

# **1996 REVIEW REPORT**

## **L-BAR GROUND-WATER CORRECTIVE ACTION PROGRAM**

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## ◆ Introduction

The L-Bar Nuclear Regulatory Commission (NRC) Source Material License SUA-1472 requires the submittal of an annual ground-water corrective action program review that describes the progress toward attaining ground-water protection standards. The first such review report, submitted in March 1990, described the corrective action program at the site and presented ground-water modeling results demonstrating the program's effectiveness. A June 28, 1990 addendum to the report updated the observed water quality at point-of-compliance wells, discussed how the addition of two pumpback wells to the barrier system could increase effectiveness, and calculated the amount of residual mass of hazardous constituents remaining in the tailings impoundment.

The second annual ground-water corrective action program review, submitted in February 1991, discussed the status of the program at the L-Bar site and provided an update to the 1990 report. The specific points discussed in the report included the installation of two additional barrier wells, the performance of the barrier well system for the previous year, the concentrations of regulated constituents at the point-of-compliance wells, and the performance of the toe drain system in collecting and removing tailings fluid from the system.

The third through sixth annual ground-water corrective action program reviews described the status of the program at the L-Bar site between 1992 and 1995. Operations and conditions at the site during those periods changed little after the 1990 report. This seventh annual ground-water corrective action program review describes operations which took place during 1996.

An extensive characterization of the tailings pile and the underlying aquifer was initiated in late 1995 and completed in 1996. This involved an extensive cone penetrometer survey of the tailings, the installation of wells and piezometers in the tailings and in the underlying aquifer, hydraulic testings of the wells, core samples of the formations under the tailings and their characterization, and tailings and radon barrier sampling and characterization. These tests allowed for an evaluation of settlement status of the tailings, the amount and quality of remaining tailings fluid, the impact of tailings on water levels and water quality under the tailings, and an evaluation of geochemical and geotechnical characteristics of tailings, radon barrier, underlying Mancos Shale and

the First Tres Hermanos sandstone aquifer. These sample results, characterizations and interpretations have been compiled in a report entitled *Hydrogeology Investigation of the L-Bar Uranium Mill Tailings Pile, Cibola County, New Mexico* which was submitted to the NRC on December 19, 1996 (Mr. Joseph Holonich, Docket 40-8904).

In addition, an extensive ground water flow, contaminant transport and geochemical modeling exercise was initiated in 1996 and is expected to be completed in 1997.

### ◆ **Barrier System Performance**

The barrier system located west of the former tailings impoundment, consisting of a series of eleven pumpback wells, continues to intercept seepage resulting from consolidation and drainage of the tailings pile. The initial system has been in operation since 1981. The enhanced system, which includes newly installed wells 101 and 102, has been fully operational since September 1990. All pumpback wells are completed in the First Tres Hermanos sandstone. A seepage-collection trench completed in the First Tres Hermanos also intercepts seepage from the former tailings impoundment area. Discharge from the pumpback wells and the trench is collected in a sump at the bottom of the trench. The cumulative discharge is pumped from the sump to two evaporation cells located on the east portion of the property. All wells are equipped with Coyote switches that control intermittent pumping. Pumping cycles in most of these wells occur every 15 minutes. Well 102 pumps intermittently, with cycles occurring every 2 hours. The western barrier wells collected a combined 2,153,616 gallons of fluid in 1996 at a mean pumping rate of 4.15 gpm. The seepage collection trench collected an additional 366,625 gallons at a mean rate of 0.71 gpm.

The barrier system on the east side of the former tailings impoundment consists of pumpback well 89, which is also equipped with a Coyote switch to control intermittent pumping on a 15 minute cycle. The purpose of this well is to recover ground water which may be affected by seepage to the northeast. Pumpback well 89 recovered 143,844 gallons of fluid in 1996 at a mean pumping rate of 0.28 gpm. This water is pumped directly to the evaporation ponds. Past water-level data collected on a monthly basis indicated that pumpback well 89 is effectively producing a capture zone and eliminating any further

eastward migration of seepage beyond point-of-compliance well MW-17B.

Water-level measurements and fluid recovery volumes are recorded for each pumpback well on a monthly basis. Table 1 provides a summary of the fluid recovery data, and illustrates the mean pumping rate and approximate monthly recovery volume for each pumpback well. The mean pumping rates range from 0.02 gpm at well 102 to 0.85 gpm at well 2A. An average of 0.71 gpm was also collected by the seepage collection trench. A total of approximately 2,664,685 gallons of fluid was extracted by the barrier system in 1996.

### ◆ **Point-of-Compliance Monitoring**

Four point-of-compliance (POC) wells and one background well, as designated by Condition 31.A of License SUA-1472, are used to evaluate the water quality over time. These POC wells are: MW-1A to the northwest of the former tailings impoundment, MW-69 directly west of the former tailings impoundment, MW-81 to the southwest of the former tailings impoundment, and MW-17B to the northeast of the former tailings impoundment. The background well, MW-29A, is northeast of MW-17B.

As part of the Ground-Water Compliance Monitoring Program at the L-Bar tailings site, POC wells are sampled and analyzed for antimony, nickel, combined radium-226 and radium-228, selenium, thorium-230, and uranium. Water from MW-17B is also analyzed for cyanide. Table 2 summarizes the L-Bar compliance monitoring results when constituents are found at or above laboratory minimum detection levels. Updated plots of dissolved concentration versus time for hazardous constituents monitored at the POC wells are shown in Figures 1 through 5. These plots illustrate data collected from 1988 through the most recent sampling event performed in October 1996. The behavior of each hazardous constituent is described below.

- ◆ **Antimony (Sb)** has in the past been detected in wells MW-17B and MW-69 at concentration levels slightly above the ground-water protection standard (GPS) of 0.2 mg/l. The maximum observed concentration of antimony is 0.39 mg/l, occurring in MW-69 in October 1989. Antimony was not detected above 0.10 in any POC wells in 1990



or 1991. Antimony was detected in two wells during the October 1992 sampling event, both at concentrations below the ground-water protection standard of 0.20 mg/l. Antimony was found in well MW-17B at 0.011 mg/l and in MW-81 at the detection limit of 0.005 mg/l (Table 3). During 1993, antimony was not found in any POC well during the April sampling and was only found at 0.01 mg/l in MW-81 and at 0.02 mg/l in MW-1A during the October 1993 sampling period. In 1994, antimony was detected in well 17B during both sampling periods, but at the very low concentration of 0.006 mg/l. It was also detected in well MW69 in April 1994 at the 0.005 mg/l detection level. In 1995, antimony was detected in well 29A during the April sampling period at the low concentration of 0.009. Antimony was not detected in any POC wells or the background well in October 1995, or during either 1996 sampling periods at a detection level of 0.10 mg/l.

- ◆ **Cyanide (CN)** was detected several times in 1988 and 1989 at concentrations above the GPS (0.01 mg/l) at well MW-17B. In October 1989, cyanide was detected at a level of 0.38 in well 17B. Cyanide was also detected in well 17B at a level of 0.024 in October 1990. Cyanide was not detected in MW-17B above the laboratory detection limit between 1990 and October 1996. However, cyanide was again detected in MW-17B during the October 1996 sampling event at 0.05 mg/l. Two replicates of this sample were also analyzed during this sampling event with cyanide concentrations reported of 0.02 mg/l and non-detect at a level of 0.01 mg/l. As noted, this is the first time cyanide has been detected in MW-17B since 1990 and the variance indicated by the replicate results show some uncertainty exists about its presence or absence in the well. We are unsure of why cyanide is occasionally detected in this well. We do not believe cyanide was used in the mill process, and it is not likely that cyanide was present in the tailings pond with its very low pH. We will continue to monitor for cyanide per the license condition.
- ◆ **Nickel (NI).** License SUA-1472 was amended in 1992 to change the GPS for nickel to 0.05 mg/l from the earlier GPS of 0.001 mg/l. Nickel was not detected in any POC well at the laboratory detection limit of 0.04 mg/l in 1992 (Table 5). However, laboratory results for the April 1993 sampling showed significantly elevated nickel concentrations in three POC wells, MW-17B (0.22 mg/l), MW-69 (0.25 mg/l), and MW-81 (0.13 mg/l). These reported results were over an order of magnitude higher than the highest previous reported nickel concentration for each of the wells. A laboratory check discovered no problems with the

analysis or concentration calculations and no apparent source of nickel contamination was found. The results for wells MW-1A and MW-29A during the same period showed no nickel detected at the 0.04 mg/l detection limit. The results for the October 1993 sampling period reported non-detects for nickel in all POC wells except MW-17B, which showed a nickel concentration at the detection limit of 0.04 mg/l. Nickel was not detected in any of the POC wells or the background well during 1994, 1995, or 1996.

The elevated nickel concentrations reported for the April 1993 sampling period are viewed as suspect due to the large difference between historical well concentrations and the April 1993 results and because the results were not repeated during the October 1993 sampling period or during the 1994, 1995 or 1996 sampling periods.

- ◆ **Selenium (Se)** was not detected above the GPS of 0.01 mg/l in any POC well during 1996. However, selenium was detected above the GPS (0.01 mg/l) in MW-17B (0.366 mg/l), MW-69 (0.012 mg/l), and MW-81 (0.23 mg/l) in April 1995. Selenium was not detected in any POC wells or the background well in October 1995. In 1994, selenium was not detected in any monitor well. However, selenium was detected above the GPS of 0.01 mg/l in three wells in 1993: MW-17B (0.014 mg/l), MW-69 (0.02 mg/l), and MW-81 (0.16 mg/l) (Table 6).

MW-17B has historically reported selenium concentrations of between 0.17 and 0.50 mg/l until the October 1992 sample, which reported a non detect at 0.01 mg/l. This sample was viewed as suspect at the time because it was so out of line with previous samples. However, the 1993 and 1994 sample results continued to support the reduced reported selenium concentration in MW-17B. In MW-17B, the April 1993 sample result showed a concentration of 0.014 mg/l, just above the GPS while the October 1993 and both 1994 results reported non-detects at the 0.01 mg/l detection limit. Therefore, the 0.366 mg/l reported for April 1995 now appears to be out of line with the recent trend at this well. Selenium was again not detected above the GPS of 0.01 mg/l in MW-17B during the October 1995 or either 1996 sampling periods.

The concentration reported for MW-69 during October 1993 was 0.02 mg/l, just above the detection limit of 0.01 mg/l. This result is not inconsistent with the concentration history for this well. In April 1995, selenium was detected in MW-69 at 0.012 mg/l, but it was not detected

in October 1995 or during 1996. The concentration of 0.16 mg/l reported for MW-81 during October 1993 was at that time the highest reported selenium concentration from this well. The previous high was 0.10 mg/l, reported in May 1991. The April 1993 sample reported a detection at 0.003 mg/l. In 1994, selenium was not detected in MW-81, even with the detection limit of 0.002 used during the October 1994 sampling period. In 1995, MW-81 had a result of 0.23 mg/l in April, a new highest result for this well. Yet, selenium was not detected in MW-81 in October 1995, even with a detection limit reported of 0.002 mg/l. Selenium was not found above the GPS in MW-81 during 1996 although the concentration for May 1996 was reported at the GPS of 0.01 mg/l. With such a pattern, it is difficult to determine if a trend exists for selenium at this well.

