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Technical Assessment of BY-112 Liquid Observation Well(LOW) Anomalous Readings

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Abstract: This document contains a technical assessment of the cause and disposition of Interstitial Liquid Level(ILL) readings taken in February 1997 on Hanford waste tank 241-BY-112 that were below specified limits. Some readings were determined to be spurious while other readings were below the limit because of normal data scatter. The data assessment did discover that a new ILL had formed below the currently established baseline because of the normal drainage of the interstitial liquid over time. A new baseline and limit will be established. Because the new ILL appears to be stable and consistent with post saltwell pumping behavior, and because there is no other evidence to the contrary, the tank is judged not to be leaking.

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TECHNICAL ASSESSMENT

OF BY-112
LIQUID OBSERVATION WELL(LOW)
ANOMALOUS READINGS

TABLE OF CONTENTS

1.0 SUMMARY

On February 4, 1997, the weekly routine surveillance Liquid Observation Well (LOW) neutron scan was performed. The estimated Interstitial Liquid Level (ILL) was significantly below the established limit. Additional scans were subsequently performed to either confirm the February 4 scan or prove it invalid. Some of the additional scans were slightly below the lower limit. An Occurrence Report (Reference 1) was generated.

A technical review of the LOW data and other relevant surveillance data for the tank was conducted. There are two key conclusions from the review. The first conclusion is that the feature about 44 inches above the bottom, historically assumed to be the ILL, has not changed significantly. The majority of the additional below-limit scans are within the normal expected scatter for the equipment used. The current baseline and tolerances were statistically determined 18 months ago, and are too restrictive to accurately reflect present data scatter. A baseline which includes all available data from 1995 would have notably wider tolerances, and most of the low data points would fall within limits. The high degree of data scatter is further magnified by the fact that the historic ILL has become increasingly blurred over time as the interstitial liquid has slowly drained and the feature has changed shape.

The second conclusion is that a new liquid interface has been forming for several years approximately 20 inches above the tank's dished bottom. This interface represents the true drainable liquid level in the tank. The new liquid interface first appeared on the LOW neutron scans about 1989, some five years after saltwell pumping was completed. LOW scans made between 1986 and the present support the gradual draining and equilibration of the interstitial liquid, and the formation of intermediate layers with different moisture content. This phenomenon is consistent with expectations after saltwell pumping. The new ILL is at the very bottom of the LOW, and is not readily apparent using the existing LOW vans. However, this feature is readily apparent when measured with the new LOW vans.

Four new LOW vans have been designed and procured, and are in the final stages of acceptance and operational testing. The new vans have significantly better resolution, accuracy, and repeatability than the old equipment. One of the new LOW vans was used to perform a neutron scan of BY-112 on February 13, 1997. The scan clearly shows the new liquid interface around 20 inches, near the bottom of the LOW. The new ILL appears to be stable and consistent with post saltwell pumping behavior.

Based on an assessment of existing data, unofficial data obtained using the new LOW vans, and the absence of any other evidence to the contrary, BY-112 does not appear to be leaking. The ILL baseline for BY-112 will be recalculated based on the feature at 20 inches, and the ILL will be monitored with the new LOW vans as soon as they pass the OTP which is in progress.

2.0 Description of Problem

The ILL measurements taken from neutron scans are the primary means of leak detection in BY-112. The present ILL baseline for this tank was established on October 10, 1995 by correlating all of the 1995 data available at the time. So the baseline was based on a little over 9 months of data. This best-fit linear correlation has been continuously projected forward and is the existing baseline. The allowable tolerance of 3 standard deviations(sd) was based on the data scatter during that same 9 month period, and the tolerance has also been projected forward to the present time.

A very low reading was obtained on February 4, 1997. Since that time 13 additional readings have been obtained. See Figures 1 and 2. Since the first repeat scans were also more than 3 sd below the baseline, this tank has been under investigation.

3.0 Assessment and Discussion

The tank and waste history are summarized in Appendix A. The events during the assessment are summarized in Appendix B. Associated assessment action plans and results are summarized in Appendix C. The assessment is divided into the following sections: New and Old equipment comparison, Historical ILL Feature, New (deeper) ILL Feature, Normal vs. Offset Modes, Drywell Evaluation, Core Analysis, and Conclusions.

3.1 New and Old Equipment Comparison

The LOW van surveillance equipment currently in service has changed little since the late 70's. Depth errors are common, and typical data scatter on any tank is 3 to 4 inches, with occasional excursions that are notably larger. Problems include depth calibration, depth encoder slippage, cable pileup, inconsistent slack switch settings, and poor probe resolution. Some of these problems result from original design limitations, while others result from the years of service. Consequently, no single data point is reliable enough to draw conclusions. All deviant data must be rechecked, and only a change in the long-term trend of the data is meaningful. This trend analysis requires many data points before an apparent change can be confirmed or refuted.

Because of the age, condition, and inherent design limitations, the old vans are being replaced. The new LOW vans were designed specifically to eliminate some of the known problems with the old equipment. The depth system is approximately 30 times more accurate (typically +/- 0.10 inches at 100 feet), and the resolution of moisture features is about 10 times better. The new equipment is presently undergoing final operational testing, and will be put into regular service as soon as it is completed. BY-112 was surveyed with both systems, and the differences between the two vans should be taken into consideration when comparing the data.

3.2 Historical ILL Feature

The first ILL scan available on the CASS computer system was obtained in 1986, about two years after completion of saltwell pumping. This scan showed a layer of drained salt cake from the waste surface at about 113 inches down to about 42-44 inches above bottom. Below this depth the moisture content rose sharply as indicated by a higher count plateau. The scan shown in Figure 3 is similar to the 1986 scan. This scan profile remained relatively stable until 1989, when a small spike appeared at the very bottom of the scan. Between 1989 and 1997 this spike on bottom became more prominent. This spike will be discussed in detail in the next section. See Figures 3 and 4 for a comparison of 1989 vs. 1997 profiles.

The moisture increase around 44 inches from the bottom of the dish was assumed to represent the post-pumping liquid interface in the tank, and this feature remains the basis for the official baseline today. The data from January 1, 1995 to October 10, 1995 was used to determine the baseline and allowable 3 sd tolerance. This baseline and tolerance band has been projected forward to the present, and are still the official values being used. See Figures 1 and 2. It should be noted that data scatter is expected. Reference 2, allows a deviation in readings of 3.6 inches in the absence of sufficient data to establish a statistically meaningful baseline and 3 sd tolerance band.

Figure 1 shows that there have been many occasions over the last few years where the data fell below the 3 sd tolerance band. In most cases, however, reruns were within tolerance, and the low point was considered invalid and marked as "suspect" data in the database. It is also noteworthy that there have been several points recently below the limit, rather than just the occasional flyer. This is now believed to result from continued degradation of the old equipment.

If the ILL data is re-baselined using all the data available, a much larger data set than the current official baseline, the baseline decreases by about 1/2 inch. This change by itself does not have a large impact on the baseline, however the 3 sd tolerance band increases from 1.314 inches to 2.161 inches. By including more of the deviant data the tolerance band is widened by about 50 percent. See Figure 5. Using this new baseline and tolerance, many of the points that were previously out of tolerance are now acceptable. If this feature were to continue being monitored as the "official" ILL, the new baseline and tolerances in Figure 5 would give a more realistic view of the data trend.

One factor complicating the analysis of this feature is the continued drainage of liquid from this sludge. This has caused the feature to flatten and spread out, making any liquid interface less clear. The software that automatically evaluated the liquid level from the raw scans can wander up and down the interface, adding to the scatter. The best analysis situation is a very sharp drop in count rates at the liquid interface, and the more spread out the count rate decay is the more erratic the evaluation becomes.

Taking all these factors into consideration it is concluded that the top of this sludge does not appear to be changing abnormally at the present time and is typical of slowly draining sludge.

3.3 New (deeper) ILL Feature

Since about 1989 a small spike of increased moisture has been appearing at the very bottom of the old van scans. Only the first, and perhaps second, data points on the survey respond to it, and there has not been enough resolution with the old equipment to clearly identify this as a true liquid interface. It has, however, been increasing with time, which is typical of a collection pool.

To help resolve whether this new feature is really a lower liquid interface a scan with the new LOW van was performed. See Figures 5 and 6. The new van collected data several inches deeper than the old equipment. The data was also collected 7 times slower (0.9 ft/min vs. 6.0 ft/min) and at 6 times higher data density (0.20 inches vs. 1.2 inches). The vertical resolution of the new probe is also about 3 times better. The net result is a very clear and well-defined liquid interface at about 20 inches from bottom.

As the sludge occupying the bottom 3.5 feet of the tank slowly drained over the years, the drained liquid has been collecting on the bottom. The waste near the LOW below 20 inches is 100 percent saturated, while the waste above that point is at least partially drained. This indicates that the feature previously thought to be the ILL around 44 inches is no longer the liquid interface, but the top of a slowly draining sludge layer.

Another factor confirming that the feature at 20 inches is a true liquid interface is that the response time and shape of the feature exactly matches the probe response to the liquid interface of water in a barrel. The barrel test was performed as part of the new van operational testing, and the profile matches the response at 20 inches perfectly. The feature at 44 inches, on the other hand, takes much longer to respond. This stretching of the feature is typical of a draining sludge, and not a true liquid interface.

