Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

May 28, 1985

Mr. Harold R. Denton, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: LaSalle County Station Units 1 and 2
Acceptance Criteria for Firecode CT
Gypsum Fire Stops
NRC Docket Nos. 50-373 and 50-374

References (a): June 24, 1983, letter from D.L. Farrar to J.G. Keppler regarding Firecode CT Gypsum Cement Fire Stops.

(b): August 5, 1983, letter from C.W. Schroeder to J.G. Keppler on the same subject.

(c): November 23, 1983, letter from C.W. Schroeder to H.R. Denton regarding Fire Protection Commitments.

(d): February 10, 1984, letter from C.W. Schroeder to J.G. Keppler regarding same subject.

(e): Transco Test Report No. TR-161.

(f): December 10 and 13, 1985, letters from R.J. Smith of M&M Protection Consultants to D. Elias regarding Transco Test Reports TR-159 and TR-161.

(g): April 30, 1985, letter from R.J. Smith of M&M Protection Consultants to D. Elias regarding crack criteria.

(h): June 20, 1985 telecon between A. Bournia, R. Ferguson, S. West, of your staff, and J. Marshall, H. Massin, et al of CECo.

Dear Mr. Denton:

In reference (d) we committed to revise the Firecode CT Gypsum Fire Stop surveillance and installation procedures to incorporate the 1/32" acceptance criteria for cracks and separations. We agreed to this stringent requirement because we could not justify a larger separation criterion based on existing test reports.

A006
1/1

On November 20, 1984, Transco successfully performed a fire test on two 9" x 14.5" penetration fire seals consisting of 5" CT Gypsum Cement and 4" CT Thermafiber with a 14.5" long by 1/4" wide through crack in the cement. In one penetration the cement was on the bottom or exposed side, and in the other penetration the thermafiber was on the bottom. Both penetration seals passed the temperature criteria on the unexposed side as well as the IEEE-634 and ANI hose stream tests. However, water did leak through one of the penetrations during the ASTM E119 solid hose stream test. This test, which was witnessed by M&M, is documented in Transco Test Report No. TR-161, and this report was reviewed and approved by M&M (Refs. (f) and (g)).

Because of this test M&M recommended that we expand the separation criteria for operability to 3/32" for initial installation and 1/4" for normal surveillance. However, M&M also recommended that we repair any seals with cracks wider than 1/8" even if the seal was considered to be operable (ref. (g)). Their recommendations were applicable to all fire penetration seal configurations consisting of 5" CT Gypsum Cement and 4" CT Thermafiber except those which could be subjected to a solid hose stream (paragraphs 6 and 7 of Ref. (g)).

Since the fire penetration seals at LaSalle are similar in configuration to those described above, we propose to revise the acceptance criteria for cracks and separations in our installation and surveillance procedures for all CT Gypsum and Thermafiber fire seals except those in the refuel floor area as follows:

1. Initial and Repair Acceptance Criteria (initial installation and after repairs)

Crack Width	Corrective Action
$< 3/32"$	None required.
$\geq 3/32"$	Seal not acceptable - must be repaired.

2. Surveillance Acceptance Criteria

Crack Width	Corrective Action
$< 5/32"$	None required
$\geq 5/32"$ and $< 1/4"$	Seal is operable and must be repaired on an orderly schedule.
$\geq 1/4"$	Seal is inoperable and must be repaired.

The acceptance criteria for the fire stops in the refuel floor, the only area in the plant where solid hose stream nozzles are installed, will remain at 1/32". References (a), (b), and (c) document the fire penetration seal configurations installed at LaSalle and their basis.

All other commitments that we made in reference (c) regarding the training of plant personnel and the tracking of abnormal penetration seals will not be changed.

We request your prompt review of this issue and concurrence with our revised acceptance criteria. We have attached copies of references (a), (b), (e), (f), and (g) for your use.

