



Commonwealth Edison

One First National Plaza, Chicago, Illinois
Address Reply to: Post Office Box 767
Chicago, Illinois 60690 - 0767

July 15, 1988

Mr. Thomas E. Murley, Director
Office of Nuclear Reactor Regulation
U.S. Nuclear Regulatory Commission
Washington, DC 20555

Subject: Quad Cities Station Units 1 and 2
"Response to NRC Request for Information
Pertaining to the Premature Solidification
of Radioactive Decontamination Solution
Waste at Quad Cities Station"
NRC Docket Nos. 50-254 and 50-265

Reference (a): Meeting Minutes Generated by T. Ross (NRC)
from May 24, 1988 Meeting with Commonwealth
Edison, Chem Nuclear and NRC Personnel
Regarding above Referenced Topic

Dear Mr. Murley:

The purpose of this letter is to provide additional information to members of your staff regarding the premature solidification of a decontamination solution radioactive waste liner which occurred at Quad Cities Station on April 20, 1988. The details of this event are documented in Quad Cities Licensee Event Report (LER) 88-014, Rev. 00, dated June 22, 1988. Additionally, there have been numerous telephone conference calls between representatives of Commonwealth Edison (I.M. Johnson, D.L. Farrar, S. Davis, G. Spedl, et.al.) and members of your staff, in particular, Mr. T. Ross, (NRR Quad Cities Licensing Project Manager) and Mr. J. Lee (NRR, Plant Systems Branch). These discussions culminated in a May 24, 1988 meeting between NRC, CECO and Chem Nuclear personnel. Reference (a) documents the scope of the discussion, as well as those items for which additional information was being requested. Commonwealth Edison initially agreed to respond to these items within forty-five days of the meeting. This commitment date was extended to July 15, 1988 in subsequent discussions between I.M. Johnson and T. Ross.

Attached, please find Commonwealth Edison's response. The response consists of several sections which are described as follows:

8807290103 880715
PDR ADOCK 05000254
P FDC

Handwritten:
Aool
1/1
Add: NRR/DEP/RPS
Ltr. Incl

- 1) Attachment A: Information Pertaining to the Quad Cities Unit 2 Decontamination and Resultant Waste Solidification

This includes a discussion of event and factors that may have caused premature acceleration of the solidification process. This includes information on the decontamination as well as other information which had been requested by the staff during the meeting, but not detailed in the meeting minutes (specifically the order in which the resins had been sluiced into the liner).

- 2) Attachment B: Corresponding Between Commonwealth Edison and Chem-Nuclear Regarding the Affected Liner.

- 3) Attachment C: Past Practices of Surrogate Waste Samples in the Solidification of Decontamination Solutions at Quad Cities Station.

This includes a letter from P. Denault to S. Davis, (CECo), dated July 14, 1988 which describes in more detail the process by which the surrogate sample is prepared.

- 4) Attachment D: Plans for Disposal of Waste Liner and Implementation Schedule.
- 5) Attachment E: Proposed Long Term Corrective Actions.

Reference (a) also indicated that Commonwealth Edison would receive, under separate cover, a request to transmit solidified resin material samples to the NRC, or its contractor. These samples were collected at Quad Cities by the Idaho National Engineering Laboratory (INEL), personnel who were participating in a project under the direction of Dr. P. Reed, NRC, Research. The request for sample transmittal is to also explain the intended disposition of said samples. The samples which were collected represent both unsolidified resin which had been sluiced into the liner, prior to the addition of cement, as well as samples that were "grabbed" from the top of the liner after the mixer shaft seized.

It is our preliminary judgement that these samples may not accurately depict the actual Quad Cities liner. At this time, it is uncertain that the unsolidified mixed resin samples are truly representative of the liner since the samples were taken from the top portion of the cask, after it had been agitated, but not during the actual period of agitation. In the case of the samples taken from the liner following the addition of concrete, their representativeness to the liner is also in question. These dip samples were taken from the top of the liner and may have collected an unrepresentatively

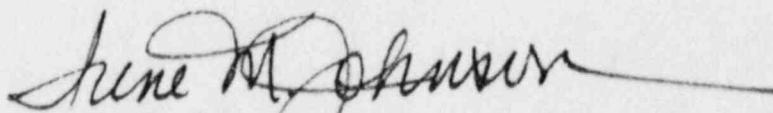
July 15, 1988

large percentage of foam in the event foam was formed during mixing. Commonwealth Edison is doing further reviews of these samples in order to confirm their beliefs. The results of our review will be provided to your staff at the time that the samples are transmitted to your contractor for off-site analysis.

Commonwealth Edison's current plan to encapsulate the affected liner and for disposal to Barnwell, South Carolina by early September, 1988.

Please direct any questions that you may have regarding this matter to this office.

Yours very truly,



I. M. Johnson
Nuclear Licensing Administrator

lm

- Attachments A: Information Pertaining to the Quad Cities
Unit 2 Decontamination and Resultant Waste
Solidification
- B: Correspondence Between Commonwealth Edison and
Chem-Nuclear Regarding the Affected Liner
- C: Past Practices of Surrogate Waste Sample Usage
- D: Plans for Disposal of Waste Liner and Implementation
Schedule
- E: Proposed Long Term Corrective Actions

cc: T. Ross-NRR
QC Resident Inspector

4910K

ATTACHMENT A

"INFORMATION PERTAINING TO THE QUAD CITIES UNIT 2
DECONTAMINATION AND RESULTANT WASTE SOLIDIFICATION"

- Narrative Summary of the Decontamination and Solidification Process
- Cause of Premature Hardening
- Order in which Resin Wastes Were Sluiced into Solidification Liner

NARRATIVE SUMMARY OF THE DECONTAMINATION AND SOLIDIFICATION PROCESS

In late April 1988, Unit 2 of Commonwealth Edison's Quad Cities Station was chemically cleaned using the LOMI process. This method employs a solution of vanadous formate with picolinic acid as a sequestrant for iron, partially neutralized with sodium hydroxide. Make up water is usually treated with hydrazine to remove dissolved oxygen.

The decontamination was performed first on the recirc pump discharge piping, followed by recirculation of the spent solvent through cleanup resin columns containing Weak Base Anion (WBA) resin and Strong Acid Cation (SAC). Due to station concerns relating to high reactor vessel water level, excess water was drained through resin columns consisting of mixed bed Strong Base Anion (SBA) resin and SAC. All resin used at that point was sluiced to the solidification liner. New resin was then loaded into the resin columns, followed by decon of the suction piping. Upon completion, solvent was cleaned up using WBA and SAC resin. Once the majority of solvent was removed from the suction piping, the expended resin was sluiced to the liner and fresh resin reloaded. A final clean-up or polishing of the water from the entire system was performed. Finally, the remaining resin was sluiced, from the resin columns into the solidification liner. These operations were performed by the decontamination vendor, LN Technologies. A sample of simulated spent resin waste was also prepared by LN Technologies and used by the solidification vendor for purposes of performing test solidifications. The rationale for use and preparation of the simulated waste sample will be discussed in more detail later.

The waste solidification process was performed by Chem-Nuclear. Excess water was drawn out of the liner to the extent prescribed by the solidification formula to be used. The liner mixing motor was then started, and after some period of mixing resin samples were drawn by a representative of EG&G Idaho.

The solidification formula called for the addition of 7500 pounds of cement to the liner. Per normal operations of the cement addition was stopped for a period of approximately 15 minutes after the first 2400 pounds had been added to permit Chem-Nuclear personnel time to refill the cement addition hopper. During this 15 minute delay, however, the entire cement mixture increased in viscosity to the point that no further addition was possible. At that point, the EG&G samples were drawn from the surface of the cement mixture.

CAUSE OF PREMATURE HARDENING

During the extensive investigation into this event performed by CECO and its representatives, it was determined that the only parameter that underwent significant change in this case involved the formula used by Chem-Nuclear to solidify the spent resin waste. This change involved the total deletion of lime.

Through considerable research, no evidence appears to exist that calcium undergoes significant chelation reaction with picolinic acid (unlike other chelates such as EDTA). Thus, it appears that lime reaction with excess chelant is not a consideration.

However, it has been well documented and demonstrated both in the nuclear industry and elsewhere that the introduction of lime to a cement mixture serves to retard or slow the hydration reaction. Furthermore, lime will act to neutralize the relatively low pH waste, thus introducing a very significant heat of neutralization to the liquid waste in the liner. Some small quantity of heat will also be given off through the ion exchange of calcium with the unexchanged sites on cation resin (CECO estimates that only 50% of the theoretical capacity for the mixed bed resin used for polishing was expended).

