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35 Station 21

ENGINEERING DATA TRANSMITTAL

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Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
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(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1	1	Cog.Eng. AR Tedeschi	[signature]	9-14-94	S2-45	Operations JR Biggs	[signature]	9/14/94	T4-01	1	1
1	1	Cog. Mgr. SH Rifaey	[signature]	9/14/94	S2-45	RS Popielarczyk	[signature]	9/14/94	R1-30	1	1
1	1	QA DC Board	[signature]	9/14/94	S1-57	RE Raymond			R2-54	3	6
		Safety				JD Long			R3-82	3	
		Env.				GA Barnes			H5-09	3	
1	1	Other TL Moore	[signature]	9/14/94	H5-09	WF White			L7-06	3	
1	1	Other RP Anantatmula	[signature] For	9/14/94	R1-30	SG Pitman			P8-44	3	

18.	19.	20.	21. DOE APPROVAL (if required) Ctrl. No.
T. L. Moore [signature] 9/14/94 Signature of EDT Originator / Date	S. H. Rifaey [signature] for 9/14/94 Authorized Representative for Receiving Organization / Date	S. H. Rifaey [signature] for 9/14/94 Cognizant Manager / Date	[] Approved [] Approved w/comments [] Disapproved w/comments

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Document Number:	WHC-SD-WM-ETP-119, REV. 0
Document Title:	Engineering Task Plan and Status of 241-S-106 Enraf Level Gauge Wire Break
Release Date:	9/14/94

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This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

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WHC Information Release Administration Specialist:

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APPROVED FOR PUBLIC RELEASE

9/14/94 D. Solis

6. Author

Name: T. L. Moore

T L Moore 9/13/94

Signature

Organization/Charge Code

7EA30/N3064

7. Abstract

This document outlines the approach taken to resolve the Enraf Level Gauge wire breakage on the gauge installed on Tank 241-S-106. It also collects the documentation gathered as of 9/13/94.

9. Impact Level N/A

10. RELEASE STAMP

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REV. 0

ENGINEERING TASK PLAN AND STATUS OF 241-S-106 ENRAF LEVEL GAUGE WIRE BREAK

Author
T. L. Moore

September 1994

Filename: PLAN

ETN-94-0036

TABLE OF CONTENTS

ENGINEERING TASK PLAN AND STATUS OF 241-S-106 ENRAF LEVEL GAUGE WIRE BREAK

1.0 ABSTRACT

Enraf[1] Series 854 level gauges have been selected to replace aging and obsolete Food Industry Corporation (FIC) level gauges in underground waste storage tanks. Installation began early in fiscal year 1994 with a total of 18 gauges scheduled during the fiscal year. One of the installations in tank 241-S-106 (S-106) experienced the loss of a displacer after about 10 weeks of service due to failure of wire which holds the displacer in the tank. A task team was formed which identified the need for short-term actions to re-establish tank waste level monitoring and to permanently address wire failure. The failed wire was removed and sent to Pacific Northwest Laboratory (PNL) for analysis. It was determined that the cause of the wire failure was due to chloride ion stress corrosion cracking (SCC) of the 316 stainless steel (SS) wire. Radiation induced breakdown of the polyvinyl chloride (PVC) riser liners is suspected to be the source of the chloride ions.

The short-term actions include confirming the source of the chloride ions while continuing to monitor liquid levels. The S-106 gauge was placed back into service with newly cleaned 316SS wire for two weeks, after which it will be removed for analysis. All wires from gauges installed this year will be removed as soon as possible and replaced with new 316SS wire. The wire that is removed will be analyzed for chloride ion accumulation. All wires will be replaced at intervals as determined necessary by the results of the analyses.

The long-term solution will be to determine the most suitable wire material for use in existing conditions within the tanks. It will also consider the implications of removing the PVC riser liners and the consequences of leaving them in place.

The conclusion of the short-term path and identifying the long-term solution is expected to be complete in time for a November 7 start of implementation of the long-term solution. This date would also be the latest date for resumption of Enraf level gauge installations in additional tanks.

2.0 BACKGROUND

The measurement of liquid levels in underground waste storage tanks at Hanford is the primary method of early leak detection and detection of

[1]Enraf, Inc., Houston, Texas.

intrusion of liquids into the tanks. The age of the tanks and the history of the single-shell tanks developing leaks resulted in a high priority being placed on early leak detection. The gauges used for many years for this purpose are no longer available and are rapidly failing. As a result, continued and uninterrupted level detection is a critical activity for monitoring the status of the waste being stored in underground tanks.

After extensive evaluation and testing, the Enraf Series 854 level gauge was selected to replace FIC gauges as the primary instrument for monitoring waste surface levels in waste storage tanks within Westinghouse Hanford Company Tank Waste Remediation System (TWRS). The wire from which the displacer is suspended was selected based upon historical use of 300 series stainless steel for instruments to be placed in the tanks. The wire purchased for installation on the gauges is 316SS. After about 10 weeks of service, the displacer attached to the gauge installed in tank S-106 separated from the wire, resulting in an error message on the gauge readout which indicated that the displacer was missing.

3.0 ACTIONS TAKEN

The wire was retrieved from the tank vapor space by instrument technicians. It was observed through the riser adapter sight glass that the plummet was missing and that the wire looked black and rough. A task team was identified to evaluate the occurrence and recommend a solution. The task team included representation from TWRS Engineering, TWRS Plant Engineering, PNL Material Sciences, TWRS Corrosion Engineering, TWRS Operations, Quality Assurance, and the U.S. Department of Energy, Richland Operations Office. After examination and laboratory analysis it was determined that the 0.008 inch diameter wire had separated due to SCC leaving behind a corrosion product with high chloride ion content. Laboratory analyses were also completed to determine if chloride ions were present at other locations along the length of the wire, but no significant amount was found. The length of the remaining wire was measured and it was determined that approximately four to six feet of wire were missing. This conclusion was based on the vendor's stated length of wire supplied. The wire material was analyzed to determine if it was in fact 316SS as ordered from the gauge manufacturer. It was confirmed to be 316SS. PNL Material Sciences and TWRS Corrosion Engineering identified the most probable cause of the corrosion as the breakdown of the PVC riser liner into compounds containing chloride ions that contacted the wire. The breakdown of PVC under radiation into these compounds is well documented in technical literature. The small diameter wire and its stress would make it particularly vulnerable to chloride ion corrosion.

Operations took vapor samples from the tank vapor space and inside the PVC liner and found no evidence of chlorine. Operations also took a swab of the inside of the PVC liner. Litmus paper attached to the swab did not indicate the presence of acids or bases. This swab was visually examined and was observed to be dry. The analysis has not yet been completed so it is not known whether high levels of chloride ions are present inside the PVC liner.

4.0 RECOMMENDATIONS

The solution to this occurrence was recommended to be broken down into a short-term and a long-term solution. The recommended short-term path covers about two months time and concentrates on identifying the source of the chloride ions that caused the S-106 wire breakage and determining if any of the other gauges currently installed are being exposed to the same corrosive conditions. All installations of Enraf level gauges beyond those scheduled for this fiscal year are on hold until this issue is resolved (estimated to be about November 7, 1994). This recommendation allows the continued measurement of liquid levels while evaluating corrosive conditions in tanks where Enraf gauges are installed. Emergency replacements for failed FIC gauges will be considered on an individual basis.

The long-term path is recommended to begin in parallel with the short-term path. The problems/issues listed below would be analyzed, and documented recommendations would be issued. It is expected that this effort will take approximately two months to be completed in parallel with the short-term path and will result in implementation beginning about November 7, 1994.

5.0 SHORT-TERM PATH

5.1 Existing Installations

The short-term solution for tank S-106 is to put the Enraf level gauge back into service with another drum containing 316SS wire that has been cleaned to ensure that no chloride ions are present on the surface prior to its use, and then remove the wire after two weeks (about September 9) and analyze it for any signs of chloride ions or chloride ion induced corrosion. At the same time it would be replaced with another drum containing 316SS and placed back into service. This new drum will be removed one month later for analysis if no significant amount of chloride ions are found on the wire from the previously removed drum. If significant amounts of chloride ions are found, a decision will be made at that time regarding the next step in the short-term path. This would provide two benefits: 1) to get the gauge back into service; and 2) to determine if there are any signs of chloride ions accumulating on the wire.

As soon as they can be scheduled (the team recommends one per day), all other Enraf gauges currently installed will have their drums replaced and the removed wires will be examined and analyzed. As each drum is removed, it will be replaced with one containing 316SS wire and put back into service. Whether or not they are again replaced will depend upon the analyses results. It is expected that all drums can be removed and the analyses completed within one week after the removal of the S-106 one month in-tank wire test. If this schedule can be met, a decision date of October 21 is expected for identifying the cause of the S-106 wire failure.

In the meantime both PNL Material Sciences and TWRS Corrosion Engineering identified tantalum wire as a potential short-term fix for all tanks that currently have Enraf gauges installed. This recommendation carried with it a caveat that the tantalum wire should not come into contact with the caustic waste since tantalum, while being very resistant to oxidizing and reducing acids, is fairly resistant to dilute caustic solutions but is attacked by strong (>14pH) caustic solutions. Tantalum is also sensitive to galvanic corrosion and must not contact the steel riser. This makes it a candidate for installation in PVC lined risers only. The use of tantalum was discussed in a meeting on September 2 but was not considered to be acceptable because of the caveat. Instead, the task team recommended that gauges currently installed have their wires removed for analysis and replaced with new 316SS wire. It was agreed that installations of Enraf gauges with 316SS wires could proceed on tanks where the riser to be used does not contain a PVC liner.

5.2 Risk Summary

The most probable source of chloride ions is the PVC liner. This conclusion will be finalized if chloride ion contamination/corrosion is found from other wires within PVC liners and not on wires within plain carbon steel risers. If no further accumulation of chloride ions is noted from wire inspection, it can be assumed that the chloride ion contamination came from the installation or manufacturing process. At this time, however, it is prudent to conclude that all 316SS wires of the installed Enraf gauges within PVC liners are potentially corroding and risk failure.

This conservative assumption is the basis behind replacement of all existing Enraf wire drums. While the data gained from analysis of the removed wires is valuable to the final analysis, the replacement is more beneficial for minimizing risk of further wire failure and displacer loss.

Some corrosion may have occurred already on the wires being replaced. The removal activity, including wrapping it on the spool, may cause its failure at the weakened location. In this case, the replacement activity just accelerated a failure already in process, which would not have been possible to stop.

The failure on loss of wire and displacer in tank S-106 was analyzed by Unreviewed Safety Question Screening "aka Safety Review" 8D114-RJVV-94072. It concluded that this action is within the accident basis and risk acceptance guidelines. The effects on retrieval and impacts on supernatant pump operation have not been documented. Documentation of these impacts will occur as part of the final retrieval plan recommendations.

