Commonwealth Edison
1400 Opus Place
Downers Grove, Illinois 60515

February 10, 1994

Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Attention: Document Control Desk

Subject: Braidwood Station Units 1 and 2
Byron Station Units 1 and 2
LaSalle County Station Units 1 and 2
Zion Station Units 1 and 2

Commonwealth Edison Company Response: "Request for Additional Information regarding Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers," Pursuant to 10 CFR 50.54(F) Letters

NRC Dockets 50-454 and 50-455
NRC Dockets 50-456 and 50-457
NRC Dockets 50-373 and 50-374
NRC Dockets 50-295 and 50-304

References: See Appendix 1

The purpose of this letter is to provide the Commonwealth Edison response to the Nuclear Regulatory Commission's Requests for Additional Information for those nuclear plants using Thermo-Lag as Fire Protection Barriers. Four of Commonwealth Edison's six nuclear stations use Thermo-Lag. Because of this, Commonwealth Edison Nuclear Operations Division developed an integrated plan designed to optimize the company's response to this issue. The format for our response uses this letter and its attachments to explain our corporate strategy as well as to provide a detailed response to the specific questions contained in the Request for Additional Information.

The Requests for Additional Information submitted to Commonwealth Edison established dates for the four specific stations that fell on or after February 14, 1994. LaSalle Station's original due date was to have been February 11, 1994 but the letter was re-issued by the NRC initiating a new time clock. As a result, Commonwealth Edison and the NRC determined, in a phone conference between J. Dyer and I. M. Johnson, that the combined response would be due on February 14, 1994.

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Scope of the Problem

Significantly different amounts of Thermo-Lag 330-1 have been employed at the six Commonwealth Edison Nuclear Stations. Our Dresden and Quad Cities Nuclear Power Stations use none of the subject material. Usage at the remaining stations is summarized in the Table on Page 4 of this letter. Specific details for each of the four stations are provided in the respective station attachment to this letter.

Strategy

Commonwealth Edison Company has been reviewing the Thermo-Lag issue since the initial NRC Information Notices were published in 1991. CECo responded to Generic Letter 92-08 with a series of submittals during 1992 and early 1993. In addition, we have participated in the activities of the NUMARC Thermo-Lag Committee and the NUMARC Fire Protection Working Group through a series of NUMARC responses and attendance at several industry meetings. In 1993, CECo formed a project team with members from all CECo Nuclear Stations as well as all effected corporate departments. This team prepared and approved a project plan, involving a three phase strategy, to best focus Commonwealth Edison's response to the Thermo-Lag issue at the four effected sites. This plan was presented to the Nuclear Regulatory Commission on January 26, 1994, in a Commonwealth Edison Company presentation detailing the company's response plan.

Phase 1	Overall As Built Assessment
Phase 2	Preliminary Engineering and Testing
Phase 3	Engineering and Modification

The CECo team's use of this program plan is designed to ensure the most technically suitable, timely, and resource effective solution to the Thermo-Lag issue.

Significant aspects of the program plan include a re-analysis of the safe shutdown analysis for our stations, where appropriate. Preliminary results of this analysis indicate that various current installations of Thermo-Lag may not be required to maintain the ability to safely shutdown the plant. Another aspect employs a Safety Significance Assessment to evaluate equipment and cabling to establish a prioritization plan to correct configurations with the most safety significance in a timely fashion. The Safety Significance Assessment combines an analysis of the importance of the individual configuration to the Safe Shutdown Analysis and the specific Fire Safety Margin of that configuration to determine the relative priority assigned to resolve each of the effected barriers.

Corrective Actions:

Commonwealth Edison is currently identifying corrective actions that can be effectively employed to address the Thermo-Lag issue. Our final plans will include some combination of the options discussed in this letter. Some of the options which are currently under consideration are:

Elimination of unnecessary or non-essential barriers where the Safe Shutdown Analysis indicates the barrier is unnecessary.

Replacement/Upgrading of existing barriers. Prior to exercising this option final acceptance criteria for testing programs must be approved. (Generic Letter 86-10, Supplement 1, in final form) Also, the NUMARC Applicability Guide will be required for final determination of bounding criteria for existing programs. Once an approved fire barrier material is identified, final engineering design and material procurement can proceed.

Re-routing of cables, though not currently a likely option, could be considered for some unique cases.

The preliminary scope and schedule for corrective actions at each of the stations is summarized here: (See Attachments 1 through 4 for additional detail)

LaSalle - The LaSalle County Station intends to replace the existing Thermo-Lag materials with an approved alternative fire barrier system in 1994. This decision is based upon the extensive efforts which would be required to qualify the existing in-plant fire barrier configurations and the relatively small quantities of material that are currently installed. However, this schedule is contingent upon several issues that must be resolved by the end of the second quarter of 1994. The major issue involves the validation of an approved alternative fire barrier material. This subject is delineated in further detail in LaSalle's Item VI.B Response (See Attachment 3).

Zion - The major use of Thermo-Lag involves protection of conduit which appears to be within the scope of the NUMARC testing. Preliminary indications are that NUMARC Phase I conduit test assemblies passed fire endurance testing. Upon final acceptance of NUMARC Phase I and II testing, Zion intends to address its Thermo-Lag conduit barriers in 1994. The remaining Thermo-Lag barriers are being evaluated on a case by case basis and, if required, will be addressed as soon as practicable.

Byron/
Braidwood - The scope of use of Thermo-Lag at Byron and Braidwood precludes resolution of this issue in 1994. As outlined in our strategy the Safety Significance Assessment will be utilized to prioritize the existing barriers. Corrective Actions will be initiated in 1994. The final schedule for Byron and Braidwood will be determined following the finalization of the NUMARC bounding criteria and the selection of corrective action options in Phase 2 of the Commonwealth Edison Program Plan.

	Total Fire Zones	TSI Zones	Linear Feet	Conduit and Jct. Box	Trays	Unique Config.
Byron	204	14	3129	805ft, 118sf	2324	Multiple trays boxed together
Braidwood	204	12	1609	493ft, 26sf	1116	Multiple trays boxed, 6 tray penetrations
LaSalle	147	1	200	0	200	TSI material is sprayed on 3 trays
Zion	156	6	500	460	0	2 walls 5'x25'
Dresden	NA	No Thermo-lag				
Quad-Cities	NA	No Thermo-lag				

It is our intent to employ the standardized acceptability criteria that will be available from the NUMARC Applicability Guide and the ongoing engineering assessment of Thermo-Lag at Commonwealth Edison to provide all the information requested in the 50.54(f) letters that is not currently available. The Attachments provided to this letter constitute Commonwealth Edison's best efforts at a timely response to the Requests for Additional Information. Commonwealth Edison will provide a supplemental response within ninety (90)days of receipt of the NUMARC Applicability Guide updating the NRC on new information obtained.

To the best of my knowledge and belief, the statements contained in this document are true and correct. In some respects these statements are not based on my personal knowledge, but on information furnished by other CECo employees, contractor employees, and/or consultants. Such information has been reviewed in accordance with company practice, and I believe it to be reliable.

Sincerely,

L.O. DelGeorge

L.O. DelGeorge
Vice President

"OFFICIAL SEAL"
NADINE M. ESPISITO
NOTARY PUBLIC, STATE OF ILLINOIS
My Commission Expires 10/19/97.

Nadine M. Espisito

Attachments: (1) Braidwood Station response to:
"Request for Additional Information regarding Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers," Pursuant to 10 CFR 50.54(F)

(2) Byron Station response to:
"Request for Additional Information regarding Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers," Pursuant to 10 CFR 50.54(F)

(3) LaSalle Station response to:
"Request for Additional Information regarding Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers," Pursuant to 10 CFR 50.54(F)

(4) Zion Station response to:
"Request for Additional Information regarding Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers," Pursuant to 10 CFR 50.54(F)

cc: J. Martin, Regional Administrator-RIII
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D. Hills, Senior Resident Inspector (LaSalle)
T. Taylor, Senior Resident Inspector (Quad Cities)
J.D. Smith, Senior Resident Inspector (Zion)

Appendix I

(1) USNRC Generic Letter 92-08, "Thermo-Lag Fire Barriers"

(2) USNRC letter to D. L. Farrar dated December 20, 1994, "Request for Additional Information regarding Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers," Pursuant to 10 CFR 50.54(F) - LaSalle Nuclear Station, Units 1 and 2

(3) USNRC letter to D. L. Farrar dated December 21, 1994, "Request for Additional Information regarding Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers," Pursuant to 10 CFR 50.54(F) - Braidwood Nuclear Power Station, Units 1 and 2

(4) USNRC letter to D. L. Farrar dated December 21, 1994, "Request for Additional Information regarding Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers," Pursuant to 10 CFR 50.54(F) - Byron Nuclear Power Station, Units 1 and 2

5) USNRC letter to D. L. Farrar dated December 21, 1994, "Request for Additional Information regarding Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers," Pursuant to 10 CFR 50.54(F) - Zion Nuclear Power Station, Units 1 and 2

6) Commonwealth Edison Company Presentation to the Nuclear Regulatory Commission on January 26, 1994 pertaining to the Commonwealth Edison Company's Thermolag Action Plan

Attachment 1

Braidwood Station Response

"Request for Additional Information
regarding Generic Letter 92-08,
"Thermo-Lag 330-1 Fire Barriers,"
Pursuant to 10 CFR 50.54(F)

I.B.1 *Describe the Thermo-Lag 330-1 barriers installed in the plant. Include the intended purpose, fire rating, type and dimension of the barrier.*

Thermo-Lag 330-1 barriers have been installed at Braidwood Station to satisfy one or more of the following criteria:

a. meet 10 CFR 50.48 or Appendix R to 10 CFR 50,
b. support an exemption from Appendix R,
c. achieve physical independence of electrical systems,
d. meet plant operating license conditions,
e. satisfy licensing commitments.

The fire barriers for cable trays/risers at Braidwood were constructed to be either 1-hour or 3-hour fire barriers. None were built as radiant heat shields. To the best of our knowledge, these cable tray/riser barriers were constructed of materials intended to be used for 3-hour barriers (primarily the 1 inch nominal thickness preformed panels). Our initial reviews of Material Receiving Reports (MRR's) have found that only the 1 inch panels were purchased. Because the same installation methods were used regardless of the fire barrier design rating, the 1-hour cable tray/riser barriers should meet the original requirements for a 3-hour barrier. For conduit, our reviews of MRR's shows that both 1-hour and 3-hour barrier materials were purchased.

In Addendum A, we have listed cable tray and riser sections, conduit, junction boxes, and penetration seals that have been covered with Thermo-Lag to meet criteria a through e above. Included are the sizes and the wrapped footage of each riser, tray, and conduit and the size and amount of barrier material used to cover each junction box and penetration.

Braidwood Station has several unique Thermo-Lag installations where several risers are wrapped in a single Thermo-Lag enclosure. These include:

1R220 Partially wrapped with 1R224	El 364
1R221 Partially wrapped with 1R225	El 364
2R214 Totally wrapped with 2R216	El 383
1R303 Totally wrapped with 1R304	El 401
2R259 Totally wrapped with 2R253	El 401
1R222 Totally wrapped with 1R226 & 1R265 (1R266)	El 401

1.B.2 *For the total population of Thermo-Lag fire barriers described under Item 1.B.1, submit an approximation of:*

a. For cable tray barriers: the total linear feet and square feet of 1-hour barriers and the total linear feet and square feet of 3-hour barriers.

b. For conduit barriers: the total linear feet of 1-hour barriers and the total linear feet of 3-hour barriers.

c. For all other fire barriers: the total square feet of 1-hour barriers and the total square feet of 3-hour barriers.

d. For all other barriers and radiant energy heat shields: the total linear or square feet of 1-hour barriers and total linear or square feet of 3-hour barriers, as appropriate for the barrier configuration or type.

An approximation of the total linear feet and square feet of Thermo-Lag fire barriers installed at Braidwood Station is given below. This information summarizes the totals from the tables in Addendum A which provide similar approximations by individual component.

	1 Hour	3 Hour
Horizontal Cable Tray Barriers		
Total linear feet	55	361
Total square feet	292	2215
Vertical Cable Riser Barriers		
Total linear feet	113	628
Total square feet	488	3098
Conduit Barriers		
Total linear feet	201	292
Other Fire Barriers		
1) Junction Boxes, Total square feet	0	26
2) Penetrations, Total square feet	0	152
3) Air drops	*	*

* Total square footage included in the riser totals above.

II.B.1 *State whether or not you have obtained and verified each of the aforementioned parameters for each Thermo-Lag barrier installed in the plant. If not, discuss the parameters you have not obtained or verified.*

The NRC's 24 fire barrier and 8 cable parameters are individually addressed in Addenda B and C respectively. Information associated with these specific parameters was obtained for Braidwood from various design drawings, design documents and reports. These include: cable pan piece part drawings, riser section drawings, electrical installation drawings, conduit tabulation drawings, junction box schedules, cable engineering data base, procurement specifications, material receiving inspection reports, fire protection report and vendor test reports.

Plant walkdowns were performed in September and October 1993 to obtain parameter information which could not be obtained elsewhere. These plant walkdowns were also performed to preliminarily verify, where practical, the information obtained from design drawings, design documents and reports. This verification was considered preliminary because the scope of the walkdowns and methods used for verification were based on the fire barrier, cable tray and conduit parameters identified as critical at that time. Preliminary verification was documented by creating walkdown reports, videotaping and photographing.

The preliminary verification of fire barrier and cable parameters will be supplemented by a final verification as needed based on the final list of critical parameters. Final verification will be physical (in the form of walkdowns) where practical. In cases where physical verification is not practical, an independent review of design drawings and documents will be performed as needed and considered the final verification. In some cases, the preliminary verification of parameters may be determined to be sufficient, such that further verification is not needed.

Obtaining and verifying parameters was not considered practical when fire barriers or other components had to be destructively removed. These activities will not be performed at Braidwood until the importance of each parameter to the acceptability of the Braidwood fire barriers can be better determined.

The scope of activities being performed or planned to obtain and verify certain fire barrier and cable tray parameters may change as the final list of critical parameters and their relative importance is better defined.

To date, only 5 of the NRC's 24 fire barrier parameters have not been obtained for Braidwood. These are:

1) panel rib orientation (#11)
2) dry-fit, post-buttered or pre-buttered joints (#16)
3) joint gap width (#17)
4) additional trowel material (#23)
5) edge guards (#24)

The following fire barrier parameters have been preliminarily verified by plant walkdowns:

1) raceway orientation (#1)
2) conduit (#2)
3) cable tray with T-section (#5)
4) support protection, thermal shorts (penetrating elements) (#7)
5) joint configuration (#18)
6) steel bands or wire (#19)

To date, only three of the eight NRC's cable parameters have not been determined for Braidwood. These are:

1) distribution of cable within the protected conduit or cable tray (#4);
2) in the few cases where air drops exist, the proximity of cables to the unexposed (inside) surface of the fire barrier (#5);
3) in the few cases where air drops exist, presence of materials between cables and unexposed side of fire barrier material (#6).

Preliminary verification of the five "obtained" cable parameters through plant walkdowns is considered not practical and has not been performed.

II.B.2 *For any parameter that is not known or has not been verified, describe how you will evaluate the in-plant barrier for acceptability.*

The acceptability of in-plant fire barriers must be based on specific acceptance criteria. This criteria must include critical fire barrier and cable parameters. The critical parameters must be determined from configuration testing or from other means. The evaluation of in-plant configurations for acceptability at Braidwood will be based on the critical parameters and their identification/measurement at Braidwood. Until the critical parameters are determined, the scope of the evaluation is unknown.

If any critical parameters cannot be directly identified/measured or verified, the following courses of action may be taken to evaluate the barrier configurations:

1) Review installers' records and procedures to identify installation standards, practices and procedures.

2) Assume the limiting or worst case condition for the parameter (e.g. all joints are post-buttered instead of pre-buttered).

3) Perform destructive examinations on a sample of configurations to identify installation techniques used at Braidwood.

II.B.3 *Describe the type and extent of the unknown parameters at your plant.*

Known and unknown information regarding the 24 fire barrier and 8 cable parameters at Braidwood is discussed in the response to Items II.B.1 and in more detail in Addenda B and C. The significance of the unknown information relative to NUMARC's application guidance cannot be determined until configuration testing is completed, the final list of critical parameters is determined and the NUMARC guidelines are finalized.

III.B.1 *Describe the barriers discussed under Item I.B.1 that you have determined will not be bounded by the NUMARC test program.*

The determination of whether Braidwood's Thermo-Lag fire barriers are "bounded" by the NUMARC test program will require a detailed comparison of the wrapped component (tray, riser, conduit, etc.) parameters and the fire barrier installation parameters to those of the NUMARC configurations. These comparisons cannot be made until the component configurations included in the NUMARC program and their parameter values are identified. The entire NUMARC program scope should be known in April 1994 when Phase II tests are completed. The NUMARC application guidelines are scheduled to be issued at that time also. This will allow the detailed comparison of the Braidwood barriers with NUMARC's to begin. A preliminary assessment of Braidwood's wrapped component configurations (tray, riser, conduit, junction boxes, penetrations) has been performed to determine if they were included in the scope of the NUMARC test program known to date. This assessment included a comparison of the component's physical dimensions, configuration orientation, and percent volumetric cable fill to that of tested NUMARC component configurations. It did not include a comparison of fire barrier installation parameters. The results of this assessment are provided in the columns of Tables Ia through IV titled "In Scope". The tables reflect that while most trays, conduits, and junction boxes are in the scope of the NUMARC program, few risers and no penetrations are included. It should be noted that this preliminary assessment did not take into account horizontal and vertical offsets, reducers or unique terminations present in the Braidwood tray and conduit configurations which may affect their acceptability. A more detailed assessment of the Braidwood configurations may result in a smaller number of configurations being bounded by NUMARC tests.

Tables Ia and Ib indicate approximately 50 percent of the Braidwood cable trays and risers have "percent cable fill" values that are less than 15 percent. These configurations have been categorized as "out of NUMARC scope" because, to date, all NUMARC test configurations had greater than 15 percent cable fill. Future testing may include configurations with less than 15 percent fill which would apply to Braidwood.

III.B.2 *Describe the plant-specific corrective action program or plan you expect to use to evaluate fire barrier configurations particular to the plant. This description should include a discussion of the evaluations and tests being considered to resolve the fire barrier issues identified in Generic Letter 92-08 and to demonstrate the adequacy of the existing in-plant barrier.*

The Braidwood Station plant specific corrective action program to evaluate the unique fire barrier configurations is documented in the "Commonwealth Edison Thermo-Lag and Other Fire Barrier Qualification Program Plan". This plan was prepared and accepted by the Commonwealth Edison Company Fire Barrier Materials Task Team in October 1993. This program was presented and discussed with the NRC Staff on January 26, 1994 and therefore the response for this section is left intentionally brief. Braidwood Station is implementing this program to reach resolution of each installed Thermo-Lag fire barrier.

The Mission Statement of the Program is "Identify and develop various solutions that meet the requirements of Appendix R, for the fire barrier material issue at each of the six nuclear sites. Conceptualize, evaluate and recommend the most cost effective solution for each site in a written report". The Program is comprised of three phases:

1) Overall as-built Assessment

2) Preliminary Engineering and Testing

3) Engineering and Modification.

The plant specific corrective actions will be determined as part of the Preliminary Engineering and Testing phase of the Program. This work is currently in progress in accordance with the overall Plan.

III.B.3 *If a plant-specific fire endurance test program is anticipated describe the anticipated test specimens, test methodology and acceptance criteria including cable functionality.*

The Program plan recognizes plant-specific fire barrier installation testing is an option. At this time, Braidwood Station has not identified any specific test specimens. If any test specimens are identified, it is expected that the test and acceptance criteria would be developed and discussed with the NRC as plant unique or shared test programs are assigned.

IV.B.1 *Describe those barriers that you have determined will fall within the scope of the NUMARC program for ampacity derating, those that will not be bounded by the NUMARC program, and those for which ampacity derating does not apply.*

Ampacity deratings apply only to barriers protecting power cables. The Braidwood/Byron design addressed power cable ampacity derating using an analytical approach rather than using the originally published TSI ampacity derating factors. This analytical approach arrived at derating factors that are much greater than the publicized TSI derating factors and are in line with the preliminary results of the TU tests. Braidwood Station does not presently plan to rely on the NUMARC Program, TU and TVA ampacity test results to address the ampacity derating concerns associated with the TSI Thermo-Lag barriers.

The analytical methods are based on the use of Stolpe's Method (IEEE paper 70-TR557-PWR by J. Stolpe) to determine the heat generated by the cable mass and heat transfer principles to determine the heat dissipated through the cable tray/fire barrier assembly. This analytical method can be applied to any upgrades that may be made to the existing in-plant barriers.

Commonwealth Edison Company is aware of NUMARC's intent to perform additional ampacity derating tests following Phase 2 Fire Tests, and will evaluate the test results when they become available.