3.4 Normal vs. Offset Mode

Most of the historical scans on BY-112 were taken in normal mode. In this normal mode the van is positioned close enough to the LOW for the boom to hang the probe directly over the LOW riser, and the probe is lowered directly into the opening. In the offset mode, the van is positioned well away from the LOW and the probe is suspended in the LOW from a spider assembly which is mounted on top of the LOW riser. The scan procedure makes allowances for both modes, and there should not be any measurable difference in the results from the two modes. The offset mode is used when it is impractical to get the van close to the LOW. Because of questionable safety of the vehicle access bridge during certain weather conditions, both modes have been used on BY-112.

As shown in Figure 1 and Table 1, it can be seen that many of the surveys which came out below tolerance were run in the offset mode. To determine if the mode was a contributing factor, three consecutive scans were obtained on February 25, 1997 in normal mode. Three consecutive scans were also obtained in the offset mode on February 27, 1997. The three surveys showed around 1.5 inches of scatter in both cases, and the average of the three was very similar. The offset mode data was slightly lower, but not enough to account for the errors seen. The difference between the two modes was well within the expected data scatter for the equipment in general. The spider assembly was eliminated as a possible source of the depth errors.

Table 1. Estimated ILL from LOW Scans Taken in February 1997

Date	ILL (inches)	Deviation from baseline (inches)	Std Dev	Mode
2/4/97	37.70	-6.53	-14.90	Offset
2/8/97	43.56	-0.67	-1.53	Offset
2/8/97	42.44	-1.79	-4.08	Offset
2/8/97	42.38	-1.85	-4.22	Offset
2/11/97	42.26	-1.97	-4.49	Offset
2/11/97	42.02	-2.21	-5.04	Offset
2/11/97	42.36	-1.87	-4.27	Offset
2/19/97	44.18	-0.06	-0.14	Normal
2/25/97	42.38	-1.86	-4.25	Normal
2/25/97	43.92	-0.32	-0.74	Normal
2/25/97	43.21	-1.02	-2.33	Normal
2/27/97	43.18	-1.07	-2.44	Offset
2/27/97	42.61	-1.63	-3.73	Offset
2/27/97	41.99	-2.26	-5.15	Offset

3.5 Drywell Evaluation

The drywells were evaluated to see if there was any indication of increased contamination. On February 27, 1996 Rust Geotech, in conjunction with the Grand Junction Projects Office, surveyed each drywell with the high resolution Spectral Gamma survey system as part of efforts to provide baseline characterization surveys for the Vadose Zone. The conclusion in the final report (document number GJ-HAN-29, Tank BY-112) states, "SGLS logs show no subsurface contamination that could be associated with a possible leak of tank BY-112. The tank's categorization as "sound" is supported by the spectral gamma-ray log data."

On February 13, 1997 the drywells were again surveyed with the older gross-gamma equipment that has been in service for the last 20 years. A review of the scans indicated that all drywells are still normal, and that no contaminated intervals were indicated.

3.6 Core Samples

Two core samples have been taken from BY-112. Core number 174 was taken from Riser 18 on October 3, 1996 and core number 177 was taken from Riser 21 on October 7, 1996. These risers are on the opposite side of the tank from the LOW. See Figure 8. The results vary between the two cores. See Figure 9. The Riser 18 core shows a "wet sludge" from about 3 feet to bottom, but it is unclear from the core description whether this is residual or drainable liquid. Sludges tend to have high residual liquids even after they have drained. The Riser 21 core indicates moist salt cake all the way to the bottom of the core, and does not indicate any saturated or drainable intervals at all. If the true liquid level were still at 44 inches this core should have had some saturated intervals. If the ILL is right on bottom the core should have had a few inches of "wet" salt cake.

The data from these two cores indicates that the waste in this tank is very heterogeneous, and the layers most likely do not extend laterally from wall to wall. The sludge at 3 feet in core 174 supports the ILL neutron profile, and the lack of a saturated material on bottom in core 177 indicates that the liquid level is right on bottom if it exists. Overall, parts of the core analysis support the ILL profiles and the existence of a liquid interface very near bottom, while other aspects raise questions. Overall the core analysis was considered interesting, but inconclusive.

3.7 Conclusions

Based primarily on evaluation of the scans from the new LOW van, the changes in the neutron profile that have occurred over the last few years, and a lack of evidence to the contrary, it is concluded that BY-112 is not leaking. The interstitial liquid appears to be slowly draining from the sludge around 44 inches, but any drained liquid is being collected at the liquid interface around 20 inches. The ILL should be re-baselined based on the 20 inch feature and monitored with the new LOW vans as soon as the vans complete operational testing.

4.0 REFERENCES

1. Occurrence Report Number RL--PHMC-TANKFARM-1997-0018, "241-BY-112 Liquid Observation Well Anomalous Reading," February 20, 1997.

2 OSD-T-151-00031 Rev B-4, "Operating Specifications for Tank Farm Leak Detection and Single Shell Tank Intrusion Detection," December 4, 1996.

FIGURE 1

Scatter Graph of Estimated ILL from July 1994 to March 1997 Showing Baseline Established in Oct 1995

