Entergy

Entergy Operations, Inc.
P.O. Box 756
Port Gibson, MS 39150
Tel 601 437 6408
Fax 601 437 2795

Joseph J. Hagan
Vice President
Operations
Grand Gulf Nuclear Station

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U.S. Nuclear Regulatory Commission
Document Control Desk
Mail Stop P1-37
Washington, D.C. 20555

Subject: Grand Gulf Nuclear Station
Docket No. 50-416
License No. NPF-29
Response to the Request for Additional Information Regarding Generic Letter (GL) 92-08: Thermo-Lag Fire Barriers, dated October 28, 1996

GNRO-96/00134

Gentlemen:

Generic Letter (GL) 92-08 was issued by the NRC to obtain information needed to verify that Thermo-Lag 330-1 fire barrier systems comply with NRC fire protection requirements for protecting equipment required to achieve and maintain safe shutdown in the event of a fire.

Reporting Requirement Item 2(c) of GL 92-08 requests information concerning the ampacity derating of cables enclosed in Thermo-Lag fire barriers and the evaluation and application of test results performed to determine the ampacity derating of Thermo-Lag barriers. GGNS provided preliminary responses to Item 2(c) by letters dated December 21, 1994 and March 29, 1995, [References 1 and 2] respectively.

The information provided in References 1 and 2 was reviewed by the Staff and determined to be incomplete. As such, by letter dated November 6, 1995 [Reference 3], the Staff requested that GGNS submit ampacity derating evaluations, including any applicable test reports for NRC review. The anticipated test procedure or a description of the analytical methodology (including typical calculations) that will be used to determine the ampacity derating parameters for Thermo-Lag fire barriers installed at GGNS was also requested.

A029 1/1

By letter dated June 28, 1996 [Reference 4], GGNS provided the response to the November 6, 1995 request, which is considered the completed GGNS response to GL 92-08 Reporting Requirement 2(c). This submittal included the results of the similarity analysis approach utilized to address resolution of ampacity derating issues pertaining to GGNS Thermo-Lag fire barriers, [References 6 and 7]. The GGNS approach is based on the results of ampacity derating tests previously reviewed by the Staff.

Following completion of the Staff's preliminary review of the GGNS June 28, 1996 submittal, the Staff identified additional questions requiring clarification as delineated in the October 28, 1996 Request for Additional Information [Reference 5]. Attachment 1 to this submittal documents the GGNS responses to the questions identified.

This information is being submitted under affirmation in accordance with 10 CFR 50.54(f)(Attachment 2).

Please contact Charles E. Brooks at (601) 437-6555 should you have any questions, or require additional information.

Your truly,

CRH/CEB/mtc
attachment:
1. GGNS response to the NRC Request for Additional Information, dated October 28, 1996
2. Affirmation, per 10 CFR 50.54(f) of the GGNS Response to 92-08 RAI (Item 2C), dated November 6, 1995

cc:
Mr. R. B. McGehee (w/a)
Mr. R. S. Reynolds (w/a)
Mr. J. E. Tedrow (w/a)
Mr. H. L. Thomas (w/a)
Mr. J. W. Yelvertson (w/a)

Mr. L. J. Callan (w/a)
Regional Administrator
U.S. Nuclear Regulatory Commission
Region IV
611 Ryan Plaza Drive, Suite 400
Arlington, TX 76011

cc: Mr. J. N. Donohew, Project Manager (w/2)
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Mail Stop 13H3
Washington, D.C. 20555

Attachment 1 to

GNRO-96/00134

Grand Gulf Nuclear Station
Response to Generic Letter 92-08 (Item 2C) RAI
dated October 28, 1996

The following questions resulted from the Staff's preliminary review of the GGNS response to the GL 92-Request for Additional Information, dated June 28, 1996.

1. 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 is specified for use when the spacing between the conduit surfaces is not greater than the conduit diameter or less than 1/4 of the conduit diameter. The calculations did not use a conduit grouping factor. Provide a discussion about conduit grouping factors at GGNS.

   GGNS Response:

   There are two parts to this response; one applies to multiple conduits enclosed in a common enclosure, and the other applies to individually enclosed conduits.

