TENNESSEE VALLEY AUTHORITY

CHATTANOOGA, TENNESSEE 37401

400 Chestnut Street Tower II

January 4, 1985

Director of Nuclear Reactor Regulation
Attention: Ms. E. Adensam, Chief
Licensing Branch No. 4
Division of Licensing
U.S. Nuclear Regulatory Commission
Washington, D.C. 20555

Dear Ms. Adensam:

In the Matter of the Application of) Docket Nos. 50-390
Tennessee Valley Authority) 50-391

References: 1. Letter dated August 14, 1984 from T. M. Novak to H. G. Parris.

2. Letter to you from L. M. Mills dated September 6, 1984.

By reference 2, TVA provided responses to NRC concerns, related to the Watts Bar Nuclear Plant (WBN) fire protection program provided by reference 1. On November 9, 1984 during a telephone conference call, the NRC requested additional information.

Enclosed are revised responses (enclosure 1) to items 2 and 17 and revised requests for deviation (enclosure 2) from 10 CFR 50 Appendix R including a new deviation request (deviation 16).

A letter from T. J. Kenyon dated November 27, 1984, provided TVA with the meeting summary for the November 14, 1984, appeal regarding TVA's position on intervening combustibles and sprinkler obstructions in terms of complying with the provisions of 10 CFR 50, Appendix R. At the bottom of page 2 of this letter, item No. 1 regarding the results of the appeal meeting appears to be misleading. This item should indicate that for redundant safe shutdown circuits spaced greater than 20 feet apart but less than or equal to 30 feet apart with intervening combustibles, the full area between the circuits would have sprinkler coverage in accordance with "stricter criteria" which TVA presented during the appeal. For similar conditions but with the circuits greater than 30 feet apart, TVA would apply the "stricter criteria" to a 30-foot-wide path between the circuits.

During a meeting between TVA and NRC on December 4, 1984, in Bethesda, Maryland, this was brought to the attention of Mr. Kenyon. He agreed at that time that his statement in the referenced letter was misworded and that the intent was as stated above.

B002
1/1

If you have any questions concerning this matter, please get in touch with D. P. Ormsby at FTS 858-2682.

Very truly yours,

TENNESSEE VALLEY AUTHORITY

J. W. Hufham, Manager
Licensing and Regulations

Sworn to and subscribed before me
this 4th day of Jan. 1985

Bryant M. Lowery
Notary Public
My Commission Expires 4/8/86

Enclosures (2)
cc: U.S. Nuclear Regulatory Commission (Enclosures)
Region II
Attn: Mr. James P. O'Reilly Administrator
101 Marietta Street, NW, Suite 2900
Atlanta, Georgia 30303

ENCLOSURE 1

WATTS BAR NUCLEAR PLANT
NRC QUESTIONS OF AUGUST 14, 1984

Item No. 2

A "walkdown" of all plant areas required for safe shutdown (and access routes thereto) should be performed to demonstrate that sufficient emergency lighting is provided.

Response

In August 1984, a shift engineer and special projects manager performed a walkdown of unit 1 emergency lighting. After all area lighting (normal, DC, standby and crane lights) were disabled, an assessment was made of the capability to perform manual actions to achieve safe shutdown, including access to required areas, with emergency lighting. It was determined that additional lighting was needed in three areas of the Auxiliary Building.

A followup lighting walkdown of unit 1 was conducted on November 25, 1984 by the shift engineer involved in the August 1984 review, with several operator personnel. Once again, all lighting was disabled and all areas and access paths were determined to have sufficient lighting with the exception of the boric acid blender area on elevation 713 of the Auxiliary Building. Corrective action to add emergency lighting to this area has been initiated.

The areas checked were those identified in the original plant shutdown logic (Fire Protection Submittal, September 1980). The revised shutdown logic will require an additional walkthru which is planned as soon as all required manual actions have been identified.

A lighting walkdown of unit 2 will also be conducted with noted deficiencies corrected before fuel load of that unit.

Item No. 17

TVA should identify the end-use of room 692-A31 and propose fire protection in conformance with the guidelines of Appendix A to BTP APCSB 9.5-1.

Response

In TVA's previous response provided September 6, 1984, it was stated that the subject room would be used as a tool room. TVA no longer plans to use this room as a tool room but will instead install permanent plant equipment. Room 692-A31 has been modified to qualify as a three-hour fire-rated enclosure which meets the requirements of Appendix A to BTP APCSB 9.5-1, D.2.i and Appendix R separation guidelines (III.G.2.a). When plans are finalized, a fire hazard analysis will be performed based on proposed use with permanent plant equipment and additional fire protection will be added if indicated by the analysis.

ENCLOSURE 2
WATTS BAR NUCLEAR PLANT
10 CFR 50 APPENDIX R DEVIATION REQUESTS

1. Deviation - Section III.G.2 requires redundant safe shutdown components to be separated from each other by one of the following methods:

   a. Separation of cables and equipment and associated nonsafety circuits of redundant trains by a fire barrier having a 3-hour rating.

   b. Separation of cables and equipment and associated nonsafety circuits of redundant trains by a horizontal distance of more than 20 feet with no intervening combustibles or fire hazards. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area.

   c. Enclosure of cable and equipment and associated nonsafety circuits of one redundant train in a fire barrier having a 1-hour rating. In addition, fire detectors and an automatic fire suppression system shall be installed in the fire area.

   Floor slabs in the Auxiliary Building have unprotected penetrations. Therefore, some redundant safe shutdown components located on different floor elevations are not in literal compliance with Section III.G.2.

   Justification

   The Auxiliary Building is a designated fire area and is separated from adjacent fire areas by reinforced concrete construction that is equivalent to 3-hour fire rated barriers. The Auxiliary Building is further divided into 1-1/2 hour rated enclosures. However, not all floor slabs within the building are designated as complete fire barriers. They are constructed of reinforced concrete that is equivalent to 3-hour fire rated barriers except for equipment hatch openings, stairwells, unsealed spare conduit sleeves, and unprotected heating, ventilating, and air-conditioning (HVAC) duct penetrations. All other floor penetrations have a 3-hour fire rated seal.

   A water curtain designed in accordance with National Fire Protection Association (NFPA) 13 Section 4-4.8.2 will be provided for stairwell openings which are located near column lines A12/S and A4/S and through floor slabs 713.0 and 737.0 in the Auxiliary Building and the normally closed equipment hatch located at A13/S-772. These modifications will be installed under an engineering change notice (ECN) and will be complete by April 19, 1985. One and one-half hour rated fire dampers will be installed in HVAC ducts located at column line and elevation A6/S-713, A10-A11/S-713, and A5/R-737. This modification will be installed under the same ECN and will be complete by March 1, 1985. No other equipment hatches, stairwells, or HVAC duct penetrations can expose redundant safe shutdown equipment located on different floor elevations to damage from a single fire. This statement is based on compliance with section III.G.2.b requirements by providing greater than 20-foot cumulative

horizontal separation between the redundant equipment located near the remaining unprotected openings and by providing area fire detection and automatic suppression coverage.

The spare conduit sleeves consist of a section of rigid steel conduit embedded in the reinforced concrete floor slabs. Both ends of the sleeves extend only a few inches from the floor slabs and both ends are sealed with type PLG threaded conduit plugs (see figure 1-1). The plugs provide tight seals which will ensure that no smoke or hot gases will propagate through the sleeves.

