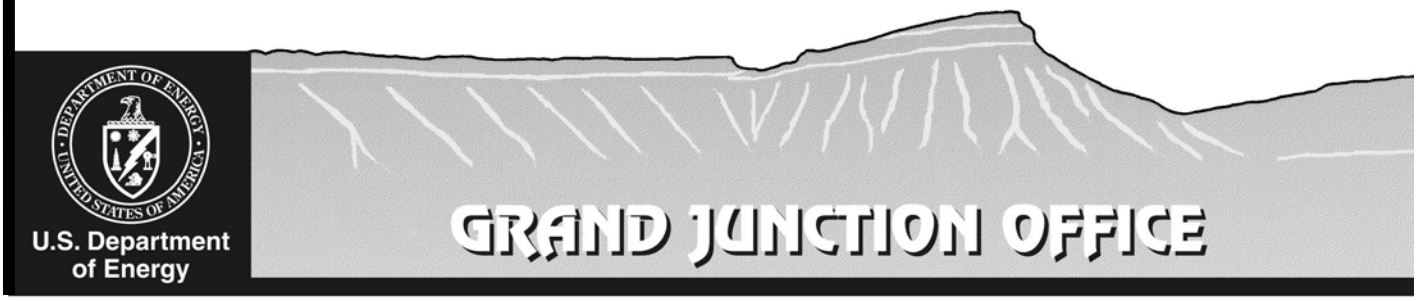
GJO–2003–415–TAC

Hanford Tank Farms Vadose Zone Monitoring Project

Quarterly Summary Report for First Quarter Fiscal Year 2003

February 2003



Work Performed Under DOE Contract No. DE–AC13–02GJ79491 for the U.S. Department of Energy
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Quarterly Summary Report for First Quarter Fiscal Year 2003

February 2003

Prepared for
U.S. Department of Energy
Idaho Operations Office
Grand Junction Office
Grand Junction, Colorado

Prepared by
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Hanford Tank Farms Vadose Zone Monitoring Project
Quarterly Summary Report for First Quarter Fiscal Year 2003

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1.0 Introduction

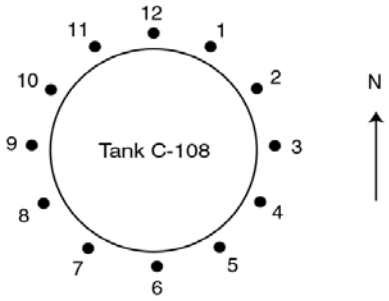
Routine quarterly reports for the Hanford Tank Farms Vadose Zone Monitoring Project are issued to summarize the results of monitoring activities, to provide the status of any on-going special investigations, and to provide an updated listing of borehole intervals where monitoring is planned in the coming months.

For readers not familiar with the Hanford Tank Farms borehole numbering scheme, the following illustration shows how to identify the location of a borehole from its identification number:

Tank Farm Numbering Scheme

A Farm	10
AX Farm	11
B Farm	20
BX Farm	21
BY Farm	22
C Farm	30
S Farm	40
SX Farm	41
T Farm	50
TX Farm	51
TY Farm	52
U Farm	60

Tank Farm Borehole Numbering Scheme



Boreholes are identified by numbers using the format FF-TT-PP, where "FF" = tank farm, "TT" = tank, and "PP" = the position around the tank in a time-clock numeral from 1 to 12 (12 = north). For example, borehole 30-08-02 is in the C Tank Farm, around tank C-108, and at approximately the 2 o'clock position.

2.0 Monitoring Results

A summary of monitoring operations from October 1 to December 31, 2002 is included in Table 2-1.

Table 2-1. Summary of Monitoring Operations for 1st Quarter of FY 2003

Month	October	November	December	FY Cumulative Total
Total Boreholes	15	41	16	72
Main Log Footage	674	2655.5	1091	4420.5
Rerun Log Footage	50	90	40	180
Total Footage	724	2745.5	1131	4600.5

Appendix A is a table that provides further details of boreholes monitored during the 1st quarter of FY 2003, including borehole number, tank number, logging depths and footage, total score (logging priority), projected next monitoring date, dates of High Rate Logging System (HRLS) logging events, dates of RAS monitoring events, and a comment section. This table is derived from the project's monitoring database, which is continually updated as boreholes are monitored

(DOE 2003b). Boreholes are selected by a priority score (total score) that emphasizes proximity to tanks with significant drainable liquid remaining and/or the presence of contaminant plumes or where possible contaminant movement is suspected. The most significant change that occurs in the database is the monitoring frequency. Where monitoring results suggest possible contaminant movement, the monitoring frequency and monitoring depth intervals may be changed. Monitoring frequencies may also be changed in response to special requests (e.g. retrieval monitoring). As discussed in Section 7.0 of the *Annual Monitoring Report for Fiscal Year 2002* (DOE 2003a), some lower priority boreholes were selected for monitoring. This re-prioritization included boreholes in the vicinity of tanks undergoing salt well pumping and those being considered for closure in the near future, such as in C Farm.

A total of 72 boreholes were monitored during the first quarter of FY 2003. The following sections describe the routine monitoring performed in each tank farm. In the interest of brevity, plots for boreholes where no apparent change was observed will not be included in this report. These logs are available on request.

2.1 A Tank Farm

A total of thirteen boreholes located around tanks A-101, -102, and -103 were monitored in A Farm this quarter. No apparent changes in the radionuclide contaminant distribution were observed.

2.2 AX Tank Farm

A total of two boreholes located between tanks AX-101 and -102 were monitored in AX Farm this quarter. No apparent changes in the radionuclide contaminant distribution were observed.

2.3 B Tank Farm

Routine monitoring was not performed in B Farm this quarter.

2.4 BX Tank Farm

Routine monitoring was not performed in BX Farm this quarter.

2.5 BY Tank Farm

A total of 24 boreholes located around tanks BY-101, -103, -105, -106, -107, -108, -109, -110, and -112 were monitored in BY Farm this quarter. No apparent changes in the radionuclide contaminant distribution were observed.

2.6 C Tank Farm

Routine monitoring was not performed in C Farm this quarter.

2.7 S Tank Farm

Routine monitoring was not performed in S Farm this quarter.

2.8 SX Tank Farm

Routine monitoring was not performed in SX Farm this quarter.

2.9 T Tank Farm

A total of eleven boreholes located around tanks T-102, -103, -104, -106, -107, -108, and -109 were monitored in T Farm this quarter. Evidence of apparent changes in radionuclide contaminant distribution was observed in two of these boreholes. Borehole 50-04-10 continues to show an increase in both total counts and ^{60}Co total counts between depths of 67 and 68 ft. Borehole 50-06-18 continues to show an increase in both total counts and ^{60}Co total counts between depths of 117 and 119 ft. The attached plots (Appendix B) show a comparison of the RAS monitoring events and the SGLS measurements for these two boreholes.

Moisture logging was performed in the following T Farm boreholes during this quarter: 50-06-04, 50-06-18, 50-08-08, and 50-09-01. This work was performed at the request of the CH2M Hill Hanford Group (CHG) vadose zone group. The results are discussed further in Section 3.0, "Special Investigations," of this report. Log plots for these boreholes are included in Appendix C.

2.10 TX Tank Farm

Routine monitoring was not performed in TX Farm this quarter.

2.11 TY Tank Farm

A total of four boreholes located around tanks TY-103, -104, -105, and -106 were monitored in TY Farm this quarter. Borehole 52-06-05 continued to show evidence of increasing ^{60}Co concentrations relative to prior RAS measurements at depths of 131 and 145 ft. A plot for this borehole included in Appendix B shows continued movement based on the RAS measurements. Borehole 52-03-06 showed no additional changes in ^{137}Cs concentrations. This borehole showed an increase of ^{137}Cs concentration between depths 55 and 58 ft during the initial RAS monitoring event on 5/2/02 (Appendix E of DOE 2003a).

2.12 U Tank Farm

A total of eighteen boreholes located around tanks U-104, -105, -107, -108, -109, -110, -111, and -112 were monitored in U Farm this quarter. Boreholes 60-04-08, 60-05-05, 60-07-01, 60-07-02, 60-07-10, and 60-07-11 have all shown evidence of ^{238}U concentration changes in the past. Monitoring data collected from these boreholes this quarter showed no further evidence of changes in radionuclide contaminant distribution.

Boreholes in the vicinity of tank U-107 are monitored on a quarterly basis in support of salt cake dissolution studies. In addition, neutron moisture logs were collected in these boreholes in November 2002. This work was performed at the request of the CHG tank waste retrieval program. The SGLS, RAS, and neutron moisture data collected in boreholes 60-07-01, 60-07-02, 60-10-01, 60-10-11, 60-08-04, 60-07-10 and 60-07-11 until November 2002 comprise a baseline against which future measurements can be compared to assess any effect of the dissolution studies. Additional monitoring is planned in February 2003 during the dissolution tests, and again after the tests have been completed. The results are discussed further in Section 3.0, "Special Investigations," of this report. Log plots are included in Appendix D.

3.0 Special Investigations

3.1 Tank C-106 Retrieval Monitoring

In anticipation of future tank C-106 (C Farm) retrieval activities, all boreholes surrounding this tank have tentatively been assigned a monitoring frequency of 6 months (biannual). This frequency may change when the retrieval project monitoring requirements are finalized. No tank C-106 retrieval monitoring was performed during this quarter. The next RAS routine monitoring event is scheduled for January 2003.

3.2 Tank S-102 Retrieval Monitoring

In anticipation of future tank S-102 (S Farm) retrieval activities, all boreholes surrounding this tank have tentatively been assigned a monitoring frequency of 6 months (biannual). This frequency may change when the retrieval project monitoring requirements are finalized. No tank S-102 retrieval monitoring was performed during this quarter. The next RAS routine monitoring event is scheduled for spring 2003.

3.3 Tank S-112 Retrieval Monitoring

Monitoring of boreholes in the vicinity of tank S-112 is being performed in response to a verbal request from CHG tank waste retrieval operations, in anticipation of planned retrieval operations. RAS data were collected in six boreholes during June 2002 to provide a baseline against which future measurements collected during waste retrieval operations can be compared. The six boreholes have tentatively been placed on a monitoring frequency of 6 months (biannual) until retrieval project monitoring requirements are defined. No monitoring in support of the tank S-112 retrieval project was conducted this quarter. The next routine RAS monitoring event is scheduled for March 2003.

