APP-015-I






POWERTECH (USA) INC.

Dewey-Burdock Project
Application for NRC
Uranium Recovery License
Fall River and Custer Counties,
South Dakota
Technical Report

Appendices
Volume I
Appendix 2.2-A – 2.5-F

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Prepared for

U.S. Nuclear Regulatory Commission
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LIST OF APPENDICES - VOLUME I

APPENDIX 2.2-A

WELL LOCATION DATA

Table 1: Wells within 2 km of the Project Boundary

Hydro ID	Township	Range	Section	1/4 - 1/4 Location	Coordinates East[1]	Coordinates North[1]	Screened Location[2]	Well Use
1	7	1	9	SESE	1027696	429227	Chilson	Stock
2	7	1	16	SESE	1026724	423922	Chilson	Domestic
3	7	1	22	SWNW	1028593	421104	Chilson	Stock
4	7	1	15	SESE	1032516	423080	Unknown	Stock
5	7	1	14	NENW	1035181	427284	Fall River	Stock
6	7	1	14	NESE	1037218	425012	Unknown	Stock
7	7	1	23	NWNW	1033304	422417	Fall River	Domestic
8	7	1	23	SWSE	1036052	418515	Fall River	Domestic
9	7	1	23	NENE	1038003	421806	Fall River	Stock
12	7	1	4	SESE	1026978	434378	Chilson	Stock
13	7	1	3	NWNW	1028360	438470	Chilson	Domestic
14	7	1	2	NWSW	1033704	434723	Fall River	Stock
15	7	1	2	NENW	1035304	438317	Chilson	Stock
16	7	1	1	NESW	1041428	434446	Chilson	Domestic
17	7	1	12	SENW	1040223	431329	Fall River	Stock
18	7	1	9	SWSW	1022812	428960	Fall River	Domestic
37	7	2	18	NWSW	1044183	423947	Unknown	Stock
38	6	1	33	SWNW	1024328	442289	Fall River	Stock
40	6	1	30	SWNW	1013415	447182	Inyan Kara	Domestic
41	6	1	31	SWNE	1015385	442081	Unknown	Stock
42	7	1	5	SWNE	1021144	436481	Chilson	Domestic
43	6	1	34	SWSE	1031123	439436	Chilson	Domestic
49	6	1	32	NWNW	1018932	444022	Fall River	Stock
51	7	1	9	SENE	1027411	431487	Chilson	Stock
61	7	1	11	NWSE	1036832	429987	Chilson	Stock
96	41N	60W	22	SWSW	1011630	451853	Chilson	Domestic
102	6	1	18	SWNE	1016825	458312	Chilson	Domestic
106	6	1	18	NENE	1018099	459625	Unknown	Stock
107	6	1	18	SWNE	1017018	458158	Fall River	Domestic
108	6	1	18	SWNE	1016478	458698	Fall River	Domestic
109	6	1	17	NENW	1020801	459625	Chilson	Domestic
110	6	1	17	NENE	1023777	459643	Chilson	Stock
111	6	1	17	NWNE	1022074	459586	Fall River	Stock
112	6	1	16	SESE	1027864	455881	Fall River	Stock
113	7	2	6	NESW	1046437	434417	Unknown	Stock
114	7	2	7	SESW	1045410	428654	Unkpapa	Stock
115	6	1	18	SENE	1017697	457640	Fall River	Domestic
116	6	1	18	SENE	1017992	458111	Fall River	Stock
117	6	1	8	SWSE	1022177	460796	Unknown	Stock
138	6	1	18	NENE	1017537	459030	Fall River	Domestic
147	6	1	17	NESW	1020879	456566	Chilson	Monitor
220	6	1	19	SENE	1017872	452334	Unknown	Stock
270	6	1	19	NWSW	1014108	451942	Unknown	Stock
436	6	1	20	NWNE	1021450	454700	Fall River	Monitor
506	7	2	8	SWNW	1050129	430704	Unkpapa	Stock
510	7	1	12	SESE	1042933	428178	Chilson	Stock
609	6	1	29	SWNE	1021735	447808	Chilson	Monitor
610	6	1	29	SWNE	1021599	447969	Fall River	Monitor
611	6	1	20	NWNE	1021835	453954	Chilson	Monitor
612	6	1	20	NWNE	1021755	454128	Chilson	Monitor
613	6	1	20	NWNE	1022125	453775	Fall River	Monitor
614	6	1	20	NWNE	1022185	453769	Fuson	Monitor
615	6	1	20	NWNE	1022172	453708	Chilson	Monitor
616	6	1	20	SWNE	1022132	453134	Chilson	Monitor

Table 1: Wells within 2 km of the Project Boundary (Continued)

Hydro ID	Township	Range	Section	1/4 - 1/4 Location	Coordinates East[1]	Coordinates North[1]	Screened Location[2]	Well Use
617	6	1	20	NENW	1021026	453582	Chilson	Monitor
618	7	1	2	SENE	1038074	435906	Unknown	Stock
619	7	1	2	SENW	1034866	436729	Chilson	Stock
620	6	1	35	NWNW	1033951	443209	Chilson	Stock
622	6	1	20	NENE	1022776	454033	Chilson	Monitor
623	6	1	20	NENE	1022686	454311	Fall River	Monitor
628	6	1	20	SESE	1022496	449718	Fall River	Stock
631	6	1	23	SWSW	1034177	449309	Fall River	Stock
635	7	1	14	NENW	1004085	427131	Not a Well[3]	NA
637	7	1	11	NESE	1038075	430320	Unknown	Monitor
638	7	1	2	NENE	1038269	437976	Fall River	Monitor
639	7	2	7	SENW	1045704	430722	Unknown	Stock
640	7	1	12	SESE	1043010	427965	Unknown	Stock
642	7	1	12	SESE	1042926	428042	Unknown	Stock
645	7	1	16	NENE	1027681	427998	Unknown	Stock
650	7	1	1	SESE	1043781	433331	Chilson	Stock
656	6	1	31	SENW	1014230	442000	Unknown	Stock
657	6	1	20	NWNE	1021483	454729	Chilson	Monitor
662	7	1	11	SESW	1035381	428928	Unknown	Monitor
668	7	1	15	NWNE	1031029	427450	Inyan Kara	Stock
676	6	1	34	SESW	1030846	439891	Alluvial	Monitor
677	7	1	4	SWSW	1023527	434077	Alluvial	Monitor
678	7	1	9	SWNE	1026522	431925	Alluvial	Monitor
679	6	1	27	NWSE	1032294	446245	Alluvial	Monitor
680	7	1	11	NESW	1035078	429969	Chilson	Monitor
681	6	1	32	NENW	1020330	443725	Fall River	Monitor
682	7	1	11	SENW	1035139	431257	Chilson	Monitor
683	6	1	29	NESW	1020212	446104	Fall River	Monitor
684	7	1	11	NESW	1035191	429744	Chilson	Monitor
685	6	1	32	NWNE	1020690	443409	Fall River	Monitor
686	7	1	11	NESW	1034970	429749	Chilson	Monitor
687	6	1	32	NENW	1020081	443724	Fall River	Monitor
688	7	1	11	NESW	1035027	429974	Fall River	Monitor
689	6	1	32	NENW	1020316	443789	Chilson	Monitor
690	7	1	11	NESW	1035114	429970	Unkpapa	Monitor
691	6	1	32	NENW	1020364	443698	Fall River	Monitor
692	7	1	11	NESW	1035075	430014	Chilson	Monitor
693	6	1	32	NENW	1020327	443661	Unkpapa	Monitor
694	7	1	15	NWNW	1028717	426836	Fall River	Monitor
695	6	1	32	SESE	1022385	439312	Fall River	Monitor
696	7	1	15	NWNW	1028538	427141	Chilson	Monitor
697	6	1	32	SESE	1022350	439347	Chilson	Monitor
698	7	1	2	NESW	1035909	435651	Fall River	Monitor
703	7	1	1	SWSE	1041621	434334	Unkpapa	Domestic
704[4]	7	1	5	SWNE	1020966	436647	Chilson (Beginning 2/4/2009)	Domestic
704[4]	7	1	5	SWNE	1020966	436647	Unkpapa (Cemented to Chilson 1/28/2009)	Domestic