6.0 LONG-TERM PATH

The long-term solution is to be completed in parallel with the short-term corrosion testing. If this is done, then October 21 should also be the date for identifying the long-term solution. Allowing a couple of weeks for documenting and approving the recommended long-term solution will allow implementation to begin about November 7. It is expected that the long-term solution will identify a wire material that is most compatible with the tank waste and any other considerations, such as PVC degradation, etc. It will also consider removal of PVC liners, its benefits, and its potential problems. A detailed plan will be written which identifies the criteria for successfully completing the long-term solution.

7.0 OTHER RECOMMENDATIONS

Other recommendations include proceeding on schedule with the installation of Enraf gauges in tanks 241-AW-101, 241-T-109, and 241-C-106. Tank 241-C-106 will use a riser with no PVC liner; therefore, no corrosion problems are anticipated. Tanks 241-AW-101 and 241-T-109 will have their wires removed and replaced after two weeks for analysis just as is being done on the wire from S-106. If any sign of chloride ion accumulation is found on any of the wires being analyzed, then the wire will be replaced every two weeks, or as appropriate based on the amount of chloride ion accumulation, until the long-term solution is identified and implemented.

8.0 PROBLEMS/ISSUES FOR LONG-TERM RESOLUTION

8.1 Identify source of chloride ions that caused S-106 Enraf gauge wire breakage.

8.2 Evaluate wire on all gauges currently installed to determine if chloride ions are present.

8.3 Select wire for future installations that will not be susceptible to corrosion caused displacer separation.

8.4 Determine effects of PVC liners being left in risers and recommend whether or not to remove them.

8.5 Determine and document potential long-term effects of PVC dropping into the tanks.

8.6 Determine and document the effect of displacers falling into the tanks on mixer pumps, transfer pumps, pretreatment and treatment of waste, etc.

APPENDIX A

Internal Memorandum, September 2, 1994
R. P. Anantatmula to R. S. Popielarczyk
"Recommendation of Material for Enraf Gage Wire"

Westinghouse
Hanford Company

Internal
Memo

From: Corrosion Engineering
Phone: 373-0785 R1-30
Date: September 2, 1994
Subject: RECOMMENDATION OF MATERIAL FOR ENRAF GAGE WIRE

RECEIVED
SEP 6 1994
T.L. MOORE

To: R. S. Popielarczyk R1-30

cc: W. G. Brown	S2-45	D. A. Reynolds	R2-11
W. C. Dunbar	R1-30	S. H. Rifaey	S2-45
T. L. Moore	H5-09	A. R. Tedeschi	S2-45
P. C. Ohl	R1-30	W. F. White	L7-06
		RPA File/LB	

References:

(1) Metals Handbook, 9th Edition, Volume 13, Corrosion, ASM International, Metals Park, Ohio, 1987.

(2) WHC-EP-0772, "Characterization of the Corrosion Behavior of the Carbon Steel Liner in Hanford Site Single-Shell Tanks", Westinghouse Hanford Company, Richland, Washington, June 1994.

This memo addresses the action items assigned to Corrosion Engineering at the 8/29/94 ENRAF level gage wire failure evaluation meeting. The action items are as follows:

1. Recommend a wire material that is suitable for use in waste tanks with polyvinyl chloride (PVC) liner inside the carbon steel riser from the stock of materials that is currently available from ENRAF, INC.

2. Recommend a wire material that is suitable for use in waste tanks with no PVC liner inside the carbon steel riser from the stock of materials that is currently available from ENRAF, INC.

3. What is the worst case scenario for corrosion if PVC liner pieces fall in the waste and sink to the bottom of the tank.

According to the discussions at the 8/29/94 meeting, ENRAF supplies AISI type 316 stainless steel (316), Invar, Hastelloy C-4 and tantalum wires for use with the tank waste surface level detectors. Of the four material types provided by ENRAF, tantalum wire is best suited for use in tanks with PVC liners already in place. Tantalum has excellent resistance to corrosion by oxidizing and reducing acids and is fairly resistant to dilute alkaline solutions. Although the level detector wire is not expected to be in contact with the waste, it is important to note that tantalum is attacked by strong alkaline solutions (pH>14) even at room temperature (1) and the small cross sectional area of the wires used in the present application provides very little corrosion allowance. It should be pointed out also that there is no available data directly supporting the use of tantalum wire in our waste environments. In addition, it is assumed for the present analysis

R. S. Popielarczyk
Page 2
September 2, 1994

that the PVC liner is continuous and there is no possibility of a galvanic couple developing between the tantalum wire and the carbon steel riser.

For waste tanks with no PVC liner, 316 wire will provide acceptable corrosion resistance. The primary concern with 316 is chloride stress corrosion cracking (chloride SCC), however, the low chloride levels (in the absence of a PVC liner) significantly reduce this concern. Please note that Hastelloy C-4 is expected to provide superior resistance to chloride SCC at a higher cost.

The worst case scenario for dropped PVC liner pieces is:

> "Rapid release of chlorides from PVC leading to localized pitting of the tank bottom".

Such localized attack is expected only in tanks containing waste at pH<12 (2). This scenario assumes that the PVC is degraded enough by radiation that it will quickly release all the harmful chloride ions locally to the steel in contact. The localized pitting effect may be somewhat tendered since the chloride ion migration is diffusion controlled and is driven by concentration gradient as opposed to direct infusion.

I hope that the above discussion of the three action items is adequate for your purpose. I would like to bring to your attention, however, that this is only a short-term fix. If the PVC liners are not going to be removed from the tanks that already have them in place, we should select a material that is compatible for use in both types of tanks, i.e, tanks with and without PVC liners. Should you have any questions or need additional assistance, please feel free to call me on 373-0785.

R. P. Anantatmula

R. P. Anantatmula, Fellow Engineer
Corrosion Engineering

APPENDIX B

Laboratory Data from PNL

CORRESPONDENCE DISTRIBUTION COVERSHEET

Author	Addressee	Correspondence No.
R. S. Popielarczyk 3-5751	S. G. Pitman, PNL	9455637

Subject: LETTER OF INSTRUCTION (LOI)

INTERNAL DISTRIBUTION

Approval	Date	Name	Location	w/att
		Correspondence Control	R1-03	X
		R. P. Anantatmula	R1-30	X
		G. A. Barnes	H5-09	X
		D. C. Board	S1-57	X
		N. R. Croskry	R2-76	X
		S. H. Rifaey	S2-45	X
		C. P. Schroeder	L7-06	X
		L. K. Severud	S7-84	X
		F. L. Sievers	R2-76	X
		T. L. Moore	H5-09	X
X [signature]		R. S. Popielarczyk (2)	R1-30	X
		W. F. White	L7-06	X

RECEIVED
AUG 19 1994
T.L. MOORE

Westinghouse
Hanford Company

P.O. Box 1970 Richland, WA 99352

August 18, 1994 9455637

S. G. Pitman
Component Analysis Group
Pacific Northwest Laboratory
Post Office Box 999
Richland, Washington 99352

LETTER OF INSTRUCTION (LOI)

Attached please find the letter of instruction (LOI) requesting Pacific Northwest Laboratory to perform metallurgical examination on the displacer wire off of the new tank 241-S-106 level gage.

Respectfully yours,

R. S. Popielarczyk, Manager
Waste Tank Design Engineering

yrc

Attachments

RL - A. B. Sidpara

PNL - R E. Einziger

9455637
Attachment 1
Page 1 of 2

LETTER OF INSTRUCTION (LOI)
EXAMINATION OF WIRE USED WITH ENRAF LEVEL DETECTOR IN TANK 241-S-106

1.0 INTRODUCTION

Westinghouse Hanford Company (WHC) is planning on performing chemical analysis and, corrosion and metallurgical evaluation of the wire used in conjunction with ENRAF level detector in tank 241-S-106. The wire is 8 mils in thickness and was supplied by ENRAF, Inc. The wire has been assumed to have been fabricated from AISI type 316 stainless steel (316). However, the wire has failed in approximately 2 months from exposure in the vapor space of the tank inside the riser. The 316 wire is expected to be resistant to the waste stored in tank 241-S-106. Westinghouse Hanford Company is hereby requesting the services of Pacific Northwest Laboratories (PNL) to carry out the evaluation to determine the wire material. If the material is carbon steel, then no further investigation is required. However, if the material is determined to be type 316 or other nickel-base alloy, further investigation is required to assess the cause for failure.

2.0 SCOPE OF WORK

The scope of work initially consists of the following:

1. Photograph the wire supplied on the drum. Measure its thickness at several places including both the regions where the surface is tarnished and the surface is shiney.

2. Determine the composition of the wire at both the shiney and corroded zones by using X-ray fluorescence spectroscopy or other comparable analytical technique.

3. Test the wire under tension to determine its ductility.

Identify if the material is one of those normally supplied by ENRAF (i.e., Hastelloy-C4, Invar or 316).

If the material is determined to be other than carbon steel, please continue the investigation as follows.

4. Cut and mount pieces of the supplied unexposed and broken wires and perform optical metallography on the mounted specimens - Examine the structure and evaluate corrosion experienced by the wire.

5. Perform scanning electron microscopy (SEM) on the mounted specimens-Determine composition of the corrosion product.

6. Compile data and provide a report to WHC.

3.0 SCHEDULE

Complete the initial examination of the supplied wire as described in Items 1 through 3 of scope of work above and report results by August 24, 1994. If the material is determined to be different from carbon steel, perform further investigation according to Items 4 through 6 in the scope of work above and issue final report by September 15, 1994.

4.0 COST ESTIMATE

Costs for performing Items 1, 2 and 3 are not to exceed 10K dollars unless authorized by the Administrative contact or his designee. Cost estimates for Items 4 through 6 to be determined based on the results of preliminary analysis.

5.0 REPORTING

Reporting of the work performed per the initial scope shall be accomplished by an informal correspondence of the results obtained. Regardless of the magnitude of the scope of work, a final report shall be provided.

The following items are to be included in the final report: 1) Identifiaiton of equipment used for the analyses of the wire by serial number and the calibration or validation data showing dates for the equipment. 2) Identification of the personnel performing the testing and their qualification to perform said tests.

6.0 SAFETY CLASSIFICATION

The work described in this letter of instruction will be carried out under PNL Safety Class (Impact Level) 3.

7.0 WHC CONTACTS

The following personnel are assigned as liaison with PNL for the scope of work described herein: R. P. Anantatmula, Technical Contact and R. S. Popielarczyk, Administrative Contact.

August 22, 1994

Mr. Robert Popielarczyk
Westinghouse Hanford Co.
P.O. Box 1970
Richland, WA 99352

Dear Bob,

At your request PNL has completed a brief analysis of the level gauge wire failure.

I reported in my letter of August 18 that the failure was due to contact of the 316 stainless steel wire to a high-chloride environment, and that this environment was probably the result of radiation-induced breakdown of the polyvinyl chloride (PVC) riser.