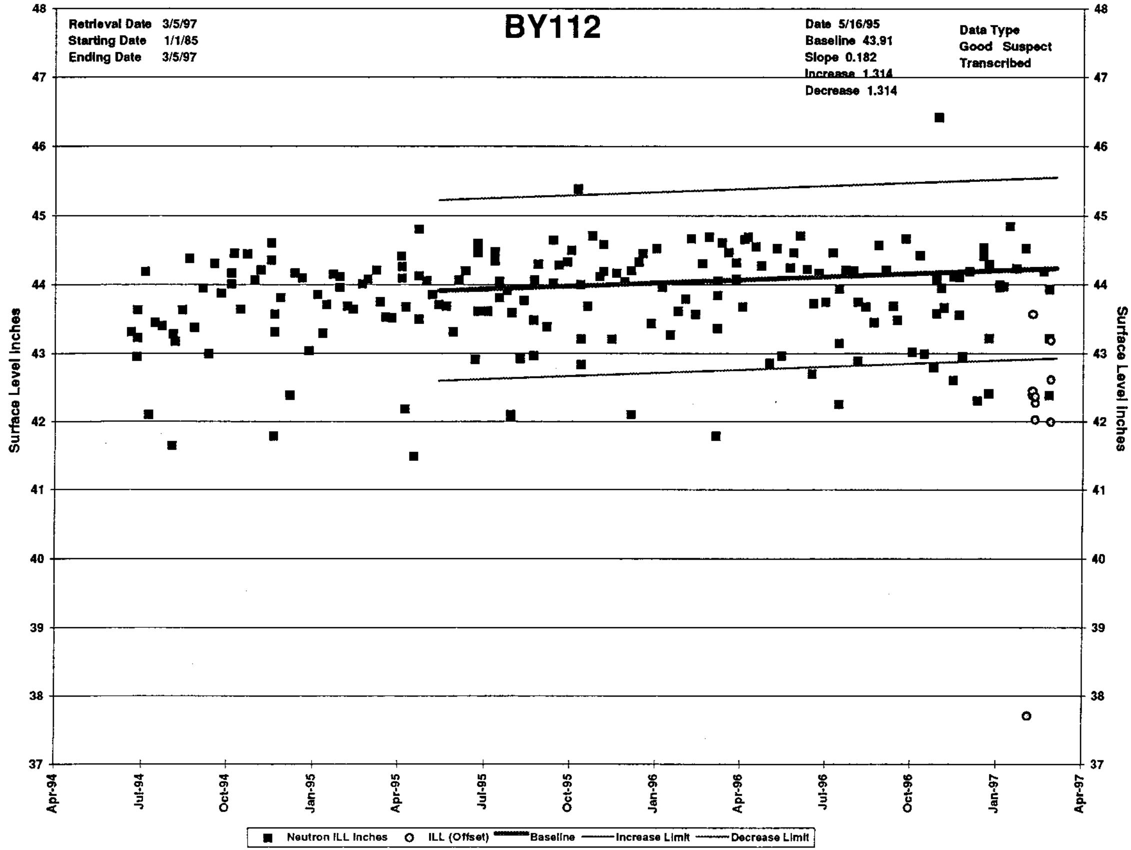


FIGURE 2

Scatter Graph of Estimated ILL from October 1996 to March 1997

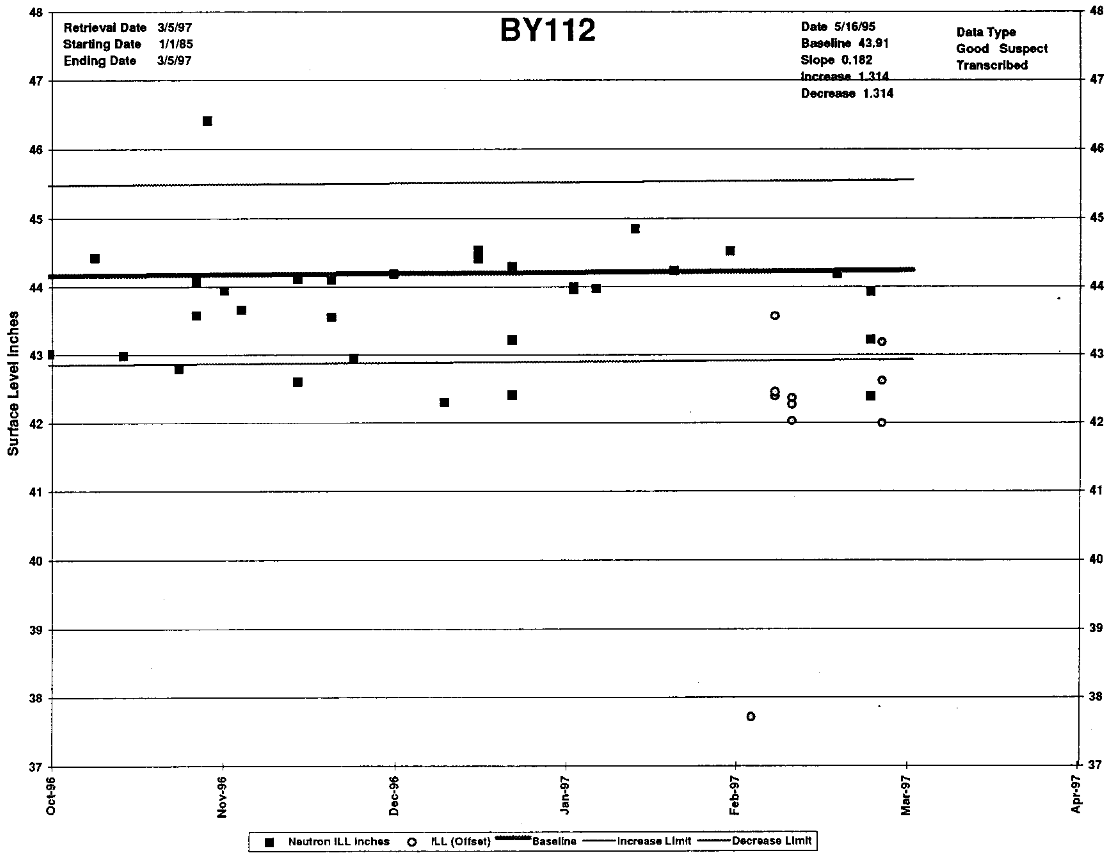


Figure 3

Line Graph of LOW Newtron Scan Data of April 13, 1989

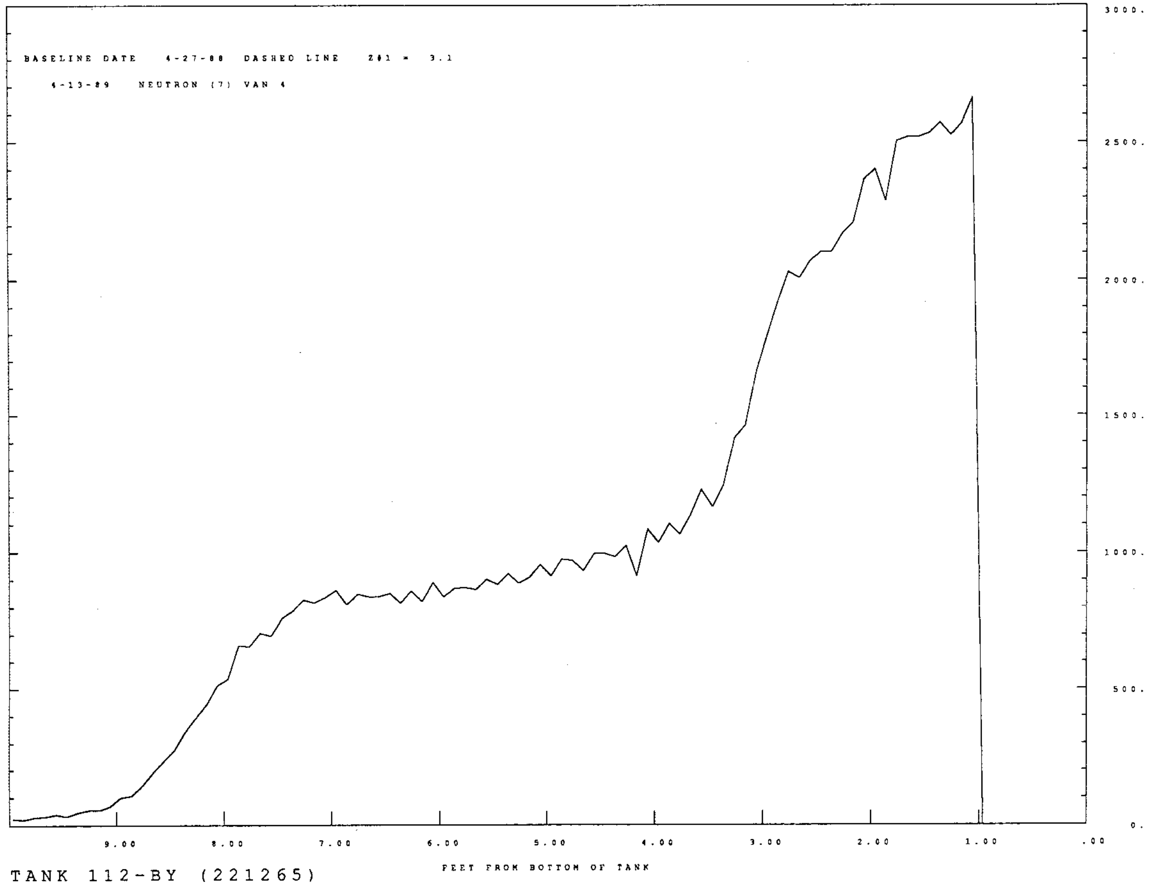


Figure 4
Line Graph of LOW Neutron Scan Data of February 25, 1997

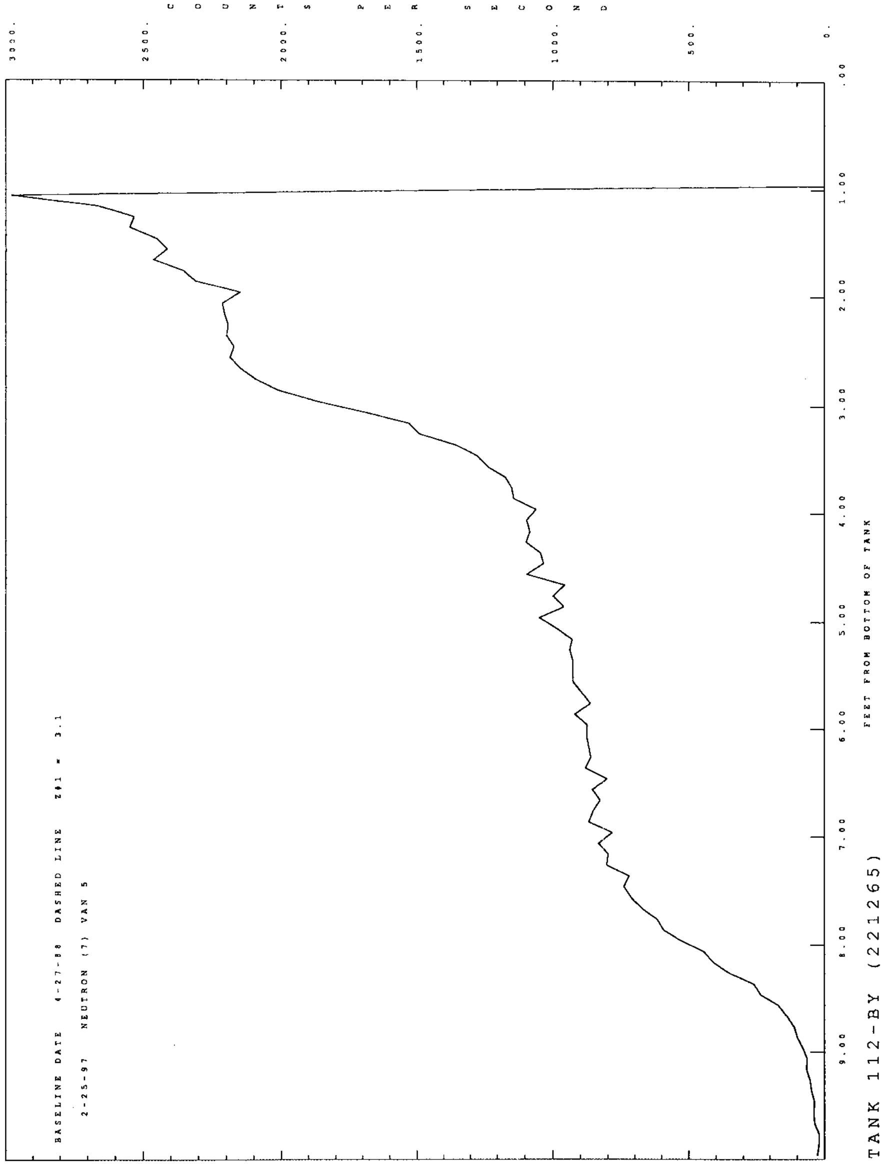


Figure 5

Scatter graph of Estimated ILL from Jul 1994 to Mar 1997 Showing Unofficial Baseline Derived Using All Data from Jul 1994