   Multiple conduits in a common enclosure

   A derating factor of 48% was used for GGNS configurations where two horizontal conduits (1 x 2) are enclosed within a common enclosure fabricated by installing Thermo-Lag 330-1 nominal 1-¼" thick panels directly on the surface of these conduits. There are two instances of such configurations at GGNS:

   - conduits 1BBRNR42 and 1BBRNR43 are enclosed in such a configuration for a length of approximately 18'
   - conduits 1BBRNR43 and 1BBRNR45 are enclosed in such a configuration for a length of approximately 7'

   Section 5.6.d of Engineering Report GGNS-96-0032 Revision 0 documents the development of the 48% derating based on a comparison of test results for multiple conduits versus a cable tray enclosed in a similar fire barrier configuration. The test results demonstrate that the ampacity derating for multiple conduits (2 rows of 3 conduits) enclosed in a ½" thick baseline Thermo-Lag 330-1 with stress skin and trowel grade overlay (26%) are bounded by the ampacity derating for a 24" x 4" cable tray enclosed in a similar configuration (40%). A similar comparison of the GGNS configuration (1 row of 2 conduits) enclosed in nominal 1-¼" thick 330-1 Thermo-Lag versus a cable tray enclosed in 1-¼" thick 330-1 Thermo-Lag, with a 770-1 overlay upgraded to a 3 hour rated fire barrier, leads to the conclusion that the tray configuration bounds the 2 conduit configuration. Based on the significant conservatism of the assumed derating, it was considered reasonable to conclude that the 9% derating required for conduit grouping is implicitly accounted for in the 48% derating, and therefore this 9% derating for conduit grouping was not explicitly applied to this configuration. Note also that, even if an additional 9% derating were to be applied to the specified installations, which have already been derated by 48%, the minimum ampacity margin for cables in these conduits would be 14.5%.

   Individually enclosed conduits

   No grouping factors were applied to individually enclosed conduits. This was based on the fact that in the two cases where enough separation did not exist to individually enclose conduits, a common enclosure was utilized.

Conversely, if conduits were individually enclosed, they were considered to have sufficient separation and adequate margins to justify not explicitly applying a conduit grouping factor.

Due to Thermo-Lag tolerances, exact separation between conduit surfaces can not be non-destructively determined for individually enclosed conduit configurations. Based on further review of individually enclosed conduits, it has been determined that there are some cases where the spacing between two adjacent conduits may be less than one conduit diameter (but greater than ¼ conduit diameter). Therefore, a conduit grouping factor of 0.91 (three conduits in a horizontal row) can be conservatively applied to all cables routed in power and control conduits within the scope of Engineering Reports GGNS-96-0006 Revision 0 and GGNS-96-0032 Revision 0. There are no cases within GGNS Thermo-Lag protected conduit installations which would require a derating higher than 0.91 (three conduits in a horizontal row). Although application of the 0.91 factor (9% derating) to base ampacities of all cables routed in power and control conduits results in reduced ampacity margins for these cables, the minimum ampacity margin for cables routed in individually enclosed conduits, after application of this derating, is 18.4 %.

2. It is not clear how the licensee calculated the full load amperes (FLA) for applicable conduits. The constant KVA loads will draw 11 percent more current at 90 percent of the rated voltage available at its terminals. Additionally, some loads may operate at overload or at a service factor of 15 percent. Accordingly, the FLA could be as high as 125 percent of the FLA at nominal voltage. The licensee needs to address this aspect of system operation in the ampacity derating analysis.

GGNS Response:

The full load ampere (FLA) ratings for all power circuits were retrieved from equipment nameplate data and/or determined from available design information. As indicated in Generic Letter 92-08, ampacity derating for Thermo-Lag has been characterized primarily as a cable life issue, with potential reduction in the design life of cables, as a result of continuous operation at higher than design temperatures. GGNS agrees with this characterization, and therefore considered circuit loading for steady state operation, in order to evaluate the cables for continuous operation. The undervoltage conditions cited in the question are transient in nature and would not be present on a continuous basis. Power cables installed at GGNS were procured for service conditions which include conductor temperatures not exceeding 90° C in normal operation, with up to 100 hours of ''emergency'' operation at 130 ° C, per year for a 40 year service life. Cables within the scope of this evaluation are expected to withstand the transient overload conditions, which are considered to be part of the expected service conditions for power cables utilized at GGNS, and operate for the design life of the plant carrying their normal steady state FLA. Continuously energized constant KVA loads powered by cables within the scope of this evaluation are sized to drive no more than 100% of their rated horsepower. Therefore overloading of cables connected to constant KVA loads, due to continuous operation at 115% of rated horsepower, does not require additional ampacity derating consideration.