IV.B.2 *For the barriers you have determined fall within the scope of the NUMARC program, describe what additional tests or evaluations you will need to perform to derive valid ampacity derating factors.*

The analytical approach that Commonwealth Edison Company has utilized for design cable deratings will require further analysis to account for any additional barrier upgrade materials that are added to existing barriers. Additional materials thickness attributed to added barrier materials will further derate ampacity.

IV.B.3 *For the barrier configurations that you have determined will not be bounded by the NUMARC test program, describe your plan for evaluating whether or not the ampacity derating test relied upon for the ampacity derating factors used for these electrical components protected by Thermo-Lag 330-1 are correct and applicable to the plant design. Describe all corrective actions needed and submit the schedule for completing such actions.*

Ampacity derating tests were not utilized in determining design ampacity deratings. Analytical methods were utilized as discussed in response to IV.B.1. Each barrier that requires replacement will be re-evaluated to determine proper ampacity deratings based on the properties of the replacement barrier material. Braidwood Station will review the test results, when they become available, and consider them for applicability in our evaluation of the barriers.

IV.B.4 *In the event that the NUMARC fire barrier tests indicate the need to upgrade existing in-plant barriers or replace existing Thermo-Lag barriers with another fire barrier system, describe the alternative action you will take (and schedule) to confirm that the ampacity derating factors were derived by valid tests and are applicable to the modified plant design.*

Braidwood Station has not utilized testing to arrive at design cable deratings. Analytical methods have been utilized as described in the response to IV.B.1. All barriers that require upgrade or replacement will be re-evaluated analytically to determine proper ampacity derating once the upgrade or replacement materials are known. In addition, Braidwood Station will review the NUMARC ampacity test results when they become available.

V.B *Describe the specific alternatives available to you for achieving compliance with NRC fire protection requirements in plant areas that contain Thermo-Lag fire barriers.*

Due to the uncertainties regarding NUMARC testing and acceptance criteria, as well as the complexity of many plant installations, a combination of resolutions will be necessary for Braidwood Station to achieve compliance with fire protection requirements in the most cost effective manner. The options presently available include, but are not limited to, those listed below.

1) Remove the existing Thermo-Lag fire barrier and replace with an approved fire barrier.

2) Upgrade the existing Thermo-Lag fire barrier with additional Thermo-Lag material or another approved fire barrier.

3) Reroute the cable out of the fire area of concern or reroute it such that it would comply with one of the separation criteria of 10 CFR 50 Appendix R Section III.G (for example, 20 feet of separation between redundant trains with no intervening combustibles and detection and automatic suppression throughout the fire area).

4) Make a determination that selected fire barriers are no longer required based upon re-evaluation of the Safe Shutdown Analysis contained in the Braidwood Fire Protection Report.

5) Perform an analysis on the TSI fire wrap materials in the as-installed configurations. Using a Certified Fire Protection Engineer, assess area combustible loadings, area fire detection and suppression, and spatial orientation of the zone and equipment in the zone. Where justifiable, exemptions (Deviation from Appendix R) could be applied for based on low combustible loading in the area, area wide fire detection and/or suppression, and the amount of intervening combustibles between redundant cables.

6) A Probabilistic Risk Analysis (PRA) using the model being developed by EPRI could be performed. The results of this study could be the basis for an exemption request.

7) Qualify the current installation through unique testing applications or by a review of other utilities' testing.

VI.B *Submit an integrated schedule that addresses the overall corrective action schedule for the plant. At a minimum, the schedule should address the following aspects for the plant:*

1) implementation and completion of corrective actions and fire barrier upgrades for fire barrier configurations within the scope of the NUMARC program, and

2) implementation and completion plant-specific analysis testing, of alternative actions for fire barriers outside the scope on the NUMARC program.

Braidwood Station intends to resolve the Thermo-Lag issues in accordance with the Program Plan it has already developed. The resolution will focus on safety, utilizing a method applying relative Safe Shutdown Risk and Fire Hazard Margins to select which fire barriers will be addressed first. Braidwood intends to perfom detailed engineering evaluations and begin physical work on selected barriers in 1994. Braidwood intends to take the appropriate action to qualify all Safe Shutdown fire barriers by 1996. More detailed schedules of specific activities will be available with a supplemental response to be provided within ninety (90) days of issuance of the NUMARC Applicability Guide.

VII. *Describe the sources of the information provided in response to this request for information and how the accuracy and validity of the information was verified.*

The sources of the information provided in this response include plant design drawings, design data bases and reports, procurement specifications, material receiving inspection reports, vendor test reports and preliminary field walkdown reports. These source documents, except the preliminary field walkdown reports, were developed according to approved quality programs and procedures during plant design and construction and are considered correct. The preliminary field walkdowns were done using a standard walkdown checklist and the information obtained was verified. Similarly, calculations estimating the fire barrier linear footage, fire barrier square footage and cable fill perfonned in the preparation of this response were independently reviewed. A detailed listing of the source documents used is provided as Addendum D.

Addendum A
Table Ia
Braidwood Risers

TRAY NODE	WIDTH (in)	DEPTH (in)	USABLE DEPTH (in)	RATING	LINEAR FT.	D.L	%VOL. FILL	SQ.FT.	IN SCOPE
1R200	12	12	2	3 HR	13.5	32.47	4	63.0	N
1R201	12	12	2	3 HR	4	32.47	4	18.7	N
1R202	12	12	2	3 HR	12	29.36	4	56.0	N
1R203	12	12	2	3 HR	5	29.36	4	23.3	N
1R252	12	12	2	3 HR	20.5	106.96	14	95.7	N
1R253	12	12	2	3 HR	2.5	54.55	7	11.7	N
1R255	12	12	3	3 HR	22.5	36.36	7	105.0	N
1R256	12	12	2	3 HR	4	112.77	15	18.7	Y
1R304	18	12	2	3 HR	7.5	103.12	13	42.5	N
2R240	18	12	2	3 HR	13	133.85	18	73.7	Y
1R220	24	12	2	3 HR	10.5	37.90	5	70.0	N
1R221	24	12	2	3 HR	7.5	64.97	9	50.0	N
1R222	24	12	2	3 HR	22.5	62.07	8	150.0	N
1R224	24	12	3	3 HR	10.5	56.91	11	70.0	N
1R225	24	12	3	3 HR	7.5	143.88	28	50.0	Y
1R226	24	12	3	3 HR	24	128.35	25	160.0	Y
1R240	24	12	2	3 HR	10.5	72.74	10	70.0	N
1R241	24	12	2	3 HR	6.5	103.63	14	43.3	N
1R243	24	12	3	3 HR	9	77.67	15	60.0	Y
1R244	24	12	3	3 HR	8	98.93	19	53.3	Y
1R245	24	12	3	3 HR	8.5	100.77	20	56.7	Y
1R265	24	12	3	3 HR	20.5	104.27	20	136.7	Y
1R266	24	12	3	3 HR	4	96.80	19	26.7	Y
1R294	24	12	3	3 HR	4	76.60	15	26.7	Y
1R303	24	12	2	3 HR	2.5	48.07	6	16.7	N
1R305	24	12	2	3 HR	5	64.74	8	33.3	N
2R216	24	12	2	3 HR	19	106.24	14	126.7	N
2R234	24	12	3	3 HR	6	112.58	22	40.0	Y
2R253	24	12	2	3 HR	11	73.36	10	73.3	N
2R259	24	12	2	3 HR	20	82.54	11	133.3	N
2R282	24	12	3	3 HR	10.5	62.55	12	70.0	N
2R292	24	12	2	3 HR	9.5	93.83	12	63.3	N
2R214	24	12	2	3 HR	19	80.71	11	126.7	N
1R246	12	12	2	1 HR	9.5	33.47	4	44.3	N
1R248	12	12	2	1 HR	7	86.88	11	32.7	N
1R247	18	12	2	1 HR	19	36.71	5	107.7	N
1R700	18	12	2	1 HR	9	18.53	2	51.0	N
1R701	18	12	2	1 HR	10	77.81	10	56.7	N

	Thermo-Lag Linear Feet			
	12"x12"	18"x12"	24"x12"	Total
1 HOUR	17	38	0	55
3 HOUR	84	21	256	361

	Thermo-Lag Square Feet			
	12"x12"	18"x12"	24"x12"	Total
1 HOUR	77	215	0	292
3 HOUR	392	116	1707	2215

Note: Node 2R253 has both TSI and 3M material. Only TSI was used for calculations.

Addendum A
Table Ib
Braidwood Cable Trays

TRAY NODE	SIDE RAIL HT.(in)	WIDTH (in)	DEPTH (in)	TOTAL DEPTH (in)	USABLE DEPTH (in)	RATING	LINEAR FT.	D.I.	%VOL. FILL	SQ.FT.	IN SCOPE
2686E	4	24	6	10	3	3 HR	6	132.53	27	38	Y
11996C	2	24	6	8	3	3 HR	23	92.17	27	138	Y
1580R	4	24	4	8	2	3 HR	5.5	52.34	10	33	N
1580S	2	24	6	8	3	3 HR	5.5	91.47	27	33	Y
1794T	4	24	4	8	2	3 HR	12.5	48.07	9	75	N
1831E	4	24	4	8	2	3 HR	6	69.53	14	36	N
2684E	2	24	6	8	3	3 HR	9.5	108.36	32	57	Y
2688E	2	24	6	8	3	3 HR	5.5	6.20	2	33	N
2926K	2	24	4	6	2	3 HR	6.5	94.39	25	37	Y
2949K	2	24	4	6	2	3 HR	17	93.83	25	96	Y
1780S	0	24	4	4	2	3 HR	27	64.74	25	144	Y
1782S	0	24	4	4	2	3 HR	11	71.23	28	59	Y
1841T	0	24	4	4	2	3 HR	12	10.27	4	64	N
2921L	0	24	4	4	2	3 HR	12	65.86	26	64	Y
2922L	0	24	4	4	2	3 HR	23	65.86	26	123	Y
2923L	0	24	4	4	2	3 HR	20	65.86	26	107	Y
2924L	0	24	4	4	2	3 HR	16	65.86	26	85	Y
2926A	0	24	4	4	2	3 HR	6.5	63.79	25	35	Y
2926L	0	24	4	4	2	3 HR	9	65.86	26	48	Y
2941A	0	24	4	4	2	3 HR	14	82.54	32	75	Y
2942A	0	24	4	4	2	3 HR	10.5	65.50	26	56	Y
2945A	0	24	4	4	2	3 HR	16	63.79	25	85	Y
2945K	0	24	4	4	2	3 HR	16	78.33	31	85	Y
2946A	0	24	4	4	2	3 HR	17.5	63.79	25	93	Y
2946K	0	24	4	4	2	3 HR	17.5	78.33	31	93	Y
2947A	0	24	4	4	2	3 HR	11	63.79	25	59	Y
2947K	0	24	4	4	2	3 HR	11	78.33	31	59	Y
2948K	0	24	4	4	2	3 HR	7	93.83	37	37	Y
2950A	0	24	4	4	2	3 HR	12	63.79	25	64	Y
2950K	0	24	4	4	2	3 HR	12	94.39	37	64	Y
2951A	0	24	4	4	2	3 HR	14	63.79	25	75	Y
2951K	0	24	4	4	2	3 HR	14	94.39	37	75	Y
2682E	2	18	6	8	2	3 HR	11	133.85	26	55	N
1791T	4	18	4	8	2	3 HR	11.5	64.10	13	58	N
1944U	4	18	4	8	3	3 HR	13	99.37	29	65	Y
1793U	2	18	4	6	2	3 HR	21	97.60	26	98	Y
1882U	2	12	6	8	2	3 HR	23.5	130.45	26	94	N
1883U	2	12	6	8	3	3 HR	26.5	113.16	33	106	N
1884U	2	12	6	8	3	3 HR	13.5	113.16	33	54	N
1718M	2	12	4	6	2	3 HR	14	112.77	30	51	Y
1556C	0	12	4	4	2	3 HR	16.5	32.47	13	55	N
1556D	0	12	4	4	2	3 HR	18	29.36	12	60	N
1558L	0	12	4	4	2	3 HR	14	54.55	21	47	Y
1837E	0	12	4	4	2	3 HR	11	72.19	28	37	Y
1842T	0	12	4	4	2	3 HR	16.5	20.55	8	55	N
1917T	0	12	4	4	2	3 HR	12	33.27	13	40	N
1739A	0	18	12	12	2	1 HR	10.5	36.71	5	60	N
1617F	0	18	4	4	2	1 HR	13.5	10.98	4	59	N
1617G	0	18	4	4	2	1 HR	12.5	53.58	21	54	Y
1618F	0	18	4	4	2	1 HR	8.5	11.70	5	37	N
1618G	0	18	4	4	2	1 HR	11.5	56.77	22	50	Y
1619F	0	18	4	4	2	1 HR	27	35.88	14	117	N
1619G	0	18	4	4	2	1 HR	12	60.86	24	52	Y
1737A	0	18	4	4	2	1 HR	13.5	42.22	17	59	Y
1738A	0	18	4	4	2	1 HR	14	36.71	14	61	N

Thermo-Lag Linear Feet

	24"x10"	24"x8"	24"x6"	24"x4"	18"x8"	18"x6"	18"x4"	12"x8"	12"x6"	12"x4"	Total
1 HOUR	0	0	0	0	0	0	113	0	0	0	113
3 HOUR	6	68	24	309	36	21	0	64	14	88	628

Thermo-Lag Square Feet

	24"x10"	24"x8"	24"x6"	24"x4"	18"x8"	18"x6"	18"x4"	12"x8"	12"x6"	12"x4"	Total
1 HOUR	0	0	0	0	0	0	488	0	0	0	488
3 HOUR	38	405	133	1648	176	98	0	254	51	293	3096

Note: Nodes 2921L and 2942A have both TSI and IM materials. Only TSI was used in calculations.

Addendum A
Notes for Tables Ia and Ib

1. The Wrapped Footage numbers for cable trays and risers are design data and were provided by Sargent & Lundy via DIT CG-EXT-0055-00.

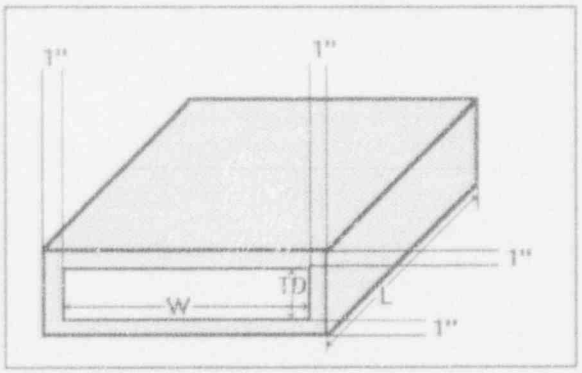
2. The linear footage for each tray/riser size is a sum of all the wrapped footage for each tray/riser of that size.

3. The square footage is an estimate that assumes all wrapped trays/risers are boxed in with 1" thick material for the entire wrapped length.

4. The formula used for calculating square footage is:

SQ. FT. = ((2x((W+2)+(TD+2)))xL)/144

where: W = tray/riser width
TD = total depth of tray/riser including side rail height
L = wrapped length
W+2 and TD+2 = the width/depth of the Thermo-Lag sheets which are one inch wider/taller than the trays/risers on each side of the tray (see sketch below). The sum of W+2 and TD+2 is multiplied by 2 to include each side and the top and bottom of each tray/riser.
Division by 144 converts from square inches to square feet



5. The Percent Volumetric Fill was calculated in order to determine if the installation is within the scope of NUMARC tests which were conducted with a 15% filled volume. At this point we assume that, in order to be within the scope of NUMARC testing, an installation must have at least 15% volumetric fill.

6. The following formula is used to calculate a cable tray's % Vol. Fill based on the actual Design Index (DI) and overall tray height. DI, as defined in Sargent & Lundy Electrical Drafting Standard EDSB-128, is a measure of tray fill based on allowable fill. DI is used to monitor tray fill and indicate overfill conditions when greater than 1.25. Because DI is calculated assuming square cables, a $\pi/4$ factor has been used in the formula to account for round cables.

$$\% \text{ Vol. Fill} = \frac{\text{Sum of Cable Areas} \times 100\%}{\text{Tray or Riser Area}}$$

$$= \frac{(\Sigma D^2)(\pi/4) \times 100\%}{(H)(W)}$$

$$= \frac{(\Sigma D^2)\,\pi \times 100\%}{4\,(H)(W)}$$

$$= \frac{((DI)(W)(UD)/100)\,\pi \times 100\%}{4\,(H)(W)}$$

$$= \frac{(DI)(UD)\,\pi}{4\,(H)}$$

UD = Useable depth of the tray or riser

H = Total height/depth of tray or riser including any side rails

W = Width of tray or riser

D = Individual cable diameter

$$DI = \frac{(\Sigma D^2)\,100}{(W)(UD)}$$

Solving the above equation for (ΣD^2): $(\Sigma D^2) = \frac{(DI)(W)(UD)}{100}$

Addendum A
Table II
Braidwood Conduit

CONDUIT	SIZE	RATING	FILL	FEET HORIZONTAL	FEET VERTICAL	TOTAL LINEAR FEET	IN SCOPE	REMARKS
C0A32KH	3/4"	3 HR	18.9	27	0	27	Y	WRAPPED WITH C0A32KJ;INCLUDES 12'-0" MAX FLEX
C0A32KJ	3/4"	3 HR	51	23	0	23	Y	WRAPPED WITH C0A32KH;INCLUDES 6'-0" MAX FLEX
C0A22QA	3/4"	3 HR	51	0	4.3	4.3	Y	WRAPPED WITH C0A22QB
C0A22QB	3/4"	3 HR	18.9	0	4.3	4.3	Y	WRAPPED WITH C0A22QA
C0A32KF	3/4"	3 HR	18.9	10	11.5	21.5	Y	INCLUDES 6'-0" MAX FLEX
C0A32KG	3/4"	3 HR	51	10	11.5	21.5	Y	INCLUDES 6'-0" MAX FLEX
C0A22PV	3/4"	1 HR	51	6	0	6	Y	FLEX CONDUIT
C0A22PW	3/4"	3 HR	18.9	6	0	6	Y	FLEX CONDUIT
C0A22PV	3/4"	3 HR	51	8.5	6.5	15	Y	
C0A22PW	3/4"	3 HR	18.9	8.5	6.5	15	Y	
C0A32KT	3/4"	3 HR	18.9	15	3	18	Y	
C0A32KT	3/4"	3 HR	18.9	0	13	13	Y	
C1A5189	3"	3 HR	28.2	0	12	12	Y	
C1A5196	3"	3 HR	38.9	0	12	12	Y	
C1A51A2	3"	3 HR	22.1	0	16	16	Y	
C0A35E0	2"	3 HR	26.2	10	16	26	Y	INCLUDES 6'-0" MAX FLEX
C0A2594	2"	3 HR	26.2	9	0	9	Y	
C0A35E3	2"	3 HR	26.2	23	4	27	Y	
CGA2594	2"	3 HR	26.2	5	4	9	Y	
C0A12R5	1"	3 HR	42.9	13	6	19	Y	INCLUDES 6'-0" MAX FLEX
C1A1414	4"	1 HR	18.8	25	0	25	Y	
C1A1415	3"	1 HR	43.5	25	0	25	Y	
C1A6169	3 AL	1 HR	28.2	19	8	27	Y	
C1A6170	3 AL	1 HR	28.2	8	8	16	Y	
C1A6171	3 AL	1 HR	28.2	15	8	23	Y	
C1A1416	2"	1 HR	22	25	6	25	Y	
C0A12C1	2 1/2"	1 HR	50.8	45	15	60	Y	INCLUDES 6'-0" MAX FLEX AND 4'-7" PULLSLEEVE

	Linear Feet							
	3/4"	1"	2"	2 1/2"	3"	3" Alum.	4"	Total
1 HOUR	0	0	25	60	25	66	25	201
3 HOUR	162	19	71	0	40	0	0	292

Notes for Table II

1. The wrapped footage figures for conduit are design data that were provided by Sargent & Lundy in DIT CG-EXT-0055-00.

2. The total linear feet is calculated by adding the wrapped vertical and horizontal footage figures for each size of conduit.

Addendum A
Table III
Braidwood Junction Boxes

JCTBOX	SIZE HEIGHT	SIZE WIDTH	SIZE DEPTH	RATING	TYPE	SQ.FT.	IN SCOPE
2JB2545A	12	12	6	3 HR	TSI	5.8	Y
2JB2539A	12	12	6	3 HR	TSI	5.8	Y
2JB2535A	12	12	6	3 HR	TSI	5.8	Y
1JB2743A	16	16	6	3 HR	TSI	8.5	Y

Total Square Feet	
1 HOUR	0
3 HOUR	26

Notes for Table III

1. The junction box sizes are design data and were provided by Sargent & Lundy in DIT CG-EXT-0055-00.

2. The square footage calculation assumes that each junction box is covered on all six sides by 1" thick preformed Thermo-Lag panels. The actual amount will be somewhat less, as some junction boxes are mounted on walls and thus are covered with Thermo-Lag on only five sides.

