.DAT
FIND "ERROR" D:\SCRATCH\READCAF.OUT
REM DEL READCAF.OUT
REM ************** FORM ISTS
COPY \PCS\TL\INPUT\%1IST.IN INFL
E:\SY\PCSETS\PCSETS > %1IST.OUT
FIND "ERROR" %1IST.OUT
FIND "ERROR" %1IST.OUT >> SYSBAT.DAT
REM ####### READ AREA DATA ###########
COPY \PCS\TL\INPUT\%1DATA.IN INFL
E:\SY\PCSETS\PCSETS > %1DATA.OUT
FIND "ERROR" %1DATA.OUT
FIND "ERROR" %1DATA.OUT >> SYSBAT.DAT
REM ************** ISTS
COPY SOLVIST.IN INFL
E:\SY\PCSETS\PCSETS > SOLVIST.OUT
FIND "ERROR" SOLVIST.OUT
FIND "ERROR" SOLVIST.OUT >> SYSBAT.DAT
FIND "NO EQUATION" SOLVIST.OUT >> SYSBAT.DAT
COPY BKFL F:\SETSBU\%1IST.FIR
GOTO SKIPSTEM
```

94-0083

```
REM ***************    STEMS
DCOPY SOLVSTEM.IN INFL
E:\SY\PCSETS\PCSETS > SOLVSTEM.OUT
FIND "ERROR" SOLVSTEM.OUT
FIND "ERROR" SOLVSTEM.OUT >> SYSBAT.DAT
FIND "NO EQUATION" SOLVSTEM.OUT >> SYSBAT.DAT
COPY BKFL F:\SETSBU\%1STEM.FIR
:SKIPSTEM
REM ***************    STEMS
COPY SOLVE.IN INFL
E:\SY\PCSETS\PCSETS > SOLVE.OUT
FIND "ERROR" SOLVE.OUT
FIND "ERROR" SOLVE.OUT >> SYSBAT.DAT
REM FIND "NO EQUATION" SOLVE.OUT >> SYSBAT.DAT
COPY BKFL F:\SETSBU\%1STEM.FIR
GOTO SKIPEQN
REM ***************
REM COPY GENFTUPG.IN INFL
REM E:\SY\PCSETS\PCSETS > GENFTUPG.OUT
REM CALL DO HP SGFL.SUP CO
REM ******************
:SKIPEQN
REM SEQ SET UP ****************************
COPY \PCS\TL\INPUT\%1SU.IN INFL
E:\SY\PCSETS\PCSETS > %1SU.OUT
FIND "****" %1SU.OUT >> SYSBAT.DAT
FIND "NO EQUATION" %1SU.OUT >> SYSBAT.DAT
FIND "ERROR" %1SU.OUT >> SYSBAT.DAT
COPY BKFL F:\SETSBU\%1HDG.FIR
COPY \PCS\BLOCKSTA.IN INFL
E:\SY\PCSETS\PCSETS > BLOCKSTA.OUT
REM MAKE ET SWFL ***********************
ECHO Y | DEL D:\SCRATCH\*.*
DEL SWFL
COPY WRITETOP.IN INFL
E:\SY\PCSETS\PCSETS > WRITETOP.OUT
FIND "****" WRITETOP.OUT >> SYSBAT.DAT
FIND "NO EQUATION" WRITETOP.OUT >> SYSBAT.DAT
FIND "ERROR" WRITETOP.OUT >> SYSBAT.DAT
E:\SY\BASIC\GWBASIC F:\PCS\READBLKS >> SYSBAT.DAT
DEL BKFL
COPY D:\SCRATCH\READTEMP.IN INFL
E:\SY\PCSETS\PCSETS > D:\SCRATCH\READTEMP.OUT
FIND "****" D:\SCRATCH\READTEMP.OUT >> SYSBAT.DAT
FIND "NO EQUATION" D:\SCRATCH\READTEMP.OUT >> SYSBAT.DAT
FIND "ERROR" D:\SCRATCH\READTEMP.OUT >> SYSBAT.DAT
COPY BKFL \SETSBU\%1TOPS.FIR
REM **************** OUTPUTS
DIR F:\SETSBU\%1*.FIR >> SYSBAT.DAT
DIR %1*.OUT >> SYSBAT.DAT
REM COPY BLOCKSTA.OUT SETS.OUT
REM E:\SY\PCSETS\PURGE
REM TYPE TEMP.DOC >> SYSBAT.DAT
CALL DO HP SYSBAT.DAT CO
rem COPY %1.OUT SETS.OUT
REM E:\SY\PCSETS\PURGE
REM CALL DO HP TEMP.DOC CO
CD ..
SHIFT
GOTO START
:END
ECHO R R
ECHO DONE
ECHO RR
```

TLSEQ.BAT

```
:START
IF %1A==A GOTO FINISH
F:
CD \PCS\TL\SEQ
REM  ASSUMES THAT THE LATEST BLOCKFILE ETTOPS.FIR IS IN \SETSBU
REM  AND THAT THE LATEST FIRE SOLUTION ISTSOLN.FIR IS IN \SETSBU
DEL SEQBAT.DAT
REM GOTO JUMP
REM ******* FORMAT AND READ IN IST EQUATIONS ***********
DEL BKFL
COPY \SETSBU\%1IST.FIR BKFL
DEL SWFL
COPY WRITISTS.IN INFL
E:\SY\PCSETS\PCSETS > WRITISTS.OUT
FIND "****" WRITISTS.OUT >>  SEQBAT.DAT
FIND "NO EQUATION" WRITISTS.OUT >>  SEQBAT.DAT
REM FIND "ERROR" WRITISTS.OUT >>  SEQBAT.DAT
E:\SY\BASIC\GWBASIC F:\PCS\READISTS >> SEQBAT.DAT
```

COMPARTMENT FIRE FREQUENCY WORKSHEET

PLANT - CLINTON
COMPARTMENT D-8

Reference Area:
Reactor Building (BWR)

Transients allowed in this area
Welding, Ext. cords, Heaters, Open flame, Heating of combustibles
Flammable liquid or gas tanks/piping in this zone: Yes ___ No X

Components	Generic Fire Frequency (f) (1)	Location Weighting Factor (WL) (2)	M (3)	Ignition Source Weighting Factor WI			Compartment Fire Frequency
Rx BLDG COMPONENTS				Number of these ignition sources in the compartment	Total number of these ignition sources in the Reactor Building		
Electrical Cabinets	6.0E-02	1.0E+00	B	3	773	3.9E-03	1.9E-04
Pumps	2.6E-02	1.0E+00	B	0	59	0.0E+00	0.0E+00
PLANT-WIDE COMPONENTS				Weight (or Btus) of cable insulation in this compartment	Weight (or Btus) of cable insulation in Appendix R areas, excluding radwaste or containment		
Non-qualified cable run	8.2E-03	1.0E+00	E	0	0	0.0E+00	0.0E+00
Junction box/splice in NQ cable	1.6E-03	1.0E+00	E	0	0	0.0E+00	0.0E+00
Junction box in Q cable	1.6E-03	1.0E+00	E	0	0	0.0E+00	0.0E+00
				Number of these ignition sources in the compartment	Total number of these ignition sources in all locations listed in Table 1-3		
Fire Protection Panels	2.4E-03	1.0E+00	F	1	114	8.8E-03	2.1E-05
RPS MG sets	6.6E-03	1.0E+00	F	0	2	0.0E+00	0.0E+00
Transformers	7.9E-03	1.0E+00	F	0	169	0.0E+00	0.0E+00
Battery Chargers	4.0E-03	1.0E+00	F	0	6	0.0E+00	0.0E+00
Air compressors	4.7E-03	1.0E+00	F	2	11	1.8E-01	8.5E-04
Ventilation Subsystems	9.6E-03	1.0E+00	F	2	630	3.2E-03	3.0E-05
Elevator motors	8.3E-03	1.0E+00	F	0	6	0.0E+00	0.0E+00
Dryers	8.7E-03	1.0E+00	F	0	3	0.0E+00	0.0E+00
				Number of these ignition sources in the compartment	Total number of these ignition sources in all plant locations (including those not specified in Table 1-3)		
Off-gas/H2 recombiner	8.8E-02	1.0E+00	G	0	4	0.0E+00	0.0E+00
Hydrogen Tanks	3.2E-03	1.0E+00	G	0	0	0.0E+00	0.0E+00
Gas turbines	3.1E-02	1.0E+00	G	0	0	0.0E+00	0.0E+00
				Enter 1 if these fires could occur, enter 0 they can not occur.	Total number of compartments where misc. other hydrogen fires could be present		
Miscellaneous hydrogen fires	3.2E-03	1.0E+00	C	0	3	0.0E+00	0.0E+00
TRANSIENTS					Total number of compartments in Table 1-3 plant locations		