I spoke with PNL polymer expert Ross Gordon on this subject, and he confirmed that he would expect PVC to degrade, giving off Cl_2, HCl, and HClO (hypochlorous acid, an oxidizing acid). This degradation of PVC is well documented, so I suggest that we do not proceed with mechanical scraping of the PVC risers to obtain a sample for analysis, or with analysis of PVC under irradiation.

Also, we completed mechanical tests of the 316 wire, and found no significant change in strength along its length. We did not test wire from the degraded region because it is too brittle to pick up without breaking.

I have the following recommendations for resolution of this problem:

1. Removing risers. An ideal solution would be to remove the PVC risers. I realize, though, that this might not be feasible at this time.

2. Replacing wire. If the risers cannot be removed, the wire obviously must be replaced. I would replace the wire with tantalum wire, which is available as a replacement from the vendor. Tantalum has excellent resistance to hydrochloric acid, good resistance to caustic solutions, and can absorb 150 volumes of hydrogen before becoming embrittled.

   In addition to replacing the wire, the other metallic components should be replaced. If tantalum components cannot be located, it should be possible to fabricate some from platinum.

I wouldn't conduct any additional tests with stainless steel wire, when it is relatively cheap and easy to replace the wire with a different alloy. At best, the results will probably be ambiguous; at worst, the tests could lead to another ONO and to some rather embarrassing questions.

One other available wire choice is Alloy C-4. This alloy would be expected to last longer than stainless steel, but is not a good choice for hydrochloric acid service.

I have some good sources for corrosion data, and will try to summarize the applicable data before our Tuesday meeting. I consider the failure analysis to be complete at this point. If, however, you would like to have additional documentation (such as a formalization of the letter report I sent previously) or additional analysis, such as metallographic examination of the stainless steel wire, please contact me.

Very truly yours,

Stan G. Pitman
Senior Research Engineer

cc: RP Anantatmula
GA Barnes
JB Colson
JJ Klos
AL Lund
TL Moore Sr.
TJ Peters
RE Westerman
JH Wicks

Battelle

Pacific Northwest Laboratories
Battelle Boulevard
P.O. Box 999
Richland, Washington 99352
Telephone (509)

August 18, 1994

Mr. Robert Popielarczyk
Westinghouse Hanford Co.
P.O. Box 1970
Richland, WA 99352

Dear Bob,

At your request Louise Lund and I have investigated the failure of a level detector in Tank S-106. Our immediate action items from the meeting yesterday were to measure the length of the wire and to determine its composition. We have completed these items and conducted additional analyses to assist in determining the cause of the failure. Our observations are as follows:

1. <u>Length of Wire.</u> The length from the drum to the failed end was determined to be 83 feet, 3 in. This does not include the small pieces that broke from the lower end, as we did not want to damage the evidence by attempting to straighten them. This measurement was performed by cutting the wire into 9-ft. lengths and taping them to a table, where they will be available for additional examination. The length measurement was not done using calibrated equipment.

2. <u>Composition of Wire.</u> The wire is 316 stainless steel, as specified. The composition of the wire was evaluated using an X-ray fluorescence technique, with a 316 stainless steel standard for comparison. Three samples were submitted for analysis, evenly spaced along the length. In addition, the small broken pieces were analyzed. The composition was found to be consistent along the length. The results of the analysis are attached, along with certifications for the materials standards that were used. Sample A was taken 1 ft. from the failed end, sample B was taken midway along the length, sample C was taken 1 foot from the reel end, and sample D consisted of the broken fragments.

3. <u>Diameter of Wire.</u> The diameter of the wire was measured using calibrated calipers accurate to plus or minus 0.0005 in. No significant variation of diameter was measured along the length of the wire. The results of the measurements are attached.

4. <u>Scanning Electron Microscope Examination.</u> Two broken fragments were examined in the scanning electron microscope (SEM) to determine the morphology of the fractures and to evaluate the deposits or corrosion products that were present. A detailed description of the results cannot be presented here due to time constraints, but the results can be summarized as follows:

    a. The fragments failed in a brittle manner, without appreciable ductility. This indicates that failure did not occur due to a simple overload.

    b. The fragments were covered with a relatively thick corrosion product. This corrosion product was determined to be very high in chlorine, and a smaller amount of sulfur was found to be present.

    c. Examination of the ends of the broken wire fragments showed that the wire was hollow; most of the inside had apparently been corroded away in the embrittled regions. To verify that this was not due to corrosion following a brittle failure, a section was bent until it broke, and the fresh surface was examined. It was also found to be hollow.

5. <u>Chemical Analysis of Wire Surface.</u> The wire was analyzed for contaminants using X-Ray fluorescence. The corrosion product on the broken fragments was found to be very high in chlorine, in accordance with the SEM results. After this observation was made, the other samples (A,B, and C) were analyzed to determine the relative amounts of chlorine. Sample A (nearest the waste level) was found to have a relatively high amount; sample B a lower amount, and no chlorine was detected on sample C (nearest the drum). Additional analyses are underway to determine the actual compounds that are present.

In order to prevent recurrence of this problem, it is necessary to determine the failure mode of the wire. Various failure modes have been considered, including chloride stress corrosion cracking, caustic stress corrosion cracking, hydrogen embrittlement, and general corrosion. Although the complete analysis is not yet complete, my preliminary conclusion is that the wire corroded rapidly from contamination with chlorine. The failure mode may have been chloride stress corrosion cracking, intergranular attack, or accelerated general corrosion due to the high chloride environment.

It is my opinion that chloride probably resulted from radiation-induced degradation of the PVC (polyvinyl chloride) liner in the riser. This problem could be alleviated by using an alloy with higher nickel content or by replacing the PVC component with another material.

I hope this analysis will contribute to an expedient solution to your problem. I will keep you informed of further test results that may affect your decisions.

Very truly yours,

Stan G. Pitman
Senior Research Engineer

APPENDIX A

X-RAY FLUORESCENCE ANALYSIS

7 REFERENCES

1. N. F. Landers and L. M. Petrie, "CSAS: An Enhanced Criticality Safety Analysis Module with Search Options," Sect. C4 of *SCALE: A Modular Code System for Performing Standardized Computer Analyses for Licensing Evaluation*, NUREG/CR-0200, Rev. 4 (ORNL/NUREG/CSD-2/R4), Vols. I, II, and III (draft November 1993). Available from Radiation Shielding Information Center as CCC-545.

2. *SCALE: A Modular Code System for Performing Standardized Computer Analyses for Licensing Evaluation*, NUREG/CR-0200, Rev. 4 (ORNL/NUREG/CSD-2/R4), Vols. I, II, and III (draft November 1993). Available from Radiation Shielding Information Center as CCC-545.

3. *MicroSoft BASIC Professional Development System Version 7.1*, Microsoft Corporation (1990).

4. *QuickScreen Version 3.0*, Crescent Software (1989).

5. *QuickPak Professional: Advanced Programming Library for BASIC Compilers, Version 3.2*, Crescent Software (1990).

?? UNITS	EL	SPECIMEN D	+/-		SRM 849	+/-
MG	TI	< 0.021		TI	0.093	0.030
	V	0.118	0.008	V	< 0.027	
	CR	16.87	0.84	CR	5.51	0.28
	MN	0.790	0.043	MN	1.77	0.10
	FE	65.1	3.3	FE	84.2	4.2
	CO	< 0.045		CO	< 0.14	
	NI	13.93	0.70	NI	6.96	0.36
	CU	0.258	0.016	CU	0.204	0.030
	GA	< 0.003		GA	< 0.012	
	GE	< 0.003		GE	< 0.012	
	SE	< 0.002		SE	< 0.005	
	PB	< 0.004		PB	< 0.014	
	AS	0.005	0.001	AS	0.014	0.004
	RB	< 0.001		RB	< 0.003	
	SR	0.002	0.000	SR	< 0.002	
	Y	< 0.001		Y	< 0.002	
	ZR	0.001	0.000	ZR	< 0.002	
	NB	0.005	0.001	NB	0.310	0.016
	MO	2.40	0.12	MO	0.153	0.008

Maurice H. Stans
Secretary

National Bureau of Standards
A. V. Astin, Director

Certificate of Analysis

STANDARD REFERENCE MATERIAL 1155

Stainless Steel

Cr 18-Ni 12-Mo 2 (AISI 316)

(This material also is available in chip form as SRM 160b, primarily for application in chemical methods of analysis)

Element	Percent by Weight
Carbon	0.046
Manganese	1.63
Phosphorus	0.020
Sulfur	.018
Silicon	.50$_2$
Copper	.169
Nickel	12.18
Chromium	18.45
Vanadium	0.047
Molybdenum	2.38
Cobalt	0.10$_1$
Lead	.001

PROVISIONAL

SIZE AND METALLURGICAL CONDITION: Samples are 1¼ in (3.2 cm) in diameter and ¾ in (1.9 cm) thick, and are issued in the annealed condition.

PROVISIONAL CERTIFICATION: The provisional value listed for an element is the present best estimate of the true value based on the use of methods at NBS of high reliability. To check for possible systematic errors, other SRM's were chemically analyzed concurrently. The provisional value is not expected to deviate from the true value by more than ± 1 in the last significant figure reported; for values having subscripted numbers the deviation is not expected to be more than ± 5 in the subscripted numbers. Based on the results of homogeneity testing, maximum variations within and among samples are less than the estimated accuracy figures given above.

Washington, D. C. 20234
August 4, 1969

J. Paul Cali, Acting Chief
Office of Standard Reference Materials

(over)

Fe (64.456)

032

U. S. Department of Commerce
John T. Connor, Secretary
National Bureau of Standards
A. V. Astin, Director

Certificate of Analysis

Standard Reference Materials

445 - 450
845 - 850
D845 - D850

Spectrographic Stainless Steel Standards (Group II)

This supersedes the Provisional Certificate dated September 15, 1955

NUMBER [a]			DESIGNATION	Mn	Si	Cu	Ni	Cr	Mo	Nb
				Percent	Percent	Percent	Percent	Percent	Percent	Percent
445	845	D845	Cr 13–Mo 0.9 (Modified AISI 410) [b]	0.77	0.52	0.065	0.28	13.31	0.92	0.11
446	846	D846	Cr 18–Ni 9 (Modified AISI 321)	.53	1.19	.19	9.11	18.35	.43	.60
447	847	D847	Cr 24–Ni 13 (Modified AISI 309)	.23	0.37	.19	13.26	23.72	.059	.03
448	848	D848	Cr 9–Mo 0.3 (Modified AISI 403)	2.13	1.25	.16	0.52	9.09	.33	.49
449	849	D849	Cr 5.5–Ni 6.5	1.63	0.68	.21	6.62	5.48	.15	.31
450	850	D850	Cr 3–Ni 25	(c)	.12	.36	24.8	2.99	....	.05

[a] Sizes: 400 series, rods ½ in. in diameter and 4 in. long.
800 series, rods ½ in. in diameter and 2 in. long.
D800 series, disks 1¼ in. in diameter and ¼ in. thick.