Previous Chem-Nuclear solidification practices involved the introduction and thorough mixing of the entire quantity of lime to the liquid waste prior to commencing with cement addition. The lime addition step normally took ½ to 1 hour to complete. The introduction of cement to the liner was also performed at a slow enough rate that the heat contributions of neutralization and resin depletion would normally have on the order of two hours to dissipate prior to the time significant cement hydration could occur. With the deletion of lime from the formula used in the subject case, the cement itself had to provide neutralizing and ion exchange capacity. The simultaneous use of the cement to neutralize and solidify the waste brought about a circumstance whereby the heat of neutralization raised the temperature of the cement mixture (calculation shows by approximately 45°F), which acted to greatly accelerate the hydration, the heat from which would have acted to cause further acceleration of the process.

In summary, CECO concludes that the heat of chelation is not of significance. The heat of neutralization, the heat of hydration, and to a lesser extent, the heat of ion exchange acted together to cause a significant temperature increase in the cement. The fact that this heat could not dissipate quickly enough, together with the absence of a retardant from the solidification formula resulted in the premature hardening of the cemented waste. Thus, CECO concludes that the deletion of lime, together with no requirement in the Chem-Nuclear PCP to require monitoring of the hydration rate of the test solidification are the causes of premature hardening.

ORDER IN WHICH RESIN WASTES WERE SLICED
INTO THE SOLIDIFICATION LINER

1. First, 3 columns of SAC clean-up resin were sluiced, 21 ft³ total
2. Then 3 columns of WBA clean-up resin, 21 ft³ total
3. 3 columns mixed bed SAC/SBA 21 ft³ total (14 ft³ SBA, 7 ft³ SAC)
4. 2 columns SAC, 14 ft³ total
5. 2 columns WBA, 14 ft³ total
6. 2 columns mixed bed SAC/SBA 14 ft³ total (9 ft³ SBA, 5 ft³ SAC)
7. 1 column 5 ft³ WBA, 2 ft³ SAC
1 column 3 ft³ SAC, 4 ft³ SBA

40 ft³ WBA
27 ft³ SBA
52 ft³ SAC

119 ft³ total

ATTACHMENT B

"CORRESPONDENCE BETWEEN COMMONWEALTH EDISON AND
CHEM-NUCLEAR REGARDING AFFECTED LINER"

- June 15, 1988 letter from J. Jeffrey (Chem-Nuclear) to S. Davis (CECo)

- June 17, 1988 letter from J. Jeffrey (Chem-Nuclear) to R. Petri (CECo)



June 15, 1988

Mr. Steve Davis
Commonwealth Edison Company
Technical Center, Room 306
1319 South First Avenue
Maywood, IL 60153

Dear Mr. Davis:

I enjoyed our meeting in Channahon on June 10th and feel it was very productive. The following is a list of questions that you desired to be answered and Chem-Nuclear's (CNSI) response to those questions.

1. Question: What is CNSI's current theory on the cause of the Problem?

Response: Testing was conducted at our Barnwell Testing Facility utilizing LOMI and Bead Resin Solution with a pH of 3.0 based on the surrogate sample provided by Quad Cities prior to the solidification. It was found that the addition of P-20 Binder initially increased the temperature 20°F due to the heat of neutralization of the solution. It was also found that addition of lime caused the same temperature increase. Temperature increase for a more typical Bead/LOMI with a pH of 5 to 6 was only 3-4°F. This increased temperature doubled the rate of hydration, which increased the viscosity and effectively reduced mixing time by half. Although addition of lime initially would have given the same temperature increase, no thickening would have occurred and the mix could be allowed to cool to ambient prior to the cement addition.

2. Question: Why has CNSI changed its opinion of why the problem occurred?

Response: At the time of our original assessment of the situation, it appeared that premature thickening of the waste hindered addition of all the required binder. This premature thickening was thought to be due to chemical reactions involving the decon solution and the lime formed during the initial hydration of cement. This opinion was based on CNSI's knowledge of chelate material in general and was not based on actual testing. Once surrogate sample testing was initiated, it was evident that the Quad Cities waste was more susceptible to thickening due to higher temperatures as explained in the Response to Question #1.

3. Question: Do you have a Certificate of Compliance on the P-20 used?

Response: Certificate of Compliance on the P-20 is enclosed as Addendum I.

4. Question: What do you intend to do to prevent reoccurrence of the problem?

Response: All future solidification will be accomplished utilizing an approved PCP formula. This includes the use of lime when prescribed. In addition, solidification procedures will be changed to alert the operator to low pH situations. Steps will be added to monitor for temperature rise caused by waste neutralization following lime addition. If this temperature rise is observed, the solidification process will be interrupted to allow the temperature to decay to ambient. It will then not add to the temperature rise from cement hydration causing faster hydration and the attendant higher viscosity.

5. Question: Do you have the procedure available for encapsulation of the problem liner?

Response: CNSI Procedure SD-OP-084-445 for encapsulation of the Quad Cities liner is enclosed as Addendum II. It has also been officially sent to both the plant and the CNSI operator.

6. Question: Has the encapsulation process been accepted by the State of South Carolina for burial at Barnwell?

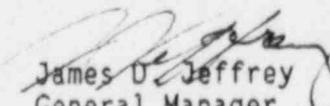
Response: Encapsulation is an accepted practice for disposal of certain waste forms at the Barnwell site. Recent conversations with the State (DHEC) have confirmed that encapsulation is a viable method of providing stability for this liner.

7. Question: In what time frame did the samples, which were run to determine minimum binder needs, go hard?

Response: As stated in our letter of June 6 to Mr. Ray Petrie, the samples, which were run to determine the minimum amount of binder which could be stirred into the mixture to assure there was no free liquid, were hard and water free within 24 hours. Although no hour-by-hour check was made of the progress of solidification, it was noted that both samples tested were firm and definitely not mixable six hours after mixing.

If I can be of further assistance in this area or if there are additional questions, please do not hesitate to call me.

Sincerely,


James D. Jeffrey
General Manager
Nuclear Services

c: Irene Johnson
Ray Petrie
Mike Ryan

June 10, 1988

CERTIFICATION

This is to certify that Portland Pozzalon Cement manufactured by Santee Cement Company, Holly Hill, S. C. and packaged by Concrete Bag Products Co., Inc., Gilbert, S. C. for Chem-Nuclear Systems, Inc., Barnwell, S. C. under the label of P-20 contains 81% + or - 1% Type I Portland Cement and 19% + or - 1% Fly Ash, meeting the ASTM specifications C595 for Portland Pozzalon Cement, purchased under these #N-447375, #N-448077, #N-450083.

CONCRETE BAG PRODUCTS CO., INC.

M. R. Greenthaler

M. R. Greenthaler
President

SANTEE

Santee Cement Company
A Subsidiary of ~~dundee~~

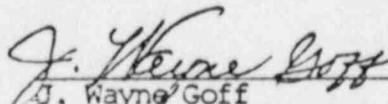
P. O. Box 6924
Columbia, South Carolina 29260
(803) 736-0702

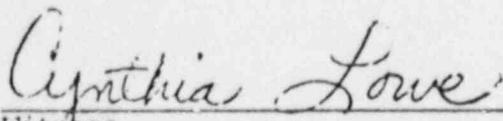
Mr. Dan Lackey
Chem Nuclear Systems, Inc.
P O Box 726
Barnwell, S.C. 29812

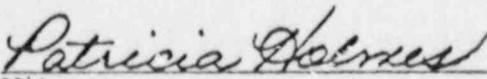
A F F I D A V I T

This is to certify that TYPE IP Portland-Pozzoland Cement, as manufactured by SANTEE CEMENT COMPANY at our facilities at Holly Hill, South Carolina, is warranted to conform at time of shipment to present A.S.T.M. Specification C-595; A.A.S.H.T.O. Specification M-240 and Federal Specification SS-C-1960/4 for TYPE IP Portland-Pozzolan Cement. The Pozzolan used conforms to A.S.T.M. C0618, Class F and amount used does not exceed 20% by weight of cement. The total alkali expressed as sodium equivalent $[Na_2O+K_2O (0.685)]$ is less than 0.60%

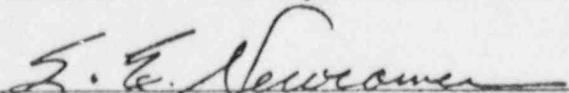
No other warranty is made or to be implied.