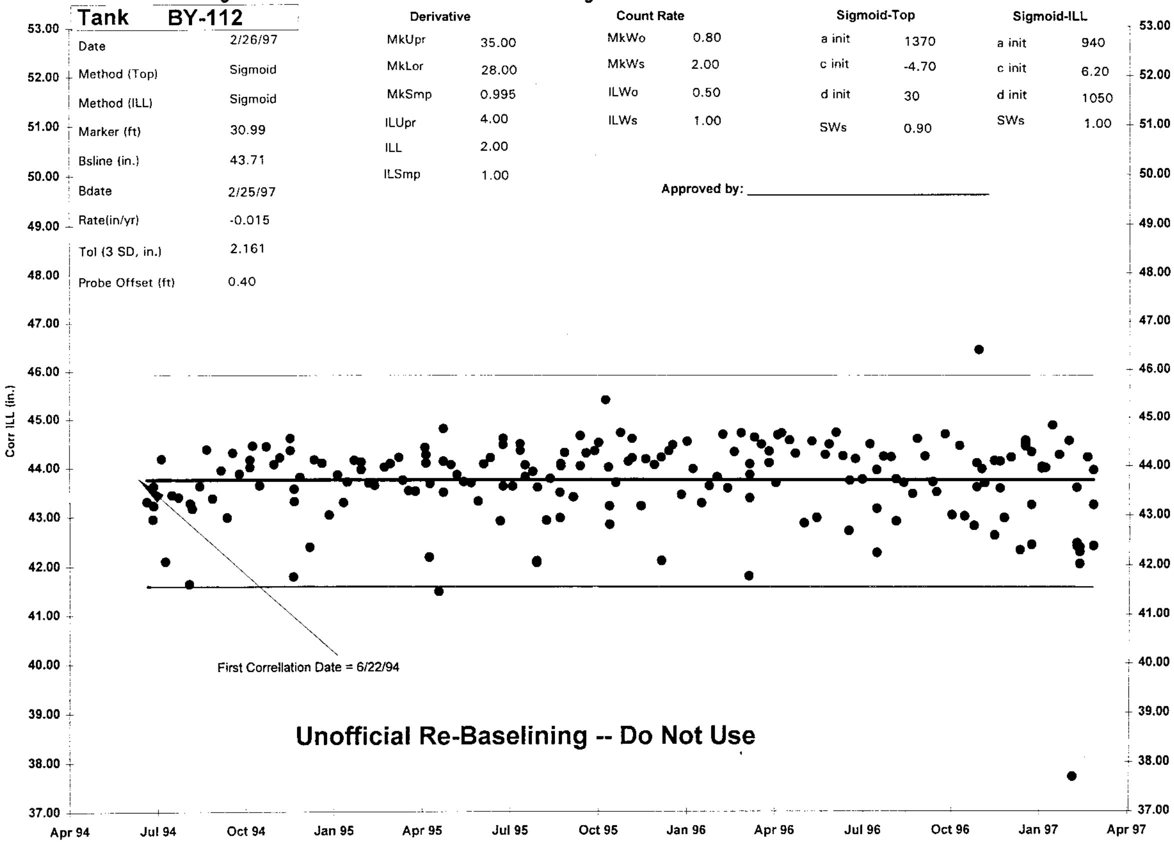


Figure 6

Line Graph of LOW Neutron Scan Data from 0 to 50 feet of February 13, 1997 Using the New Low Van

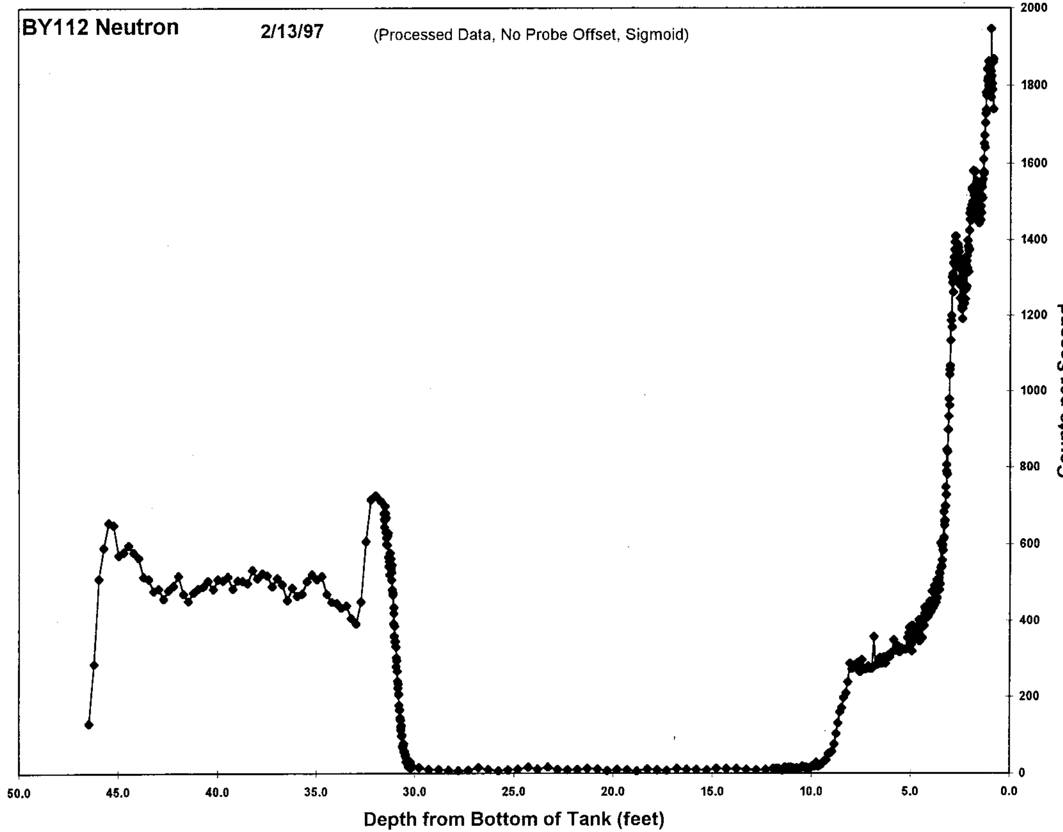


Figure 7

Line Graph of LOW Neutron Scan Data from 10 to 50 inches of February 13, 1997 Using the New Low Van