- ◆ **Combined Radium-226 (Ra-226) and Radium-228 (Ra-228)** continues to be found in all POC wells and the background well at levels just above or just below the GPS (Table 7).
- ◆ **Thorium-230 (Th-230)** continues to be found in all POC wells and the background well at levels above the GPS of 0.13 pCi/l (Table 8).
- ◆ **Uranium (U)** was again only detected above the GPS of 0.50 mg/l in MW-69 in 1996 (Table 9). The uranium concentration in MW-69 was slightly above the GPS for both sampling periods as has been the case for most sampling periods since 1988. Uranium concentrations are consistently below the GPS in all other POC wells.

## ◆ **Tailings Fluid Discussion**

In 1996, the toe drains system was shut down on July 23 at 1300 hours. Before that date, approximately 386,000 gallons of tailings fluid were collected from the horizontal drains and pumped to the evaporation cells. The chemical make-up of the tailings fluid in 1996 is shown in Table 10.

The toe drain system has assisted in mitigating the impact of tailings fluid on the local ground-water system. It also has assisted in removing excess tailings fluid from beneath the radon barrier cap, allowing final settlement. As the fluid level in the pile has lowered, the flow rate out of the drains has also decreased.



Comparing the drainage collected in 1995 (0.69 million gallons) to 1994 (0.88 million gallons), 1993 (1.05 million gallons), 1992 (1.3 million gallons), 1991 (1.6 million gallons), 1990 (2.4 million gallons), and 1989 (3.3 million gallons), it was clear that the tailings were in a period of steady but gradual decrease in drainage rate. The extensive tailings characterization study conducted in 1995 and 1996 determined that nearly all primary settlement of the tailings has occurred. It also determined that the contribution of the toe drains to enhanced settlement and to groundwater protection was no longer significant. Therefore the drains were shut down on July 23, 1996. Water levels in all piezometers near the face of the dam, and near the horizontal drain intakes, were monitored following shutdown. No discernable rebound in water levels was recorded in any piezometer. The remaining tailing fluid in the tailings fluid evaporation cells will be allowed to evaporate after which they will be covered with radon barrier material and brought to tailings cover grade. The two barrier well evaporation ponds remain open as that system is still operational.

## ◆ **Summary**

The ground-water protection program at the L-Bar Uranium Mine continues to operate as designed. The system was enhanced on the west side in 1990 with the addition of two new pumping wells, bringing the total pumping wells on the west side to twelve. Since then, one very low productivity well (MW-05) has been removed from service, leaving eleven wells on the west side in service. The drawdown experienced in the pumping and neighboring wells has indicated that the system is providing an effective barrier to further downstream transport of contaminants.

Semi-annual sampling at point-of-compliance wells continues at the site. The concentrations of regulated constituents are reported for each of the point-of-compliance wells for 1996 and preceding years.

The toe drain system at the site has been taken out of operation as it no longer significantly contributes to tailings drainage or groundwater protection.

A significant tailings characterization study was completed in 1996 and this report has been submitted to NRC. Groundwater flow, contaminant

transport and geochemical modeling of the site is progressing with completion expected in 1997.

**Table 1. Barrier Well Production Summary - 1996**

Barrier Well No.	Mean Pumping Rate (gpm)	Mean Monthly Production (gallons)	Annual Production (gallons)
2A	0.85	36,865	442,385
8	0.44	18,960	227,514
10A	0.44	19,002	228,027
13B	0.04	1,544	18,528
69	0.38	16,290	195,484
77	0.05	2,347	28,166
82	0.23	10,039	120,468
83	0.75	32,304	387,650
84	0.65	28,096	337,156
101	0.30	13,121	157,456
102	0.02	899	10,782
Subtotal - West Side Barrier Wells	4.15	179,468	2,153,616
Trench	0.71	30,552	366,625
Subtotal - Entire West Side	4.86	210,020	2,520,241
89 (East Pumpback Well)	0.28	11,987	143,844
TOTAL	5.14	222,007	2,664,085

**Table 2. Summary of L-Bar Compliance Monitoring — Constituent Concentrations When Detected: 03/88 to 10/96**

POC WELL	CONSTITUENT CONCENTRATIONS WHEN DETECTED						
	Bb (0.2 mg/l)	Ni (0.05 mg/l)	Se (0.01 mg/l)	U (0.5 mg/l)	Ra <sup>226</sup> + Ra <sup>228</sup> (5 pCi/l)	Th <sup>230</sup> (0.13 pCi/l)	CN (0.01)
1A	0.02 (10/93)	0.006 (03/88) 0.004 (07/88) 0.005 (08/88) 0.0064 (10/89) 0.0041 (10/90)	0.009 (07/88) 0.0038 (10/89) 0.002 (05/96) 0.005 (10/96)	0.002 (05/91) 0.001 (10/91) 0.001 (04/92) 0.002 (10/92) 0.003 (04/93) 0.002 (10/93) 0.002 (04/94) 0.001 (10/94)	0.30 (06/88) 0.17 (07/88) 0.80 (08/88) 0.26# (05/89) 0.13# (10/89) 6.37 (04/90) 0.40 (10/90) 10.3 (05/91) 0.9 (10/91) 1.6 (04/92) 2.6 (10/92) 3.9 (04/93) 2.9 (10/93) 0.6 (04/94) 0.5 (10/94) 1.6 (04/95) 0.9 (10/95) 0.9 (05/96) 1.3 (10/96)	0.20 (07/88) 0.07 (05/89) 0.07 (04/90) 4.20 (10/90) 0.70 (05/91) 22.8 (10/91) 4.5 (10/92) 0.5 (04/93) 0.4 (10/93) 0.6 (04/94) 2.8 (10/94) 0.4 (04/95) 0.3 (10/95) 1.4 (05/96) 0.8 (10/96)	
17B	0.24 (06/88) 0.29 (10/89) 0.10 (05/91) 0.011 (10/92)  0.006 (04/94) 0.006 (10/94)	0.011 (03/88) 0.016 (06/88) 0.007 (07/88) 0.011 (08/88) 0.007 (09/88) 0.010 (05/89) 0.012 (10/89) 0.016 (04/90) 0.026 (10/90) 0.04 (10/91) 0.22 (04/93) 0.04 (10/93)	0.33 (01/88) 0.41 (03/88) 0.46 (06/88) 0.50 (07/88) 0.42 (08/88) 0.35 (09/88) 0.27 (05/89) 0.28 (10/89) 0.27 (04/90) 0.17 (10/90) 0.40 (05/91) 0.30 (10/91) 0.40 (04/92) 0.014 (04/93) 0.366 (04/95) 0.006 (05/96) 0.003 (10/96)	2 (05/89) 0.025 (05/91) 0.028 (10/91) 0.036 (04/92) 0.032 (10/92) 0.030 (04/93) 0.035 (10/93) 0.036 (04/94) 0.030 (10/94) 0.036 (04/95) 0.037 (10/95) 0.0345 (05/96) 0.032 (10/96)	1.10 (03/88) 1.00 (06/88) 19.6 (07/88) 0.90 (08/88) 0.70# (05/89) 0.77# (10/89) 4.00 (04/90) 6.70 (10/90) 3.40 (05/91) 3.70 (10/91) 4.7 (04/92) 5.2 (10/92) 5.0 (04/93) 1.9 (10/93) 3.5 (04/94) 5.0 (10/94) 5.3 (04/95) 9.3 (10/95) 5.4 (05/96) 13.7 (10/96)	0.82 (03/88) 0.30 (06/88) 0.30 (07/88) 0.02 (08/88) 0.10 (05/89) 0.31 (10/89) 0.04 (04/90) 3.40 (10/90) 1.0 (05/91) 0.9 (10/91) 0.9 (04/92) 0.4 (10/92) 0.2 (04/93) 0.8 (10/93) 0.3 (04/94) 3.2 (10/94) 0.4 (04/95) 1.3 (05/96) 0.5 (10/96)	0.10 (06/88) 0.07 (07/88) 0.20 (08/88) 0.03 (05/89) 0.38 (10/89) 0.024 (10/90) 0.05 (10/96)
69	0.27 (06/88) 0.25 (07/88) 0.39 (10/89) 0.005 (04/94)	0.011 (03/88) 0.010 (06/88) 0.016 (07/88) 0.011 (08/88) 0.006 (09/88) 0.012 (05/89) 0.016 (10/89) 0.0063 (04/90) 0.010 (10/90) 0.070 (05/91) 0.25 (04/93)	0.020 (03/88) 0.012 (08/88) 0.020 (05/89) 0.0066 (10/89) 0.02 (10/93) 0.012 (04/95)	1.10 (06/88) 1.10 (07/88) 0.93 (08/88) 2.50 (05/89) 1.0 (10/89) 0.68 (04/90) 0.492 (05/91) 0.641 (10/91) 0.506 (04/92) 0.63 (10/92) 0.691 (04/93) 0.539 (10/93) 0.526 (04/94) 1.51 (10/94) 0.892 (04/95) 1.9 (10/95) 1.28 (05/96) 0.91 (10/96)	2.30 (07/88) 1.22 (08/88) 0.45# (05/89) 0.39# (10/89) 6.40 (04/90) 7.30 (10/90) 7.20 (05/91) 3.50 (10/91) 8.1 (04/92) 10.5 (10/92) 11.6 (04/93) 8.9 (10/93) 8.8 (04/94) 1.3 (10/94) 7.8 (04/95) 4.6 (10/95) 6.7 (05/96) 13.2 (10/96)	0.13 (07/88) 0.45 (08/88) 0.20 (05/89) 0.2 (10/89) 0.04 (04/90) 9.80 (10/90) 8.5 (05/91) 1.3 (10/91) 0.4 (10/92) 0.2 (04/93) 0.6 (10/93) 0.5 (04/94) 2.8 (10/94) 0.9 (05/96) 0.4 (10/96)	—

# Only analyzed for radium 226

**Table 2 (continued). Summary of L-Bar Compliance Monitoring — Constituent Concentrations When Detected: 03/88 to 10/96**