The rooms containing the required safe shutdown circuits that are separated from their redundant circuits by the floors with the unprotected openings are provided with fire detection and automatic sprinkler systems. These systems will provide fully developed sprinkler patterns at the ceiling level during a fire as discussed in deviation 15 which was forwarded to the NRC by letter from J. A. Domer to E. Adensam dated December 13, 1984. The ceiling coverage will protect spare conduit sleeves from damage from a fire located below the sleeves and will minimize the temperatures on their unexposed side. Unacceptable heat transfer through the spare sleeves is not considered credible for a fire located above the sleeves.

It is TVA's position that the level of protection that will be achieved by locating redundant safe shutdown components on different elevations is equivalent to the separation requirements of Section III.G.2.b. Therefore, we request approval of the deviation to literal compliance with Section III.G.2.b.

2. Deviation - Section III.L.2.d of 10CFR50, Appendix R, requires the process monitoring function for alternative or dedicated shutdown to be capable of providing direct readings of the process variables necessary to perform and control a plant shutdown. In attachment 1 of IE Information Notice No. 84-09 dated February 13, 1984, the NRC identified the instrumentation they consider necessary for alternative or dedicated shutdown. Contrary to these guidelines, the following instrumentation has not been provided in the auxiliary control room (ACR):

   a. Cold leg temperature (T_{cold})

   b. Tank level for the condensate storage tank (CST) and refueling water storage tank (RWST)

   c. Wide range steam generator level.

   Justification

   a. T_{cold} instrumentation, in conjunction with other system parameters, is used to monitor natural circulation in the reactor coolant loop and to set the reactor cooldown rate. Both of these functions, however, can be accomplished by using T_{sat}, the saturation temperature corresponding to the secondary side steam generator pressure. Instrumentation has been provided in the auxiliary control room which enables the operator to determine T_{sat}.

The use of this instrumentation to safely cool down a PWR plant has been demonstrated in startup tests at TVA's Sequoyah Nuclear Plant (SQN) unit 1 and during hot functional testing on Watts Bar (WBN) unit 1. The test utilized T_{sat} monitoring as part of the normal plant procedure to perform and control the necessary safety functions and to bring the plant to safe shutdown.

It has been suggested that T_{sat} cannot be relied on to verify natural circulation conditions in the reactor coolant loop due to the inherent lag in temperature response between the primary and secondary systems. An interruption in natural circulation in one loop, however, can be detected by obsevation of an increased delta-T between the hot leg temperature (T_{hot}) and T_{sat} in the other loops. This information was previously submitted to the NRC by letter from L. M. Mills to E. G. Edensam dated June 17, 1983.

It is TVA's opinion that no significant increase in operator action is required using this monitoring arrangement and that the process monitoring functions are adequate for safe shutdown. Therefore, TVA requests an approval of the deviation to the NRC position that cold leg temperature monitoring is required in the ACR by Appendix R, Section III.L.2.d.

b. The CST level indication is not considered essential in the ACR due to automatic switchover capability to the essential raw cooling water (ERCW) header.

During shutdown procedures, automatic switchover of the auxiliary feedwater pump suction from the CST to the ERCW header will be functional when control is established in the ACR.

The RWST level indication is not considered essential in the ACR due to the large inventory and small demand requirements. The RWST contains almost 20 times the inventory required for cold shutdown. This is primarily used as makeup for contraction due to cooldown over a period of hours.

TVA, therefore, requests approval of the deviation to the NRC position that level indication for CST and RWST is required by 10 CFR 50, Appendix R, Section III.L.2.d.

c. Narrow range steam generator level and auxiliary feedwater (AFW) flow indication to each generator is provided in the ACR. This instrumentation provides input to the automatic controls utilized to maintain steam generator level during plant shutdown during a fire. Although wide range instrumentation is available in the main control room (MCR), no automatic control or safety system inputs are derived from this instrumentation. Using AFW flow indication, the operator is able to confirm adequate reactor coolant system (RCS) post trip steam generator inventory control should the level fall below the narrow range.

h. All fire doors will be adjusted to ensure the gap between the door and the frame does not exceed the maximum allowable clearance as specified in NFPA 80, paragraph 2-5.4. Fire door frames with exccessive gaps between the frames and wall openings will be provided with spacers and with 1-1/2" x 1/2" 12-gauge angles in accordance with sketch No. SK ACH-G1 (ILL.1 of UL letter). High temperature sealant will be utilized to seal off the small openings caused by slight irregularities in the wall construction.

i. All fire doors and frames that are missing UL labels will be replaced unless documentation from the manufacturer is on file indicating that they were originally shipped to TVA as UL labeled equipment. Where such documentation exists application of new labels as proposed by UL to the doors and frames will not provide additional assurance for their adequacy and will not be pursued by TVA.

j. All fire doors with unlabeled louvers were provided by the manufacturer as a labeled assembly. Therefore, no action is required by TVA.

The following information responds to specific findings that were not covered by UL's general recommendations:

a. Opening A61 between the radiological lab and the counting room does not penetrate a fire barrier. Therefore, a fire door is not required in the opening.

b. Door A121, which has plywood covering its louvered opening, will be replaced with a solid door.

c. Door A128, which has a missing louver, will either be replaced or a labeled louver will be installed. The cut-out for a switch in this door's frame will be repaired.

d. A continuous astragel will be provided on door A160. The astragel on door A189 extends the full height of its door and does not need replacement.

e. The transom panel for door A172 is not damaged and does not need to be repaired.

f. The wall above door C12 will be repaired.

g. The extra strike plate for door C63 will be removed and the frame repaired.

h. Doors A118, C13, C49, and C50 were supplied as part of labeled assemblies and the existing piano hinges are an integral part of these assemblies. Although the hinges are not labeled separately, they are identical to the piano hinges that were used to obtain the UL approval for the assemblies. Therefore, no corrective action is required.

All corrective actions will be implemented by April 19, 1985.

It is TVA's opinion that narrow range level indication along with AFW flow indication, which provides primary indication of heat removal capability, is sufficient for use in safe shutdown procedures whenever the ACR is utilized. TVA, therefore, requests a deviation from the requirement to provide wide range level indication.

5. Deviation - Fire Doors - TVA previously reported a number of fire rated doors that were altered to meet NRC requirements or damaged and repaired onsite during construction. To ensure that modifications which have been made to fire doors do not compromise the fire barrier, TVA has contracted with Underwriters Laboratories, Inc. (UL) to provide an evaluation of the fire doors as they exist in the plant. Attached is a copy of a letter from UL dated November 29, 1984, which summarizes their evaluation and provides recommendations for modifications necessary to ensure the performance of the fire doors. TVA will address the general recommendations of UL as follows:

   a. The installation of plastic and metal signs on fire doors is a minor modification which will not change the fire rating of the doors. Based on guidance in the handouts from the NRC Appendix R Workshop that was held in Atlanta, Georgia, on May 4, 1984, such minor modifications do not constitute a deviation. Therefore, as discused with the NRC Project Manager and NRC Chemical Engineering Branch reviewer on January 2, 1985, TVA does not propose to remove signs from fire doors as recommended by UL.

   b. All existing gasketing material will be removed and replaced with material which is UL listed for use on fire rated door assemblies.

   c. All conduit penetrations into the door frame will be anchored either in accordance with sketch No. SK ACH-G2 (ILL.2 of UL letter) or by a continuously welded fitting (item 4 of UL letter).

   d. Small holes in fire doors and frames will be filled with steel rivets or sheet metal screws. Larger holes caused by the removal of previously installed hardware will be covered with a steel plate in accordance with UL recommendations. Dents in the door skin and other minor damage to doors will be repaired in accordance with the fire door manufacturer's recommended practices. Doors which show signs of damage other than as listed above will be replaced with new fire rated doors.

   e. All doors which require maintenance to the hardware will be repaired or will have the hardware replaced as necessary to ensure the proper operation of the door.

   f. Double doors and doors with transom panels that have electric strikes in the head of the door will be replaced with labelled door assemblies. The replacement assemblies will have electric strikes located such that the label will not be invalidated.

   g. Double doors with flush bolts on the inactive door will be provided with UL listed bolts in addition to the existing brass bolt which is required for the proper operation of door status switches.

