UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

September 7, 1982

Docket No. 50-289

MEMORANDUM FOR: John Stolz, Chief, Operating Reactors Branch #4, DL

FROM: Richard Jacobs, Project Manager, Operating Reactors Branch #4, DL

SUBJECT: FORTHCOMING MEETING WITH GPUN CONCERNING REPAIR OF TMI-1 OTSGs

Date & Time: Wednesday, September 15, 1982
9:30am-3:00pm

Location: Phillips Building, P-422
Bethesda, MD

Purpose: To discuss GPUN's explosive expansion repair technique which will be used in the TMI-1 OTSGs.

Requested Participants: NRC-DEisenhut, GLainas, WJohnston, RBosnak, JStolz, CMcCracken, TIppolito, RJacobs, JRajan FYoung, Region I; ~~H. Gray, Region I~~

GPUN-RWilson, et. al.

NRC Consultants-FRC LLeonard, et. al.

Richard Jacobs, Project Manager
Operating Reactors Branch #4
Division of Licensing

cc: See next page

ORIGINAL TO J. DORR
4/13/82

J. Burr -

UNITED STATES
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Go

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FYoung, Region I; [redacted]

GPUN-RWilson, et. al.

NRC Consultants-FRC LLeonard, et. al.

Richard Jacobs, Project Manager
Operating Reactors Branch #4
Division of Licensing

cc: See next page

Thurs - Rm P118 @ 9 am.

MEETING NOTICE DISTRIBUTION

OPERATING REACTORS, DIVISION OF LICENSING

Docket File
NRC PDR
L PDR
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NSIC
ORB#4 Rdg
JStolz
Project Manager-RJacobs
GLainas
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OSD-3
SShowe, IE (PWR) or CThayer, IE (BWR)
Licensing Assistant
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RMattson
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Meeting Notice File
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MJambour
NRC Participants:
DEisenhut
WJohnston
RBosnak
CMcCracken
TIppolito
JRajan
FYoung, Region I
HGray, Region I

Regional Administrator
U. S. N. R. C., Region I

Babcock & Wilcox
a McDermott company

Nuclear Power Generation Division
3315 Old Forest Road
P.O. Box 1260
Lynchburg, Virginia 24505-1260
(804) 385-2000

September 13, 1982
GPUN-82-260

Mr. D. G. Slear
TMI-1 Project Engineering Manager
GPU Nuclear
100 Interpace Parkway
Parsippany, N.J. 07054

Attention: B. Elam

Subject: GPUN (TMI-1)
Master Services Contract, Effective Date February 4, 1982
Reference Nos: B&W 582-7105, GPUN C 290082
Task 3 - OTSG Tube Expansion Repair Program
Information Required to Support Precoat SER

Dear Mr. Slear:

The following questions were transmitted to B&W in a letter from R. C. Buff to R. Baker and J. Conklin dated September 7, 1982. Responses are provided as follows:

Question 1: Immunol - Manufacturer; commercial, industrial or nuclear grade; physical and chemical composition; procurement lead times, costs etc.

Answer: Manufacturer:

Harry Miller Corporation
Philadelphia, Pennsylvania

Grade:

The B&W Purchase Order will specify that the manufacturer provide Immunol X 236 and it will invoke a requirement for certification that it meets the contamination levels of the GPUN specification or to provide the results of chemical analyses on the lot supplied for use.

Physical and Chemical Composition:

Liquid - nonionic surfactant
Coconut diethanolamide and nonylphenol - 15 ethylene oxide

Procurement lead time approximately ten days for intermediate quantities. Cost approximately $5.00 per gallon.

Question 2: B&W certification that Immunol will satisfy limits of GPUN SPEC 1101-22-006-R4 (chemical constituents).

Answer: Certification to meet GPUN specification 1101-22-006-R4 will be provided via certification from the supplier, chemical analysis from the supplies or chemical analysis from B&W. A minimum of one week following receipt of sample is required for B&W to perform chemical analysis.

Question 3: B&W confirmation/certification that Immunol remaining in the RCS will have no deleterious effect on performance/safe operation of the primary system.