Cable fires - welding	6.1E-03	1.0E+00	C	1	121	8.3E-03	4.2E-05
Transient fires - welding	3.1E-02	1.0E+00	C	1	121	8.3E-03	2.6E-04
				Sum of ignition source weighting factors for transients	Total number of zones in Table 1-3 plant locations		
Transients-other	1.3E-03	1.0E+00	D	9	121	7.4E-02	9.7E-05
						TOTAL	1.5E-03

(1) From FEDB Report Table 1-3
(2) See FIVE Reference Table 1.1 for guidance
(3) Ignition source weighting factor method. See FEDB Table 1-3 for guidance.

94-0083

RESULTS OF MAINTENANCE HISTORY REVIEW FOR OIL AS A TRANSIENT COMBUSTIBLE IN FIRE AREA D-8

In order to determine the significance of oil as a transient combustible in fire area D-8, maintenance records and surveillance data were reviewed to determine how often oil was present in the fire zone. The only oil lubricated equipment located within fire area D-8 are the two breathing air compressors. Since no other fire areas can be reached by traversing fire area D-8. Correspondingly, only activities related to the breathing air compressors need to be considered when determining the significance of transient oil.

The breathing air compressors are located within fire area D-8, it is assumed that each oil change requires 1 shift (8 hours).

Preventive Maintenance Activities

The first group of maintenance records examined were for preventive maintenance activities (PMs). PMs are performed either at regular time intervals or in response to a specific event or number of events.

0RA01CA(B) - Change compressor oil every 6 months. Since nothing requires that both compressors have the oil changed simultaneously, oil changes are analyzed as occurring separately.

(2 compressors)(2 evol/yr)(480 min/evol) = 1920 min/yr

1VD01CA - Grease lubricated.

Corrective Maintenance Activities

The remainder of the maintenance records examined were for corrective maintenance activities. Corrective maintenance is performed in response to degradation or failure of a piece of equipment. Only maintenance work requests (MWRs) that specifically included oil replacement in the job steps or listed oil in the materials used section were included.

The following corrective maintenance activities were performed over the period of 6/22/94 - 4/28/86.

0RA01CB - 1 evolution

(1 evol/8.15 yr)(480 min/evol) = 58.9 min/yr

Significance Calculation

The sum of all of the oil traverses of fire zone D-8 is 1978.9 min/yr. The total number of minutes in a year is 525,600. This gives a probability of oil being present in fire zone D-8 of 1978.9/525600 or 3.77E-03.

3.99E-04 - Transient Combustible Ignition Frequency for Fire Zone D-8 (Transient Section, Attachment PRA-6).

0.1 - Probability of Oil Being Exposed In Violation of the Fire Protection Program (FIVE manual).

<2.0E-07 - Whole Zone CCDP for Fire Zone D-8.

(3.77E-03)(3.99E-04)(0.1)(2.0E-07) = 3.01E-14, Not significant as a transient combustible

(Note: the product of the transient combustible ignition frequency, probability of oil being exposed and the probability of oil being in the zone is also referred to as the ignition frequency for transient oil)

It should be noted that the breathing air compressors are currently tagged out and are in the process of being abandoned in place. When this change is completed it will effectively eliminate the risk from transient or fixed oil fires in fire area D-8.

94-053

Evaluation of Ampacity Derating for Thermo-Lag Installation

Topic:

Consideration of the existing cable ampacities in this area with respect to the NRC concerns over the ampacity derating needed for Thermo-lag installations.

Design statement:

Clinton Power Station project ampacities for cables in tray and conduit were established in calculations 19-G-01 and 19-G-02, respectively. These values are conservative in magnitude and were used during the design process as one of the parameters for selecting the size and type of cable for a specific circuit. A separate calculation (19-AI-8) was performed to determine the amount of ampacity derating needed to account for the increased heat retention (due to the Thermo-lag installation) in a cable tray. No specific calculation was performed to establish a derating factor for cables installed in Thermo-lag protected conduits. Derating values are viewed as suspect by the NRC, but no new values have been endorsed by them.

For the installation in fire area D-8, the conduits contain a single 3/C, 750 MCM, 5KV cable each and have a one hour wrap of Thermo-lag applied. The cables are carrying a three phase power feed so there will be no magnetic heating of the conduits. The conduits are transversing an area which does not contain heat producing equipment/machinery and has free air exchange with the outside environment. Based on these considerations, an ambient air temperature of 40°C is a conservative value to use in reviewing this installation.

CONDUIT	CABLE	TYPE	PROJECT AMPACITY, CONDUIT IN 40C AMBIENT	LOAD AMPERES	LOAD_%_OF AMPACITY	ALLOWABLE DERATING
C92118	1DG31A	3/C,750,5KV	514	338.4	65.84%	34.16%
C92120	1DG31B	3/C,750,5KV	514	338.4	65.84%	34.16%

This review indicates that these cables are not overloaded and could be subjected to a 34% ampacity derating requirement without being impacted.