3. The actual percent fill of conduits (1BBAOT22, 1BBAOT23, 1BBAOT25) exceeded the allowable percent fill. Provide justification for cable ampacity if the conduit fill exceeds the value given in National Electric Code (NEC) tables.

GGNS Response:

These conduits form penetrations at the control building to the auxiliary building interface. They are not actually Thermo-Lag clad, but are embedded in the concrete walls of the control building and auxiliary buildings where they interface. They were initially included in the Thermo-Lag ampacity derating database because cables within Thermo-Lag clad trays transition from the control building to the auxiliary building via these penetrations. However, in actual practice, no additional derating due to application of Thermo-Lag is required for these conduits.

The actual fill within these penetrations does exceed the 40% fill allowable by the NEC. These overfilled penetrations were evaluated and justified during the original plant construction by the AE. The justification took into consideration the cable diversity as well as the loads serviced by the cables, the majority of which are control/instrumentation circuits, or intermittent loads (MOVs).

4. Base ampacities for #12 AWG control cables in random fill trays are from Table 11 or 12 of ICEA P-54-440 (1972). These tables are for 601-2000 volt cables. What is the voltage rating of the control cables (2/C, 4/C, 7/C, 12/C #12 AWG)?

GGNS Response:

With the exception of cable codes CBT (12/C #12 AWG), CYT (12/C #12 AWG), and CY4 (4/C #12 AWG), all control cables have a 1 kV voltage rating. Cables with codes CBT and CYT are rated at 600 V. Cables with code CY4 were originally supplied with a 1 kV rating, but subsequently supplied with a 600 V rating, so they will all be assumed to be rated at 600 V. Cables with the above identified codes are jacketed cables with non-jacketed conductors. Therefore, the appropriate cable ampacity (I_o) for cables with these three codes should be retrieved from table 3 of ICEA P-54-440 (1972). All other #12 AWG cables within the scope of this evaluation are jacketed cables with jacketed conductors, and therefore the appropriate cable ampacity (I_o) for these cables should be retrieved from table 12 of ICEA P-54-440 (1972), as they have been. Cable ampacity (I_o) for #12 AWG cables was not retrieved from Table 11 of ICEA P-54-440 (1972), since none of these cables are triplexed. All circuits utilizing cables with codes CBT, CYT, and CY4, routed in the two Thermo-Lag protected cable trays (7 cables total), were re-evaluated utilizing cable ampacities (I_x) based on Table 3 of ICEA P-54-440 (1972). This re-evaluation shows that the affected cables have ampacity margins in excess of 35%.

Tables 11 or 12, as appropriate, were utilized by the AE for power cables installed within open top trays at GGNS during original plant design and construction. This practice was considered appropriate for power cables within the scope of this evaluation, since these are either triplexed cables with jacketed conductors, or jacketed cables with jacketed conductors. Consequently, cable ampacities (I_o) from Tables 11 or 12 of ICEA P-54-440 (1972) were utilized for power cables within the scope of this evaluation.

5. What ampacity derating test or analysis bounds those configurations in Section 13.1.3.b.11 & 13.1.3.b.12 of licensee document, Engineering Standard ES-02?. The licensee is requested to provide the ampacity derating parameters with applicable technical justification for the subject configurations.

GGNS Response:

Grand Gulf Nuclear Station (GGNS) had no installed Thermo-Lag configurations as identified in Engineering Standard ES-02, Section 13.1.3.b.11 or 13.1.3.b.12 at the time Engineering Reports No. GGNS-96-0006, Rev. 0 and GGNS-96-0032, Rev. 0 were issued. Although Engineering Standard ES-02 provides installation details for these two configurations, the standard also requires Nuclear Plant Engineering approval prior to installing or modifying Thermo-Lag enclosures. This design review and approval is specifically required to ensure the installation is bounded by tested configurations and potential affects on design analyses (supports, ampacity derating, etc.) have been evaluated. Therefore, Engineering Report No. GGNS-96-0006, Rev. 0 was correct and addressed all installed Thermo-Lag enclosure configurations at GGNS at the time of issuance.