It is TVA's position that, with the implementation of the corrective actions, the fire doors will be restored to a labeled configuration. We therefore wish to withdraw this deviation request.

12. Deviation - Section III.G.2 of 10CFR50, Appendix R, allows redundant circuits within the same fire area to be separated by 1 hour fire rated barriers. TVA previously identified furnace test results for the 1-hour rated fire barrier material manufactured by 3M Company that was being used to comply with this requirement did not meet the cold-side temperature criteria in ASTM E 119. UL has reevaluated these test results based upon more specific criteria established by the staff and 3M representatives in a meeting on September 13, 1984. Attached is a copy of a letter which summarizes the results of the UL reevaluation and for 1-hour barrier systems applied to open ladder steel cable trays, rigid steel conduits, cable air drops, and steel junction boxes.

When using 3M's 1-hour rated fire barrier material at WBN, TVA commits to installing the material in accordance with the manufacturer's instructions for systems A through E identified in the attached letter. It is our position that completion of this commitment will provide fire barriers that satisfy the appropriate cold-side temperature criteria and that a deviation will no longer exist for systems B through E.

However, in UL's evaluation for system A cable tray enclosures, the cold-side temperature reached 250°F above ambient at 59 minutes into the test. At 60 minutes, the cold-side temperature had increased to 263°F above ambient. This exceeds the allowable limit in the staff guidelines by 13°F.

Justification

The 1-minute period at the end of the furnace test where the system A cold-side temperature exceeded the staff guidelines is not significant when considering the total test duration of one hour.

TVA therefore requests approval of the deviation from the cold-side temperature requirements for the 3M system A fire barriers for a full hour.

14. Deviation - Section III.N requires that areas protected by automatic total flooding gas suppression systems have electrically supervised self-closing fire doors.

a. Previously TVA requested approval of a deviation from the requirements to provide daily inspections on fire doors with automatic hold-open and release mechanisms in the diesel generator building (DGB). TVA wishes to withdraw this deviation as we will comply with the requirements of Appendix R as outlined in the Standard Technical Specifications.

b. TVA deviates from the requirements to electrically supervise three fire doors for DGB rooms which are protected by automatic total flooding CO_2 suppression systems.

All other fire doors for DGB rooms with CO_2 systems are maintained in the closed position and will be provided with electrical supervision that will annunciate in the MCR. This supervision is being provided under ECN 5230.

c. The 480V board rooms in the DGB deviate from the requirement to install fire rated doors which are kept closed and supervised in areas protected by automatic total flooding gas suppression systems. The DGB board rooms are not compartmentalized by fire-rated construction and are part of the respective diesel generator cell fire areas.

Justification

a. Withdrawn

b. Three self-closing sliding doors associated with the fuel oil transfer room (D14) and the lube oil storage room (D7 and D8) have automatic hold-open and release devices which release automatically upon actuation of the CO_2 suppression system. None of these doors are supervised in accordance with section III.N. TVA has also provided non-fire rated doors in the same openings as the sliding doors. The nonrated doors, which are normally closed, have louvers in them to provide ventilation to the area. In accordance with the standard technical specifications, the three door openings will be inspected daily to ensure no obstructions are present which will prevent the sliding fire doors from closing. TVA feels that the door configurations coupled with the daily inspections provide a reasonable degree of assurance that the doors will not be blocked and the addition of supervisory switches to the sliding fire doors will not significantly improve the system. TVA, therefore, requests a deviation from the requirement to provide supervisory switches on all fire doors in the DGB which separate areas protected by automatic total flooding gas suppression systems.

c. The DGB is compartmentalized into four diesel cells and common areas by 3-hour fire rated construction. Each diesel cell consists of a 480v board room, air intake room, and air exhaust room located on El 760.5, and their corresponding engine room located directly below on El 742.0.

The doors located in the 3-hour fire rated walls which separate each diesel cell on El 760.5 are self-closing fire doors. These doors will be provided with electrical supervision which annunciates in the MCR. This work is being accomplished under ECN 5230 and will be completed by March 1, 1985. The interior walls within each diesel cell on El 760.5 separating the 480V board rooms from the air intake and air exhaust rooms are of non-fire-rated masonry construction. Consequently, the doors in each of these walls are not fire rated doors. The walls and doors are intended to provide a means of containing the CO_2 in the 480V board room and are not intended to provide separation from exhaust rooms. The doors, however, are required by section III.N to be fire rated doors due to the total flooding CO_2 suppresssion system provided in the board rooms. These 480V board room doors are of metal construction and will be provided with electrical supervision which annunciates in the MCR. This work will also be done on ECN 5230 and will be completed by March 1, 1985.

These self-closing electrically supervised metal doors will ensure that the proper concentration of CO_2 is maintained to extinguish a fire in the 480v board room. Based on this assurance, we do not feel that the installation of fire doors in these particular openings is necessary. TVA, therefore, requests approval for deviation from the literal requirement of Section III.N which requires self-closing fire doors in these openings.

16. Deviation - Section III.G.3 requires fire detection and a fixed fire suppression system in areas, rooms, or zones for which alternate shutdown capability is provided. Contrary to this requirement, fire detection and fixed fire suppression systems are not provided throughout the control building.

Justification

The control building (CB) is a separate fire area and is separated from adjacent fire areas by reinforced concrete construction equivalent to 3-hour fire rated barriers. Fire detection is provided throughout the CB, except for the corridor on elevation 708.0 and the stairways (C1 and C2). The corridor and stairways are enclosed by a 1-1/2-hour equivalent fire rated barrier and contain no fixed combustibles. Fixed fire suppression systems are provided throughout the CB, except for the below listed rooms:

Room Name	Room No.
250v Battery Board Room	692.0 - C4 and C5
24v and 48v Battery Board and Charger Room	692.0 - C8
Stairs C1 and C2	-
Corridor	708.0 - C2
Main Control Room	755.0 - C12
Relay Room	755.0 - C13 and C20

These rooms are separated from other zones within the control building by barriers which are equivalent to 1-1/2-hour fire rating. None of the above listed rooms has a fixed combustible fuel load greater than 30,000 Btu/ft^2 which equates to a fire severity of only 23 minutes. In addition, the CB is provided with standpipe and hose systems and portable extinguishers throughout the building.

As stated in SECY 83-269 dated July 5, 1983, attachment A, Section 1.2.7, the purpose of providing fire detection and fixed fire suppression in an area containing normal shutdown equipment is to limit the severity of a fire in the area such that it will not damage alternate safe shutdown capability. Based on the limited quantity of fixed combustibles in the rooms without suppression systems and on the compartmentation and fire protection features provided, the purpose stated in SECY 83-269 is satisfied. Therefore, TVA requests approval of the deviation to the requirements of Section III.G.3 to provide fire detection and fixed fire suppression systems throughout the CB.