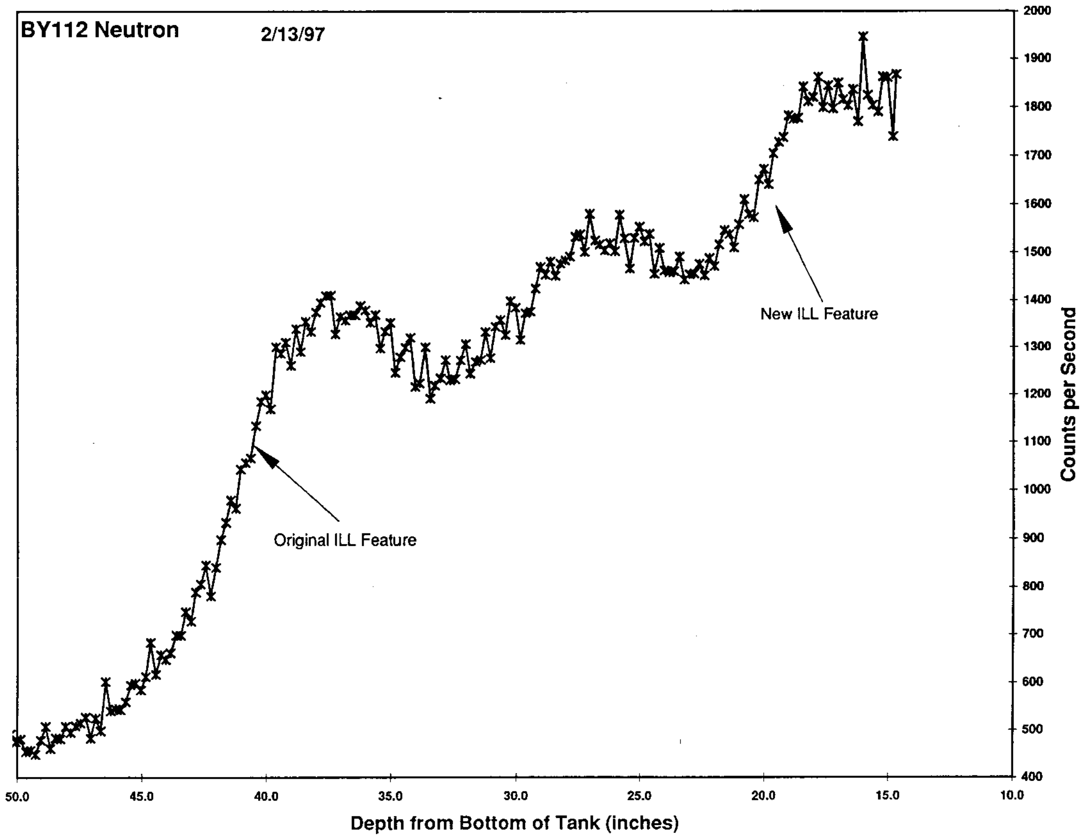


Figure 8
Riser Configeration for Tank 241-BY-112

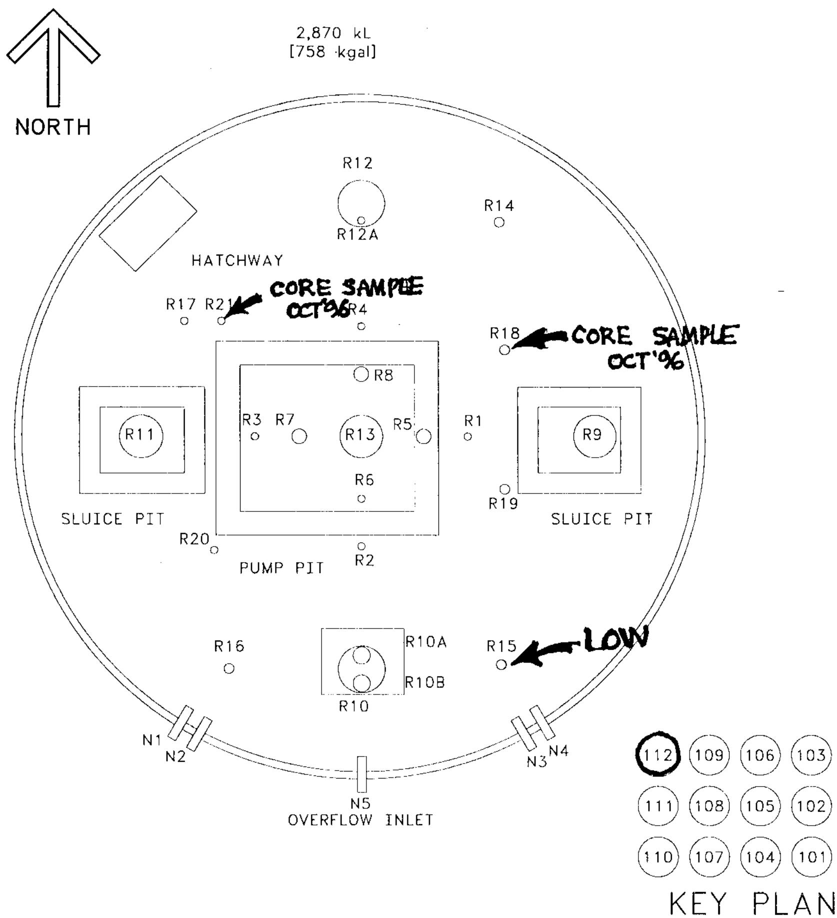
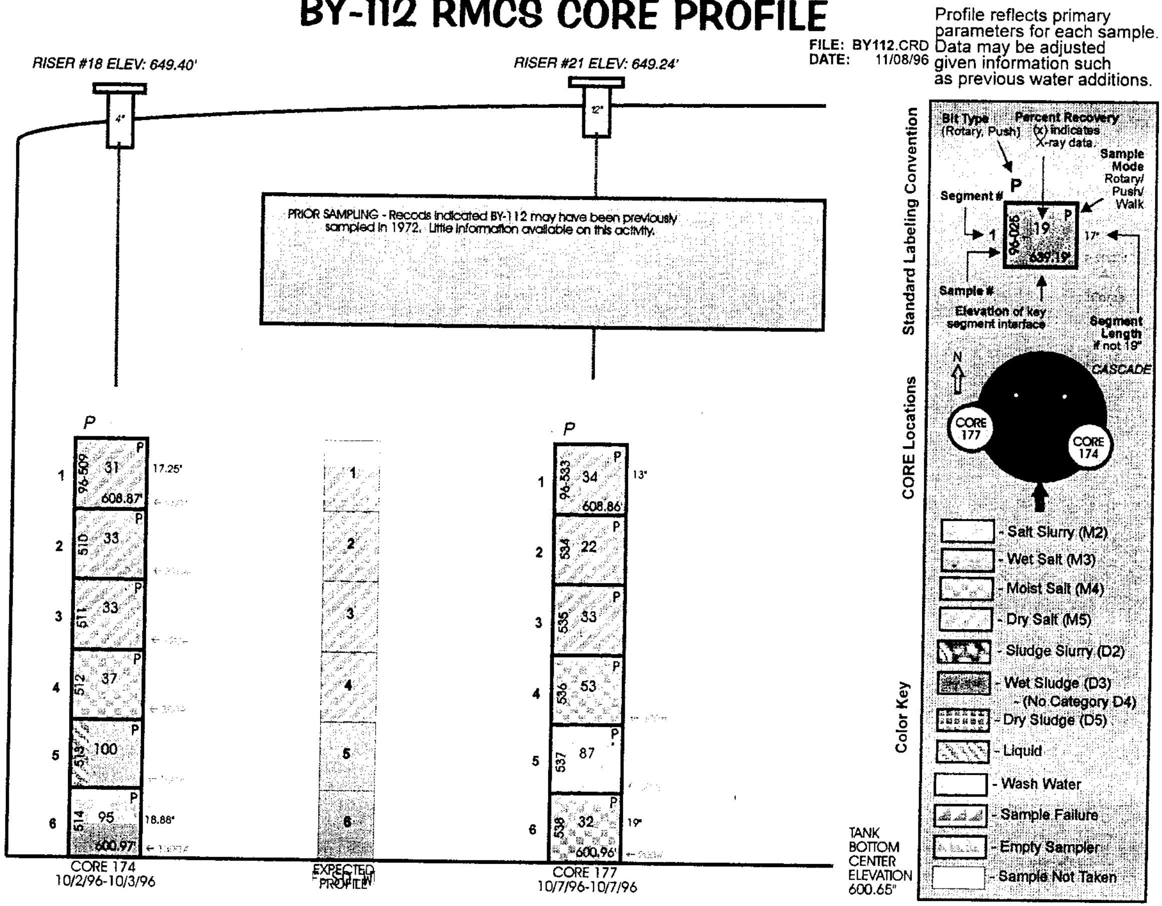


Figure 9

BY-112 RMCS CORE PROFILE



APPENDIX A
HISTORY OF BY-112 TANK, WASTE CONTENTS, AND SURVEILLANCE

TANK DESIGN AND CONSTRUCTION

BY Tank Farm was constructed during 1948 and 1949. There are twelve tanks in the farm. Tank BY-112 has 758,000 gallon capacity. The tank has a dished bottom with a primary mild steel liner(ASTM A283 Grade C) and a concrete dome with 24 risers. The Liquid Observation Well (LOW) is in 6-inch diameter riser 15. The tank is passively ventilated. The tank was removed from the Ferrocyanide Watch List in September 1996. The tank is categorized as sound with interim stabilization and intrusion prevention completed.

WASTE CONTENTS

Tank first waste received by BY-112 was metal waste from B Plant in 1951. Transfers in and out of the tank were made through 1957. The tank was then static until 1965. In 1966, a heater was placed in the tank to cause evaporation, and BY-112 became the second In-Tank Solidification unit. Supernate was pumped out in 1976. The only waste related activity since 1976 has been Salt Well pumping which was completed in 1984. The tank was interim stabilized in 1984, and intrusion prevention was completed in 1991. Two full core samples of the waste were obtained in October 1996 through risers 18 and 21. See Figure A-1 "Tank 241-BY-112 Level History.

A photographic montage of tank BY-112's interior taken in April 1988 shows a white dry surface of salt cake. See color negative series # 8801299. The waste surface level has not changed since the photographs were taken, and the photographs are assumed to accurately represent the current appearance of the waste surface. See Figure A-2 "BY-112 Waste Surface Near LOW," Figure A-3 "BY-112 Waste Surface Near Sludge Weight," and Figure A-4 "BY-112 Waste Surface Near SaltWell Screen."

The waste remaining in BY-112 is classified an non-complexed. Using the Tank Layer Model (TLM) and the Supernatant Mixing Model (SMM), tank BY-112 contains a top layer of 283 kgal of salt cake above a layer of 6 kgal of ferrocyanide sludge, atop a bottom layer of 2 kgal of metal waste. The TLM and SMM models are based on historical transfer data.

There are seven drywells around BY-112. None of the drywells have ever shown radiation levels significantly above background.

The waste surface level for tank BY-112 as measured by a manual tape in riser number 19 has been steady at about 113 inches.