Table 1: Wells within 2 km of the Project Boundary (Continued)

Hydro ID	Township	Range	Section	1/4 - 1/4 Location	Coordinates East[1]	Coordinates North[1]	Screened Location[2]	Well Use
705	6	1	21	NENE	1028624	453314	Chilson	Monitor
706	6	1	21	NENE	1028589	453276	Fall River	Monitor
707	6	1	34	SWNE	1031935	441809	Alluvial	Monitor
708	7	1	3	SESW	1030254	434094	Alluvial	Monitor
709	7	1	15	SENW	1029286	426603	Alluvial	Monitor
3026	7	1	12	NENE	1043638	432833	Chilson	Monitor
4002	6	1	30	NWSW	1013414	446931	Inyan Kara	Domestic
7002	7	1	23	NWNW	1033333	421931	Chilson	Stock

Notes:
1 Coordinate system is NAD 27 South Dakota State Plane South.
2 Inyan Kara indicates that screened interval includes both Chilson and Fall River.
3 Hydro ID 635 is not a well. It is a pipe from Hydro ID 5.
4 Hydro ID 704 was originally completed in the Unkpapa aquifer. It was recompleted 1/28/2009 in the Chilson aquifer.

Table 2: Historical Wells Not Present

Hydro ID	Township (S)	Range (E)	Section	1/4 - 1/4 Location	Easting[1]	Northing[1]	Screened Location[2]
10	7	1	13	NENE	1011956	427239	Chilson
39	6	1	29	NENE	991314	448657	Unknown
48	6	1	19	SENW	983693	453037	Unknown
425	7	1	14	SENW	1002848	426208	Chilson
429	6	1	20	SENE	991556	452954	Chilson
431	6	1	20	SENE	991556	452954	Chilson
432	6	1	20	SENE	991556	452954	Chilson
433	6	1	20	SENE	991556	452954	Chilson
502	6	1	27	NWSE	1000389	446361	Alluvial
605[3]	7	1	10	SWSE	1000213	428484	NA
621	6	1	27	NWSE	1000329	446398	Alluvial
634	6	1	34	NESE	1000901	440168	Unknown
646	7	1	15	SWNE	999646	426409	Fall River
651	7	1	14	NWSE	1004408	424246	Chilson
658	7	1	15	SWNE	999633	426398	Chilson
659	7	1	10	SWNE	1000274	431049	Fall River
660	7	1	10	SWNE	1000221	431030	Chilson
661	7	1	12	NENW	1009376	431971	Chilson
663	7	1	10	SWSE	999058	428346	Chilson
664	7	1	10	SWSE	999033	428338	Fall River
669	7	1	15	NWNE	999404	427910	Chilson
670	7	1	15	NWNE	999464	427937	Fuson
671	7	1	15	NWNE	999415	427870	Fall River
672	7	1	15	NWNE	999031	427480	Fall River
673	7	1	15	NWNE	999027	427512	Fuson
674	7	1	15	NWNE	998954	427513	Chilson

Notes: [1] Coordinate system is NAD 27 South Dakota State Plane South.
[2] Inyan Kara indicates that screened interval includes both Chilson and Fall River.
[3] 605 is not a well but a pipeline from well 668.

Table 3: Historical Wells Plugged and Abandoned

Hydro ID	Township (S)	Range (E)	Section	1/4 - 1/4 Location	Easting[1]	Northing[1]	Screened Location[2]
606	7	1	11	SWSW	1033713	428609	Chilson
636	7	1	11	NESW	1034774	429982	Unknown
652	7	1	2	NWSE	1036360	434742	Inyan Kara
653	7	1	22	NWNE	1030679	422487	Unknown
654	6	1	34	NWNE	1032372	443410	Inyan Kara
655	6	1	34	NENE	1033454	443307	Inyan Kara
665	7	1	11	SWSW	1033153	428901	Fall River
666	7	1	11	SWSW	1033128	428870	Chilson

Notes: [1] Coordinate system is NAD 27 South Dakota State Plane South.
[2] Inyan Kara indicates that screened interval includes both Chilson and Fall River.

APPENDIX 2.2-B

Well Inventory

POWERTECH (USA) INC.