J. Wayne Goff
Manager, Technical Services


Cynthia Lowe
Witness


Patricia Holmes
Witness

SWORN TO AND SUBSCRIBED BEFORE ME THIS
18 DAY OF May 19 87.


S. E. Newcomer
NOTARY PUBLIC OF SOUTH CAROLINA
My commission expires: 6-30-1990

REVISIONS

REV.	DESCRIPTION	DATE	APPROVED

UNCONTROLLED COPY WILL NOT BE UPDATED

CNSI SAFETY REVIEW
BOARD APPROVAL

BY *[Signature]*
DATE 6/9/88

REVISION STATUS

SHEET	1	2	3	4	5	6	7	8	9								
REV.	-	-	-	-	-	-	-	-	-								
SHEET																	
REV.																	

PREPARED <i>[Signature]</i>	DATE 5-9-88	CHEM - NUCLEAR SYSTEMS, INC.	
ALARA <i>[Signature]</i>	5/12/88	TITLE OPERATING PROCEDURE FOR IN-SITU SOLIDIFICATION USING MOBILE IN-SITU UNIT (MIU-1) AT QUAD CITIES.	
ENGINEER <i>[Signature]</i>	5/10/88		
QUALITY <i>[Signature]</i>	5-10-88		
APPROVED <i>[Signature]</i>	5/2/88	Addendum II	

APPROVED <i>[Signature]</i>	DATE 5/2/88	SAFETY FOR J. SALTER <i>[Signature]</i> 5-10-88	DOCUMENT NO. SD-OP-084-445	REV. -	SHEET 1
--------------------------------	----------------	--	-------------------------------	-----------	------------

TABLE OF CONTENTS

	<u>PAGE NO.</u>
1.0 SCOPE	3
1.1 Purpose	3
1.2 Applicability	3
2.0 REFERENCES	3
3.0 REQUIREMENTS.	3
3.1 Prerequisites	3
3.2 Equipment	3
4.0 ASSEMBLY.	4
5.0 PRE-OPERATIONAL TESTING	5
6.0 SYSTEM OPERATION	6
7.0 SYSTEM SHUTDOWN/DISASSEMBLY	7
8.0 ACCEPTANCE CRITERIA	8
9.0 RECORDS AND REPORTS	8
9.1 Process Memo	8
9.2 Solidification Records	8
APPENDIX A - SAFETY DATA SHEETS.	9

1.0 SCOPE

1.1 Purpose

This is a procedure for In-Situ Encapsulation Of 14-195 and Smaller Liners. It provides instructions for batch mixing cement in a mixing liner and transfer of the cement mixture to a 21-300 encapsulation liner.

1.2 Applicability

The instructions contained in this document apply to use of the In-Situ Solidification equipment.

2.0 REFERENCES

- 2.1 CNSI Procedure, SD-OP-003, "Process Control Program For CNSI Cement Solidification Units"
- 2.2 CNSI Procedure, QA-TP-009, "Hydrostatic Test Requirements"
- 2.3 CNSI Procedure, FO-AD-007, "Nuclear Services Equipment Shipping Procedure."

3.0 REQUIREMENTS

3.1 Prerequisites

3.1.1 Acquire a Radiation Work Permit (or equivalent) from the utility's Health Physics Department.

3.1.2 Inspect and use, as appropriate, protective clothing, safety glasses, chemical splash goggles, face shield, hard hat, safety shoes, gloves and respirator. Know where the closest eye wash and safety shower are and how to use them.

CAUTION: HOSES AND OTHER PRESSURE RETAINING COMPONENTS MAY BE PRESSURIZED. FACE SHIELDS AND APPROPRIATE PROTECTIVE CLOTHING SHALL BE WORN DURING DISASSEMBLY OF THIS EQUIPMENT.

3.1.3 All straight ladders must be tied at the top or held at the bottom by a co-worker.

3.2 Equipment

The equipment required consists of a mixing liner, hydraulic power unit, pumps, hoses, and a 21-300 encapsulation liner which will contain the liner to be encapsulated with cement.

3.2.1 Mixing Liner

The mixing liner is a steel liner with the addition of an outlet in the bottom with isolation valves and connection to a cement transfer system.

3.2.2 Transfer System

The transfer system is a 1-1/2" or 2" diaphragm pump, suction and discharge hose with a disposable tail piece, and manually operated valves used to transfer the cement mixture from the mixing liner to the encapsulation liner.

3.2.3 Air Manifold

The air manifold consists of the necessary valves, air dryer, hoses, piping and fittings necessary to connect an air supply from the utility and operate the cement transfer system pump(s).

3.2.4 Encapsulation Liner

This process uses a 21-300 encapsulation liner with pre-poured cement base and top motion limiters to center the liner to be encapsulated and prevent it from floating.

3.2.5 Level Indication

Level indication is monitored by either a TV camera or mirror and a clearly marked indicator to ensure proper cement level in the encapsulation liner.

3.2.6 Service Water Manifold

The service water manifold consists of the necessary valves, piping and fittings to connect a service water supply from the utility to the mix liner.

4.0 ASSEMBLY

- 4.1 Set mix liner off the trailer to a level surface capable of supporting its weight in area adjacent to process area.
- 4.2 Install mixer head on mix liner.
- 4.3 Locate hydraulic unit next to mix liner.
 - 4.3.1 Connect hydraulic hoses between mixhead and hydraulic unit.
 - 4.3.2 Connect hydraulic power lead to 3 phase 60 cycle, 480 VAC, 60 AMP source.
- 4.4 Locate air distribution manifold adjacent to hydraulic unit.
 - 4.4.1 Connect plant service air to manifold inlet.
 - 4.4.2 Check oil level of oiler.

- 4.4.3 Check all outlet valves shut.
- 4.5 Locate cement transfer pump adjacent to mix liner (a location midway between mix and disposable liner may better suit the situation).
 - 4.5.1 Connect the air supply hose from the air manifold to the transfer pump supply. Fully open the throttle valve on the pump inlet block.
 - 4.5.2 Connect section(s) of 1-1/2" non-collapsible suction hose between cement transfer pump suction and mix tank outlet.
 - 4.5.3 Connect 1-1/2" discharge hose from cement transfer pump to the encapsulation liner.
- 4.6 Locate service water manifold adjacent to hydraulic unit.
 - 4.6.1 Connect service water supply from the plant source to inlet of the manifold.
 - 4.6.2 Connect the 1/2" hose from the service water manifold and secure end to mix tank.

5.0 PRE-OPERATIONAL TESTING

The transfer system is connected between the mixing liner and a service water discharge.

- 5.1 Perform a pre-operational check of the transfer system using service water.
 - 5.1.1 Test the transfer system for proper operation and leakage by adding service water to the mixing liner and pump with the transfer pump with discharge hose plugged. Precautions shall be taken to vent hose prior to removal of plug (test to be performed and documented IAW Reference 2.2).

NOTE: DO NOT DISCHARGE SERVICE WATER INTO THE ENCAPSULATION LINER.
- 5.2 Perform pre-operational check of Hydraulic Unit.
 - 5.2.1 Ensure hydraulic reservoir is at proper level. Add oil as necessary as determined by sight glass.
 - 5.2.2 Jog hydraulic unit to ensure proper direction of rotation.
 - 5.2.3 Operate hydraulic unit to ensure proper operation of mixing motor and check all hydraulic hose connections for leakage.

6.0 SYSTEM OPERATION

- 6.1 Verify the following conditions exist:
- 6.1.1 The liner to be encapsulated is ready for transfer.
 - 6.1.2 A PCP sample has been completed satisfactorily in accordance with Reference 2.1.
 - 6.1.3 Pre-operational checks have been completed satisfactorily in accordance with Steps 5.1 through 5.2.
 - 6.1.4 The mixer head is ready for operation on the mixing liner.
- 6.2 Prepare the encapsulation liner to receive the liner to be encapsulated and the cement mixture.
- 6.2.1 Open and inspect the encapsulation liner for foreign materials, damage, and ensure that the pre-poured bottom is intact. Record liner condition and serial number in the Daily Operations Log.
 - 6.2.2 Install the temperature probe.
 - 6.2.3 Install a clearly marked indicator such that the cement level in the encapsulation liner after filling will be at least 5 inches above the encapsulation liner top. Ensure level indicator is visible.
 - 6.2.4 Firmly attach a disposable cement hose tailpiece to the encapsulation liner and connect to cement transfer pump.
 - 6.2.5 Transfer the liner to be encapsulated into the encapsulation liner and ensure that it is properly positioned to provide required encapsulation thickness.
 - 6.2.6 Install the rebar grid work on top of the liner. The grid should rest on the barrel-top and be approximately centered above the liner being encapsulated.
 - 6.2.7 Install the motion limiter in the encapsulation liner.
- 6.3 Add and mix the required amounts of chemicals and cement to the mixing liner and prepare for transfer per the following steps:
- NOTE: REFER TO THE PROCESS CONTROL PROGRAM (REFERENCE 2.1 FOR THE PROPER AMOUNT OF WATER AND CHEMICALS.
- 6.3.1 Add the required amount of water to the mixing liner.
 - 6.3.2 Start the mixer and adjust the speed to approximately 10 rpm. (Speed may be varied at operators discretion to ensure proper mixing.)