3. The formula used for calculating square footage is:

$$SQ.\ FT. = (2x(((W+2)x(H+2))+((W+2)x(D+2))+((H+2)x(D+2))))/144$$

where: W = junction box width
H = junction box height
D = junction box depth

W+2, H+2 and D+2 = the actual width, height and depth of the Thermo-Lag sheets which are one inch wider/taller/deeper than the sides of the junction boxes.
(W+2) x (H+2) = The area of the Thermo-Lag sheet on the junction box top or bottom
(W+2) x (D+2) = the area of the Thermo-Lag sheet on either end of the junction box
(H+2) x (D+2) = the area of the Thermo-Lag sheet on either side of the junction box

The sum of the areas is multiplied by 2 to include both sides, both ends and the top and bottom. The division by 144 converts from square inches to square feet.

Addendum A
Table IV
Braidwood Penetrations

PENETRATION	DRAWING	RATING	HEIGHT	WIDTH	DEPTH	SQ.FT.	IN SCOPE
E0351073	20E-1-3052A	3 HR	12	59	22	26.6	N
E0362059/E0362060	20E-0-3062	3 HR	24	36	32	32.7	N
E0383146	20E-0-3073	3 HR	14	36	9	9.8	N
E0382487	20E-0-3074	3 HR	36	24	54	51.0	N
E0382488	20E-0-3074	3 HR	24	24	42	32.0	N

Total Square Footage	
1 HOUR	0
3 HOUR	152

Notes for Table IV

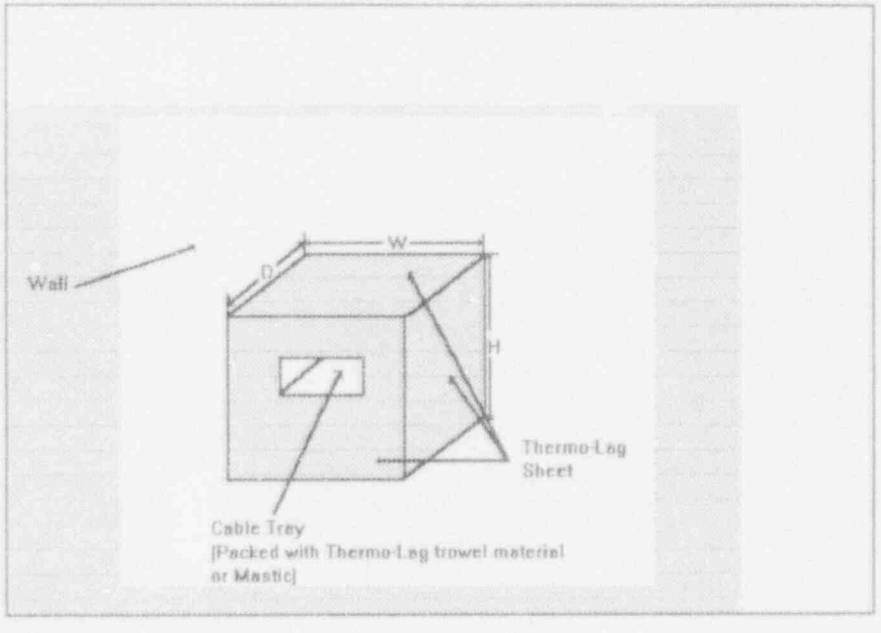
1. The penetration seal material estimates are based on the dimensions provided in the design drawing. However, the drawings provide a dimensional tolerance of ±3 inches for any dimension, so the actual amount of material is within these tolerances.

2. Each of the penetration seals is essentially a box made of Thermo-Lag panels (see sketch below). The formula used to calculate square footage is as follows:

SQ. FT. = ((2x((HxD)+(WxD)))+(HxW))/144

where: H = height of the seal
W = width of the seal
D = depth of the seal
2x((HxD)+(WxD)) = the total area of the top and bottom and both sides of the seal enclosure

Division by 144 provides the conversion from square inches to square feet



Addendum B

Fire Barrier Parameters

Listed below are the 24 fire barrier parameters identified in Section II.A of the Enclosure to the Request for Additional Information (RAI) Regarding Generic Letter 92-08. The discussion associated with each parameter identifies whether the parameter is known and verified for the Thermo-Lag fire barriers at Braidwood Station. As applicable, the means of obtaining and verifying the parameters are also discussed. This information supplements the Braidwood response to Item II.B.1 of the RAI.

1) Raceway Orientation (horizontal, vertical, radial bends):

   The orientation of cable pans was obtained from the cable pan piece parts and riser section drawings. Preliminary verification of this information was performed during the plant walkdowns. Final verification will include performing additional walkdowns to photograph and generate cable tray sketches as necessary to supplement the drawings.

2) Conduit:

   Information identifying conduits wrapped with Thermo-Lag was obtained from the electrical installation and conduit tabulation drawings. Preliminary verification of this information was performed during the plant walkdowns. Final verification will include performing additional walkdowns to photograph or generate sketches of wrapped conduit to supplement as necessary the drawings and document the as-built configuration.

3) Junction Boxes and Lateral Bends:

   Information identifying junction boxes which are fire wrapped was obtained from the electrical installation drawings and the junction box schedules. The as-built orientation of the boxes is provided on the electrical installation drawings. Preliminary verification of this information was not performed during the plant walkdowns. Final verification will include performing walkdowns to photograph or generate sketches of junction boxes and lateral bends in the wrapped conduit to supplement as necessary the drawings and document the as-built configurations.

4) Ladder Back Cable Tray with single layer fill:

Information regarding ladder back cable tray was obtained from cable pan piece parts and cable riser drawings. This information indicates that no ladder back cable tray has been wrapped at Braidwood station. Final verification will include review of drawings and/or other documents as needed. Physical verification through walkdowns is not planned at this time because it may be destructive to fire barrier and/or components.

5) Cable Tray with T-Section:

This is included in the discussion for parameter #1 above.

6) Raceway Material:

The raceway material information was obtained and verified by review of the procurement specification. The revision of Procurement Specification L-2790 in effect at the time of the cable tray and riser installation included Sargent & Lundy (S&L) Standard EB-701 which requires all cable trays to be constructed of steel. S&L Standard EB-146, also within this specification, requires all conduits to be constructed of steel. The only exception to this specification are the aluminum conduits associated with the 125 Vdc ESF battery rack connections. (refer to Reference 8 in Addendum D). Physical verification through walkdowns is not planned at this time because it may be destructive to the fire barrier and/or components. Final verification will include review of drawings and/or other documents as needed.

7) Support Protection, Thermal Shorts (penetrating elements):

This information was obtained from design drawings. The conduit/raceway supports which must be protected due to heat transfer considerations are not individually identified as requiring wrap on any drawings. However, a general note on Braidwood installation drawing 20E-0-3251 directs the contractor to wrap all cables and supports within 18" of the firewrap envelope. Preliminary verification of this information was performed during the plant walkdowns. Final verification will include performing additional walkdowns to photograph and generate sketches as necessary to supplement the drawings. The supports will be shown in the pictures generated to address parameters #'s 1, 2, 3 and 5.

8) Air Drops:

Information identifying air drops where Thermo-Lag fire barriers have been installed was obtained from cable pan piece parts and riser section drawings. Physical verification through walkdowns is not planned at this time because it may be destructive to the fire barrier and/or components. Final verification will include review of drawings and/or other documents as needed.

9) Baseline Fire Barrier Panel Thickness:

The thickness of all fire barriers panels installed at Braidwood has been obtained. Review of Material Receiving Reports has shown that all Thermo-Lag panels (flat sheets) purchased for Braidwood Station were nominally 1" thick. Physical verification through walkdowns is not planned at this time because it may be destructive to the fire barrier and/or components. Final verification will include review of drawings and/or other documents as needed.

10) Preformed Conduit Panels:

Information regarding the use of preformed conduit panels was obtained from the Material Receiving Reports. These reports showed that preformed conduit panels were purchased in both 1/2" and 1" sizes for use at Braidwood station. Plant walkdowns have identified the overall dimensions of fire wrapped conduits. This dimension, along with the conduit outer diameter and required level of protection (1-hour or 3-hour), may be used to identify whether 1/2" or 1" preformed panels have been used for each installation. Physical verification through walkdowns is not planned at this time because it may be destructive to the fire barrier and/or components. Final verification will include review of drawings and/or other documents as needed.

11) Panel Rib Orientation (parallel or perpendicular to the raceway):

This parameter was not obtained. The direction of the ribs, where exposed, was not formally documented during the preliminary walkdowns. Interviews with the personnel who performed the preliminary walkdowns indicate that perpendicular and parallel installations exist. Physical verification through walkdowns is not planned at this time because, where ribs are not exposed, it may be destructive to the fire barrier and/or components.

12) Unsupported Span:

Unsupported spans can be determined from the location of structural supports for conduits and cable trays and the distances between them. These locations and distances can be obtained from hanger drawings. Hanger drawings are "As-Built" drawings and as such have been independently reviewed. Preliminary verification of this information was not performed during the plant walkdowns. Final verification will include performing walkdowns to photograph or generate sketches of hangers to supplement as necessary the drawings and document the as-built configuration.

13) Stress Skin Orientation (inside or out):

Information regarding stress skin orientation was obtained. Review of Material Receiving Reports showed that only materials intended to be used for 3-hour barriers were purchased for the cable trays and risers. Based on the vendor manual, this 3-hour design consists of an inner layer of Thermo-Lag stress skin type 330-69, a center layer of 1.00 inch minimum dry film thickness of the Thermo-Lag 330-1 Subliming Material and an outer layer of Thermo-Lag stress skin type 330-69. Preliminary verification of outer stress skin was performed during the plant walkdowns. Physical verification of stress skin on the inside of the configuration may be destructive. Physical verification through walkdowns is not planned at this time because it may be destructive to the fire barrier and/or components. Final verification will include review of drawings and/or other documents as needed.

14) Stress Skin over Joints or no Stress Skin over Joints:

Review of documentation at this time shows no indication that stress skin over joints was installed. Therefore, this parameter is considered to be "obtained". Although this criteria was not documented during walkdowns, interviews with the personnel who performed the walkdowns indicates that stress skin over joints is not expected to be found during future walkdowns. Final verification will include performing additional walkdowns in the attempt to ensure, as necessary, and nondestructively, that stress skin does not exist over joints.

15) Stress Skin Ties or no Stress Skin Ties:

Review of documentation at this time shows no indication that stress skin ties were installed. Therefore, this parameter is considered to be "obtained". Although this criteria was not documented during the walkdowns, interviews with the personnel who performed the walkdowns indicates that stress skin ties are not expected to be found during future walkdowns. Final verification will include performing additional walkdowns in the attempt to ensure, nondestructively, that stress skin ties do not exist.

16) Dry-fit, Post-buttered Joints or Pre-buttered Joints:

Sufficient information regarding the existence of post-buttered or pre-buttered joints has not been obtained. the walkdowns have identified existing post-buttered joints. It has not been determined whether or not the joints were pre-buttered because most joints have been post-buttered. Physical verification through walkdowns is not planned at this time because it may be destructive to the fire barrier and/or components. Final verification will include review of drawings and/or other documents as needed.

17) Joint Gap Width:

Sufficient information regarding the joint gap width has not been obtained.the walkdowns have attempted to identify whether the gap/seams associated with each installation are greater or less than 1/4". The actual gap width for each joint has not been identified as most joints are post-buttered. Physical verification through walkdowns is not planned at this time because it may be destructive to the fire barrier and/or components.

18) Butt Joints or Grooved and Scored Joints:

This parameter has been obtained. The walkdowns have identified whether the joints are butt joints or metered. Final verification will include performing additional walkdowns as necessary to verify joint types.

19) Steel Bands or Tie Wire:

This parameter has been obtained. the walkdowns have identified whether bands and/or wire ties have been used for each installation. Final verification will include performing additional walkdowns as necessary to verify the existence of steel band or tie wire.

20) Band/wire spacing:

Information has been obtained regarding band/wire spacing. the walkdowns have attempted to identify whether the band/wire spacing is greater or less than 12". These walkdowns have shown that the spacing is non-uniform. The actual spacing between all bands/wires has not been identified. Final verification will include performing additional walkdowns as necessary to verify band/wire spacing.

21) Band/Wire distance to Joints:

Information has been obtained regarding band/wire spacing. The walkdowns have attempted to identify this parameter, however, not all joints were reviewed. Final verification will include performing additional walkdowns as necessary to verify band/wire distance to joints.

22) No Internal Bands in Trays:

This parameter has been obtained. All trays and risers were provided with covers per general notes on Braidwood installation drawings 20E-0-3251 and 20E-0-3237D prior to installation of the fire wrap material. This cover will prevent any bands or wires from entering the trays or risers. Physical verification through walkdowns is not planned at this time because it may be destructive to the fire barrier and/or components. Final verification will include review of drawings and/or other documents as needed.

23) No Additional Trowel Material over Sections and Joints or Additional Trowel Material Applied:

This parameter has not been obtained. the walkdowns have identified where trowel material was used for post-buttered joints. There was no attempt made during these walkdowns to identify any other applications. Final verification will include performing additional walkdowns as necessary to verify the use of additional trowel material.

24) No Edge Guards or Edge Guards.

This parameter has not been obtained. This parameter has not been identified during the walkdowns. Interviews with the personnel who performed the walkdowns indicate that edge guards are not expected to be found during future walkdowns. Final verification will include performing additional walkdowns as necessary to verify the use of edge guards.

Addendum B

In summary, the following fire barrier parameters have not been verified and are not currently known:

1) Panel rib orientation on the inside of the panel (#11) ;
2) Dry-fit, post-buttered, or pre-buttered joints (#16);
3) Joint gap width (#17);
4) Additional trowel material (#23);
5) Edge guards (#24).

Addendum C

Cable Parameters

Listed below are the 8 cable parameters identified in Section II.A of the Enclosure to the Request for Additional Information (RAI) Regarding Generic Letter 92-08. The discussion associated with each parameter identifies whether the parameter is known and verified for the Thermo-Lag fire barriers at Braidwood Station. As applicable, the means of obtaining and verifying the parameters are also discussed. This information supplements the Braidwood response to Item II.B.1 of the RAI.

1) Cable Size and Type

The size and type of each cable have been determined using the Sargent & Lundy Interactive Cable Engineering (SLICE) computer program and the associated Braidwood cable data base. The SLICE Cable Tray Loading report provides a list of all cables in each routing point along with its segregation code indicating whether the cable is control, power or instrumentation. This report also provides the cross-sectional area associated with each cable. The SLICE Cable Tabulation Main File report provides the cable type for all cables. This report also provides a cable type code which can be used in conjunction with the Byron/Braidwood 6/20E-0-3000B series installation drawings (Electrical Installation Cable Information) to identify the outer diameter of each cable. Final verification will include review of drawings and/or other documents as needed.

2) Cable Jacket Type (Thermoplastic, Thermoset) and Materials

All safe shutdown cables, with the exception of two, which are wrapped with Thermo-Lag are Okonite brand cables based on a review of the Fire Protection Report, the SLICE Cable Tabulation Main File report and the 6/20E-0-3000B series drawings. The jacket for these cables is Okolon (Hypalon). The remaining two cables were manufactured by Samuel Moore based on these same references. This cable jacket is also made of Hypalon. Final verification will include review of drawings and/or other documents as needed.

3) Cable Conductor Insulation Type and Materials

The Okonite cable insulation type is Okoguard (EPR) while the Samuel Moore cable insulation type is EPDM based on vendor information/design documents. Final verification will include review of drawings and/or other documents as needed.

4) Cable Fill And Distribution of Cables Within Protected Conduits and Cable Trays

Cable fill for cable tray and risers has been obtained from the Sargent & Lundy SLICE Cable Tray Loading report. The SLICE report provides cable fill as "Design Index." Design Index is explained further in Addendum A of this letter. This information was used to calculate percent volumetric fill for each routing point.

The conduit tabulation drawings identify the size of each conduit and the cables contained within each conduit. Conduit fill has been determined using parameter 1 information (cable size and type), the conduit tabulation drawings and Sargent & Lundy Standard EDSB-10 (Electrical Drafting Reference for Determining Conduit & Pipe Sizes 6-9-86).

Preliminary verification of this information was not performed during the plant walkdowns. Physical verification through walkdowns is not planned at this time because it may be destructive to the fire barrier and/or components. Final verification will include review of drawings and/or other documents as needed.

The distribution of cables in protected trays and conduits has not been obtained. Physical verification through walkdowns is not planned at this time because it may be destructive to the fire barrier and/or components.

5) Proximity of cables to the unexposed (inside) surfaces of the fire barrier.

This parameter has been not been completely obtained. All cable trays and risers were provided with covers per general notes on Braidwood installation drawings 20E-0-3251 and 20E-0-3237D prior to installation of the fire wrap material. These covers will prevent any cables from being in contact with the fire barrier material. This parameter is unknown, however, in the few cases where air drops exist. Physical verification through walkdowns is not planned at this time because it may be destructive to the fire barrier and/or components. Final verification will include review of drawings and/or other documents as needed.

6) Presence of materials between the cables and the unexposed side of the fire barrier material (for example, Sealtemp cloth, which is used in the NUMARC test specimens).

Same as parameter #5 above.

7) Cable Operating Temperature:

All safe shutdown cables which require fire wrap are Okonite or Samuel Moore cables. These cables have a 90°C maximum continuos conductor rating rating based on the procurement specification. The Byron/Braidwood cable system was designed to maintain the conductors at or below 90°C. Final verification will include review of drawings and/or other documents as needed.

8) Temperatures at Which The Cables Can no Longer Perform Their Intended Function When Energized at Rated Voltage And Current

Okonite 5 kV and 600V cables have been tested to 173.9°C (345°F) for 180 minutes based on Okonite Test Reports No. NQRN-3, Rev. 4 and No. NQRN-1A, Rev. 5. The Samuel Moore cable has been tested to 171.1°C (340°F) per NTS Report No. 558-1088, dated 10-9-91. These tests were performed at appropriate voltage and current levels for the cable. The tests were part of the original Environmental Qualification test program. At this time, test results do not exist which indicate that cable functionality evaluations for cable above these temperatures are necessary. Final verification will include review of drawings and/or other documents as needed.

In summary, only distribution of cables within protected conduits or cable trays (#4), proximity of cables to the unexposed (inside) surfaces of the fire barrier in the few cases of air drops (#5), the presence of material between cables and the unexposed side of the fire barrier material in the few cases of air drops (#6) have not been obtained.

Addendum D
Information Sources

The following were used as information sources for the response to the Request for Additional Information dated December 21, 1993 regarding Generic Letter 92-08

1) Braidwood/Byron Fire Protection Report

2) Braidwood Station Re-Review of the Fire Hazards Safe Shutdown Analysis -- Sargent & Lundy Design Information Transmittal (DIT) BB-EXT-0718

3) NUMARC TSI Thermo-Lag Fire Barrier Check List -- Sargent and Lundy DIT-CG-EXT-0055-00

4) Sargent & Lundy Interactive Cable Engineering (SLICE) Program, Reports S-101-1 (cable tabulation main file) and S-106-1 (cable tray loading)

5) Braidwood Station Electrical Installation Cable Information Drawings, Series 6/20E-0-3000B

6) Braidwood Station Cable Pan Installation Drawing 20-0-3237D Revision Z, Data 1A

7) Braidwood Station Cable Pan General Notes and Installation Details Drawing 20E-0-3251, Revision BA

8) Braidwood Station Electrical Installation and Conduit Tabulation Drawings:
20E-1-3361 Revision CW
20E-1-3361CT1 Revision AC
20E-2-3361 Revision CK
20E-2-3371CT1 Revision S

9) Sargent & Lundy Specification L-2790, Electrical Installation Work, Braidwood Station Unit 1 and 2

10) Sargent & Lundy Specification L-2823, 600 Volt Power and Control Cable, Braidwood Station Units 1 and 2

11) Sargent & Lundy Specification L-2851, 8kV and 5kV Power Cables, Braidwood Station Units 1 and 2

12) Sargent & Lundy Specification L-2852, Instrumentation Cable, Braidwood Station Units 1 and 2

13) Sargent and Lundy Standards EDSB-10 (Electrical and Drafting Standard for Determining Conduit and Pipe Size)

14) Okonite Test Reports NORN-3, Revision 4 and NORN-1A, Revision 5

15) NTS Report No. 558-1088, 10-9-81 (Qualification of Samuel Moore cable)

16) TSI Technical Note 20684

17) Braidwood Field Walkdown Data Reports.

18) Memo from J. Behn dated 1/25/94.