The information put out by the NRC has related to ampacities for cables in trays. In IEIN 94-22 (and Sandia Lab report 94-0146) the largest derating value mentioned by the NRC is 46.4% for a #8 AWG conductor in a tray with a three hour wrap of Thermo-lag applied. This does not translate directly to conduit installations. Single cables in conduits have larger ampacities (IEEE S-135-1, IPCEA P-46-426) than cables in tray (NEMA WC51-1972, IPCEA P-54-440). Testing performed by UL (ref. project #86NK23826, file

R6802) and TVA (see the report by M. Salley and K. Brown) has demonstrated that the ampacity derating needed for cables in Thermo-lag wrapped conduits is significantly less than that for similarly wrapped tray. The UL derating value of 9.4% for conduit with a three hour wrap of Thermo-lag is one example of this. The derating needed for a one hour wrap would be expected to be an even lower value. This further supports that there is no ampacity concern with these DG cables.

Although no definitive derating numbers for conduit have been established, we can review the reasons for ampacity limitations and derating. Cable ampacities are selected to limit the amount of heat a cable will produce while carrying a continuous load. This ensures that the cable will not be forced to operate at a temperature above its rating. In this instance the cables are rated for continuous 90°C operation for the life of the cable. Below, the cables tested by Sandia lab for the NRC are examined with respect to the methodology developed by Stolpe (IEEE Transaction Paper 70 TP 557 PWR *Ampacities for cables in Randomly Filled Cable Trays* by J. Stolpe). For this evaluation, tray fill was determined per step 2.2 of ICEA P-54-440 which uses diameter squared for area without the pi/4 component. This resulted in a tray fill depth of 1.41" and the P-54-440 tabulated values for 1.5" fill were utilized in the comparison of data. All heat intensities were calculated using the actual cross-sectional area of the cable. Since the same numbers were used for each section of the evaluation, the heat intensities can be directly compared.

Cable	Diameter	Area	90C Resist	Open Amps	Watts/ft	Ht Intensity	Tlag Amps	Watts/ft	Ht Intensity
NRC #8	0.23	0.041548	0.0008	23.7	0.449352	10.81534	12.7	0.129032	3.105638
NRC #4	0.33	0.08553	0.000323	37.9	0.460944	5.389261	24.2	0.188927	2.208901
NRC #2/0	0.52	0.212372	0.000101	113.6	1.307272	6.155574	73.5	0.547248	2.576835
NEMA #8	0.23	0.041548	0.0008	15.3	0.187272	4.507402	11.4	0.086528	2.08262
NEMA #4	0.33	0.08553	0.000323	34	0.372926	4.36017	23.12	0.172441	2.016143
NEMA #2/0	0.52	0.212372	0.000101	85.3	0.920016	4.332092	64.8	0.425363	2.002912
CPS #8	0.23	0.041548	0.0008	13.1	0.137288	3.30435	8.9	0.063368	1.525188
CPS #4	0.33	0.08553	0.000323	29.1	0.273181	3.193975	19.8	0.126472	1.478686
CPS #2/0	0.52	0.212372	0.000101	81.5	0.67286	3.168306	55.4	0.310806	1.463497
3/C,750,5KV	3.428	9.22938	0.000016	514	14.26858	1.545779			
1DG31A	3.428	9.22938	0.000016	338.4	6.183786	0.67001			

The first set of numbers translates the ampacities reported in 94-22 into heat intensities for open (unwrapped) and Thermo-lag wrapped trays. The NEMA numbers show the heat intensities that would be produced if the ampacity values from table 3-1 of P-54-440 were utilized for the cables tested by the NRC. The CPS numbers show the heat intensities that would be produced if the methodology used for determining ampacity limits at CPS (Calc 19-G-1) were applied to these conductors, but using a 1.5" fill rather than the nominal 2" fill of CPS design. Tlag ampacity values for the NEMA and CPS tables were calculated based on the 32% derate factor derived in Calc 19-AI-8.

Comparison of the results shows that the NEMA values produce lower heat intensities (and therefore lower overall heat in the tray) than the NRC values. The CPS values are even more conservative with resultant lower intensities. Even though the derate factor for the NEMA and CPS sections is smaller than the NRC values (32% vs. 46.4%, 36%, and 35.3%), the Tlag heat intensities continue to demonstrate that the NEMA-based values produce more conservative results. The reasons for this are found in Stolpe's methodology.

In his paper, Stolpe describes a general method for calculating allowable cable ampacities. By determining the amount of heat that can be dissipated from the tray and distributing that heat through all the cables in the tray, Stolpe defines a conservative upper limit for cable ampacities. The method requires that the allowable depth of fill for the tray be known at the start of the design process so that the ampacity values can be determined before cable selection and installation. At CPS the initial design consideration was to select two inches as the nominal fill depth for power tray and determine the allowable cable ampacities accordingly.

In contrast, the test method used in 94-22 will produce very specific ampacity limits but it will be based on very specific configurations. Due to the limited data available at this time concerning the orientation and distribution of the reported conductors in the test tray, it is unclear just how configuration dependent these test results are. However, given the uneven heat production of the tested conductors it seems likely that relocating the conductors within the confines of the test tray would impact the heat distribution and could affect the reported results. This could mean that in order to use the ampacity values provided by this type of testing, there would have to be tests run for every type of cable singly, in multiples, and in combination with single and multiple specimens of every other type of cable. Whether the same combinations of cables would have to be tested in various sizes and configurations of tray would be a subject for debate. Just determining the various configurations to be tested would require a significant amount of review and evaluation.

To demonstrate the conservatism of the cable selection employed, the cables in area D-8 were added to the heat intensity table. As shown, the present loading of the cables (338.4 Amps) results in heat intensities lower than the lowest values shown in the right hand column. While these cables are in conduit rather than tray, this still demonstrates the acceptability of the installation since cables in conduit are allowed higher ampacities than cables in tray. Therefore since these cables would be acceptable in a tray installation, their use in a conduit is also acceptable from an ampacity aspect. Thus these cables will not be impacted by the NRC concerns over ampacity.