POC WELL	CONSTITUENT CONCENTRATIONS WHEN DETECTED						
	Bi (0.2 mg/l)	Ni (0.05 mg/l)	Se (0.01 mg/l)	U (0.5 mg/l)	Ra <sup>226</sup> + Ra <sup>228</sup> (5 pCi/l)	Th <sup>230</sup> (0.13 pCi/l)	CN (0.01)
81	0.005 (10/92)	0.017 (06/88)	0.0061 (04/90)	0.9 (05/89)	0.60 (06/88)	0.06 (06/88)	—
	0.01 (10/93)	0.004 (07/88)	0.10 (05/91)	0.005 (05/91)	0.60 (07/88)	0.12 (05/89)	
		0.005 (08/88)	0.03 (04/92)	0.009 (10/91)	0.60 (08/88)	0.03 (10/89)	
		0.004 (05/89)	0.003 (04/93)	0.008 (04/92)	1.10# (05/89)	0.06 (04/90)	
		0.0059 (10/89)	0.16 (10/93)	0.004 (10/92)	0.63# (10/89)	1.80 (10/90)	
		0.0032 (10/90)	0.23 (04/95)	0.009 (04/93)	5.40 (04/90)	2.3 (05/91)	
		0.13 (04/93)	0.01 (05/96)	0.011 (10/93)	9.00 (10/90)	0.2 (10/91)	
			0.002 (10/96)	0.020 (04/94)	4.4 (05/91)	0.6 (10/92)	
				0.014 (10/94)	5.9 (10/91)	0.4 (04/93)	
				0.022 (10/95)	8.0 (04/92)	1.0 (10/93)	
				0.0166 (05/96)	10.0 (10/92)	0.6 (04/94)	
				0.012 (10/96)	7.7 (04/93)	3.9 (10/94)	
					7.8 (10/93)	20.5 (10/95)	
					6.4 (04/94)	1.0 (05/96)	
					8.1 (10/94)	0.6 (10/96)	
					7.7 (04/95)		
					8.9 (10/95)		
					8.1 (05/96)		
					11.1 (10/96)		
29A (Back-ground)	0.009 (04/95)	0.010 (04/90)	0.003 (10/96)	0.001 (05/91)	4.20 (06/88)	0.07 (06/88)	—
				0.003 (04/93)	2.90 (07/88)	0.21 (07/88)	
				0.001 (04/94)	3.20 (08/88)	0.01 (05/89)	
				0.002 (10/94)	1.39# (05/89)	0.02 (10/89)	
					0.68# (10/89)	0.06 (04/90)	
					5.90 (04/90)	2.60 (10/90)	
					5.00 (10/90)	0.5 (05/91)	
					3.5 (05/91)	1.4 (10/91)	
					3.4 (10/91)	0.1 (10/92)	
					5.6 (04/92)	0.6 (04/93)	
					6.3 (10/92)	0.6 (10/93)	
					7.1 (04/93)	0.9 (04/94)	
					5.9 (10/93)	4.7 (10/94)	
					4.5 (04/94)	0.2 (04/95)	
					5.6 (10/94)	0.9 (05/96)	
					5.6 (04/95)	0.2 (10/96)	
					9.9 (10/95)		
					4.7 (05/96)		
					11.5 (10/96)		

# Only analyzed for radium 226



## Table 3. Antimony (Sb)

Date	1A (mg/l)	17B (mg/l)	28A (mg/l)	69 (mg/l)	81 (mg/l)	Ground- Water Protection Standard (mg/l)
01/06/88	NA	NA	NA	NA	NA	0.20
03/08/88	NA	NA	NA	NA	NA	0.20
06/22/88	ND (0.20)	0.24	ND (0.20)	0.270	ND (0.20)	0.20
07/20/88	ND (0.20)	ND (0.20)	ND (0.20)	0.250	ND (0.20)	0.20
08/08/88	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	0.20
09/20/88	NA	NA	NA	NA	NA	0.20
05/11/89	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	ND (0.20)	0.20
10/24/89	ND (0.20)	0.290	ND (0.20)	0.390	ND (0.20)	0.20
04/26/90	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.20
10/17/90	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	ND (0.10)	0.20
05/91	ND (0.10)	0.10	ND (0.10)	ND (0.10)	ND (0.10)	0.20
10/91	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	0.20
04/92	ND (0.01)	ND (0.01)	ND (0.05)	ND (0.01)	ND (0.01)	0.20
10/92	ND (0.005)	0.011	ND (0.01)	ND (0.005)	0.005	0.20
04/93	ND (0.01)	0.002	ND (0.01)	ND (0.002)	ND (0.002)	0.20
10/93	0.02	ND (0.01)	ND (0.01)	ND (0.01)	0.01	0.20
04/94	ND (0.005)	0.006	ND (0.005)	0.005	ND (0.005)	0.20
10/94	ND (0.005)	0.006	ND (0.005)	ND (0.005)	ND (0.005)	0.20
04/95	ND (0.005)	ND (0.005)	0.009	ND (0.005)	ND (0.005)	0.20
10/95	ND (0.1)	ND (0.01)	ND (0.01)	ND (0.1)	ND (0.1)	0.20
05/96	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.20
10/96	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	ND (0.1)	0.20

ND = Not detected; value shown is Method Detection Limit

NA = Not analyzed



**Table 4. Cyanide (CN)**

Date	178 (mg/l)	Ground-Water Protection Standard (mg/l)
01/06/88	NA	0.01
03/08/88	NA	0.01
06/22/88	0.10	0.01
07/20/88	0.07	0.01
08/08/88	0.20	0.01
09/20/88	NA	0.01
05/11/89	0.03	0.01
10/24/89	0.38	0.01
04/26/90	ND (0.01)	0.01
10/17/90	0.024	0.01
05/91	ND (0.02)	0.01
10/91	ND (0.02)	0.01
04/92	ND (0.01)	0.01
10/92	ND (0.01)	0.01
04/93	ND (0.02)	0.01
10/93	ND (0.01)	0.01
04/94	ND (0.01)	0.01
10/94	ND (0.01)	0.01
04/95	ND (0.01)	0.01
10/95	ND (0.02)	0.01
05/96	ND (0.01)	0.01
10/96	0.05	0.01

ND = Not detected; value shown is Method Detection Limit

NA = Not analyzed

**Table 5. Nickel (Ni)**

DATE	1A (mg/l)	17B (mg/l)	29A (mg/l)	69 (mg/l)	81 (mg/l)	Ground-Water Protection Standard (mg/l)
01/06/88	NA	NA	NA	NA	NA	0.001
03/08/88	0.006	0.011	ND (0.003)	0.011	ND (0.001)	0.001
06/22/88	ND (0.001)	0.016	ND (0.001)	0.010	0.017	0.001
07/20/88	0.004	0.007	ND (0.001)	0.016	0.004	0.001
08/08/88	0.005	0.011	ND (0.002)	0.011	0.005	0.001
09/20/88	ND (0.002)	0.007	ND (0.002)	0.006	ND (0.002)	0.001
05/11/89	ND (0.002)	0.010	ND (0.002)	0.012	0.004	0.001
10/24/89	0.0064	0.012	ND (0.003)	0.016	0.0059	0.001
04/26/90	ND (0.003)	0.016	0.010	0.0063	ND (0.02)	0.001
10/17/90	0.0041	0.026	ND (0.003)	0.01	0.0032	0.001
05/91	ND (0.04)	ND (0.04)	ND (0.04)	0.07	ND (0.04)	0.001
10/91	ND (0.04)	0.04	ND (0.04)	ND (0.04)	ND (0.04)	0.001
04/92	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	0.001
10/92	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	0.05
04/93	ND (0.04)	0.22	ND (0.04)	0.25	0.13	0.05
10/93	ND (0.04)	0.04	ND (0.04)	ND (0.04)	ND (0.04)	0.05
04/94	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	0.05
10/94	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	0.05
04/95	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	ND (0.02)	0.05
10/95	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	0.05
05/96	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	0.05
10/96	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	ND (0.04)	0.05

ND = Not detected; value shown is Method Detection Limit

NA = Not analyzed

**Table 6. Selenium (Se)**

Date	1A (mg/l)	17E (mg/l)	29A (mg/l)	69 (mg/l)	81 (mg/l)	Ground- Water Protection Standard (mg/l)
01/06/88	ND (0.03)	0.33	ND (0.006)	NA	NA	0.01
03/08/88	ND (0.005)	0.41	ND (0.005)	0.020	ND (0.003)	0.01
06/22/88	ND (0.006)	0.46	ND (0.006)	ND (0.006)	ND (0.030)	0.01
07/20/88	0.009	0.50	ND (0.015)	ND (0.003)	ND (0.003)	0.01
08/08/88	ND (0.004)	0.42	ND (0.004)	0.012	ND (0.004)	0.01
09/20/88	ND (0.004)	0.35	ND (0.008)	ND (0.008)	ND (0.004)	0.01
05/11/89	ND (0.01)	0.27	ND (0.010)	0.020	ND (0.010)	0.01
10/24/89	0.0038	0.28	ND (0.002)	0.0066	ND (0.020)	0.01
04/26/90	ND (0.005)	0.27	ND (0.050)	ND (0.005)	0.0061	0.01
10/17/90	ND (0.05)	0.17	ND (0.250)	ND (0.005)	ND (0.250)	0.01
05/91	ND (0.1)	0.40	ND (0.1)	ND (0.1)	0.10	0.01
10/91	ND (0.01)	0.30	ND (0.1)	ND (0.1)	ND (0.1)	0.01
04/92	ND (0.01)	0.40	ND (0.01)	ND (0.01)	0.03	0.01
10/92	ND (0.001)	ND (0.01)	ND (0.01)	ND (0.001)	ND (0.01)	0.01
04/93	ND (0.002)	0.014	ND (0.002)	ND (0.002)	0.003	0.01
10/93	ND (0.01)	ND (0.01)	ND (0.01)	0.02	0.16	0.01
04/94	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	ND (0.01)	0.01
10/94	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	0.01
04/95	ND (0.002)	0.366	ND (0.002)	0.012	0.23	0.01
10/95	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	ND (0.002)	0.01
05/96	0.002	0.006	ND (0.001)	ND (0.001)	0.01	0.01
10/96	0.005	0.003	0.003	ND (0.001)	0.002	0.01