3.4 Tank U-107 Retrieval Monitoring

A special investigation of boreholes around tank U-107 (U Farm) continues. This investigation was initiated in June 2001 at the request of the DOE-ORP Project Manager to support waste retrieval operations. The sixth quarterly monitoring event for selected boreholes was initiated on November 4, 2002 and completed on November 14, 2002. No significant changes in contaminant profile have been observed in six monitoring events conducted since June 2001. However, slow downward movement of processed uranium is evident over the period from 1995 to 2001 in boreholes located on the north side of tank U-107. This movement is associated with a plume originating from tank U-104. It is likely that the elapsed time between monitoring events is not sufficient to detect subtle changes in contaminant profile resulting from slow movement of contaminants in the vadose zone. It is recommended these boreholes continue to be monitored on a quarterly basis until the waste retrieval operations are completed. The next scheduled monitoring event in U Farm is February 2002.

The CHG vadose zone group requested that Stoller perform neutron-moisture logging in the seven boreholes surrounding tank U-107. This moisture logging was performed in conjunction with the RAS monitoring of tank U-107 in November 2002. Appendix D includes plots of seven boreholes where moisture logging was conducted. The spatial relationships between stratigraphy, contamination, and moisture are presented. Additional moisture logging will be performed in these same boreholes at least once during retrieval and again after retrieval is complete. These measurements will be used in conjunction with the RAS monitoring measurements to assess the impact of retrieval operations on the vadose zone. The next moisture-logging event is scheduled for mid-February.

3.5 T Farm Moisture Logging

The CHG vadose zone group requested Stoller to perform neutron-moisture logging in four T Farm boreholes: 50-06-04, 50-06-18, 50-08-08, and 50-09-01. This logging was in support of the T Farm investigative drilling in the vicinity of tank T-106. The Log Data Reports and log plots were submitted to CHG through a letter report on October 30, 2002 (Stoller 2002). A plot of these boreholes included in Appendix D presents the spatial relationships between stratigraphy, contamination, and moisture. The volume percent moisture was not presented on these plots due to variations in the borehole construction (e.g. cement grout, bentonite, and multiple casings).

4.0 Operational Issues

The monitoring rate (boreholes/day) steadily increased during each successive quarter of FY 2002. This rate incorporates all operational aspects of monitoring, including both scheduled and unscheduled down time for maintenance, operator support, security, etc. The monitoring rate achieved during the 1st quarter of FY 2003 decreased to 1.3 boreholes per day. The monitoring rate achieved during the previous quarter was 2.2 boreholes per day. The project goal is to achieve an average of 3 boreholes per day.

The decrease in monitoring rate this quarter is due to an increase in the total amount of down time. This increase can primarily be attributed to three issues. First, a new RAS vehicle was purchased by CHG to resolve ergonomic problems associated with the previous vehicle. Monitoring was shut down for approximately 2.5 weeks while the monitoring equipment was transferred from the old vehicle to the new vehicle. Second, the NaI(Tl) crystal for the large detector was broken on 12/05/2002, causing a delay of approximately 6 days. Third, there continues to be a significant amount of time lost due to the lack of operator support, usually because the operators are assigned other tasks by CHG management.

CHG is aware that the lack of operator support continues to affect the productivity of the monitoring project and have recently assigned the RAS a higher priority to improve operator support.

Stoller used extra padding around the large detector to help prevent the crystal from breaking in the future. Padding was also applied to the tailgate of the vehicle to help protect all the detector assemblies while they are stored and during transit. The operators are aware that these crystals are fragile and are using extreme care while handling detectors.

Tables 4-1 and 4-2 include summaries of production and operational issues, respectively, that affect monitoring production.

Table 4-1. Summary of Monitoring Production

Quarter	Total Work Days	Total Days Down	Total Boreholes Monitored	Boreholes Monitored per Day
2nd of FY02	55	34.1	74	1.3
3rd of FY02	59	21.1	113	1.9
4th of FY02	66	27.6	144	2.2
1st of FY03	56	34.7	72	1.3
Cumulative Total	236	117.5	403	N/A
Average/Quarter	59.0	29.4	100.8	1.7

Table 4-2. Summary of Operational Down Time

Quarter	Equipment/ Truck Problems (hrs)	No HPT/ Operator Support (hrs)	Security Measures (hrs)	No Charge Code or Administrative (hrs)	Moving Truck (hrs)	Weather (hrs)	Misc. (hrs)	Total Down Time (hrs)
2nd of FY02	143	40	24	58	9	18	15	307
3rd of FY02	30.5	62	0	36	27	8	26	189.5
4th of FY02	81	122	0	0	37	0	8	248
1st of FY03	71	107	0	18	18	0	98	312
Cumulative Total	325.5	331	24	112	91	26	147	1056.5
Average/Quarter	81.4	82.8	6	28	22.8	6.5	36.8	264.1

5.0 Future Monitoring Operations

Appendix E provides a summary by tank farm of prioritized boreholes available for monitoring through the end of the 2nd quarter of FY 2003. This list includes all boreholes with a total score in excess of 23 and a next monitoring date that is overdue or will become overdue within 90 days and likely contains more boreholes than can actually be monitored during the quarter.

As of the 3rd quarter, the highest priority boreholes in all tank farms have been monitored at least once. The monitoring will continue to cycle through the farms, collecting additional data from boreholes of interest, those selected for special study, and a number of boreholes that have lower priority but have not been logged for several years. Tank farms C, SX, U, S, BX, BY, T, and TY are anticipated to be visited during the 2nd quarter of FY 2003.

Stoller continues to receive special requests for additional monitoring (e.g. retrieval monitoring). Each of these requests impacts the routine monitoring as outlined in the Baseline Monitoring Plan (DOE 2003b). The procurement of a second monitoring system is required to minimize these impacts. Stoller has recently finalized specifications (Appendix F) for a second monitoring system that will be built to meet retrieval operations requirements. The new system will allow the collection of both total gamma and neutron-moisture measurements simultaneously.

References

U.S. Department of Energy (DOE), 2003a. *Hanford Tank Farms Vadose Zone Monitoring Project, Annual Monitoring Report for Fiscal Year 2002*, GJO-2003-400-TAC, Grand Junction Office, Grand Junction, Colorado.

U.S. Department of Energy (DOE), 2003b. *Hanford Tank Farms Vadose Zone Monitoring Project, Baseline Monitoring Plan*, GJO-HGLP 1.8.1, Revision 0, Grand Junction Office, Grand Junction, Colorado.

Stoller 2002. Letter from Doug W. Steele to Robert Yasek (DOE-ORP), Subject: "Neutron Moisture Logs for Vadose Zone Boreholes in the T Tank Farm," Control No. 1000-T03-0139, S.M. Stoller Corporation, Richland, Washington, October 30, 2002.