Prepared Mark McMenamin 12/9/94

Reviewed David G. Fortstein 12/9/94

References

ICEA P-54-440 (NEMA WC 51-1986)
ICEA P-46-426 (IEEE S-135-1)
IEEE Transaction paper 70 TP 557 PWR *Ampacities for Cables in Randomly Filled Cable Trays* by J. Stolpe
EPRI Power Plant Elec. Ref. Series Vol.4 *Wire and Cable*
IEIN 94-022
Sandia Lab report SAND 94-0146
UL project #86NK23826, file R6802
Calc 19-G-01 R/1
Calc 19-G-02 R/0
Calc 19-AI-8 R/0
Calc 19-AK-6 R/0
Calc 19-AN-14 R/9
K-2982 Power Cable Purchase Spec. Proposal Data
SLICE version 7.3
ROC Y-104156, dated 8/10/94

Evaluation of USAR Changes for Division 1 Safe Shutdown Cables in Fire Area D-8

Cables 1DG75C and 1DG75D

These two cables are shown in fire area D-8 in Tables 4.2.3.3-1 and 4.2.4.3-1 of USAR Appendix F, but are omitted from fire area D-8 in Figures 4.2.3.3-1 and 4.2.4.3-1 of USAR Appendix F.

These two cables are in fact in tray route point 19108C, but that route point is completely within fire area D-5 (elevation 737') and does not penetrate through the ceiling up into fire area D-8. The two cables are routed from the DG control panel to the diesel generator (both in fire area D-5, elevation 737') and do not pass through fire area D-8. Therefore, these two cables should be removed from fire area D-8 in USAR Appendix F.

Cables 1VD09H and 1VD78A

Cable 1VD09H is shown in fire area D-8 in Tables 4.2.3.3-1 and 4.2.4.3-1 of USAR Appendix F, but is omitted from fire area D-8 in Figures 4.2.3.3-1 and 4.2.4.3-1 of USAR Appendix F. Cable 1VD78A is shown in fire area D-8 in Tables 4.2.3.3-1 and 4.2.4.3-1 and Figures 4.2.3.3-1 and 4.2.4.3-1 of USAR Appendix F.

These two cables are safe shutdown as shown in Enclosure 2. These two cables are likewise in tray route point 19108C, but that route point is completely within fire area D-5 (elevation 737') and does not penetrate through the ceiling up into fire area D-8. The two cables are, however, in conduit C92123 that does penetrate the 762' slab into fire area D-8, and so the cables are indeed routed within fire area D-8. Therefore, change the route point for these two cables in fire area D-8 in USAR Appendix F from 19108C to C92123, and add cable 1VD09H to the fire area D-8 Figures in USAR Appendix F.

Additionally, cable 1VD78A is indeed routed in conduit C91257 but this conduit is located completely within fire area D-5 (elevation 737') and does not penetrate through the ceiling up into fire area D-8. Therefore, delete conduit C91257 from fire area D-8 in USAR Appendix F.

Cable 1VD09A

This cable is shown in fire area D-8 in Figures 4.2.3.3-1 and 4.2.4.3-1 of USAR Appendix F, but is omitted from fire area D-8 in Tables 4.2.3.3-1 and 4.2.4.3-1 of USAR Appendix F.

This cable is safe shutdown as shown in Enclosure 2, and is routed in conduits C92111 and C92112 within fire area D-8. Therefore, add this cable to fire area D-8 Tables in USAR Appendix F.

Cable 1VD75A

This cable is shown in fire area D-8 in Tables 4.2.3.3-1 and 4.2.4.3-1 and Figures 4.2.3.3-1 and 4.2.4.3-1 of USAR Appendix F. The cable routing as drawn on the Figures shows this cable on the north wall of fire area D-8.

This cable is safe shutdown as shown in Enclosure 2, and is routed in conduit C92137 within fire area D-8. This conduit penetrates the 762' slab near the west wall of fire area D-8 and is routed overhead to panel 1PL54JA. Therefore, correct the cable routing as shown on the fire area D-8 Figures in USAR Appendix F.

Cable 1VD75D

This cable is not shown in fire area D-8 in Tables 4.2.3.3-1 and 4.2.4.3-1 or Figures 4.2.3.3-1 and 4.2.4.3-1 of USAR Appendix F.

This cable is safe shutdown as shown in Enclosure 2, and is routed in conduit C91861 within fire area D-8. Therefore, add this cable to fire area D-8 in USAR Appendix F.

Cable 1VD09M

This cable is shown in fire area D-8 on Figure 4.2.4.3-1 of USAR Appendix F, but is omitted from fire area D-8 in Figure 4.2.3.3-1 and Tables 4.2.3.3-1 and 4.2.4.3-1 of USAR Appendix F.

This cable is routed in conduits from fire area D-2 (elevation 719') to fire area D-5 (elevation 737') and does not penetrate through the ceiling up into fire area D-8. Therefore, this cable should be removed from fire area D-8 in USAR Appendix F.

Potential Impact of Changes

In most cases, the changes are 1) deletions of cables or route points which are not safe shutdown or located in fire area D-8, or 2) corrections of USAR Appendix F tables or figures to be consistent with each other. These cases are considered within the original Safe Shutdown Analysis. Several of the changes are adding or rerouting safe shutdown cables within fire area D-8, and are evaluated for their potential impact on the Safe Shutdown Analysis.

Addition of cable 1VD75D - The USAR change adds this Division 1 safe shutdown cable to fire area D-8. This cable is enclosed completely within conduit. Addition of this cable 1VD75D to fire area D-8 does not invalidate any of the justification for existing deviations (USAR Appendix F 4.2.3.3 and 4.2.4.3) to 10CFR50 Appendix R for fire area D-8. Other Division 1 safe shutdown cables are also within fire area D-8 and have already been evaluated in the Safe Shutdown Analysis. herefore, this change has no adverse impact on the conclusions of the Safe Shutdown Analysis, and is therefore safe to implement.

Changes in cable 1VD75A and 1VD75D routing - The USAR change relocates the routing of cable 1VD75A from the north side of D-8 to the west side of D-8, and adds the routing of cable 1VD75D to the north side of D-8. These cables are enclosed completely within conduit. Changes to the routing of these Division 1 safe shutdown cables within fire area D-8 does not invalidate any of the justification for existing deviations (USAR Appendix F 4.2.3.3 and 4.2.4.3) to 10CFR50 Appendix R for fire area D-8. In their revised locations, Division 1 cables 1VD75A and 1VD75D are now closer to Division 2 safe shutdown cables 1DG31A and 1DG31B, but are still not as close to those cables as other Division 1 safe shutdown cables 1VD01A and 1VD09A. The proximity of Division 1 cables 1VD01A and 1VD09A to Division 2 cables 1DG31A and 1DG31B was evaluated in the Safe Shutdown Analysis; therefore, these changes have no adverse impact on the conclusions of the Safe Shutdown Analysis, and are therefore safe to implement.