ND = Not detected; value shown is Method Detection Limit

NA = Not analyzed

Table 7. Radium 226 and 228, Combined

Date	1A (pCi/l)	17B (pCi/l)	29A (pCi/l)	69 (pCi/l)	81 (pCi/l)	Ground-Water Protection Standard (pCi/l)
01/06/88	NA	NA	NA	NA	NA	5.00
03/08/88	NA	1.10	NA	NA	NA	5.00
06/22/88	0.30	1.00	4.20	ND	0.60	5.00
07/20/88	0.17	19.60	2.90	2.30	0.60	5.00
08/08/88	0.80	0.90	3.20	1.22	0.60	5.00
09/20/88	NA	NA	NA	NA	NA	5.00
05/11/89	0.26#	0.70#	1.39#	0.45#	1.10#	5.00
10/24/89	0.13#	0.77#	0.68#	0.39#	0.63#	5.00
04/26/90	6.37	4.00	5.90	6.40	5.40	5.00
10/17/90	0.40	6.7	5.00	7.30	9.00	5.00
05/91	10.3	3.4	3.5	7.2	4.4	5.00
10/91	0.9	3.7	3.4	3.5	5.9	5.00
04/92	1.6	4.7	5.6	8.1	8.0	5.00
10/92	2.6	5.2	6.3	10.5	9.2	5.00
04/93	3.9	5.0	7.1	11.6	7.7	5.00
10/93	2.9	1.9	5.9	8.9	7.8	5.00
04/94	0.6	3.5	4.5	8.8	6.4	5.00
10/94	0.5	5.0	5.6	1.3	8.1	5.00
04/95	1.6	5.3	5.6	7.8	7.7	5.00
10/95	0.9	9.3	9.9	4.6	8.9	5.00
05/96	0.9	5.4	4.7	6.7	8.1	5.00
10/96	1.3	13.7	11.5	13.2	11.1	5.00

ND = Not detected; value shown is Method Detection Limit

NA = Not analyzed

# Only analyzed for Radium 226



Table 8. Thorium 230

Date	1A (pCi/l)	17B (pCi/l)	29A (pCi/l)	69 (pCi/l)	81 (pCi/l)	Ground-Water Protection Standard (pCi/l)
01/06/88	NA	NA	NA	NA	NA	0.13
03/08/88	NA	0.82	NA	NA	NA	0.13
06/22/88	ND (0.22)	0.30	0.07	NA	0.06	0.13
07/20/88	0.20	0.30	0.21	0.13	NA	0.13
08/08/88	ND (0.17)	0.02	ND (0.11)	0.45	ND (0.30)	0.13
09/20/88	NA	NA	NA	NA	ND (0.02)	0.13
05/11/89	0.07	0.10	0.01	0.20	0.12	0.13
10/24/89	ND (0.01)	0.31	0.02	0.2	0.03	0.13
04/26/90	0.07	0.04	0.06	0.04	0.06	0.13
10/17/90	4.20	3.40	2.60	9.80	1.80	0.13
05/91	0.7	1.0	0.5	8.5	2.3	0.13
10/91	22.8	0.9	1.4	1.3	0.2	0.13
04/92	ND	0.9	ND	ND	ND	0.13
10/92	4.5	0.4	0.1	0.4	0.6	0.13
04/93	0.5	0.2	0.6	0.2	0.4	0.13
10/93	0.4	0.8	0.6	0.6	1.0	0.13
04/94	0.6	0.3	0.9	0.5	0.6	0.13
10/94	2.8	3.2	4.7	2.8	3.9	0.13
04/95	0.4	0.4	0.2	ND	ND	0.13
10/95	0.3	ND (0.5)	ND (0.4)	ND (0.4)	20.5	0.13
05/96	1.4	1.3	0.9	0.9	1.0	0.13
10/96	0.8	0.5	0.2	0.4	0.6	0.13

ND = Not detected; value shown is Method Detection Limit

NA = Not analyzed

**Table 9. Uranium (U)**

Date	1A (mg/l)	17B (mg/l)	29A (mg/l)	69 (mg/l)	81 (mg/l)	Ground- Water Protection Standard (mg/l)
01/06/88	NA	NA	NA	NA	NA	0.50
03/08/88	NA	ND (0.50)	NA	NA	NA	0.50
06/22/88	NA	ND (0.50)	ND (0.50)	1.10	ND (0.04)	0.50
07/20/88	ND (0.50)	ND (0.50)	ND (0.50)	1.10	ND (0.50)	0.50
08/08/88	ND (0.50)	ND (0.50)	ND (0.50)	0.93	ND (0.50)	0.50
09/20/88	NA	NA	NA	NA	NA	0.50
05/11/89	ND (0.50)	2.00	ND (0.50)	2.50	0.90	0.50
10/24/89	ND (0.50)	ND (0.50)	ND (0.50)	1.0	ND (0.50)	0.50
04/26/90	ND (0.50)	ND (0.50)	ND (0.50)	0.68	ND (0.50)	0.50
10/17/90	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	ND (0.50)	0.50
05/91	0.002	0.025	0.001	0.492	0.004	0.50
10/91	0.001	0.028	ND (0.001)	0.641	0.009	0.50
04/92	0.001	0.036	ND (0.001)	0.506	0.008	0.50
10/92	0.002	0.032	ND (0.001)	0.63	0.004	0.50
04/93	0.003	0.030	0.003	0.691	0.009	0.50
10/93	0.002	0.035	ND (0.001)	0.539	0.011	0.50
04/94	0.002	0.036	0.001	0.526	0.020	0.50
10/94	0.001	0.030	0.002	1.51	0.014	0.50
04/95	ND (0.001)	0.036	ND (0.001)	0.892	0.021	0.50
10/95	ND (0.001)	0.037	ND (0.001)	1.9	0.022	0.50
05/96	ND (0.0009)	0.0345	ND (0.0009)	1.28	0.0166	0.50
10/96	ND (0.001)	0.032	ND (0.001)	0.91	0.012	0.50

ND = Not detected; value shown is Method Detection Limit

NA = Not analyzed



Table 10. Chemistry of the Tailings Seepage Water

Parameter	October 1991 Sample	October 1992 Sample	April 1993 Sample	October 1993 Sample	April 1994 Sample	October 1994 Sample	April 1995 Sample	October 1995 Sample	May 1996 Sample	Units
Aluminum	3,390	3,250	3,180	3,850	3,130	3,890	3,660	4,030	3370	mg/l
Ammonia nitrogen	512	573	625	625	714	733	606	652	702	mg/l as N
Antimony	ND (0.3)	ND (0.1)	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.1)	ND (0.2)	ND (2.0)	ND (10.0)	mg/l
Arsenic	ND (0.5)	2	4	ND (2)	ND (2)	ND (1)	ND (1.0)	ND (1.0)	0.57	mg/l
Barium	ND (0.2)	ND (0.2)	ND (0.2)	ND (0.5)	ND (0.5)	0.2	ND (0.2)	ND (0.2)	ND (0.01)	mg/l
Beryllium	0.6	0.7	0.6	0.2	1.2	1.1	0.7	0.6	0.508	mg/l
Cadmium	0.06	0.1	ND (0.1)	ND (0.2)	0.5	0.5	0.1	0.1	0.412	mg/l
Calcium	460	405	471	485	540	495	482	457	551	mg/l
Chloride	1,550	896	631	628	686	463	654	650	752	mg/l
Chromium	3.2	2.5	2.6	3.0	3.5	3.8	3.5	3.1	3.06	mg/l
Cobalt	2.8	2.2	2.4	2	3	3.2	2.8	2.7	2.31	mg/l
Copper		6.2	6.8	7.5	8.5	8.0	7.2	8.4	8.2	mg/l
Fluoride	29.2	32	37	< 0.1	30	34	53	40	ND (0.1)	mg/l
Gross Alpha		137,000	198,000	225,000		162,000	140,000			pCi/l
Gross Beta		106,000	76,700	95,100		108,000	97,600			pCi/l
Iron	4,990	4,900	4,420	5,450	5,920	6,170	5,150	4,820	4390	mg/l
Lead	0.17	2	ND (1)	ND (2)	ND (2)	ND (1)	ND (1.0)	ND (1.0)	0.65	mg/l
Magnesium	1,090	882	940	1,060	1,150	1,100	1,040	1,090	1120	mg/l
Manganese	86	67.8	71.8	78.5	92	84.5	79.2	80.2	80.3	mg/l
Mercury	ND (0.0003)	ND (0.0003)	ND (0.0003)	ND (0.0003)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	ND (0.0002)	mg/l
Molybdenum	ND (1.0)	ND (1.0)	ND (1)	ND (2)	ND (2)	ND (1)	ND (1.0)	ND (1.0)	ND (0.05)	mg/l

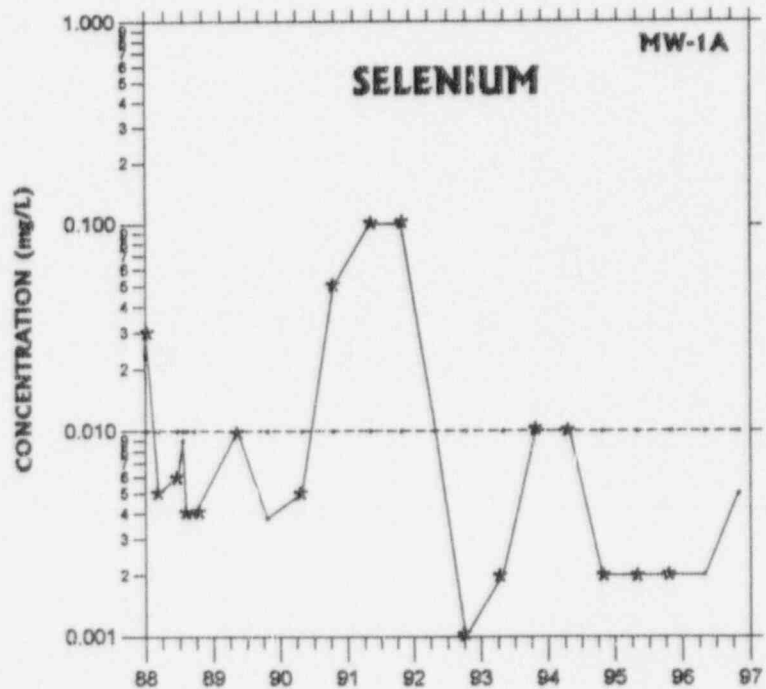
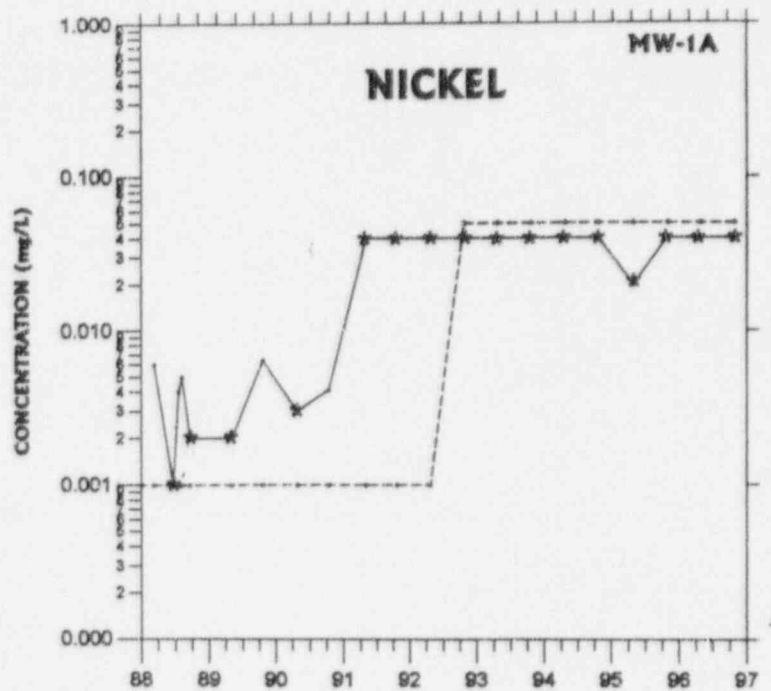
ND = Not Detected