- 6.3.3 Add the required amount of cement in accordance with the Process Control Program.
- 6.3.4 Add the required amount of lime in accordance with the Process Control Program.
- 6.3.5 Increase mixer speed to approximately 20 rpm. (Speed may be varied at operators discretion to ensure proper mixing.)
- 6.3.6 Confirm the flow characteristics of the mixture and that it has a smooth, fluid consistency. Continue to mix for 15 minutes.

NOTE: BORIC ACID AND/OR SODIUM SULFATE MAY BE ADDED TO THE LINER TO ASSIST IN CONTROL OF THE EXOTHERM BASED ON THE TEMPERATURE AT THE START OF THE PROCESS. REFER TO REFERENCE 2.1 FOR REQUIRED AMOUNTS.

NOTE: ALL DRY CHEMICAL ADDITIONS WILL BE $\pm 10\%$ OF CALCULATED AMOUNTS.

- 6.3.7 Ensure the transfer hose is attached to the encapsulation liner, level indicator is visible and the temperature indicator is installed to monitor the exotherm.
- 6.3.8 Transfer the cement mixture into the encapsulation liner until the proper level is achieved (level indicator is covered). Secure the transfer system.
- 6.3.9 Disconnect the transfer hose at the disposable tailpiece. Flush any remaining cement mixture into a suitable container.
- 6.3.10 Disconnect tailpiece from encapsulation liner.
- 6.3.11 The TV camera can be de-energized and removed (if used).
- 6.3.12 After cement begins to set (approximately 1 hour), remove the motion limiter and fill holes, if necessary.

7.0 SYSTEM SHUTDOWN/DISASSEMBLY

- 7.1 Secure the hydraulic unit and disconnect hoses and electrical power.
- 7.2 Flush the fillhead, mixing liner, and transfer system to ensure removal of all cement mixture.

NOTE: IF IT IS NECESSARY TO ADD ADDITIONAL CEMENT MIXTURE TO LINER DUE TO SLUMPING, REPEAT STEPS 6.4 THRU 7.2.

- 7.3 After Section 8.0 (Acceptance Criteria) has been completed, seal the encapsulation liner.
- 7.4 After final process is complete drain the mix tank completely.
- 7.5 Disassembly may be in any order; ensure all systems disconnected from plant supplies. (Any contaminated hoses may be disposed of in process liner or in accordance with plant directions.)
- 7.6 Package for shipment in accordance Reference 2.3.

8.0 ACCEPTANCE CRITERIA

- 8.1 A solidified cement encapsulation liner shall be considered acceptable if the following conditions are met:
 - 8.1.1 Visual inspection of the end product, normally 24-72 hours after process completion, shows a uniform product with no free-standing water.
 - 8.1.2 The end product, after satisfactory visual inspection, resists penetration when probed with a wooden rod or dowel approximately 1" in diameter.

CAUTION: THE SOLIDIFIED MATRIX MUST BE LESS THAN 175°F AND BE STEADILY DECREASING IN TEMPERATURE PRIOR TO SEALING. ADD A SMALL AMOUNT OF DRY CEMENT TO SOLIDIFY ANY LIQUID ON THE BILLET SURFACE THAT HAS NOT ABSORBED WITH THE DECREASING TEMPERATURE. THE LINER SHALL NOT BE SEALED SOONER THAN 30 HOURS AFTER COMPLETION OF MIXING.

9.0 RECORDS AND REPORTS

9.1 Process Memo

The Process Memo shall accompany the shipment with appropriate copies mailed to the Supervisor, Waste Processing Services.

9.2 Solidification Records

The technician shall maintain a copy of the CNSI Solidification Worksheets. A copy of the CNSI Solidification Worksheets and the temperature recording of each solidification shall be mailed to the Supervisor, Waste Processing Services upon completion of the solidification.

APPENDIX A
MATERIAL SAFETY DATA SHEETS
(6 PAGES)

DOCUMENT

SD-OP-084-445

REV.

-

SHEET

9

Material Safety Data Sheet

From Genium's Reference Collection
 Genium Publishing Corporation
 1145 Catalyn Street
 Schenectady, NY 12303-1836 USA
 (513) 377-8855



GENIUM PUBLISHING CORP.

No. 4
BORIC ACID
 (Revision C)

Issued: March 1983
 Revised: January 1987

SECTION 1. MATERIAL IDENTIFICATION

22

MATERIAL NAME: BORIC ACID

DESCRIPTION/USES: Natural state is the mineral sassolite. Used for heat-resistant glass; glass fibers; porcelain enamels; boron chemicals; metallurgy; as a flame retardant in textile products; in fungus control on citrus fruits; ointment; electroplating baths.

OTHER DESIGNATIONS: Orthoboric Acid, Boracic Acid, Hydrogen Borate, H_3BO_3 ; CAS #10043-35-3

MANUFACTURER/SUPPLIER: Available from several suppliers, including:
 Ashland Chemical Co., Industrial Chemicals & Solvents Div., PO Box 2219,
 Columbus, OH 43216; Telephone: (614) 889-3333
 US Borax and Chemical Co., 3075 Willshire Blvd., Los Angeles, CA 90010;
 Telephone: (213) 381-5311



HMIS

H 0

F 0

R 0

PPE*

*See Sect. 8

R 1

I -

S 2

K 0

SECTION 2. INGREDIENTS AND HAZARDS

%

HAZARD DATA

Boric Acid, CAS #10043-35-3

ca 100

No TLV Established.*

Rat, Oral, LD₅₀: 2660 mg/kg

Human, Skin, 15 mg/3 Days,
 Intermittent: Mild Irritation

Infant, Oral, LDLo: 934 mg/kg

* Control as a nuisance particulate.

ACGIH TLV is 30 mppcf or 10 mg/m³ total dust, or 5 mg/m³ respirable dust.

SECTION 3. PHYSICAL DATA

Boiling Point ... Not Found

Vapor Pressure, 21°C, mm Hg ... 15 (due to H₂O)

Water Solubility, g/100g @ 20°C ... 4.9

Vapor Density (Air = 1) ... Not Found

Evaporation Rate ... Not Found

Specific Gravity (H₂O = 1) ... 1.435

Melting Point ... 330° to 356°F (170 to 180°C)

% Volatile by Volume ... Not Found

Molecular Weight ... 61.84

pH @ 20°C, 1% Aqueous Soln ... ca 5.2

4% Aqueous Soln ... ca 3.9

Appearance and odor: Fine or granular white powder or colorless crystals. Odorless.

SECTION 4. FIRE AND EXPLOSION DATA

LOWER

UPPER

Flash Point and Method

Autoignition Temperature

Flammability Limits in Air

Not Found

Not Found

Noncombustible

Not Found

Not Found

EXTINGUISHING MEDIA: Use whatever agent is most appropriate to extinguish surrounding fire. Boric acid does not support combustion and is noncombustible.

There are no unusual fire or explosion hazards associated with this material.

There are no special fire-fighting procedures when extinguishing a boric acid fire.

Fire fighters should use self-contained breathing apparatus and wear fully protective clothing when fighting fires of boric acid.

SECTION 5. REACTIVITY DATA

Boric acid is stable. Hazardous polymerization cannot occur.

Boric acid is a weak acid. It loses chemically combined water upon heating, forming metaboric acid (HBO₂) at 212 to 221°F (100 to 105°C), then pyroboric acid (H₂B₄O₇) at 285 to 320°F (140 to 160°C), and boric anhydride (B₂O₃) at higher temperatures.

It reacts with basic materials such as alkali carbonates and hydroxides to form borate salts. A mixture of potassium and boric acid may explode on impact. When it is mixed with acetic anhydride, it can react violently when heated to 136-140°F (58-60°C).

If moisture is present, boric acid can be corrosive to iron.

No products of hazardous decomposition should be expected.

SECTION 6. HEALTH HAZARD INFORMATION | TLV

Boric acid is not listed as a carcinogen by the NTP, IARC, or OSHA.