[b] The carbon content of the standards is between 0.06 and 0.1 percent; phosphorus 0.02 and 0.03 percent; and sulfur 0.01 and 0.02 percent. By difference, the approximate iron contents are 445, 845, and D845—83.2 percent; 446, 846, and D846—68.8 percent; 447, 847, and D847—61.8 percent; 448, 848, and D848—85.3 percent; 449, 849 and D849—84.2 percent; 450, 850, and D850—70.8 percent. The metallurgical structure of the standards is that resulting from hot-rolling and annealing.

[c] Dashes indicate elements not certified for spectrographic analysis.

Fe = 84.92

CAUTION: These standards are intended for the analysis of stainless steel samples with similar metallurgical history and dimensions. Samples with cross section larger than ½ in. in diameter may be analyzed with the ½ in. standards provided that the latter are mounted in a supporting piece such as a steel disk, 2½ in. in diameter and ¾ in. thick, drilled near the edge with holes to fit the standard closely and equipped with set screws to lock the standard in place. The standards should be mounted with the circular cross section flush with one surface of the disk and may be cleaned and sparked in this position.

HOMOGENEITY of the standards was examined spectrochemically at the National Bureau of Standards and was found satisfactory for the elements certified.

CHEMICAL ANALYSES were made on millings cut from the cross section of the rods. The values indicated for the certified elements Mn, Si, Cu, Ni, Cr, Mo, and Nb represent the averages of results from chemical analyses made by the National Bureau of Standards, Armco Steel Corporation (Research Laboratories and the Rustless Division), Allegheny-Ludlum Steel Corporation, and Wilbur B. Driver Company.

DISK STANDARD SAMPLES for use in x-ray spectrometric analysis were prepared from the rods ½ in. in diameter by upset forging. The use of the disk samples for optical emission analysis has not been investigated and is not recommended.

WASHINGTON, D. C. 20234
January 19, 1966

W. Wayne Meinke, Chief,
Office of Standard Reference Materials.

(This certificate supersedes [illegible])

(OVER)

Supplemental Information

OTHER ELEMENTS: In addition to the certified elements, the following are present at the approximate concentrations listed:

NUMBER			Ti	Ta	W	V	Sn
			Percent	*Percent*	*Percent*	*Percent*	*Percent*
445	845	D845	0.03	0.002	0.42	0.05	....
446	846	D846	.34	.030	.04	.03	0.02
447	847	D847	.02	.002	.06	.03	....
448	848	D848	.23	.026	.14	.02	.05
449	849	D849	.11	.021	.19	.01	.07
450	850	D850	.05	.002	.21	.006	.09

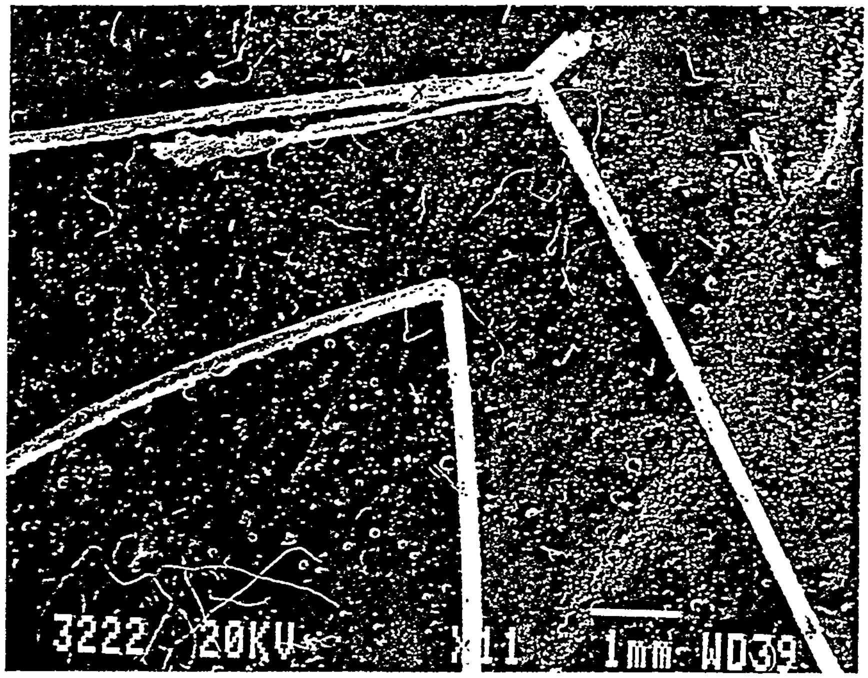
Because of minor irregularities in the samples observed in homogeneity testing and because the values represent the analytical results by a single laboratory, these elements have *not* been certified; however, the indicated results are given for additional information on the composition of the steels.

MATERIAL in rod form for the standards was furnished to the Bureau by the Uddeholm Company, Sweden.

APPENDIX B

EDX ANALYSIS

#8



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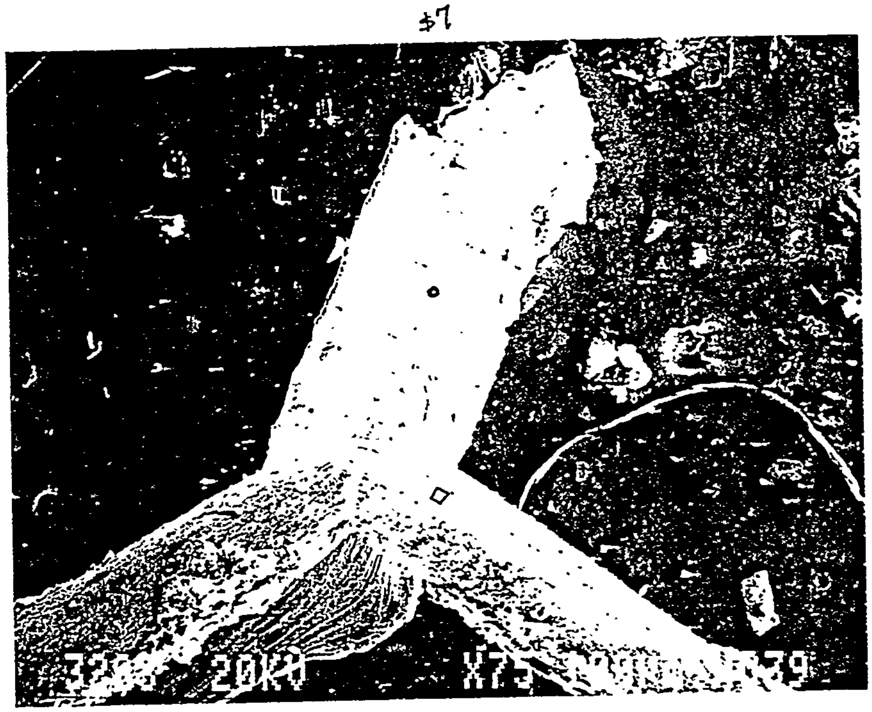

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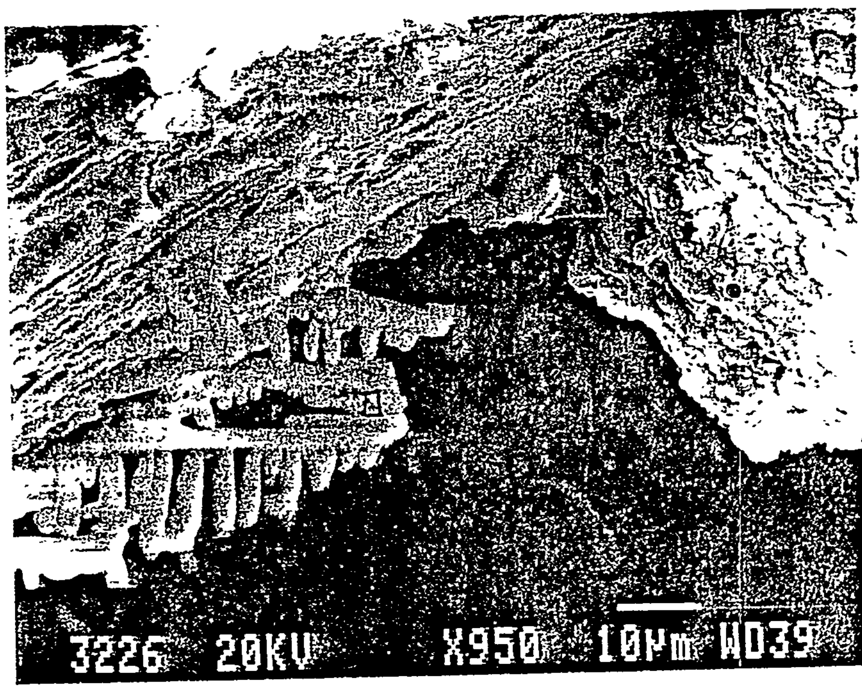
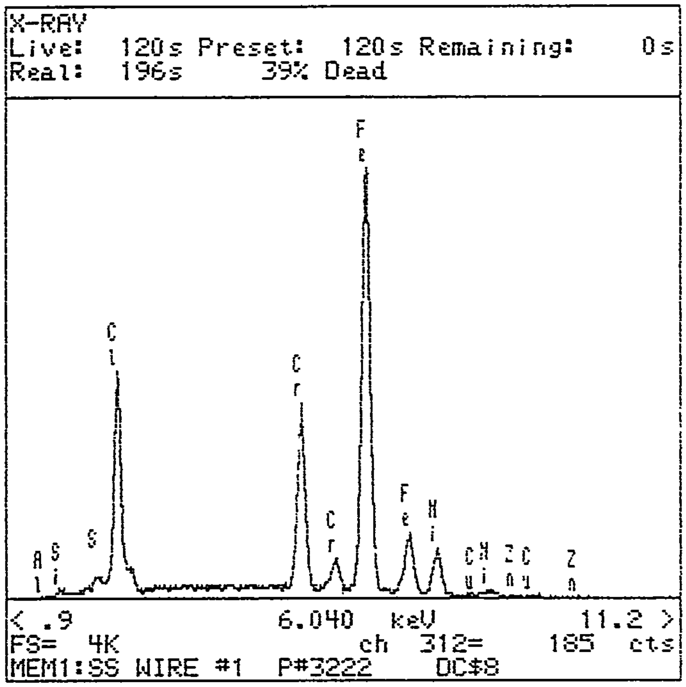
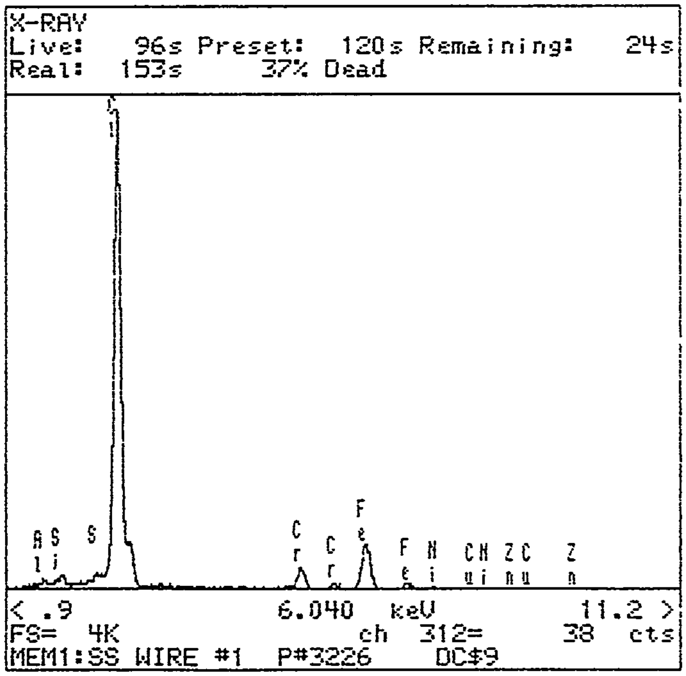
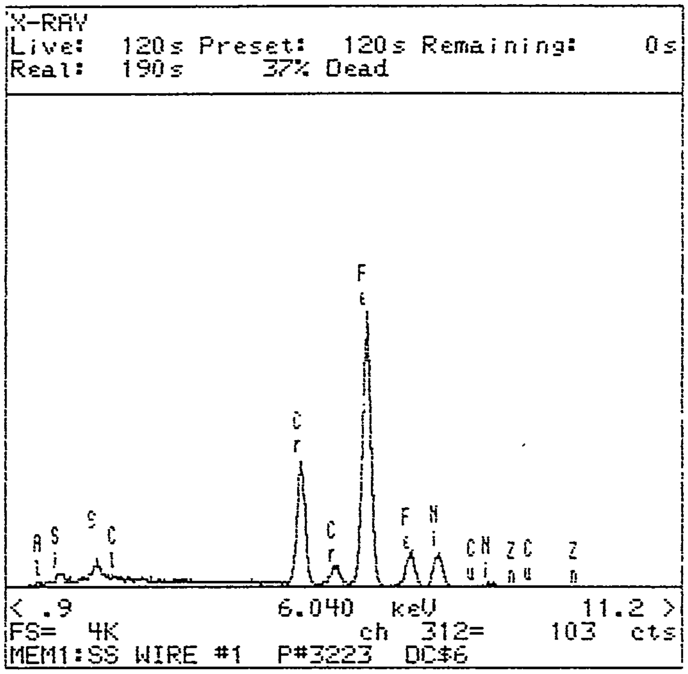