Although not originally utilized or planned to be used, the configuration identified in ES-02, Section 13.1.3.b.12 was determined to be required as a result of field changes identified during actual upgrade of the Thermo-Lag enclosures during RF08. As a result, ampacity derating for this configuration was evaluated and a derating factor of 23% was established. This evaluation utilized a similarity analysis like the one used in Engineering Report No. GGNS-96-0006, Rev. 0. Specifically, the configuration identified in ES-02, Section 13.1.3.b.12 (1/2" base Thermo-Lag 330-1 material with a 1/4" overlay) was compared to configurations evaluated in Engineering Report No. GGNS-96-0032, Rev. 0, Section 5.6.c ''Single conduits clad in Thermo-Lag 330-1/770-1, upgraded to a 3 hour fire barrier rating''. Engineering Report No. GGNS-96-0032, Rev. 0, Section 5.6.c established a 23% ampacity derating factor based on comparison to ampacity derating test performed for TVA and TSI at Omega Point Laboratories (Report Numbers 11960-97337 & 97338). A comparison of the 13.1.3.b.12 configuration and configurations utilized in the OPL test was performed for critical parameters as established in Section 6.1 of both Engineering Report Numbers GGNS-96-0006 and GGNS-96-0032 (Material Type, Material Thickness, Stress Skin Location, and Raceway/Base Material/Overlay Material Interface Mechanisms). This comparison determined that with regard to ampacity derating, the configurations identified in ES-02, Section 13.1.3.b.12 is bounded by those tested at OPL (Report Numbers 11960-97337 & 97338). Therefore, the 23% ampacity derating factor established in Engineering Report No. GGNS-96-0032, Section 5.6.c is bounding for the configuration identified in ES-02, Section 13.1.3.b.12.

A review of the configurations identified in ES-02, Sections 13.1.3.b.11 and 13.1.3.b.12 determined that the 13.1.3.b.12 configuration is a worse case with regard to ampacity derating. Therefore, the ampacity derating factor established for the 13.1.3.b.12 configuration will bound the configuration identified in ES-02, Section 13.1.3.b.11. As part of the paper work close out for the Thermo-Lag Upgrade Modification at GGNS, Engineering Report No. GGNS-96-0006 is being ''as-built'' to include an ampacity derating factor for the two configurations identified in ES-02, Sections 13.1.3.b.11 and 13.1.3.b.12.

6. Sections 6.1.1 and 6.1.2 of the Engineering Report GGNS-96-0006 which was part of the licensee submittal dated June 28, 1996, contains a reference to both conduit and air drop fire barriers (i. e., Flexi-Blanket 330-660) material properties. The licensee should explain how the installed configurations are bounded by the referenced ampacity derating tests. The licensee is requested to describe geometrically the fire barrier construction and identify the ampacity derating test being considered for the specific Thermo-Lag fire barrier configurations.

GGNS Response:

GGNS did not specifically establish an ampacity derating factor for Flexi-Blanket 330-660 material in Engineering Report GGNS-96-0006, Rev. 0. Use of Flexi-Blanket 330-660 material at GGNS is limited to runs of less than three linear feet on conduits/air drops. This short distance (<3 linear feet) will mitigate local heating effects by conducting heat laterally along the length of the conduit and circuit conductors. Therefore, GGNS considers the ampacity derating factor established for the specific conduit/cable tray arrangement as bounding for the short runs of conduit/cable air drop enclosed with Flexi-Blanket 330-660 material.

Although GGNS considers the above approach conservative and acceptable, a more detailed review of the GGNS site specific use of Flexi-Blanket 330-660 material was made. A review of the ''Safety Evaluation by the Office of Nuclear Reactor Regulation - Ampacity Issues Related to Thermo-Lag Fire Barriers - Texas Utilities Electric Company - Comanche Peak Steam Electric Station, Unit 2 - Docket No. 50-446'' was made with regard to ampacity derating issues for Flexi-Blanket 330-660 material. Page No. 8, Paragraph No. 4 of the above safety evaluation discusses TU Category 3 configurations (Flexi-Blanket). This paragraph describes the worst-case configuration (conduit-cable tray installation) and states: ''It is expected that the ampacity derating margin of 30 percent for the specific cables in this configuration at CPSES, Unit 2 would bound the Category 3 configurations''. A similar comparison at GGNS can be made. In all cases except one, Flexi-Blanket material at GGNS is installed on conduits and cable air drops entering cable tray enclosures. The one exception involves a 4" conduit which is primarily wrapped with nominal 1 1/4" thick Thermo-Lag 330-1 prefabricated conduit sections. A short section (approximately 2 linear feet)of this conduit has the 330-1 material removed and protection is provided by Flexi-Blanket 330-660 material. A review of all circuits at GGNS, which are enclosed in the Flexi-Blanket 330-660 material, determined that a minimum ampacity derating margin of 36.6% is available after base ampacities are considered. Therefore, even using the more conservative approach outlined in the safety evaluation for TU identified above, the 36.6% ampacity derating margin available at GGNS is certainly bounded by the 30% margin determined to be acceptable at TU.