SUMMARY OF RISKS: Excessive inhalation of boric acid dust can cause irritation to the mucous membranes of the respiratory tract. This material is not significantly absorbed through intact skin. It is readily absorbed through damaged, abraded, and burned skin, or open wounds and areas of active dermatitis when they are exposed to dry materials or aqueous solutions. Ingestion or absorption of boric acid may cause nausea, vomiting, anuria (absence of or defective excretion of urine), erythematous (abnormally red) lesions on the skin and mucous membranes, abdominal cramps, CNS effects after 24 hours, circulatory failure, and coma. Poisoning can be acute or chronic. The acute fatal dose to adults is reported at 5 to >30g (moderate to slightly toxic). Studies of dogs and rats have shown that infertility and damage to testes can result from acute or chronic ingestion of boric acid. Evidence of toxic effects on the human reproductive system is inadequate. **TARGET ORGANS:** Skin and central nervous system. The primary route of entry is by way of damaged or abraded skin, ingestion, or inhalation. **ACUTE EFFECTS:** Eye irritation, skin irritation, and gastric disturbances from ingestion. **CHRONIC EFFECTS:** Excessive amounts of this material, absorbed into the blood stream may result in erythema, a macular (blotchy) rash, dizziness, gastric disturbances, and depression. **FIRST AID: EYE CONTACT:** Flush eyes thoroughly, including under eyelids, with running water for 15 minutes. Get medical help.* **SKIN CONTACT:** Remove grossly contaminated clothing under a safety shower. Flush affected area with water; wash with soap and water. Get medical help.* **INHALATION:** Remove victim to fresh air. Restore and/or support his breathing as required. Get medical help.* **INGESTION:** Rinse victim's mouth with water. Give him 2 to 3 glasses of water to drink to dilute the material. Induce vomiting. Never give anything by mouth to someone who is unconscious or convulsing. Get medical help.*

* GET MEDICAL ASSISTANCE = In plant, paramedic, community. Get medical help for further treatment, observation, and support after first aid.

SECTION 7. SPILL, LEAK, AND DISPOSAL PROCEDURES

Before using boric acid it is essential that proper emergency procedures be established and made known to all personnel involved with it.

Notify safety personnel of boric acid spills. Provide adequate ventilation. Cleanup personnel need protection against inhalation of dust. Sweep up or vacuum the spill, avoid dusting conditions, and place waste material in an appropriate container for reclamation or disposal. Absorb liquid spills on vermiculite or dry sand. Flush the residue with a lot of water.

Reclaim dry boric acid for salvage or reuse. Unsalvageable waste may be buried in an approved landfill. Follow Federal, state, and local regulations.

SECTION 8. SPECIAL PROTECTION INFORMATION

When dusty conditions prevail, use a NIOSH-approved dust respirator. Provide general dilution and local exhaust ventilation in sufficient volume and pattern to keep concentration of hazardous ingredients listed in section 2 at a minimum.

Wear body-protective clothing appropriate to the work situation to minimize skin contact. Prevent eye contact by wearing chemical safety goggles where dusty conditions occur or splashing is possible. Use rubber gloves to prevent repeated or prolonged skin contact. Soiled clothing must be laundered before it is worn again.

Eyewash stations, washing facilities, and safety showers should be available to areas of use and handling.

Contact lenses pose a special hazard; soft lenses may absorb irritants and all lenses concentrate them. Particles may adhere to contact lenses and cause corneal damage.

SECTION 9. SPECIAL PRECAUTIONS AND COMMENTS

Store boric acid in closed containers in a cool, dry area. Storage bins should have a 60-degree sloping-cone bottom with a provision to prevent the entry of water. Carbon steel or aluminum containers are suitable for this dry storage. Stainless steel is needed for moist conditions.

Practice good housekeeping to prevent the accumulation and generation of dust.

Avoid breathing boric acid dust. Minimize skin contact by using proper gloves and suitable work clothing appropriate to the work situation. Practice good personal hygiene. Wash thoroughly after handling this material and before eating, drinking, or smoking. Do not take this material out of your work area or to your home on your clothing or equipment. Do not eat boric acid. Avoid contact with this material, especially when skin is cut or abraded or if active dermatitis is present.

DOT Classification: Not listed.

Data Source(s) Code: 1, 4-11, 14, 25, 26, 34, 42, 43, 48, 49, 55, 58, 81, 84, CK

Judgements as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Genium Publishing Corp. extends no warranties, makes no representations and assumes no responsibility as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.

Approvals *[Signature]*

Indust. Hygiene/Safety *[Signature]* 4/87

Medical Review *[Signature]*

MATERIAL SAFETY DATA SHEET

GENIUM PUBLISHING CORPORATION
1145 CATALYN ST., SCHENECTADY, NY 12303 USA
(518) 377-8854



NO. 39

CALCIUM HYDROXIDE
Revision A

DATE October 1984

SECTION I. MATERIAL IDENTIFICATION

MATERIAL NAME: CALCIUM HYDROXIDE
OTHER DESIGNATIONS: Hydrated Lime, High Calcium Hydrated Lime, Caustic Lime, Calcium Hydrate, Slaked Lime, $\text{Ca}(\text{OH})_2$, ASTM C259, C53, etc. GE Material D4B3, CAS #001 305 620
MANUFACTURER: Material available from many sources, including:
Ash Grove Cement Co. Harshaw Chemical Co. Warner Co., Ind. Mineral Div.
P.O. Box 25900 1945 E. 97th Street P.O. Box 448
Overland Park, KS 66255 Cleveland, OH 44106 Bellefonte, PA 16823
Tel: (913) 381-8901 Tel: (216) 721-8300 (Tel: (717) 355-4761

SECTION II. INGREDIENTS AND HAZARDS

	%	HAZARD DATA
Typical Composition:*		
Calcium hydroxide, $\text{Ca}(\text{OH})_2$	>90	8-hr TWA $5\text{mg}/\text{m}^3$ ^{3**} Rat, Oral LD ₅₀ 7.3 gm/kg
Calcium carbonate, CaCO_3	<4	
Magnesium oxide, MgO	<3	
Other oxides (Al_2O_3 , Fe_2O_3 , SiO_2 , etc.)	<3	
*Commercial material prepared by hydration of lime.		
**ACGIH (1984) TLV; no specific OSHA PEL established (minimum control would be as a nuisance particulate).		

SECTION III. PHYSICAL DATA

Decomposition point (-H ₂ O), ---	580	Specific gravity (H ₂ O=1) -----	2.3-2.4
Water solubility, g/100 ² sat. solution:		pH of saturated solution at 25 C -	12.5
at 0 C -----	0.185	Molecular weight $\text{Ca}(\text{OH})_2$ -----	74.1
at 25 C -----	0.159		
at 100 C -----	0.017		

Appearance & Odor: Crystals or soft, white powder or granules. Odorless.

SECTION IV. FIRE AND EXPLOSION DATA

Flash Point and Method	Autoignition Temp.	Flammability Limits in Air	Lower	Upper
N/A	N/A	N/A	--	--

Extinguishing media: This material is not combustible. Use extinguishing media which is appropriate for the surrounding fire.
When heated above 580 C, material can decompose to produce CaO. When this material is involved in a fire situation, firefighters should wear full protective clothing, and use eye protection and self-contained breathing apparatus.

SECTION V. REACTIVITY DATA

This is a stable solid in a sealed container at room temperature. When exposed to the air it will slowly absorb carbon dioxide to form calcium carbonate. When heated at temperatures above 580 C, it loses water to form calcium oxide or lime.
Calcium hydroxide is a strongly alkaline material which is incompatible with acidic materials. It forms salts with nitroparaffins in the presence of water which are explosive when dried. It can cause the explosive decomposition of maleic anhydride. Boiling elemental phosphorus in a calcium hydroxide solution can liberate spontaneously flammable phosphines. It liberates NH_3 from ammonium salts.