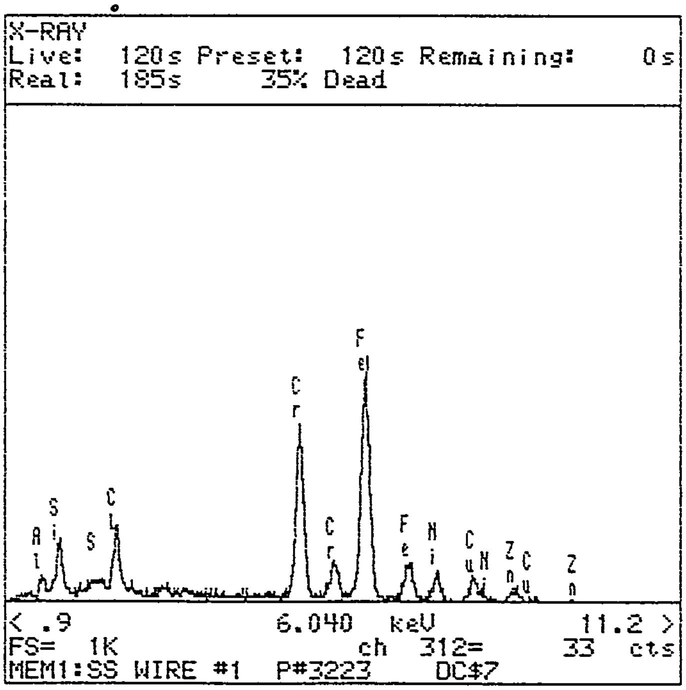
$9

'8)


X-RAY
Live: 120s Preset: 120s Remaining: 0s
Real: 196s 39% Dead
Fe
Cl
Cr
Fe
Ni
Cr
Al Si S
Cu Ni Zn Cu
Zn
< .9 6.040 keV 11.2 >
FS= 4K ch 312= 185 cts
MEM1:SS WIRE #1 P#3222 DC$8


X-RAY
Live: 96s Preset: 120s Remaining: 24s
Real: 153s 37% Dead
Cl
Fe
Cr
Cr
Al Si S
Fe Ni
Cu Ni Zn Cu
Zn
< .9 6.040 keV 11.2 >
FS= 4K ch 312= 38 cts
MEM1:SS WIRE #1 P#3226 DC$9


X-RAY
Live: 120s Preset: 120s Remaining: 0s
Real: 190s 37% Dead
< .9 6.040 keV 11.2 >
FS= 4K ch 312= 103 cts
MEM1:SS WIRE #1 P#3223 DC$6


X-RAY
Live: 120s Preset: 120s Remaining: 0s
Real: 185s 35% Dead
< .9 6.040 keV 11.2 >
FS= 1K ch 312= 33 cts
MEM1:SS WIRE #1 P#3223 DC$7

APPENDIX C

WIRE MEASUREMENTS

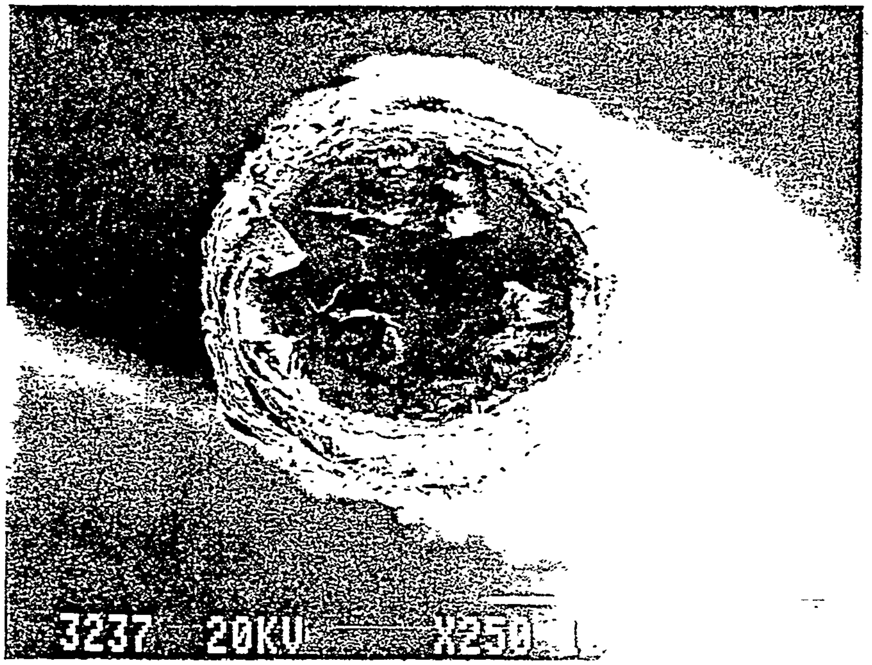
End Mark	Dia 1	2	3
1	.0075	.0075	.0075
3	.0075	.0075	.0075
5	.0075	.0075	.0075
7	.0075	.0075	.0075
9	.0080	.0080	.0080
11	.0075	.0080	.0080
13	.0075	.0075	.0080
15	.0075	.0075	.0075
17	.0080	.0075	.0075
19	.0075	.0075	.0080

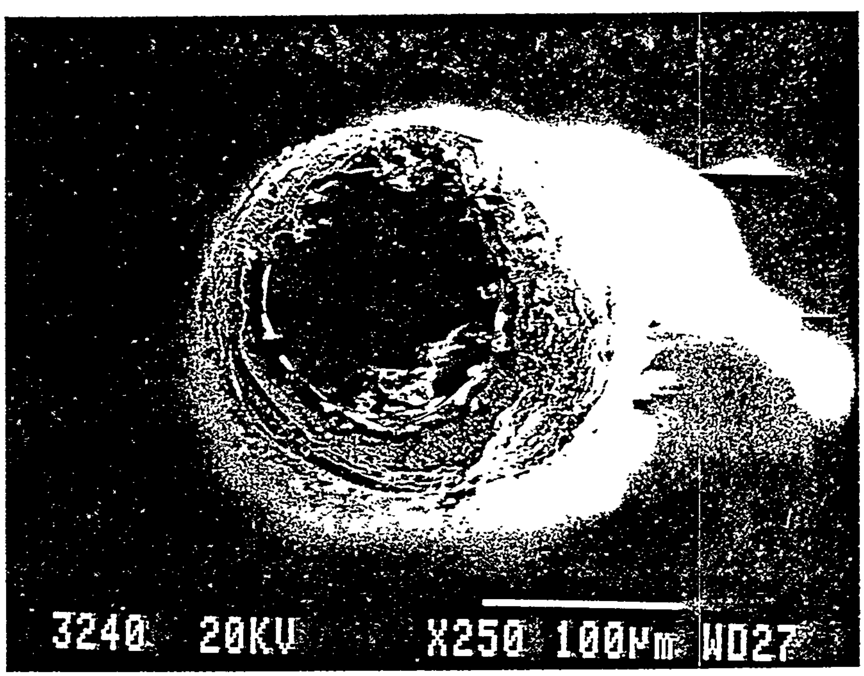
Dial Calliper
QA No
366-15-06-001
Expires 03-04-96

D.A. Criswell
8/17/94

APPENDIX D

SEM MICROGRAPHS


3237 20KV X250


3240 20KV X250 100μm WD27

Battelle
Pacific Northwest Laboratories
Battelle Boulevard
P.O. Box 999
Richland, Washington 99352
Telephone (509)

August 23, 1994

Mr. Robert Popielarczyk
Westinghouse Hanford Co.
P.O. Box 1970
Richland, WA 99352

Dear Bob,

Yesterday I transmitted a letter recommending removal of the PVC riser liner, if possible, and replacement of the wire and associated lifting hardware if the PVC cannot be removed. The intent of this letter is to summarize some of the information that may affect the decision on which alloy to use for the wire.

In the current tank configuration, the wire may be exposed to an oxidizing environment with high concentrations of hydrochloric acid. Of the alloys that are readily available from the vendor (316 stainless steel, Hastelloy C-4, Invar, and tantalum), tantalum is clearly the best choice for this environment. Tantalum is one of the most corrosion resistant metals in hydrochloric acid, chlorine gas, and hypochlorous acid. According to the Handbook of Corrosion Data (American Society for Metals, 1990), "Specific corrosion tests and many industrial applications show that tantalum is completely inert to hydrochloric acid in all concentrations under atmospheric pressure to at least 90°C (195°F). This has been demonstrated by long industrial experience." The same handbook describes tantalum as completely inert to hypochlorous acid, an oxidizing acid that is highly corrosive to most metals.