References:

E30-1001-00A-CPR Rev. S	CIS4-DG Rev. 1
E29-1001-01A-EI Rev. AH	E29-1001-04A-EI Rev. Y
CIS4-VD Rev. 2	E29-1000-04C-EI Rev. M
E29-1002-04A-EI Rev. R	E29-1603-09A-EI Rev. H
E29-1603-10A-EI Rev. S	ECN 6319
EPED Calculation 19-AI-41 Rev. 0	EPED Calculation 19-AI-51 Rev. 1

Prepared: Brian T. Ford 12-12-94

Reviewed: Mark McMenamin 12/12/94

8A.100
L34-94(12-16)-6
Y-104525
December 16, 1994

TO: Director - Licensing

FROM: J. R. Langley [signature], 12/13/94
NSED - Director Date

SUBJECT: Proposed Amendment to CPS SAR.

SAR Sections Affected: Appendix F 3.4.8.3, 3.4.8.4.1, 3.4.8.4.2, 3.4.8.4.3, 4.1.4.1, 4.2.3.3, 4.2.4.3, 4.2.2.19, Table 4.2.3.3-1, Table 4.2.4.3-1, Figure 4.2.3.3-1, Figure 4.2.4.3-1

Safety Evaluation or Screening Form attached: ✓ YES ___ NO

SAR Section 1.8 impacted: ___ YES ✓ NO

If yes, identify Section 1.8 impact and affected sections.

Justification of Change: Enclosure 5 of the attached safety evaluation provides the detailed justification for deletions and corrections to the safe shutdown cables in fire area D-8. The attached safety evaluation also provides detailed justification for the new deviation (USAR change) from the 10CFR50 App. R requirement for a 1-hour rated fire barrier to protect one division of safe shutdown cables. Neither change has an adverse impact on the safe shutdown capability of the plant, due to the existing defense-in-depth provided.

Originator: [signature] / 12-8-94

Concurrence: N/A /
Division of Responsibility

Supervisor: RPB 12/13/94 [signature] / 12/13/94

Attachments: Affected SAR Pages
Safety Evaluation/Screening, LIC Log No. 94-0083
(if applicable)

cc: K A Leffel, V-922
M McMenamin
M O'Flaherty
R P Bhat
C Small
S Wilson

NF-139 (4/94)

The performance goals for the safe shutdown functions are assured by Method 2.

3.4.8.3 Modifications in the Fire Area

- o Division 2 diesel-generator cables 1DG31A and 1DG31B, in conduits, will be protected by a ~~1-hour~~ fire rated material. DELETE
- o Thermal detectors will be provided in the area of diesel-generator cables 1DG31A and 1DG31B.

3.4.8.4 Deviations

Engineering justification for the following deviations is found in Section 4.2 of this report. ADD

3.4.8.4.1 Barriers

- • The Thermo-Lag 330-1 cable firewrap installed in Fire Area D-8 is not 1-hour fire rated (see Subsection 4.2.2.19).

3.4.8.4.~~1~~2 Detection REVISE

- o The general area of D-8 does not have an area fire detection system (see Subsection 4.2.3.3).

3.4.8.4.~~2~~3 Suppression

- o No automatic fire suppression is provided for this area (see Subsection 4.2.4.3).

3.4.9 FIRE AREA D-9

3.4.9.1 Description

This fire area consists of the Division 2 diesel-generator ventilation fan room and air intake located along the south wall of the diesel-generator building at elevation 762 feet 0 inch (see Figure FP-12).

3.4.9.2 Shutdown Analysis

Loss of Division 2 cables or Division 2 diesel-generator vent fan 1B will not prevent the safe shutdown of the reactor. There are no Division 1 safe shutdown cables or equipment in this area. Method 1 safe shutdown systems can be utilized to bring the reactor to a safe shutdown condition.

The performance goals for the safe shutdown functions are assured by Method 1.

3.4.9.3 Modifications in the Fire Area

No modifications are planned for this fire area.

3.4.9.4 Deviations

Engineering justification for the following deviation is found in Section 4.2 of this report.

4.1.4 DIESEL-GENERATOR BUILDING

4.1.4.1 Fire Area D-8

- Division 2 diesel-generator cables 1DG31A and 1DG31B will be protected by a ~~1-hour~~ fire rated material. DELETE
- Thermal detectors will be provided in the area of diesel-generator cables 1DG31A and 1DG31B.

4.1.4.2 Fire Area D-10

- An automatic wet pipe sprinkler system will be installed for 10 feet on both sides of column line 129 over the BOP cable trays from row AC to AF.

4.1.4.3 Fire Area D-1

- Area fire detection will be provided in this fire area.

4.1.4.4 Fire Area D-2

- Area fire detection will be provided in this fire area.

4.1.4.5. Fire Area D-3

- Area fire detection will be provided in this fire area.

4.1.4.6 Fire Area D-4

4.1.4.6.1 Fire Zone D-4b

- Area fire detection will be provided in this fire zone.

4.1.4.7 Fire Area D-5

4.1.4.7.1 Fire Zone D-5b

- Area fire detection will be provided in this fire zone.

4.1.4.8 Fire Area D-6

4.1.4.8.1 Fire Zone D-6b

- Area fire detection will be provided in this fire zone.

4.1.5 FUEL BUILDING

4.1.5.1 Fire Area F-1

4.1.5.1.1 Fire Zone F-1a

- Area fire detection will be provided in this fire zone.

diesel generator room cooling fans are running severely limits the ability of a smoke detection system and increases the likelihood of false alarms. In the event of a fire in either Fire Area D-7 or D-9, safe shutdown can be achieved by the use of Division 1/Method 1 safe shutdown systems. Therefore, based on these fire areas' low combustible fire loading, operational limitations of a fire detection system, and the ability to achieve safe shutdown, a fire detection system is not necessary in Fire Areas D-7 and D-9.

Fire Area D-8 does not have a complete fire detection system. The Division 2 diesel-generator cables, 1DG31A and 1DG31B (see Figure 4.2.3.3-1), are in conduit and are protected by a 1-hour fire rated material and local thermal fire detection as shown in Figure FP-12b. The fire loading in this fire area is low. The Division 2 cables are separated from the combustibles in the area by a missile wall and a reinforced concrete that has two HVAC ventilation openings. Based on the partial fire detection provided, low combustible fire loading, and separation from combustibles, additional fire detection is not necessary in Fire Area D-8.

DELETE

FP-14b. Manual firefighting equipment is readily accessible, and response to a fire would be prompt, since the continuously manned main control room is adjacent to these fire zones. The safe shutdown analysis has demonstrated that in case of a fire anywhere within this fire area, safe shutdown can be achieved.

Based upon the fire detection coverage, manual fire suppression capabilities, and the ability to bring the plant to a safe shutdown condition, complete fire area suppression is not warranted for Fire Area CB-6.

4.2.4.3 Diesel Air Intake Structure (D-8)

Description of Deviation

Fire Area D-8 is not protected by an automatic suppression system.