Figure A-1
Tank 241-BY-112 Level History

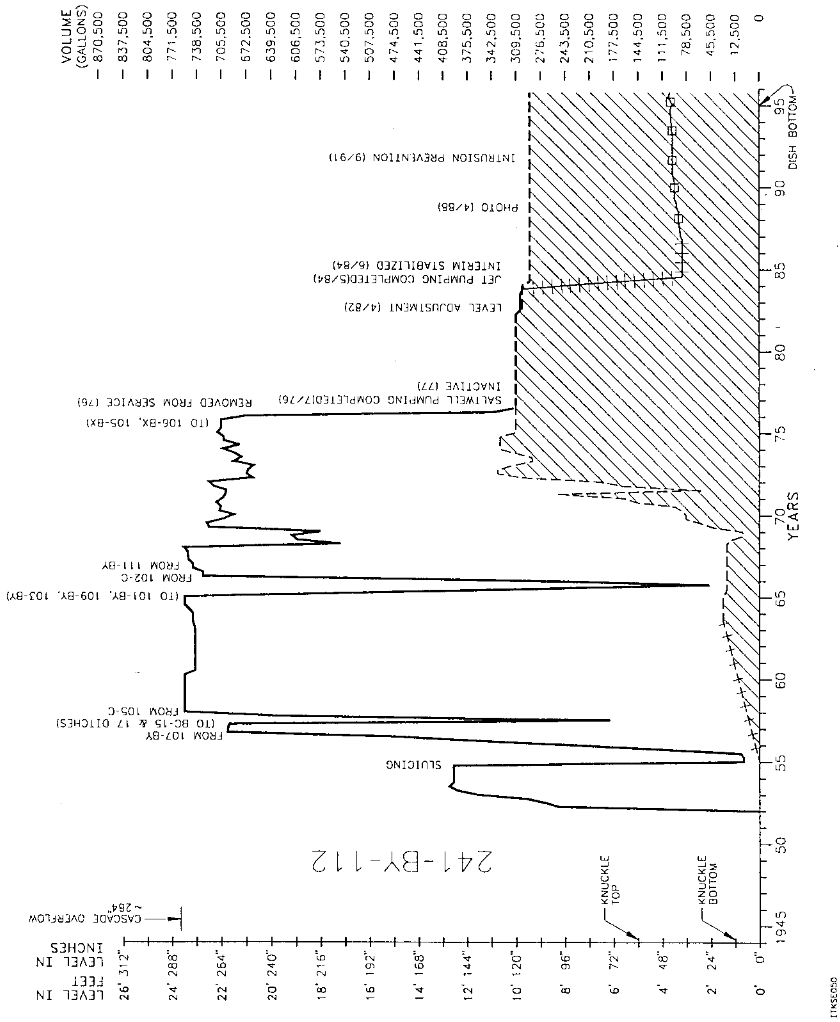


Figure A-2
BY-112 Waste Surface Near LOW

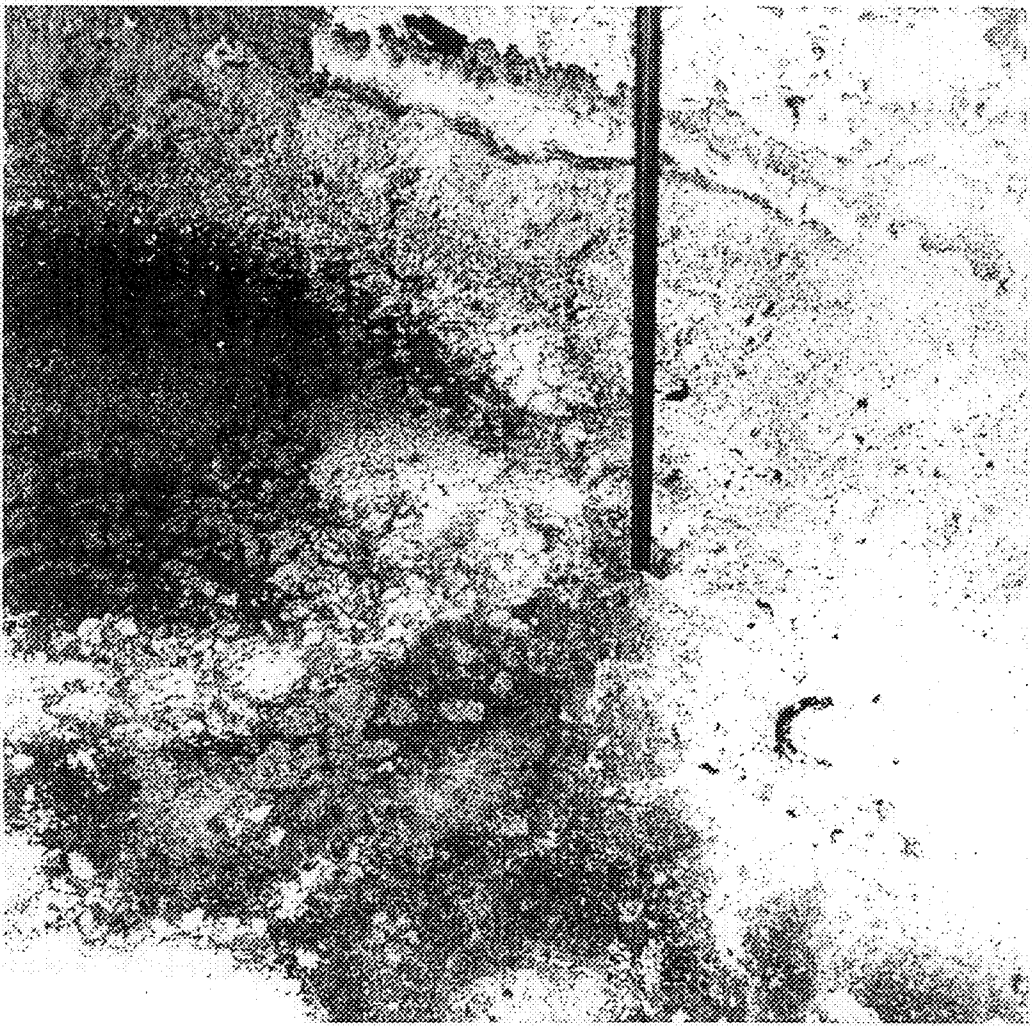


Figure A-3
BY-112 Waste Surface Near Sludge Weight

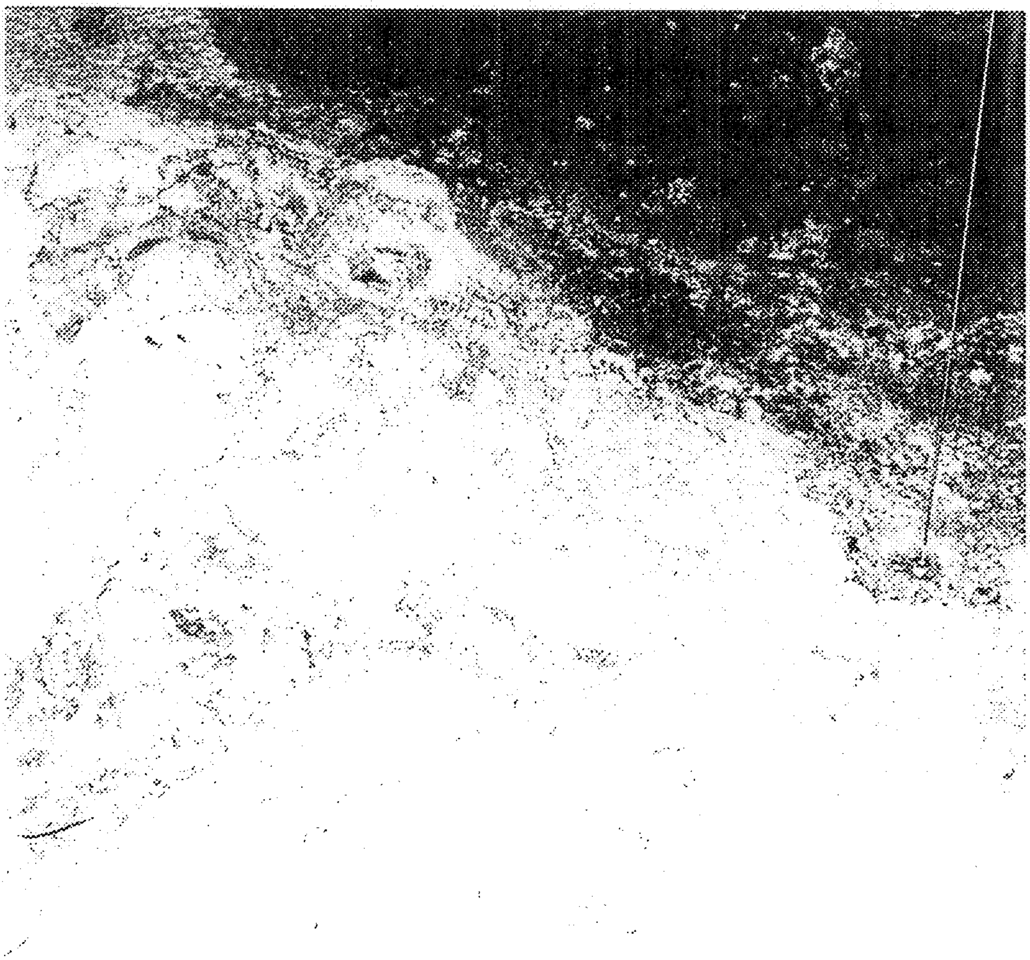
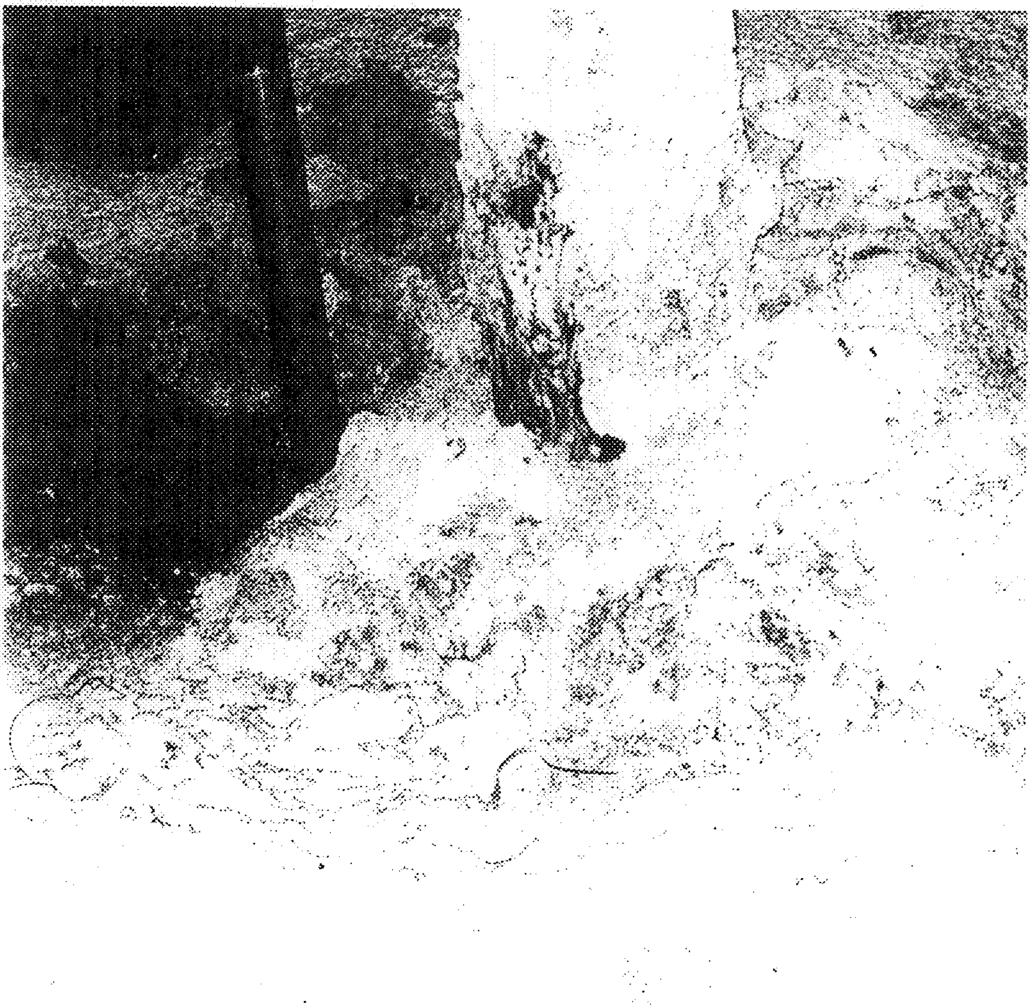