Attachment 2

Byron Station Response

"Request for Additional Inform...ion
regarding Generic Letter 92-08,
"Thermo-Lag 330-1 Fire Barriers,"
Pursuant to 10 CFR 50.54(F)

Byron Station Response
Request for Additional Information
regarding Generic Letter 92-08,
"Thermo-Lag 330-1 Fire Barrier",
Pursuant to 10 CFR 50.54(F)

I.B.1 *Describe the Thermo-lag 330-1 barriers installed in the plant. Include the intended purpose, fire rating, type and dimension of the barrier.*

Thermo-Lag 330-1 barriers have been installed at Byron Station to meet one or more of the the following criteria:

a. meet 10 CFR 50.48 or Appendix R to 10 CFR, Part 50
b. support an exemption from Appendix R,
c. achieve physical independence of electrical systems,
d. meet a condition of the plant operating license,
e. satisfy licensing commitments.

The fire barriers for cable trays/risers at Byron were constructed to be either 1-hour or 3-hour fire barriers. None are built as radiant heat shields. Most of the 3-hour barriers on trays and risers are constructed of two 0.5 inch (1-hour rated) Thermo-Lag prefabricated panels in accordance with TSI Technical Note 20684 "Thermo-Lag Fire Barrier System Installation - Procedures Manual". Also, some 3-hour barriers were constructed of one 1.0 inch (3-hour rated) prefabricated panel. All 1-hour barriers are constructed of 0.5 inch (1-hour rated) prefabricated panels.

These barriers are listed in Tables 1-4 along with fire rating, type, and dimension of the fire barrier. There is a separate table for horizontal cable tray, vertical cable tray, conduit, and junction boxes. There are two additional Thermo-Lag 330-1 fire barrier installations which serve other functions. One application is to protect structural steel in one small location in the Auxiliary Building and the other serves as an electrical penetration seal in a Lower Cable Spreading Room. These two installations are described in Table 5.

I.B.2For the total population of Thermo-Lag fire barriers described under Item I.B.1, submit an approximation of:

a.For cable tray barriers: the total linear feet and square feet of 1-hour barriers and the total linear feet and square feet of 3-hour barriers.

b.For conduit barriers: the total linear feet of 1-hour barriers and the total linear feet of 3-hour barriers.

c.For all other fire barriers: the total square feet of 1-hour barriers and the total square feet of 3-hour barriers.

d.For all other barriers and radiant energy heat shields: the total linear or square feet of 1-hour barriers and the total linear or square feet of 3-hour barriers, as appropriate for the barrier configuration or type.

An approximation of the total linear feet and square feet of Thermo-Lag fire barriers at Byron is given below. Tables 1-5 also provide an approximation by individual barrier.

1 Hour/3 Hour
Horizontal Cable Tray barriers
Total linear feet2711009
Total square feet11395143

Vertical Cable Riser barriers
Total linear feet 134 628
Total square feet7613809

Conduit barriers
Total linear feet290511

Other fire barriers
1) Junction Boxes, total square feet11107
2) Protection of structural beam (Sq. Ft)21
3) Electrical penetration seal, total square feet8

II.B.1 *State whether or not you have obtained and verified each of the aforementioned parameters for each Thermo-lag barrier installed in the plant. If not, discuss the parameters you have not obtained or verified.*

Byron Station has assessed the parameters believed to be critical for characterizing its fire barriers. The 24 fire barrier and 8 cable parameters are individually addressed in Addenda A and B , respectively. Information associated with these specific parameters was obtained for Byron from various design drawings, design documents and reports (See Addendum C). These include: cable pan piece part drawings; riser section drawings; electrical installation drawings; conduit tabulation drawings; junction box schedules; cable engineering data base; procurement specifications; material receiving inspection reports; Fire Protection Report; and vendor test reports.

Preliminary plant walkdowns were performed to obtain parameter information which could not be obtained elsewhere. These plant walkdowns were also provided preliminary verification, where practical, of the information obtained from design drawings, design documents and reports. Preliminary verification was documented by creating walkdown reports, videotaping and photographing.

The preliminary verification of fire barrier and cable parameters will be supplemented by a final verification as needed. Final verification will be physical (in the form of walkdowns), where practical. In cases where physical verification is not practical, an independent review of design drawings, documents, etc. will be performed as needed and considered the final verification. In some cases, the preliminary verification may be determined to be sufficient such that further verification is not needed.

Obtaining and verifying parameters is not considered practical when fire barriers or other components must be destructively removed. These activities will not be performed at Byron until the importance of each parameter to the acceptability of the fire barriers can be better determined.

The scope of activities being performed or planned to obtain and verify certain fire barrier and cable tray parameters may change as the final list of critical parameters and their relative importance is better defined.

To date, only 11 of the NRC's listed fire barrier and cable parameters cannot be readily obtained for Byron. These are:

1) Panel thickness (Addendum A, item #9)
2) Panel rib orientation, where ribs are concealed (item #11)
3) Stress skin orientation, inside barrier where two .5 inch panels are installed (item #13)
4) Pre-buttering, where post-buttering conceals (item #16)
5) Joint gap width, where post-buttering conceals (item #17)
6) Internal bands (item #22)
7) Additional trowel material (item #23)
8) Edge guards (item #24)
9) Cable fill and distribution within barrier (Addendum B, item #4)
10) Proximity of cable to barrier (item #5)
11) Presence of materials between cables (item #6)

Obtaining these parameters can only be done by destructively removing fire barrier material.

Some of the NRC's listed parameters are easily obtainable from existing design documents but have not been specifically reviewed and verified at this time. These parameters will be obtained and verified when the information is required to complete activities for the barrier. All of these parameters are identified and discussed in Addenda A and B.

II.B.2 *For any parameter that is not known or has not been verified, describe how you will evaluate the in-plant barrier for acceptability.*

Byron Station has anticipated the parameters believed to be critical for characterizing its fire barriers. The NUMARC Application Guide, expected in April 1994, will provide definitive input to deciding what additional or existing parameters are critical for qualification to the tested configurations.

Additional information, when obtained, will determine whether upgrading each plant Thermo-Lag installation to meet tested configurations is the most cost effective method of meeting Appendix R requirements. In cases, where upgrading the existing barriers to meet tested configurations is chosen as the optimum method of resolution, the following options exist to evaluate the acceptability of these parameters:

1) Review available installer records and procedures to ascertain installation standards and practices,
2) Perform destructive examinations on a sufficient sample of installations to establish parameter,
3) Assume parameter is limiting in nature (e.g., all joints are post-buttered instead of pre-buttered).

II.B.3 *Describe the type and extent of the unknown parameters at your plant.*

Known and unknown information regarding the 24 fire barrier and 8 cable parameters at Byron is discussed in the response to Items II.B.1 and in more detail in Addenda A and B. The significance of the unknown information relative to NUMARC's application guidance cannot be determined until configuration testing is completed, the final list of critical parameters is determined and the NUMARC guidelines are finalized.

III.B.1 *Describe the barriers discussed under Item I.B.1 that you have determined will not be bounded by the NUMARC test program.*

Byron Station has identified the Thermo-Lag fire barriers it believes are within the scope of the NUMARC Test Program. This determination and a description are provided in the attached Tables 1-4 for horizontal trays, vertical risers, conduits, and junction boxes, respectively. The designation of being "within scope" or "out of scope" is established by determining if the Byron cable raceway defined by physical dimensions, configuration, and percent cable fill is the same or bounded by the configuration tested under the NUMARC Program. It is recognized that a determination of scope is not sufficient to guarantee the Byron fire barrier will be qualified by a successful NUMARC test. A detailed comparison of

Thermo-Lag installation parameters between the plant installation and the test configuration will be required to precisely establish its status as being "bounded" by the test. Completion of the NUMARC Phase II Tests and issuance of the NUMARC Application guide (expected in April, 1994) will be necessary in order for Byron to make the final assessment. Byron believes the installations designated "within scope" are likely to be bounded given sufficient verification of parameters and application of appropriate upgrade enhancements.

Byron recognizes that the "within scope" raceways in Tables 1-4 may contain horizontal or vertical offsets, reducers, or other unique terminations that are not within the scope of the current NUMARC Test Program. Byron has not identified all of these potential non-bounded components at this time. All of these components, which are typically used in most raceway systems, will be identified during the continuing evaluation process and resolved using alternatives available.

Tables 1 and 2 indicate approximately 50 percent of the Byron cable trays and risers have "percent cable fill" values that are less than 15 percent. At this time, Byron is forced to categorize these trays as "out of scope" because all NUMARC tests are not bounding below 15% cable fill. Cable tray with less than 15% cable fill has already been identified as a candidate test configuration in proposed expanded generic test programs. Therefore, there is potential these installations may be brought within the scope of future tests.

The use of Thermo-Lag for purposes other than for protection of Safe Shutdown functions is described in Table 5. These barriers are considered outside the scope of the NUMARC Test program and will be resolved by using alternative methods to accomplish the function. These barriers were separated from the barriers of Tables 1-4 because they should be treated differently from barriers providing Safe Shutdown functions. The parameters pertinent to their intended function are different and methods for resolution will be different.

III.B.2 *Describe the plant-specific corrective action program or plan you expect to use to evaluate fire barrier configurations particular to the plant. This description should include a discussion of the evaluations and tests being considered to resolve the fire barrier issues identified in Generic Letter 92-08 and to demonstrate the adequacy of the existing in-plant barriers.*

The Byron Station plant-specific corrective action program to evaluate the unique fire barrier configurations is documented in the "Commonwealth Edison Thermo-Lag and Other Fire Barrier Qualification Program Plan". This plan was prepared and accepted by the Commonwealth Edison Company Fire Barrier Materials Task Team in October 1993. This program was presented, in an abbreviated form, and discussed with the NRR Staff on January 26, 1994. Byron Station is implementing this program to reach resolution of each Thermo-Lag fire barrier installed at the Station.

The Program is comprised of multi-components:

Assessment of As-Built Configuration

- o Data collection and assessment of barrier configurations
- o Assessment of Safety Significance
- o Review of Fire Protection Report Safe Shutdown Analyses
- o Comparisons to NUMARC Tested configurations
- o Documentation preparation

Preliminary Engineering and Testing

- o Assessment of solution options
- o Identification of solution for each configuration
- o Development of required Test Programs

Engineering and Preparation of Work Packages

- o Prioritization of work and schedule
- o Design engineering
- o Material and labor procurement
- o Preparation of work packages

The plant-specific corrective actions will be determined as part of the Preliminary Engineering and Testing phase of the Program. This work is currently in progress in accordance with the overall Plan.

III.B.3 *If a plant-specific fire endurance test program is anticipated describe the anticipated test specimens, test methodology and acceptance criteria including cable functionality.*

The Program plan recognizes plant-specific fire barrier installation testing is an option. At this time, Byron Station has not identified any specific test specimens. Prior to accepting any barrier as qualified to a plant-specific test, information will be made available to describe test specimens, methodology, and acceptance criteria including cable functionality.

IV.B.1 *For the barriers described under Item I.B.1, describe those that you have determined will fall within the scope of the NUMARC program for ampacity derating, those that will not be bounded by the NUMARC program, and those for which ampacity derating does not apply.*

The Byron / Braidwood design addressed power cable ampacity derating using an analytical approach rather than using the originally published TSI ampacity derating factors. This analytical approach arrived at derating factors that are much greater than the publicized TSI derating factors and are in line with the preliminary results of the TU tests. Byron Station does not presently plan to utilize the NUMARC Program TU and TVA ampacity test results to address the ampacity derating concerns associated with the TSI Thermo-Lag barriers.

The analytical methods are based on the use of "Stolpe's Method" (IEEE Paper 70-TR557-TWR) to determine the heat generated by the cable mass and heat transfer principles to determine the heat dissipated through the cable tray / fire barrier assembly. This analytical method will be applied to any upgrades that may be made to the existing in-plant barriers.

Byron Station is aware of NUMARC'S intent to perform additional ampacity derating tests following Phase 2 Fire Tests, and will evaluate the test results when they become available.

Ampacity deratings apply only to barriers protecting power cables.

IV.B.2 *For the barriers you have determined fall within the scope of the NUMARC program, describe what additional testing or evaluation you will need to perform to derive valid ampacity derating factors.*

The analytical approach that Byron Station has utilized for design cable deratings will require further analysis to account for any additional barrier upgrade materials that are added to existing barriers. Additional materials thickness attributed to added barrier materials will further derate ampacity.

IV.B.3 *For the barrier configurations that you have determined will not be bounded by the NUMARC test program, describe your plan for evaluating whether or not the ampacity derating tests relied upon for the ampacity derating factors used for those electrical components protected by Thermo-Lag 330-1 (for protecting the safe-shutdown capability from fire or to achieve physical independence of electrical systems) are correct and applicable to the plant design. Describe all corrective actions needed and submit the schedule for completing such actions.*

Ampacity derating tests were not utilized in determining design ampacity deratings, analytical methods were utilized as discussed in the response to IV.B.1. Each barrier that requires replacement will be re-evaluated to determine proper ampacity deratings based on the properties of the replacement barrier material.

IV.B.4 *In the event that the NUMARC fire barrier tests indicate the need to upgrade existing in-plant barriers or to replace existing Thermo-Lag barriers with another fire barrier system, describe the alternative actions you will take (and the schedule for performing those actions) to confirm that the ampacity derating factors were derived by valid tests and are applicable to the modified plant design.*

Byron Station does not utilize testing to arrive at design cable deratings, analytical methods are utilized as discussed in the response to IV.B.1. As derating test results become available Byron will evaluate them. All barriers that require upgrade or replacement will be re-evaluated analytically to determine proper ampacity derating once the upgrade or replacement materials are known.

V.B *Describe the specific alternatives available to you for achieving compliance with NRC fire protection requirements in plant areas that contain Thermo-lag fire barriers.*

Due to the uncertainties regarding NUMARC testing and acceptance criteria, as well as the complexity of many plant installations, a combination of resolutions will be necessary for Byron Station to achieve compliance with fire protection requirements in the most cost effective manner. The options presently available include, but are not limited to, those listed below.

1. Remove the existing Thermo-Lag fire barrier and replace with an approved fire barrier.

2. Upgrade the existing Thermo-Lag fire barrier with additional Thermo-Lag material or another approved fire barrier.

3. Reroute the cable out of the fire area of concern or reroute it such that it would comply with one of the separation criteria of 10 CFR 50 Appendix R Section III.G (for example, 20 feet of separation between redundant trains with no intervening combustibles and detection and automatic suppression throughout the fire area).

4. Make a determination that selected fire barriers are no longer required based upon re-evaluation of the Safe Shutdown Analysis contained in the Byron Fire Protection Report. Potential bases for eliminating barriers could be that previously designated Safe Shutdown cables are not actually required to achieve Safe Shutdown, when new evaluations are considered.

5. Perform an analysis on the TSI fire wrap materials in the as-installed configurations. Using a Certified Fire Protection Engineer, assess area combustible loadings, area fire detection and suppression, and spacial orientation of the zone and equipment in the zone. When justifiable, exemptions (Deviation from Appendix R) could be applied for based on low combustible loading in the area, area wide fire detection and/or suppression, and the amount of intervening combustibles between redundant cables.

6 A Probabilistic Risk Analysis (PRA) using the model being developed by EPRI could be performed. The results of this study could be the basis for an exemption request.

7. Qualify the current installation through unique testing applications or by a review of other utilities testing.

VI.B *Submit an integrated schedule that addresses the overall corrective action schedule for the plant. At a minimum, the schedule should address the following aspects for the plant:*

1. implementation and completion of corrective actions and fire barrier upgrades for fire barrier configurations within the scope of the NUMARC program,

2. implementation and completion of plant-specific analyses, testing, or alternative actions for fire barriers outside the scope of the NUMARC program.

Byron Station is committed to resolve the Thermo-Lag issues in accordance with the Program Plan it has already developed. The resolution will focus on safety, utilizing a method applying relative Safe Shutdown Risk and Fire Hazard Margins to select which fire barriers will be addressed first. Byron will perform detailed engineering evaluations in 1994 with a commitment to begin physical work on selected barriers in 1994. Byron intends to take the appropriate action to qualify all Safe Shutdown fire barriers by 1996. More detailed schedules of specific activities will be available with a supplemental response to be provided within ninety (90) days of the issuance of the NUMARC Applicability Guide.

VII *Describe the sources of the information provided in response to this request for information and how the accuracy and validity of the information was verified.*

The sources of the information provided in this response include plant design drawings, design data bases and reports, procurement specifications, material receiving inspection reports, vendor test reports and preliminary field walkdown reports. These source documents, except for the preliminary field walkdown reports, were developed according to approved quality programs and procedures during plant design and construction and are considered correct. The preliminary field walkdowns were not performed to an approved procedure, however the information gathered during these walkdowns was independently verified on a representative sample. Similarly, calculations of fire barrier linear footage, fire barrier square footage and cable fill performed in the preparation of this response were independently reviewed. A detailed listing of source documents used in the preparation of this response is provided as Addendum C.

Cable Tray Node	Tray Width in Inches	Tray Depth in Inches	Side Rail Height in Inches	Total Depth in Inches	Usable Depth in Inches	Design Index	(note 6) Actual Percent Fill	Minimum 15% Met	Wrapped Tray Length in Feet	Fire Rating	Approx. Sq. Ft. of TSI 1hr. rating	Approx. Sq. Ft. of TSI 3hr. rating	Within NUMARC Scope
1517A	18	4		4	2	36.33	14.26	no	5.50	3HR		25.50	no
1517B	18	4	2	6	2	105.99	27.73	yes	5.50	3HR		27.89	yes
1580R	24	6		6	2	51.48	13.47	no	6.00	1HR	34.43		no(note 1)
1580S	24	4		4	3	85.29	50.21	yes	6.00	1HR	31.74		yes(note 1)
1598M	12	4		4	2	17.40	6.83	no	18.50	3HR		62.83	no
1617F	18	4		4	2	10.98	4.31	no	12.50	1HR	51.32		no
1617G	18	4		4	2	53.23	20.89	yes	11.00	1HR	45.32		yes
1618F	18	4		4	2	11.70	4.59	no	10.00	1HR	41.32		no
1618G	18	4		4	2	56.42	22.14	yes	12.50	1HR	51.32		yes
1619F	18	4		4	2	35.88	14.08	no	27.00	1HR	109.32		no
1619G	18	4		4	2	57.45	22.55	yes	25.00	1HR	101.32		yes
1680A	12	4	2	6	2	121.22	31.72	yes	12.00	3HR		45.56	yes
1681A	12	4	2	6	2	121.22	31.72	yes	14.00	3HR		52.89	yes
1682A	12	4	2	6	2	121.22	31.72	yes	15.00	3HR		56.56	yes
1683A	12	4	2	6	2	121.22	31.72	yes	12.50	3HR		47.39	yes
1684A	12	4	2	6	2	17.40	4.55	no	8.00	3HR		30.89	no
1685A	18	4		4	2	75.21	29.52	yes	10.00	3HR		45.00	yes
1686A	18	4	2	6	2	78.88	20.64	yes	14.00	3HR		67.56	yes
1687A	18	4	2	6	2	78.88	20.64	yes	12.50	3HR		60.56	yes
1689A	12	4	2	6	2	79.51	20.81	yes	12.50	3HR		47.39	yes
1690A	12	4	2	6	2	51.54	13.49	no	4.50	3HR		18.06	no
1694A	12	4	2	6	2	51.54	13.49	no	12.00	3HR		45.56	no
1708L	12	4		4	2	41.33	16.22	yes	13.75	3HR		47.00	yes
1708M	12	4	2	6	2	116.15	30.39	yes	13.75	3HR		51.97	yes
1780S	24	4	2	6	2	64.74	16.94	yes	27.50	3HR		158.72	yes
1782S	24	4		4	2	71.23	27.96	yes	8.00	3HR		44.83	yes
1791T	24	4	4	8	2	50.76	9.96	no	13.00	3HR		81.61	no
1793U	18	4	2	6	2	95.18	24.91	yes	23.00	3HR		109.56	yes
1794T	24	4	4	8	2	50.76	9.96	no	13.50	3HR		84.61	no
1794U	18	4	2	6	3	93.75	36.80	yes	11.00	3HR		53.56	yes
1795U	18	4	4	8	3	93.32	27.47	yes	16.50	3HR		85.28	yes