Appendix A
Boreholes Monitored During First Quarter FY 2003

Appendix A. Boreholes Monitored During First Quarter FY 2003

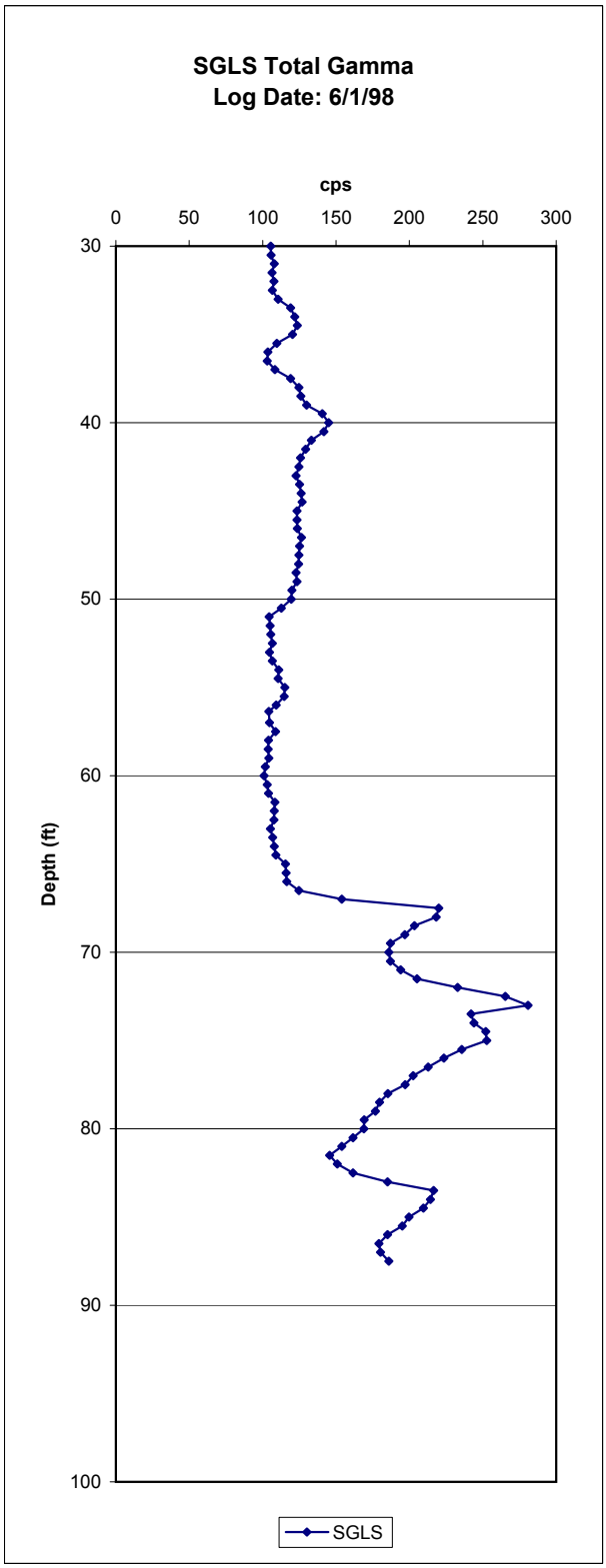
Borehole Number	Tank	Top	Bottom	Footage	Rerun Footage	Total Score	Next Log Date	HRLS	RAS Event A	RAS Event B	RAS Event C	RAS Event D	RAS Event E	RAS Event F	Comment
10-00-07	A-101	45	85	40	10	89	10/05/03		06/20/01	10/10/02					No apparent change
10-00-08	A-101	45	85	40		89	10/05/03		06/25/01	10/10/02					No apparent change
10-01-05	A-101	45	85	40		89	10/04/03		06/20/01	10/09/02					No apparent change
10-01-06	A-101	45	85	40		89	10/02/03		06/27/01	10/07/02					No apparent change
10-01-08	A-101	45	85	40	10	89	10/02/03		06/27/01	10/07/02					No apparent change
10-01-09	A-101	45	63	18		89	10/02/03		06/26/01	10/07/02					No apparent change
10-01-10	A-101	45	85	40		89	10/02/03		06/27/01	10/07/02					No apparent change
10-01-11	A-101	45	85	40		89	10/02/03		06/27/01	10/07/02					No apparent change
10-02-01	A-102	45	90	45	10	32	10/02/03		10/07/02						No apparent change
10-02-03	A-102	45	123	78		32	10/03/03		10/08/02						No apparent change
10-02-08	A-102	45	100	55		32	10/04/03		10/09/02						No apparent change
10-03-02	A-103	45	85	40		18	09/13/07		10/09/02						No apparent change
10-03-07	A-103	45	123	78	10	43	10/03/03		10/08/02						No apparent change
11-01-05	AX-101	45	85	40		66	10/04/03		10/09/02						No apparent change
11-01-07	AX-101	45	85	40	10	66	09/13/07		10/09/02						No apparent change
22-00-03	BY-103	50	146	96		50	11/20/03		11/19/01	11/25/02					No apparent change
22-01-07	BY-101	40	80	40		29	11/20/03		11/25/02						No apparent change
22-03-06	BY-103	40	99	59		38	11/10/03		11/16/01	11/15/02					No apparent change
22-03-07	BY-103	40	98	58	10	38	11/16/03		11/26/01	11/21/02					No apparent change
22-03-08	BY-103	40	99	59		38	11/16/03		11/19/01	11/21/02					No apparent change
22-03-09	BY-103	30	97	67		38	11/16/03		11/26/01	11/21/02					No apparent change
22-05-01	BY-105	40	98	58		62	11/16/03		11/14/01	11/21/02					No apparent change
22-05-09	BY-105	40	98	58	10	62	11/20/03		11/14/01	11/25/02					No apparent change
22-06-01	BY-106	40	80	40		51	11/22/03		11/27/01	11/27/02					No apparent change
22-06-07	BY-106	35	131	96		64	11/22/03		11/28/01	11/27/02					No apparent change
22-07-01	BY-107	40	98	58		43	11/15/03		12/06/01	11/20/02					No apparent change
22-07-09	BY-107	20	99	84	10	55	11/28/03		12/19/01	12/03/02					No apparent change
22-07-10	BY-107	20	80	60		18	10/30/07		11/25/02						No apparent change
22-08-01	BY-108	25	99	74		61	11/15/03		12/14/01	11/20/02					No apparent change
22-08-05	BY-108	35	98	63		74	05/19/03		12/17/01	07/30/02	11/20/02				Apparent change 75-82 ft not confirmed
22-08-06	BY-108	40	98	58	10	61	11/14/03		12/14/01	11/19/02					No apparent change
22-08-07	BY-108	40	110	70		49	11/15/03		12/17/01	11/20/02					No apparent change
22-09-01	BY-109	40	80	40		30	11/14/03		11/19/02						No apparent change
22-09-02	BY-109	40	99	59		17	10/24/07		11/19/02						No apparent change
22-09-05	BY-109	40	80	40	10	17	10/24/07		11/19/02						No apparent change
22-10-05	BY-110	40	98	58		41	11/14/03		12/11/01	11/19/02					No apparent change
22-12-03	BY-112	40	99	59		16	10/23/07		11/18/02						No apparent change
22-12-05	BY-112	40	80	40		16	10/23/07		11/18/02						No apparent change
22-12-06	BY-112	40	80	40	10	16	10/23/07		11/18/02						No apparent change
50-02-02	T-102	30	70	40		24	12/18/03		01/22/02	12/23/02					No apparent change
50-02-08	T-103	30	85	55		28	12/18/03		01/14/02	12/23/02					No apparent change
50-02-09	T-102	30	85	55		30	12/18/03		01/16/02	12/23/02					No apparent change
50-03-04	T-103	20	120	100	10	28	12/21/03		01/14/02	12/26/02					No apparent change
50-03-05	T-103	30	120	90		28	12/21/03		01/14/02	12/26/02					No apparent change
50-04-07	T-104	20	70	50		23	12/21/03		01/21/02	12/26/02					No apparent change
50-04-10	T-104	35	88	53		55	03/16/03		07/31/01	01/22/02	08/29/02	12/16/02			Apparent change 67-68 ft, ongoing 12/16/02
50-06-18	T-106	25	130	95		142	03/31/03		08/01/01	01/29/02	09/03/02	12/31/02			Possible increase 117-119 ft (Co-60), possible ongoing
50-07-08	T-107	35	88	53		17	11/20/07		12/16/02						No apparent change
50-08-09	T-108	30	100	70		27	12/25/03		01/16/02	12/30/02					No apparent change

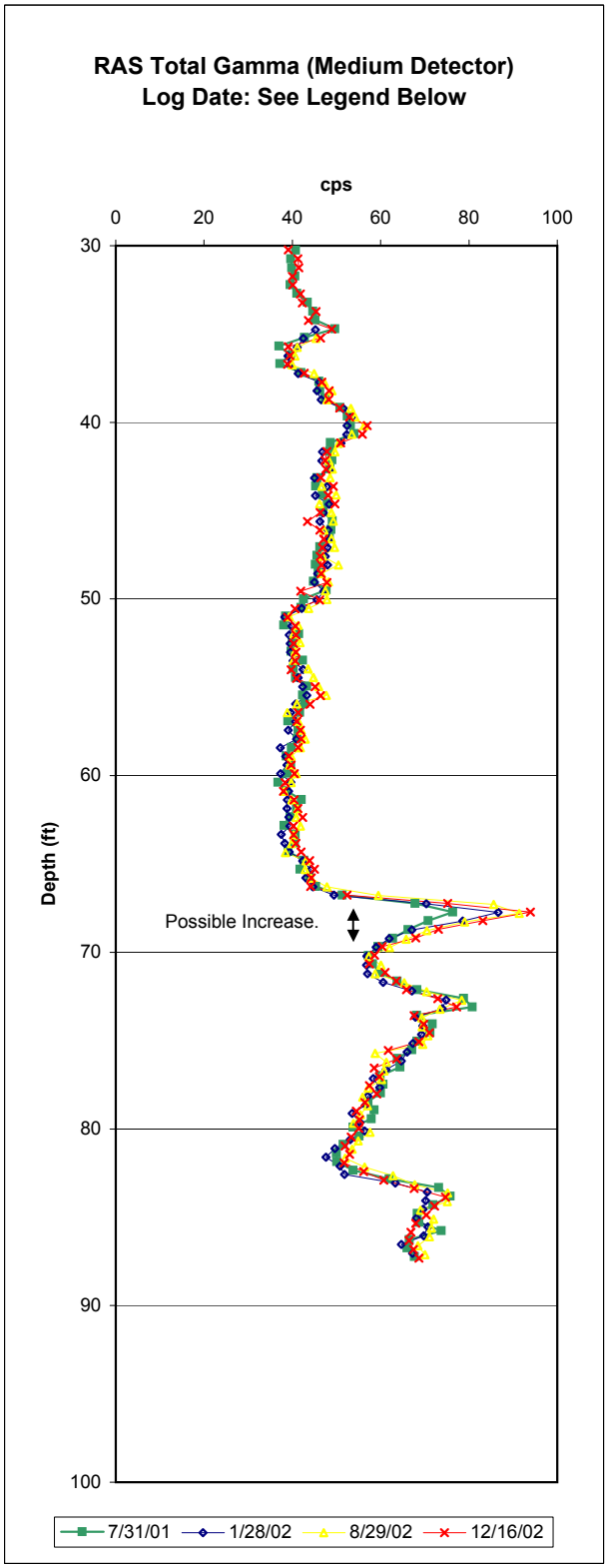
Appendix A. Boreholes Monitored During First Quarter FY 2003

Borehole Number	Tank	Top	Bottom	Footage	Rerun Footage	Total Score	Next Log Date	HRLS	RAS Event A	RAS Event B	RAS Event C	RAS Event D	RAS Event E	RAS Event F	Comment
50-09-05	T-109	30	90	60	10	29	12/25/03		01/10/02	12/30/02					No apparent change
52-03-06	TY-103	40	100	60		56	03/04/03		05/02/02	05/21/02	08/22/02	12/04/02			Definite change 55-60 ft; report issued 5/14/02
52-04-06	TY-104	40	98	58	10	3	11/29/03		12/04/02						No apparent change
52-05-07	TY-105	40	96	56		82	06/02/03		05/02/02	12/04/02					No apparent change
52-06-05	TY-106	40	147	107		66	03/04/03		05/08/02	12/04/02					Possible change 130-148 ft, ongoing 12/04/03
60-04-08	U-104	40	118	78		94	02/12/03		07/16/01	10/22/01	01/03/02	04/10/02	08/27/02	11/14/02	Apparent change (74-78 and 84-89 ft) not confirmed
60-05-04	U-105	35	72	37		44	02/12/03		07/16/01	10/24/01	08/27/02	11/14/02			No apparent change
60-05-05	U-105	35	123	88		44	02/11/03		07/16/01	08/27/02	11/13/02				Possible increase 75-80 ft
60-05-07	U-105	35	123	88	10	7	11/08/03		11/13/02						No apparent change
60-07-01	U-107	40	98	58		85	02/03/03		07/12/01	10/04/01	12/26/01	04/10/02	08/23/02	11/05/02	Apparent change 83-88 ft not confirmed
60-07-02	U-107	35	125	90		53	02/02/03		07/12/01	10/04/01	12/26/01	04/15/02	08/23/02	11/04/02	Apparent decrease 90-100 ft not confirmed
60-07-10	U-107	40	98	58		85	02/03/03		07/09/01	10/24/01	12/27/01	04/15/02	08/26/02	11/05/02	Apparent change (SGLS); 53-65 ft not confirmed
60-07-11	U-107	40	124	84	10	85	02/03/03		07/12/01	10/24/01	12/27/01	04/15/02	08/26/02	11/05/02	Apparent change (SGLS); 73-95 ft not confirmed
60-08-04	U-108	35	127	92		56	02/03/03		07/09/01	10/25/01	12/28/01	04/15/02	08/27/02	11/05/02	No apparent change
60-09-01	U-109	35	75	40		18	10/16/07		11/11/02						No apparent change
60-09-07	U-109	35	75	40		18	10/16/07		11/11/02						No apparent change
60-09-08	U-109	35	75	40	10	18	10/17/07		11/12/02						No apparent change
60-09-10	U-109	35	124	89		18	10/16/07		11/11/02						No apparent change
60-10-01	U-110	35	125	90		10	02/04/03		07/17/01	10/04/01	12/27/01	04/11/02	08/26/02	11/06/02	No apparent change
60-10-11	U-110	35	98	63		10	02/04/03		07/17/01	10/04/01	01/02/02	04/11/02	08/26/02	11/06/02	No apparent change
60-11-07	U-111	35	123	88	10	37	11/07/03		10/25/01	11/12/02					No apparent change
60-11-12	U-111	35	124	89		37	11/07/03		11/05/01	11/12/02					No apparent change
60-12-03	U-112	35	124	89		9	11/08/03		11/13/02						No apparent change