Very truly yours,

H. L. Massin
Nuclear Licensing Administrator

lm

Attachments

cc: Resident Inspector - LSCS
A. Bournia - NRR
G. Diederich - LSCS
D. Elias

0175K

Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

June 24, 1983

Mr. James G. Keppler, Regional Administrator
- Region III
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

Subject: LaSalle County Station Units 1 and 2
Firecode CT Gypsum Cement Firestops
NRC Inspection Report Nos.
50-373/82-54 and 50-374/82-22
NRC Docket Nos. 50-373 and 40-374

References (a): R. L. Spessard letter to Cordell Reed dated April 28, 1983.

(b): D. L. Farrar letter to J. G. Keppler dated May 27, 1983.

(c): D. L. Farrar letter to J. G. Keppler dated June 10, 1983.

Dear Mr. Keppler:

The subject inspection report requested that we address the following issues concerning the fire endurance capability of U.S. Gypsum Firecode CT Gypsum cement firestops:

1. Cracking and separation
2. Breakthroughs
3. Cable density
4. Deviation from test configurations
5. Mixture control

Attached is our response to these items and the documentation which justifies our position. A list of the documentation that is enclosed is provided in Attachment 1.

As explained in Reference (c), our response regarding the Unit 1 wall penetrations will be submitted by August 5, 1983.

To the best of my knowledge and belief the statements contained herein and in the attachment are true and correct. In some respects these statements are not based on my personal knowledge but upon information furnished by other Commonwealth Edison and contractor employees. Such information has been reviewed in accordance with Company practice and I believe it to be reliable.

If there are any further questions in this matter, please contact this office.

Very truly yours,

D. L. Farrar
Director of Nuclear Licensing

lm

CWS 6/24/83
cc: NRC Resident Inspector - LSCS 1/O

Attachment

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ATTACHMENT

Engineering Response to Inspection Report No.'s
50-373/82-54 and 50-374/82-22

1. Cracking and Separation

The cracks and voids, which varied in width from hairline to 3/8", found in some penetration firestops of Firecode CT Gypsum Cement do not degrade the fire endurance capability of the seal. Seven of the attached reports document cracking in fire seals that were successfully tested. U.S. Gypsum (USG) fire test report no.'s 1, 3, 5, and 6 reference hairline cracks, USG report no. 7 and Transco report no. 1 reference 1/8" wide cracks, and USG report no. 2 references 1/2" wide cracks.

The LaSalle penetration firestops also have a layer of Thermafiber CT Felt in addition to the gypsum cement. Although the felt by itself can not withstand the hose stream test, it will prevent the passage of flame and hot gases. Successful tests on penetration firestops containing only Thermafiber CT Felt are documented in USG report no.'s 6, 7, and 8. In test no. 6, the felt prevented the cables above a cable pan penetration from burning (see Detail D1). USG report no. 7 also documents a successful three-hour test on a cable pan penetration in which only felt was installed around the pan. USG report no. 8 documents a successful 2½-hour test on many different types of penetrations containing only thermafiber. This test was terminated before three hours had expired because of problems with the penetrations containing galvanized pipes.

We consider a fire seal acceptable if it contains no cracks, voids, or separations greater than 3/8" wide. Cosmetic factors such as surface smoothness, ripples, craters, fine surface cracks, chips, gouges, and all other minor blemishes are also acceptable. Any crack in the CT Gypsum cement greater than 3/8" wide is to be cleaned and repaired with the gypsum cement.

2. Breakthroughs

Breakthroughs, the addition of cables to a seal, do not degrade the integrity of the firestop if the spaces around the new cables are filled with gypsum cement. USG report no. 1 and both Transco reports document successful three-hour fire tests on penetration firestops containing breakthroughs. In the USG test, four cables were removed from two openings and two cables were added to two penetrations. Transco report no. 1 documents a test on a penetration fire seal that four cables were added to. The second Transco report describes a test on a penetration fire seal with two breakthroughs. Although one of the two cables that were added ignited, no openings in the seal occurred. This cable was not qualified to IEEE 383 and did not ignite due to the passage of flame or hot gases. The copper conductors in the cable transferred enough heat to cause the cable jacket on the unexposed side to auto-ignite.