Answer: B&W will provide a letter to GPUN documenting that Immunol X 236 is acceptable for use on RCS components and that residue remaining after removal by felt plugs or wiping and water flush will not have a deleterious effect on performance and/or operation of the primary system. For the specific case of TMI-1, however, additional work is underway to test for reactions with combinations of sulfur and kinetic expansion residue.

Question 4: B&W technical description and sketches providing the method of precoating and cleaning/removal, anticipated doses for precoating and cleaning/removal, and ALARA assessment.

Answer: Application/Removal:

The application method of Immunol will consist of a three part system:

(a) Spray to coat the heads and tubesheets,

(b) Recirculating system to apply Immunol from the upper tubesheet down through the tubes, and

(c) A pipe ring in the lower head fed with air to bubble Immunol up through the tubes.

The removal method will be to use Ph controlled demineralized water to wash down the coated surfaces. Inaccessible areas will be isolated. Felt plugs will be used as part of the removal of expansion residue and will be blown through the tubes. Inaccessible areas which will be plugged include:

(a) Hot legs, cold legs, and

(b) Tubes with explosive plugs in the upper tubesheet

Radiation exposure estimates will be provided when the details of the tooling have been identified.

Question 5: Impact of introducing Immunol to the secondary system (small amount of leakage through cracked tubes). Also a discussion of the effect of leakage into the crevice prior to expansion.

Answer: The introduction of Immunol into the secondary system in small quantities is not considered a contaminant problem for two reasons. First, the secondary system is equipped with condensate polishers, which are capable of removing contaminants from the secondary system prior to plant startup. Secondly, at operating temperature, Immunol will volatilize in the secondary system, and subsequently be removed.

For the specific case of TMI-1, the secondary side nitrogen pressure should be maintained higher than the primary side pressure during the time period up to the completion of expansion. Immunol in the crevice prior to expansion might prevent forming a good joint.

Should you have any questions or comments regarding this information please contact me at (804) 385-2611 in Lynchburg.

Very truly yours,

L. J. Stanek
Engineering Product Manager

LJS/sdl

cc: R.L. Long
J.J. Colitz
M.J. Graham
D.W. Demers
H.D. Hukill
R.A. Knief
J.A. Mahn
R.J. Toole
L.R. Allen
W.J. Smith
F.R. Faist
C.K. Lee
R.E. Kosiba

bcc: P.E. Troy
R.E. Wascher
B.A. Karrasch
J. Veenstra
Record Center T13.3.3.5
J.F. Pearson
D.G. Culberson
R.J. Baker
L.D. Dixon
J.R. Concklin
[redacted]

9/17/82

To: J. Durr
From: H. Gray
Subject: TMI-1 - Bethesda Meeting 9/15/82 on Kinetic Expansion of OTSG Tube Ends in UTS

(1) Attached is attendance list
(2) " is C.V. Dodd memo of 8/17/82 on E.C. from Aug 8-9 meeting - GPU - NRC at TMI.
(3) Meeting of 9/15/82 Summary
  (A) GPU and consultants and NRC and Consultants all agree that there is no technical reason why kinetic expansion of tube ends should not proceed.
  (B) H Gray questions / concerns
    a) Monitor or check air after some shots to confirm no contaminating element was introduced such as Cu, Pb, Cl, S, P, Hg.
    b) Side 2 - N_2 blanket over H_2O with 10°F reduction in Dew Point - What is proof that this is adequate to keep H_2O out of tube / tubesheet crevice? Should margin be more?
    c) Separation of high / low grain perfect channels is accomplished by color code of channels.
(4) GPU presentation is attached. — H Gray —