Reducers, Couplings and Plugs

RE and REC reducers are used in threaded heavy wall conduit systems
RE reduces conduit hubs to a smaller size
REC connects two different sizes of conduit together or is used to replace a coupling and reducer in an installation
PLG plugs are used for closing threaded conduit hubs

RE reducers have:
- integral bushing which prevents damage to wires
- full, clean cut tapered threads

REC reducers have:
- integral bushing in both ends which prevents damage to wires
- funnel shaped interior to guide the wires from large to small conduit, making it easy to pull wires

PLG plugs:
- have clean tapered threads
- are available in two styles, flush (recessed), or square head type

- RE reducers—RE1108 through RE54 in steel; all others in *Feraloy*
- REC reducers—REC21 and REC32 in steel; all others in *Feraloy*
- PLG plugs—*Feraloy*

- *Feraloy*—zinc electroplate and aluminum cellulose lacquer
- Steel—zinc electroplate with chromate treatment▲

- Copper-free aluminum—add suffix SA to Cat. No.▲

- NEC: Class I, Groups A, B, C, D
  Class II, Groups E, F, G
  Class III
(see listings for specific Cat. Nos. suitable for Groups A or B)

RE

Size	Cat. #
1/2-1/8	RE1108
1/2-1/4	RE1208
1/2-3/8	RE1308
3/4-1/2	RE21†
1-1/2	RE31†
1-3/4	RE32†
1 1/4-1/2	RE41†
1 1/4-3/4	RE42†
1 1/4-1	RE43†
1 1/2-1/2	RE51†
1 1/2-3/4	RE52†
1 1/2-1	RE53†
1 1/2-1 1/4	RE54†
2-1/2	RE61†
2-3/4	RE62†
2-1	RE63†
2-1 1/4	RE64†
2-1 1/2	RE65†
2 1/2-1	RE73
2 1/2-1 1/4	RE74
2 1/2-1 1/2	RE75
2 1/2-2	RE76
3-1	RE83
3-1 1/4	RE84
3-1 1/2	RE85
3-2	RE86
3-2 1/2	RE87
3 1/2-2	RE96
3 1/2-2 1/2	RE97
3 1/2-3	RE98
4-2	RE106
4-2 1/2	RE107
4-3	RE108
4-3 1/2	RE109
5-4	RE01210
6-5	RE01412

REC

Large Hub Size	Small Hub Size	Cat. #
3/4	1/2	REC21†
1	1/2	REC31†
1	3/4	REC32†
1 1/4	3/4	REC42†
1 1/4	1	REC43†
1 1/2	3/4	REC52†
1 1/2	1	REC53†
1 1/2	1 1/4	REC54†
2	3/4	REC602†
2	1	REC603†
2	1 1/4	REC604
2	1 1/2	REC605
2 1/2	1 1/2	REC75
3	2	REC86
3 1/2	2 1/2	REC97
4	3	REC108
5	4	REC01210

PLG

Size	Cat. #
1/2	PLG1†
3/4	PLG2†
1	PLG3†
1 1/4	PLG4‡
1 1/2	PLG5‡
2	PLG6‡
2 1/2	PLG7
3	PLG8
3 1/2	PLG9
4	PLG10

Square Head	
1/2	PLG15†
3/4	PLG25†
1	PLG35†
1 1/4	PLG45‡
1 1/2	PLG55‡
2	PLG65‡
2 1/2	PLG75
3	PLG85
3 1/2	PLG95
4	PLG105

FIGURE 1-1

▲Denotes revision
†Suitable for use in Class I, Groups A and B areas
‡Suitable for use in Class I, Group B areas

Attachment 2

1/17

UNDERWRITERS LABORATORIES INC.

an independent, not-for-profit organization testing for public safety

November 29, 1984

Mr. John B. Lyons
Chief of Technical and
Adminstrative Staff
Tennessee Valley Authority
W12D126
400 Summit Hill Dr.
Knoxville, TN 37902

Our Ref: Project 84NK26564, File NC777-1

Dear Mr. Lyons:

UL established Project 84NK26564 to conduct the investigation described in UL's letter dated October 12, 1984 to review the installation of doors and frames installed in Watts Bar Nuclear Power Station.

The investigation was conducted as outlined in the Application forwarded with UL's October 23, 1984 letter. The anticipated field inspections were conducted by the undersigned (Daniel J. Kaiser) and William R. Carney on November 1 and 2, 1984. The inspection was to review the "as installed" conditions of the specified openings.

The following summary represents the judgment of Underwriters Laboratories Inc., based upon the results of the examination as it relates to established principles and previously recorded data.

The general Observations are a summary of all observations made. The UL Comments apply to those observations and the proposed construction revisions made by and discussed with Tennessee Valley Authority representatives.

G E N E R A L O B S E R V A T I O N S

1. Signs - All of the doors were provided with one or several signs. The signs were of both large and small sizes and made of steel, aluminum or plastic, and were fastened to the door face with pop-rivets or steel sheet-metal screws.

UL COMMENTS

Plant-ons (signs) of a large size or those that consist of a combustible material may adversely affect the performance of the door under fire conditions. See Pars. 1-3.4, 2-8.3 and App. G of the National Fire Protection Association (NFPA) Standard No. 80-1983. Note that the NFPA Recommendations are not intended to prohibit the use of small signs indicating function, use or location of doors.

Additionally, the application of the unlabeled combustible materials could adversely affect the ability of the door assemblies to perform as an effective fire barrier. If a fire should occur on the side opposite the combustible material, the heat transmitted through the door could cause the combustible material to ignite and allow flames on the unexposed surface.

During discussions, it was agreed that if one small metallic sign could not provide all the information provided, stencilling the additional information on the door would not affect the performance of a UL Classified door under fire exposure.

2. Gasketing - Some of the door assemblies were provided with unlabeled, field installed, gasketing materials.

UL COMMENTS

The application of the unlabeled gasketing materials could adversely affect the ability of the door assemblies to perform as an effective fire barrier. If a fire should occur on the side opposite the gasketing material, the heat transmitted through the door could cause the gasketing material to ignite and allow flames on the unexposed surface.

UL Classifies gasketing material for use on fire doors. See Page 258 of UL's 1984 Building Materials Directory (BMD). The UL Labeled gasketing may be installed in the field in accordance with the installation instructions provided with the materials, provided it does not interfere with the operation of the door.

3. Small Security Plates - Several of the door assemblies had small, narrow steel security plates through-bolted to the door at the latch area.

UL COMMENTS

The through-bolting of a small, narrow steel security plate at the latch area is judged not to adversely affect the performance of the door under fire conditions. However, in the case of bullet-resisting doors, the bullet resistance may be affected.

4. Conduit Penetrations - Several of the frames were provided with electrical conduit penetrations.

UL COMMENTS

The installation of conduit to one side of a door frame with the proper fitting and conduit penetration protection, as shown by ILL. 2, is judged not to adversely affect the performance of the frame assembly under fire conditions.

As an alternate to protecting the complete throat of the frame adjacent to the penetration continuously welding the fitting to the frame and then protecting the inside of the conduit is judged not to adversely affect the performance of the frame assembly under fire conditions.

5. Door Position Indicators - For security purposes, door and frame assemblies had surface mounted door position indicator (magnetic switches) installed at the top of the assembly.

Other frames had frame switches located on the hinge rabbet of the frames and frame push buttons installed on the face of the frames.

UL COMMENTS

The installation of the surface mounted door position indicators is judged not to adversely affect the performance of the door and frame assembly.

The installation of the frame switches and frame buttons is judged not to adversely affect the performance of the door and frame assembly.

It should be noted that since some of these devices did not bear any type of UL label, we are unable to judge them from an electrical hazard or security aspect.

6. Holes In Doors and Frames - Doors and frames had small screw hole openings which remained after hardware or plant-ons were removed. In addition, several doors and frames had larger hole openings which remained after hardware was replaced.

UL COMMENTS

These openings could adversely affect the performance of the door assemblies under fire conditions.

As proposed, the filling of small screw holes with steel rivets or steel sheet metal screws is judged not to affect the performance of the assembly under fire exposure.