Table 1. Current Wells within 2 Kilometers of Project Area

	Legal Location				SD State Plane South NAD 27		NGVD29	Construction Summary									
Hydro ID	T.	R.	Sec.	Qtr. Qtr.	East (ft)	North (ft)	Surface Elevation(1) (ft)	Date Completed	Total Depth (ft below ground surface)	Depth to Top of Screen or Bottom of Casing (ft below ground surface)	Depth to Bottom of Screen or Bottom of Open Hole (ft below ground surface)	Casing Diameter (in) Casing Depth (ft below ground surface)	Flowing Artesian	Aquifer(2)	Use	Other Name	Source
ALLUVIAL																	
676	6S	1E	34	SESW	1030846	439891	3666 (6)	9/26/2007	18.50 (7)	2-inch PVC 0.010-slot 12.5	to 22.5	2-inch PVC 0 to 12.5 ft	no	Alluvial	Monitor	DB-GW676	C
677	7S	1E	4	SWSW	1023527	434077	3571 (6)	9/25/2007	14.15 (7)	2-inch PVC 0.010-slot 4	to 14	2-inch PVC 0 to 4 ft	no	Alluvial	Monitor	DB-GW677	C
678	7S	1E	9	SWNE	1026522	431925	3596 (6)	9/25/2007	14.42 (7)	2-inch PVC 0.010-slot 4	to 14	2-inch PVC 0 to 4 ft	no	Alluvial	Monitor	DB-GW678	C
679	6S	1E	27	NWSE	1032294	446245	3716 (6)	9/26/2007	39.03 (7)	2-inch PVC 0.010-slot 19	to 39	2-inch PVC 0 to 19 ft	no	Alluvial	Monitor	DB-GW679	C
707	6S	1E	34	SWNE	1031935	441809	3692 (6)	5/5/2011	40.18 (7)	2-inch PVC 0.010-slot 30	to 40	2-inch Sched 40 PVC 0 to 30 ft	no	Alluvial	Monitor	DB11-34-ALLUV-4	C
708	7S	1E	3	SESW	1030254	434094	3633 (6)	5/4/2011	21.94 (7)	2-inch PVC 0.010-slot 12	to 22	2-inch Sched 40 PVC 0 to 12 ft	no	Alluvial	Monitor	DB11-3-ALLUV-3	C
709	7S	1E	15	SENW	1029286	426603	3595 (6)	5/9/2011	38.25 (7)	2-inch PVC 0.010-slot 28	to 38	2-inch Sched 40 PVC 0 to 28 ft	no	Alluvial	Monitor	DB11-15-ALLUV-4	C
FALL RIVER																	
5	7S	1E	14	NENW	1035181	427284	3643	12/26/1975	2267, cement bridge plug 850, last measured 175	open hole 155	to 175	28# 8 5/8-inch 0 to 155 ft and 4-inch steel 0 to 155 ft	yes	Fall River	Stock	D-17, API 40 047 20065	A, B, D, E, downhole tool
7	7S	1E	23	NWNW	1033304	422417	3574	Late 1950s	200	UNK	UNK	6	no	Fall River	Domestic	D-27, R. Kenobbie	A, B
8	7S	1E	23	SWSE	1036052	418515	3542	1930s Repaired 6/10/1951	240	perforated 160 to 165	and 222 to 227	3-inch from 6 to 27 feet below surface over 2-inch black steel with 6-inch at surface	yes	Fall River	Domestic	D-29, Englebert	A, B, C
9	7S	1E	23	NENE	1038003	421806	3594	1960s	90	UNK	UNK	6-inch (Source A) 2-inch steel (Source E)	yes	Fall River	Stock	D-25	A, B, E
14	7S	1E	2	NWSW	1033700	434723	3672	UNK	470 (source A) 300 (source E)	UNK	UNK	4	historically yes, presently no	Fall River	Stock	D-5	A, B, E
17	7S	1E	12	SENW	1040223	431329	3789	1954	156	UNK	UNK	3	no	Fall River	Stock	D-13	A, B, C
18	7S	1E	9	SWSW	1022812	428960	3566	Late 1920s Early 1930s	527	UNK	UNK	4	yes	Fall River	Domestic	D-10, D. Andersen	A, B, E
38	6S	1E	33	SWNW	1024328	442289	3634	11/12/1949	550	open hole 494	to 550	4-inch 0 to 494 ft	yes	Fall River	Stock	B-4	A, B, C, F
49	6S	1E	32	NWNW	1018932	444022	3628	1970s	540 (historically 600)	screen 475	to 540	4	yes	Fall River	Stock		A, E
107	6S	1E	18	SWNE	1017018	458158	3708	UNK	90	UNK	UNK	5	historically yes, presently unknown	Fall River	Domestic		A
108	6S	1E	18	SWNE	1016478	458698	3705	UNK	90	UNK	UNK	UNK	UNK	Fall River	Domestic		A
111	6S	1E	17	NWNE	1022074	459586	3794	UNK	100	UNK	UNK	4	no	Fall River	Stock		A
112	6S	1E	16	SESE	1027864	455881	3831	UNK	120	UNK	UNK	4 1/2	no	Fall River	Stock		A
115	6S	1E	18	SENE	1017697	457640	3720	Original before 1977 Replaced 10/2/1984	360	4-inch PVC 1/64-slot 200 to 220	and 300 to 360	6-inch yellow mine 0 to 180 ft 4-inch PVC 160 to 200 ft 4-inch PVC 220 to 300 ft	yes	Fall River	Domestic		A, C
116	6S	1E	18	SENE	1017992	458111	3723	UNK	UNK	UNK	UNK	1	historically yes, presently unknown	Fall River	Stock		A
138	6S	1E	18	NENE	1017537	459030	3724	1977	100	UNK	UNK	UNK	historically yes, presently unknown	Fall River	Domestic		H
436	6S	1E	20	NWNE	1021450	454799	3737	8/18/1981	590	open hole 505	to 590	4-inch 10#/ft black iron 0 to 505 ft	no	Fall River	Monitor	D-3FR	C, J, L
610	6S	1E	29	SWNE	1021599	447969	3704	6/27/1978	680	1-inch 40# black iron torch slotted 630	to 672	1-inch 40#/ft black iron 0 to 630 ft	no	Fall River	Monitor	D-20FR, BPZ-21 FR	C, J, K
613	6S	1E	20	NWNE	1022125	453775	3738	8/14/1981	580, lithologic log to 600	open hole 504	to 580	4-inch 10#/ft black iron 0 to 504 ft	no	Fall River	Monitor	D-1FR	C, J, L
623	6S	1E	20	NENE	1022686	454311	3750	8/17/1981	580	open hole 503	to 580	4-inch 10#/ft black iron 0 to 503 ft	no	Fall River	Monitor	D-4FR	C, E, J, L
628	6S	1E	20	SESE	1022496	449718	3737	UNK	523	326	523	UNK	no	Fall River	Stock		GPS, downhole tool
631	6S	1E	23	SWSW	1034177	449309	3744	2/1998	80	5-inch steel 1/4 x 6 slots 30	to 70	5-inch 15.5#/ft steel 0 to 30 ft	no	Fall River	Stock		C
638	7S	1E	2	NENE	1038269	437976	3791	Before 1979	180	UNK	UNK	2	no	Fall River	Monitor	D-2	B
681	6S	1E	32	NENW	1020330	443725	3624	1/27/2008	600	3-inch PVC 0.020-slot 585	to 600	6-inch SDR21 0 to 585 ft 3-inch PVC 575 to 585 ft	yes	Fall River	Monitor	DB07-32-3C	C
683	6S	1E	29	NESW	1020212	446104	3669	3/4/2008	650	2-inch PVC 0.020-slot 635	to 650	4-inch SDR17 0 to 635 ft 2-inch PVC 625 to 635 ft	no	Fall River	Monitor	DB07-29-7	C