Reference

10 CFR 50, Appendix R, Section III.G.2.c references that cable and equipment and associated non-safety-related circuits of one redundant train in a fire barrier having a I-hour rating shall be enclosed. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area. (Partial fire detection is provided for the fire area. See Deviation 4.2.3.3.)

Fire Area Involved

Fire Area D-8 Elevation 762 feet 0 inch (see Figures FP-12a and 12b and Cable Tray Figure 10).

Description of Safe Shutdown Equipment and Cables

Fire Area D-8 consists of the Division 1 diesel-generator air intake structure. Division 1 cables (in conduit) and Division 2 cables (in conduit), 1DG31A and 1DG31B, are in this fire area.

Engineering Justification

DELETE

The Division 2 power feed cables, 1DG31A and 1DG31B (as shown on Figure 4.2.4.3-1), that run along the south wall of this fire area are separated from the Division 1 diesel-generator ventilation system by a missile shield and a partial concrete wall. The Division 2 cables will be protected with a 1-hour fire rated material and local thermal detection. The only combustibles in the area are electrical insulation in cabinets, HVAC duct insulation materials, and lubricants, resulting in a low fire loading. In the event of a fire in this fire area, safe shutdown can be achieved by the use of Division 2/Method 2 systems. Based on the provision of a 1-hour fire rated barrier and a partial fire detection system, low fire loading, and the ability to achieve safe shutdown, an automatic suppression system is not necessary in Fire Area D-8.

DELETE.

4.2.4.4 Partial Suppression in Fire Area A-l

Description of Deviation

A complete automatic suppression system has not been provided in Fire Area A-l (see Subsection 4.2.5.1).

4.2.2.19 Thermo-Lag 330-1 Cable Fire Wrap Not 1-hour Fire Rated

Description of Deviation

The Thermo-Lag 330-1 cable fire wraps installed in fire area D-8 are not qualified as 1-hour rated installations.

Reference

10 CFR Part 50, Appendix R, Subsection III.G.2.

Fire Area Involved

The fire area involved in this deviation is D-8.

Description of Safe Shutdown Equipment

The systems affected include the Division 1 diesel generator ventilation fan and panel and Division 2 diesel generator power cables.

If fire area D-8, the original design provided for thermal detection and 1-hour fire rated barrier (Thermo-Lag) enclosing the Division 2 diesel generator cables. USAR Appendix F, Subsections 4.2.3.3 and 4.2.4.3 identify deviations from Appendix R Section III.G.2.c requirements for the installation of an automatic fire detection and suppression system throughout fire area D-8. As discussed in SSER 5, Subsections 9.5.1.4 and 9.5.5, and SSER 6, Subsections 9.5.1.4 and 9.5.5, the NRC accepted these deviations on the basis of the limited quantities of combustibles, area wide automatic fire detection in the adjacent fire area, enclosure of the conduits of one division in a 1-hour fire rated barrier and the installation of thermal detectors above those conduits.

The new deviation proposed by this USAR change is to delete the reference to the 1-hour rating of the Thermo-Lag fire wrap installed to protect the Division 2 diesel generator cables in fire area D-8.

Engineering Justification

The Appendix R Subsection III.G.2 requirements concern the ability to achieve and maintain safe shutdown. The deviation from the requirement for a 1-hour rated fire barrier enclosing the division of safe shutdown cables in fire area D-8 is justified on the basis that several design and programmatic fire protection features are in place in fire area D-8 to ensure that the safe shutdown capability is maintained. The following is an outline of the defense-in-depth features.

Engineering Justification (Continued)

1. It is unlikely for a fire to occur which is capable of affecting safe shutdown cables in fire area D-8 due to the administrative controls and the physical design features. The administrative controls include control of ignition sources, control of combustible and flammable materials and the "No Smoking" rules. The physical design features of fire area D-8 include 3-hour fire rated walls (except for exterior wall), 3-hour fire rated floor, and 24-inch minimum reinforced concrete ceiling which is not fire rated; relatively open layout; and restricted access to this fire area.

2. Fire modeling of the fire area D-8 has shown that the fixed and transient combustibles, either individually or collectively, present no credible risk of safe shutdown cable damage in fire area D-8.

3. In the event that fire occurs in fire area D-8, it is not credible to postulate damage to both the redundant divisions of safe shutdown equipment due to the Division 2 cables being in conduit on the outside of the existing missile barrier.

4. In the event that a fire occurs in fire area D-8, the as-built Thermo-Lag cable wrap will protect the wrapped Division 2 safe shutdown cables for a duration sufficient to permit manual fire fighting by the CPS fire brigade.

5. In the event that the fire is not extinguished by the fire brigade, the Probabilistic Risk Assessment (PRA) evaluation did not identify any safety benefit, with regard to core damage prevention, containment isolation, containment heat removal or containment hydrogen control provided by the Thermo-Lag installed in fire area D-8.

6. In the unlikely event of a fire in D-8 that disables both divisions of redundant safe shutdown equipment, it is reasonable to expect that operator training, Emergency Response Organization (ERO) activation, and symptom-based procedures provide a final line of defense to ensure plant safety.

TABLE 4.2.3.3-1

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.	
~~1DG75C~~	~~19108C~~	~~D-8~~	~~K1E~~	~~1DG01KA~~	DELETE
~~1DG75D~~	~~19108C~~	~~D-8~~	~~K1E~~	~~1DG01KA~~	
1VD09H	~~19108C~~ C92123	D-8	K1E	1HS-VD070*	REVISE
1VD78A	~~19108C~~	D-8	K1E	1TE-VD007	
~~1VD78A~~	~~C91257~~	~~D-8~~	~~K1E~~	~~1TE-VD007~~	DELETE
1VD01A	C92109	D-8	P1E	1VD01CA	
1DG31A	C92118	D-8	P2E	1DG01KB	
1DG31B	C92120	D-8	P2E	1DG01KB	
1VD01E	C92124	D-8	C1E	1KY-VD080*	
1VD04E	C92124	D-8	C1E	1PDS-VD030	
1VD18B	C92124	D-8	C1E	1TIT-VD007*	
1VD75A	C92137	D-8	K1E	1TE-VD001,1TIC-VD001	
1VD75C	C92144	D-8	K1E	1TIC-VD001*	
1VD09A	C92112	D-8	P1E	1TZ-VD001A	ADD
1VD09A	C92111	D-8	P1E	1TZ-VD001A	
1VD75D	C91861	D-8	K1E	1TZ-VD001B	

TABLE 4.2.4.3-1

CABLE NO.	ROUTE PT.	ZONE	SEQ CODE	ASSOC. EQUIP.