Since breakthroughs do not degrade the fire seal because the new gypsum cement bonds to the old cement, there is no limit on the number of breakthroughs in the seal as long as the cable fill density has not been exceeded. A fire seal with "n+1" cables has the same integrity as a seal with "n" original cables and to which a cable is added.

3. Cable Density

No cable tray penetration in a three-hour fire rated wall in Unit 2 or in a three-hour fire rated floor in either unit has a cable density greater than the maximum density tested. The maximum cable pan density tested is 40% for floor penetrations (USG report no. 1 and both Transco reports) and 51% for wall penetrations (USG report no.'s 5 and 7). As documented by the S&L letters, no floor penetration has a cable density greater than 40%, and the maximum density in a Unit 2 wall penetration is 49.1%.

For your information, the cable pan density is calculated by dividing the sum of the cross sectional area of the cables by the cross sectional area of the cable pan and multiplying by 100. The attached S&L letter dated June 17, 1983, explains the relationship between the cable pan density (CD) and the S&L design index (DI) for vertical cable riser penetrations. For horizontal cable pan penetrations, the formula is:

$$CD = \frac{(\pi/4) \times DI}{2} \times 100$$

As stated in reference (c), we will furnish our response regarding the Unit 1 wall penetrations by August 5, 1983.

4. Deviation from Test Configurations

The design of all the penetration firestops at LaSalle is verified by the attached test reports. The installed penetration seals are either identical or similar to at least one of the penetration configurations that were tested. Some of the tests also represent a more severe service condition on this type of seal than it can experience in the plant because thermafiber felt was not used in the test or the stress on the test specimen was greater.

a. Control Room Floor Penetrations

The fire endurance capability of the control room floor penetrations is verified by the two attached Transco test reports. Transco report no. TR-109 describes a three-hour fire test on a 32" X 109.5" penetration containing Firecode CT Gypsum cement. Although the surface area of the test specimen is 26% smaller than the 28" X 170" control room floor penetration, they have similar configurations. Both penetrations are long and narrow and have the same thickness of gypsum cement. However, the test specimen was subjected to a more severe service condition because it had cable trays, which increase the loading and heat conduction, and thermafiber felt only inside the cable trays. The control room floor penetration fire seals have no cable trays and have a layer of felt throughout the seal. The test specimen is also four inches wider, and for these types of penetrations, the maximum stress that the seal can withstand decreases as the width increases but varies very little with changes in the length. Therefore, the heat transfer rate per unit area and the stress on the test penetration is greater.

The other Transco report describes a test on a 5' X 6' penetration which is only 10% smaller than the 28" X 170" control room floor penetration. This test also represents a more severe service condition for the firestop because the test specimen had eight cable trays and no thermafiber felt. The stresses at the side of the test seal are also greater because the hose stream produces a greater bending moment, and the gypsum cement has less surface area to adhere to than in long and narrow type penetrations.

b. Floor Penetrations with 12" X 30" Cable Trays

Although none of the attached reports describe a test on a penetration firestop with a 12" X 30" cable tray, many of them describe tests on penetrations with similar or multiple cable trays. USG report no.'s 1 and 4 document a test on a 30" X 4" and 36" X 4" cable tray, respectively. The Transco reports describe tests on penetration seals with three and eight cable trays and the sum of the cross sectional area of the cable trays used in each test is greater than the 12" X 30" cable tray. This increases the heat transfer rate and loading of the seal. Thus, the test specimens were subject to a more severe service condition than the field installations can experience.

5. Mixture Control

The attached USG letters provide additional information regarding Firecode CT Gypsum Cement. The June 8, 1983, letter describes what gypsum cement is, how it is made, what happens when water is mixed with it, and how temperature affects it. The other USG letter furnishes additional information on the water-to-plaster ratio and the dry density range. As explained in these letters, the effectiveness of the gypsum cement fire seal is not a function of this ratio or density, it is dependent on the integrity of the seal after it is installed.

Therefore, based on the inspection results, we consider the seals to be operable. Please note that USG Research Center analyzed a portion of a seal that had been removed and found that its density was within the range of 25 to 30 lbs/ft^3.