Table 1. Current Wells within 2 Kilometers of Project Area

Hydro ID	Legal Location: T.	R.	Sec.	Qtr. Qtr.	SD State Plane South NAD 27: East (ft)	North (ft)	NGVD29: Surface Elevation(1) (ft)	Construction Summary: Date Completed	Total Depth (ft below ground surface)	Depth to Top of Screen or Bottom of Casing (ft below ground surface)	Depth to Bottom of Screen or Bottom of Open Hole (ft below ground surface)	Casing Diameter (in) Casing Depth (ft below ground surface)	Flowing Artesian	Aquifer(2)	Use	Other Name	Source
685	6S	1E	32	NWNE	1020690	443409	3626	2/4/2008	595	2-inch PVC 0.020-slot 580	to 595	4-inch SDR17 0 to 580 ft 2-inch PVC 570 to 580 ft	yes	Fall River	Monitor	DB07-32-4C	C
687	6S	1E	32	NENW	1020081	443724	3626	2/6/2008	605	2-inch PVC 0.020-slot 590	to 605	4-inch SDR17 0 to 590 ft 2-inch PVC 580 to 590 ft	yes	Fall River	Monitor	DB07-32-5	C
688	7S	1E	11	NESW	1035027	429974	3687	4/1/2008	255	3-inch PVC 0.020-slot 245	to 255	6-inch SDR17 0 to 245 ft 3-inch PVC 235 to 245 ft	no	Fall River	Monitor	DB08-11-17	C
691	6S	1E	32	NENW	1020364	443698	3626	3/10/2008	505	3-inch PVC 0.020-slot 490	to 505	6-inch SDR17 0 to 490 ft 3-inch PVC 480 to 490 ft	yes	Fall River	Monitor	DB08-32-9C	C
694	7S	1E	15	NWNW	1028717	426836	3600	3/22/2008	392	3-inch PVC 0.020-slot 377	to 392	6-inch SDR17 0 to 377 ft 3-inch PVC 367 to 377 ft	yes	Fall River	Monitor	DB08-15-3	C
695	6S	1E	32	SESE	1022385	439312	3594	3/20/2008	508	3-inch PVC 0.020-slot 493	to 508	6-inch SDR17 0 to 493 ft 3-inch PVC 483 to 493 ft	yes	Fall River	Monitor	DB08-32-13	C
698	7S	1E	2	NESW	1035909	435651	3739	3/25/2008	205	3-inch PVC 0.020-slot 180	to 205	6-inch SDR21 0 to 180 ft 3-inch PVC 170 to 180 ft	no	Fall River	Monitor	DB08-2-1	C
706	6S	1E	21	NENE	1028589	453276	3823.29(3)	12/5/2009	328	3-inch PVC 0.020-slot 284	to 314	6-inch SDR17 0 to 284 ft 3-inch PVC 274 to 284 ft	no	Fall River	Monitor	DB09-21-2	C
FUSON																	
614	6S	1E	20	NWNE	1022185	453769	3739	9/14/1981	620	open hole 609	to 620	4-inch 10#/ft black iron 0 to 609 ft	no	Fuson	Monitor	D-1FU	C, J, L
CHILSON																	
1	7S	1E	9	SESE	1027696	429227	3624	1950s	600	UNK	UNK	4	yes	Chilson	Stock	D-11	A, B
2	7S	1E	16	SESE	1026724	423922	3554	1930s Recompleted 11/17/1981	640 original 650 recompleted	4-inch slotted 10#/ft black iron 566 to 608	and 629 to 650	4-inch 10#/ft black iron 0 to 566 ft and 608 to 629 ft	yes	Chilson	Domestic	D-20, W. Peterson	A, B, C
3	7S	1E	22	SWNW	1028593	421104	3541	11/28/1970	2400, cement bridge plug 1030	open hole 367	to 1030	4 1/2-inch steel 0 to 389 suspended inside 8 5/8-inch 20# steel 0 to 367 ft	yes	Chilson	Stock	D-24, API 40 047 20045	A, B, D
12	7S	1E	4	SESE	1026978	434378	3641	Late 1960s	730 (source A) 805 (source B)	UNK	UNK	4 1/2	yes	Chilson	Stock	D-7	A, B
13	7S	1E	3	NWNW	1028360	438470	3673	1950s Recompleted 10/22/1980	625	open hole 580	to 625	5 1/2-inch 14# steel 0 to 580 ft	yes	Chilson	Domestic	D-6, K. Spencer	A, B, C
15	7S	1E	2	NENW	1035304	438317	3713	UNK	280 (source A) 495 (source B)	UNK	UNK	4	no	Chilson	Stock	D-3	A, B, E
16	7S	1E	1	NESW	1041428	434446	3869	Mid 1970s	330	UNK	UNK	4 1/2	no	Chilson	Domestic	D-1, C. Daniel	A, B
42	7S	1E	5	SWNE	1021144	436481	3596	1949 Rehabilitated 11/15/2009	Original 600 Current 580	4-inch PVC 0.25-slot 280	to 300 with open hole below to 580	4-inch PVC 0 to 280 ft 8-inch steel 0 to 220 ft reduced to 1 1/4-inch at surface	yes	Chilson	Domestic	D-8, L. Putnam	A, B, C
43	6S	1E	34	SWSE	1031123	439436	3672	UNK	350	UNK	UNK	4	historically yes until Triangle Mine dewatered then no, presently unknown	Chilson	Domestic	B-5, Spencer Homestead	A, B
51	7S	1E	9	SENE	1027411	431487	3615	1890s	550	UNK	UNK	10	yes	Chilson	Stock	D-9	A, B
61	7S	1E	11	NWSE	1036832	429987	3740	UNK	525	UNK	UNK	5	no	Chilson	Stock	D-12	A, B
96	41N	60W	22	SWSW	1011630	451853	3664	UNK	560	UNK	UNK	5	yes	Chilson	Domestic	Dixon	A
102	6S	1E	18	SWNE	1016825	458312	3708	UNK	267	UNK	UNK	5	yes	Chilson	Domestic		A
109	6S	1E	17	NENW	1020801	459625	3835	UNK	220	UNK	UNK	UNK	no	Chilson	Domestic	Cook	A
110	6S	1E	17	NENE	1023777	459643	3817	UNK	240	UNK	UNK	6 1/2	no	Chilson	Stock		A
147	6S	1E	17	NESW	1020879	456566	3729	2/9/1982	750	open hole 650	to 750	4 1/2-inch 0.219-wall steel 0 to 650 ft	no	Chilson	Monitor	D-8LK, HAM-4	C, J
510	7S	1E	12	SESE	1042933	428178	3759	6/12/1988	540	5-inch PVC 0.064-slot 300 to 340	and 480 to 520	5-inch PVC 0 to 300 ft and 340 to 480 ft	yes	Chilson	Stock		C
609	6S	1E	29	SWNE	1021735	447808	3702	6/26/1978	1000	1-inch 40# black iron torch slotted 903	to 966	1-inch 40#/ft black iron 0 to 903 ft	no	Chilson	Monitor	D-20LK, BPZ-20	C, J, K
611	6S	1E	20	NWNE	1021835	453954	3731	10/17/1981	815	8 5/8-inch 0.030-slot galvanized steel 695 to 730	and 755 to 800	20-inch steel 0 to 25 ft 10 3/4-inch steel 0 to 695 ft 8 5/8-inch steel 730 to 755 ft	no	Chilson	Monitor	D-PW	C, J, L
612	6S	1E	20	NWNE	1021755	454128	3732	8/14/1981	800	open hole 692	to 800	4-inch 10#/ft black iron 0 to 692 ft	no	Chilson	Monitor	D-2LK	C, J, L
615	6S	1E	20	NWNE	1022172	453708	3738	8/13/1981	800	open hole 712	to 800	4-inch 10#/ft black iron 0 to 712 ft	no	Chilson	Monitor	D-1LK	C, J, L, downhole tool
616	6S	1E	20	SWNE	1022132	453134	3745	9/15/1981	835	open hole 735	to 835	4-inch 10#/ft black iron 0 to 735 ft	no	Chilson	Monitor	D-5LK	C, J, L