SECTION VI. HEALTH HAZARD INFORMATION	TLV 5 mg/m ³
<p>This material in the presence of moisture, is a moderately caustic irritant and can be damaging to human tissue. Excessive skin contact will irritate the skin and produce dermatitis. Eye contact gives a burning sensation with severe irritation and possible damage. Inhalation in particulate form is irritating and can be damaging to the mucous membranes of the upper respiratory tract. Do not ingest.</p>	
<p>FIRST AID:</p>	
<p><u>Eye Contact:</u> Promptly flush with plenty of running water, including under eyelids, for at least 15 minutes; then, get prompt medical attention.</p>	
<p><u>Skin Contact:</u> Wash exposed skin with plenty of water. Remove contaminated clothing promptly. Get medical help if exposed area is large or if irritation persists.</p>	
<p><u>Inhalation:</u> Remove to fresh air. Contact physician immediately.</p>	
<p><u>Ingestion:</u> Dilute by giving 2 glasses of water or milk to drink, followed by fruit juice or diluted vinegar to neutralize the alkali; then consult physician.</p>	
SECTION VII. SPILL, LEAK, AND DISPOSAL PROCEDURES	
<p>Those involved in clean up of spills should use protective equipment (See Sect. VIII).</p>	
<p>Pick up spilled powder avoiding dusting conditions and place in a clean steel container for reclaim or disposal. Safety personnel should be involved when large spills occur.</p>	
<p>Traces of residue can be flushed to the sewer with much water dilution.</p>	
<p>DISPOSAL: Consider the following methods of disposing of scrap material: Use to neutralize waste acid; spread on surface or ground in an isolated protected area to react with CO₂ from the air to form CaCO₃ (limestone); or disperse in water, neutralize with hydrochloric acid, precipitate with soda ash and flush to sewer with much water to keep below 250 mg NaCl/liter. Follow Federal, State, and Local regulations.</p>	
SECTION VIII. SPECIAL PROTECTION INFORMATION	
<p>Provide general ventilation and local exhaust ventilation for dust control (or mist control if used as a water dispersion) to meet TLV requirements. Vent dust to appropriate collector. Provide approved dust or mist respirators or self-contained respirators for non-routine or emergency use above the TLV.</p>	
<p>Wear rubber gloves, protective clothing, long sleeve shirt with buttoned collar, apron, safety glasses or goggles, face shield, etc. to prevent skin or eye contact with this material as required for the conditions under which it is used. Use of protective creams on areas of skin exposed to dust has been recommended.</p>	
<p>An eyewash station and safety shower must be readily available where this material, or its water dispersions, are used.</p>	
<p>Remove severely contaminated clothing promptly and launder before reuse.</p>	
SECTION IX. SPECIAL PRECAUTIONS AND COMMENTS	
<p>Store in a cool, dry area in tightly closed containers. Protect containers from physical damage. Keep away from acidic materials and other incompatibles (See Sect. V).</p>	
<p>Prevent contact with clothing or with the body, or inhalation of dust or solution mist.</p>	
<p>Use due caution in mixing with water and handling the alkaline water dispersions of this material (milk of lime). Follow good personal hygiene practices. Wash thoroughly after handling.</p>	
DATA SOURCE(S) CODE: 1, 2, 4-9, 11, 14, 20, 47	
<p><small>Judgments as to the suitability of information herein for purchaser's purposes are necessarily purchaser's responsibility. Therefore, although reasonable care has been taken in the preparation of such information, Genium Publishing Corporation assumes no responsibility, makes no representations and assumes no liability as to the accuracy or suitability of such information for application to purchaser's intended purposes or for consequences of its use.</small></p>	<p>APPROVALS: MIS/CRD <i>J.M. Giesen</i> INDUST. HYGIENE/SAFETY <i>J.M. Giesen</i> MEDICAL REVIEW: 27 September 1984</p>

SAFETY DATA SHEET

Chem-Nuclear Systems, Inc.

SECTION I - IDENTIFICATION	
Product Name or Code No.	S-4
Physical Description	White granular substance
General Chemical Composition	salts

SECTION II - PHYSICAL DATA	
Boiling Point (F.)	Specific Gravity (H ₂ O = 1)
N/A	N/A
	True Density (Solids)
	2.7
Solubility In Water	Particle Size (Typical)
High	N/A

SECTION III - FIRE AND EXPLOSION HAZARDS		
Flash Point (Liquids)	N/A	
Fire Extinguishing Methods	water fog to keep containers cool	
Flammability (Solids)	N/A	
Explosive Limits In Air	N/A	Upper
		Lower

SECTION IV - HEALTH HAZARDS, HANDLING, AND STORAGE	
Toxicity	Avoid ingestion and prolonged skin contact
Recommended Handling	avoid excessive dusting
Recommended Storage	store in dry area

SAFETY DATA SHEET

Chem-Nuclear Systems, Inc.

SECTION V - REACTIVITY		
Stability	Unstable	Conditions To Avoid
	Stable XX	
Incompatibility (Materials to avoid)		strong alkalis, mineral acids
Hazardous Decomposition Products		
Hazardous Polymerization	May Occur	Conditions To Avoid
	Will Not Occur XX	

SECTION VI - SPILL PROCEDURES AND WASTE DISPOSAL	
Steps To Be Taken In Case Material Is Released Or Spilled	
flush with excess water	
Waste Disposal Method	
soil or sanitary landfill	

SECTION VII - SPECIAL PRECAUTIONS	
none	
EMERGENCY CONTACT: CNSI BARNWELL, SOUTH CAROLINA (803) 259-1782	



CHEM-NUCLEAR SYSTEMS, INC.

220 Stoneridge Drive • Columbia, South Carolina 29210

June 17, 1988
3145A

Mr. Ray Petrie
Commonwealth Edison Company
Quad Cities Station
22710 206th Avenue North
Cordova, IL 61242

Dear Mr. Petrie:

Mix testing performed subsequent to the problems encountered with the Quad Cities liner indicate that the amount of P-20 added to the waste was sufficient to absorb all free water in the liner, even if only 75% of the reduced amount was mixed into the billet.

Lab tests were performed to estimate the physical condition of the solidified product at Quad Cities, where only one-third of the planned amount of P-20 binder had been added to a liner containing radioactive resin beads saturated with LOMI chelating chemicals. The waste material was simulated by soaking 231 gm. of virgin MR-3 resin beads in 100 gm. of LOMI liquid overnight, and then adjusting the pH to 3.0 with about 7 gm. of 50% sodium hydroxide. From this mixture, two 100 ml. portions were transferred to small polyethylene cylinders to represent the geometry of the actual liner. Standard P-20 binder was then added in each case to a total of 33 gm. instead of the 100 gm. normally required. The following table shows that after oven curing for 24 hours no free liquid was generated if 75% of the binder had been dispersed in the waste.

	<u>Mix 1</u>	<u>Mix 2</u>
Simulated Waste	100 ml.	100 ml.
P-20 Added and Mixed	33 gm.	25 gm.
P-20 Spread on Top	None	8 gm.
Total P-20 Added	33 gm.	33 gm.
Condition of Product After Curing @ 145°F And Then Cooling To Room Temp. Before Opening Bottom Of Container	Hard - No Liquid On Bottom	Firm - No Liquid On Bottom

Based on processing logs and reports from the operator, which indicate proper mixing throughout the majority of the processing period, it can be theorized that a minimum of 75% of the binder was mixed properly and that there is no free water in the container.

If I can be of any further assistance, please contact me.

Sincerely,


James D. Jeffrey,
General Manager
Nuclear Services

REVIEW OF CHEM-NUCLEAR LETTER DATED JUNE 15, 1988

The premature hardening is more likely the cause of both thermal and chemical (lack of retardant) factors, rather than just thermal considerations as described in the Chem-Nuclear letter.

Solidification vendors should ideally perform PCP solidifications in an adiabatic, or at least, well insulated condition to avoid the situation whereby excessive heat dissipation from a small sample could yield a non-conservatively high indication of the hydration rate of the sample.

The Chem-Nuclear letter also implies in the response to Question #1 that the subject waste batch did not have a pH typical of LOMI/Resin waste. CECO later learned that the basis for this stems solely from Chem-Nuclear's pH measurement of several simulated waste samples rather than actual waste samples. CECO's current position is that the pH of the waste batch was very typical given the fact the pH of the spent solutions deposited on the resin was quite typical of other decons performed at CECO stations which involved the use of LOMI.

REVIEW OF CHEM-NUCLEAR LETTER DATED JUNE 17, 1988

This letter provides a basis for Chem-Nuclear's position that the liner is currently free of standing liquid. Although CECO was not on hand to observe the lab scale solidifications described in this letter, CECO agrees with the test methodology and the conclusions drawn therein.