Attachment 1

List of Attached Documentation

A. U.S. Gypsum Fire Test Reports

1. Concrete Floor Fire Stop Test of Nonqualified IEEE 383 Cable Penetrations Protected with Firecode CT Gypsum and Thermafiber Felt dated March 14, 1980.
2. Fire Stop Systems Without Cable in a Three-Hour Fire Rated Wall dated September 6, 1979.
3. Concrete Floor Fire Stop Test of IEEE Qualified Cable Penetrations dated August 13, 1979.
4. Poke-Thru Wall Fire Test dated May 21, 1979.
5. Firestop Systems for Electric Cable Penetrations Thru Three-Hour Fire Rated Wall dated March 20, 1979.
6. Fire Test of Concrete Floor Slab with Electrical Cable Penetration Firestops dated December 7, 1978.
7. Firecode CT Gypsum Thermafiber Access Firestopping for Walls dated July 24, 1978.
8. Thermafiber Access Firestopping for Floors dated June 19, 1978.

B. Transco Fire Test Reports

1. Report No. TR-109, Fire and Hose Stream Tests of TCO-001 Cement (USG Firecode CT Gypsum Cement), dated April 7, 1983.
2. Fire Endurance Test on Transco Penetration Seal Systems in a Concrete Floor Utilizing Firecode CT Gypsum Cement dated August 5, 1981.

C. Letters

1. June 17, 1983, letter from Mr. J.S. Esterman of S&L to Mr. T.E. Watts (SCE-1829).
2. June 14, 1983, letter from Mr. J.S. Esterman of S&L to Mr. T.E. Watts (SCE-1827).
3. June 8, 1983, letter from Mr. R.G. Lange of USG to Mr. E.L. Seckinger.
4. June 3, 1983, letter from Mr. R.L. Bartlett of USG to Mr. E.L. Seckinger.

Commonwealth Edison
One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690

August 5, 1983

Mr. James G. Keppler, Regional Administrator
- Region III
U.S. Nuclear Regulatory Commission
799 Roosevelt Road
Glen Ellyn, IL 60137

Subject: LaSalle County Station Units 1 and 2
Firecode CT Gypsum Cement Firestops -
Supplemental Information
I.E. Inspection Report Nos.
50-373/82-54 and 50-374/82-22
NRC Docket Nos. 50-373 and 50-374

References (a): D.L. Farrar letter to J.G. Keppler
dated June 24, 1983.

(b): D.L. Farrar letter to J.G. Keppler
dated July 6, 1983.

Dear Mr. Keppler:

Attached is the information that the NRC requested on the coefficient of expansion for Firecode CT Gypsum cement and cable densities in Unit 1 cable tray penetrations. This completes our response to the subject inspection reports.

Commonwealth Edison Company is prepared to discuss this and other related information with your staff. Please contact this office if further discussion is desired.

Very truly yours,

C W Schroeder 8/5/83

C. W. Schroeder
Nuclear Licensing Administrator

lm

cc: NRC Resident Inspector - LSCS

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ATTACHMENT

Supplemental Response to Inspection Report No.'s
50-373/82-54 and 50-374/82-22

1. Cracking and Separation - Thermal Expansion

When Firecode CT Gypsum cement is heated, it will expand to fill or decrease voids in the seal. Its thermal coefficient of linear expansion is between 8.35 and 8.60 x 10^{-6} in/in/^{o}F inclusive. Gypsum cement also expands about 0.12% during setting. The attached July 21, 1983, letter from U.S. Gypsum provides additional information on this subject.

3. Cable Density - Unit 1 Wall Penetrations

As documented in reference (1), the maximum cable fill density tested in a wall penetration with a cable tray is 51%, and two Unit 1 cable tray penetrations in three-hour fire rated walls, AB2135 and AB2142, have cable fill densities greater than the tested limit. Penetrations AB2135 and AB2142 have cable fill densities of 51.4% and 52.6%, respectively. The attached July 27, 1983, Sargent and Lundy letter lists all of the Unit 1 wall penetrations with cable fill densities greater than 40%.