The corrosion resistance of Alloy C-4 in hydrochloric acid is better than that of the stainless steels, but is still not acceptable for the current application. According to the Handbook of Corrosion Data, Hastelloy B-2 and Hastelloy C-276 are the most corrosion resistant of the nickel-base alloys to hydrochloric acid. Hastelloy B-2 "is one of the few metals with a corrosion rate under 0.5 mm/y (20 mils/y) in all concentrations and at temperatures up to the atmospheric boiling point in nonaerated acid in the absence of oxidizing agents." From the same source, "Hastelloy C-276 has excellent corrosion resistance (less than 0.13 mm/y, or 5 mils/y) in all concentrations of hydrochloric acid at room temperatures..."

These corrosion rates, while acceptable for many applications, are clearly too high for the current application. If only 0.001 in. of corrosion occurs, the cross-sectional area decreases by about half, resulting in a doubling of stress in the wire. Unfortunately, corrosion rates of Hastelloy C-4 would be higher than those of alloys B-2 and C-276.

I think the resistance to an oxidizing acid environment should be the main factor in selecting a replacement alloy for stainless steel. However, it is possible that the wire could be exposed to the waste solution, so an adequate resistance to high-pH solution is necessary.

According to several sources, stainless steels and nickel-base have acceptably low corrosion rates in sodium hydroxide solutions at the temperatures and concentrations relevant to this application. Tantalum, however, is subject to attack by sodium hydroxide solutions, with the rate of attack increasing with concentration and temperature. For example, a test of tantalum wire immersed in 10% sodium hydroxide solution at room temperature and at 100°C for 210 days produced a corrosion rate of 0.24 microns per year.

One source of corrosion data was found that conflicts with the data previously mentioned (Corrosion Data Survey, Metals Section, Sixth Edition, National Association of Corrosion Engineers). This source indicated that tantalum would have unacceptably high corrosion rates in sodium hydroxide solutions, even at low temperatures and concentrations; however, it was not possible to determine the exact configuration of the tests or to evaluate the references for the data.

My opinion is that the wire should be replaced with tantalum, because of the very aggressive nature of the oxidizing acid environment. If it is important to prevent recurrence of the problem, I would conduct a few tests of Hastily, tantalum, and a platinum-rhodium alloy in both acidic and caustic environments under gamma irradiation. The results of these tests may be very useful in recommending replacement components for this tank and other tanks with PVC riser liners.

Please contact me if I can provide any additional information or clarification.

Very truly yours,

Stan G. Pitman
Senior Research Engineer

cc: RP Anantatmula
GA Barnes
JB Colson
JJ Klos
AL Lund
TL Moore Sr.
TJ Peters
RE Westerman
JH Wicks

APPENDIX C

WHC-SD-WM-TP-265
"Test Plan for Enraf Series 854
LeveL Gauge Testing in Tank 241-S-106"

DISTRIBUTION SHEET

To	From	Page 1 of 1
Distribution	G. A. Barnes	Date August 23, 1994
Project Title/Work Order		EDT No. 604965
WHC-SD-WM-TP-265, Test Plan for Enraf Series 854 Level Gauge Testing in Tank 241-S-106		ECN No.

Name	MSIN	Text With All Attach.	Text Only	Attach./ Appendix Only	EDT/ECN Only
R. P. Anantatmula	R1-30	X			
D. A. Barnes	R1-51	X			
G. A. Barnes	H5-09	X			
J. R. Biggs	T4-01	X			
D. C. Board	S1-57	X			
W. G. Brown	S2-45	X			
J. H. Huber	R1-49	X			
T. L. Moore	H5-09	X			
R. Ni	S5-07	X			
S. G. Pitman	P8-44	X			
R. S. Popielarczyk	R1-30	X			
R. E. Raymond	R2-54	X			
S. H. Rifaey	S2-45	X			
J. S. Schofield	R1-67	X			
C. P. Schroeder	L7-06	X			
W. F. White	L7-06	X			
J. H. Wicks	T4-08	X			
OSTI (2)	L8-04	X			

RECEIVED
SEP 6 1994
T.L. MOORE

5 dta. 4
AUG 25 1994

ENGINEERING DATA TRANSMITTAL

Page 1 of 1
1. EDT 604965

2. To: (Receiving Organization) Distribution	3. From: (Originating Organization) Mechanical Equipment	4. Related EDT No.: NA
5. Proj./Prog./Dept./Div.: TWRS/Mechanical Equipment	6. Cog. Engr.: G. A. Barnes	7. Purchase Order No.: NA
8. Originator Remarks: Transmitted for release.		9. Equip./Component No.: NA
		10. System/Bldg./Facility: 241-S
11. Receiver Remarks:		12. Major Assm. Dwg. No.: NA
		13. Permit/Permit Application No.: NA
		14. Required Response Date: August 23, 1994

15. DATA TRANSMITTED

(A) Item No.	(B) Document/Drawing No.	(C) Sheet No.	(D) Rev. No.	(E) Title or Description of Data Transmitted	(F) Approval Designator	(G) Reason for Transmittal	(H) Originator Disposition	(I) Receiver Disposition
1	WHC-SD-WM-TP-265	All	0	Test Plan for Enraf Series 854 Level Gauge Testing in Tank 241-S-106	Q	1	1	

16. KEY

Approval Designator (F)	Reason for Transmittal (G)	Disposition (H) & (I)
E, S, Q, D or N/A (see WHC-CM-3-5, Sec.12.7)	1. Approval 2. Release 3. Information 4. Review 5. Post-Review 6. Dist. (Receipt Acknow. Required)	1. Approved 2. Approved w/comment 3. Disapproved w/comment 4. Reviewed no/comment 5. Reviewed w/comment 6. Receipt acknowledged

17. SIGNATURE/DISTRIBUTION
(See Approval Designator for required signatures)

(G) Reason	(H) Disp.	(J) Name	(K) Signature	(L) Date	(M) MSIN	(J) Name	(K) Signature	(L) Date	(M) MSIN	(G) Reason	(H) Disp.
1	/	Cog.Eng. GA Barnes	[signature]	8/24/94	H5-09						
1	/	Cog. Mgr. TL Moore	[signature]	8/23/94	H5-09						
1	/	QA DC Board	[signature]	8/24/94	S1-57						
		Safety									
		Env.									
1	/	JR Biggs	[signature]	8-23-94	T4-01						
1	/	~~RE Raymond~~	[signature]	8/25/94	S2-25 ~~R2-54~~						

18.	19.	20.	21. DOE APPROVAL (if required)
G. A. Banres	J. R. Biggs [signature] 8-23-94	T. L. Moore [signature] 8/24/94	Ctrl. No.
Signature of EDT Originator / Date	Authorized Representative for Receiving Organization / Date	Cognizant Manager / Date	[] Approved [] Approved w/comments [] Disapproved w/comments

BD-7400-172-2 (04/94) GEF097

BD-7400-172-1 (07/91)

RELEASE AUTHORIZATION

Document Number:	WHC-SD-WM-TP-265 REV. 0
Document Title:	TEST PLAN FOR ENRAF SERIES 854 LEVEL GAUGE TESTING IN TANK 241-S-106
Release Date:	8/24/94

* * * * * * * * * * * * *

This document was reviewed following the procedures described in WHC-CM-3-4 and is:

APPROVED FOR PUBLIC RELEASE

* * * * * * * * * * * * *

WHC Information Release Administration Specialist:

N. L. Solis — 8/24/94

(Signature) — **(Date)**

A-6001-400 (07/94) WEF256

SUPPORTING DOCUMENT

1. Total Pages ~~5~~ 10

2. Title Test Plan for Enraf Series 854 Level Gauge Testing in Tank 241-S-106	3. Number WHC-SD-WM-TP-265	4. Rev No. 0
5. Key Words Enraf, level gauge, LIT APPROVED FOR PUBLIC RELEASE 8/24/94	6. Author Name: G. A. Barnes Signature Organization/Charge Code 7EA30/N3064	

7. Abstract

This document details a plan to test an Enraf level gauge in tank 241-S-106.

9. Impact Level Q

10. RELEASE STAMP

WHC-SD-WM-TP-265
Revision 0

Test Plan for Enraf Series 854 Level Gauge Testing In Tank 241-S-106

G.A. Barnes
Mechanical Equipment

August 23, 1994

Filename: TPLNS106

ETN 94-0036

TABLE OF CONTENTS

1.0 INTRODUCTION

An Enraf[1] Series 854 level gauge was installed on tank 241-S-106 (S-106) during the first week of June 1994. On August 11, 1994, the gauge's measuring wire broke. An investigation has been started to determine how the wire broke. This test plan identifies a qualification test that is part of this investigation.

2.0 OBJECTIVE

This is a qualification test to verify the design adequacy of the Enraf 854's stainless steel measuring wire in tank S-106. This test will also provide evidence as to the location and extent of potential corrosion on the measuring wire due to tank environment. The results from this testing will provide data for better material selections.

Even though the unit will be tested in an operational system, this test is not a Process Test as defined in WHC-IP-0842, Sect. 8.10 and EP 4.2 because changes are not being made to process operating parameters. The Enraf gauge will be operated by previously approved procedures. Also, no design changes are being made to the Enraf gauge or facility.

3.0 SCOPE

This test will involve placing the existing Enraf Series 854 level gauge back into service with the same type of measuring wire (316 stainless steel) that originally broke on August 11, 1994. The gauge will be operated for 14 days. At the end of the 14-day test, the wire shall be sent to Pacific Northwest Laboratory (PNL) for analysis.

4.0 TEST PROCEDURE

This test plan shall be inserted into the appropriate Job Control System work package for test execution.

All work performed on the Enraf Series 854 level gauge during this testing shall be performed in accordance with Tank Farm Maintenance Procedure 6-TF-125.

4.1 Remove the wire drum and displacer from the Enraf Series 854 level gauge installed on tank S-106. Thoroughly clean approximately the first 20 feet of measuring wire and the displacer with alcohol.

4.2 Reinstall the wire drum and displacer.

4.3 Start the Enraf level gauge.

---

[1]Enraf, Inc.

4.4 Tank Farm Operations shall monitor and record the tank liquid level per TF-OR-WST-01-D on a daily basis.

4.5 At the end of 14 days of operation, remove the wire drum from the level gauge and send it to PNL for analysis (PNL contact-S. G. Pitman).

5.0 SAFETY

There is no anticipated safety impact with this testing (see Appendix A for Unreviewed Safety Question Screening).

6.0 QUALITY ASSURANCE

Quality Assurance will not be required to witness any part of the testing.

7.0 ORGANIZATION AND FUNCTIONAL RESPONSIBILITIES

Tank Farm Operations is responsible for providing a Person In Charge (PIC). The PIC will also be the Test Director.