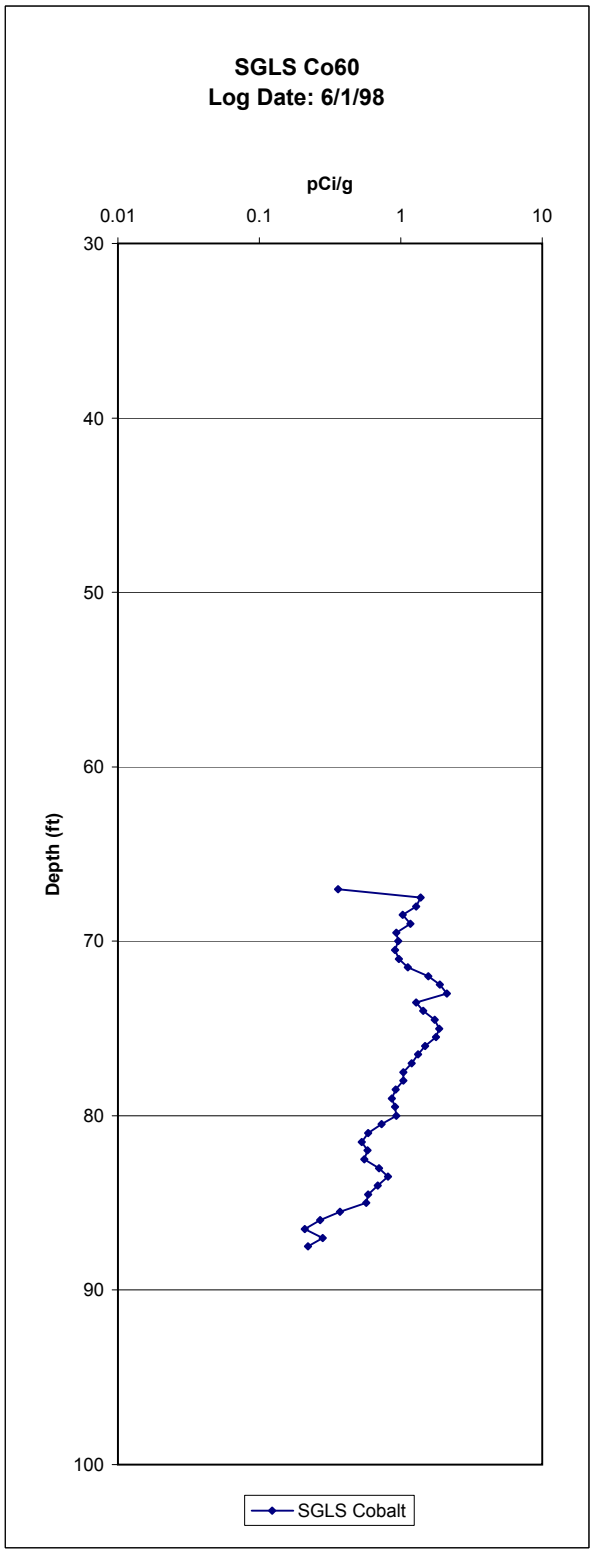
Appendix B
Comparison of the Current RAS and the SGLS Baseline Measurements