Both penetrations are located in the wall between the cable spreading room (fire zone 4D1) and the cable area (fire zone 5A4) at elevation 749' in the auxiliary building. This wall is approximately 12" thick, and the firestop in both penetrations consist of 5" of Firecode CT Gypsum cement and a layer of Thermafiber CT felt in the cable tray and 2" of cement and 6" of felt in the area around the cable tray.

Since the cable fill densities in these two penetrations are less than 2% above the test limit, we do not believe that the fire endurance capability of the firestops is degraded. However, to provide additional assurance that the seal meets the requirements for a three-hour fire rated barrier, we propose to enlarge the firestop in each penetration by filling in the remainder of volume in the opening with gypsum cement and felt. Thus, each penetration will contain the equivalent of two three-hour fire rated seals. This work will be completed within three months after NRC concurrence.

To prevent any other penetrations from exceeding the cable fill density limit, we will revise existing engineering procedures by December 31, 1983, to ensure that this item is reviewed in the design of modifications. The station will review its procedures and revise them as necessary to ensure that any design changes involving Safe Shutdown Analysis - required fire seals be submitted to engineering for review and approval. To assist the station, engineering is in the process of issuing electrical drawings that list all electrical firestops in fire rated walls or floors.

UNITED STATES GYPSUM COMPANY
101 S Wacker Drive
Chicago, Illinois 60606
312/321-4000

July 21, 1983

Mr. E. L. Seckinger
Commonwealth Edison - SNED
P.O. Box 767
Chicago, IL 60690

SUBJECT: LaSalle County Station
USG Fire Stop Systems
NRC Allegation Regarding Thermal Expansion

Dear Mr. Seckinger:

In reply to the NRC requesting additional information that FIRECODE CT Gypsum Cement expanded during a fire, we offer the following for their consideration.

On page 100, Table VIII, of the Manual of Lathing and Plastering, John R. Diehl AIA Author, Copyright 1960, MAC Publishers Association, refers to typical properties of gypsum as reported by the Gypsum Association in which the Thermal Coefficient of Linear Expansion is one of the properties listed (copy attached). The Thermal Coefficient of Linear Expansion (in/in/^{o}Fx10^{-6}) of gypsum aggregated with vermiculite aggregate ranges from 8.35 to 8.60 x 10^{-6}. FIRECODE CT Gypsum Cement is aggregated with vermiculite and falls within this range.

In addition to thermal expansion, gypsum expands during setting. FIRECODE CT Gypsum Cement has a setting expansion of 0.12% and unlike portlant cement mixes which shrink, always has a net expansion.

If you require further information, please contact me.

Very truly yours,

UNITED STATES GYPSUM COMPANY

R. L. Bartlett

R. L. Bartlett
Technical Representative

RLB/dlh
attachment

cc: #151 R. G. Lange
#173 P. G. Smith
#440-3 E. L. Whiteside
Mr. Tom Hoff
TRANSCO, Inc.
55 E. Jackson Blvd.
Chicago, IL 60604

Table VIII.

Properties of Gypsum Job-Mixed Basecoat Plasters

Property	Sand		Perlite		Vermiculite		Wood Fibered to Sand	
	1 : 2	1 : 3	1 : 2	1 : 3	1 : 2	1 : 3	1 : 0	1 : 1
Compressive Strength Pounds per sq. in.	775-1050	525-700	600-800	450-600	400-525	250-325	1750-2350	
Tensile Strength Pounds per sq. in.	150-200	100-150	165-170	90-150	130-160	70-100	280-400	240-250
Modulus of Elasticity Pounds per sq. in. x 10^6	1.0	1.15-1.20	0.21-0.33			0.028	0.65-0.75	
Density In-Place Pounds per cu. ft.	104-120	104-120	50-56	41-45	50-55	42-45	79-82	
Coefficient of Linear Expansion inches/inch/degree F x 10^{-6}	6.50	6.75	7.35	7.30	8.35	8.60	9.30	
Thermal Conductivity BTU/sq. ft./hour/°F/ inch thickness	5.51	5.60	1.64	1.31	1.74	1.42	3.15	

Source: Gypsum Association.

a relatively high percentage of cementitious material) are generally subject to greater initial shrinkage upon drying than are *lean* mixes. It is generally recommended that mixes tending toward the lean side be used for exterior plaster, due to the materials used and the presence of environmental conditions producing movement. Along with this are the more severe consequences of possible cracking resulting from movement than would be the case in interior applications.