\* October, 1996 Sample represents the Evaporation Cell Tailings Fluid

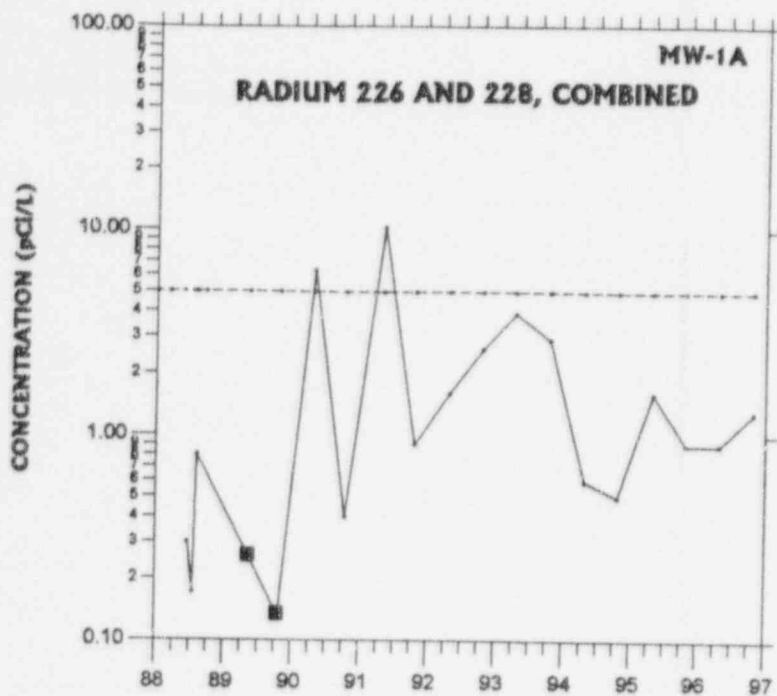
**Table 10 (continued). Chemistry of the Tailings Seepage Water**

Parameter	October 1991 Sample	October 1992 Sample	April 1993 Sample	October 1993 Sample	April 1994 Sample	October 1994 Sample	April 1995 Sample	Oct 1995 Samp.	May 1996 Samp.	Units
Nickel	2.6	2	2.6	2	3	3	2.4	2.3	ND (4.0)	mg/l
Nitrate	10.2	ND (50)	1.7	0.8	0.6	5	4.0	8.2	0.79	mg/l as N
Nitrite		ND (0.01)	ND (0.01)	ND (0.01)	0.05	ND (0.01)	ND (0.01)			mg/l as N
Potassium	400	400	500	600	660	590	300	500	400	mg/l
Radium 226 + 228	2,601	8,283.9	5,038	4,783.9	3,526.2	4,798.6	5,840	210.6	3028.9	pCi/l
Selenium	0.5	ND (2.0)	2	ND (5)	0.01	ND (2)	0.09	0.073	0.04	mg/l
Silicon	146	180	86	70	150	152	403	65	80	mg/l
Silver	ND (0.2)	0.2	ND (5)	ND (0.5)	ND (0.5)	5.8	ND (0.2)	ND (0.2)	0.05	mg/l
Sodium	1,460	1,250	1,300	1,550	1,520	1,550	1,510	1,740	1500	mg/l
Sulfate	39,000	43,500	44,600	44,000	42,800	43,000	40,800	41,800	39400	mg/l
Thallium	ND (0.5)	2	ND (2)	ND (5)	ND (5)	ND (2)	2.0	ND (2.0)	1.9	mg/l
Thorium 230	69,900	169,000	111,000	180,000	154,000	155,000	154,000	162,000	165000	pCi/l
Tin	ND (1.0)	ND (1.0)	ND (1)	ND (2)	ND (2)	ND (1)	ND (1.0)	ND (1.0)	ND (2.0)	mg/l
Uranium	6.78	66.1	115	90.1	130	11.2	96.9	142	92900	mg/l
Vanadium	198	180	162	188	184	193	192	175	182	mg/l
Zinc	15.0	12.0	13.8	15.5	16.5	16.2	15.2	15.2	15.0	mg/l
pH	1.81	1.96	1.84	1.83	1.95	2.02	1.94	2.0	2.03	pH
Conductivity	21,000	29,300	34,000	33,700	32,100	36,200	34,300		32400	umhos/cm
(TDG) total dissolved solids	56,000	59,900	58,400	57,800	61,700	60,900	59,200	57,800	55100	mg/l
(TSS) total suspended solids		20	50	10	ND (4)	ND (4)	ND (4.0)	ND (4.0)	91	mg/l

ND = Not Detected

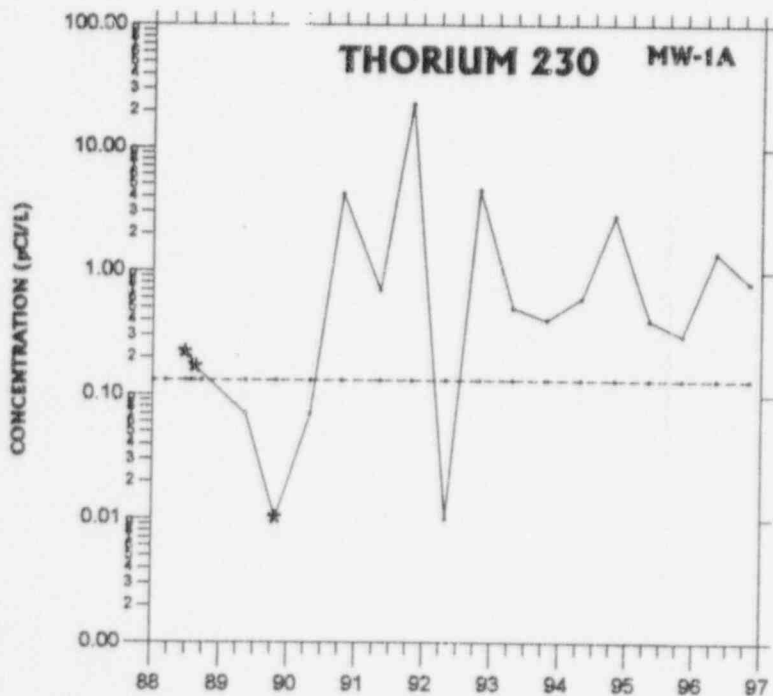


- - - Groundwater Protection Standard
- \* Not Detected, Value Plotted is Method Detection Limit
- Only Analyzed for Re226