Table 1. Current Wells within 2 Kilometers of Project Area

	Legal Location				SD State Plane South NAD 27		NGVD29	Construction Summary									
Hydro ID	T.	R.	Sec.	Qtr. Qtr.	East (ft)	North (ft)	Surface Elevation(1) (ft)	Date Completed	Total Depth (ft below ground surface)	Depth to Top of Screen or Bottom of Casing (ft below ground surface)	Depth to Bottom of Screen or Bottom of Open Hole (ft below ground surface)	Casing Diameter (in) Casing Depth (ft below ground surface)	Flowing Artesian	Aquifer(2)	Use	Other Name	Source
617	6S	1E	20	NWNE	1021026	453582	3723	9/15/1981	810	open hole 715	to 810	4-inch 10#/ft black iron 0 to 715 ft	no	Chilson	Monitor	D-6LK	C, J, L
619	7S	1E	2	SENW	1034866	436729	3701	UNK	286	231	286	4	no	Chilson	Stock	D-4, Daniel West, MET	B, downhole tool
620	6S	1E	35	NWNW	1033951	443209	3731	UNK	UNK	UNK	UNK	UNK	no	Chilson	Stock		GPS
622	6S	1E	20	NENE	1022776	454033	3747	8/17/1981	780	open hole 714	to 780	4-inch 10#/ft black iron 0 to 714 ft	no	Chilson	Monitor	D-4LK	C, E, J, L
650	7S	1E	1	SESE	1043781	433331	3820	UNK	196	146	196	4	no	Chilson	Stock		GPS, downhole tool
657	6S	1E	20	NWNE	1021483	454729	3740	8/18/1981	800	open hole 715	to 800	4-inch 10#/ft black iron 0 to 715 ft	no	Chilson	Monitor	D-3LK	C, J, L
680	7S	1E	11	NESW	1035078	429969	3688	12/19/2007	436	4.5-inch PVC 0.020-slot 426	to 436	6-inch SDR21 0 to 426 ft 4.5-inch PVC 406 to 426 ft	no	Chilson	Monitor	DB07-11-11C	C
682	7S	1E	11	SENW	1035139	431257	3720	2/21/2008	460	2-inch PVC 0.020-slot 450	to 460	4-inch SDR17 0 to 450 ft 2-inch PVC 440 to 450 ft	no	Chilson	Monitor	DB07-11-2	C
684	7S	1E	11	NESW	1035191	429744	3691	2/13/2008	423	2-inch PVC 0.020-slot 413	to 423	4-inch SDR17 0 to 413 ft 2-inch PVC 403 to 413 ft	no	Chilson	Monitor	DB07-11-14C	C
686	7S	1E	11	NESW	1034970	429749	3694	2/24/2008	428	2-inch PVC 0.020-slot 418	to 428	4-inch SDR17 0 to 418 ft 2-inch PVC 408 to 418	no	Chilson	Monitor	DB07-11-15	C
689	6S	1E	32	NENW	1020316	443789	3626	3/11/2008	730	3-inch PVC 0.020-slot 715	to 730	6-inch SDR17 0 to 715 ft 3-inch PVC 705 to 715 ft	yes	Chilson	Monitor	DB08-32-10	C
692	7S	1E	11	NESW	1035075	430014	3701	4/16/2008	335	3-inch PVC 0.020-slot 325	to 335	6-inch SDR17 0 to 325 ft 3-inch PVC 315 to 325 ft	no	Chilson	Monitor	DB08-11-19	C
696	7S	1E	15	NWNW	1028538	427141	3602	3/21/2008	587	3-inch PVC 0.020-slot 572	to 587	6-inch SDR17 0 to 572 ft 3-inch PVC 562 to 572 ft	yes	Chilson	Monitor	DB08-15-2	C
697	6S	1E	32	SESE	1022350	439347	3594	3/18/2008	682	3-inch PVC 0.020-slot 667	to 682	6-inch SDR17 0 to 667 ft 3-inch PVC 657 to 667 ft	yes	Chilson	Monitor	DB08-32-12	C
704(4)	7S	1E	5	SWNE	1020966	436647	3599	Original 4/29/2008 Perforated 2/4/2009	UNK	UNK	UNK	UNK	UNK	Chilson (Beginning 2/4/2009)	Domestic	L. Putnam 704 Unkpapa	O
705	6S	1E	21	NENE	1028624	453314	3825.53(3)	12/5/2009	Borehole TD 600 Cemented to 460	3-inch PVC 0.020-slot 428	to 458	6-inch SDR17 0 to 428 ft 3-inch PVC 418 to 428 ft	no	Chilson	Monitor	DB09-21-1	C
3026	7S	1E	12	NENE	1043638	432833	3822	3/26/2008	196	3-inch PVC 0.020-slot 166	to 196	6-inch SDR21 0 to 166 ft 3-inch PVC 156 to 166 ft	no	Chilson	Monitor	DB08-1-6	C
7002	7S	1E	23	NWNW	1033333	421931	3571	1930s	500	UNK	UNK	5 1/2	yes	Chilson	Stock	D-26	A, B
INYAN KARA																	
40(5)	6S	1E	30	SWNW	1013415	447182	3635	About 1969	660 (680 for BY-1)	UNK	UNK	6	yes	Inyan Kara	Domestic	40S, 40U possibly BY-1	A, G C for BY-1
668	7S	1E	15	NWNE	1031029	427450	3622	1/31/1977	574	10-inch stainless steel 280 to 335 (300 to 350 source E)	and 8-inch stainless steel 480 to 555 (495 to 550 source E)	10-inch steel 0 to 280 ft (0 to 300 ft source E) and 335 to 480 ft (350 to 495 ft source E)	yes	Inyan Kara	Stock	Burdock Well	C, E, K, N
4002	6S	1E	30	NWSW	1013414	446931	3621	1940s	700	UNK	UNK	6	yes	Inyan Kara	Domestic	40L	A, G
UNKPAPA																	
114	7S	2E	7	SESW	1045410	428654	3764	UNK	365	UNK	UNK	UNK	no	Unkpapa	Stock	E-2, Bennett Canyon Well	A, B, I
506	7S	2E	8	SWNW	1050129	430704	3936	UNK	470	UNK	UNK	UNK	no	Unkpapa	Stock	E-3	B
690	7S	1E	11	NESW	1035114	429970	3700	4/15/2008	631	3-inch PVC 0.020-slot 621	to 631	6-inch 18# 0 to 621 ft 3-inch PVC 611 to 621 ft	yes	Unkpapa	Monitor	DB08-11-18	C
693	6S	1E	32	NENW	1020327	443661	3626	3/8/2008	930	3-inch PVC 0.020-slot 910	to 930	6-inch 18# 0 to 910 ft 3-inch PVC 890 to 910 ft	yes	Unkpapa	Monitor	DB08-32-11	C
703	7S	1E	1	SWSE	1041621	434334	3877	4/18/2008	525	3-inch PVC 0.020-slot 475	to 525	6-inch 18# 0 to 475 ft 3-inch PVC 465 to 475 ft	no	Unkpapa	Domestic	C. Daniel DB08-1-7	C
704(4)	7S	1E	5	SWNE	1020966	436647	3599	4/29/2008	955	3-inch PVC 0.020-slot 915	to 955	6-inch 18# 0 to 915 ft 3-inch PVC 905 to 915 ft	yes	Unkpapa (Cemented to Chilson 1/28/2009)	Domestic	L. Putnam DB08-5-1	C
UNKNOWN																	
4	7S	1E	15	SESE	1032516	423080	3580	3/5/1965	2264, cement bridge plug 1645	open hole 971	to 1645	24# 8 5/8-inch 0 to 971 ft reduced to 3-inch at surface	yes	Unknown	Stock	D-19, API 40 047 05093	A, B, D
6	7S	1E	14	NESE	1037218	425012	3671	Late 1950s	280 original 200 last measured	open hole 135	to 200	12-inch steel 0 to 135 ft	no	Unknown	Stock		A, E

Table 1. Current Wells within 2 Kilometers of Project Area

Hydro ID	Legal Location				SD State Plane South NAD 27		NGVD29	Construction Summary						Flowing Artesian	Aquifer(2)	Use	Other Name	Source
	T.	R.	Sec.	Qtr. Qtr.	East (ft)	North (ft)	Surface Elevation(1) (ft)	Date Completed	Total Depth (ft below ground surface)	Depth to Top of Screen or Bottom of Casing (ft below ground surface)	Depth to Bottom of Screen or Bottom of Open Hole (ft below ground surface)	Casing Diameter (in) Casing Depth (ft below ground surface)						
37	7S	2E	18	NWSW	1044183	423947	3689	UNK	145	open hole 93	to 145	5 1/2-inch 0 to 93 ft		no	Unknown	Stock		A, E, downhole tool
41	6S	1E	31	SWNE	1015385	442081	3611	UNK	UNK	UNK	UNK	6		yes	Unknown	Stock	B-3	A, B, G
106	6S	1E	18	NENE	1018099	459625	3724	UNK	196	open hole 160	to 196	7-inch steel 0 to 160 ft		yes	Unknown	Stock		A, E, downhole tool
113	7S	2E	6	NESW	1046437	434417	3844	UNK	40	UNK	UNK	UNK		no	Unknown	Stock	E-1, Bennett #2 Well	A, B, I
117	6S	1E	8	SWSE	1022177	460796	3923	UNK	UNK	UNK	UNK	6		No	Unknown	Stock		A
220	6S	1E	19	SENE	1017872	452334	3680	10/16/1984	900	historically 4-inch slotted PVC 780 to 800 and 840 to 880	presently 6-inch PVC screen 463 to 523, caved below	historically 6" yellow mine 0-520 ft and 4" PVC 500-780, 800-840 & 880-900 ft, presently 6" PVC 0-463 ft		yes	Unknown	Stock		C, E
270	6S	1E	19	NWSW	1014108	451942	3659	UNK	UNK	UNK	UNK	2-inch steel		yes	Unknown	Stock		GPS, E
618	7S	1E	2	SENE	1038074	435906	3759	UNK	133	62	133	5		no	Unknown	Stock		GPS, downhole tool
637	7S	1E	11	NESE	1038075	430320	3743	Fall 1976	UNK	UNK	UNK	2		no	Unknown	Monitor	BPZ-5	K, M
639	7S	2E	7	SENW	1045704	430722	3771	UNK	UNK	UNK	UNK	UNK		no	Unknown	Stock		GPS
640	7S	1E	12	SESE	1043010	427965	3754	UNK	UNK	UNK	UNK	1		no	Unknown	Stock		GPS
642	7S	1E	12	SESE	1042926	428042	3757	UNK	33	open hole 12	to 33	5-inch steel 0 to 12		no	Unknown	Stock		GPS, E, downhole tool
645	7S	1E	16	NENE	1027681	427998	3609	UNK	UNK	UNK	UNK	UNK		no	Unknown	Stock		GPS
656	6S	1E	31	SENW	1014230	442000	3622	UNK	UNK	UNK	UNK	UNK		yes	Unknown	Stock		GPS
662	7S	1E	11	SESW	1035381	428928	3679	7/26/1978	880	5 1/2-inch 14# torch slotted 666	to 780	5 1/2-inch 14# steel 0 to 666 ft		yes	Unknown	Monitor	Sundance Well	C, K, N

Notes:
(1) Surface elevations are based on a digital elevation model (DEM), except where noted. Accuracy is plus or minus 15 feet.
(2) Inyan Kara indicates screened interval is across Fall River and Chilson.
(3) Surveyed by Andersen Engineers, March 2011
(4) 704 was originally completed in the Unkpapa aquifer. It was recompleted 1/28/2009 in the Chilson aquifer.
(5) Hydro ID 40 possibly replaced by BY-1 (depth 680 ft and casing diameter 5.5 inches) on 3/4/1982
(6) Surveyed top of casing minus measured stick-up
(7) Measured depth from top of casing minus measured stick-up
UNK = Unknown

