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Perry Nuclear Power Plant
Docket No. 50-440
Response to the Request for Additional Information - Thermo-Lag Ampacity Derating Issues, Perry Nuclear Power Plant, Unit No. 1

Ladies and Gentlemen:

In a letter dated June 28, 1996, information regarding the ampacity derating issue at the Perry Nuclear Power Plant (PNPP), Unit No. 1, was submitted to the Nuclear Regulatory Commission (NRC). In a request for additional information dated September 5, 1996, the NRC staff stated that an initial review of the response had been performed, and additional information was needed to complete the review. Attachments 1 and 2 to this letter provide the response to the request for additional information.

If you have questions or require additional information, please contact Mr. James D. Kloosterman, Manager - Regulatory Affairs, at (216) 280-5833.

Very truly yours,

Lew W Myers

Lew W. Myers
Vice President - Nuclear

KMN:sc

Attachments

cc: NRC Project Manager
NRC Resident Inspector
NRC Region III

A029 1/1

BACKGROUND

As described in Reference 2, the NRC staff requested that additional information be provided with respect to the ampacity derating issues for circuits protected by Thermo-Lag 330-1 fire barriers at the Perry Nuclear Power Plant (PNPP). Responses to the request for additional information are provided below.

NRC Question 2.1

Confirm that all fire barrier construction for the subject configuration(s) are representative of the barrier construction used in the Comanche Peak Steam Electric Station (CPSES), Unit 2, ampacity derating tests.

PNPP Response to Question 2.1

As stated in Reference 3, the following characteristics could affect the ampacity derating factor when comparing the Thermo-Lag barriers at PNPP to the configurations tested by Texas Utilities Electric Company (TUEC):

1. Configuration of the Raceway Protected (e.g., tray, conduit, boxes, airdrops)
2. Raceway Material (e.g., steel, aluminum)
3. Raceway Size
4. Barrier Material (i.e., Thermo-Lag 330-1, 330-660 blanket)
5. Thickness of the Barrier
6. Joint Assembly (e.g., prebuttered, dry fit)
7. Stress Skin Application (i.e., inside or outside barrier)

The Thermo-Lag installations tested by TUEC to obtain the ampacity derating factors used in the PNPP ampacity derating calculations are described in References 4 and 5. The tested configurations are described below:

TESTED TRAYS - One 4-inch × 4-inch steel tray was tested. The barrier material consisted of a Thermo-Lag 330-1 preformed panel with a baseline thickness of 1/2"; +.125", -0". The joints were prebuttered. The upgrade applied Stress Skin over all seams, with 5" overlap on either side of the joints. An additional layer of approximately 3/16" thick trowel grade material was added for the 5" overlap. A coating of Thermo-Lag 350 Topcoat material was applied over upgraded areas.

TESTED CONDUITS - Three conduits were tested: a 3/4" steel conduit, a 2" steel conduit, and a 5" steel conduit. The baseline barrier material for all sizes consisted of Thermo-Lag 330-1, preformed, half round sections with a thickness of 1/2"; +.125",-0". The joints were prebuttered. The upgrade for the 3/4" and 2" conduits applied a preformed overlay section with a thickness of 1/4"; +.125", -0". These preformed sections were applied over the baseline with joints prebuttered. No additional preformed overlay section upgrade material was applied over the 5" conduit. A coating of Thermo-Lag 350 Topcoat material was applied over the upgraded areas.

TESTED AIR DROPS - Two types of air drops were tested: small air drops (single cable outside of a conduit) and large air drops (several cables bundled into one barrier). The barrier material consisted of a Thermo-Lag 330-660 blanket. Three layers were applied, with a 2" - 4" overlap at the seams. The overlap areas were prebuttered with Thermo-Lag 330-660 Trowel Grade material.

These configurations involved a reinforcement of the baseline application with additional stress skin and/or Thermo-Lag thickness to achieve the additional structural strength and thermal resistance needed to survive the 1-hour fire test. Therefore, from an ampacity perspective, these upgraded assemblies presented a worse case when compared to the baseline installations.

A review of the plant design documents, installation instructions, and vendor documentation has been completed to determine the general installation techniques and details used for installation of the fire rated Thermo-lag barriers at PNPP. A walkdown of several installations was done to verify the overall applicability of this information. The examination of internal assembly details was limited to those areas where the material has been removed. Therefore, the information on the barriers reflects the typical construction of the majority of the installations at PNPP. The installations at PNPP are comparable to the baseline installations described in References 4 and 5 without the upgrades.