Cable Tray Node	Tray Width in Inches	Tray Depth in Inches	Side Rail Height in Inches	Total Depth in Inches	Usable Depth in Inches	Design Index	(note 6) Actual Percent Fill	Minimum 15% Met	Wrapped Tray Length in Feet	Fire Rating	Approx. Sq. Ft. of TSI 1hr. rating	Approx. Sq. Ft. of TSI 3hr. rating	Within NUMARC Scope
1803U	18	4	4	8	3	90.93	26.77	yes	7.50	3HR		40.28	yes
1980A	24	4	2	6	2	64.26	16.81	yes	4.00	3HR		25.56	yes
21573H	12	4		4	2	1.50	0.59	no	8.50	1HR	26.40		no
21848H	12	4		4	2	1.50	0.59	no	8.00	1HR	24.90		no
2549E	12	4		4	2	32.47	12.74	no	22.00	3HR		74.50	no
2549F	12	4		4	2	29.03	11.39	no	21.17	3HR		71.73	no
2580R	24	4		4	2	42.54	16.70	yes	3.50	3HR		20.83	yes
2580S	24	6		6	2	93.49	24.46	yes	4.00	3HR		25.56	yes
2617F	18	4		4	2	29.78	11.69	no	16.00	1HR	65.32		no
2617G	18	4		4	2	60.55	23.77	yes	14.00	1HR	57.32		yes
2618F	18	4		4	2	30.50	11.97	no	8.00	1HR	33.32		no
2618G	18	4		4	2	65.02	25.52	yes	11.00	1HR	45.32		yes
2619F	18	4		4	2	39.84	15.64	yes	28.00	1HR	113.32		yes
2619G	18	4	2	6	2	80.62	21.10	yes	25.00	1HR	110.18		yes
2653P	18	4		4	2	22.78	8.94	no	16.50	3HR		73.17	no
2653Q	18	4		4	2	21.86	8.58	no	19.00	3HR		84.00	no
2654P	12	4		4	2	34.17	13.41	no	17.00	3HR		57.83	no
2654Q	12	4		4	2	32.79	12.87	no	16.00	3HR		54.50	no
2725A	18	4	4	8	2	64.02	12.56	no	17.25	1HR	82.88		no
2726A	18	4	4	8	2	60.30	11.83	no	15.50	1HR	74.71		no
2727A	18	4		4	2	60.30	23.67	yes	9.50	1HR	39.32		yes
2921B	24	4		4	2	36.15	14.19	no	14.00	3HR		76.83	no
2921L	24	4		4	2	63.45	24.90	yes	17.00	3HR		92.83	yes
2922B	24	4		4	2	36.15	14.19	no	21.50	3HR		116.83	no
2922L	24	4		4	2	63.45	24.90	yes	21.50	3HR		116.83	yes
2923B	24	4		4	2	36.15	14.19	no	17.50	3HR		95.50	no
2923L	24	4		4	2	62.97	24.72	yes	17.50	3HR		95.50	yes
2924B	24	4	2	6	2	36.15	9.46	no	15.50	3HR		90.72	no
2924L	24	4		4	2	62.97	24.72	yes	15.50	3HR		84.83	yes
2926A	24	4		4	2	63.83	25.05	yes	6.00	3HR		34.17	yes
2926B	24	4	2	6	2	36.15	9.46	no	7.50	3HR		45.39	no

Cable Tray Node	Tray Width in Inches	Tray Depth in Inches	Side Rail Height in Inches	Total Depth in Inches	Usable Depth in Inches	Design Index	(note 6) Actual Percent Fill	Minimum 15% Met	Wrapped Tray Length in Feet	Fire Rating	Approx. Sq. Ft. of TSI 1hr. rating	Approx. Sq. Ft. of TSI 3hr. rating	Within NUMARC Scope
2926K	24	4	2	6	2	97.85	25.60	yes	6.00	3HR		36.89	yes
2926L	24	4		4	2	62.97	24.72	yes	7.50	3HR		42.17	yes
2941A	24	4	2	6	2	81.89	21.43	yes	20.00	3HR		116.22	yes
2942A	24	4	2	6	2	63.83	16.70	yes	18.00	3HR		104.89	yes
2942B	24	4	2	6	2	38.71	10.13	no	17.00	3HR		99.22	no
2943A	24	4		4	2	63.83	25.35	yes	12.00	3HR		66.17	yes
2943B	24	4		4	2	36.15	14.19	no	11.50	3HR		63.50	no
2944A	24	4		4	2	63.83	25.05	yes	10.50	3HR		58.17	yes
2944B	24	4		4	2	36.15	14.19	no	10.00	3HR		55.50	no
2945A	24	4		4	2	63.83	25.05	yes	16.50	3HR		90.17	yes
2945K	24	4		4	2	89.15	34.99	yes	19.50	3HR		106.17	yes
2946A	24	4		4	2	63.63	25.05	yes	19.00	3HR		103.50	yes
2946K	24	4		4	2	89.15	34.99	yes	19.00	3HR		103.50	yes
2947A	24	4		4	2	63.83	25.05	yes	9.50	3HR		52.83	yes
2947K	24	4		4	2	89.15	34.99	yes	9.50	3HR		52.83	yes
2948K	24	4	2	6	2	97.02	25.39	yes	7.00	3HR		42.56	yes
2949K	24	4	2	6	2	97.02	25.39	yes	17.00	3HR		99.22	yes
2950A	24	4		4	2	63.83	25.05	yes	17.00	3HR		92.83	yes
2950K	24	4	2	6	2	97.85	25.60	yes	12.50	3HR		73.72	yes
2951A	24	4		4	2	63.83	25.05	yes	13.50	3HR		74.17	yes
2951K	24	4	2	6	2	97.85	25.60	yes	13.50	3HR		79.39	yes
2952K	24	4	2	6	2	89.15	23.33	yes	18.00	3HR		104.89	yes
2952L	24	4	2	6	2	71.83	18.80	yes	20.50	3HR		119.06	yes
2954K	24	4	2	6	2	89.15	23.33	yes	17.50	3HR		102.06	yes
2954L	24	4	2	6	2	71.83	18.80	yes	17.50	3HR		102.06	yes
2955K	24	4	2	6	2	89.15	23.33	yes	13.50	3HR		79.39	yes
2955L	24	4		4	2	65.63	25.76	yes	13.50	3HR		74.17	yes
2956K	24	4	2	6	2	89.15	23.33	yes	11.50	3HR		68.06	yes
2956L	24	4		4	2	65.63	25.76	yes	11.00	3HR		60.83	yes
2958B	18	4	2	6	2	29.83	7.81	no	19.00	3HR		90.89	no

Cable Tray Node	Tray Width in Inches	Tray Depth in Inches	Side Rail Height in Inches	Total Depth in Inches	Usable Depth in Inches	Design Index	(note 6) Actual Percent Fill	Minimum 15% Met	Wrapped Tray Length in Feet	Fire Rating	Approx. Sq. Ft . of TSI 1hr. rating	Approx. Sq. Ft . of TSI 3hr. rating	Within NUMARC Scope
						Total Linear FT		1-HR	270.75				
						Total Linear FT (note 2)		3-HR	1008.67				
						Total Square FT		1-HR	1139.069				
						Total Square FT (notes 3,4)		3-HR	5143.15				

Cable Tray Node	Tray Width in Inches	Tray Depth in Inches	Side Rail Height in Inches	Usable Depth in Inches	Design Index	(note 6) Actual Percent Fill	Minimum 15% Met	Wrapped Tray Length in Feet	Fire Rating	Approx. Sq. Ft. of TSI 1hr. rating	Approx. Sq. Ft. of TSI 3hr. rating	Within NUMARC Scope
1R219	12	12		2	32.47	4.25	no	14.00	3HR		68.06	no
1R220	24	12		2	37.04	4.85	no	15.00	1HR	99.51		no (note 1)
1R221	24	12		2	63.89	8.36	no	48.25	3HR		326.72	no (note 1)
1R222	24	12		2	61.72	8.08	no	1.83	3HR		17.26	no
1R223	12	12		2	29.99	3.92	no	12.33	3HR		60.26	no
1R224	24	12		3	49.56	9.73	no	16.25	1HR	107.43		no (note 1)
1R225	24	12		3	137.42	26.97	yes	20.58	3HR		142.26	yes (note 1)
1R226	24	12		3	121.40	23.82	yes	30.83	3HR		210.59	yes (note 1)
1R245	24	12		3	100.26	19.68	yes	14.00	3HR		98.39	yes
1R246	12	12		2	33.47	4.38	no	9.33	1HR	42.78		no (note 1)
1R248	12	12		2	81.34	10.64	no	7.00	1HR	32.68		no (note 1)
1R251	12	12		2	17.40	2.28	no	17.50	3HR		84.39	no
1R252	12	12		2	110.33	14.43	no	26.00	3HR		124.06	no (note 1)
1R253	12	12		2	41.33	5.41	no	2.25	3HR		13.22	no (note 1)
1R255	12	12		3	27.55	5.41	no	28.83	3HR		137.26	no (note 1)
1R256	12	12		2	116.15	15.20	yes	4.50	3HR		23.72	yes (note 1)
1R294	24	12		3	75.10	14.74	no	4.67	1HR	34.09		no
1R303	24	12		2	50.76	6.64	no	5.42	3HR		41.19	no
1R304	18	12		2	97.47	12.75	no	9.08	3HR		55.34	no
1R305	24	12		2	64.74	8.47	no	7.75	3HR		56.72	no
1R700	18	12		2	16.25	2.13	no	7.67	1HR	44.34		no
1R701	18	12		2	58.60	7.67	no	10.00	1HR	56.76		no
2R200	12	12		2	32.47	4.25	no	19.75	3HR		94.89	no
2R201	12	12		2	34.17	4.47	no	19.83	3HR		95.26	no (note 1)
2R202	18	12		2	22.78	2.96	no	13.17	3HR		78.52	no
2R203	18	12		2	49.31	6.45	no	27.67	3HR		160.69	no
2R204	12	12		2	29.03	3.80	no	21.08	3HR		101.10	no
2R205	12	12		2	32.79	4.29	no	18.67	3HR		89.85	no (note 1)
2R206	18	12		2	21.86	2.86	no	14.50	3HR		86.06	no
2R207	18	12		2	42.04	5.50	no	25.17	3HR		146.52	no
2R213	18	12		2	25.49	3.33	no	[illegible]	3HR		106.85	no

Cable Tray Node	Tray Width in Inches	Tray Depth in Inches	Side Rail Height in Inches	Usable Depth in Inches	Design Index	(note 6) Actual Percent Fill	Minimum 15% Met	Wrapped Tray Length in Feet	Fire Rating	Approx. Sq. Ft. of TSI 1hr. rating	Approx. Sq. Ft. of TSI 3hr. rating	Within NUMARC Scope
2R214	24	12		2	82.64	10.81	no	41.00	3HR		278.39	no (note 1)
2R215	18	12		3	132.89	26.08	yes	14.00	3HR		83.22	yes
2R216	24	12		2	118.78	15.54	yes	41.00	3HR		278.39	yes (note 1)
2R253	24	12		2	78.29	10.24	no	18.00	3HR		125.06	no
2R256	18	12		3	83.08	16.30	yes	21.25	3HR		124.31	yes
2R257	24	12		3	88.21	17.31	yes	13.25	3HR		93.39	yes
2R258	24	12		3	92.26	18.11	yes	2.50	3HR		21.72	yes
2R259	24	12		2	80.20	10.49	no	31.00	3HR		211.72	no
2R260	18	12		2	29.83	3.90	no	5.00	3HR		32.22	no
2R282	24	12		3	64.68	12.69	no	10.50	3HR		75.06	no
2R292	24	12		2	97.02	12.69	no	9.25	3HR		66.72	no
2R323	12	12		2	44.67	5.84	no	9.50	1HR	43.51		no
2R324	12	12		2	60.85	7.96	no	7.00	1HR	32.68		no
2R326	18	12		2	60.30	7.89	no	19.00	1HR	104.76		no
2R329	12	12		3	106.74	20.95	yes	6.42	1HR	30.17		yes
2R330	24	12		2	99.09	12.96	no	4.00	1HR	29.85		no
2R700	18	12		2	37.33	4.88	no	8.00	1HR	46.10		no
2R701	18	12		2	72.96	9.55	no	10.00	1HR	56.76		no

Total Linear FT 1-HR	133.84	Total Square FT 1-HR	761.43
Total Linear FT 3-HR (note 2)	627.91	Total Square FT 3-HR (notes 3,4)	3809.35

Table 1 and 2 Notes

General Note:

The data in this table was derived from information contained in design drawings, verified by ongoing walkdowns and Safe Shutdown Analysis reviews.

Note:

1. This cable tray/riser is wrapped in a common Thermo-Lag envelop with an adjacent tray/riser. In effect, two trays/risers are contained within one barrier envelop. In this configuration, the barrier is not expected to be bounded by NUMARC testing because of barrier widths in excess of tested configurations. If necessary, the barrier on this tray/riser can be re-configured such that it wraps only one tray/riser and thereby is bounded by a successful NUMARC test.

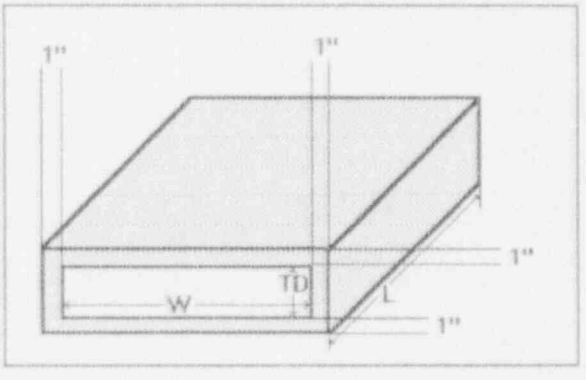
2. The linear footage for each tray/riser is a sum of all the wrapped footage for each tray/riser of that fire rating.

3. The square footage is an estimate that assumes all 3-hr rated wrapped trays/risers are boxed in with 1" thick material for the entire wrapped length. For 1-hr rated wrapped trays/risers, it is assumed it is boxed with 0.5" thick material. The actual square footage would be somewhat higher because this estimate does not account for the triangular shaped boxes used to encase radial bends and tray/riser intersections. Also, in some installations, the tray stiffeners were enclosed in the Thermo-Lag material which would also increase the square footage.

4. The formula used for calculating approximate square footage (ASF) is:

$$ASF = 2 \times \left(\left(L \times \frac{(W + D + SRH)}{12} \right) + \frac{W \times (D + SRH)}{144} \right)$$

where: W = tray/riser width
D = depth of tray/riser
SRH = side rail height
L = wrapped length
W and D are increased by +2" or +1" to account for barrier thickness as discussed in Note 3.
The sum of +2 and +1 includes each side and the top and bottom of each



tray/riser.

5. The Percent Volumetric Fill was calculated in order to determine if the installation is within the scope of NUMARC tests which were conducted with a 15% filled volume. At this point we assume that, in order to be within the scope of NUMARC testing, an installation must have at least 15% volumetric fill.

6. The following formula is used to calculate a cable tray's actual percent fill (APF).

$$\text{Given: Design Index} = \frac{(\text{Total of All Cable Diameters})^2}{\text{Usable Area}} \times 100$$

$$\text{APF} = \frac{(\text{Design Index} \times \text{Usable Depth} \times \pi/4)/100}{\text{Tray Depth} + \text{Side Rail Height}}$$

$\pi/4$ provides the conversion from square cables to round cables

CONDUIT	SIZE	FIRE RATING	TYPE	CABLE FILL	WRAPPED FEET HORIZONT	WRAPPED FEET VERTICAL	TOTAL LINEAR FEET	REMARKS	Within NUMARC Scope
2DG157	.602"	1HR	TSI	N/A	0	5	5	Air drop	no
C0A12C1	2.5	3HR	TSI	49.8	43	17	60	6' flex, 4" pull slv	yes
C0A2116	4	3HR	TSI	16.2	25	4	29		yes
C0A2171	4	3HR	TSI	33.6	26	23	49		yes
C0A22MC	1	3HR	TSI	11.8	30	9	39	1" pull sleeve	yes
C0A22MF	1	3HR	TSI	30.5	28	9	37	1" pull sleeve	yes
C0A22MJ	0.75	3HR	TSI	19	36	11	47	7' flex	yes
C0A22MK	1	3HR	TSI	30.5	36	11	47	7' flex	yes
C0A32GV	0.75	3HR	TSI	19	14	35	49	6' flex	yes
C0A32GW	1	3HR	TSI	30.5	14	19	33	6' flex	yes
C1A1414	4	1HR	TSI	18.7	26	4	30		yes
C1A1493	2	1HR	TSI	21.4	24	4	28		yes
C1A14C9	3	1HR	TSI	42.9	25	4	29		yes
C1A5207	4	3HR	TSI	16.8	12	0	12		yes
C1A5259	4	3HR	TSI	16.8	3	21	24		yes
C1A6169	3	1HR	TSI	27.7	19	7	26	Alum Conduit	yes
C1A6170	3	1HR	TSI	27.7	8	7	15	Alum Conduit	yes
C1A6171	3	1HR	TSI	27.7	14	7	21	Alum Conduit	yes
C2A1414	3	1HR	TSI	42.9	18	4	22		yes
C2A1415	1.5	1HR	TSI	35.2	19	4	23		yes
C2A1477	3	1HR	TSI	34.6	19	4	23		yes
C2A2486	0.75	1HR	TSI	19	2	0	2	flex conduit	yes
C2A4113	4	3HR	TSI	26.6	5	3	8		yes
C2A4155	6"X6"	3HR	TSI	21.3	16	0	16	Wireway	yes
C2A5103	2	3HR	TSI	21.8	3	11	14		yes
C2A5105	2.5	3HR	TSI	34.6	0	7	7		yes
C2A5106	3	3HR	TSI	23.2	0	7	7		yes
C2A5107	4	3HR	TSI	17.9	0	11	11		yes
C2A5108	4	3HR	TSI	28.9	0	11	11		yes
C2A5109	2.5	3HR	TSI	33.5	0	11	11		yes
C2A7186	3	1HR	TSI	27.7	20	7	27	Alum Conduit	yes

CONDUIT	SIZE	FIRE RATING	TYPE	CABLE FILL	WRAPPED FEET HORIZONT	WRAPPED FEET VERTICAL	TOTAL LINEAR FEET	REMARKS	Within NUMARC Scope
C2A7187	3	1HR	TSI	27.7	10	6	16	Alum Conduit	yes
C2A7188	3	1HR	TSI	27.7	16	7	23	Alum Conduit	yes

Total Linear FT 1-HR 290
Total Linear FT 3-HR 511

JCT BOX	HEIGHT Inches	WIDTH Inches	DEPTH Inches	FIRE RATING	TYPE	Approx. Sq. Ft. of TSI 1 hr. rating	Approx. Sq. Ft. of TSI 3 hr. rating	Within NUMARC Scope
2JB2227A	12	12	6	3HR	TSI		5.83	yes
1JB1403A	36	24	12	3HR	TSI		26.17	no
1JB1402A	36	24	12	3HR	TSI		26.17	no
2JB1998A	8	8	6	1HR	TSI	2.88		yes
2JB1339A	24	24	8	3HR	TSI		16.61	yes
2JB1065A	12	24	18	3HR	TSI		16.17	no
2JB1066A	18	24	12	3HR	TSI		16.17	no
2JB1410A	24	12	6	1HR	TSI	8.21		yes

Total Square FT 1-HR 11.08
Total Square FT 3-HR 107.11

Table 4 Notes

General Note:

The data in this table was derived from information contained in design drawings, verified by ongoing walkdowns and Safe Shutdown Analysis reviews.

Note:

1. The square footage calculation assumes that each 3-HR rated junction box is covered on all six sides by 1" thick preformed Thermo-Lag panels. For 1-HR rated wrapped junction boxes, it is assumed it is boxed with 0.5" thick material. The actual amount will be somewhat less, as some junction boxes are mounted on walls and thus are covered with Thermo-Lag on only five sides.

2. The formula used for calculating square footage is.

SQ. FT. = (2x(((W+2)x(H+2))+((W+2)x(D+2))+((H+2)x(D+2))))/144

where: W = junction box width
H = junction box height
D = junction box depth

For 3-HR rated barriers:

W+2, H+2 and D+2 = the actual width, height and depth of the Thermo-Lag sheets which are two inches wider/taller/deeper than the sides of the junction boxes.
(+2" because of a layer on both sides or on top and bottom)
(W+2) x (H+2) = The area of the Thermo-Lag sheet on the junction box top or bottom
(W+2) x (D+2) = the area of the Thermo-Lag sheet on either end of the junction box
(H+2) x (D+2) = the area of the Thermo-Lag sheet on either side of the junction box

For 1-HR rated barriers the box dimensions are increased by +1" (layer on both sides or on top and bottom)

The sum of the areas is multiplied by 2 to include both sides, both ends and the top and bottom. The division by 144 converts from square inches to square feet.

TABLE 5
OTHER BARRIERS

Barrier	Description	Length	Fire Rating	Est. sq FT	Purpose
Tray (1980A)	24 X 4 inch Tray	4 FT	3HR	21.33	Protect I-beam
Wireway	6 X 6 inch	2FT	3HR	8.0	Electrical Penetration Seal
C0A84F6 Seal	4" Conduit	2FT	3HR	n/a	Electrical Penetration
C0A84F8 Seal	4" Conduit	2FT	3HR	n/a	Electrical Penetration

Addendum A

FIRE BARRIER PARAMETERS

Listed below are the 24 fire barrier parameters identified in Section II.A of the Enclosure to the Request for Additional Information (RAI) Regarding Generic Letter 92-08. The discussion associated with each parameter identifies whether the parameter is known and verified for the Thermo-Lag fire barriers at Byron Station. As applicable, the means of obtaining and verifying the parameters are also discussed. This information supplements the Byron response to Item II.B.1 of the RAI.