Sources:
A. Water Wells in Edgemont Project Area, Silver King Mines, May 1977, in letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979
B. Tennessee Valley Authority Draft Environmental Statement, 1979, Table 2.5.2-1
C. South Dakota Water Well Records - Notice of Well Construction Records, Artesian Well Repair Records, and Well Drillers Reports
D. South Dakota Oil and Gas Records
E. Dewey Burdock Groundwater Well Report for 2010 and 2011 Field Work Completed, M. Beshore, Powertech (USA) Inc., October 4, 2011
F. Responses to Nuclear Regulatory Commission Comments (Revision 1), C. Hocking , RESPEC, to M. Hollenbeck, Powertech (USA) Inc., July 22, 2010
G. Letter from SKM to TVA, Domestic and Livestock Wells Monitored During Dewey Pump Test, April 12, 1982
H. Additional Water Wells in Edgemont Project Area, Silver King Mines, Inc., Interoffice Correspondence, Andersen to Caywood, August 3, 1979
I. Forest Service Wells and Springs, in letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979
J. Hydrogeologic Investigations at Proposed Uranium Mine Near Dewey, South Dakota, Tennessee Valley Authority, WR28-2-520-128, J. Mark Bogss, October 1983
K. Coordinates, Elevations and Water Levels for Burdock Piezometers, in letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979
L. Baseline Water Quality and Water Level/Flow Rates, in letter from Keith Andersen, Silver King Mines, Inc., to Steve Stampfli, Office of Surface Mining, South Dakota Department of Water and Natural Resources, March 3, 1982
M. Burdock Mine Area Hydrology Status Report, Silver King Mines, Inc. Interoffice Correspondence from Keith Andersen to R.M. Caywood, December 18, 1978, included in letter from Keith Andersen to John Hatch, South Dakota Water Rights Commisssion, January 12, 1979
N. Analysis of Aquifer Tests conducted at the Proposed Burdock Uranium Mine Site, Burdock, South Dakota, Tennessee Valley Authority, WR28-1-520-109, J.M. Boggs and A.M. Jenkins, May 1980
O. Interoffice communication, Len Eakin, Powertech (USA) Inc., to Mike Beshore, Powertech (USA) Inc., May 9, 2011

Table 2. Historical Wells Noted in Data Sources within 2 Kilometers but No Longer Present at Surface

Hydro ID	Legal Location				SD State Plane South NAD 27		NGVD29	Construction Summary					Flowing Artesian	Former Aquifer	Previous Use	Other Name	Source
	T.	R.	Sec.	Qtr. Qtr.	East (ft)	North (ft)	Surface Elevation(1) (ft)	Date Completed	Total Depth (ft)	Depth to Top Screen (ft)	Depth to Bottom Screen (ft)	Casing Diameter (in)					
ALLUVIAL																	
502	6S	1E	27	NWSE	1000389	446361	3716	UNK	46	UNK	UNK	UNK	no	Alluvial	Unknown	B-2	B
621	6S	1E	27	NWSE	1000329	446398	3717	UNK	50	UNK	UNK	UNK	no	Alluvial	Unknown	B-1	B
FALL RIVER																	
646	7S	1E	15	SWNE	999646	426409	3611	August 1977	293	251	293	1	yes	Fall River	Monitor	B-9FR	C
659	7S	1E	10	SWNE	1000274	431049	3651	Fall 1976	UNK	UNK	UNK	UNK	yes	Fall River	Monitor	B-6FR	C
664	7S	1E	10	SWSE	999033	428338	3621	11/7/1978	360	315	360	4.5	yes	Fall River	Monitor	B-11FR	C
671	7S	1E	15	NWNE	999415	427870	3623	10/18/1978	350	300	350	4.5	yes	Fall River	Monitor	B-10FR	C
672	7S	1E	15	NWNE	999031	427480	3622	Fall 1976	376	334	376	4	yes	Fall River	Monitor	B-1FR	K, N
FUSON																	
670	7S	1E	15	NWNE	999464	427937	3623	10/19/1978	395	377	395	4.5	yes	Fuson	Monitor	B-10FU	C, K, N
673	7S	1E	15	NWNE	999027	427512	3622	11/6/1978	420	400	420	4.5	no	Fuson	Monitor	B-1FU, B-2FU	C, K, N
CHILSON																	
10	7S	1E	13	NENE	1011956	427239	3736	1970s	200	UNK	UNK	UNK	no	Chilson	Stock	D-15	A, B
425	7S	1E	14	SENW	1002848	426208	3630	UNK	237	UNK	UNK	UNK	UNK	Chilson	Unknown		USGS
429	6S	1E	20	SENE	991556	452954	3783	NA	800	NA	NA	NA	NA	Chilson	NA		
431	6S	1E	20	SENE	991556	452954	3783	NA	815	NA	NA	NA	NA	Chilson	NA		
432	6S	1E	20	SENE	991556	452954	3783	NA	800	NA	NA	NA	NA	Chilson	NA		
433	6S	1E	20	SENE	991556	452954	3783	NA	835	NA	NA	NA	NA	Chilson	NA		
651	7S	1E	14	NWSE	1004408	424246	3600	NA	NA	NA	NA	NA	NA	Chilson	NA		E
658	7S	1E	15	SWNE	999633	426398	3611	August 1977	545	503	545	1	yes	Chilson	Monitor	B-9LAK	K, M, N
660	7S	1E	10	SWNE	1000221	431030	3652	Fall 1976	UNK	UNK	UNK	UNK	yes	Chilson	Monitor	B-6	O
661	7S	1E	12	NENW	1009376	431971	3694	Fall 1976	UNK	UNK	UNK	UNK	no	Chilson	Monitor	B-8	O
663	7S	1E	10	SWSE	999058	428346	3621	11/7/1978	550	504	550	4.5	yes	Chilson	Monitor	B-11LAK	C, K, N
669	7S	1E	15	NWNE	999404	427910	3622	10/25/1978	550	510	550	4.5	yes	Chilson	Monitor	B-10LAK	C, K, N
674	7S	1E	15	NWNE	998954	427513	3621	11/6/1978	570	525	570	4.5	yes	Chilson	Monitor	B-2LAK	C, K, N
UNKNOWN																	
39	6S	1E	29	NENE	991314	448657	3733	UNK	700	UNK	UNK	5	no	Unknown	Stock		A
48	6S	1E	19	SENW	983693	453037	3663	Late 1960s	725	UNK	UNK	2 1/2	yes	Unknown	Stock		A
634	6S	1E	34	NESE	1000901	440168	3689	UNK	UNK	UNK	UNK	UNK	no	Unknown	Unknown		GPS
OTHER																	
605(2)	7S	1E	10	SWSE	1000213	428484	3642	NA	NA	NA	NA	NA	NA	Not a Well(2)	NA		E

Notes: (1) Surface elevations are based on a digital elevation model (DEM), except where noted. Accuracy is plus or minus 15 feet.
(2) Hydro ID 605 is not a well. It is a pipe from Hydro ID 668.
UNK = Unknown
NA = Not applicable, not a well