PNPP TRAYS - The cable trays at PNPP are protected using Thermo-Lag 330-1 prefabricated panels. The joints are prebuttered, with Thermo-Lag 330-1 trowel grade applied to the joints prior to assembly. The baseline fire barrier panel thickness is specified on plant design drawings (Reference 6). The 1-hour barriers installed at PNPP have a thickness of 1/2"; +.125", -0". This information is also applicable to junction box assemblies.

PNPP CONDUITS - Preformed conduit sections are used for raceways where ampacity derating is a concern. Stress skin is inside preformed assemblies. The joints are prebuttered, with Thermo-Lag 330-1 trowel grade applied to joints prior to assembly. The completed conduit assembly for the 1-hour barriers installed at PNPP have a thickness of 1/2"; +.125", -0". The 3-hour barrier installed at PNPP has a thickness of 1"; +.25", -0".

PNPP AIR DROPS - The PNPP design uses two layers of the Thermo-Lag 330-660 conformable blanket, surrounding the cables with a 2" overlap at the seams. Thermo-Lag 330-1 trowel grade is applied to gaps and joints. There is no overcoat required for small air drops; however, the large drops between trays have a coating of trowel grade material. For some applications, the cables are grouped in a layer of Thermo-Lag 330-70 conformable blanket over stress skin. The assembly is protected with a 0.5"; +.125", -0" layer of Thermo-Lag 330-1 trowel grade material over another layer of stress skin. This is equivalent to the thickness and material type used for the preformed panels protecting the tray.

The following table provides a comparison of the TUEC tested installations and the installed PNPP installations.

COMPARISON OF PNPP AND TUEC THERMO-LAG CONFIGURATIONS

CONFIGURATION OF THE RACEWAY AND BARRIER	COMANCHE PEAK TESTED CONFIGURATION	PERRY CONFIGURATION
TRAY		
Raceway Material	Steel	Steel
Raceway Size	24" wide; 4" high	6"-30" wide; 3" & 5" high
Barrier Material	Thermo-Lag 330-1 preformed panels	Thermo-Lag 330-1 preformed panels
Baseline Thickness of Material	1/2"; +.125," -0"	1/2"; +.125," -0"
Additional Thickness of Upgrade	Trowel grade/Stress Skin At Joints	None
Joint Assembly	Prebuttered	Prebuttered
Stress Skin Application	Inside Barrier	Inside Barrier
Top Coat	Thermo-Lag 350	None
CONDUIT		
Raceway Material	Steel	Steel
Raceway Size	3/4" & 2"	3/4" - 2"
Barrier Material	Thermo-Lag 330-1 preformed sections	Thermo-Lag 330-1 preformed sections
Baseline Thickness of Material	1/2"; +.125," -0"	1/2"; +.125," -0"
Additional Thickness of Upgrade	1/4"; +.125," -0"	None
Joint Assembly	Prebuttered	Prebuttered
Stress Skin Application	Inside Barrier	Inside Barrier
Top Coat	Thermo-Lag 350	None
CONDUIT		
Raceway Material	Steel	Steel
Raceway Size	5"	2" - 4"
Barrier Material	Thermo-Lag 330-1 preformed sections	Thermo-Lag 330-1 preformed sections
Baseline Thickness of Material	1/2"; +.125," -0"	1/2"; +.125," -0"
Additional Upgrade	Trowel Grade/Stress Skin (Bends Only)	None
Joint Assembly	Prebuttered	Prebuttered
Stress Skin Application	Inside Barrier	Inside Barrier
Top Coat	Thermo-Lag 350	None
AIR DROP		
Raceway Material	None	None
Barrier Material	Thermo-Lag 330-660 blanket	Thermo-Lag 330-660 blanket
Baseline Material Application	2 Layers	2 Layers
Additional Upgrade	1 Layer	None
Joint Assembly	Prebuttered	Prebuttered
Stress Skin Application	N/A	N/A

Based on the comparison of the Thermo-Lag installations tested by TUEC to obtain the derating factors described in Reference 5 and those installed at PNPP, the PNPP Thermo-Lag installations are bounded by the TUEC installations for ampacity derating concerns. The PNPP configurations are conservative, from an ampacity perspective, because the tested configurations have a slightly greater thickness of Thermo-Lag material than the PNPP configurations. Therefore, the use of the TUEC ampacity derating factors at PNPP is justified. The upgraded assemblies tested by TUEC presented a worst case when compared to the baseline installation applicable to the PNPP assemblies from an ampacity perspective.