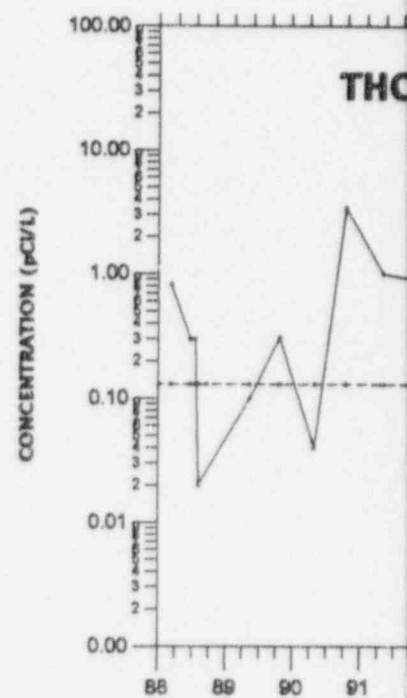
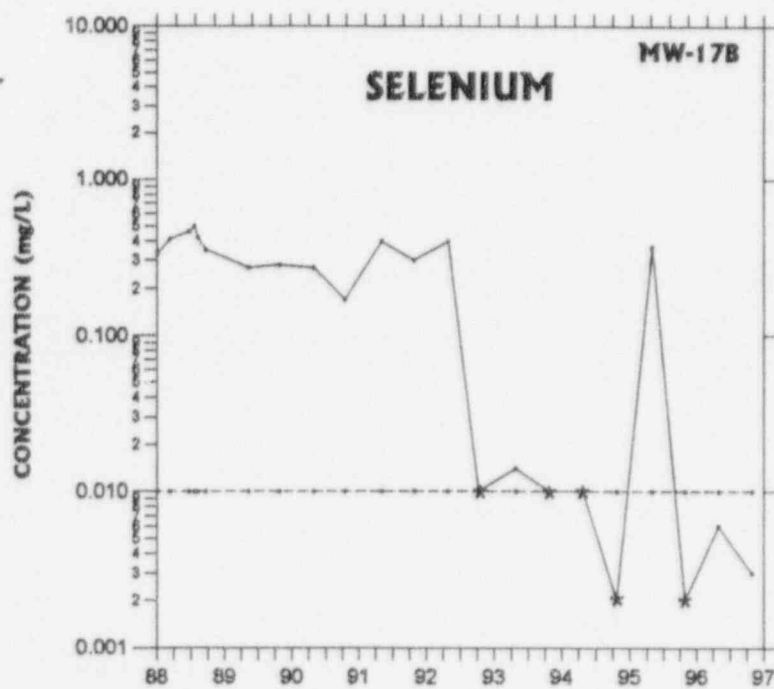
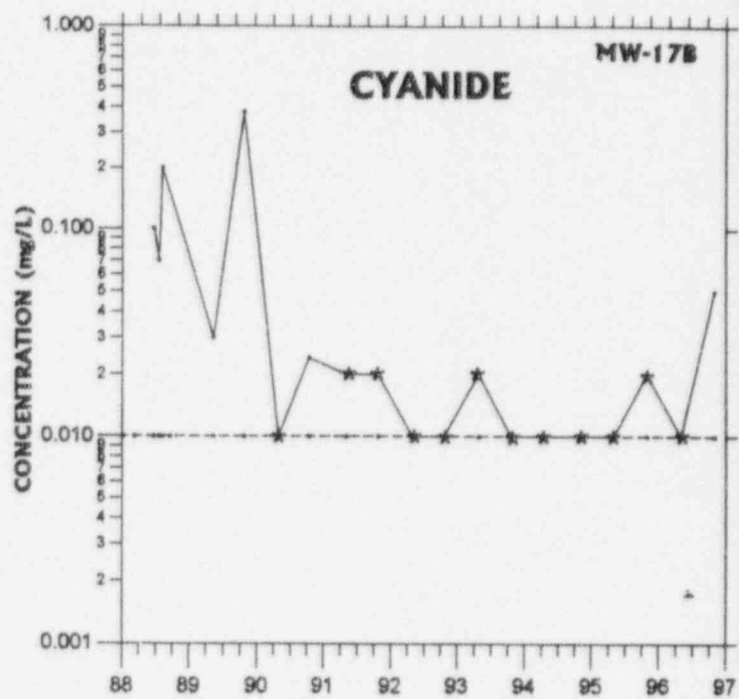
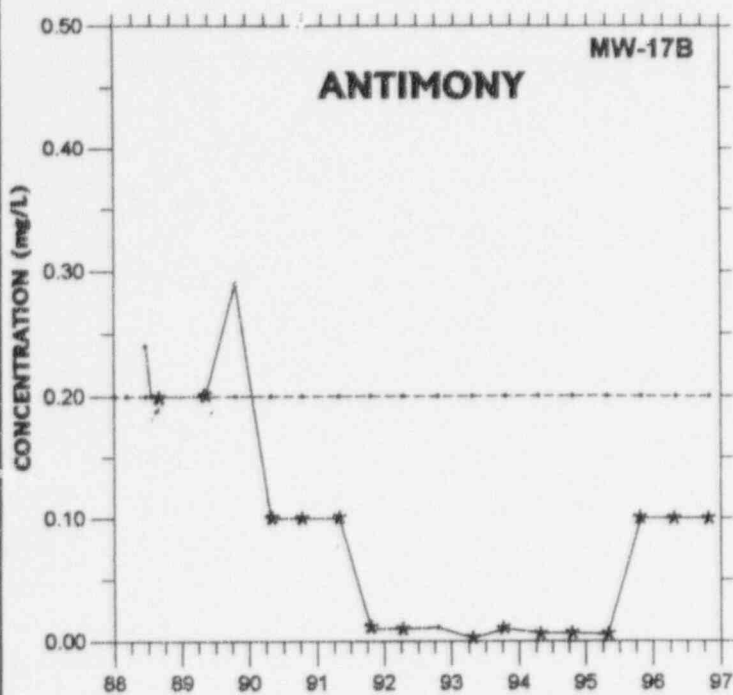
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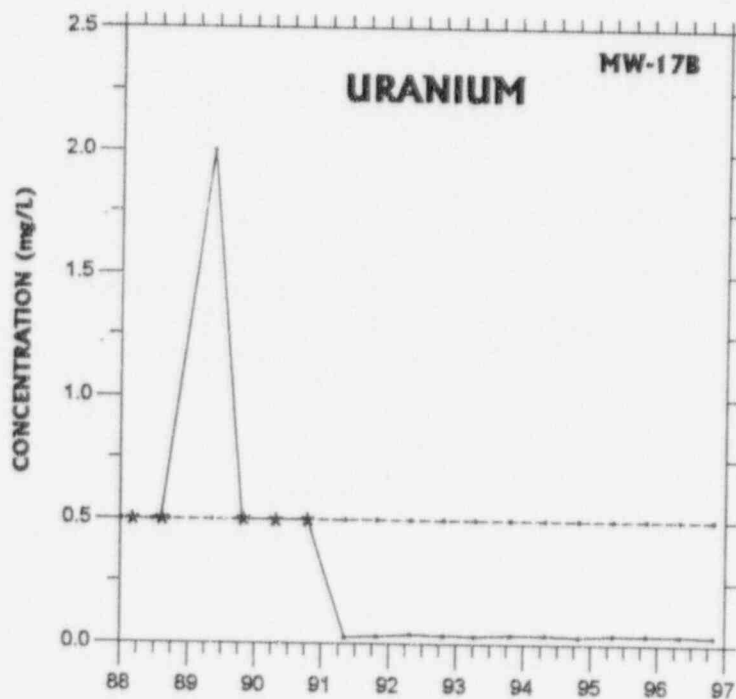
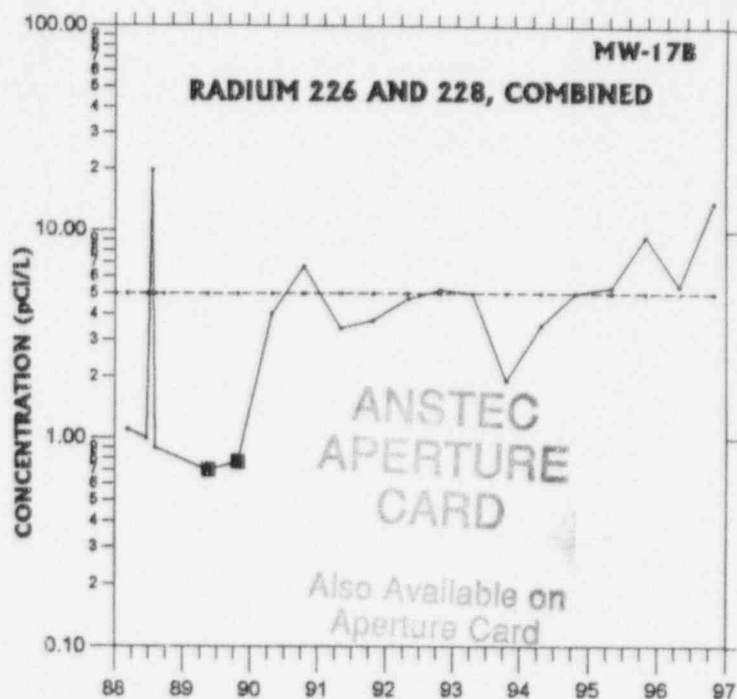
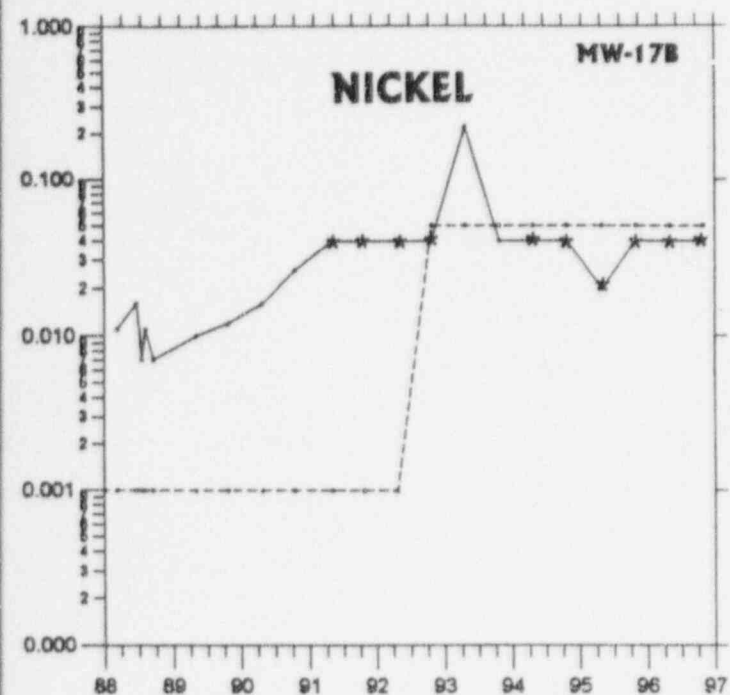


DATE: 2/28/99	Concentrations at Point of Compliance Well MW-1A	
REF: 1060-017		
INTERA		Figure 1

9702100225-01



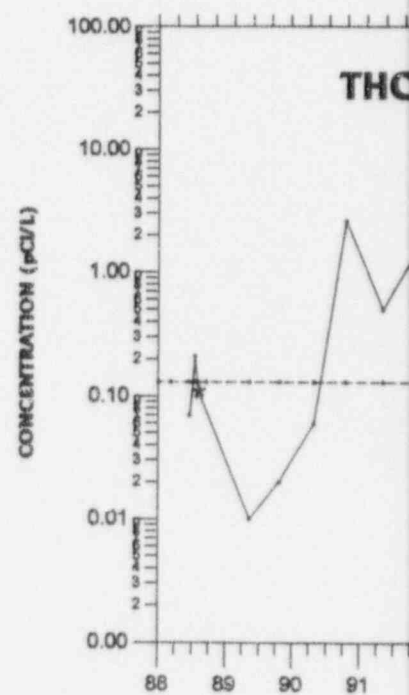
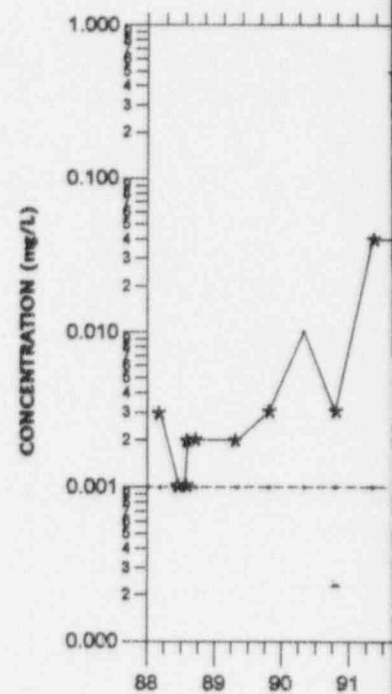
- - - Groundwater Protection Standard
- \* Not Detected, Value Plotted is Method Detection Limit
- Only Analyzed for Ra226