Figure A-4
SY-112 Waste Surface Near Saltwell Screen



APPENDIX B
SEQUENCE OF EVENTS

04Feb97 Routine weekly LOW reading of the estimated height of the Interstitial Liquid Level(ILL) in BY-112 was about 6.5 inches below the baseline and about 5 inches below the OSD-T-151-00031 limit.

08Feb97 Three follow-up scans were taken in order to confirm or correct the scans obtained on 04Feb. The ILL estimate from one scan was within the acceptable limit. The ILL estimates from the other two scans were about 1/2 inches below the limit. See Figure 1 and the data Table 1. Maintenance problems with the LOW van prevented obtaining confirmatory readings until 08Feb.

The Shift Manager was notified of the anomalous readings.

10Feb97 DA Barnes reviewed the readings and notified GL Dunford that a data anomaly had occurred and that he was reviewing the data.

11Feb97 Data assessment continued. DA Barnes prepared draft memo summarizing data anomaly as understood at that point. A Discrepancy Report was prepared. See Reference 1.

12Feb97 GL Dunford convened a fact finding/decision meeting to determine future course of action. Present at the meeting were DA Barnes, JG Burton, GL Dunford, JM Barnett, MJ Holm, RJ Brown, RW Reed. After that meeting, KG Wade(DOE/RL) and DJ Saueressig were briefed and JG Burton decided to declare an Off-Normal, Cat 10 C., Unusual Occurrence. Several action items were identified at the meeting. See Appendix C "ACTION PLANS." DA Barnes explained that, based on his review and analysis of the BY-112 data, he believed that the historic ILL baseline did not represent the true liquid level in the tank, and should be re-established based on a feature very near the bottom of the tank.

13Feb97 The drywells around BY-112 were surveyed and compared to historical profiles. No contaminated intervals were noted in any drywell, and all scans matched baseline scans with normal background levels.

13Feb97 A neutron survey was obtained on BY-112 with the new LOW van equipment. The new van's depth system is approximately 30 times more accurate than existing equipment, and the resolution of moisture features is about 10 times better. This scan clearly identified the new liquid interface about 20 inches from the bottom of the tank.

19Feb97 FDH and WDOE representatives met with DA Barnes. Mr. Barnes explained the LOW monitoring process and the on-going evaluation of the BY-112 LOW data. The WDOE tentatively agreed with the unofficial opinion that the real ILL was about 20 inches from the bottom of the tank, rather than around 44 inches, as previously believed. The WDOE asked for additional information to be provided.

19Feb97 The weekly LOW surveillance scan was performed on BY-112. The estimated ILL was near the historic baseline.

NOTE: The surveys performed prior to 4Feb97 were obtained by East van crews, who were using the normal, or "drive-up" method. The normal "drive-up" setup is to position the LOW van next to the riser so that the probe can be lowered directly into the riser from a jib crane on the van. When the West crews took over the operation on 4Feb97 they used an offset assembly called a "spider" to simplify the rig-up. This assembly allows the van to be positioned several feet away from the well, and the probe is lowered into the well using a pulley assembly attached to the top of the well. The LOW operating procedure makes provisions for either direct or spider mode, and the two methods should (theoretically) give the same results. Since most of the out-of-tolerance scans were taken in "spider" mode, the possibility of systematic depth errors in this mode was also investigated.

19Feb97 RW Reed informally briefed KG Wade(DOE/RL) on the progress and findings to date.

25Feb97 LOW Van #4 was used to obtain 3 scans of BY-112 LOW in normal "drive-up" mode. Two surveys were within tolerance, and the other reading was below tolerance.

27Feb97 LOW Van #4 was used to obtain 3 scans of BY-112 LOW using the offset spider technique with the spider assembly. Two surveys were below tolerance, with the third being acceptable, but below baseline. Overall, the difference between the three normal mode vs. the three offset mode surveys was not considered significant, and the spider assembly was eliminated as the primary source of error. See Table 1.

APPENDIX C
ACTION PLAN and RESULTS

1. **ACTION:** Find out if there was any standing water in the LOW, since that would erroneously affect readings at the bottom of the LOW.

RESULTS: JR Brown checked with the Operators who performed the scans from Feb 4 through Feb 12. The same operator performed the scans. He reported that the pre-scan contamination swabs were damp as from normal condensation in a LOW. But, the swabs were not dripping wet as they would be if they were submerged in standing water at the bottom of the LOW. Therefore, water in the LOW was eliminated as the cause for the anomalous readings.

2. **ACTION:** Perform a neutron scan with a New LOW van, which has better depth resolution, to confirm or correct assumptions about historic Interstitial Liquid Level(ILL) interface, and suspected ILL interface near the bottom of the LOW.

RESULTS: A scan was made with new Van #2. DA Barnes provided field support while the scan was made. The results of the scan support the hypothesis that the historic baseline has been focused on the top of the sludge layer, rather than the liquid interface. The actual ILL appears to be about 20 inches from the bottom of the tank. The scan with the new van shows a classical liquid interface about 20 inches above the bottom of the tank, and the historic baseline feature is smeared across a longer distance. See Figures 6 and 7.

3. **ACTION:** Perform Drywell scan to see if any sign of a leak is present. Last known run at the time of the meeting was June 1994. No prior scans have been significantly above background radiation levels.

RESULTS: Scans of the seven drywells around BY-112 were performed 13Feb97 and the results were analyzed on 14Feb97. No readings significantly above background were found. Thus, there is no evidence of the tank leaking past the drywells.

4. **ACTION:** Review BY-112 temperature profile data on Surveillance Analysis Computer System (SACS) for any anomalies that might explain or be associated with the recent LOW anomaly.

RESULTS: SACS near-term temperature data were reviewed. No evidence of unusual behavior was evident. No temperature fluctuations were apparent that would indicate a gas release event. See Figure C-1. [NOTE: since BY-112 is classified as a category 3 tank per the latest Flammable Gas Standing order, gas releases are not expected. This check was made to confirm the lack of typical gas release event changes in tank waste temperatures.]

5. **ACTION:** Review temperature data in SACS for any historic level fluctuations that could indicate Gas Release Events.

RESULTS: SACS long-term temperature data were reviewed. There is no evidence of periodic or random temperature fluctuations that are normally associated with Gas Release Events. The temperature fluctuations are gradual, and entirely consistent with seasonal temperature swings. See Figure C-2.

6. **ACTION:** Establish a technical team to evaluate ILL data from BY-112 and other tanks as appropriate.

RESULTS: GL Dunford appointed DA Barnes, RW Reed, and MJ Holm to evaluate the data and present their findings and recommendations.

7. **ACTION:** Evaluate the capability to and the feasibility of Saltwell pumping BY-112 if necessary.