Also as proposed, the continuous welding of a No. 16 gauge steel plate covering the hole, overlapping the hole by a minimum of 3/4 in. is judged not to affect the performance of the assembly under fire exposure.

It is judged that the proper filling or covering of the holes would eliminate the possible adverse affect on the performance of the assemblies.

7. In-Operable Hardware - Some openings had components in bad repair or had in-operable doors, latches and/or door closers or hardware parts missing or pins or mounting screws missing.

UL COMMENTS

Fire doors should be in good repair and operable at all times. Their use is valueless unless properly maintained and closed or able to close at the time of fire.

In-operable hardware could prevent the door from closing and latching and thereby adversely affect the ability of the assembly to perform as an effective fire barrier.

It is our understanding that power station proposes to repair or replace all in-operable hardware. See NFPA 80, Chapter 14 on Care and Maintenance of openings.

8. Electric Strikes - In addition to the normal self-latching hardware, several pairs of doors and single swing doors were installed with a UL Listed electric strike mounted in the head of the frame or in the transom panels with latches mounted in the top channel of the doors.

UL COMMENTS

Electric strikes are intended to replace the strike plate used in fire door frames. Many of the electric strikes used in your assemblies were used as a secondary latching operation. Therefore, provided that the electric strike is installed per the manufacturer's installation instructions, the single swing door assemblies with the electric strike installed in the head of the frame are judged not to affect the performance of the assembly under fire exposure.

For those assemblies with electric strikes located in the transom panel, the installation of the electric strike and associated wiring and fittings could adversely affect the performance of the door assemblies under fife conditions.

It is our understanding that the power station proposes to replace those doors with an overall assembly evaluated for this particular construction.

9. Unlabeled Hardware - Some openings were equipped with unlabeled hardware components or those not intended to be used in the particular assembly being reviewed.

(Note: Mostly unlabeled top and bottom flush bolts on inactive doors of pairs were observed.

UL COMMENTS

The protection of an opening depends not only upon the use of Labeled doors of the proper type, but also upon the use of Labeled frames and other Labeled hardware accessories intended for use in the particular fire door assemblies.

NFPA 80, Pars. 1-6.1, 2-5.1 and 2-8.2.1, requires that only Labeled doors, door frames and hardware be used in fire rated openings.

It is our understanding that the power station proposes to replace all unlabeled/noncompatible components with Labeled devices.

See the UL Building Materials Directory for the appropriate UL Markings to be provided on the various devices.

10. Excessive Gaps Between Door and Frame - The clearances in many door and frame assemblies exceed the maximum clearance specified in NFPA 80, Par. 2-5.4.

UL COMMENTS

Excessive clearances could adversely affect the assembly's ability to perform satisfactorily under fire conditions.

It is our understanding that the power station purposes to review all assemblies with excessive clearances and adjust the assemblies to the maximum gaps specified in NFPA 80.

12. With regard to the installation of the existing opening fire door frames, NFPA 80, PAR. 2-3 requires that "Frames shall be securely anchored to the wall construction." The installation of the frames with approximately a 1/4 in. gap around the perimeter of the frame between the frame and the masonry wall may not meet this intent. Two adverse conditions may develop under fire situations.

1. Since the frame is not tight against the wall, it may not be prevented from rotating around its vertical axis when subjected to fire. The "caulk" not being a permanent, incompressible material cannot be considered capable of holding the frame in position. If the frame does twist, the strike may twist away from the latch bolt, allowing the latch to become disengaged and the door to swing open.

2. The amount of "caulk" sealing the opening from one side of the frame to the other may not act as an effective fire barrier. The materials, generally known as "caulk", normally do not resist the action of high temperature. Even seal materials which are intended for use a high temperatures may not have sufficient structural integrity to prevent the passage of fire when the fire undergoes great temperature changes.

Normally frames for existing openings are drawn tight at both the head and both jambs. A high temperature seal material is then applied around the perimeter of the frame where it meets the wall to seal off very small openings which may be present due to slight irregularities in the wall construction.

It is judged that the alternate installation shown on the attached ILL. 1 would be acceptable provided:

1. The frames have steel shims between the anchor reinforcement and the wall.

2. The head of the frames are constructed as shown for the jambs.

13. Unlabeled Louvers - Some door were provided with unlabeled louvers.

UL COMMENTS

There are some manufacturers who are eligible to install louvers at their manufacturing locations. When manufacturers install the louver in accordance with their Follow-Up Service Procedure, the louver does not necessarily bear a label.

We were unable to note whether you received the doors with the louvers or the louvers were added at another point in time.

It is our understanding that the power stations proposes to review their records and determine if the Labeled doors were received with the louvers installed. If they were not provided with the doors, it is our understanding that the power station proposes to replace the unlabeled louvers with Labeled louvers.

14. Reserved.

15. Hollow-Metal Frames - Some pressed steel frames were provided without labels.

UL COMMENTS

Par. 2-5.1 of NFPA 80-1083 states that "Only Labeled frames shall be used."

It is our understanding that the power station proposes to replace all unlabeled components with Labeled devices. However, if it can be determined that some of the door assemblies manufactured by the various manufacturers are constructed as described in their UL Follow-Up Procedure, it may be possible to apply labels to those assemblies under a separate project to visit the station at the same time as the manufacturer's representative. Please note that we will require the written authorization of the door manufacturer before we are in a position to try to make this determination.

See the UL Building Materials Directory for the appropriate UL Markings to be provided on the various components.

16. Unlabeled Doors - Some doors did not bear labels.

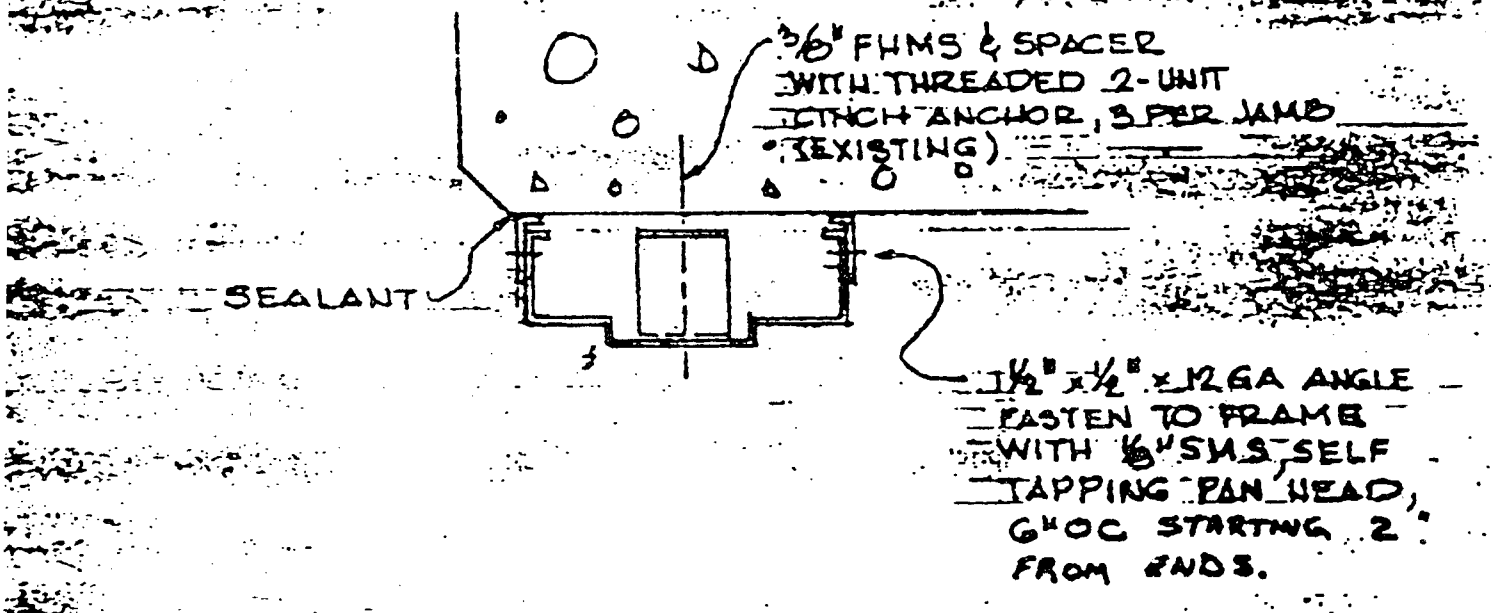
UL COMMENTS

Par. 16.1 of NFPA 80-1983 states that "Only Labeled or Listed doors shall be used."