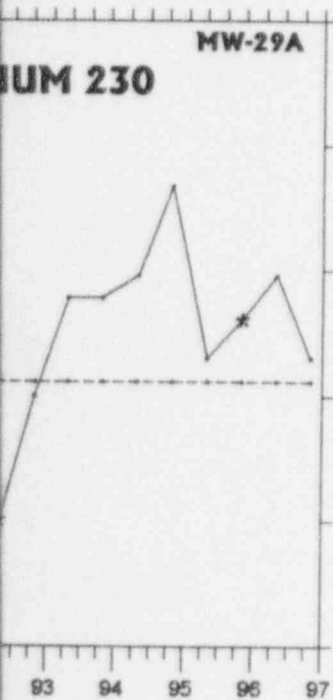
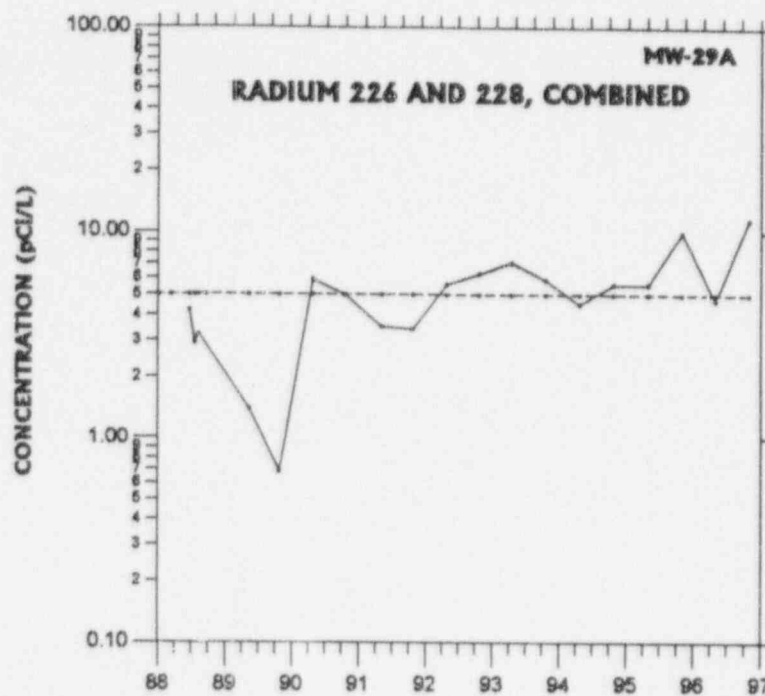
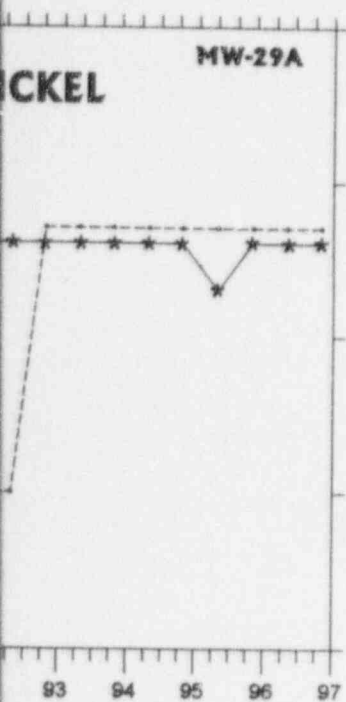
DATE: 2/28/96	Concentrations at Point of Compliance Well MW-17B	
REF: 1060-612		
INTERA		Figure 2

9702100225-02





- - - Groundwater Protection Standard
- ★ Not Detected, Value Plotted is Method Detection Limit
- Only Analyzed for Ra226

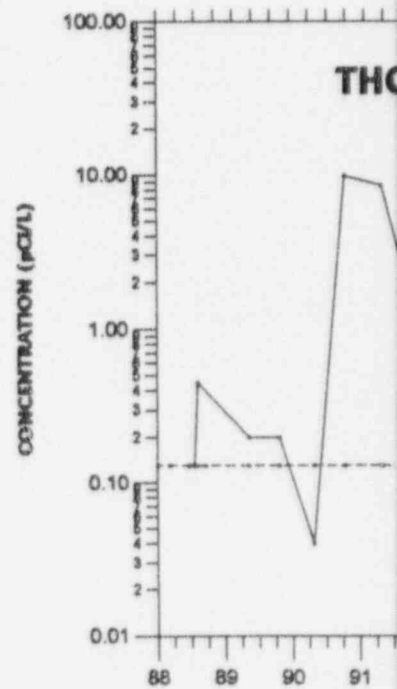
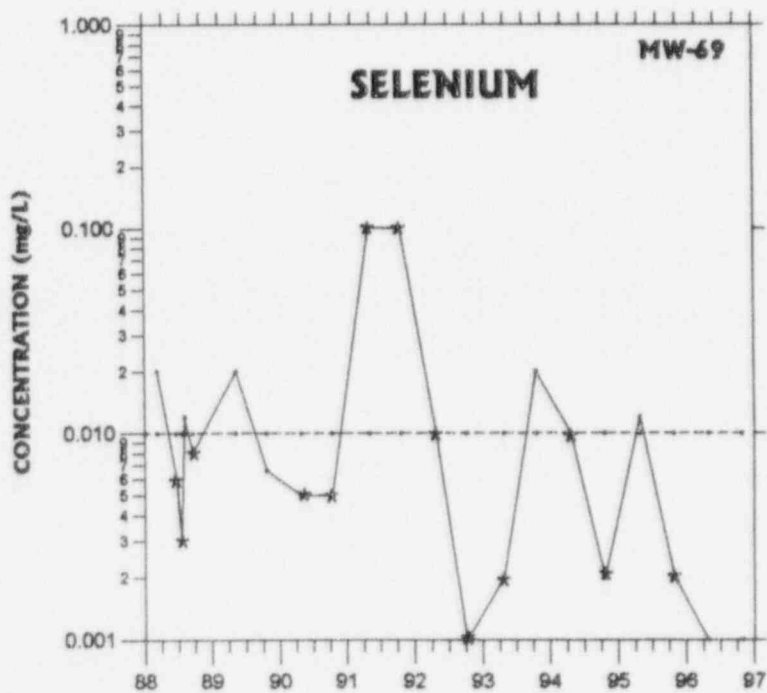
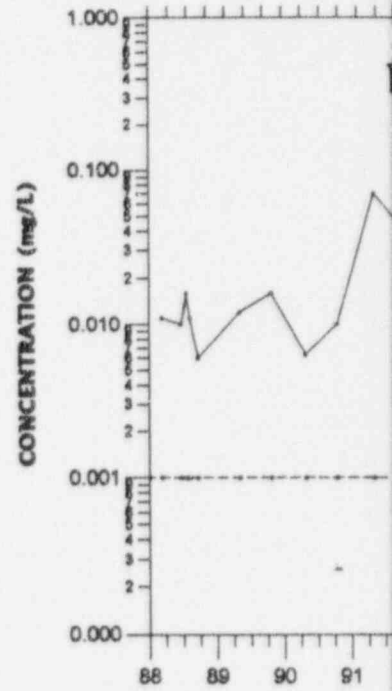
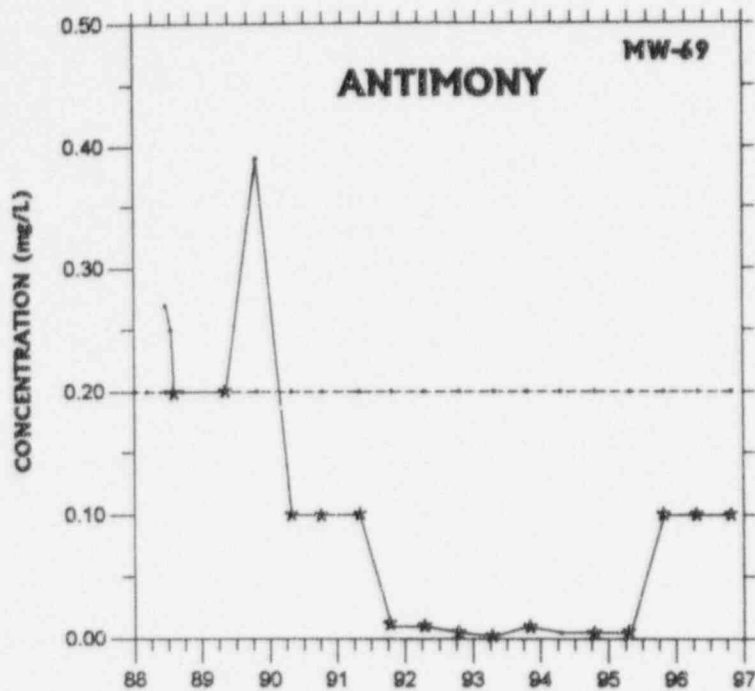


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CARD

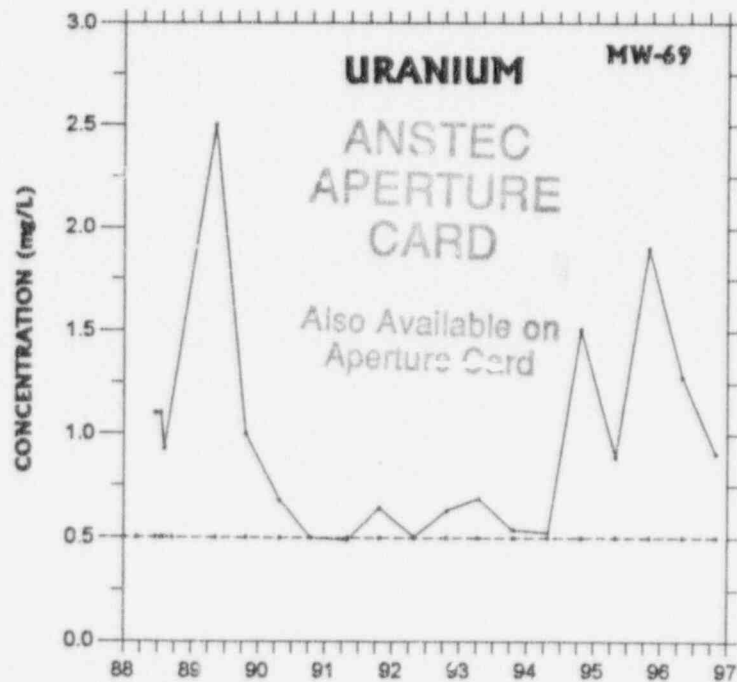
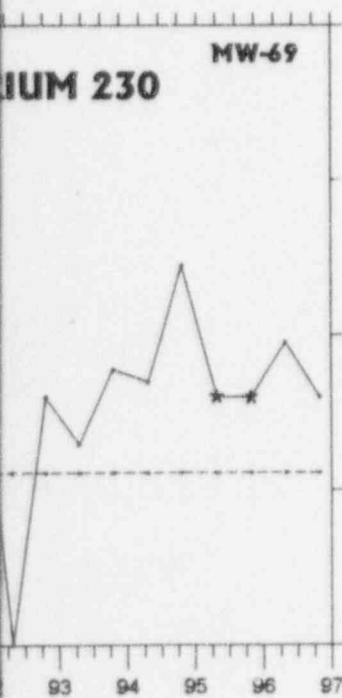
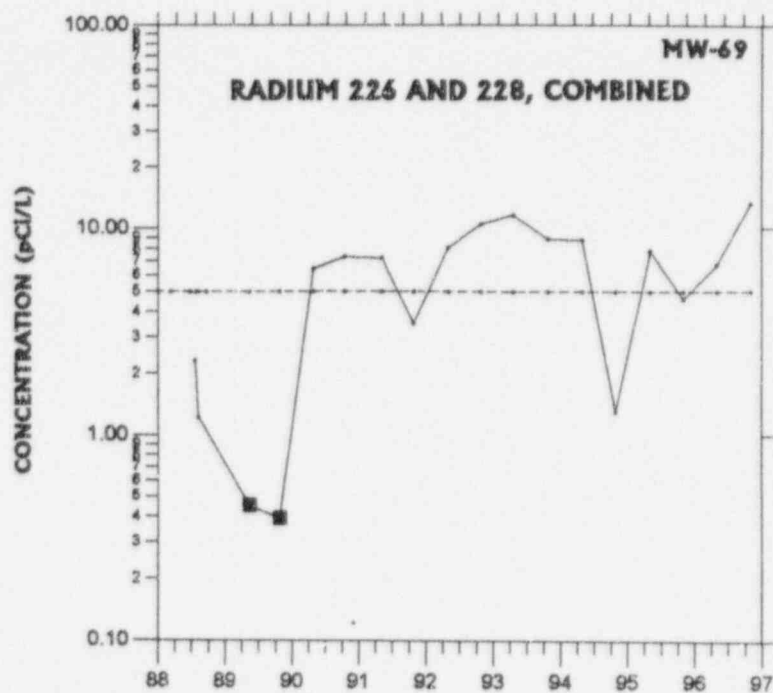
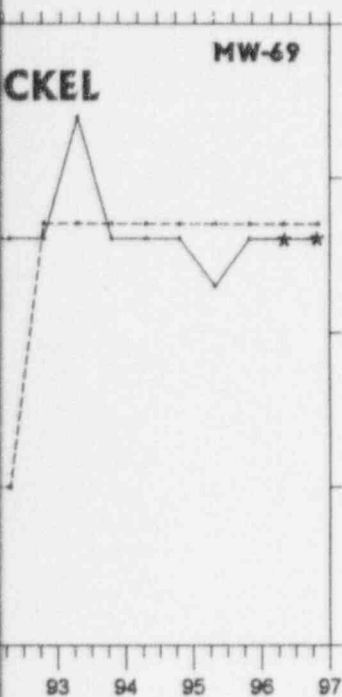
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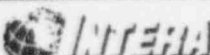
DATE: 2/28/96	Concentrations at Point of Compliance Well MW-29A	
REF: 1060-012		
INTERA		Figure 3