1) Raceway Orientation (horizontal, vertical, radial bends):

The orientation of cable pans wrapped with Thermo-Lag is identified on cable pan piece parts and riser section drawings. Preliminary verification of this information was done during the preliminary field walkdowns. Final verification will include performing additional walkdowns to photograph or generate sketches of wrapped conduit to supplement as necessary the drawings.

2) Conduit:

Conduits wrapped with Thermo-Lag are identified on the electrical installation and conduit tabulation drawings. Preliminary verification of this information was performed during the preliminary field walkdowns. Final verification will include performing additional walkdowns to photograph or generate sketches of wrapped conduit to supplement as necessary the drawings.

3) Junction Boxes and Lateral Bends:

Junction boxes which are fire wrapped were identified on the electrical installation drawings and the junction box schedules. The as-built orientation of the boxes is provided on the electrical installation drawings. Preliminary verification of this information was performed during the preliminary field walkdowns. Final verification of the as-built configurations for junction boxes and lateral bends in the conduits will be documented as discussed for parameter #2 above.

4) Ladder Back Cable Tray with single layer fill:

A determination if ladder back cable tray is wrapped with Thermo-Lag can be made from cable piece parts and cable riser drawings. These drawings will be used to verify this parameter as required. Physical verification through walkdowns is not planned at this time since it may be destructive to the fire barrier.

5) Cable Tray with T-Section:

This is included in the discussion for parameter #1 above.

6) Raceway Material:

The electrical installation specification in effect at the time of installation of currently fire wrapped raceways, requires that all cable trays, risers, and conduits be constructed of steel. The only exception to this specification are the aluminum conduits associated with the 125 Vdc ESF battery rack connections (See Reference 7 on Addendum C). Physical verification through walkdowns is not planned at this time since it may be destructive to the fire barrier and/or components. Final verification will include review of drawings and/or other documents as needed.

7) Support Protection, Thermal Shorts (penetrating elements):

The conduit/raceway supports which must be protected due to heat transfer considerations are not identified as requiring wrap on any drawings. However, a general note on drawing 6E-0-3251 directs the contractor to wrap all cables and supports within 18" of the firewrap envelope. Wrapping of raceway supports and other potential thermal shorts was assessed during the preliminary plant walkdowns. Final verification will include performing additional walkdowns to photograph or generate sketches of supports as necessary.

8) Air Drops:

A review of the cable pan piece parts and riser section drawings in conjunction with preliminary walkdowns have identified airdrops where Thermo-lag fire barriers have been installed. Final verification will include performing additional walkdowns to photograph or generate sketches of airdrops to supplement as necessary the drawings.

9) Baseline Fire Barrier Panel Thickness:

The thickness of all fire barriers has not been determined at this time. Most of the 3-hour barriers on trays and risers are constructed of two 0.5 inch (1-hour rated) Thermo-Lag prefabricated panels in accordance with TSI Technical Note 20684. Also, some 3-hour barriers were constructed of one 1.0 inch (3-hour rated) prefabricated panels. All 1-hour barriers are constructed of 0.5 inch (1-hour rated) prefabricated panels. Preliminary field walkdowns have identified the outside diameters/overall dimensions of all wrapped raceways. This information, used in conjunction with known raceway dimensions, provides an indication of the number of panels used on each raceway. Physical verification is not planned at this time since it will be destructive to the fire barrier.

10) Preformed Conduit Panels:

As discussed for parameter #9, both 0.5" and 1" preformed conduit panels have been used at Byron Station. This information was obtained from the preliminary plant walkdowns. Preliminary field walkdowns have identified the outside diameters/overall dimensions of all wrapped conduits. This information, used in conjunction with known conduit dimensions, provides an indication of the type of panel used on each conduit. Physical verification is not planned at this time since it will be destructive to the fire barrier.

11) Panel Rib Orientation (parallel or perpendicular to the raceway):

The direction of the ribs, where exposed, was documented during the preliminary walkdowns. Where the ribs are not exposed, this parameter can only be determined by destructive means. This is not planned at this time.

12) Unsupported Span:

The distances between structural supports for conduits and cable trays are shown on the hanger drawings and can be obtained as required. Final verification will include performing additional walkdowns to photograph or generate sketches of wrapped conduit to supplement as necessary the drawings.

13) Stress Skin Orientation (inside or out):

Preliminary walkdowns have identified this parameter for the outer layer of barrier. The inner layer, if present, can only be verified by disassembly of the fire barrier which is not planned at this time.

14) Stress Skin over Joints or no Stress Skin over Joints:

This parameter was not formally identified during the preliminary walkdowns. Stress skin over joints was not a requirement of the installation procedures and is not expected to be found during future walkdowns.

15) Stress Skin Ties or no Stress Skin Ties:

This parameter was not formally identified during the preliminary walkdowns. Stress skin ties were not a requirement of the installation procedures and are not expected to be found during future walkdowns.

16) Dryfit, Postbuttered Joints or Pre-buttered Joints:

Preliminary walkdowns have identified existing post-buttered joints. It has not been determined whether or not the joints were pre-buttered since most joints have been post-buttered. Future determination of pre-buttering has not been planned at this time since it would be by destructive means.

17) Joint Gap Width:

Preliminary walkdowns have attempted to identified whether the gap/seams associated with each installation are greater or less than 1/4". The actual gap width for each joint has not been identified as most joints are post-buttered. Future determination of actual gap width has not been planned at this time since it would be by destructive means.

18) Butt Joints or Grooved and Scored Joints:

Preliminary walkdowns have identified whether the joints are butt joints or mitered. Final verification will include additional walkdowns if necessary to verify joint type.

19) Steel Bands or Tie Wire:

Preliminary walkdowns have identified whether bands and/or wire ties have been used for each installation. Final verification will include additional walkdowns if necessary to verify band type.

20) Band/wire spacing:

Preliminary walkdowns have attempted to identify in general whether the band/wire spacing is greater or less than 12". The actual spacing between all bands/wires has not been identified. Final verification will be performed as necessary in future walkdowns.

21) Band/Wire distance to Joints:

Preliminary walkdowns have attempted to identify in general this parameter, however, not all joints were reviewed. Final verification will be performed as necessary in future walkdowns.

22) No Internal Bands in Trays:

This parameter has not been obtained. Future determination of internal bands is not planned at this time since it would be by destructive means.

23) No Additional Trowel Material over Sections and Joints or Additional Trowel Material applied.

Preliminary walkdowns have identified where trowel material was used for post-buttering joints. There was no attempt made during these walkdowns to identify any other applications. Final verification will be performed as necessary in future walkdowns.

24) No Edge Guards or Edge Guards.

This parameter has not been obtained. Future determination of edge guards is not planned at this time since it would be by destructive means.

Addendum B

CABLE PARAMETERS

Listed below are the 8 cable parameters identified in Section II.A of the Enclosure to the Request for Additional Information (RAI) Regarding Generic Letter 92-08. The discussion associated with each parameter identifies whether the parameter is known and verified for the Thermo-Lag fire barriers at Byron Station. As applicable, the means of obtaining and verifying the parameters are also discussed. This information supplements the Byron response to Item II.B.1 of the RAI.

1) Cable Size and Type

The size and type of each cable have been determined using the Sargent & Lundy Interactive Cable Engineering (SLICE) computer program and the associated Byron cable database. The SLICE S-106-1 (Cable Tray Loading) provides a list of all cables in each routing point along with its segregation code indicating whether the cable is control, power or instrumentation. This report also provides the cross-sectional area associated with each cable. SLICE report S-101-1 (Cable Tabulation Main File) provides the cable type for all cables. This report also provides a cable type code which can be used in conjunction with the 6/20E-0-3000B series drawings (Electrical Installation Cable Information) to identify the outer diameter of each cable. Final verification will include a review of design documents and drawings as needed.

2) Cable Jacket Type (Thermoplastic, Thermoset) and Materials

Cable Jacket Type and Materials are specified in the Fire Protection Report, the SLICE S-101-1 report and the 6/20E-0-3000B series drawings. Final verification will include review of these design documents and drawings as needed.

3) Cable Conductor Insulation Type and Materials

Cable Jacket Type and Materials are specified in the Fire Protection Report, the SLICE S-101-1 report and the 6/20E-0-3000B series drawings. Final verification will include review of these design documents and drawings as needed.

4) Cable Fill And Distribution of Cables Within the Protected Conduits or Cable Tray

Cable fill for cable tray and risers has been obtained from the SLICE S-106-1 report which calculates a design index based on the sum of all cable diameters squared divided by usable area. The number is therefore given as percent fill. The cable tray or riser dimensions are also provided.

The conduit tabulation drawings identify the size of each conduit and the cables contained within each conduit. Conduit fill has been determined using parameter 1 information (cable size and type) and the conduit tabulation drawings.

The distribution of cables in protected trays and conduits is not known and can only be obtained by disassembly of the barrier. Plans for identifying the distribution have not been made at this time.

5) Proximity of cables to the unexposed (inside) surfaces of the fire barrier.

This parameter is unknown. Plans for identifying the proximity have not been made at this time. The proximity of cables in protected trays and conduits is not known and can only be obtained by disassembly of the barrier. Plans for identifying the distribution have not been made at this time.

6) Presence of materials between the cables and the unexposed side of the fire barrier material (for example, Sealtemp cloth, which is used in the NUMARC test specimens).

This parameter is unknown. Plans for identifying the presence of materials have not been made at this time. The presence of materials in protected trays and conduits is not known and can only be obtained by disassembly of the barrier. Plans for identifying the distribution have not been made at this time.

7) Cable Operating Temperature:

Cable Jacket Type and Materials (Cable operating temperature) are specified in the Fire Protection Report, the SLICE S-101-1 report and the 6/20E-0-3000B series drawings. Final verification will include review of design documents and drawings as needed.

8) Temperatures at Which The Cables Can no Longer Perform Their Intended Function When Energized at Rated Voltage And Current

For the most likely installed cables at Byron, Okonite 5 kV and 600V cables have been tested to 173.9°C (345°F) for 180 minutes based on Okonite Test Reports No. NORN-3, Rev. 4 and No. NORN-1A, Rev. 5. Actual installed cables at Byron can be determined as discussed for parameter (2). At this time, test results do not exist which indicate that cable functionality evaluations for cable above these temperatures are necessary. Final verification will include review of design documents and drawings as needed.

Addendum C
Information Sources

The following were used as information sources for the response to the Request for Additional Information dated December 21, 1993 regarding Generic Letter 92-08.

1) Byron/Braidwood Fire Protection Report, through Amendment 15

2) Byron Station Unit 1 and 2 TSI Fire Wrapped Conduit and Cable Trays, Sargent and Lundy DIT-BY-EPED-0270, dated 12/22/92

3) Design Index to Actual Percent Fill Conversion and Estimated TSI Square Footage, Sargent and Lundy DIT-BB-EXT-0730, dated 1/25/94

4) Sargent and Lundy Interactive Cable Engineering (SLICE) Program, Reports S-101-1 (cable information) and S-106-1 (tray information)

5) Byron Station Electrical Installation Cable Information Drawings, Series 6/20E-0-3000B

6) Byron Station Cable Pan General Notes and Installation Details Drawing 6E-0-3251, Revision AY

7) Byron Station Electrical Installation and Conduit Tabulation Drawings:
   6E-1-3361, Revision CC
   6E-1-3361CT1, Revision AC
   6E-2-3361, Revision CD
   6E-2-3361CT1, Revision AD

8) TSI Technical Note 20684, "Thermo-Lag Fire Barrier System Installation-Procedure Manual"

9) Byron Field Walkdown Reports

10) Memo, James Behn to Don Robinson(BY)/Bob Jacobs(BW), dated January 25, 1994

Attachment 3

LaSalle Station Response

"Request for Additional Information
regarding Generic Letter 92-08,
"Thermo-Lag 330-1 Fire Barriers,"
Pursuant to 10 CFR 50.54(F)

LaSalle County Station Response
"Request for Additional Information Regarding Generic Letter 92-08, Thermo-Lag 330-1 Fire Barriers, Pursuant to 10CFR50.54(F)"

I.B.1 *Describe the Thermo-Lag 330-1 barriers installed in the plant. Include the intended purpose, fire rating, type and dimension of the barrier.*

The LaSalle County Station utilized Thermo-Lag 330-1 barriers to meet 10CFR50.48 and to achieve separation between redundant electrical systems. The use of these barriers is part of the Stations's overall Fire Protection program which is an operating license condition and a licensing commitment for the Station specified in the LaSalle County Station Updated Final Safety Analysis Report (UFSAR), Appendix H, Section H.4, "Safe Shutdown Analysis".

The subject fire barriers have been applied to cable trays located in Fire Zone 5C11. This fire zone is an area common to both units and spans the grade elevation in the Turbine Building. Multi-divisional cables required for safe shutdown are routed in this fire zone. Equipment and electrical cabling required for safe shutdown are identified in Tables H.4-71 and H.4-72 of the UFSAR. The affected Division 2 power and control cables located in this fire zone were selected to be protected by a fire protection barrier to meet the licensing commitments for the safe shutdown analysis. Instrumentation cables required for safe shutdown have been routed independent of the subject fire zone.

The affected Division 2 power and control cables are routed exclusively in their own separate cable trays. Therefore, the Thermo-Lag 330-1 has only been applied to the affected power and control cable trays and their respective cable tray supports.

There are four separate lengths of cable tray that have been wrapped with Thermo-Lag 330-1; one power cable tray and one control cable tray per unit. The power and control cable trays for each unit are located in the corridor separating the diesel-generator rooms from the Division 2 essential switchgear rooms. Each power cable tray is approximately 30-inches wide and 4-inches deep. Each control cable tray is approximately 30-inches wide and 6-inches deep. Each power and control cable tray has been wrapped with a 1-hour Thermo-Lag 330-1 fire barrier.

I.B.2.a *For the total population, state the total linear feet and square feet used for one-hour cable tray barriers and three-hour cable tray barriers.*

The estimated total linear feet and square feet (i.e., surface area) of

Thermo-Lag 330-1 fire barriers at the LaSalle County Station for Fire Zone 5C11 is provided below:

Unit 1 Power Cable Tray:

Electrical Installation Drawing Reference:	1E-1-3433, Sheet 1
Routing Points:	163A, 164A, 165A
Cable Tray Segregation Code:	1BP
Area:	Columns J to L and Columns 8.5 to 9
Elevation:	732'-0"
Size:	4"H x 30"W
Total Estimated Linear Length:	27 feet
Total Estimated Surface Area:	153 square feet

Unit 1 Control Cable Tray:

Electrical Installation Drawing Reference:	1E-1-3433, Sheet 1
Routing Points:	163B, 164B, 165B
Cable Tray Segregation Code:	1BC
Area:	Columns J to L and Columns 8.5 to 9
Elevation:	730'-8"
Size:	6"H x 30"W
Total Estimated Linear Length:	25 feet
Total Estimated Surface Area:	150 square feet

Unit 2 Power Cable Tray:

Electrical Installation Drawing Reference:	1E-2-3433
Routing Points:	153A, 154A, 155A
Cable Tray Segregation Code:	2BP
Area:	Columns J to L and Column 21.5
Elevation:	732'-9"
Size:	4"H x 30"W
Total Estimated Linear Length:	30 feet
Total Estimated Surface Area:	170 square feet

Unit 2 Control Cable Tray:

Electrical Installation Drawing Reference:	1E-2-3433
Routing Points:	153B, 154B, 155B
Cable Tray Segregation Code:	2BC
Area:	Columns J to L and Column 21.5
Elevation:	730'-8"
Size:	6"H x 30"W

Total Estimated Linear Length:	30 feet
Total Estimated Surface Area:	180 square feet

Therefore, there is approximately 112 linear feet and 653 square feet of power and control cable trays wrapped with a one-hour fire barrier of Thermo-Lag 330-1 at the LaSalle County Station. There are no three-hour cable tray fire barriers installed at the LaSalle County Station.

I.B.2.b *For the total population, state the total linear feet used for one-hour conduit barriers and three-hour conduit barriers.*

Not applicable. There are no one-hour or three-hour conduit fire barriers installed at the LaSalle County Station.

I.B.2.c *For the total population, state the total square feet used for one-hour fire barriers (other) and three-hour fire barriers (other).*

Not applicable. There are no one-hour or three-hour fire barriers (other) installed at the LaSalle County Station.

I.B.2.d *For the total population, state the total linear feet or square feet used for one-hour radiant energy heat shields and other barriers, and three-hour radiant energy heat shields and other barriers.*

Not applicable. There are no one-hour or three-hour radiant energy heat shields or other barriers installed at the LaSalle County Station.

II.B.1 *State whether or not you have obtained and verified each of the aforementioned parameters for each Thermo-Lag barrier installed in the plant. If not, discuss the parameters you have not obtained or verified.*

The parameters noted below are identified in the request for additional information regarding Generic Letter 92-08 pursuant to 10CFR50.54(F), and were obtained through a review of electrical installation drawings and design documents:

Raceway Parameters:

- Orientation (horizontal, vertical, radial bends)

  The orientation of the cable trays are identified on Electrical Installation Drawings 1E-1-3433 (Sheet 1) for Unit 1 and Electrical Installation Drawing 1E-2-3433 for Unit 2. Each cable tray is primarily oriented in the horizontal plane with several slight offsets in the vertical plane and several

bends in the horizontal plane to allow for routing the trays between the walls separating the diesel-generator rooms and the essential switchgear rooms.

- Dimensions

  The dimensions for the power and control cable trays that have been wrapped with Thermo-Lag 330-1 material in Fire Zone 5C11 are 30-inches wide and 4-inches deep and 30-inches wide and 6-inches deep respectively.

- Conduit (no cable)

  There are no conduits that have been wrapped with Thermo-Lag 330-1 material.

- Junction Boxes and Lateral Bends

  There are no junction boxes or lateral conduit bends that have been wrapped with Thermo-Lag 330-1 material.

- Ladder-Back Cable Tray with Single Layer Cable Fill

  There are no ladder-back type cable trays located that have been wrapped with Thermo-Lag 330-1 material.

- Cable Tray with T-Section

  Based upon the disposition of the "Orientation" Parameter above, none of the fire-wrapped cable trays located in Fire Zone 5C11 have been provided with T-Sections.

- Raceway Material

  Per Sargent & Lundy (S&L) Specification J-2560, "Cable Pans and Supports", which was in effect at the time of the cable tray fabrication, all cable trays were constructed from No. 14 gauge pre-galvanized sheet steel. The affected cable trays that were wrapped with Thermo-Lag 330-1 in Fire Zone 5C11 are solid bottom (back) type cable tray in lieu of ladder type constructed cable tray.

- Air Drops

  The cable trays wrapped with the Thermo-Lag 330-1 material in Fire

Zone 5C11 include cable air drops at various locations.

- Box Barrier Systems

  There are no junction boxes or raceway enclosures attached to walls or ceilings that have been enclosed by the Thermo-Lag 330-1 material.

Cable Parameters:

- Cable Size and Type

  The size and type for each power and control cable have been incorporated into the Sargent & Lundy Interactive Cable Engineering (SLICE) computer program. The "Cables/Raceway" report provides a list of cables for each routing point and identifies the cable tray segregation code. The "Cables and Routing" report includes a unique type code for each cable. The "Cable Type Codes" report includes all the cable physical characteristics for a given cable type code, including cable outside diameter.

- Cable Jacket Type (thermoplastic, thermoset) and Materials

All cables routed in trays that require a one-hour rated fire barrier were procured with various Sargent & Lundy cable specifications. These specifications included Commonwealth Edison Company (CECo) cable standards that required cable jackets constructed of hypalon.

- Cable Conductor Insulation Type and Materials

  The cable insulation for the affected power and control cables consists of ethylene propylene rubber.

- Cable Fill and Distribution of Cables Within Protected Conduits and Cable Trays

  Cable fill for cable trays has been obtained from the SLICE "Cable Trays" report which calculates a depth of fill based on the cable area for each cable for a given routing point. The number provided is actual percent fill based upon an allowable fill for a given routing point.

  There are no conduits routed that require a one-hour fire barrier required to satisfy licensing commitments of LaSalle UFSAR Appendix H, Section H.4.

  The distribution of cables in fire-wrapped cable trays is discussed in II.B.2 and II.B.3.

- Cable Operating Temperature

  These cables have a 90°C temperature rating. The SLICE "Power Cable Ampacity" reports indicate that the 90°C rating is not exceeded.