It is our understanding that the power station proposes to replace all unlabeled components with Labeled devices. However, if it can be determined that some of the door assemblies manufactured by the various manufacturers are constructed as described in their UL Follow-Up Procedure, it may be possible to apply labels to those assemblies under a separate project to visit the station at the same time as the manufacturer's representative. Please note that we will require the written authorization of the door manufacturer before we are in a position to try to make this determination.

See the UL Building Materials Directory for the appropriate UL Markings to be provided on the various components.

9/17



REPAIR DETAIL FOR EXISTING LABEL FRAMES TO STABILIZE FRAME TO WALL

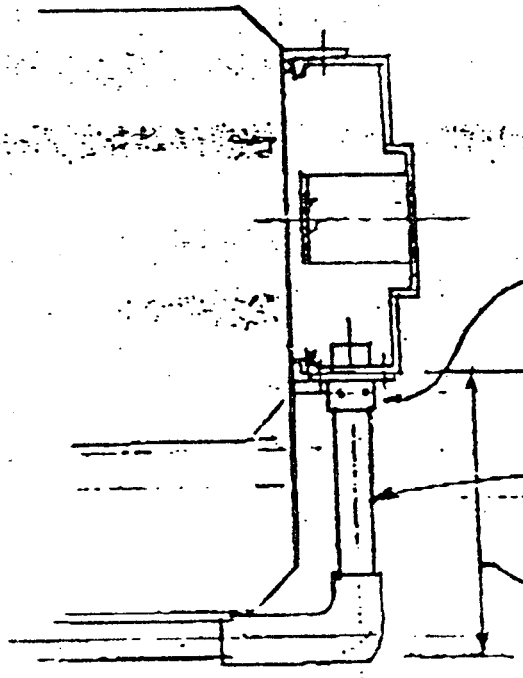
FILE
NC777-1
ILL 1

WATTS BAR NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY

SKACH-G1

W/17

FILE
NK77-1
ILL 2

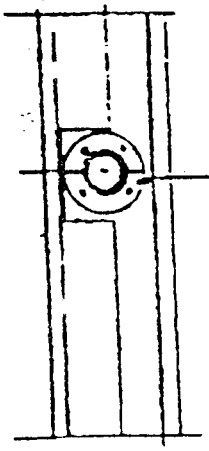


WHERE CONDUIT IS NOT SECURED TO FRAME MOUNT A SPLIT SLEEVE WITH SM. SCREW INTO FRAME AND CONDUIT FASTENING CONDUIT SECURELY TO FRAME

EXISTING COND.

WHERE CONDULET EXIST - REMOVE BLANK COVER AND FILL CONDUIT WITH RTV 600 SEALANT BY GENERAL ELECTRIC. IN OTHER AREAS REMOVE CONDUIT JOINT AND INSTALL RTV SEALANT

PLAN



SLEEVE AROUND CONDUIT PENETRATIONS WHICH ARE NOT WELDED OR MECHANICALLY FASTENED

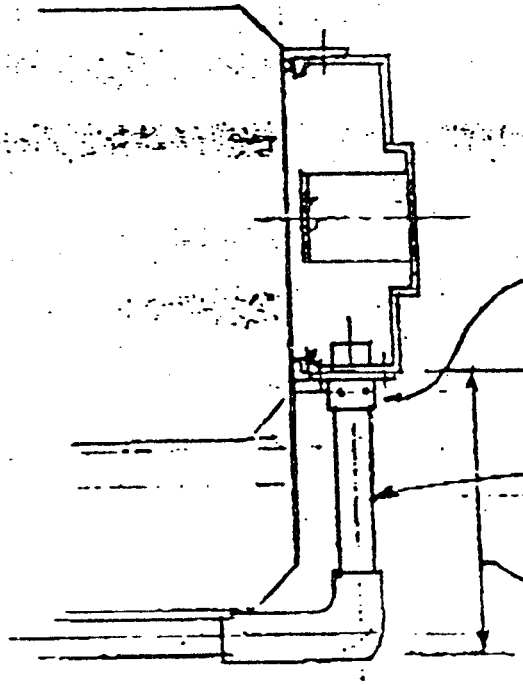
ELEVATION

WATTS BAR NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY

SK ACH-G2

10/17

FILE
NK777-1
ILL 2

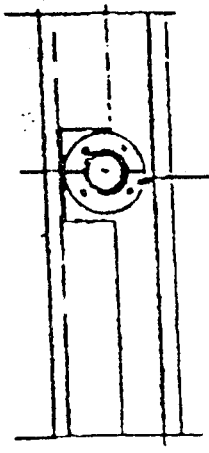


WHERE CONDUIT IS NOT SECURED TO FRAME MOUNT A SPLIT SLEEVE WITH SM. SCREW INTO FRAME AND CONDUIT FASTENING CONDUIT SECURELY TO FRAME

EXISTING COND.

WHERE CONDULET EXIST - REMOVE BLANK COVER AND FILL CONDUIT WITH RTV 600 SEALANT BY GENERAL ELECTRIC. IN OTHER AREAS REMOVE CONDUIT JOINT AND INSTALL RTV SEALANT

PLAN



SLEEVE AROUND CONDUIT PENETRATIONS WHICH ARE NOT WELDED OR MECHANICALLY FASTENED

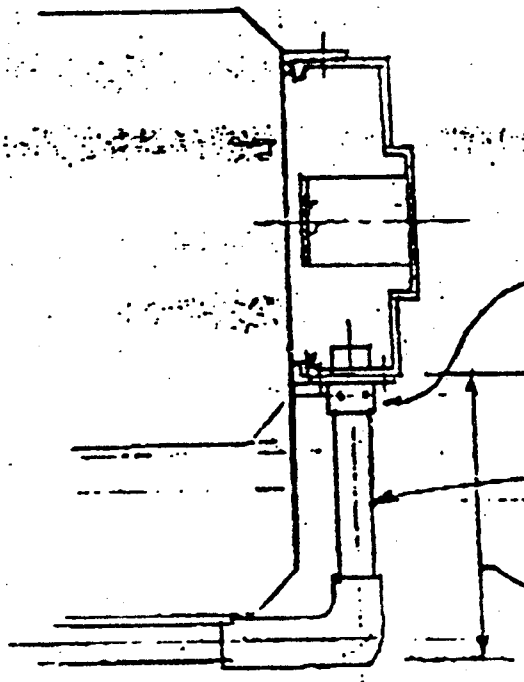
ELEVATION

WATTS BAR NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY

SK ACH-G2

-10/17

FILE
NK777-1
ILL 2

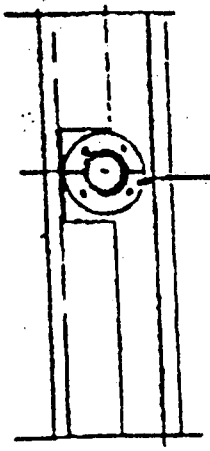


WHERE CONDUIT IS NOT SECURED TO FRAME MOUNT A SPLIT SLEEVE WITH SM. SCREW INTO FRAME AND CONDUIT FASTENING CONDUIT SECURELY TO FRAME

EXISTING COND.