NRC Question 2.2

Confirm whether the installed Thermo-Lag fire barriers are single (one 1" thick) or double (two 1/2" thick) layer systems. The Thermo-Lag fire barrier system tested at CPSES 2 was a single layer system.

If a double layer system is used at PNPP then the scaling methodology used on the TU test results is invalid and may prove to be non-conservative for application. If the above case proves true, CEI should provide additional justification for the extrapolation of the single layer test results to a double layer system or provide an alternative basis for ampacity derating determination and analysis of the installed Thermo-Lag configuration.

PNPP Response to Question 2.2

At PNPP, the 1" thick preformed conduit sections of Thermo-Lag are single layer systems. These are used for 3-hour rated barriers. As stated in Reference 3, only one conduit is protected by a 3-hour fire rated barrier at PNPP. However, this conduit contains only control power and position indication circuits for the inboard MSIV main pilot air control valves. As described in Attachment 1 of Reference 3, control cables are adequately sized at PNPP.

NRC Question 2.3

The typical ampacity derating calculation for a conduit (1R33F0103B) used an adjustment factor of 0.8 for 6 energized conductors per National Electric Code (NEC). This conduit included 7 cables (at least 30 conductors). The NEC recommends adjustment factor of 0.6 which includes the effects of a load diversity of 50 percent. Provide justification for using 0.8 instead of 0.6.

PNPP Response to Question 2.3

Attachment 1 of Reference 3 provided the following information for conduit number 1R33F0103B, which contains seven cables.

Type of Cable in this Conduit	Number of Cables	B/M Number	Cable Class	Circuit Number
A	1	EKA-72	3/C #6	1M39F6B
B	1	EKA-75	3/C #12	1E12F8B
C	2	EKB-12	2/C #14	
D	2	EKB-16	9/C #14	
E	1	EKC-11	STP #16	

As stated in Reference 3, a random sampling of cables supplying loads with operating duration less than 120 seconds (types C and D) was selected for calculation of their ampacity margins. Their positive margins indicated that the cables supplying loads of short operating duration are adequately sized at PNPP, and therefore, were excluded from the calculation. In addition, instrumentation cables (type E) were excluded from the calculation because they are not sized on the basis of ampacity. They carry low current in the milli-amp range and the Thermo-Lag fire barriers have no impact on the ampacity of these cables. Therefore, the only cables included in the derating calculation for this conduit were types A and B. The adjustment factor provided in NEC Table 310-19 Note 8 was applied. Load diversity was not credited as part of the Reference 7 calculation.

From the table above, there is one type A cable in this conduit, which is a three-conductor #6 AWG cable. In addition, there is one type B cable in this conduit, which is a three-conductor #12 AWG cable. As stated above, the only cables included in the derating calculation for this conduit were types A and B. Per National Electric Code (NEC), the adjustment factor is 0.8 for 6 energized/current carrying conductors in conduit.

NRC Question 2.4

For cables installed in exposed or enclosed groups of conduits in air, the grouping factors given in Table IX of ICEA Standard P-46-426 shall be used when the spacing between conduit surfaces is not greater than the conduit diameter or less than 1/4 of the conduit diameter. The sample calculation did not use conduit grouping factor. Provide a discussion about conduit grouping factor at PNPP.

PNPP Response to Question 2.4

The use of the conduit grouping factor described in ICEA Standard P-46-426 applies to cables installed in exposed or enclosed groups of conduits in air. However, conduits are wrapped individually at PNPP. Therefore, the use of the conduit grouping factor is not applicable to PNPP.

NRC Question 2.5

Provide conduit size and conduit fill for the sample calculation for conduit number 1R33F0103B. Provide justification of cable ampacity if the conduit fill exceeds the value given in NEC tables.

PNPP Response to Question 2.5

Conduit number 1R33F0103B is a 2.5" conduit. As stated in Section 3.03 of Reference 7, conduits, trays, and cables are installed per Installation Standard Specification SP-2250, Electrical Work and Equipment (Reference 8). This installation specification administratively controls the maximum conduit fill for conduits at PNPP to be 40%, in accordance with National Electric Code (NEC) requirements provided in Table 1 of NEC Chapter 9.

NRC Question 2.6

Provide specific and complete examples of the ampacity derating calculations illustrating all aspects of those calculations in detail (baseline ampacity with source, cable characteristics, cable diameter, tray size and type, percent fill, fire barrier rating, etc.) for typical 1-hour tray (480 volt circuit) and typical air drops.

PNPP Response to Question 2.6

A typical ampacity derating calculation for a tray is provided as Attachment 2.