References:

1. Letter C. R. Hutchinson to the U.S. Nuclear Regulatory Commission, dated March 29, 1995 - Response to Follow-up to the Request for Additional Information (RAI) Regarding Generic Letter 92-08 Issued Pursuant to 10CFR50.54(f) on December 28, 1994: "Thermo-Lag 330-1 Fire Barriers".

2. Letter C. R. Hutchinson to the U.S. Nuclear Regulatory Commission, dated December 21, 1994 - Response to Follow-up to the Request for Additional Information (RAI) Regarding Generic Letter 92-08 Issued Pursuant to 10CFR50.54(f) on December 21, 1993: "Thermo-Lag 330-1 Fire Barriers".

3. Letter U.S. Nuclear Regulatory Commission to C. Randy Hutchinson, dated November 6, 1995 - Request for Additional Information Regarding Generic Letter 92-08, "Thermo-Lag 330-1 Fire Barriers".

4. Letter C. R. Hutchinson to the U. S. Nuclear Regulatory Commission, dated June 28, 1996 ''Response to the Request for Additional Information Regarding Generic Letter (GL) 92-08 Item 2(c), Thermo-Lag Fire Barriers, dated November 6, 1995''.

5. Letter U. S. Nuclear Regulatory Commission to J. J. Hagan, dated October 28, 1996 ''Request for Additional Information Related to Ampacity Derating issues for Thermo-Lag Fire Barriers for Grand Gulf Nuclear Station''.

6. Engineering Report No. GGNS-96-0006 Revision 0, "Grand Gulf Nuclear Station Engineering Report for Evaluation of Ampacity Deratings for Thermo-Lag Fire Barrier Enclosed Cables in Fire Areas/Zones OC202, OC402, OC702 and 1A316".

7. Engineering Report No. GGNS-96-0032 Revision 0, "Grand Gulf Nuclear Station Engineering Report for Evaluation of Ampacity Deratings for Thermo-Lag Fire Barrier Enclosed Cables in Fire Areas/Zones OC214, OC302, OC308 and 1A539".

Attachment 2 to

GNRO-96/00134

Grand Gulf Nuclear Station
Response to Generic Letter 92-08 (Item 2C) RAI
dated November 6, 1995

Affirmation per 10CFR50.54(f)

BEFORE THE

UNITED STATES NUCLEAR REGULATORY COMMISSION

LICENSE NO. NPF-29

DOCKET NO. 50-416

IN THE MATTER OF

MISSISSIPPI POWER & LIGHT COMPANY
and
SYSTEM ENERGY RESOURCES, INC.
and
SOUTH MISSISSIPPI ELECTRIC POWER ASSOCIATION
and
ENTERGY OPERATIONS, INC.

AFFIRMATION

I, J. J. Hagan being duly sworn, state that I am Vice President, Operations GGNS of Entergy Operations, Inc.; that on behalf of Entergy Operations, Inc., System Energy Resources, Inc., and South Mississippi Electric Power Association I am authorized by Entergy Operations, Inc. to sign and file with the Nuclear Regulatory Commission, this response (GNRO-96/00134)to the Generic Letter 92-08 Request for Additional Information dated October 28, 1996 for Grand Gulf Nuclear Station; that I signed this response as Vice President, Operations GGNS of Entergy Operations, Inc., and that the statements made and the matters set forth therein are true and correct to the best of my knowledge, information and belief.

J. J. Hagan

STATE OF MISSISSIPPI
COUNTY OF CLAIBORNE

SUBSCRIBED AND SWORN TO before me, a Notary Public, in and for the County and State above named, this 23 day of December, 1996.

(SEAL)

B. W. Crocker
Notary Public

Notary Public State of Mississippi At Large
My Commission Expires: February 1, 1998
BONDED THRU HEIDEN-MARCHETTI