Table 3. Plugged and Abandoned Wells within 2 Kilometers of the Project Area

Hydro ID	Legal Location				SD State Plane South NAD 27		NGVD29	Construction Summary					Flowing Artesian	Former Aquifer (2)	Previous Use	Other Name	Source
	T.	R.	Sec.	Qtr. Qtr.	East (ft)	North (ft)	Surface Elevation (1) (ft)	Date Completed	Total Depth (ft)	Depth to Top Screen (ft)	Depth to Bottom Screen (ft)	Casing Diameter (in)					
FALL RIVER																	
665	7S	1E	11	SWSW	1033153	428901	3672	August 1977	252	210	252	1	no	Fall River	Monitor	B-7FR	K, M, N
CHILSON																	
606	7S	1E	11	SWSW	1033713	428609	3668	UNK	UNK	UNK	UNK	UNK		Chilson	Unknown	D-16	B
666	7S	1E	11	SWSW	1033128	428870	3669	August 1977	441	399	441	1	no	Chilson	Monitor	B-7LAK	C
INYAN KARA																	
652	7S	1E	2	NWSE	1036360	434742	3748	UNK	UNK	UNK	UNK	UNK		Inyan Kara	Unknown		C
654	6S	1E	34	NWNE	1032372	443410	3687	UNK	UNK	UNK	UNK	8		Inyan Kara	Unknown		C
655	6S	1E	34	NENE	1033454	443307	3719	UNK	UNK	UNK	UNK	12		Inyan Kara	Unknown		GPS
UNKNOWN																	
636	7S	1E	11	NESW	1034774	429982	3698	UNK	UNK	UNK	UNK	7		Unknown	Unknown		GPS
653	7S	1E	22	NWNE	1030679	422487	3569	UNK	UNK	UNK	UNK	UNK		Unknown	Unknown		GPS

Notes: (1) Land elevations based on Digital Elevation Model (DEM).
(2) Inyan Kara indicates that screened interval includes both Chilson and Fall River.
UNK = Unknown

SOURCE A

WATER WELLS IN EDGEMONT PROJECT AREA

(Silver King Mines, Inc., May 1977, in a letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979)

WATER WELLS IN EDGEMONT PROJECT AREA

Well No.	Location			
1	SE/4 SE/4	Sec.	9	T7S,R1E
2	SE/4 SE/4	Sec.	16	T7S,R1E
3	SW/4 NW/4	Sec.	22	T7S,R1E
4	SE/4 SE/4	Sec.	15	T7S,R1E
5	NE/4 NW/4	Sec.	14	T7S,R1E
6	NE/4 SE/4	Sec.	14	T7S,R1E
7	NW/4 NW/4	Sec.	23	T7S,R1E
8	NW/4 SE/4	Sec.	23	T7S,R1E
9	NE/4 NE/4	Sec.	23	T7S,R1E
10	NE/4 NE/4	Sec.	13	T7S,R1E
11	NW/4 SW/4	Sec.	24	T7S,R1E
12	SE/4 SE/4	Sec.	4	T7S,R1E
13	NW/4 NW/4	Sec.	3	T7S,R1E
14	NW/4 SW/4	Sec.	2	T7S,R1E
15	NW/4 NW/4	Sec.	2	T7S,R1E
16	NW/4 SE/4	Sec.	1	T7S,R1E
17	SE/4 NW/4	Sec.	12	T7S,R1E
18	NW/4 SW/4	Sec.	9	T7S,R1E
19	NW/4 NW/4	Sec.	18	T7S,R1E
20	NW/4 SW/4	Sec.	17	T7S,R1E
21	SW/4 NW/4	Sec.	19	T7S,R1E
22	NE/4 SW/4	Sec.	27	T40N, R60W
23	NW/4 NW/4	Sec.	29	T7S, R1E
24	NE/4 NW/4	Sec.	28	T7S,R1E
25	SE/4 NW/4	Sec.	27	T7S,R1E
26	SW/4 NE/4	Sec.	35	T7S,R1E
27	SE/4 SE/4	Sec.	33	T7S,R1E
28	NE/4 SW/4	Sec.	22	T8S,R2E
29	NE/4 NW/4	Sec.	16	T8S,R2E
30	SE/4 SE/4	Sec.	31	T7S,R2E
31	SW/4 NW/4	Sec.	31	T7S,R2E

Continued - Page 2

Well No.	Location			
32	SW/4 SW/4	Sec. 30	T7S,R2E
33	NW/4 SE/4	Sec. 25	T7S,R1E
34	NW/4 NW/4	Sec. 30	T7S,R2E
35	SW/4 NE/4	Sec. 19	T7S,R2E
36	NW/4 NE/4	Sec. 30	T7S,R2E
37	NW/4 SW/4	Sec. 18	T7S,R2E
38	SW/4 NW/4	Sec. 33	T6S,R1E
39	NE/4 NE/4	Sec. 29	T6S,R1E
40	NW/4 SW/4	Sec. 30	T6S,R1E
41	SW/4 NW/4	Sec. 31	T6S,R1E
42	SW/4 NE/4	Sec. 5	T7S,R1E
43	SE/4 SW/4	Sec. 34	T6S,R1E
44	NW/4 SE/4	Sec. 31	T7S,R2E
45	NW/4 NW/4	Sec. 5	T8S,R2E
46	SW/4 NE/4	Sec. 31	T7S,R2E
47	SW/4 SW/4	Sec. 32	T7S,R2E
48	SE/4 NW/4	Sec. 19	T6S,R1E
49	SW/4 SW/4	Sec. 29	T6S,R1E
50	SW/4 SW/4	Sec. 28	T41N,R60W
51	SW/4 NE/4	Sec. 9	T7S,R1E
52	NE/ SE/4	Sec. 30	T7S,R2E
53	SW/4 NE/4	Sec. 30	T7S,R2E
54	NE/4 SE/4	Sec. 25	T7S,R1E
55	NW/4 NE/4	Sec. 36	T7S,R1E
56	SE/4 SE/4	Sec. 32	T7S,R2E
57	NE/4 SE/4	Sec. 5	T8S,R2E
58	NW/4 NE/4	Sec. 31	T7S,R1E
59	NE/4 NW/4	Sec. 5	T8S,R2E
60	NE/4 SW/4	Sec. 33	T7S,R2E
61	NW/4 SE/4	Sec. 11	T7S,R1E
62	SW/4 SW/4	Sec. 25	T7S,R1E
63	SW/4 NW/4	Sec. 36	T7S,R1E

Continued - Page 3

Well No.	Location			
64	SW/4 NE/4	Sec. 9	T8S,R2E
65	NW/4 NE/4	Sec. 9	T8S,R2E
66	NE/4 NW/4	Sec. 8	T8S,R2E
67	SE/4 NW/4	Sec. 8	T8S,R2E
68	NE/4 NE/4	Sec. 8	T8S,R2E
69	SW/4 SE/4	Sec. 25	T7S,R1E
70	SE/4 SW/4	Sec. 25	T7S,R1E
71	NW/4 SE/4	Sec. 6	T8S,R2E
72	NW/4 SE/4	Sec. 6	T8S,R2E
73	NE/4 SW/4	Sec. 6	T8S,R2E
74	NE/4 SW/4	Sec. 6	T8S,R2E
75	SW/4 SW/4	Sec. 17	T8S,R2E
76	SE/4 NW/4	Sec. 17	T8S,R2E
77	NW/4 NE/4	Sec. 17	T8S,R2E
78	NE/4 SE/4	Sec. 20	T8S,R2E
79	NE/4 SE/4	Sec. 27	T8S,R2E
80	SW/4 NW/4	Sec. 35	T8S,R2E
81	SW/4 NW/4	Sec. 14	T8S,R2E
82	SW/4 SW/4	Sec. 10	T8S,R2E
83	NE/4 SW/4	Sec. 14	T8S,R2E
84	SW/4 NW/4	Sec. 10	T8S,R2E
85	NE/4 SE/4	Sec. 28	T8S,R2E
86	NW/4 SW/4	Sec. 6	T8S,R2E
87	NW/4 NE/4	Sec. 1	T8S,R1E
88	NE/4 SE/4	Sec. 35	T7S,R1E
88	SE/4 SE/4	Sec. 35	T7S,R1E
89	NW/4 NE/4	Sec. 11	T8S,R1E
90	SE/4 NW/4	Sec. 23	T8S,R2E
91	SE/4 NW/4	Sec. 12	T8S,R2E
92	SE/4 SW/4	Sec. 23	T8S,R2E
93	SE/4 NE/4	Sec. 2	T8S,R2E
94	SW/4 SW/4	Sec. 34	T7S,R2E