~~1DG75C~~	~~19108C~~	~~D-8~~	~~K1E~~	~~1DG01KA~~
~~1DG75D~~	~~19108C~~	~~D-8~~	~~K1E~~	~~1DG01KA~~
1VD09H	~~19108C~~ C92123	D-8	K1E	1HS-VD070*
1VD78A	~~19108C~~	D-8	K1E	1TE-VD007
~~1VD78A~~	~~C91257~~	~~D-8~~	~~K1E~~	~~1TE-VD007~~
1VD01A	C92109	D-8	P1E	1VD01CA
1DG31A	C92118	D-8	P2E	1DG01KB
1DG31B	C92120	D-8	P2E	1DG01KB
1VD01E	C92124	D-8	C1E	1KY-VD080*
1VD04E	C92124	D-8	C1E	1PDS-VD030
1VD18B	C92124	D-8	C1E	1TIT-VD007*
1VD75A	C92137	D-8	K1E	1TE-VD001,1TIC-VD001
1VD75C	C92144	D-8	K1E	1TIC-VD001*
1VD09A	C92112	D-8	P1E	1TZ-VD001A
1VD09A	C92111	D-8	P1E	1TZ-VD001A
1VD75D	C91861	D-8	K1E	1TZ-VD001B

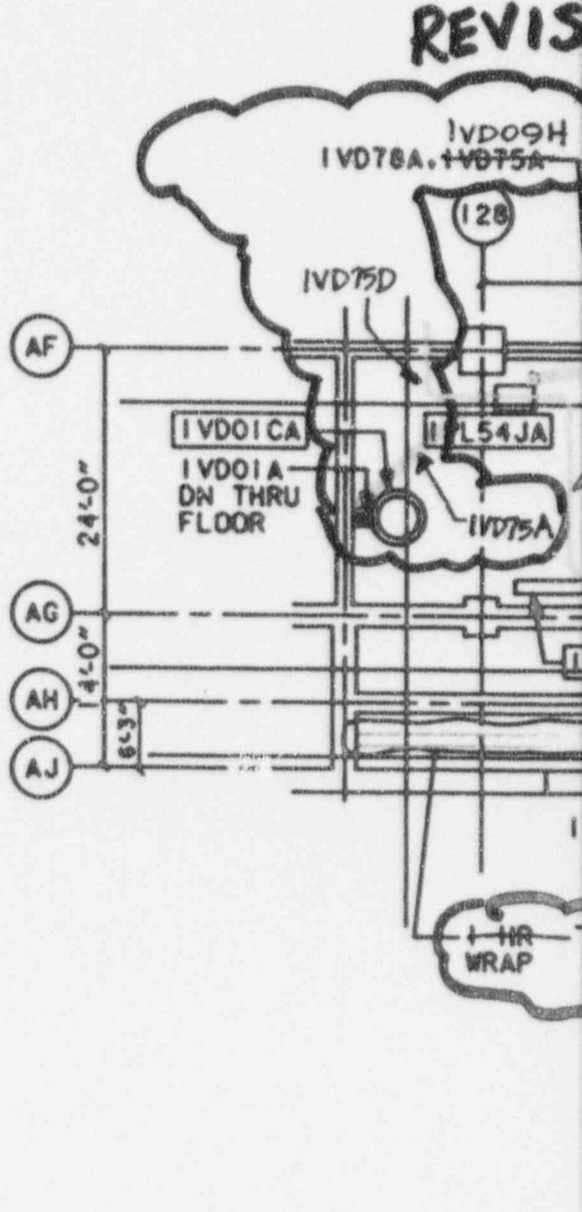
DELETE (1DG75C, 1DG75D)

REVISE (1VD09H: 19108C → C92123)