RESULTS: According to M Koch, when salt well pumping was concluded circ 1984, they had obtained a pumping rate of 0.038 gal/min. Saltwell pumping is considered complete when the pumping rate reaches 0.05 gal/min. So, the tank was considered to have no pumpable liquid and 7,000 gallons of drainable liquid when salt well pumping was completed.

8. **ACTION:** Compute a new baseline for the ILL using recent readings to see if recent readings would fall within the 3 standard deviation tolerance band.

RESULTS: When the baseline and 3 sd tolerance bands are computed using all available data since 1995, most of the estimated ILLs are within tolerance. See Figure 5.

9. **ACTION:** Check Rust Geotech drywell survey to see if they have looked at BY-112 since June 1994, and if they did, review the results.

RESULTS: Rust Geotech did a drywell survey of BY-112 in February 1996. The survey, reported in April 1996, found radiation levels near background levels with no indications of past or recent activity.

10. **ACTION:** Check with Characterization Project to see if they have taken a core sample of BY-112, and if so, review the findings.

RESULTS: Two core samples of BY-112 were obtained in October 1996. Photographs of the extruded core samples from all 12 core sample segments [six 19-in. long segments from each of two risers] were obtained. Initial observations of the core samples as received at the analytical lab show very little drainable liquid. The samples do not show evidence of an ILL between three and four feet above the tank bottom. See Figure 9.

11. **ACTION:** Calculate the volume of liquid that might be present in the tank.

RESULTS: Ignoring the 4-ft radius where the side walls of the tank join the dished bottom (a conservative assumption), and treating the dished bottom as a cone, the volume of the interstitial liquid can be approximated by adding the volume of the cone to the volume of the cylinder to the height of the ILL and multiplying by a porosity value. The porosity of sludge is assumed to be 16%

per internal WHC letter of August 9, 1995, JB Colman to DB Engelman, "Analytical Method for Estimating Pumpable Liquid Remaining in Hanford Single Shell Waste Storage Tanks."

The estimated volume of interstitial liquid (IL) remaining in BY-112 is:

Vol_{IL} = (porosity){[volume cone] + [volume cylinder]}
Vol_{IL} = (0.16){[⅓(3.14)(33.74 ft)^2(1 ft)] + [(3.14)(37.5 ft)^2((20-12 in)/12 in/ft)]}
Vol_{IL} = (0.16){[1,192 ft^3] + [2,945 ft^3]}
Vol_{IL} = (0.16)(4,137 ft^3)
Vol_{IL} = 662 ft^3
Vol_{IL} = 662 ft^3(7.48 gal/ft^3)
Vol_{IL} = 4,950 gal NOTE: This is an estimate of ILL remaining based on the above assumptions. All pumpable ILL was officially declared to have been removed in 1984.

Assuming that the capillary forces prevent the last 12 inches of ILL from draining, and that the IL was drained from the bottom of the dish, then the volume of drainable IL based on the new ILL at 20 inches can be estimated as follows:

Vol_{IL} = (porosity)(volume cylinder)
The height of the cone representing the dished bottom is 12 inches. Therefore, the volume in the cone is assumed to be held up because of capillary forces and would not drain.
Vol_{IL} = (0.16)(2,945 ft^3)
Vol_{IL} = 471 ft^3
Vol_{IL} = 471 ft^3(7.48 gal/ft^3) = 3,520 gal

RW Reed 10 Mar 97
Calculations by R.W. Reed

PF Kison 3/10/97
Peer review by P.F. Kison

Figure C-1

Line Graph of Temperature Data from January 21, 1997 to February 12, 1997

BY-112

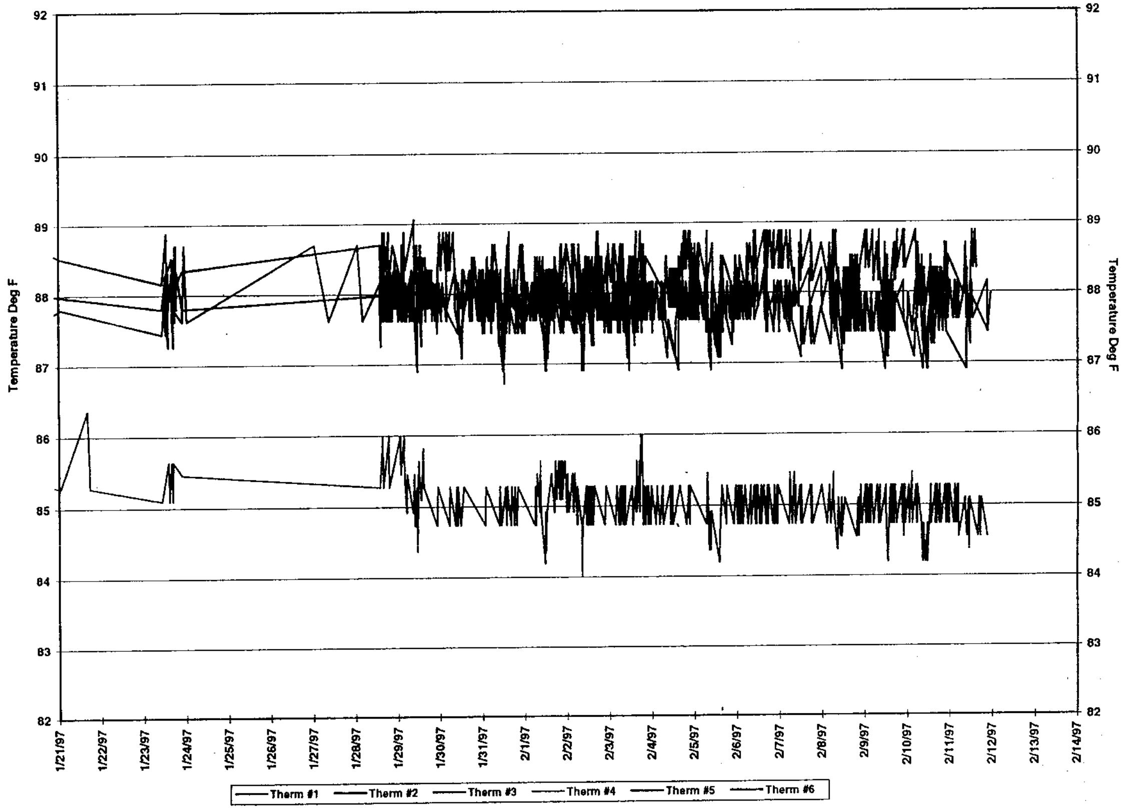
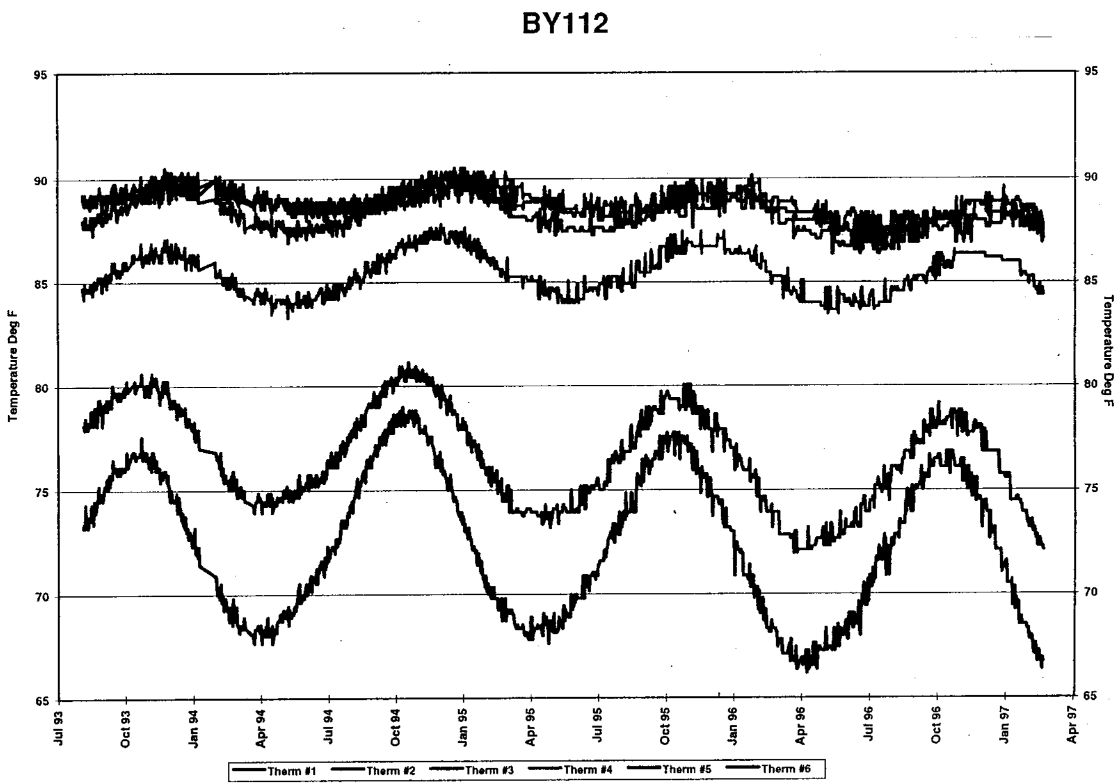


Figure C-2
Line Graph of LOW Temperature Data from August 1993 to February 1997



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