WHERE CONDULET EXIST - REMOVE BLANK COVER AND FILL CONDUIT WITH RTV 600 SEALANT BY GENERAL ELECTRIC. IN OTHER AREAS REMOVE CONDUIT JOINT AND INSTALL RTV SEALANT

PLAN



SLEEVE AROUND CONDUIT PENETRATIONS WHICH ARE NOT WELDED OR MECHANICALLY FASTENED

ELEVATION

WATTS BAR NUCLEAR PLANT
TENNESSEE VALLEY AUTHORITY

SK ACH-G2

SPECIFIC OBSERVATIONS

General

Except as otherwise noted: 1) UL labels were in evidence on all fire doors, fire door frames and hardware accessories, 2) general observations of conduit penetration refer to the frame, 3) gaps may be adjustable by balancing the door(s).

NOTE - Many of the door and frame labels were painted over and were illegible. This report assumes that all the information on the labels was consistent with the information on other doors/frames. It is further assumed that the utility will verify the actual information on the labels.

Door No.	Applicable General Observation	Additional Remarks
A2	1, 2	-
A3	1, 2, 5, 7, 16	7. Door does not close.
A4	1, 2, 5	7. Door does not close.
A5	1, 2, 5, 16	-
A6	1, 2, 5, 16	-
A8	1, 5, 7, 16	7. Door does not close.
A9	1, 5	-
A10	1, 5, 7	7. Door does not close.
A11	1, 5	-
A12	1, 7, 16	7. Bottom hinge not secured to frame. Hardware inoperable; latch missing.
A25	1, 16	-
A26	1, 2, 9, 15, 16	9. Top and bottom flush bolts on inactive door were unlabeled.

Door No.	Applicable General Observation	Additional Remarks
A28		-
A29	2, 5, 7, 10	Excessive gaps at jamb prevented closer from closing door.
A30	2, 4, 5, 9, 10	-
A31	1, 2, 5, 16	-
A32	1, 2, 5	-
A60	1, 4, 5, 6, 7, 10	Electric strike mounted in head of frame and top of door.
A61	-	Door not mounted in the opening.
A62	1, 2, 9, 15, 16	No labels on doors, frame, hardware or gasketing.
A63	1, 6, 10, 13	Unlabeled louver.
A68	1, 2, 5, 10	-
A81	1, 10, 13	Unlabeled louver.
A110	1, 2, 5, 6, 9, 10, 15, 16	Electric strike surface mounted and unlabeled thumb turn lockset.
A111	1, 2, 5, 6, 9, 16	Electric strike surface mounted and unlabeled thumb turn lockset.
A118	2, 3, 4, 9, 15, 16	Unlabeled door, frame and hardware. Door secured to frame with piano hinge.
A121	1, 10	Plywood covering louver opening. Door inaccessible due to radiation caution.

Door No.	Applicable General Observation	Additional Remarks
A125	2, 4, 16	Electric strike mounted in head of frame and lock installed in door head.
A126	2, 6, 10	-
A127	1, 2, 7, 10, 13	Unlabeled louver. Door closer does not close door.
A128	1, 2, 6	Cutout in door for a louver but louver is not installed. Frame has cut-out for frame switch but switch is not installed.
A129	1, 6, 9, 10, 15	Unlabeled top and bottom flush bolts.
A131	1, 6, 9, 10, 15	Unlabeled top and bottom flush bolts.
A132	1, 2, 4, 5, 6, 8	-
A136	1, 2, 7, 9, 15	Lockset inoperable.
A137	1, 2, 9, 10	Unlabeled top and bottom flush bolts. Door closer does not close door.
A138	1, 9, 10	Door closer does not close door. Frame label is painted over.
A139	1	Frame label is painted over.
A140	4, 5	-
A141	1, 3, 4, 5, 9	Unlabeled top and bottom flush bolts.
A142	1, 3, 4, 5, 9	Unlabeled top and bottom flush bolts.

Door No.	Applicable General Observation	Additional Remarks
A151	1, 2, 8, 9, 15, 16	Electric strike located in transom panel.
A160	1, 2, 9, 15, 16	Astragal not provided.
A162	1, 2	-
A169	1, 3, 4, 9	Unlabeled top and bottom flush bolts.
A170	1, 3, 4, 9	Unlabeled top and bottom flush bolts.
A171	1	-
A172	4, 5, 10	Transom panel needs repair.
A174	1, 9, 10	-
A175	1, 9, 10	-
A180	1, 2, 9, 15	Unlabeled top and bottom flush bolts.
A181	1, 4, 5, 16	-
A182	1, 4	-
A183	2, 4, 8, 16	-
A185	1, 4, 5	-
A187	2, 9	-
A189	2, 9	Astragal not continuous.
A192	1, 4, 5, 8	Electric strike in head of frame.
A194	1, 4, 5	-
A203	1, 3, 5, 10	-
A206	1, 2, 6	-

Door No.	Applicable General Observation	Additional Remarks
A207	4, 5, 15, 16	Top channel of door removed for magnetic switch. Should replace door.
C1	1, 5	-
C3	9, 16	Top and bottom flush bolts were unlabeled.
C7	1	-
C8	1	-
C10	1, 2, 10, 15, 16	Excessive gaps between top of door and frame.
C10	1, 3, 5, 9	Unlabeled top and bottom flush bolts.
C11	1, 2, 15, 16	-
C12	5, 15	Wall above top of frame is in need of repair.
C13	5, 7, 15, 16	Door mounted with piano hinges. Lock should be replaced.
C21	1, 5	-
C22	3, 4, 5, 9, 16	Inactive door unlabeled.
C23	1, 3, 5, 9	Unlabeled top and bottom flush bolts.
C24	3, 4, 5, 9, 16	Inactive door unlabeled.
C25	1, 4, 5	-
C30	1, 4, 5	-
C33	1, 4, 5	-

Door No.	Applicable General Observation	Additional Remarks
C49	1, 2, 4, 10, 15, 16	Door mounted with piano hinges.
C50	1, 2, 4, 10, 15, 16	Door mounted with piano hinge.
C52	3, 5 9	Unlabeled top and bottom flush bolts.
C53	1, 2	-
C60	2, 5, 15	-
C63	2	Two strike plates provided in the frame.
D7A	7	Sliding door hardware was not connected.
D12	1, 2, 15, 16	-
D13	2, 10, 15	Hinge edge of door is in need of repair.
D22	2, 15, 16	-
D24	1, 2, 15, 16	-
D27	1, 2, 15, 16	-
D30	1, 2, 15, 16	-
AE2	1, 2, 3, 4, 5, 10	-
DE4	1, 6, 10	-

In no event shall UL be responsible to anyone for whatever use or nonuse is made of the information contained in this report and in no event shall UL, its employees, or its agents incur any obligations or liability for damage, including, but not limited to consequential damages arising out of or in connection with the use, or inability to use, the information contained in this report.

The issuance of this report in no way implies Listing, Classification, or other recommendations by UL and does not authorize the use of UL Listing or Classification Marks or other reference to UL on or in connections with the product or system.

With this Report, we conclude our work on Project 84NK24322.