DELETE (1VD78A / C91257)

ADD (1VD09A, 1VD09A, 1VD75D)

- 1



S&L ECAD FILE: CLIETI.I

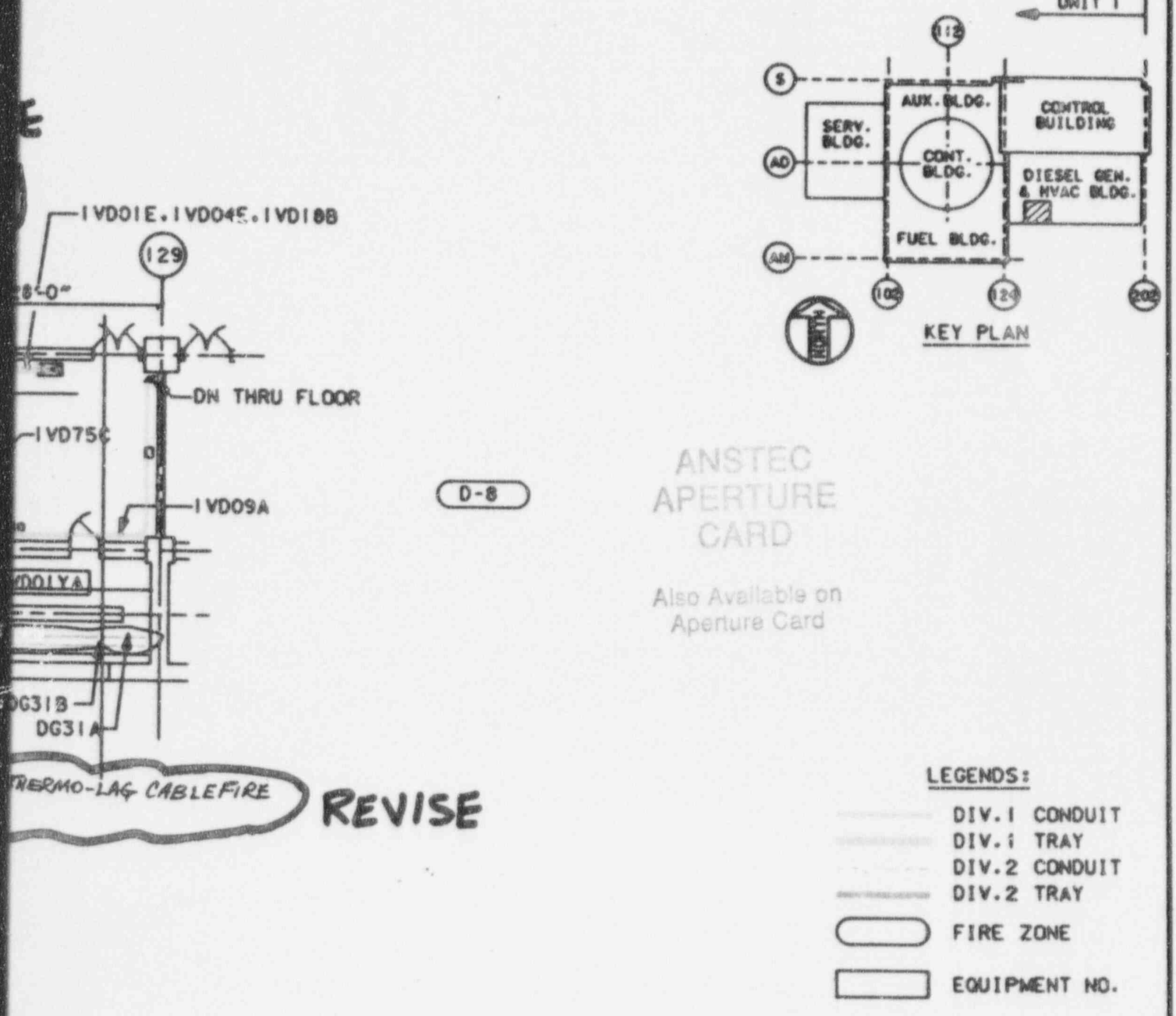
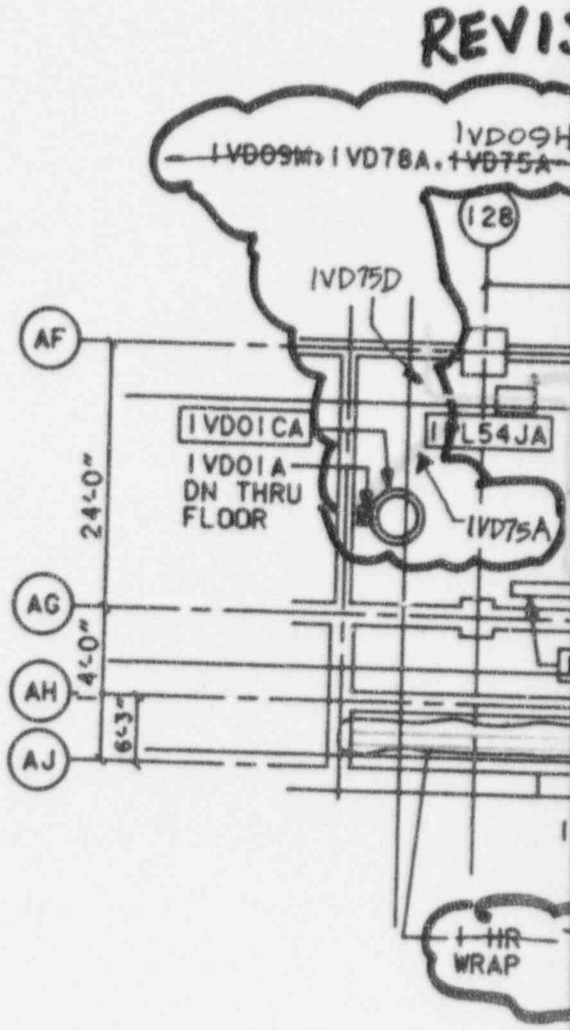


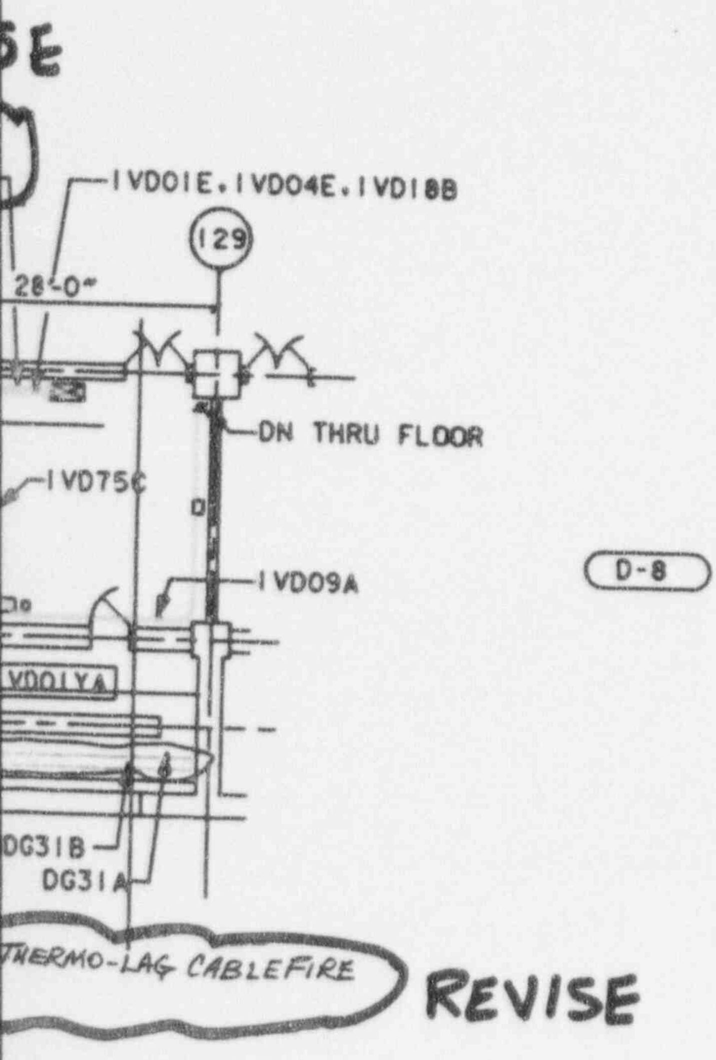
FIGURE 4.2.3.3-1

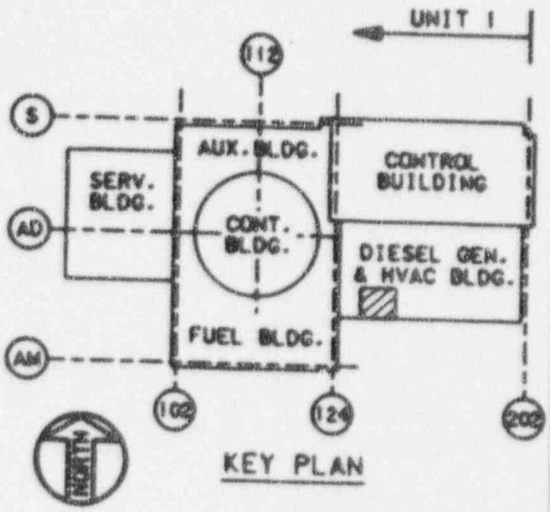
FIRE PROTECTION DEVIATION
DIESEL GENERATOR BLDG.
MEZZANINE FLOOR PLAN EL.762'-0"
FIRE AREA D-8

9511150046-09



S&L ECAD FILE: CLIETI.1





KEY PLAN

LEGENDS:

- DIV. I CONDUIT
- DIV. I TRAY
- DIV. 2 CONDUIT
- DIV. 2 TRAY
- FIRE ZONE
- EQUIPMENT NO.

FIGURE 4.2.4.3-1

FIRE PROTECTION DEVIATION
DIESEL GENERATOR BLDG.
MEZZANINE FLOOR PLAN EL. 762'-0"
FIRE AREA D-8

9511150046-10

Attachment 6
to U-602512

Fire Endurance Calculations