Summary tabulations of some of the properties of gypsum plasters are in Tables VIII and IX.

MIXING THE MATERIALS

Mixing consists primarily of two operations: first, measuring the components according to the required proportions and adding them to the mixing box or machine; second, combining the components into a homogeneous mixture while adding

Table IX.

Calculated Tensile Strains at Failure for Various Gypsum Plasters[6]

Plaster Proportions	Tensile Strength Lbs./sq. in.	Modulus of Elasticity Lbs./sq. in.	Computed Tensile Strain at Failure Microinches/ in./in.
Wood-Fibered Gypsum Plaster	290	753,000	386
1 : 4 Vermiculite Brown Coat	80	175,000	457
Lime-Gauging Finish Coat	70	111,000	631
1 : 2 Sand Scratch Coat	310	985,000	315
1 : 3 Sand Brown Coat	210	730,000	280

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SCE-1853
July 27, 1983
Project No. 4267-02

Commonwealth Edison Company
La Salle County Station - Unit 1

Cable Tray Fill Density for Horizontal
Cable Tray Wall Penetration Fire Seals
Part of Sargent & Lundy Punchlist Item 3.96

Mr. T. E. Watts
Commonwealth Edison Company
P. O. Box 767
Chicago, Illinois 60690

Dear Mr. Watts:

After completing our work identifying all electrical openings in Unit 1 that require fire seals, we have prepared a list of the horizontal cable tray wall penetrations that exceed 40 percent of cable tray volume. This information was requested in your letter of May 12, 1983, to Mr. R. H. Pollock.

Electrical Opening No.	Routing Drawing Number	Nearest Routing Point	Design Index	Cable Fill Density	Required By Safe Shutdown Analysis
AB2076	1E-1-3665	386B	1.25	49.1%	Yes
AB2081	1E-1-3665	445D	1.18	46.3%	Yes
AB2101	1E-1-3665	373B	1.20	47.1%	Yes
AB2135	1E-1-3667	592E	1.31	51.4%	Yes
AB2142	1E-1-3667	577B	1.34	52.6%	Yes
AB2146	1E-1-3667	564B	1.15	45.2%	Yes
RB2053	1E-1-3653	1395B	1.06	41.6%	No
RB2054	1E-1-3653	1395B	1.06	41.6%	No
AB2207	1E-1-3669	653B (Unit 2)	1.15	45.2%	Yes
AB2210	1E-1-3669	652B (Unit 2)	1.15	45.2	No
AB2023	1E-1-3663	286A	1.14	44.8%	Yes
AB2059	1E-1-3664	430A	1.24	48.7%	Yes
AB2065	1E-1-3664	426A	1.02	40.1%	Yes
TB2086	1E-1-3680	2113A	1.18	46.3%	No
TB2145	1E-1-3683	2370A	1.39	54.6%	No

The 3-hour fire walls were found using figure 9.5-1 of La Salle County FSAR Chapter 9. These 3-hour fire walls were compared with figure H.2-1 of Appendix H to verify that the 3-hour walls with electrical openings were required by the safe shutdown analysis. Cable fill density is calculated by using the following formula and is equivalent to the method specified in your letter:

$$\text{(Cable Fill Density) \% Tray Fill} = \frac{\frac{\pi}{4} \times \text{Design Index}}{2} \times 100$$

If you have any questions concerning this, please give me a call.

Yours very truly,

J. S. ESTERMAN

J. S. Esterman
Electrical Engineer

JSE:smg
In duplicate
Copies:
B. R. Shelton
R. H. Holyoak
G. J. Diederich
E. L. Seckinger
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