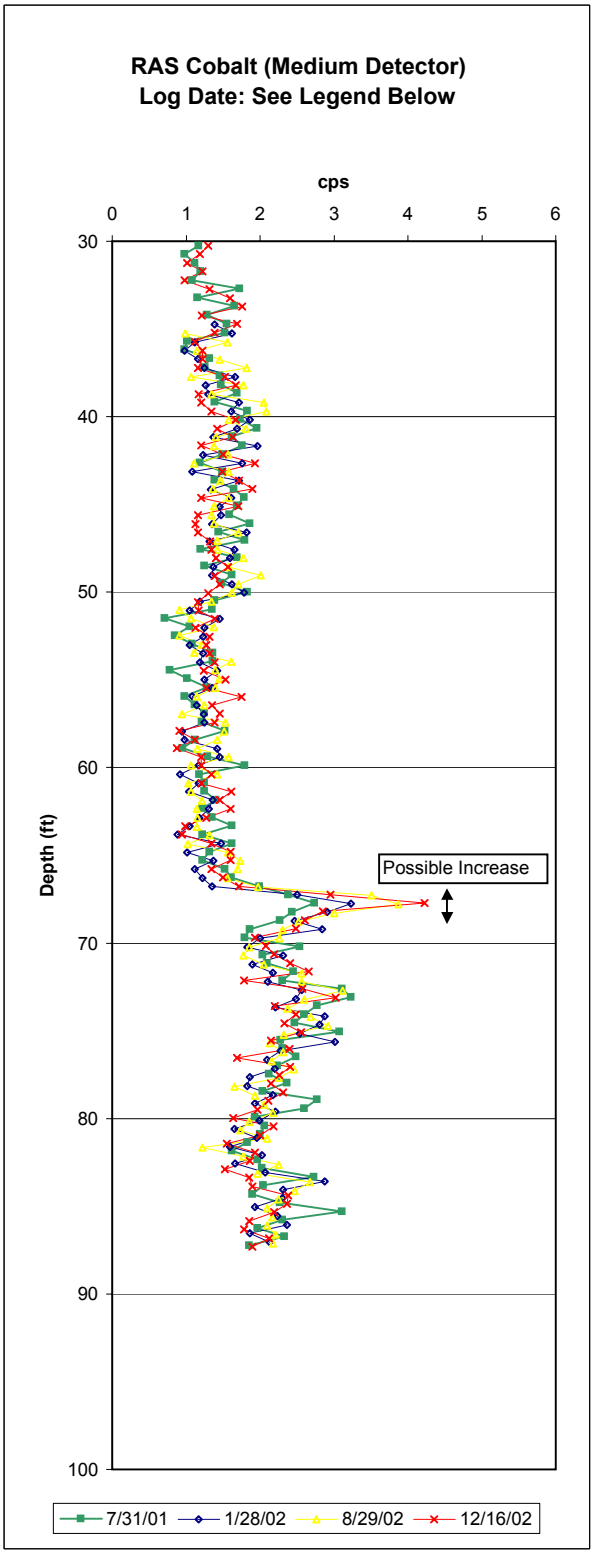
Borehole 50-04-10



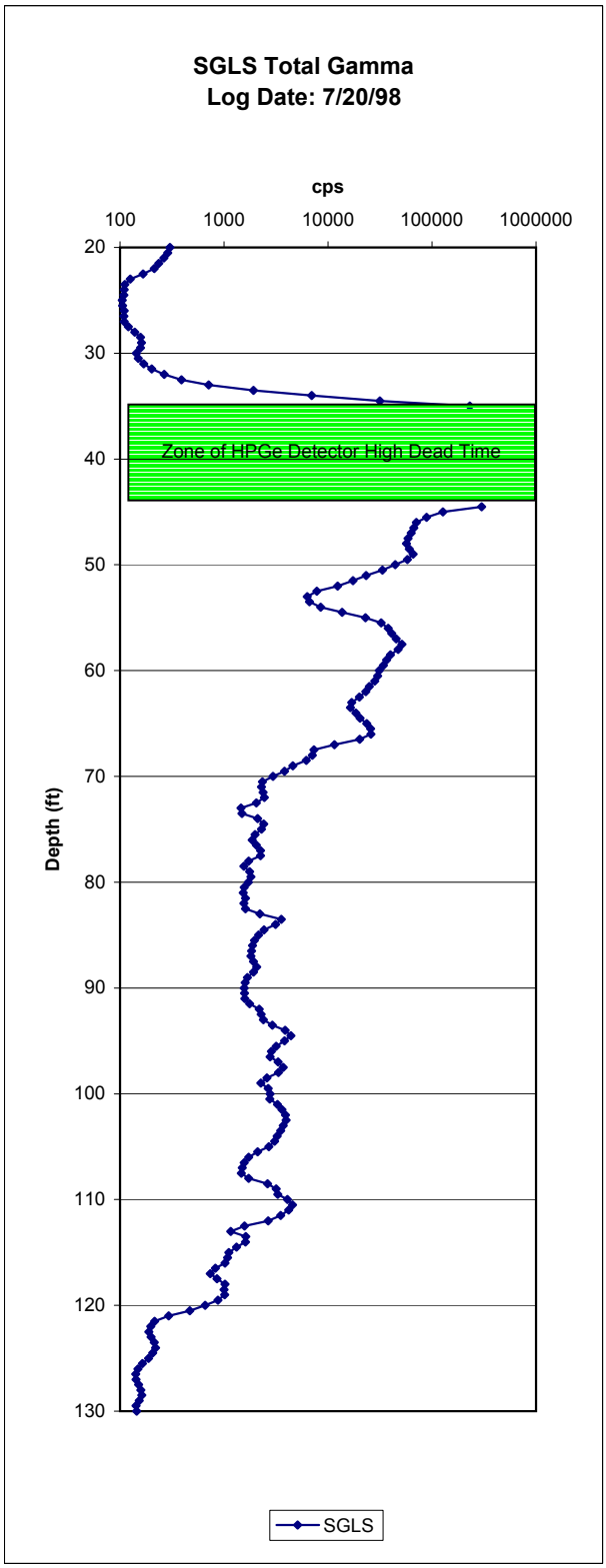


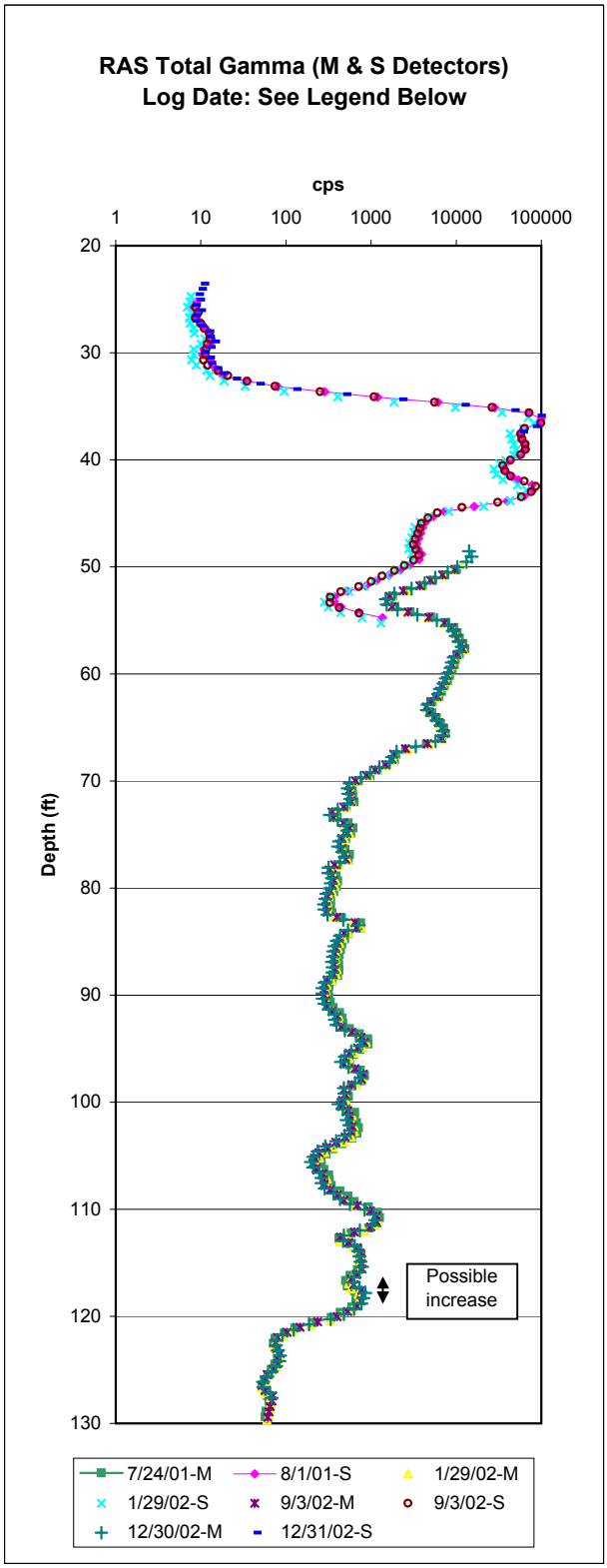
Borehole 50-04-10



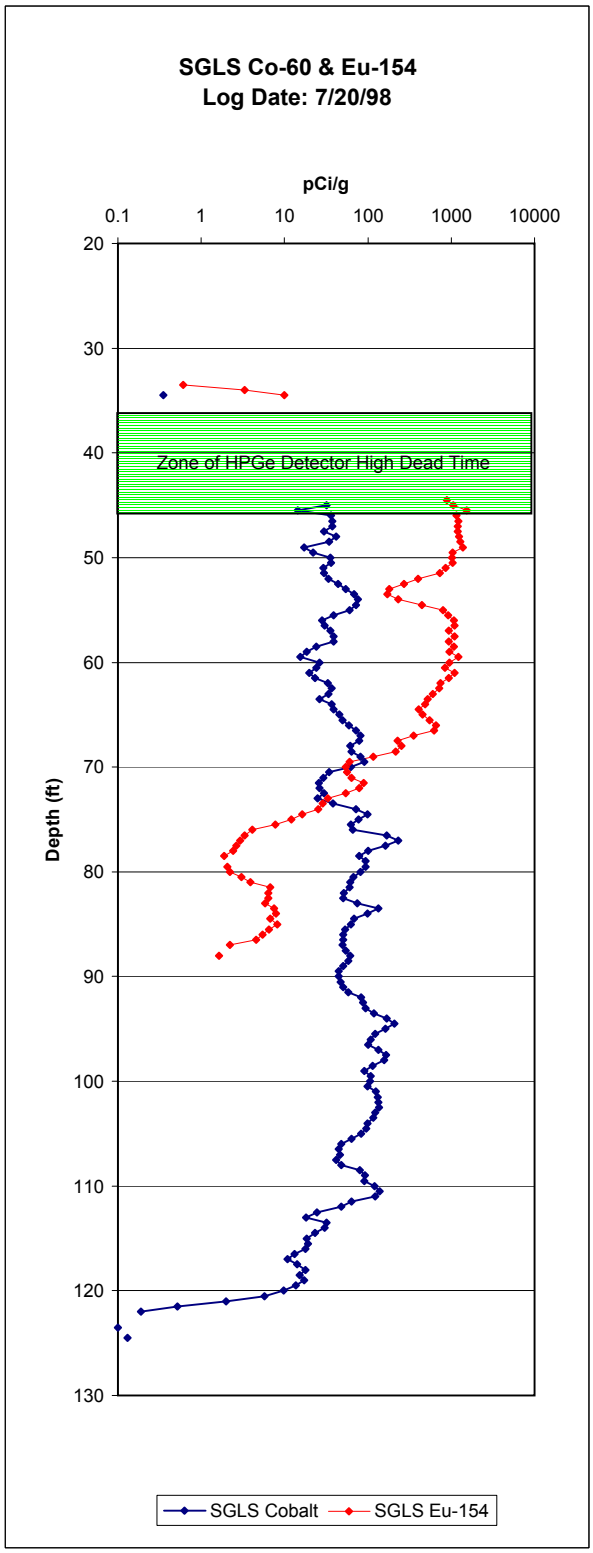


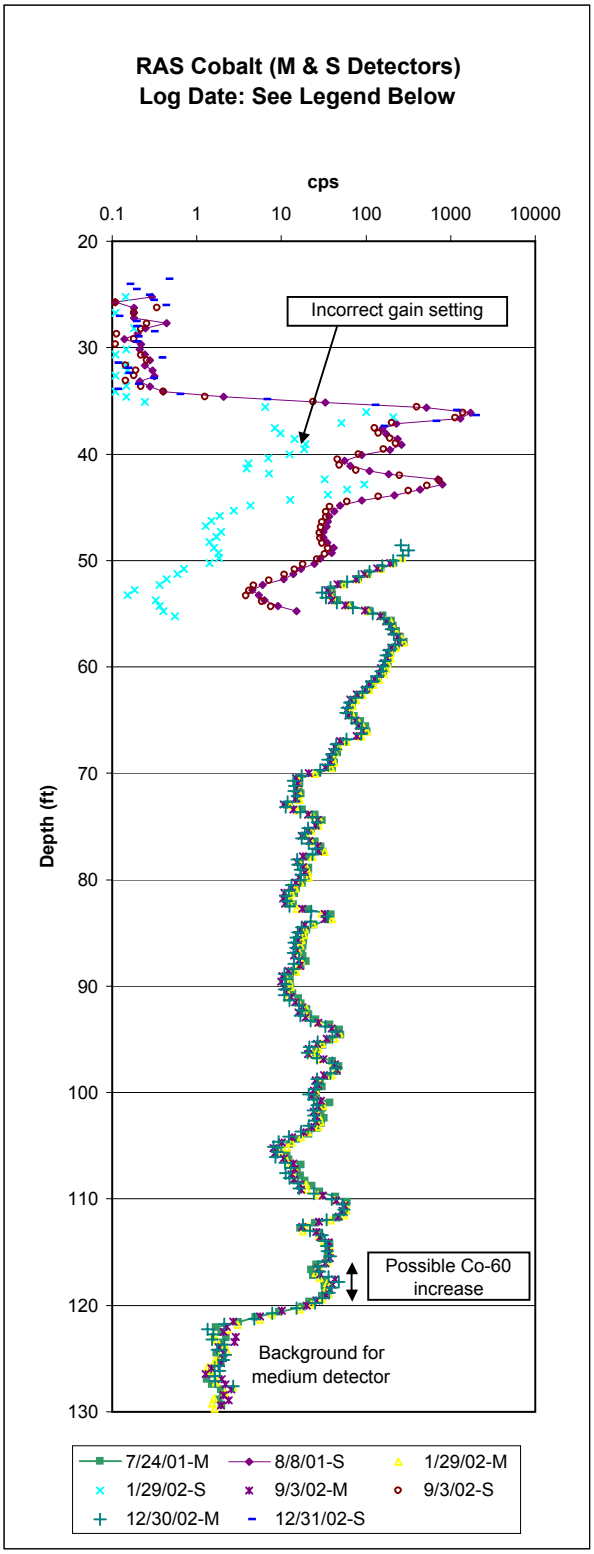
Borehole 50-06-18



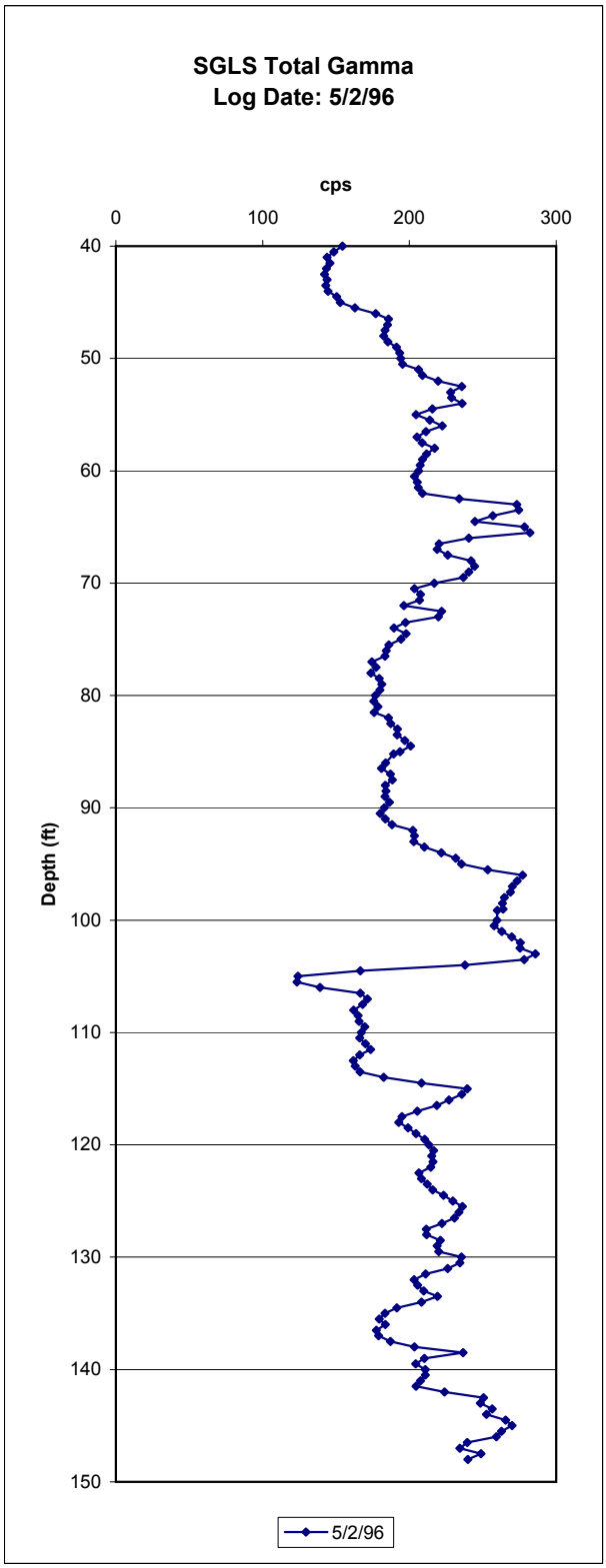


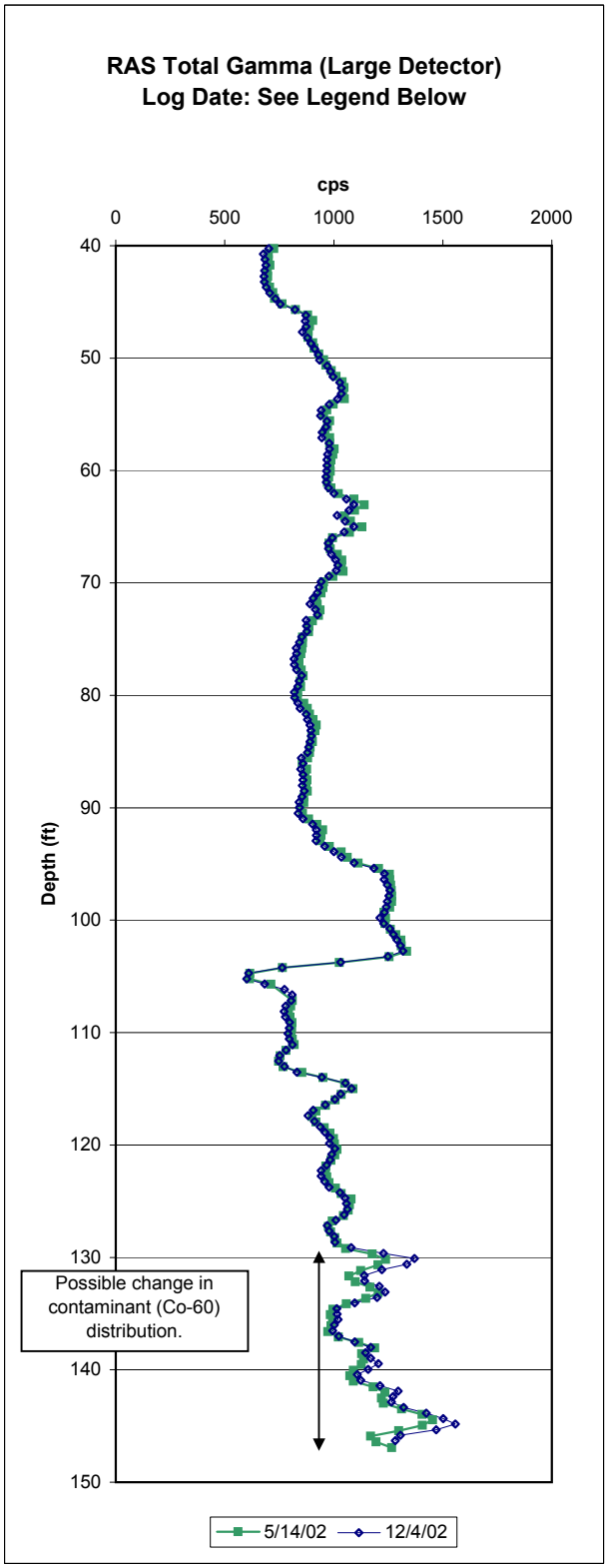
Borehole 50-06-18



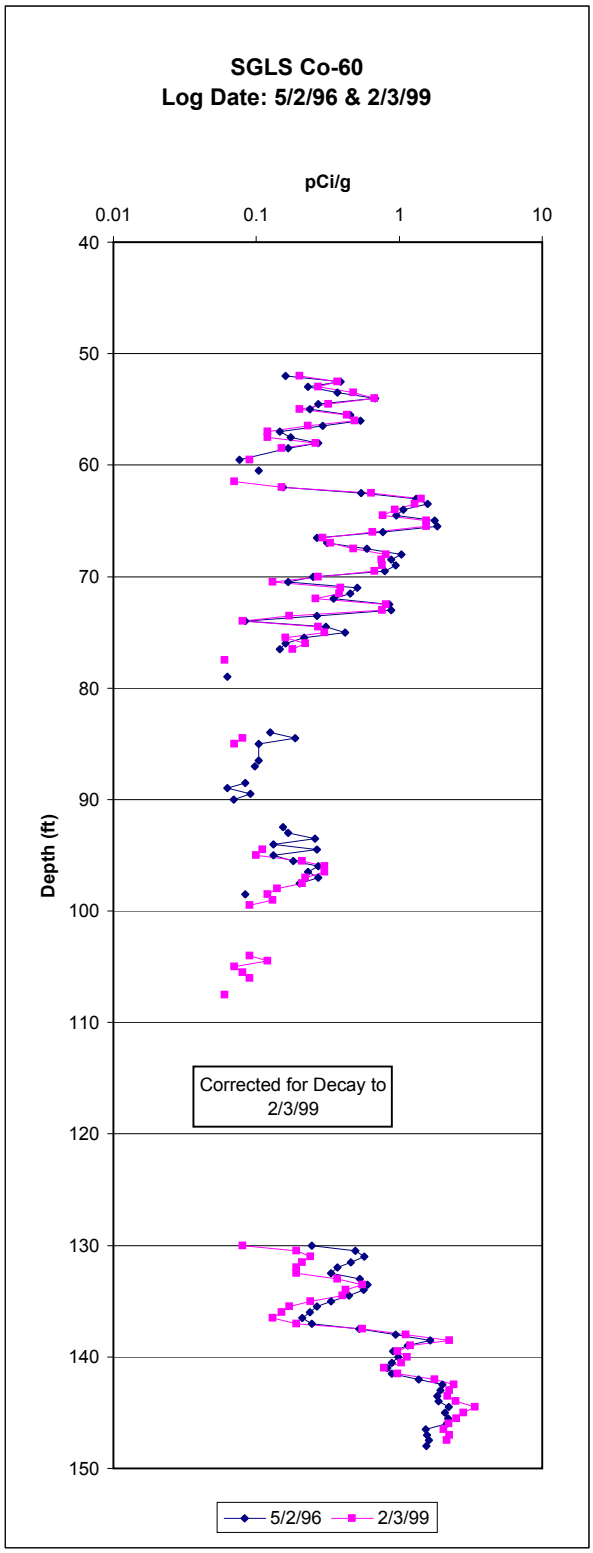


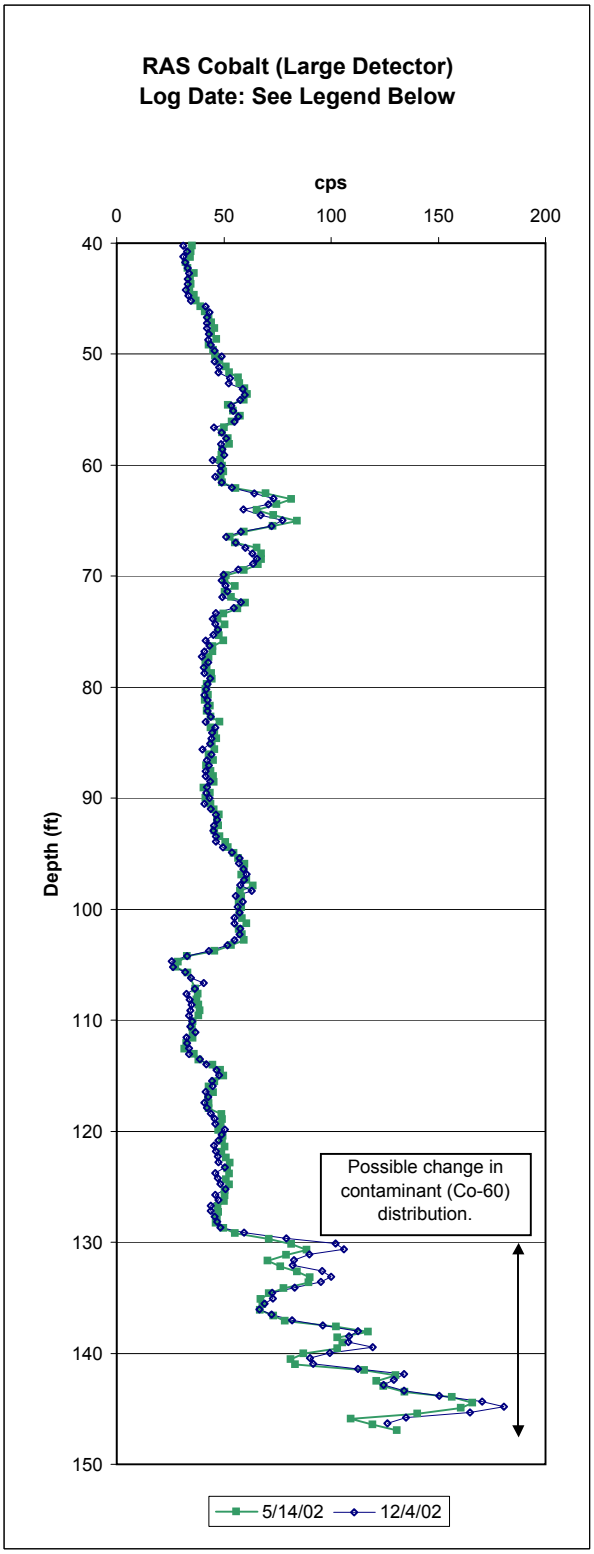
Borehole 52-06-05





Borehole 52-06-05





Appendix C
Log Plots for T Farm
Moisture Logging

Moisture Logging in T Tank Farm

50-06-04

50-06-18

50-09-01

50-08-08

Elevation (feet) NAVD88

675 665 655 645 635 625 615 605 595 585 575 565 555 545 535 525 515 505 495

Bottom of Tank Farm Excavation

Multiple casings and possible grout

Cement Grout

Hydrated Bentonite Seal

K-40
Cs-137
Co-60
Eu-154
Eu-152
Sn-126
Moisture (cps)

Note: The ground surface elevation (TOC) for borehole 50-06-18 was estimated from other nearby boreholes as 675.0 ft.