60

GPU/NRC

SEPT 15, 1982 MEETING

TMI-1 OTSG REPAIR

R JACOBS	NRC - OL
C. McCRACKEN	NRC - DE
J. Rajan	NRC DE
Bob BARRATT	F W
DAVE Pai	F.W.
JOHN PEARSON	B&W
RE Kosiba	B+W
DAVID G. SLEAR	GPUNC
Philip R. Clark	GPUNC
VINCENT K. LUK	FRC
JOSEPH J COLITZ	GPUNC
Ralph E. Nieding, Jr.	GPUNC
JOHN T. FIDLER	GPUNC
Larry Leonard	ERC
Mary Jane Graham	GPUNC
P. Scott Gracobbe	GPUN
THEODORE A. SHOCK	FRC
Charles T. Davey	FRC
Lynn Connor	The NRC Calendar
S. P. MAINGI	Pa BRP, DER
RICHARD MAJOR	ACRS
EARL J. BROWN	NRC/AEOD
H.L. BRAMMER	NRC/DE/MEB
ED WALLACE	GPUNC
SV Weems	MPR Assoc.
John Condelini	Babcock & Wilcox

[illegible]	[illegible]
John F Stolz	NRC - OL
Louis Franke	NRC/DE/MTEB
Harold Gray	NRC - RI
F YOUNG	NRC - RI
G. LAINAS	NRC/DL

Letter No. 0817-34-82

INTRA-LABORATORY CORRESPONDENCE

OAK RIDGE NATIONAL LABORATORY

From L. Frank

August 17, 1982

To: R. W. McClung

From: C. V. Dodd C. V. Dodd

Subject: Travel to Harrisburg, Pennsylvania, August 8–9, 1982

On Monday, August 8, I met with General Public Utilities (GPU) and NRC personnel to discuss the eddy-current inspection of the Three-Mile Island Unit 1 steam generators. A partial list of attendees is attached. Nick Kazanas of GPU gave a presentation of the development and qualification program for the eddy-current inspection of the steam generators. A set of inside diameter calibration standards with circumferential notch lengths of 0.060, 0.100, and 0.187 in., notch depths of 20, 40, 60, and 80%, and widths of typically 0.004 to 0.005 in. were constructed. In addition, an axial notch standard with 0.060 in. long notches was constructed.

These standards were used to test circumferential differential probes of 0.510 and 0.540 in., and an eight-coil array with 0.187 in. outside diameter pancake coils. Various gain and other conditions were run. The best combination for the differential coil system was the 0.540 in. outside diameter probe with a permanent magnet saturating core and a gain setting of 60. The permanent magnet should not have increased the signal any but only reduce the noise a small amount. I examined a probe and its field did not seem strong enough to saturate any ferromagnetism associated with Inconel (about 0.3 T is usually needed). However, it did seem to be more carefully made than the regular 0.540 in. probe. An additional mix of the 200 and 400 kHz mixed signal with an 800 kHz signal reduced the noise due to probe chatter and pilgering.

The 8X1 absolute probe showed more signal to the small defects at a gain of 53, but a fairly large lift-off signal was also present. The 8X1 probe array is being revised to increase the probe body from 0.520 to 0.540 in, which should reduce the lift-off problem.

A correlation of the defects seen by the pancake coils with the defects seen with the 0.540 in. outside diameter differential probe showed that of 3233 defects detected by the pancake coil, 3216 were also detected by the differential probe. This number was improved to 3229 by using the mix to reduce the inside diameter noise. This shows an excellent match and also showed that the 0.540 in. differential probe, operated under these conditions, can reliably detect the same type of circumferential crack. In order to directly apply the results obtained from the electrodischarge machined standards, an "effective axial crack width" for these intergranular stress-corrosion cracks must be determined.

On Monday afternoon, John Janiszewski of GPU gave a presentation of the results of the metallography of the cracks. Some cracks appeared to have regions of bulk intergranular attack associated with them, and some appeared to be very narrow with very little branching and axial component. However, the crack would only need a few branches to effectively disrupt the flow of eddy currents.