9202100225-03



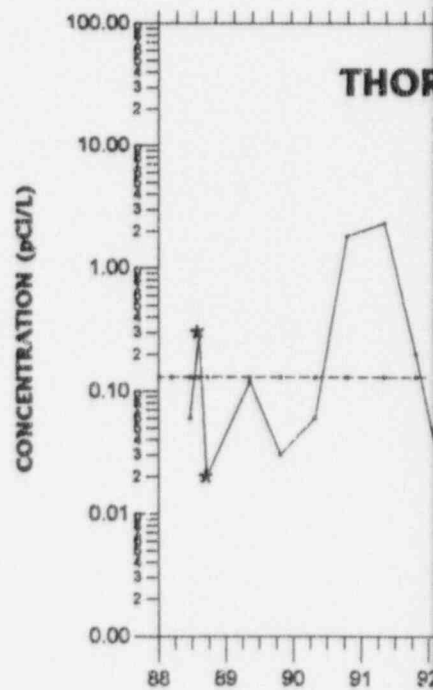
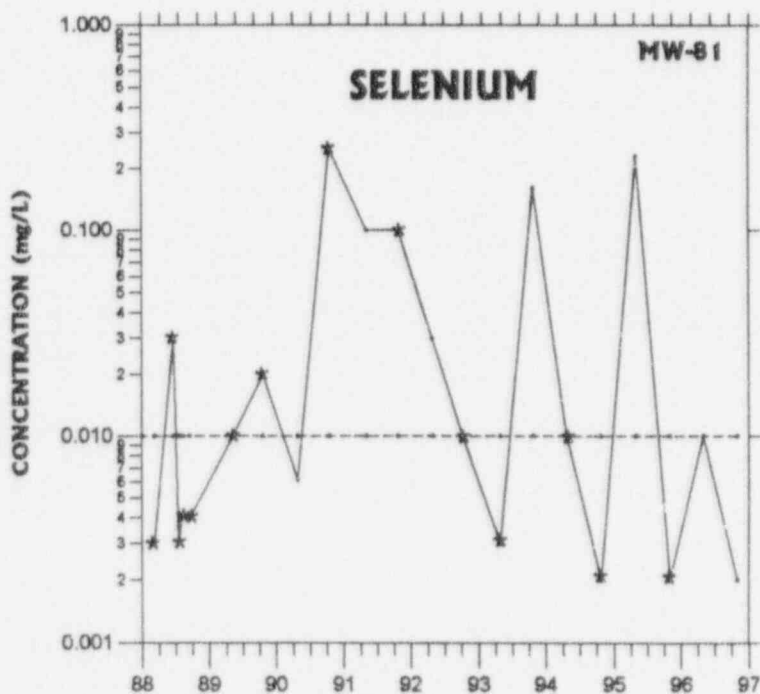
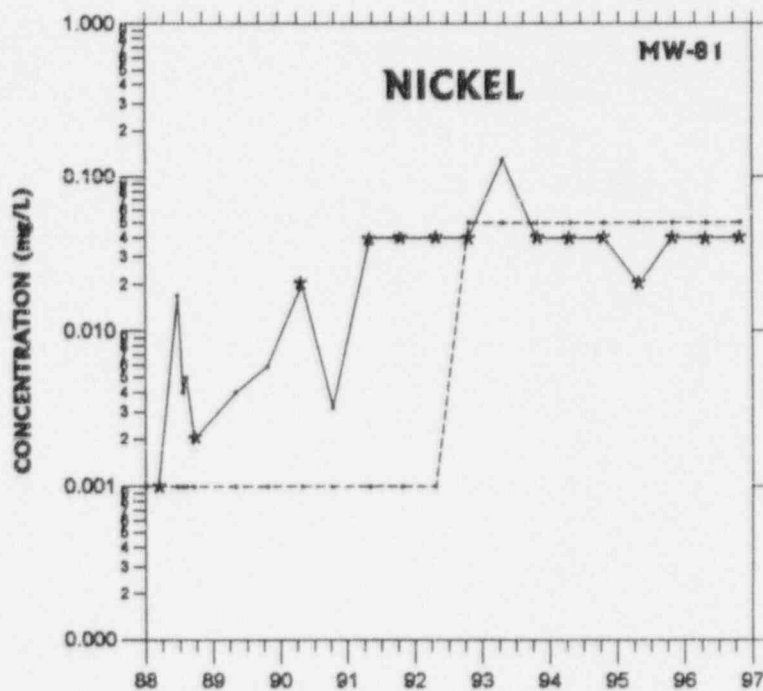
- - - Groundwater Protection Standard
- \* Not Detected, Value Plotted is Method Detection Limit
- Only Analyzed for Ra226



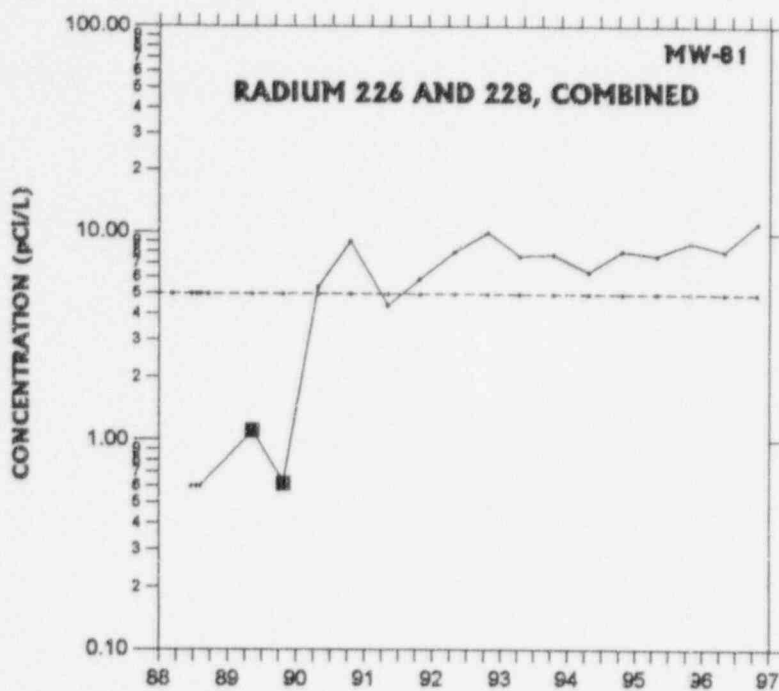
DATE: 2/28/96	Concentrations at Point of Compliance Well MW-69	
REF: 1060-012		
		Figure 4

9702100225-04



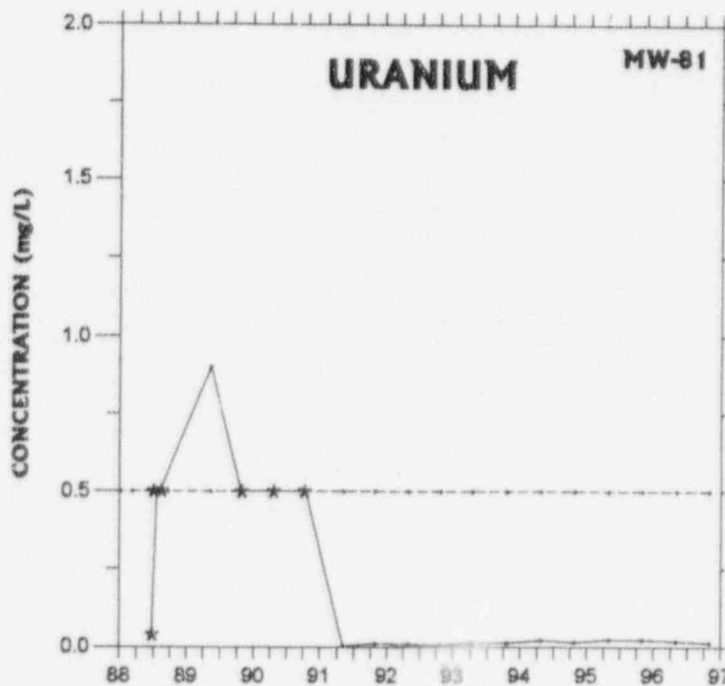
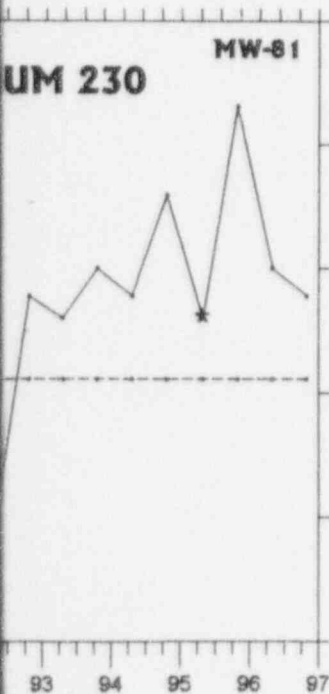


- - - Groundwater Protection Standard
- \* Not Detected, Value Plotted is Method Detection Limit
- Only Analyzed for Ra226



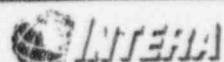
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DATE: 2/28/96

REF: 1066-012



Concentrations at Point of Compliance

Well MW-81

Figure 5

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