Tank Farm Maintenance is responsible for operating the level gauge during the testing.

PNL is responsible for analyzing the measuring wire and writing an analysis report. Formal PNL guidance on analysis scope, criteria and controls will be forthcoming in a Letter of Instruction (LOI)

8.0 REFERENCES

- Enraf Series 854 ATG Level Gauge, Instruction Manual, Part No. 4416.220, Version 2.1.
- H-2-817634, INSTM ENRAF NONIUS ASSY INSTALLATION & RISER SCHED, SHEETS 1 and 2.
- 6-TF-125, Enraf Nonius Model 854 Level Gauge Preventive Maintenance and Calibration.

APPENDIX A

Does the PROPOSED CHANGE:

A. Represent a change to the facility as described in the AUTHORIZATION BASIS documentation?

NO X YES/MAYBE

BASIS: The authorization basis for tank farms is the *Hanford Site Tank Farm Facilities Interim Safety Basis*, WHC-SD-WM-ISB-001, Rev. 0-C. The U.S. Department of Energy has authorized the use of the material in Chapter 6 for Safety Screenings and Safety Evaluations. Chapter 6 of WHC-SD-WM-ISB-001 refers the reader to the *Single-Shell Tank Interim Operational Safety Requirements*, WHC-SD-WM-OSR-005, Rev. 0. The availability of a functioning level monitoring system is required by LCO 3.1.1. If the primary waste level monitoring system in a non-interim isolated tank is inoperable, then tank farm operations has 14 days from discovery of the failure to restore the system to operable status.

The new Enraf level displacement gauge in tank 241-S-106 has been found to be non-functional. The plummet and a portion of the 316 stainless steel wire is missing (see Figure 1). The cause of the failure has not been determined conclusively. However, it is thought that the polyvinyl chloride riser liner is degrading and forming hydrochloric acid that runs down the 316 stainless steel wire and this caused the failure. The question at hand is does the loss of the plummet and the potential for another loss in the future cause hazards that are not addressed in the existing safety basis.

Two hazards can be postulated from this incident. The first deals with whether the plummet can come into contact with the tank liner and cause corrosion due to the dissimilar metals (the liner is carbon steel and the plummet has some stainless steel). Figure 1 shows that the majority of the plummet is made of polyethylene. There is only a very small portion of stainless steel exposed. The hazard from this piece of equipment would be no greater than the other equipment known to be in the tank waste. In earlier times, it was a common practice to dispose of non-functioning equipment (like Food Instrument Corporation wires and plummets, thermocouple trees, etc.) in the tank. This is no longer an accepted practice. The second hazard deals with miscellaneous debris interfering with future retrieval equipment. Since the debris is known to exist in the tanks, the safety documentation dealing with retrieval will need to cover aspects such as missiles (mixer pumps picking up small objects and propelling them around the tank) and pump failures (equipment enters the pump intakes and causes pump failure).

Therefore, the failure of this equipment does not affect the tank in its current life cycle stage.

B. Represent a change to procedures as described in the AUTHORIZATION BASIS?

NO X YES/MAYBE

BASIS: The tank farm authorization basis does not specifically mention procedures. However, the intent of this question is to determine if procedural changes will be made that do affect the safety envelope.

Two changes to procedures may happen due to this incident. The first is that the Enraf may be examined periodically for corrosion. This may lead to increased worker exposure to radiation. However, worker protection is covered by the *Tank Farm Health and Safety Plan*, WHC-SD-WM-HSP-002, Rev. 0-C. Another procedural change could be the use of a different riser liner material.

Neither of these changes would affect the safety envelope of the facility.

C. Represent a test or experiment not described in the AUTHORIZATION BASIS documentation?

NO X YES/MAYBE

BASIS: The tank farm authorization basis does not specifically mention tests or procedures. However the intent of this question is to determine if a test or experiment would affect the safety envelope.

This activity is not considered a test or experiment. The ability to measure the waste level in the tank is a necessary monitoring requirement. Therefore, the safety envelope is not affected.

USQ Tracking Number: TF-94-0299, Rev. 0 | Page 3 of 4

WHC-SD-WM-TP-265 Rev. 0
Page 6

D. Does the change impact:

- Implemented OSRs or IOSRs? NA ___ NO X YES/MAYBE ___
- Approved IOSR Compliance Implementation Plans? NA X NO ___ YES/MAYBE ___

BASIS: There already exists a requirement to measure the waste level in single-shell tanks. No new OSRs or IOSRs are required. Additionally, there is not an approved IOSR Compliance Implementation Plan for single-shell tanks at this time.

USQE #1 R. J. Van Vleet, Ph.D.
Print Name
[signature] 08/25/1994
Signature Date

USQE #2 R. L. Guthrie
Print Name
[signature] 8/25/94
Signature Date

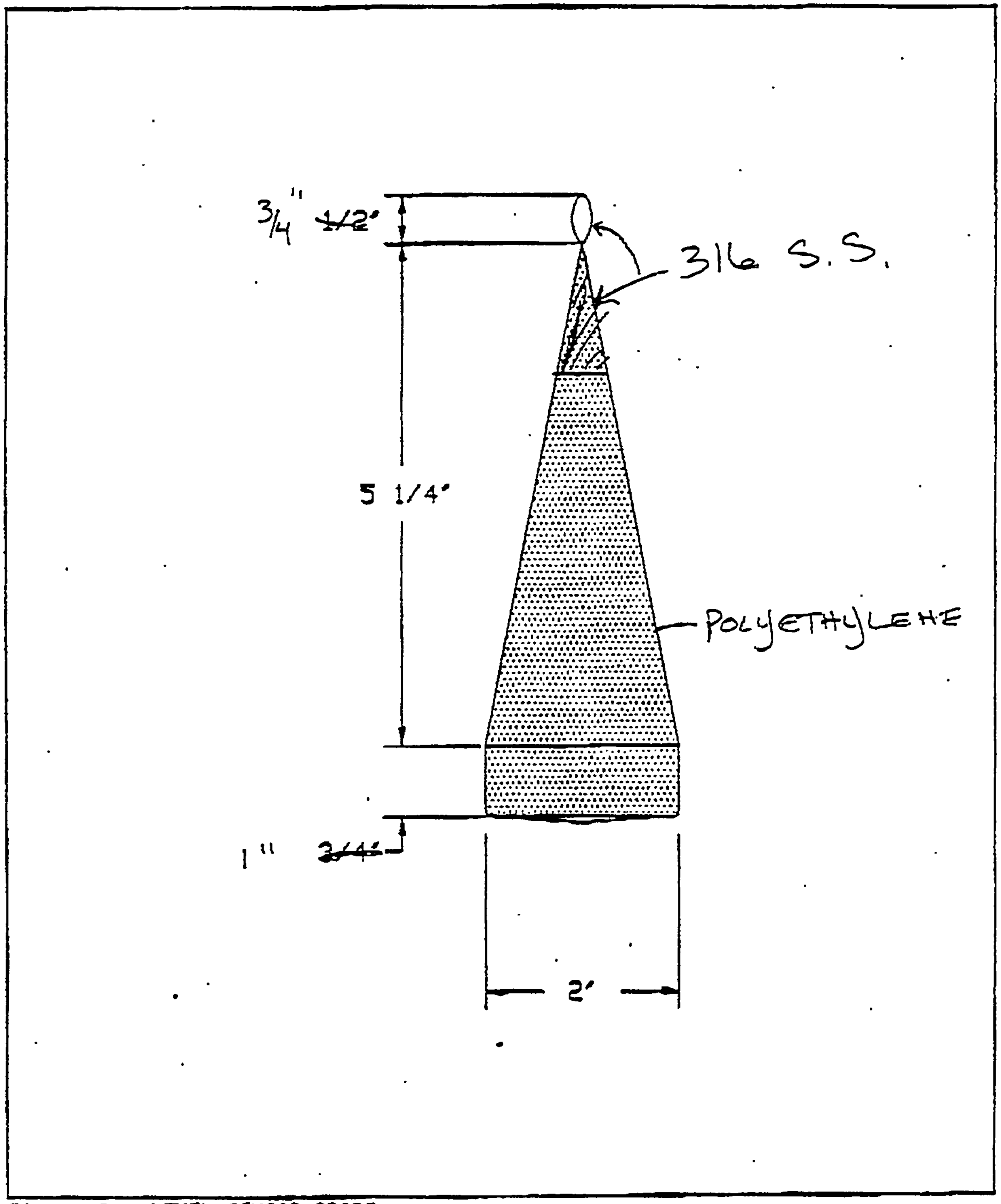


Figure I - LEVEL SENSOR PROBE

APPENDIX D

Safety Documentation

Westinghouse Hanford Company — **Internal Memo**

From: Double-Shell Tank Safety Analysis — 8D114-RJVV-94072 REISSUE
Phone: 6-2613 H4-63
Date: August 31, 1994
Subject: TRANSMITTAL OF SAFETY SCREENING TF-94-0299, *Replacement of the Plummet on the ENRAF Gauge in Tank 241-S-106*

To: A. A. Kirkpatrick R1-62

cc:	G. A. Barnes	H5-09
	K. O. Fein	H4-61
	J. H. Huber	R1-49
	M. N. Islam	R3-08
	L. S. Krogsrud	R3-08
	T. L. Moore	H5-09
	G. L. Smith	H4-63
	RJVV File/LB	

Following the guidelines in MRP 5.12 and WHC-IP-0842, 15.9, Rev. 3, the Safety Screening form was completed for replacing the plummet on the ENRAF gauge in tank 241-S-106.

If you have any questions, feel free to call me on 376-2613. Thank you very much.

R. J. Van Vleet, Ph.D.
Principal Engineer

gjr

Attachment

RECEIVED
SEP 6 1994
T.L. MOORE

ATTACHMENT

to

8D114-RJVV-94072

INDICATE THOSE THAT APPLY BY CIRCLING OR DELETING

AREA: EAST WEST

FACILITY: SST

REFERENCE DOCUMENT: ECN No. PCA No.

WORK PACKAGE No. OTHER (Specify) WHC-SD-WM-TP-265

EQUIPMENT DESCRIPTION: ENRAF level displacement gauge

TITLE: Replacement of the plummet on the ENRAF gauge in tank 241-S-106

Does the PROPOSED CHANGE:

A. Represent a change to the facility as described in the AUTHORIZATION BASIS documentation?

NO X YES/MAYBE

BASIS: The authorization basis for tank farms is the *Hanford Site Tank Farm Facilities Interim Safety Basis*, WHC-SD-WM-ISB-001, Rev. 0-C. The U.S. Department of Energy has authorized the use of the material in Chapter 6 for Safety Screenings and Safety Evaluations. Chapter 6 of WHC-SD-WM-ISB-001 refers the reader to the *Single-Shell Tank Interim Operational Safety Requirements*, WHC-SD-WM-OSR-005, Rev. 0. The availability of a functioning level monitoring system is required by LCO 3.1.1. If the primary waste level monitoring system in a non-interim isolated tank is inoperable, then tank farm operations has 14 days from discovery of the failure to restore the system to operable status.