The two cable bundle free air drop configurations tested by TUEC consisted of 12' long cable bundles (Reference 4). At PNPP, there are no air drop configurations similar to this. However,

there are raceway configurations where intersecting trays and/or conduits are not continuous (physically joined with fittings). Field walkdowns of Thermo-Lag installations were performed to determine the space between tray/tray and tray/conduit intersections. The space between tray/tray intersections is less than 16", and the space between tray/conduit intersections is less than 10". The cable(s) routed through these sections of the raceways are wrapped with Flex Blanket Thermo-Lag (Reference 6 detail "H"). The interfaces between raceways protected with Thermo-Lag materials are not factors in determining the overall ampacity derating. This type of configuration variation occurs for a short part of the overall run of the Thermo-Lag protected raceways. As stated in the NRC staff Safety Evaluation (Reference 5), the variations in construction for short distances are not expected to impact the overall ampacity derating given the conservatism applied in the derating factors used. Therefore, no ampacity derating calculations were performed for these variations in construction.

Additionally, the ampacity of cables with the above configurations were derated based on their applicable raceways (i.e., tray or conduit) in addition to derating due to the presence of Thermo-Lag. The nominal ampacity of a cable routed in a tray was derated based on the depth of cables in the tray and then derated again by 31.5% for the presence of Thermo-Lag material. The nominal ampacity of a cable routed in conduit was adjusted per NEC Table 310-19 Note 8 and further derated by 21% for the presence of Thermo-Lag material.

NRC Question 2.7

The sample calculation used a load factor of 1.0 for resistive loads and 1.1 for other loads. This is acceptable provided the loads are not operating at an overload condition or at a service factor. Provide a discussion about the overload or the service factor of the load.

PNPP Response to Question 2.7

At PNPP, long time overcurrent protection for motors is based on the full load current rating of the motor. An additional step in assuring the adequacy of motor protection was accomplished during initial testing. Field measured motor currents in excess of the full load current ratings (overload) noted during testing were reported to engineering (Reference 10). The measured values were evaluated to determine acceptability of the motor and motor protection.

At normal plant operating voltages, heater and motor load ampacities are typically below their nameplate values or have been evaluated by engineering (Reference 10). No overloads have been identified, therefore, the load factors identified are appropriate.

NRC Question 2.8

Certain non-continuous loads (heaters, heat trace circuits) may operate for an extended period when called on to operate (during extreme cold weather, the heaters might operate at near continuous levels for extended periods). Provide a discussion of these circuits.

PNPP Response to Question 2.8

Ampacity derating calculations for heater circuits described in calculation MISC-0009 (Reference 7) are based on continuously energized loads. Ampacity margins for the feeder circuits were calculated as continuous loads based on the heater nameplate rating with the exception of two heaters. For these two heaters, the calculation utilized the actual field test results (Reference 7). Therefore, the loads referenced in this question were considered to be continuously energized, regardless of environmental changes, and have been conservatively derated.

REFERENCES

1. NRC Generic Letter (GL) 92-08, Thermo-Lag 330-1 Fire Barriers.
2. NRC Letter to D. Shelton (Centerior) dated 09/05/96, Request for Additional Information - Thermo-Lag Related Ampacity Derating Issues, Perry Nuclear Power Plant, Unit No. 1 (PY-NRR/CEI-0832L).
3. Letter from D. Shelton (Centerior) to NRC dated 06/28/96, Response to the Follow-up to the Request for Additional Information Regarding Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers" - Ampacity Derating, Chemical Composition, and Radiant Energy Heat Shield (PY-CEI/NRR-2067L).
4. Omega Point Laboratories Report No. 12340-94583, 95165-95168, 95246, Ampacity Derating of Fire Protected Cables, dated 03/19/93.
5. NRC Letter to Texas Utilities Electric Company dated 06/14/95, Safety Evaluation of Ampacity Issues Related to Thermo-Lag Fire Barriers at Comanche Peak Steam Electric Station, Unit 2 (TAC No. M85999).
6. Perry Nuclear Power Plant (PNPP) Design Drawing D-201-146, Sheet 3-4.
7. PNPP Calculation Number MISC-0009, Revision 0.
8. PNPP Installation Standard Specification SP-2250, Electrical Work and Equipment.
9. National Electric Code (NEC), NFPA 70, 1996.
10. PNPP Procedure GEI-0049.
11. Insulated Cable Engineers Association (ICEA) (IPCEA) Standard P-54-440 (NEMA WC 51), 1986, Ampacities of Cables in Open-Top Cable Trays.