John Janiszewski will generate an "effective axial component" by reviewing the results of the previous metallography and furnish it to us. This number will show how applicable the calibration results from electrodischarge machined notches is for the circumferential cracks, and furnish an independent verification of the ability to detect the defects with a different probe. The results of a dimensional analysis experiment using large scale models at ORNL will be used to correct the sensitivity at one length to the sensitivity at another. It was stated that the region near the crack was depleted in chrome, but no estimate was made of the bulk electrical and magnetic properties of the region. A total of 19 ft of "good" tubing has been examined by metallography, with an additional 6 ft to be examined. No defects were detected by this test that were missed by the eddy-current test. Some of the defects detected by the eddy currents were not found by the metallographic examination, probably due to the way the samples were cut. Some of the eddy-current signals turned out to be due to manufacturing, handling, and assembly artifacts, and would not be detrimental to the service of the tube.

On Tuesday I visited the data reduction site at the Host Inn near the plant. I reviewed the results of the scan on tube A71-126. This tube was pulled and a section sent to ORNL for examination. A through-wall defect was detected using a high-frequency (5 MHz) scan with a small (0.020 in. mean radius) probe from the outside. The defect was then etched and showed a 0.005 to 0.010-in.-wide affected region on the outer surface. It is not known if this entire region appears as a low conductivity region or not. The defect was recorded as 80% through-wall by ConAm, and a blind remeasurement of the defect from tape showed 84%. The magnitude of the signal was 1/2 V at a gain of 34, and an 0.510 in. outside diameter differential probe was used.

I also looked at runs using the 0.540 in. outside diameter differential probe with a gain of 60. The practical noise level to get a reasonable measurement of the defect depth appears to be around 0.5 V, although in many cases smaller defects can be measured. Based on the 0.005 in. wide standards, this falls in the range of a 0.060 in. long defect, 40% through-wall. Depth measurements on smaller defects will probably be very inaccurate.

A 100% inspection of the full length of all the tubes is being performed using the 0.540 in. probe with a gain of 60. The number of indications is about three times as many as were observed with the 0.510 in. differential probe. Tube 810-48 showed 16 inside diameter defects, all about 1 V in amplitude, between 30 and 60% of the wall. The lowest defect was near the third support plate. The high sensitivity of this new inspection is also

picking up a number of outside diameter signals from the manufacturing process, which are not detrimental to the service and can be ignored. The tubes that exhibit the inside diameter signals should be rescanned with the 8X1 pancake coil array, and the tubes with defects greater than the plugging limit plugged. The tubes with defects below the plugging limit can be reexamined at later intervals to monitor growth of this type of defect.

There appears to be a drift and a quality assurance problem with the probes. This problem doesn't affect the accuracy of the test, but results in frequent probe changes. The inclusion of several of these types of defects in an in-line standard (for future tests) should be considered. The instrument gain in the field is set to give a repeatable voltage amplitude from a drilled hole flaw, rather than an absolute number.

The pancake coil array is operated at a single frequency and much more susceptible to different types of noise than the differential probe. This array also requires much more equipment than the differential probe. Zetec is working on a more compact system, but no estimate of the availability of this instrumentation was given.

The results that I saw on Monday and Tuesday answered all the previous questions that Emmett Murphy had submitted in his letter of April 12, 1982, except the one on safety evaluation. Some attempt should be made to determine how large a defect would have to be before it would present a safety problem. I feel that the defects that can now be reliably detected are much smaller than those that would present a hazard, but have no information to back this up.

The study, done by the utility, their contractors, and the EPRI NDE Center to determine their sensitivity limits, was outstanding.

CVD:jlb

cc: R. Barley, GPU
J. H. DeVan
L. Frank, NRC
J. C. Griess
F. J. Homan
N. Kazanas, GPU
A. L. Lotts
C. McCracken, NRC
J. Muscara, NRC
P. Patriarca
G. M. Slaughter
J. H. Smith
P. Wu, NRC
C. V. Dodd/File

9/17/82

To Conrad McCracken

From: H. Gray

Subject - TMI #1 9/15/82 Meeting - Comments

H. Gray comments/questions that were discussed but not answered are:

1) Will the air in the OTSG upper head be checked for contaminating elements such as - Cu, Pb, Cl, S, P, Hg after some (or all) shots to confirm that a mixup has not occurred?

2) Is the 10°F Dewpoint Reduction in the Side two N_2 gas space adequate to prevent H_2O introduction into the tube/tubesheet crevice from crevice dryout until completion of Kinetic Expansion? Should dew point margin be more?