The new Enraf level displacement gauge in tank 241-S-106 has been found to be non-functional. The plummet and a portion of the 316 stainless steel wire is missing (see Figure 1). The cause of the failure has not been determined conclusively. However, it is thought that the polyvinyl chloride riser liner is degrading and forming hydrochloric acid that runs down the 316 stainless steel wire and this caused the failure. The question at hand is does the loss of the plummet and the potential for another loss in the future cause hazards that are not addressed in the existing safety basis.

Two hazards can be postulated from this incident. The first deals with whether the plummet can come into contact with the tank liner and cause corrosion due to the dissimilar metals (the liner is carbon steel and the plummet has some stainless steel). Figure 1 shows that the majority of the plummet is made of polyethylene. There is only a very small portion of stainless steel exposed. The hazard from this piece of equipment would be no greater than the other equipment known to be in the tank waste. In earlier times, it was a common practice to dispose of non-functioning equipment (like Food Instrument Corporation wires and plummets, thermocouple trees, etc.) in the tank. This is no longer an accepted practice. The second hazard deals with miscellaneous debris interfering with future retrieval equipment. Since the debris is known to exist in the tanks, the safety documentation dealing with retrieval will need to cover aspects such as missiles (mixer pumps picking up small objects and propelling them around the tank) and pump failures (equipment enters the pump intakes and causes pump failure).

Therefore, the failure of this equipment does not affect the tank in its current life cycle stage.

B. Represent a change to procedures as described in the AUTHORIZATION BASIS?

NO X YES/MAYBE

BASIS: The tank farm authorization basis does not specifically mention procedures. However, the intent of this question is to determine if procedural changes will be made that do affect the safety envelope.

Two changes to procedures may happen due to this incident. The first is that the Enraf may be examined periodically for corrosion. This may lead to increased worker exposure to radiation. However, worker protection is covered by the *Tank Farm Health and Safety Plan*, WHC-SD-WM-HSP-002, Rev. 0-C. Another procedural change could be the use of a different riser liner material.

Neither of these changes would affect the safety envelope of the facility.

C. Represent a test or experiment not described in the AUTHORIZATION BASIS documentation?

NO X YES/MAYBE

BASIS: The tank farm authorization basis does not specifically mention tests or procedures. However the intent of this question is to determine if a test or experiment would affect the safety envelope.

This activity is not considered a test or experiment. The ability to measure the waste level in the tank is a necessary monitoring requirement. Therefore, the safety envelope is not affected.

D. Does the change impact:

	NA		NO		YES/MAYBE
• Implemented OSRs or IOSRs?	NA		NO	X	YES/MAYBE
• Approved IOSR Compliance Implementation Plans?	NA	X	NO		YES/MAYBE

BASIS: There already exists a requirement to measure the waste level in single-shell tanks. No new OSRs or IOSRs are required. Additionally, there is not an approved IOSR Compliance Implementation Plan for single-shell tanks at this time.

USQE #1 R. J. Van Vleet, Ph.D.
Print Name
Signature Date 09/01/1994

USQE #2 R. L. Guthrie
Print Name
Signature Date 9/1/9

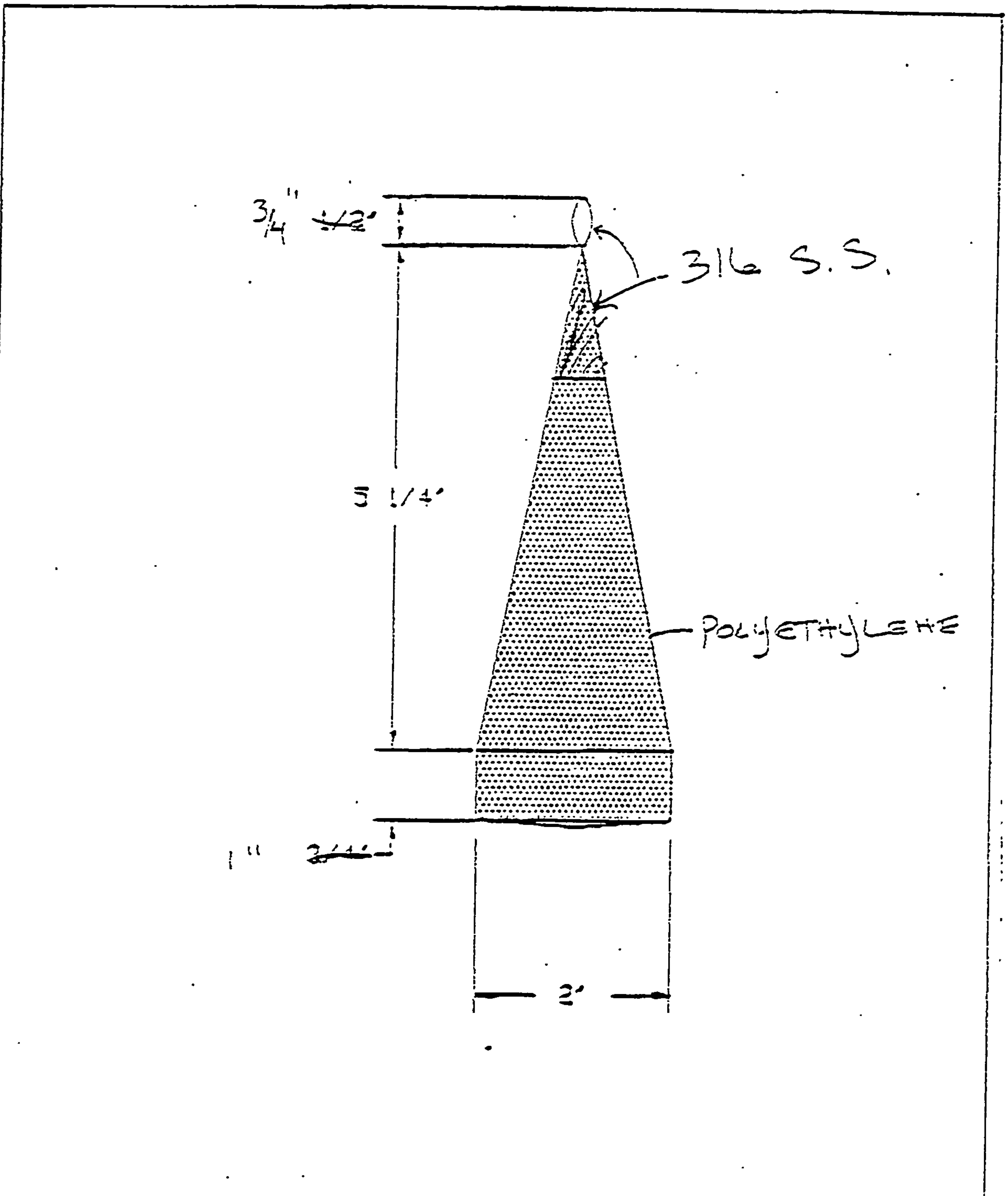


Figure 1 - LEVEL SENSOR PROBE

APPENDIX E

Table
"Liquid Level Gauge Replacement"

Liquid Level Gauge Replacement

TANK	Riser #	ENRAF INSTALLATION	TMACS INSTALLATION (ESTIMATE)	PVC LINER?	FUNDING SOURCE
106-BX	8	7/15/94	8/94 (COMPLETE-NEEDS ATP)	YES	UPGRADES
103-C	8	7/29/94	9/94	YES	UPGRADES
106-C	1	9/8/94	9/94	NO	UPGRADES
103-S	3	5/1/94	9/94	YES	UPGRADES
106-S	3	6/10/94	9/94	YES	UPGRADES
107-S	3	6/10/94	9/94	YES	UPGRADES
111-S	3	8/10/94	9/94	YES	UPGRADES
106-SX	3	8/10/94	9/94	YES	UPGRADES
102-T	8	6/23/94	6/94 (COMPLETE)	YES	OP'S
107-T	1	6/16/94	6/94 (COMPLETE)	YES	UPGRADES
109-T	1	9/8/94	9/94	YES	OP'S
111-T		SEE NOTE 1		YES	
103-U	8	7/20/94	9/94	YES	UPGRADES
105-U	8	7/27/94	9/94	YES	UPGRADES
106-U	8	8/4/94	9/94	YES	UPGRADES
107-U	8	7/28/94	9/94	YES	UPGRADES
109-U	8	7/20/94	9/94	YES	UPGRADES
101-SY	1A	7/14/94	9/94	NO	SAFETY PROGRAM
102-SY	2A	6/30/94	9/94	YES	UPGRADES (SEE NOTE 1)
103-SY	2A	7/14/94	9/94	YES	SAFETY PROGRAM
101-AW	2A	9/94 (NOT COMPLETE)	FY95	YES	SAFETY PROGRAM

NOTES:

1. T-111 HAS BEEN PUMPED AND NO LONGER MEETS THE CRITERIA (UNSTABILIZED SSTs WITH LIQUID SURFACES). AN ENRAF GAUGE WILL BE INSTALLED IN 102-SY INSTEAD OF 111-T.

APPENDIX F

Sampling Data
S-106 Vapor Space and PVC Liner Swab

SAMPLES

We sampled the airspace of tank 106-S, per the work package, on 8/23/94.

Draeger tube samples taken at various heights are as follows: (1 foot off the waste, 4 feet off the waste, 12 feet off-which corresponds to the end of the riser PVC insert, and 22 feet- which corresponds to midway up the riser insert.)

	1' off waste	4 feet	12 feet	22 feet
NH3	45 ppm	45 ppm	40 ppm	35 ppm
Chlorine	0 ppm	0 ppm	0 ppm	0 ppm
Florine	0 ppm	0 ppm	0 ppm	0 ppm
Hydrogen-Sulfide	0 ppm	0 ppm	0 ppm	0 ppm
Hydrogen	0 %	0 %	0 %	0 %
Oxygen	20.8%	20.8%	20.8 %	20.8 %
combustibles	0%	0 %	0 %	0 %
Organics	3.5 ppm	3.5 ppm	3.5 ppm	3.8 ppm

We verified that the instrument flows were correct, and that there were no kinks or holes in the hoses, even though it looks like we sampled the same point over and over.

The swab of the riser showed little, if any, moisture, a slight amount of discolored debris on the swab, and very low radiation/contamination levels. We saw no PVC particles, the riser internals felt smooth, and the swab traveled easily up and down the entire length.

Litmus paper billets attached to the sample apparatus for the bottom 4 feet showed no perceptible change in color, with the exception of the billet at the very end, which indicated a very basic composition (dark blue). The small amount of tank liquid waste that came up on the end of the sample apparatus was a bright yellow in color.

Let us know what you want done next.

Dan Niebuhr
West Tank Farms