Very truly yours,

Daniel J. Kaiser

DANIEL J. KAISER
Senior Project Engineer
Fire Protection Department

Reviewed by:

H. J. Grusszynski/HJG

H. J. GRUSZYNSKI
Senior Project Engineer
Fire Protection Department

DJK/HJG:jrr
LTR2

UNDERWRITERS LABORATORIES INC.
333 PFINGSTEN ROAD · NORTHBROOK, ILLINOIS 60062
an independent, not-for-profit organization testing for public safety

October 2, 1984

3M Company
Mr. Richard R. Licht
Supervisor, Product Development
207-1S 3M Center
St. Paul, MN 55144

Our Reference: Project 82NK21937, File R10125

Subject: Review Of Temperature Data From Fire Test Investigations Of Fire Barriers For Electrical Cables In Steel Cable Trays, Rigid Steel Conduit, Steel Junction Boxes And Air Drops

Dear Mr. Licht:

This is in response to your letter of September 14, 1984, concerning the above subject.

Per your letter, you met with officials from the United States Nuclear Regulatory Commission (NRC) on September 13, 1984 to discuss the criteria for NRC approval of fire barriers for electrical cables in redundant safety trains as outlined in "Fire Protection Program For Operating Nuclear Power Plants" (Appendix R to 10 CFR 50). Based upon your discussions with the NRC officials, it is your understanding that the criterion for NRC approval of a fire barrier for redundant safety trains is a maximum temperature rise of 250°F above the initial starting temperature at the hourly rating period time. It is also your understanding that the maximum temperature rise within the fire barrier is to be determined from measurements obtained from thermocouples positioned on the jacket of an electrical cable located in the center of the cable fill. The thermocouples are to be located on 12 in. centers along the cable with the thermocouple junction at the 12 o'clock position (cable bearing surface at 6 o'clock position).

In your letter, you requested that we review the temperature data from the fire test investigations of fire barrier systems which 3M Company conducted at Underwriters Laboratories Inc. (UL) to determine the time at which the maximum temperature rise of 250°F above the initial starting temperature occurred. Specifically, per our telephone conversation on September 19, 1984, you

FOR INFORMATION ONLY

requested that we review the temperature data from five separate fire barrier systems and that, during our review, we consider only the temperature measurements obtained from thermocouples placed on the jacket of the largest cable type included in each fire barrier system. The five fire barrier systems are summarized in the following table:

System No.	Description
"A"	Open-ladder steel cable tray wrapped with a single layer of Type M20-A intumescent mat and surrounded by an enclosure consisting of Type CS-195 composite sheet secured to steel channel framing (March 3, 1983 fire test described in UL Report R10125-1, -2 dated October 19, 1983).
"B"	Open-ladder steel cable tray wrapped with four layers of Type M20-A intumescent mat (July 14, 1983 fire test described in UL Letter Report R10125 dated November 2, 1983).
"C"	Rigid steel conduit wrapped with three layers of Type M20-A intumescent mat (December 21, 1982 fire test described in UL Report R10125-1, -2 dated October 19, 1983).
"D"	Cable air drop wrapped with five layers of Type M20-A intumescent mat (December 21, 1982 fire test described in UL Report R10125-1, -2 dated October 19, 1983).
"E"	Steel Junction box wrapped with two layers of Type M20-A intumescent mat and surrounded by an enclosure consisting of Type CS-195 composite sheet secured to steel channel framing (July 26, 1984 fire test described in UL Letter Report R10125 dated August 7, 1984).

During UL Classification investigations of electrical circuit protective systems (fire barriers), each system is evaluated with respect to its ability to protect a specific electrical wiring system against the occurrence of electrical faults during a standardized external fire exposure. In addition to monitoring each cable conductor within the fire barrier system for

electrical faults, numerous thermocouples are installed within the fire barrier in an attempt to quantify temperature rise at all anticipated hot spots. Because large electrical cables maintain cooler jacket temperatures than smaller, less massive electrical cables when exposed to the same air temperature rate-of-rise and because emphasis is placed on quantifying temperature rise at anticipated hot spots, fewer thermocouples are installed on the large electrical cables within the fire barrier systems. Consequently, in our review of the temperature data, the maximum temperature rise on the largest cable type in each of the five fire barrier systems was, in most instances, based on the temperature measurements obtained from thermocouples which were spaced greater than 12 in. OC.

In order to determine whether the measured temperature rise on the largest cable type in each fire barrier system was representative of that which would have been measured had the largest cable type been instrumented with thermocouples on 12 in. centers, the temperature data from thermocouples spaced 12 in. OC on the smallest cable type in each fire barrier system was also reviewed. Based upon the comparative review, it was determined that the measured temperature rise on the largest cable type in each fire barrier system reflected the maximum temperature rise on the cable at the hottest location within the fire barrier.

In System No. "A," the largest electrical cable type included in the fire barrier was a single-conductor 300 MCM power cable having an outside diameter of 0.755 in. The initial temperature of the cable at the start of the fire exposure test was 69°F. Therefore, based on a maximum temperature rise of 250°F, the limiting temperature on the cable was 319°F. The limiting temperature of 319°F was reached at 59 min (Thermocouple No. 14). At 60 min, the maximum temperature recorded on the single-conductor 300 MCM cable was 332°F (Thermocouple No. 14).

In System No. "B," the cable fill within the fire barrier system was comprised of bare copper conductors. The largest bare copper conductor included in the fire barrier was a 250 MCM stranded conductor having an outside diameter of 0.575 in. The initial temperature of the conductor at the start of the fire exposure test was 83°F. Therefore, based on a maximum temperature rise of 250°F, the limiting temperature on the conductor was 333°F. The limiting temperature of 333°F was not reached on the conductor during the fire exposure test. At 60 min, the maximum temperature recorded on the 250 MCM conductor was 287°F (Thermocouple No. 106).

In System No. "C," the largest electrical cable type included in the fire barrier was a single-conductor 300 MCM power cable having an outside diameter of 0.890 in. The initial temperature of the cable at the start of the fire exposure test was 68°F. Therefore, based on a maximum temperature rise of 250°F, the limiting temperature on the cable was 318°F. The limiting temperature of 318°F was not reached on the cable during the fire exposure test. At 60 min, the maximum temperature recorded on the single-conductor 300 MCM cable was 190°F in the conduit containing a nominal 40 percent cable fill (Thermocouple No. 149) and 286°F in the conduit containing a minimal cable fill (Thermocouple No. 186).

In System No. "D," the largest electrical cable type included in the fire barrier was a single-conductor 300 MCM power cable having an outside diameter of 0.890 in. The initial temperature of the cable at the start of the fire exposure test was 73°F. Therefore, based on a maximum temperature rise of 250°F, the limiting temperature on the cable was 323°F. The limiting temperature of 323°F was not reached on the cable during the fire exposure test. At 60 min, the maximum temperature recorded on the single-conductor 300 MCM cable was 293°F (Thermocouple No. 96).

In System No. "E," the largest electrical cable type included in the fire barrier was a two-conductor No. 14 AWG power/control cable with a flattened jacket measuring approximately 0.400 in. wide by 0.240 in. thick. The initial temperature of the cable at the start of the fire exposure test was 76°F. Therefore, based on a maximum temperature rise of 250°F, the limiting temperature on the cable was 326°F. The limiting temperature of 326°F was not reached on the cable during the fire exposure test. At 60 min, the maximum temperature recorded on the two-conductor No. 14 AWG cable was 242°F (Thermocouple No. 11).

If you have any questions or comments on the above, please don't hesitate to contact the undersigned.

Very truly yours,

C. J. JOHNSON
Engineering Associate
Fire Protection Department

Reviewed by:

K. W. HOWELL
Associate Managing Engineer
Fire Protection Department

CJJ/KWH:pr
LETTER

FOR INFORMATION ONLY