10^{-1} 10^{0} 10^{1} 10^{2} 10^{3} 10^{4} 10^{5}
pCi/g

0 100 200 300 400 500
Moisture (cps)

0 5 10 15 20 25 30
^{40}K (pCi/g)

Appendix D
Log Plots for U Farm
Moisture Logging

Moisture Logging in the Vicinity of Tank U-107 at U Tank Farm

60-07-02 | 60-07-01 | 60-07-11 | 60-07-10 | 60-08-04 | 60-10-11 | 60-10-01

Grout (60-07-01, 60-07-10, 60-10-11)

Elevation (feet) NAVD88: 675, 665, 655, 645, 635, 625, 615, 605, 595, 585, 575, 565, 555, 545, 535, 525, 515

^{137}Cs (SGLS Badeline decayed to 01/01/03)
NMLS 11/02
^{40}K SGLS 1995
^{238}U SGLS 1995
^{238}U SGLS 1999
^{238}U SGLS 2001

Depth reference - top of casing

Depths of ^{235}U contamination not shown but generally coincide with ^{238}U depths

pCi/g: 10^{-1} 10^{0} 10^{1} 10^{2} 10^{3}

Volume Fraction %: 0 5 10 15 20

^{40}K (pCi/g): 0 10 20 30

Appendix E
Boreholes Projected for Monitoring
During the Second Quarter of FY 2003

Appendix E. Boreholes Projected for Monitoring During Second Quarter of FY 2003

Borehole Number	Tank	Top	Bottom	Footage	Rerun Footage	Total Score	Next Log Date	HRLS	RAS Event A	RAS Event B	RAS Event C	RAS Event D	RAS Event E	RAS Event F	Comment
21-00-05	BX-101	35	125	90		33	03/09/03		03/14/02						No apparent change
21-01-01	BX-101	15	99	89		33	03/20/03		03/25/02						No apparent change
21-01-02	BX-101	35	98	63		33	03/08/03		03/13/02						No apparent change
21-02-03	BX-102	35	99	64		106	03/03/03		08/14/01	03/13/02	09/04/02				No apparent change
21-27-01	BX-102	35	99	64		106	03/03/03		08/28/01	03/13/02	09/04/02				No apparent change
21-27-08	BX-102	35	149	114		106	03/03/03		08/14/01	03/13/02	09/04/02				Apparent change 137.5-148.5 ft not confirmed
21-27-11	BX-102	30	137	107		106	03/03/03		08/20/01	03/14/02	09/04/02				No apparent change
21-03-03	BX-103	35	90	55		55	03/03/03		08/28/01	02/25/02	09/04/02				No apparent change
21-03-05	BX-103	35	80	45		30	02/20/03		02/25/02						No apparent change
21-04-11	BX-104	35	97	62		27	03/13/03		03/18/02						No apparent change
21-05-05	BX-105	35	99	64		28	03/13/03		03/18/02						No apparent change
21-05-06	BX-105	35	100	65		28	03/14/03		03/19/02						No apparent change
21-06-05	BX-106	25	75	55		26	03/20/03		03/25/02						No apparent change
21-08-07	BX-108	30	100	70		28	03/14/03		03/19/02						No apparent change
21-00-09	BX-111	35	73	38		32	03/14/03		03/19/02						No apparent change
21-00-21	BX-111	35	90	55		32	03/15/03		03/20/02						No apparent change
21-00-22	BX-111	20	73	53		32	03/15/03		03/20/02						No apparent change
21-11-03	BX-111	35	99	69		32	03/20/03		03/25/02						No apparent change
21-11-04	BX-111	35	75	45		32	03/16/03		03/21/02						No apparent change
21-11-05	BX-111	35	75	40		32	03/15/03		03/20/02						No apparent change
21-11-07	BX-111	35	75	40		32	03/15/03		03/20/02						No apparent change
22-02-07	BY-102	170	260	90		31	03/30/00								Sampling equip. in well. Not logged 07-02
22-00-02	BY-103	40	99	59		63	01/21/03		11/15/01	07/25/02					No apparent change
22-03-04	BY-103	40	101	61		63	01/19/03		11/15/01	07/23/02					Possible change 77-82 ft not confirmed
22-06-05	BY-106	20	98	78		76	01/22/03		11/27/01	07/26/02					No apparent change
22-07-02	BY-107	30	100	70		68	01/25/03		11/29/01	07/29/02					Apparent change 98-100 ft not confirmed
22-07-05	BY-107	30	97	67		68	01/25/03		12/12/01	07/29/02					Apparent change 75-81 ft not confirmed
22-07-07	BY-107	40	99	59		68	02/16/03		12/12/01	08/20/02					No apparent change
22-08-02	BY-108	25	103	78		74	01/26/03		12/13/01	07/30/02					No apparent change
22-08-12	BY-108	30	90	60		74	02/15/03		12/13/01	08/19/02					No apparent change
22-10-07	BY-110	40	80	40		53	01/14/03		12/11/01	07/18/02					No apparent change
30-00-06	C-101	30	70	40		18	02/27/02								BE - Cs-137
30-01-12	C-101	30	70	40		18	02/22/02								BE - Cs-137
30-03-01	C-103	30	125	95		51	04/12/98								Cannot log because of stairwell; 10/01 and 09/02
30-03-03	C-103	30	98	68		51	04/06/98								Water in borehole 10/01 - Cannot log
30-04-02	C-104	30	75	45		34	02/14/98								BE - Cs-137
30-04-03	C-104	20	50	30		34	02/20/00								BE - Cs-137; TD of BH is 50'
30-05-02	C-105	30	90	60		28	07/21/02		04/22/02						No apparent change
30-00-01	C-106	30	67	37		34	07/23/02		04/24/02						No apparent change
30-06-02	C-106	30	70	40		9	04/22/97								
30-06-03	C-106	30	70	40		9	04/16/97								BE - Cs-137
30-06-04	C-106	20	100	80		34	12/10/02		09/11/02						No apparent change
30-06-09	C-106	25	80	55		47	07/21/02		04/22/02						No apparent change
30-06-10	C-106	30	129	99		59	07/22/02		04/23/02						Possible change 124-126 ft Co-60
30-06-12	C-106	10	100	90		47	07/23/02		04/24/02						No apparent change
30-08-02	C-108	30	99	69		27	12/11/02		09/11/02	09/12/02					Definite change in Co-60 49-75 ft
30-08-03	C-108	30	70	40		2	09/16/97								BE - Cs-137
30-08-12	C-108	30	70	40		2	03/09/98								BE - Cs-137
30-09-06	C-109	30	98	68		40	07/22/02		04/23/02						No apparent change

Appendix E. Boreholes Projected for Monitoring During Second Quarter of FY 2003

Borehole Number	Tank	Top	Bottom	Footage	Rerun Footage	Total Score	Next Log Date	HRLS	RAS Event A	RAS Event B	RAS Event C	RAS Event D	RAS Event E	RAS Event F	Comment
30-09-07	C-109	30	100	70		27	12/10/02		09/11/02						No apparent change
30-00-09	C-110	30	57	27		19	03/06/02								
30-10-01	C-110	30	70	40		19	02/06/02								
30-10-02	C-110	30	70	40		19	02/01/02								BE - Cs-137
30-10-09	C-110	30	70	40		19	02/02/02								BE - Cs-137
30-10-11	C-110	30	70	40		19	02/07/02								
40-04-08	S-104	20	50	30		52	05/19/97								Borehole obstruction
40-07-04	S-107	40	80	40		23	06/06/97								
40-07-06	S-107	40	80	40		23	05/17/01								
40-07-08	S-107	40	80	40		23	05/24/97								
40-07-10	S-107	40	80	40		23	05/02/01								
40-07-11	S-107	35	80	45		23	05/12/01								Assuming 40-04-05 is not stable
40-09-06	S-109	40	80	40		2	12/02/02		06/05/02						No apparent change; special request
40-12-02	S-112	40	80	40		12	12/02/02		06/05/02						No apparent change; special request
40-12-04	S-112	40	80	40		12	12/01/02		06/04/02						No apparent change; special request
40-12-06	S-112	40	80	40		12	12/01/02		06/04/02						No apparent change; special request
40-12-07	S-112	40	80	40		12	12/01/02		06/04/02						No apparent change; special request
40-12-09	S-112	40	80	40		12	12/02/02		06/05/02						No apparent change; special request
41-01-01	SX-101	35	80	45		14	04/13/96								BE - Cs-137
41-01-04	SX-101	40	80	40		14	04/19/96								
41-01-07	SX-101	40	80	40		14	04/13/96								BE - Cs-137
41-01-08	SX-101	40	80	40		14	04/13/96								BE - Cs-137
41-01-11	SX-101	40	80	40		14	05/05/96								BE - Cs-137
41-02-02	SX-102	25	140	115		82	03/05/03		09/07/01	03/26/02	09/06/02				Possible change not confirmed; possible Sr-90
41-03-02	SX-103	30	80	50		45	03/21/03		03/26/02						No apparent change
41-03-05	SX-103	40	80	40		45	03/21/03		03/26/02						No apparent change
41-03-06	SX-103	40	80	40		20	04/19/00								BE - Cs-137
41-03-09	SX-103	40	80	40		20	04/18/00								BE - Cs-137
41-03-10	SX-103	40	80	40		20	04/14/00								BE - Cs-137
41-03-12	SX-103	40	80	40		20	04/12/00								BE - Cs-137
41-05-02	SX-105	40	80	40		6	04/21/00								BE - Cs-137
41-05-05	SX-105	45	132	87		6	04/29/00								BE - Cs-137
41-05-07	SX-105	45	80	35		6	04/22/00								BE - Cs-137
41-05-10	SX-105	40	95	55		6	05/04/00								BE - Cs-137
41-05-12	SX-105	35	80	45		6	05/05/00								BE - Cs-137
41-07-07	SX-107	40	75	26		56	10/16/02	04/19/02	09/26/01	04/09/02					No apparent change; HRLS 04/19/02
41-07-08	SX-107	40	76	46		56	03/16/02		09/17/01						Vent pipe obstruction FY 02
41-07-10	SX-107	40	72	32		25	05/12/00								BE - Cs-137
41-00-08	SX-109	40	89	49		58	03/05/03		08/20/01	03/28/02	09/06/02				No apparent change
41-09-02	SX-109	40	74	34		33	03/22/03		03/27/02						No apparent change
41-09-04	SX-109	40	102	62		58	03/08/00								Not logged due to bh contamination
41-09-07	SX-109	40	73	35		58	10/19/02	04/22/02	10/03/01	04/05/02					No apparent change; HRLS 04/22/02
41-09-09	SX-109	40	95	66		58	10/02/02		10/03/01	04/05/02					No apparent change
41-10-01	SX-110	40	80	40		54	09/28/02		09/13/01	04/01/02					No apparent change
41-10-02	SX-110	40	80	40		23	05/24/00								BE - Cs-137
41-11-08	SX-111	40	85	45		23	06/10/00								BE - Cs-137
41-11-10	SX-111	40	95	69		54	10/15/02	04/18/02	09/25/01	04/09/02					No apparent change; HRLS 04/18/02
41-12-03	SX-112	40	76	41		63	09/28/02		10/03/01						No apparent change
41-14-06	SX-114	30	76	46		40	03/28/03		04/02/02						No apparent change