The parameters noted below are identified in the request for additional information regarding Generic Letter 92-08 pursuant to 10CFR50.54(F), but were not obtained or verified. The dispositions for these parameters are discussed in II.B.2 and II.B.3:

<u>Raceway Parameters:</u>

- Support Protection

<u>Fire Barrier Parameters:</u>

- Baseline Panel Thickness

- Preformed Conduit Panels

- Panel Ribs
- Unsupported Span
- Stress Skin
- No Stress Skin Over Joints
- No Stress Skin Ties
- Dry Fit, Post Buttered Joints and Pre Buttered Joints
- Joint Gap Width
- Butt Joints or Grooved and Scored Joints
- Cable Tray Radial Bends with Separate Mitered Pieces
- Steel Bands or Tie Wires
- Band/Wire Spacing
- Band/Wire Distance to Joints
- No Internal Bands in Trays
- No Additional Trowel Material Over Sections, Joints
- No Edge Guards

Cable Parameters:

- Distribution of Cables in Fire-Wrapped Cable Trays
- Proximity of Cables to the Exposed (Inside) Surfaces of the Fire Barrier
- Presence of Materials Between the Cables and the Unexposed Side of the Fire Barrier Material
- Temperatures at Which Cables Can No Longer Perform Their Intended Functions When Energized at Rated Voltage and Current

II.B.2 *For any parameter that is not known or has not been verified, describe how you will evaluate the in-plant barrier for acceptability.*

The significance of individual parameters is not yet fully known. NUMARC tests are attempting to identify critical or important Thermo-Lag material and installation parameters which contribute to the successful performance as a one-hour fire barrier. The critical or important parameters found may be exclusive of and/or expand upon those listed in II.B.1. Extensive efforts to obtain parameter information, such as destructive examination, is not anticipated. Should a fire barrier material other than Thermo-Lag be selected as a replacement, the certified test reports will be evaluated in determining the acceptability of that material for the LaSalle County Station cable tray configurations. A review of identified critical or important raceway, fire barrier and cable parameters relative to the selected replacement material will be included in this evaluation.

II.B.3 *Describe the type and extent of the unknown parameters at your plant.*

Raceway Parameters:

- Support Protection

  The requirements for fireproofing the cable tray supports are specified in the Thermo-Lag Installation Procedure Manual but have not been verified. Extensive efforts to perform this review are not anticipated. A review of the support protection requirements relative to the selected replacement material will be performed.

Fire Barrier Parameters:

Drawing 1E-0-3074B and the Thermo-Lag Installation Procedure Manual specify the requirements for installation of the Thermo-Lag 330-1 fire barrier material for the affected power cable trays and control cable trays. In response to regulatory documents (i.e., Bulletin 92-01, Supplement 1, etc.) related to the Thermo-Lag 330-1 fire barrier material, the Station performed informal walkdowns for the affected cable trays. The purpose for these walkdowns was to review the as-built configurations against the design and installation documents. The results of these walkdowns concluded that the fire barrier configurations installed at LaSalle County Station generally represent the materials, workmanship, methods of assembly, dimensions and configurations from the design drawing and the Thermo-Lag Installation Procedures. However, some potential deviations from these documents were observed.

As a result of the current status for the subject cable tray fire barriers and considering that LaSalle has only a small amount of the subject material, the LaSalle County Station is considering replacing the existing material with a replacement material rather than attempting to evaluate the in-plant (i.e., as-built) cable tray fire barriers for acceptability. Therefore, efforts required in obtaining and verifying the remaining fire barrier parameters

specified in II.B.1 were not determined to be prudent.

Cable Parameters:

- Distribution of Cables in Fire-Wrapped Cable Trays

  The SLICE program does not report physical distribution of cables in cable trays. However, the SLICE "Cable Tray" reports indicate that the actual cable fills are less than the allowable fill for a given routing point.

- Proximity of Cables to the Exposed (Inside) Surfaces of the Fire Barrier

  The SLICE program does not evaluate the proximity of cables relative to cable tray siderails.

- Presence of Materials Between the Cables and the Unexposed Side of the Fire Barrier Material

  Although this parameter has not been verified, design drawings and installation procedures do not specify a covering between the cables and the unexposed side of the fire barrier material.

- Temperatures at Which Cables Can No Longer Perform Their Intended Functions When Energized at Rated Voltage and Current

  The cable equipment qualification testing included subjecting cable specimens to voltages and currents specified in the applicable test reports (Reference 6). Determination of cable performance beyond the scope of work for these tests has not been performed, but may be considered in evaluating a replacement material. See response to Item II.B.2.

III.B.1 *Describe the barriers discussed under Item I.B.1 that you have determined will not be bounded by the NUMARC test program.*

The Thermo-Lag 330-1 fire barriers at the LaSalle County Station are not within the scope of the NUMARC Test Program. Alternative fire barrier replacement materials are being considered to resolve the subject fire barrier issues.

III.B.2 *Describe the plant-specific corrective action program or plan you expect to use to evaluate fire barrier configurations particular to the plant. This description should include a discussion of the evaluations and tests being considered to resolve the fire barrier issues identified in Generic Letter 92-08 and to demonstrate the adequacy of the existing in-plant barriers.*

The LaSalle County Station does not intend to demonstrate the adequacy of the existing in-plant Thermo-Lag 330-1 fire barriers. Alternative fire barrier replacement materials are being considered to resolve the subject fire barrier issues. These alternatives are discussed in the response to V.B.

III.B.3 *If a plant-specific fire endurance test program is anticipated describe the anticipated test specimens, test methodology and acceptance criteria including cable functionality.*

At this time, a LaSalle specific fire endurance test program is not envisioned. However, if existing test results for the replacement material selected do not bound the LaSalle specific installations, a plant specific fire endurance test program will be necessary.

IV.B .1 *Describe those barriers that you have determined will fall within the scope of the NUMARC program for ampacity derating, those that will not be bounded by the NUMARC program, and those for which ampacity derating does not apply.*

The LaSalle County Station does not plan to utilize the NUMARC Program Texas Utilities and Tennessee Valley Authority ampacity test results to address the ampacity derating concerns associated with the in-plant Thermo-Lag 330-1 barriers or any replacement fire barriers.

Ampacity deratings apply only to fire barriers protecting power cables. The specific power cable trays have been identified in I.B.2.a.

IV.B.2 *For the barriers you have determined fall within the scope of the NUMARC program, describe what additional tests or evaluations you will need to perform to derive valid ampacity derating factors.*

The LaSalle County Station does not plan to utilize the NUMARC Program Texas Utilities and Tennessee Valley Authority ampacity test results to address the ampacity derating concerns associated with the in-plant Thermo-Lag 330-1 barriers or any replacement fire barriers.

IV.B.3 *For the barrier configurations that you have determined will not be bounded by the NUMARC test program, describe your plan for evaluating whether or not the ampacity derating tests relied upon for the ampacity derating factors used for these electrical components protected by Thermo-Lag 330-1 are correct and applicable to the plant design. Describe all corrective actions needed and submit the schedule for completing such actions.*

The derating factor for the in-plant Thermo-Lag 330-1 fire barriers was

determined per S&L Calculation 4266/19BC31, Revision 0. This calculation used an analytical method and determined the derating factor based upon the properties (i.e., thermal conductivity, emissivity, mastic thickness, etc.) of the Thermo-Lag coating. The results of this calculation were incorporated into the LaSalle County Station SLICE computer program to determine the impact of the derating factors relative to power cable ampacity. The SLICE program is based upon the use of Stolpe's Method to determine the heat generated by the cable mass and heat transfer principles to determine the heat dissipated through the cable tray/fire barrier assembly. The SLICE "Power Cable Ampacity" reports were generated for the affected power cable tray routing points and concluded that the calculated derating factor was found to be acceptable.

This same approach will be used to evaluate the derating factor for cables enclosed with any replacement fire barriers. The LaSalle County Station has already performed such an evaluation for 3M Company's E54A one-hour fire barrier material. Sargent & Lundy Calculation 4266/19G51, Revision 1 determined a derating factor for this fire barrier. The results of this calculation showed that the derating factor calculated for the 3M material was also found to be acceptable.

IV.B.4 *In the event that the NUMARC fire barrier tests indicate the need to upgrade existing in-plant barriers or replace existing Thermo-Lag barriers with another fire barrier system, describe the alternative actions you will take (and schedule) to confirm that the ampacity derating factors were derived by valid tests and are applicable to the modified plant design.*

See response to IV.B.3.

V.B *Describe the specific alternatives available to you for achieving compliance with NRC fire protection requirements in plant areas that contain Thermo-Lag fire barriers.*

The following replacement fire barrier materials are being considered as alternatives. The present status of the engineering design basis issues relative for each of these alternative have been identified:

- 3M Company's E54A Firewrap

  A draft scoping study has been prepared for considering this material as a replacement. A review of certified test reports for this material as applicable to the LaSalle County Station cable tray configurations must be performed. This material can no longer be procured certifying the firewrap as nuclear grade. Therefore, a material dedication for commercial-grade firewrap must be performed. A calculation required to evaluate power cable ampacity derating has been completed. A calculation revision to reconcile the cable tray hanger loads for the replacement material must be

performed.

- Transco Products, Incorporated (TPI)

  Transco Products, Incorporated distributes and installs a replacement material called Darmatt KM1. Power cable ampacity derating calculations, cable tray hanger loading assessment and a review of the certified test report as applicable to the LaSalle cable tray configurations must be performed.

- Cable Rerouting or Providing Fire Barriers for Redundant Divisional Cables.

  The original decision for providing one-hour rated fire barriers for the affected Division 2 cables was based upon minimizing the impact on initial design and construction. Rerouting of the affected Division 2 power and control cables or providing fire barriers for the redundant divisional cables in Fire Zone 5C11 may be considered as a potential alternative.

VI.B *Submit an integrated schedule that addresses the overall corrective action schedule for implementation and completion of*

1) corrective actions and fire barrier upgrades for fire barrier configurations within the scope of the NUMARC program, and

2) plant specific analyses, testing, or alternative actions for fire barriers outside the scope of the NUMARC program.

The LaSalle County Station intends to replace all of the existing Thermo-Lag materials with an acceptable alternative replacement material by the end of 1994, contingent upon completion and/or resolution of the following items by the end of the second quarter of 1994:

- Completion of all engineering design basis activities for the selected replacement alternative. The major activity common to any replacement alternative is the acceptance of a certified test report for qualifying the LaSalle County Station cable trays to the test configurations.

- Confirmation of material availability to support installation.

- Confirmation that removal of the existing Thermo-Lag and the installation of the replacement will not require planned unit outages.

- Confirmation that removal of existing Thermo-Lag will not result in potential personnel safety hazards since the majority of the affected cables are continually energized.

- As a result of Information Notice 93-41, the Nuclear Regulatory Commission (NRC) is continuing its review of fire barrier systems (i.e., Kaowool, Thermal Ceramics, 3M Interam E-50 Series) in addition to Thermo-Lag. NUMARC has also formed an ad hoc advisory committee to investigate fire barrier systems other than Thermo-Lag, which include those specified in Information Notice 93-41. In order to provide a level of assurance that the selected material replacement is acceptable, the status of industry and the NRC's reviews for all fire barrier systems must be considered and could affect LaSalle's decision in determining a replacement alternative for 1994.

VII *Describe the sources of the information provided in response to this request for information and how the accuracy and validity of the information was verified.*

Information provided in this response was obtained from the following documents, preliminary walkdowns performed by the Station and photographs and video tape documenting the existing installation. The information provided in this response was independently reviewed.

1. Electrical Installation Drawings:

   1E-0-3074B, Revision D
   1E-1-3433, Sheet 1, Revision AR
   1E-1-3433, Sheet 2, Revision T
   1E-1-3662, Revision H
   1E-2-3433, Revision AL
   1E-2-3662, Revision D

2. SLICE Program Version 7.3 - Various Reports

3. Sargent & Lundy Calculations:

   4266/19BC31, Revision 0
   4266/19G51, Revision 1

4. Fire Protection Documentation Package, Volume 4

5. Equipment Qualification Binders:

   EQ-GEN 004/CQD-045150, Revision 2
   EQ-LS 051/CQD-001985, Revision 6
   EQ-LS 053/CQD-002211, Revision 4

6. Cable Test Reports:

   Okonite Report NQRN-1A, Revision 5
   Rockbestos Company Report #QR1804, Revision 0
   Isomedix Qualification Test Report, June 1978

7. Sargent & Lundy Specifications:

   Specification J-2560
   Specification J-2966
   Specification J-2967-01
   Specification J-2967-03

8. Sargent & Lundy Draft Scoping Study for 3M Interam E-50 Series (E54A) 1-Hour Cable Tray Wrap System, November 12, 1993

9. Sargent & Lundy External Design Information Transmittal DIT-CG-EXT-0054-00, January 8, 1992

10. LaSalle County Station Updated Final Safety Analysis Report - Appendix H

11. TSI Technical Note 20684, Thermo-Lag 330-1 Fire Barrier System Installation Procedures Manual Power Generating Plant Applications, Revision V, November 1985

Attachment 4

Zion Station Response

"Request for Additional Information
regarding Generic Letter 92-08,
"Thermo-Lag 330-1 Fire Barriers,"
Pursuant to 10 CFR 50.54(F)

ZION STATION RESPONSE TO :

REQUEST for ADDITIONAL INFORMATION REGARDING GENERIC LETTER 92-08, "THERMO-LAG 330-1 FIRE BARRIERS," PURSUANT to 10CFR50.54(F)

I.B.1 *Describe the Thermo-Lag 330-1 barriers installed in the plant. Include the intended purpose, fire rating, type and dimension of the barrier.*

Zion Station utilizes TSI Thermo-Lag 330-1 material for eleven fire barrier installations. Following is a brief description of each installation. Fire protected conduit fittings, supports and thermal shorts associated with the population are not uniquely identified for this response. Conduit fitting components are included in the overall conduit length estimates. Table 1 summarizes barrier fire rating, barrier type and dimension, and barrier length or area.

1) 0AV016 - Auxiliary Building Ventilation Exhaust Fan "0A" power cable 3 inch conduit is provided with one-hour fire rated protection. The conduit is protected to meet 10CFR50 Appendix R requirements. The length of conduit protected is approximately 22 feet in Fire Zone 11.5-0.

2) 0AV017 - Auxiliary Building Ventilation Exhaust Fan "0B" power cable 3 inch conduit is provided with one-hour fire rated protection. The conduit is protected to meet 10CFR50 Appendix R requirements. The length of conduit protected is approximately 13 feet in Fire Zone 11.5-0.

3) D/G "0" - Diesel Generator "0" fuel oil transfer pumps control cable 6 inch conduit is provided with one-hour fire rated protection. The conduit is protected to meet 10CFR50 Appendix R requirements. The length of conduit protected is approximately 8 feet in Fire Zone 18.6A-1.

4) 1FW006 - Unit 1 Motor Driven Auxiliary Feedwater Pump 1C power cable 3 inch conduit is provided with one-hour fire rated protection. The conduit is protected to meet 10CFR50 Appendix R requirements. The length of conduit protected is approximately 15 feet in Fire Zone 11.3-0.

5) 1LT-459 - Pressurizer Level Transmitter 1LT-459 instrument cable 3/4 inch conduit is provided with radiant energy shield protection. The conduit is protected to meet 10CFR50 Appendix R requirements. The length of conduit protected is approximately 87 feet in Fire Zone 1.2-1.

6) 1LT-461 - Pressurizer Level Transmitter 1LT-461 instrument cable 3/4 inch conduit is provided with radiant energy shield protection. The conduit is protected to meet 10CFR50 Appendix R requirements. The length of conduit protected is approximately 76 feet in Fire Zone 1.2-1.

7) 1VC006 - Unit 1 Centrifugal Charging Pump 1A power cable 3 inch conduit is provided with one-hour fire rated protection. The portion of conduit protected includes junction boxes JB1AB960 and JB1AB1088. The conduit is protected to meet 10CFR50 Appendix R requirements. The length of conduit protected is approximately 72 feet in Fire Zones 11.3-0 and 11.4-0.

8) 2FW006 - Unit 2 Motor Driven Auxiliary Feedwater Pump 2C power cable 3 inch conduit is provided with one-hour fire rated protection. The conduit is protected to meet 10CFR50 Appendix R requirements. The length of conduit protected is approximately 48 feet in Fire Zone 11.3-0.

9) 2LT-459 - Pressurizer Level Transmitter 2LT-459 instrument cable 3/4 inch conduit is provided with radiant energy shield protection. The conduit is protected to meet 10CFR50 Appendix R requirements. The length of conduit protected is approximately 100 feet in Fire Zone 1.2-2.

10) 1FW004 - The concrete wall between the Unit 1 Turbine Driven Auxiliary Feedwater Pump and Motor Driven Auxiliary Feedwater Pumps is extended by a 5 foot high one-hour rated fire barrier. The barrier is composed of steel framing and TSI panel material. The barrier is installed to support an exemption from 10CFR50 Appendix R. The barrier is approximately 25 feet long in Fire Zone 11.3-0.

11) 2FW004 - The concrete wall between the Unit 2 Turbine Driven Auxiliary Feedwater Pump and Motor Driven Auxiliary Feedwater Pumps is extended by a 5 foot high one-hour rated fire barrier. The barrier is composed of steel framing and TSI panel material. The barrier is installed to support an exemption from 10CFR50 Appendix R. The barrier is approximately 17 feet long in Fire Zone 11.3-0.

I.B.2.a. *For the total population, state the total linear feet and square feet used for 1-hour cable tray barriers and 3-hour cable tray barriers.*

Zion Station does not presently utilize TSI Thermo-Lag material for one or three-hour cable tray fire rated applications.

I.B.2.b *For the total population, state the total linear feet used for 1-hour conduit barriers and 3-hour conduit barriers.*

Approximately 178 feet of conduit is protected with TSI Thermo-Lag material in one-hour fire rated applications. Zion Station does not presently utilize TSI Thermo-Lag material in three-hour fire rated conduit applications.

I.B.2.c *For the total population, state the total square feet used for 1-hour fire barriers (other) and 3-hour fire barriers (other).*

Approximately 234 square feet of one-hour fire rated TSI Thermo-Lag material is used to protect junction boxes and separate the redundant Auxiliary Feedwater Pumps. Zion Station does not presently utilize TSI Thermo-Lag material in three-hour fire barrier applications.

I.B.2.d *For the total population, state the total linear feet or square feet used for 1-hour radiant energy heat shields and other barriers, and 3-hour radiant energy heat shields and other barriers.*

Zion Station does not utilize one or three-hour radiant energy shields. TSI Thermo-Lag material is used to meet the 1/2-hour radiant energy shield rating established in the Nuclear Regulatory Commission's April 24, 1986 letter, subject "Implementation of Fire Protection Requirements (Generic Letter 86-10)", Appendix R Questions and Answers. Approximately 263 feet of conduit is protected with TSI Thermo-Lag material in radiant energy shield applications.

II.B.1 *State whether or not you have obtained and verified each of the parameters listed in Item II.A for each Thermo-Lag barrier installed in the plant. If not, discuss the parameters you have not obtained or verified.*

The requested TSI Thermo-Lag fire barrier and cable parameter information is tabulated in tables 2 and 3 respectively. Barrier parameter items 4, 5, 12, 22 and 24 are not applicable to Zion Station installations. The parameter information was obtained through review of electrical installation and cable tabulation design drawings. This information has only been verified to date by review of video tape documenting the existing installations and is noted as such in the tables.

Barrier parameters not obtained are (9) baseline fire barrier thickness, (11) rib orientation, (13) stress skin orientation, (16) prebuttered joints, (17) joint gap width, (18) joints grooved or scored, (19) steel bands, (20) band/wire spacing and (21) band/wire distance to joint. Cable parameters not obtained are (4) cable fill, (7) cable operating temperature and (8) temperature at which cable can no longer perform its function when energized at rated voltage and current.

The significance of individual parameters is not yet fully known. NUMARC tests are attempting to identify critical or important TSI Thermo-Lag material and installation parameters which contribute to the successful performance as a one or three-hour fire barrier. The critical or important parameters found may be exclusive of and/or expand upon those listed. Until these parameters are known extensive efforts to obtain parameter information, such as destructive examination, is not anticipated.

II.B.2 *For any parameter that is not known or has not been verified, describe how you will evaluate the in-plant barrier for acceptability.*

The significance of individual parameters is not yet fully known. NUMARC test results and application guidelines will be utilized to determine critical, important and bounding parameters. Installations will then be judged against this information.

Prior to issuance of the NUMARC information it is anticipated that design walkdowns will begin for TSI Thermo-Lag installations remaining in place. The walkdowns will utilize non-destructive examination to collect data on as many of the listed barrier and cable parameters as possible.

Additionally, removal of the D/G "0" 6 inch conduit fire barrier installation is planned. Barrier parameter data will be collected during the barrier removal.

II.B.3 *Describe the type and extent of the unknown parameters at your plant.*

The requested TSI Thermo-Lag fire barrier and cable parameter information is listed in tables 2 and 3 respectively. Barrier parameters not obtained are (9) baseline fire barrier thickness, (11) rib orientation, (13) stress skin orientation, (16) prebuttered joints, (17) joint gap width, (18) joints grooved or scored, (19) steel bands, (20) band/wire spacing and (21) band/wire distance to joint. Cable parameters not obtained are (4) cable fill, (7) cable operating temperature and (8) temper-

ature at which cable can no longer perform its function when energized at rated voltage and current.

III.B.1 *Describe the barriers discussed under Item I.B.1 that you have determined will not be bounded by the NUMARC test program.*

1FW004 and 2FW004 one-hour fire barrier wall installations are not considered within the scope of NUMARC testing.