ATTACHMENT C

- Past Practices of Using Surrogate Waste Samples in the Solidification of Decontamination Solutions at Quad Cities Station

- Discussion of Past CECO BWR Decontaminations

- Letter from P. DeNault (LN Technology) to S. Davis (CECo Dated July 14, 1988 Regarding LOMI Surrogate Sample Preparation

PAST PRACTICES OF USING SURROGATE WASTE SAMPLES IN THE
SOLIDIFICATIONS DECONTAMINATION SOLUTIONS AT QUAD CITIES STATION

The practice of using simulated waste samples for the Process Control Program (PCP) began in 1983 with the first decontamination of the Unit 2 Recirculation System Piping. Quad Cities was recognized as having one of the highest source terms in the country with dose rates on the risers of 1500 mrem/hr, on the suction and discharge piping of 500 mrem/hr and on the ring header 800 mrem/hr. Dose rates on the ion exchange columns and liner were estimated to be as high as 300 R/hr. Measured dose rates on ion exchange columns (remote reading) yellow results greater than 70 R/hr (detector next to a single column).

These elevated dose rates caused great concern for how much dose would be obtained in pulling an actual sample of waste. These ALARA concerns gave way to discussions on the use of simulated waste samples for the PCP. A simulated waste sample was able to be made that was believed to be equivalent to the real waste. The PCP was run without any difficulty and the formula scaled up for the full liner. The full liner of real waste behaved as expected with no problems arising. The practice of using simulated waste in the PCP was continued in future decontaminations for the same ALARA concerns.

CECo and its representatives have investigated whether the use of a simulated resin waste sample (rather than an actual waste sample) could have been a contributing cause of premature hardening. Although CECO recognizes that the use of the simulated sample was a violation of the vendor PCP and thus was a violation of Station Technical Specifications, CECO does not consider the use of a simulated sample to have been a contributing cause of the premature hardening for the following reasons.

The Chem-Nuclear PCP in use at the time the test solidification was performed did not call for the vendor to monitor either the temperature of the test mixture during hydration or the time required for the test mixture to harden. This established circumstances whereby it would be highly unlikely that premature hardening of the test solidification would have been detected prior to the performance of the full scale solidification. Thus, premature hardening of the contents of the liner would have likely occurred even had an actual waste sample been used.

PAST DECONS PERFORMED AT QUAD CITIES AND OTHER CECO STATIONS

The subject chemical decontamination was the sixth such performed at Quad Cities, and the eleventh performed at a CECO BWR. Enclosure 1 provides a summary of these decons. This chart had been provided to the NRC during the May 24, 1988 meeting. Each of the prior decon waste batches described therein had been successfully solidified in cement, all but one having been solidified by Chem-Nuclear.

During some decons it has become necessary to perform multiple decon solvent applications to the recirc discharge piping in order to obtain the desired reduction in radiation levels, or DF. In two cases, a subsequent decon involved the use of a decon agent different than that used in the initial decon. Yet another decon involved the use of a different decon agent to decon the Fuel Pool heat exchangers as was used on the recirc and reactor water cleanup piping. Yet, the solidification vendor had not encountered difficulty in performing the solidification prior to the subject case. Each of the previous waste batches were properly solidified with no free standing liquid.

The chemical characteristics of the subject batch of decon waste were evaluated in an effort to identify possible causes for the premature hardening of the contents of the liner. It can be seen from the enclosure that the pH of the spent solvent prior to deposition on resin, resin quantity and chelate concentration were not atypical in the subject batch. A review of the quantities of chemicals used in the formation of previous decon solvent batches also substantiates the conclusion that the subject batch was not atypical. These analyses show that if chemical characteristics of this batch of waste could have caused premature hardening of the cement, premature hardening would have likewise occurred during the solidification of one or more previous waste batches. From this, CECO concludes that the waste characteristics did not cause premature hardening of the cement.

ENCLOSURE 1

Commonwealth Edison BWR Chemical Decontaminations

Date Mo/Yr	Station-Unit	Decontamination						Solidification		
		Decon Vendor	Decon Agent	System Deconned	Metals Content	Resin Qty	Percent Chelates	Solution pH	Solidification Vendor	Solidification Binder
10/83	Quad Cities-2	London Nuclear	Can-Decon	Recirc	11.7 Kg	50 ft			Chem-Nuclear	Cement
3/84	Quad Cities-1	London Nuclear	Can-Decon	Recirc/RWCU	6.0 Kg	55 ft			Chem-Nuclear	Cement
1/86	Quad Cities-1	London Nuclear	LOMI (NP/LOMI)	Recirc/RWCU	8.4 Kg	168 ft	3.8	D5.5, S4.7, (D2.7), D4.3, R4.1	Chem-Nuclear	Cement
10/86	Quad Cities-2	LN Tech	LOMI (NP)	Recirc/RWCU	15.3 Kg	156 ft	3.9	D4.5, (OX6.0, DE2.0), S4.7, R4.7	Chem-Nuclear	Cement
9/87	Quad Cities-1	LN Tech	LOMI Can-Derem	Recirc/RWCU/ FC HX	9.2 Kg 13.2 Kg	94 ft 22 ft	6.6	D4.1, S4.3 R4.1	Chem-Nuclear	Cement
4/88	Quad Cities-2	LN Tech	LOMI	Recirc	5.4 Kg	119 ft	5.9	D4.4, S4.74	Chem-Nuclear	Cement
3/88	LaSalle-1	LN Tech	LOMI	Recirc	4.0 Kg	120 ft	5.4	D4.2, S4.3	LN Tech	Cement
11/83	Dresden-3	London Nuclear	Can-Decon	Recirc/RWCU	10.6 Kg	60 ft			Chem-Nuclear	Cement
11/84	Dresden-2	IT/PNSS	10% NS-1	Recirc/RWCU	18.5 Kg	400 ft			Chem-Nuclear	Cement
11/85	Dresden-3	London Nuclear	LOMI/LOMI	Recirc/RWCU	10.4 Kg	163 ft	4.6	D5.1, S3.9, D4.6, S5.1, R4.0	Chem-Nuclear	Cement
12/86	Dresden-2	LN Tech	LOMI/LOMI	Recirc/RWCU	13.9 Kg	160 ft	5.8	D4.4, S4.5, D4.5, R4.3, R4.7	Chem-Nuclear	Cement

ENCLOSURE 1

Commonwealth Edison BWR Chemical Decontaminations

Date Mo/Yr	Station- Unit	Decontamination							Solidification	
		Decon Vendor	Decon Agent	System Deconned	Metals Content	Resin Qty	Percent Chelates	Solution pH	Solidification Vendor	Solidification Binder
10/83	Quad Cities-2	London Nuclear	Can- Decon	Recirc	11.7 Kg	50 ft			Chem-Nuclear	Cement
11/83	Dresden-3	London Nuclear	Can- Decon	Recirc/ RWCU	10.3 Kg	60 ft			Chem-Nuclear	Cement
3/84	Quad Cities-1	London Nuclear	Can- Decon	Recirc/ RWCU	6.0 Kg	55 ft			Chem-Nuclear	Cement
11/84	Dresden-2	IT/PNSS	10 % NS-1	Recirc/ RWCU	18.5 Kg	400 ft			Chem-Nuclear	Cement
11/85	Dresden-3	London Nuclear	LOMI/ LOMI	Recirc/ RWCU	10.4 Kg	163 ft	4.7	D5.1, S3.9, D4.6, S5.1, R4.0	Chem-Nuclear	Cement
1/86	Quad Cities-1	London Nuclear	LOMI NP/LOMI	Recirc/ RWCU	8.4 Kg	168 ft	3.8	D5.5, S4.7, (D2.7), D1.3, R4.1	Chem-Nuclear	Cement
10/86	Quad Cities-2	LN Tech	LOMI NP	Recirc/ RWCU	15.3 Kg	156 ft	3.9	D4.5, (OX6.0, DE2.0), S4.7, R4.7	Chem-Nuclear	Cement
12/86	Dresden-2	LN Tech	LOMI/ LOMI	Recirc/ RWCU	13.9 Kg	160 ft	5.8	D4.4, S4.5, D4.5, R4.3, R4.7	Chem-Nuclear	Cement
9/87	Quad Cities-1	LN Tech	LOMI Can- Derem	Recirc/ RWCU/ FC HX	9.2 Kg 13.2 Kg	94 ft 22 ft	6.6	D4.1, S4.3 R4.1	Chem-Nuclear	Cement
3/88	LaSalle-1	LN Tech	LOMI	Recirc	4.0 Kg	120 ft	5.4	D4.2, S4.3	LN Tech	Cement
4/88	Quad Cities-2	LN Tech	LOMI	Recirc	5.4 Kg	119 ft	5.9	D4.4, S4.74	Chem-Nuclear	Cement



TECHNOLOGIES
CORPORATION

1501 KEY ROAD, COLUMBIA, S.C. 29201

(803) 256-4355

July 14, 1988
LN-88-00397/PW

Mr. Steve Davis
Commonwealth Edison
1319 South First Ave.
Maywood, IL 60153

Dear Steve:

To help you in your investigation of the recent Quad Cities decontamination resin solidification problem, I have prepared the following answers to questions which you communicated by telephone.