Appendix E. Boreholes Projected for Monitoring During Second Quarter of FY 2003

Borehole Number	Tank	Top	Bottom	Footage	Rerun Footage	Total Score	Next Log Date	HRLS	RAS Event A	RAS Event B	RAS Event C	RAS Event D	RAS Event E	RAS Event F	Comment
41-14-09	SX-114	40	75	35		40	03/28/03		04/02/02						No apparent change
41-14-11	SX-114	40	75	35		40	03/28/03		04/02/02						No apparent change
41-15-07	SX-115	40	90	50		65	09/20/02		09/25/01						No apparent change
50-01-09	T-101	30	90	60		61	02/24/03		07/30/01	11/08/01	01/22/02	08/28/02			Apparent change at 86-90 ft not confirmed
50-02-05	T-102	30	85	55		55	02/24/03		07/25/01	01/22/02	08/28/02				No apparent change
50-03-06	T-103	30	120	90		28	03/20/99								Water in BH 01/02- not logged
50-04-08	T-104	30	96	66		55	02/24/03		07/31/01	01/24/02	08/28/02				No apparent change
50-04-10	T-104	35	88	53		55	03/16/03		07/31/01	01/22/02	08/29/02	12/16/02			Apparent change 67-68 ft, ongoing 12/16/02
50-05-06	T-105	30	90	60		27	04/17/99								Water in BH 01/02- not logged
50-05-07	T-105	30	87	57		27	01/03/03		01/08/02						No apparent change
50-00-09	T-106	30	120	90		142	02/24/03		07/18/01	01/09/02	08/28/02				No apparent change
50-06-02	T-106	30	122	92		142	02/25/03		07/19/01	11/07/01	01/15/02	08/29/02			Apparent change at 110 ft not confirmed
50-06-03	T-106	30	118	88		142	02/24/03		07/18/01	11/12/01	01/15/02	08/28/02			Apparent change at 115 ft not confirmed
50-07-07	T-107	30	70	40		42	04/07/00								No log - water filled (06/18/01)
50-08-07	T-108	30	119	89		27	01/05/03		01/10/02						No apparent change
50-08-08	T-108	30	95	65		27	01/03/03		01/08/02						No apparent change
50-08-11	T-108	30	120	90		27	05/13/99								Water in BH 01/02- not logged
50-08-19	T-108	30	86	56		27	01/03/03		01/08/02						No apparent change
50-09-01	T-109	30	86	56		54	02/23/03		07/23/01	11/08/01	01/28/02	08/27/02			Apparent change at 85 ft result of water level
50-09-02	T-109	30	86	56		54	02/23/03		01/08/02	08/27/02					Apparent change 81-86 ft caused by different water levels
50-09-10	T-109	30	120	90		54	02/24/03		07/23/01	11/07/01	01/16/02	08/28/02			Apparent change at 76 and 94 ft not confirmed
51-01-09	TX-101	40	80	40		27	12/21/96								Borehole cannot be located
51-03-09	TX-103	40	98	58		55	11/09/02		05/13/02						No apparent change
51-03-11	TX-103	40	100	60		30	11/16/02		05/20/02						Possible change 61-62 and 90-95 ft; freq. to 6 mos.
51-04-05	TX-104	40	98	58		54	11/12/02		05/16/02						No apparent change
51-05-05	TX-105	40	80	40		64	11/13/02		05/17/02						No apparent change
51-05-07	TX-105	40	80	40		64	11/13/02		05/17/02						No apparent change
51-18-03	TX-118	10	80	70		30	04/19/97								
52-03-06	TY-103	40	100	60		56	03/04/03		05/02/02	05/21/02	08/22/02	12/04/02			Definite change 55-60 ft; report issued 5/14/02
52-06-05	TY-106	40	147	107		66	03/04/03		05/08/02	12/04/02					Possible change 130-148 ft, ongoing 12/04/03
60-04-08	U-104	40	118	78		94	02/12/03		07/16/01	10/22/01	01/03/02	04/10/02	08/27/02	11/14/02	Apparent change (74-78 and 84-89 ft) not confirmed
60-05-04	U-105	35	72	37		44	02/12/03		07/16/01	10/24/01	08/27/02	11/14/02			No apparent change
60-05-05	U-105	35	123	88		44	02/11/03		07/16/01	08/27/02	11/13/02				Possible increase 75-80 ft
60-07-01	U-107	40	98	58		85	02/03/03		07/12/01	10/04/01	12/26/01	04/10/02	08/23/02	11/05/02	Apparent change 83-88 ft not confirmed
60-07-02	U-107	35	125	90		53	02/02/03		07/12/01	10/04/01	12/26/01	04/15/02	08/23/02	11/04/02	Apparent decrease 90-100 ft not confirmed
60-07-10	U-107	40	98	58		85	02/03/03		07/09/01	10/24/01	12/27/01	04/15/02	08/26/02	11/05/02	Apparent change (SGLS); 53-65 ft not confirmed
60-07-11	U-107	40	124	84	10	85	02/03/03		07/12/01	10/24/01	12/27/01	04/15/02	08/26/02	11/05/02	Apparent change (SGLS); 73-95 ft not confirmed
60-08-04	U-108	35	127	92		56	02/03/03		07/09/01	10/25/01	12/28/01	04/15/02	08/27/02	11/05/02	No apparent change
60-10-01	U-110	35	125	90		10	02/04/03		07/17/01	10/04/01	12/27/01	04/11/02	08/26/02	11/06/02	No apparent change
60-10-11	U-110	35	98	63		10	02/04/03		07/17/01	10/04/01	01/02/02	04/11/02	08/26/02	11/06/02	No apparent change

Appendix F
Specifications for a Second Monitoring System

S. M. Stoller Corp., 2597 B ¾ Road, Grand Junction, Co. 81503 **Specifications for Geophysical Logging System**

Logging System

- self-contained for logging with no external support
- boom with minimum 6 ft reach
- remote mast assembly to allow logging in boreholes up to 100 ft from vehicle (note: borehole casing may be flush to the ground; 4 to 12 inch diameter
- overall design so that one person can set up for logging
- electric or hydraulic winch
- winch capable of holding the sonde stationary in the borehole for extended periods
- manual & computer control
- cable tension sensor & automatic shutoff
- winch speed 0.5 to 30 ft/min
- minimum of 500 ft of logging cable
- minimum 3/16 in diameter cable
- depth readout to 0.01 ft
- depth accuracy 0.1 ft in 100 ft
- computer control of logging via borehole-specific script files
- continuous logging mode: 0.5 to 5.0 ft/min
- move-stop-acquire mode:
  - depth increment 0.1 to 10.0 ft (0.5 ft default)
  - count time 10 to 1200 sec RT (30 sec default)
- computer-controlled data collection and storage
- ZIP disk drive for data transfer
- provision for MCA with minimum 1024 channels

Sonde

- maximum sonde OD 3.5 in. (min borehole ID 4 in.)
- centralizers for 4-in. to 12-in. ID boreholes
- maximum borehole temp 170 deg F
- accommodate gamma detector and neutron moisture gage concurrently
- stainless steel construction
- index marks at detector locations
- easy to decontaminate: minimum of external grooves, protuberances and other features

Gamma Detector

- total measurement range[i]
  20 to 10^{10} API units (up to 10^9 pCi/g ^{137}Cs)
  maximum radiation level approximately 300 R/h
- minimum capability of 10^5 API units
- non-paralyzable
- active gain control
- gamma energy range 100 to 2800 KeV
- PMT shielded against magnetic effects
- temperature-compensated
- verifier on tool rack

Neutron Moisture Gage

- measurement range 0 to 25 volumetric percent moisture content
- uncompensated (single source – single detector)
- source-detector spacing < 3"
- chemical neutron source (e.g. Am-Be) desirable
- detector response primarily to thermal neutrons, with minimal response to gamma photons
- source "pig" on tool rack
- additional "pig' for storage or transport of source
- source handling tool

Platform

- 4WD crew-cab
- American manufacture, model year 2002 or newer
- minimum ¾ ton chassis
- diesel power, 5.9 L minimum
- automatic transmission
- canopy & outside storage
- GVW < 10,000 lbs
- minimum seating for 3 (in logging configuration)
- backup alarm
- engine hour meter
- adequate storage for ancillary equipment
- tool rack for logging sondes

Operator Compartment

- "ergonomic" arrangement which allows continuous monitoring of system display, winch, cable and borehole during operation
- heat & AC
- tinted or shaded windows to allow easy viewing of computer displays in bright sunlight
- adjustable operator seat with lumbar support

On-Board Electrical System

- power options
  - PTO/generator, or
  - alternator/inverter
- additional 120 VAC outlets in operator and winch compartment
- interior and exterior lighting for night operation, including flood lights at rear of vehicle
- shore power connection

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[i] The desirable measurement range for the gamma detector is from background up to gamma radiation associated with a uniform distribution of approximately 10^9 pCi/g ^{137}Cs. In logging terms, this corresponds to a range of about 20 to 6 * 10^9 API units. The maximum borehole radiation level is estimated to be approximately 300 Roentgens per hour (R/h). It is recognized that these upper limits are well beyond the capability of conventional well logging technology. The vendor is encouraged to provide multiple detectors to achieve the widest possible measurement range. The use of "divide-by" circuits and/or shielding is encouraged. Multiple sondes are acceptable. The vendor will identify each proposed detector and indicate its approximate measurement range. The vendor is encouraged to propose unconventional detectors (ie. not normally used in logging practice) in order to achieve the greatest possible measurement capability. At a minimum the vendor should be able to provide gamma detectors capable of measurement up to 100,000 API units, without detector paralysis or excessive dead time.