Harold Gray
RI - 488-1325

(1)

9/15/82
N Gray

TMI I

(AM)

OTSG Kinetic Tube Expansion

Strain Gauges - on Tubes @ M.V. - No effect during/after shot.

D.S. (GPU)

(1) Restart Safety Analysis Report - Due ≃ Nov 1

(2) 9/15/82 - Meeting -

(3) 3rd Party Review by GPU Consultant - to be out ≃ 9/22/82.

Crevice Tests DONE - ≃ 3 weeks to Start Expansion -

29 Tube Samples have been removed

CRx - Primary Side initiated - Circumferential

(4) Questions - Rounded holes w/ Plugs ≃ 1/2" deep - Comment if Changed.

(RB) - FW

(5) one FW Block to be pulled at elevated temperature.

Strain Failure Criteria = S.F. ≃ 37.5

(AE) Monitor Air in S.G. to demonstrate no Lead, Copper etc introduced if explosive materials are mixed — Potentially

↳ Monitor program - Air samples for selected materials - Pb, Cu, Mg, S. etc., Cl

(7) Dehumidifier Side 2 - Criteria - Dew point 10°F Below Tubesheet Temperature - Why not lower - how determine T.S. Temp ?

(8) High-Low Changes - how separated.

(2)

H Gray
9/15/82

TMI OTSG

QUESTION / COMMENTS

1) MONITOR AIR IN S.G. AFTER ALL OR SOME OF SHOTS TO CONFIRM Pb, Cu, S, Cl, etc ARE NOT BEING INTRODUCED BY EXP. MATERIALS. — GPU will consider

2) SIDE TWO - PLANT is MAINTAIN humidity BELOW DEW POINT BY 10°F BASE ON T/S Temperatures. COULDN'T THIS BE LOWER FOR GREATER MARGIN? — Per GPU not a problem — D. Sklar

3) HOW ARE LOW CHARGE AND HIGH CHARGES SEPARATED AND IDENTIFIED. TO PREVENT MIXUPS — 19 G/Ft - CLEAN — (4 Gr/Ft - Color code)

4) HOW MANY STRAIN GAGES ON TUBES AT B&W MT VERNON. — Equivalent 205 = Mt. Vernon SG, 177 = TMI-1 SG.
↳ IN the field (difference between 205 & 177
→ DATA - 132 TUBE Row - end - ½ Yield STRAIN. (33,400 psi STRESS) 80 TUBE Row — By CAST CHANGE IN THE Row — No RESIDUAL STRESS
B&W to PROVIDE GPU WITH Report ON STRAIN GAGE -
QUAL PROGRAM REPORT - OUT 10/1/82 INC. STRAIN GAGE RESULTS
FRC * VISIT LYNCHBURG & REVIEW TEST DATA.

9/15/82

(3)

(PM) VL-FRC - Tie in of Test Data
Test Blocks + M.V. test

One shot Tests - Slight Tube Shrink - 0.001"/7" Length.
Tw " " - ± "0" Tube Shrink
{Criteria - MAX Shrink in Tube preload = 30#
" " Length ± .010" }

FRC-List of Reqd Documents - Info.
- Project. Report BTW
- FSAR - Reports - Figures, etc.
- Contr. Doc July 21 - Livingston meeting (Mechanical Testing Program)
- etc. -
- → 3 Reports + Meeting in Lynchburg for FRC to Finalize.

9/15/82

Thurs (4)

TMI-I - Kinetic Expansion - OTSG Tubes

Questions / Comments

1) Monitor or check air in OTSG after shot to prove no contamination by elements ~~of~~ like Cu, Pb, Cl, S, P, Hg. Possibly on a spot basis - once each 5 shots or so.

2) Side two of tubes (crevice side) - PLM is to maintain humidity to dew point 10°F above tube sheet temperature - Is this enough margin to prevent condensation / wetting of crevice considering possible fluxations in temperature & conditions?

3) How are high + low grain / ft. charges separated and identified to prevent mixups?