1. Lack of strong base anion resin in the resin sample given Chem Nuclear for the PCP.

The volume of LOMI loaded resin generated during a decon normally comprises 80-90% of the total waste resin expected. The other 10-20% is polishing resin used to remove traces of chemicals from the water prior to sending it to radwaste. The polishing resin is an equivalent mixture of strong acid cation (SBR) and strong base anion (SBA) resin, with 2/3 of the volume being SBR. Therefore, the percentage of SBR normally found in the liner is between 7-14%.

The mixed resin contains very little chemicals. If we assume a straight line relationship between concentration and conductivity, the weak base resins removed 97.5% of the chemicals used on the discharge side and greater than 93% of the chemicals used on the suction side at Quad Cities. We know that the strong base resins are only slightly depleted. This is by design since the column outlet water must be of a high purity.

Since the SBR contains very little of the chemical and since the anticipated SBR volume was small, our chemistry staff on site at the time a resin sample was requested decided to leave it out of the sample. It was assumed that the small amount of SBR resin would not affect the cement setting in the liner.

Data our waste group has generated during resin stabilization testing supports the above assumption. Our data show that LOMI resins and SBR resins can be stabilized with similar formulations. From this we can conclude that the SBR resins do not affect the PCP results.

LN TECHNOLOGIES

Mr. Steve Davis
July 14, 1988
Page 2

My personal recollection of previous decontaminations at Quad Cities is that no set procedure for preparing the resins for a PCP has been followed. The mix of SAC and WBA resins and the chemical loading used to simulate the LOMI chemical removal step is standardized. However, whether SBA resin is added is not documented and I know it has not been added in all cases, if at all.

Our decon procedures, approved by the plant and CECO staff, do not address waste processing operations. On jobs where LN has performed both the decontamination and waste handling, the PCP sample preparation is covered under separate waste procedures which are submitted for plant review with the decon procedures.

2. CECO and plant staff did not know that strong base anion was not added to the PCP resin sample.

LN has not received clear instructions nor have procedures been written on how to prepare a resin sample to support the Chem Nuclear waste processing operations. LN was asked to provide a resin sample, typical of that generated during a LOMI decontamination. CECO and plant staff may have assumed that SBA resins were added. LN staff, because of reasons given in item (1) have not added SBA resins.

3. The chemical loading on the PCP resins varied 10-20% with that calculated for the actual waste.

Our pre-decon calculations indicated that approximately 100 cubic feet of resin would be generated during the QC-1 recirculation system decontamination. In fact, an additional 21 cubic feet were generated due to unexpected operational problems during the decon. I refer to the high water level in the reactor vessel prior to the suction side decontamination. LN was requested to drain the excess water through their ion exchange columns to the plant radwaste system. This procedure produced the extra waste resin. Since no extra chemicals were used during this process, the extra resins effectively diluted the volume of LOMI resins and hence reduced the concentration of chemicals on the total resin volume.

The higher depletion factor for the actual resins is due to the dissolved iron, nickel, manganese from the oxide film which were removed by cation resin. The PCP resins were not depleted with simulated oxide cations.

LN TECHNOLOGIES

Mr. Steve Davis
July 14, 1988
Page 3

4. How was surrogate PCP sample prepared?

LN uses manufacturer's capacity factors adjusted to reflect actual field application experience to determine the chemical loading on the resins and hence the total resin waste volume to be generated. The same factors are used for the PCP resin sample.

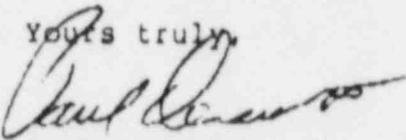
The required amount of vanadous formate, picolinic acid and sodium hydroxide is added to water to form a homogeneous mixture. The necessary amount of SAC and WBA resins are added to the beaker to absorb the ions. The mixture is stirred until the exchange process is complete. This occurs when the characteristic black color of the decon solution disappears and a water-white solution remains. LN has performed tests in its laboratories to show that greater than 90% of the chemicals are absorbed using this procedure. The PCP resins are essentially loaded to the same extent as the process resins.

The resins are then washed with demin water and stored until required for the PCP.

5. Why were cations not added to the PCP resins to simulate metals from the oxide film?

The exact amount of oxide film to be dissolved is not known prior to the decon. Because of this, it is very difficult to simulate the cation resin loading. As mentioned in section 1, virgin or undepleted resins are more difficult to stabilize with cement based processes. LN does not add metals to the PCP resin sample to create a worst case during PCP testing. If the PCP resins set and solidify when not fully depleted, the actual liner resins will behave accordingly.

I trust this information is satisfactory to your needs. Please feel free to contact me if further data is required.

Yours truly,


Paul Denault
Director
Chemical Decontamination Services

PD:pw

cc: Regan E. Voit
Dennis Farrar
Joe Sirovy

REVIEW OF LN TECHNOLOGIES LETTER DATED JULY 14, 1988

The use of WBA and SAC resin only in the preparation of the simulated waste sample as compared to the use of WBA, SBA and SAC in the full scale process is of very minor consequence. Again, even the use of an actual waste sample would not have prevented the event. The ratio of anion to cation resin in the simulated sample was very close to that in the actual waste. It seems likely that the influence on solidification chemistry of SBA and WBA would not be significantly different than that of just WBA. The vendor's field experience should be adequate to judge what constitutes an average metal oxide removal quantity to use toward producing a more representative simulated sample than by not factoring this into sample preparation at all. All of this is, of course, obviated by the use of an actual rather than a simulated PCP sample.

ATTACHMENT D

PLANS FOR DISPOSAL OF WASTE LINER

AND

IMPLEMENTATION SCHEDULE

4910K

PLANS FOR DISPOSAL OF WASTE LINER

AND

IMPLEMENTATION SCHEDULE

Based on discussion and correspondence (specifically, the June 17, 1988 letter from J. Jeffrey to R. Petri), Commonwealth Edison has confidence that the contents of the liner are solid. In order to assure that long-term stability of the liner, Commonwealth will encapsulate the liner using an approved procedure which represents a change to the Station PCP. This change to the Station PCP will be reviewed at both the Station and Corporate Level.

It is our intent to have Chem-Nuclear arrive at Quad Cities Station with the encapsulation equipment in mid-August following the complete on-site review of Chem-Nuclear documents in support of this effort. We anticipate that the encapsulated liner will be ready for shipment and ultimate burial in early September.

The revision to the PCP (which addresses the encapsulation procedure) will be submitted to the NRC in accordance with Section 6.9 of the Quad Cities Station Unit 2 Technical Specifications (DPR-30) via the Radioactive Effluent Release Report for the period during which the change was made. This report will be submitted to the NRC in February, 1989. However, an advance copy will be provided to your staff for information by August 15, 1988.

ATTACHMENT E

PROPOSED LONG TERM CORRECTIVE ACTIONS

4910K

PROPOSED LONG TERM CORRECTIVE ACTIONS

Commonwealth Edison believes that the problems experienced in the solidification of the LOM₁ liner were due to a number of factors. Chem-Nuclear provided a revised attachment to the station prior to the solidification attempt. This revised attachment addressed the deletion of lime from the recipe. This revision was predicated on both lab scale testing and the technical judgements of vendor personnel who are cement solidification chemistry experts. CECO does not have such expertise and therefore, would not have been able to anticipate that deletion of lime would have had such a severe adverse affect on the hydration rate as we now believe it did.

Nonetheless, CECO investigation into this matter brought to light some fairly broader weaknesses, i.e., the inadequate management/technical oversight of vendor's activities.

Consequently, Commonwealth Edison has committed to the following activities:

- (a) CECO will ensure that actual waste samples are used in the preparation of the test solidification of all waste batches at each of the CECO Stations.
- (b) CECO will perform and document reviews of all revisions to solidification vendors PCPs. CECO will initiate this review process prior to September 30, 1988.
- (c) CECO will ensure that the pH of all decon waste batches processed at each of the CECO stations will be properly adjusted per requirements of the vendor PCP.

Finally, as a result of this event, Quad Cities Station has developed a set of procedures to be used each time a waste batch of any type is solidified or dewatered. These procedures provide a mechanism by which the Station can ensure that adequate overview is maintained. These have been On-Site reviewed and approved.

It is Commonwealth Edison's position that these programmatic changes give us assurance that such an event should not recur.