III.B.2 *Describe the plant-specific corrective action program or plan you expect to use to evaluate fire barrier configurations particular to the plant. This description should include a discussion of the evaluations and tests being considered to resolve the fire barrier issues identified in Generic Letter 92-08 and to demonstrate the adequacy of the existing in-plant barriers.*

Zion Station TSI Thermo-Lag installations can be divided into four categories. First, 0AV016, 0AV017, 1FW006, 1VC006 and 2FW006 one-hour fire barrier conduit installations are considered within the scope of NUMARC testing. It is anticipated that some upgrade work is required to fully qualify these installations.

Second, the D/G "0" one-hour fire barrier conduit installation is considered within the scope of NUMARC testing. Although considered within the scope of NUMARC testing, removal and replacement of this installation was previously planned.

Third, 1LT-459, 1LT-461 and 2LT-459 radiant energy shield conduit installations are considered within the scope of NUMARC testing. NUMARC test results will be used to establish the radiant energy shield fire rating.

10CFR50 Appendix R states a noncombustible material is to be used for radiant energy shields. Section 9.5.1 "Fire Protection Program" of the NRC's Standard Review Plan, NUREG 0800, defines noncombustible material as "a material which in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors when subjected to fire or heat." It is believed that Zion Station TSI Thermo-Lag radiant energy shields meet this definition since combustible loading in the vicinity of each radiant energy shield is low. The combustible load is comprised of insulating oil, 70 ounces each, for 2 sealed reactor coolant drain tank pump motors. It is believed that this combustible loading is insufficient to ignite, burn, support combustion or release flammable vapors of the TSI Thermo-Lag material. An Engineering evaluation of the radiant energy shields will be performed incorporating the results of the NUMARC testing.

Fourth, 1FW004 and 2FW004 one-hour fire barrier wall installations are not considered within the scope of NUMARC testing. Removal and replacement of these installations are anticipated. Replacement is planned utilizing a tested fire wall product.

III.B.3 *If a plant-specific fire endurance test program is anticipated describe the anticipated test specimens, test methodology and acceptance criteria including cable functionality.*

Zion Station does not presently anticipate any plant specific fire endurance testing.

IV.B.1 *Describe those barriers that you have determined will fall within the scope of the NUMARC program for ampacity derating, those that will not be bounded by the NUMARC program, and those for which ampacity derating does not apply.*

Zion Station does not presently plan to utilize the NUMARC program ampacity test results to address ampacity derating concerns with TSI Thermo-Lag fire barriers.

Zion Station TSI Thermo-Lag installations not requiring ampacity evaluation are the D/G "0" control cable conduit, 1LT-459 instrument cable conduit, 1LT-461 instrument cable conduit, 2LT-459 instrument cable conduit, 1FW004 wall and 2FW004 wall.

TSI Thermo-Lag installations which required ampacity evaluation are the 0AV016 power cable conduit, 0AV017 power cable conduit, 1FW006 power cable conduit, 2FW006 power cable conduit and 1VC006 power cable conduit. These cables were evaluated as discussed in the response to Item IV.B.3.

IV.B.2 *For the barriers you have determined fall within the scope of the NUMARC program, describe what additional tests or evaluations you will need to perform to derive valid ampacity derating factors.*

Zion Station does not presently plan to utilize the NUMARC program ampacity test results to address ampacity derating concerns with TSI Thermo-Lag fire barriers.

IV.B.3 *For the barrier configurations that you have determined will not be bounded by the NUMARC test program, describe your plan for evaluating whether or not the ampacity derating tests relied upon for the ampacity derating factors used for these electrical components protected by Thermo-Lag 330-1 are correct and applicable to the plant design. Describe all corrective actions needed and submit the schedule for completing such actions.*

Zion Station presently utilizes analytical methods to determine the adequacy of cable ampacity. An ampacity derating factor specifically for TSI Thermo-Lag was not used. Cable selection, during design, includes deratings when used in tray or conduit. One design verification of cable adequacy is a thermal analysis of the cable installation, including the TSI Thermo-Lag material, when at rated voltage and full load current.

The analysis yields a calculated conductor temperature which is compared to the cable's temperature rating, i.e., 90°C. The analysis performed for each of Zion Station's TSI Thermo-Lag power cable installations found that conductor temperatures did not exceed the 90°C rating.

IV.B.4 *In the event that the NUMARC fire barrier tests indicate the need to upgrade existing in-plant barriers or replace existing Thermo-Lag barriers with another fire barrier system, describe the alternative actions you will take (and schedule) to confirm that the ampacity derating factors were derived by valid tests and are applicable to the modified plant design.*

Zion Station presently utilizes the analytical method described in IV.B.3 to determine the adequacy of cable ampacity. The ampacity analysis addressing each installation will be updated if fire barrier upgrades are required. The Zion Station schedule is as discussed in the response to Item VI.B.

V.B *Describe the specific alternatives available to you for achieving compliance with NRC fire protection requirements in plant areas that contain Thermo-Lag fire barriers.*

The most probable alternatives are :

1) Replace TSI Thermo-Lag material with other fire barrier products.

2) Upgrade existing TSI Thermo-Lag installations with another fire barrier product and conduct specific qualification tests.

3) Re-route cables to achieve 10CFR50 Appendix R requirements.

4) Install fire resistant cables.

VI.B *Submit an integrated schedule that addresses the overall corrective action schedule for implementation and completion of 1) corrective actions and fire barrier upgrades for fire barrier*

configurations within the scope of the NUMARC program, and
2) plant specific analyses, testing, or alternative actions for fire barriers outside the scope of the NUMARC program.

Following are the major milestones which address resolution of the TSI Thermo-Lag concern at Zion Station.

* Begin detailed design walkdowns.
* Issue 1(2)FW004 wall replacement design.
* Issue D/G "0" conduit fire wrap design.
* Issue NUMARC based upgrade designs.
* Install 1(2)FW004 wall replacement.
* Install D/G "0" conduit fire wrap design.
* Install NUMARC based upgrade designs.
* Perform an Engineering evaluation of the radiant energy shields incorporating the results of the NUMARC testing.

Zion Station intends to make a reasonable effort to complete these milestones in 1994. Completion of some milestones though, is contingent upon:

* Issuance of NUMARC test results.
* Issuance of NUMARC application guidelines.
* Acceptance of test results by the Commission.
* Availability of material.
* Compatibility of upgrades with present installations (detailed design).

VII. *Describe the sources of the information provided in response to this request for information and how the accuracy and validity of the information was verified.*

Information provided in this response was obtained from electrical installation drawings, electrical cable tabulation drawings, building drawings, design calculations, the Zion Station Fire Protection Report and video tape documenting existing installations.

The information provided in this response was independently reviewed and approved, and has only been verified to date through review of video tape documenting the in-plant installations.

TABLE 1

Name	Intended Purpose	Type and Dimension	Document	Field Verified	Length (Area)	Document	Field Verified
0AV016	1 Hr. Fire Barrier	3 In. Dia. Steel Conduit	Dwg. 22E-0-3078-CSL	Note 1	-22 Ft.	Dwg. 22E-0-3078-CSL	No
0AV017	1 Hr. Fire Barrier	3 In. Dia. Steel Conduit	Dwg. 22E-0-3078-CSL	Note 1	-13 Ft.	Dwg. 22E-0-3078-CSL	No
D/G "0"	1 Hr. Fire Barrier	6 In. Dia. Steel Conduit	Dwg. 22E-0-3068C	Note 1	-8 Ft.	Dwg. 22E-0-3068C	No
1FW006	1 Hr. Fire Barrier	3 In. Dia. Steel Conduit	Dwg. 22E-0-3061	Note 1	-15 Ft.	Dwg. 22E-0-3061	No
1LT-459	Radiant Energy Shield	3/4 In. Dia. Steel Conduit	Dwgs. 22E-1-3233-CSL and 3234-CSL	Note 1	-87 Ft.	Dwgs. 22E-1-3233-CSL and 3234-CSL	No
1LT-461	Radiant Energy Shield	3/4 In. Dia. Steel Conduit	Dwg. 22E-1-3234-CSL	Note 1	-76 Ft.	Dwg. 22E-1-3234-CSL	No
1VC006	1 Hr. Fire Barrier	3 In. Dia. Steel Conduit	Dwgs. 22E-0-3061, 3062 and 3069	Note 1	-72 Ft.	Dwgs. 22E-0-3061, 3062 and 3069	No
JB1AB 960	1 Hr. Fire Barrier	24 X 20 X 8 In. Steel Junction Box	Dwg. 22E-1-3213	Note 1	-13.5 Sq. Ft.	Dwg. 22E-1-3213	No
JB1AB 1088	1 Hr. Fire Barrier	16 X 16 X 12 In. Steel Junction Box	Dwg. 22E-1-3217	Note 1	-10.5 Sq. Ft.	Dwg. 22E-1-3217	No
2FW006	1 Hr. Fire Barrier	3 In. Dia. Steel Conduit	Dwg. 22E-0-3063	Note 1	-48 Ft.	Dwg. 22E-0-3063	No
2LT-459	Radiant Energy Shield	3/4 In. Dia. Steel Conduit	Dwg. 22E-2-3233	Note 1	-100 Ft.	Dwg. 22E-2-3233	No
1FW004	1 Hr. Fire Barrier	5 Ft. High by 25 Ft. Long Wall	Dwg. B-1229	Note 1	-125 Sq. Ft.	Dwg. B-1229	No
2FW004	1 Hr. Fire Barrier	5 Ft. High by 17 Ft. Long Wall	Dwg. B-1229	Note 1	-85 Sq. Ft.	Dwg. B-1229	No

Note 1 - Existing installation documented on video tape showing apparent conduit size and type.

TABLE 2

Name	Item 1 Orientation	Item 2 Conduit	Item 3 Junct.Box	Item 3 Lateral Bend	Item 6 Raceway Material	Document	Field Verified
0AV016	Horizontal and Vert. with Radial Bends	Yes	No	No	Steel	Dwg. 22E-0-3078-CSL	Note 1
0AV017	Horizontal and Vert. with Radial Bends	Yes	No	No	Steel	Dwg. 22E-0-3078-CSL	Note 1
D/G "0"	Horizontal	Yes	No	No	Steel	Dwg. 22E-0-3068C	Note 1
1FW006	Horizontal and Vert.	Yes	No	1	Steel	Dwg. 22E-0-3061	Note 1
1LT-459	Horizontal and Vert. with Radial Bends	Yes	No	-6	Steel	Dwgs. 22E-1-3233-CSL and 1-3234-CSL	Note 1
1LT-461	Horizontal and Vert. with Radial Bends	Yes	No	-4	Steel	Dwg. 22E-1-3234-CSL	Note 1
1VC006	Horizontal and Vert. with Radial Bends	Yes	2	-4	Steel	Dwgs. 22E-0-3061, 3062, and 3069	Note 1
JB1AB 960	Horizontal	N/A	Yes	N/A	Steel	Dwg. 22E-0-3062	Note 1
JB1AB 1088	Horizontal	N/A	Yes	N/A	Steel	Dwg. 22E-0-3062	Note 1
2FW006	Horizontal and Vert.	Yes	No	1	Steel	Dwg. 22E-0-3063	Note 1
2LT-459	Horizontal and Vertical with Radial Bends	Yes	No	-6	Steel	Dwg. 22E-2-3233	Note 1
1FW004	Vertical Wall	No	No	1	Steel Frame	Dwg. B-1229	Note 1
2FW004	Vertical Wall	No	No	2	Steel Frame	Dwg. B-1229	Note 1

Note 1 - Existing Installation Documented on Video Tape.

TABLE 2

	Item 7 Support Protected	Item 8 Air Drops	Item 9 Baseline Fire Barrier Thickness	Item 10 Preformed Conduit Panels	Item 11 Rib Orientation	Document	Field Verified
0AV016	Yes	No	Unknown	Yes	Unknown		Note 1
0AV017	Yes	No	Unknown	Yes	Unknown		Note 1
D/G "0"	Yes	No	Unknown	Yes	Unknown		Note 1
1FW006	Yes	No	Unknown	Yes	Unknown		Note 1
1LT-459	Yes	No	Unknown	Yes	Unknown		Note 1
1LT-461	Yes	No	Unknown	Yes	Unknown		Note 1
1VC006	Yes	No	Unknown	Yes	Unknown		Note 1
JB1AB 960	Yes	No	Unknown	No	Unknown		Note 1
JB1AB 1088	Yes	No	Unknown	No	Unknown		Note 1
2FW006	Yes	No	Unknown	Yes	Unknown		Note 1
2LT-459	Yes	No	Unknown	Yes	Unknown		Note 1
1FW004	No	N/A	Nominal 1/2 Inch	No	[illegible]zontal	Dwg. B-1229	Note 1
2FW004	No	N/A	Nominal 1/2 Inch	No	[illegible]	Dwg. B-1229	Note 1

Note 1 - Existing installation documented on video tape.

TABLE 2

Name	Item 13 Stress Skin Orientation	Item 14 Stress Skin Over Joints	Item 15 Stress Skin Ties	Item 16 Joints Dryfit	Item 16 Joints Post Buttered	Item 16 Joints Prebuttered	Document	Field Verified
0AV016	Unknown	No	No	Unknown	Yes	Unknown		Note 1
0AV017	Unknown	No	No	Unknown	Yes	Unknown		Note 1
D/G "0"	Unknown	No	No	Unknown	Yes	Unknown		Note 1
1FW006	Unknown	No	No	Unknown	Yes	Unknown		Note 1
1LT-459	Unknown	Wire Mesh Note 2	Seam Laced	Unknown	Yes	Unknown		Note 1
1LT-461	Unknown	Wire Mesh Note 2	Seam Laced	Unknown	Yes	Unknown		Note 1
1VC006	Unknown	No	No	Unknown	Yes	Unknown		Note 1
JB1AB 960	Unknown	No	No	Unknown	Yes	Unknown		Note 1
JB1AB 1088	Unknown	No	No	Unknown	Yes	Unknown		Note 1
2FW006	Unknown	No	No	Unknown	Yes	Unknown		Note 1
2LT-459	Unknown	Wire Mesh Note 2	Seam Laced	Unknown	Yes	Unknown		Note 1
1FW004	Inside	No	No	Unknown	Yes	Unknown		Note 1
2FW004	Inside	No	No	Unknown	Yes	Unknown		Note 1

Note 1 - Existing installation documented on video tape.
Note 2 - Wire Mesh is not TSI Stress Skin Product.

TABLE 2

Name	Item 17 Joint Gap Width	Item 18 Joints Butt	Item 18 Joints Grooved	Item 18 Joints Scored	Item 19 Steel Bands	Item 19 Tie Wire	Item 20 Band/Wire Spacing	Document	Field Verified
0AV016	Unknown	Yes	Unknown	Unknown	Unknown	Yes	Unknown		Note 1
0AV017	Unknown	Yes	Unknown	Unknown	Unknown	Yes	Unknown		Note 1
D/G "0"	Unknown	Yes	Unknown	Unknown	Unknown	Yes	Unknown		Note 1
1FW006	Unknown	Yes	Unknown	Unknown	Unknown	Yes	Unknown		Note 1
1LT-459	Unknown	Yes	Unknown	Unknown	Unknown	Yes	Unknown		Note 1
1LT-461	Unknown	Yes	Unknown	Unknown	Unknown	Yes	Unknown		Note 1
1VC006	Unknown	Yes	Unknown	Unknown	Unknown	Yes	Unknown		Note 1
JB1AB 960	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown		Note 1
JB1AB 1088	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown	Unknown		Note 1
2FW006	Unknown	Yes	Unknown	Unknown	Unknown	Yes	Unknown		Note 1
2LT-459	Unknown	Yes	Unknown	Unknown	Unknown	Yes	Unknown		Note 1
1FW004	Unknown	Yes	No	No	No	No	N/A		Note 1
2FW004	Unknown	Yes	No	No	No	No	N/A		Note 1

Note 1 - Existing installation documented on video tape.

TABLE 2

Name	Item 21 Band/Wire Distance to Joint	Item 23 Trowel Grade Material Over Sections	Item 23 Trowel Grade Material Over Joints	Document	Field Verified
0AV016	Unknown	Yes	Yes		Note 1
0AV017	Unknown	Yes	Yes		Note 1
D/G "0"	Unknown	Yes	Yes		Note 1
1FW006	Unknown	Yes	Yes		Note 1
1LT-459	Unknown	Yes	Yes		Note 1
1LT-461	Unknown	Yes	Yes		Note 1
1VC006	Unknown	Yes	Yes		Note 1
JB1AB 960	Unknown	Yes	Yes		Note 1
JB1AB 1088	Unknown	Yes	Yes		Note 1
2FW006	Unknown	Yes	Yes		Note 1
2LT-459	Unknown	Yes	Yes		Note 1
1FW004	N/A	No	Yes		Note 1
2FW004	N/A	No	Yes		Note 1

Note 1 - Existing installation documented on video tape.

TABLE 3

Name	Item 1 Size	Item 1 Cable Type	Item 2 Characteristics Jacket Material	Item 3 Conductor Insulation	Item 4 Cable Fill	Document	Field Verified
0AV016	3-1/C 250 MCM	Power	Kerite Hypalon Based	Kerite EPR Based	Unknown	Dwg. 22E-0-3000 pg. 232	No
0AV017	3-1/C 250 MCM	Power	Kerite Hypalon Based	Kerite EPR Based	Unknown	Dwg. 22E-0-3000 pg. 232	No
D/G "0"	Note 2	Control	Kerite Hypalon Based	Kerite EPR Based	Unknown	Note 3	No
1FW006	3/C #2 AWG	Power	Kerite Hypalon Based	Kerite EPR Based	Unknown	Dwg. 22E-0-3000 pg. 4486	No
1LT-459	1 Pair TW #16 AWG	Instrument	Hypalon Based	Hypalon Based	Unknown	Dwg. 22E-1-3000 pg. 4627	No
1LT-461	1 Pair TW #16 AWG	Instrument	Unknown	Unknown	Unknown	Dwg. 22E-1-3000 pg. 46[illegible]	No
1VC006	3/C #1/0 AWG	Power	Kerite Hypalon Based	Kerite EPR Based	Unknown	Dwg. 22E-1-3000 pg. 4229	No
2FW006	3/C #2 AWG	Power	Kerite Hypalon Based	Kerite EPR Based	Unknown	Dwg. 22E-2-3000 pg. 3486	No
2LT-459	1 Pair TW #16 AWG	Instrument	Unknown	Unknown	Unknown	Dwg. 22E-2-3000 pg. 3627	No
1FW004	N/A	N/A	N/A	N/A	N/A	N/A	N/A
2FW004	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Note 2 - 2 Cables of 4/C #10 AWG, 2 Cables of 2/C #14 AWG, 1 Cable of 4/C #14 AWG, 5 Cables of 7/C #14 AWG, 2 Cables of 9/C #14 AWG, 2 Cables of 12/C #14 AWG

Note 3 - Dwgs. 22E-0-3000 pgs. 311, 319, 435, 446, 454, 512, 521, 525, and 752, and Dwg. 22E-2-3000 pg. 2719

TABLE 3

Name	Item 5 Cable Proximity to Unexposed Surface of Fire Barrier	Item 6 Presence of Material Between Cable and Fire Barrier	Item 7 Cable Operating Temperature	Item 8 Temperature at which Cable can no Longer Perform Function (When Energized)	Document	Field Verified
0AV016	Conduit Wall Thickness	Conduit Wall (Steel)	90°C Note 1	Unknown	Dwg. 22E-0-3078-CSL	No
0AV017	Conduit Wall Thickness	Conduit Wall (Steel)	90°C Note 1	Unknown	Dwg. 22E-0-3078-CSL	No
D/G "0"	Conduit Wall Thickness	Conduit Wall (Steel)	Unknown	Unknown	Dwg. 22E-0-3068C	No
1FW006	Conduit Wall Thickness	Conduit Wall (Steel)	90°C Note 1	Unknown	Dwg. 22E-0-3061	No
1LT-459	Conduit Wall Thickness	Conduit Wall (Steel)	Unknown	Unknown	Dwgs. 22E-1-3233-CSL and 1-3234-CSL	No
1LT-461	Conduit Wall Thickness	Conduit Wall (Steel)	Unknown	Unknown	Dwg. 22E-1-3234-CSL	No
1VC006	Conduit Wall Thickness	Conduit Wall (Steel)	90°C Note 1	Unknown	Dwgs. 22E-0-3061, 3062, and 3069	No
2FW006	Conduit Wall Thickness	Conduit Wall (Steel)	90°C Note 1	Unknown	Dwg. 22E-0-3063	No
2LT-459	Conduit Wall Thickness	Conduit Wall (Steel)	Unknown	Unknown	Dwg. 22E-2-3233	No
1FW004	N/A	N/A	N/A	N/A	N/A	N/A
2FW004	N/A	N/A	N/A	N/A	N/A	N/A

Note 1 - Conductor rating is 90°C. Calculated Comductor temperatures did not exceed 90°C rating.