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Well No.	Location			
95	SE/4	Sec. 25	T40N,R61W
96	SW/4 SW/4	Sec. 22	T41N,R60W
97	Not Located		
98	SW/4 NW/4	Sec. 17	T41N,R60W
99	NE/4 NE/4	Sec. 17	T41N,R60W
100	NW/4 SE/4	Sec. 7	T41N,R60W
101	SW/4 NE/4	Sec. 1	T41N,R61W
102	SW/4 NE/4	Sec. 18	T6S,R1E
103	NW/4 NW/4	Sec. 10	T41N,R60W
104	NW/4 SW/4	Sec. 10	T41N,R60W
105	SE/4 NW/4	Sec. 9	T41N,R60W
106	NE/4 NE/4	Sec. 18	T6S,R1E
107	SE/4 NE/4	Sec. 18	T6S,R1E
108	SE/4 NE/4	Sec. 18	T6S,R1E
109	NE/4 NW/4	Sec. 17	T6S,R1E
110	NE/4 NE/4	Sec. 17	T6S,R1E
111	NW/4 NE/4	Sec. 17	T6S,R1E
112	SE/4	Sec. 16	T6S,R1E
113	NE/4 SW/4	Sec. 6	T7S,R2E
114	NE/4 SW/4	Sec. 7	T7S,R2E
115	SE/4 NE/4	Sec. 18	T6S,R1E
116	SE/4 NE/4	Sec. 18	T6S,R1E
117	SW/4 SE/4	Sec. 8	T6S,R1E
118	NE/4 SE/4	Sec. 7	T6S,R1E
119	NW/4 NW/4	Sec. 8	T6S,R1E
120	NW/4 SW/4	Sec. 5	T6S,R1E
121	SW/4 SW/4	Sec. 31	T5S,R1E
122	NE/4 NW/4	Sec. 30	T5S,R1E
123	NE/4 NW/4	Sec. 21	T42N,R60W
124	NW/4 SW/4	Sec. 18	T5S,R1E
125	SW/4 SW/4	Sec. 6	T6S,R1E

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Well No.	Location			
126	SE/4 SW/4	Sec.	16	T41N,R60W
127	SW/4 NE/4	Sec.	7	T41N,R60W
128	NW/4 SE/4	Sec.	1	T41N,R61W
129	Sec. 7	Sec.	5	T41N,R60W
130				
131	NW/4 SE/4	Sec.	4	T8S,R2E
132	NW/4 SE/4	Sec.	4	T8S,R2E
133				
134	SE/4 NW/4	Sec.	29	T40N,R60W

Water Wells in Edgemont Project Area

Map #	Owner	Use	Depth	Probable Aquifer	Remarks
1	Peterson & Son Inc.	Stock	600	K 1	Flowing 1.1 gpm, stopped during test. Casing was cut off closer to ground & flow recovered to 1.3 gpm, 6 wks after test.
2.	Peterson & Son Inc.	Domestic	640	K 1	Flowing est. 15 gpm.
3	Peterson & Son Inc.	Stock	Oil test		Flowing 3 gpm.
4.	Peterson & Son Inc.	Stock	Oil Test		Couldn't measure- broken out around casing. Also used by Glen Peterson for garden.
5.	Peterson & Son Inc.	Stock	Oil Test		Plugged at 850", possible Sundance flow. Flowing 6.6 gpm, slowed to 5 gpm during test
6.	Glen Peterson	Stock	280'	K f	SWL 11'2", Siphon Arrangement into tank.
7.	Glen Peterson " "	Domestic	500' 200"	K 1 K f	Flowing 4.25 gpm. Slowed to 3.6 during test SWL 12' 8"
8.	Leslie Coates " "	Domestic	500 240	K 1 K f	Flowing 4.2 gpm. Flow est. 1 gpm. Pumped to house.
9.	Leslie Coates	Stock	90 ?	K f	Flowing 2.5 gpm.
10	Leslie Coates	Stock	200	K 1	SWL 78' New well.
11	Leslie Coates	Stock	Oil test		Flowing 5 gpm.
12	Leslie Coates	Stock	730'	K 1	Flowing 0.6 gpm, slowed to < 0.1 gpm during test. Recovered to 0.3 gpm after 6 weeks.
13	Miles Spencer	Domestic	500	K 1	Flowing 2.5 gpm., slowed to 1.2 gpm during test, Recovered to 2.0 gpm after 6 weeks.
14.	Earl Darrow	Stock	470	K 1	Barely flowing. Stopped during test. SWL recovered to 1.0 ft.
15	Earl Darrow	Stock	280	K 1	Pump jack, couldn't measure accurately SWL approximately 24'
16	Earl Darrow	Stock	330	K 1	New well, SWL 157' 7"
17	H. P. Heck	Stock	156	K f	Windmill, couldn't measure
18	Dick Andersen	Domestic	527	K f	Flowing 7.5 gpm.

Water Wells in Edgemont Project Area

Map #	Owner	Use	Depth	Probable Aquifer	Remarks
19	Dick Andersen	Stock	740	K f	Pump jack, couldn't measure.
20	Edwin Andersen	Domestic	530	K f	Flowing 4.5 gpm.
21.	Tubbs Ranch	Stock	910	K f	Flowing 14 gpm.
22.	Coates, Andersen	Stock	800	K f	Pump jack, reported SWL 30'
23	Tubbs Ranch	Stock	600	K f	Flowing 0.8 gpm.
24	Tubbs Ranch	Domestic			Siphon arrangement, water level 23'
25	Tubbs Ranch	Stock			Windmill, couldn't measure, reported to barely flow.
26	Tubbs Ranch	Stock	350	K f	Windmill, couldn't measure, reported to barely flow.
27	Tubbs & Schultz	Stock	900	K 1	Submersible pump to pipeline. SWL 15'
28	Tubbs Ranch	Stock	300	K f	Will flow 20 gpm. H2S
29	B. Childers	Stock			Wild well, flowing est. 35 gpm. H2S around casing
30	Harold Dodson	Domestic	120	K f	Barely flows, pumped to house.
	" "	Stock	120	K f	Flows 0.75 gpm
31	F. A. Heck	Domestic	104	K f	Flows 1.3 gpm.
32	Tony Bryan	Domestic	90	K f	Pumped to house, couldn't measure, flow est. ½ gpm.
33	H. P. Heck	Domestic	96	K f	Piped into house, flowing reported 1.25 gpm
34	Tony Bryan	Stock	330	K 1	2 wells, one no flow & not used, one flows 1.5 gpm.
35	Tony Bryan	Stock	148	K 1	Pumped well, not visited.
36	Tony Bryan	Stock	255	K 1	Flowing 10 gpm.
37	Tony Bryan	Stock	145	K 1	Pumped well, not visited
38	Lloyd Putnam	Stock	550	K 1	Flowing 1.5 gpm.
39	Norris Darrow	Stock	700	K 1	Windmill, reported SWL 15'
40	Norris Darrow	Domestic Domestic	660 700	K 1 K 1	Two wells piped together, both flow, but couldn't measure

Water Wells in Edgemont Project Area

Map #	Owner	Use	Depth	Probable Aquifer	Remarks
41	Robert Bakewell	Domestic			Flows 12 gpm.
42	Lloyd Putnam	Domestic	600	K l	Flows est. 25 gpm.
43	Preston Richardson	Domestic	350	K l	Submersible pump, couldn't measure, stopped flowing when old Triangle mine dewatered.
44	Harold Dodson	Stock	130	K f	Will flow est. 40 gpm.
45	Harold Dodson	Stock	190	K f	Flows 3.1 gpm. H2S
46	Harold Dodson	Stock	Oil test	K f	Plugged at 140', but couldn't measure. Flowing around casing.
47	Harold Dodson	Stock	90	K f	SWL 10'
48	Norris Darrow	Stock	725	K l	Will flow est. 60 gpm.
49	Norris Darrow	Stock	600	K l	Flows 5 gpm.
50	Lloyd Putnam	Stock	609	K l	Flows 1.5 gpm., may be 2 wells piped together.
51	Burlington R.R.	Stock	550	K l	Flows 15.5 gpm., used by Leslie Coates.
52	Tony Bryan	Stock			Flows 2.8 gpm.
53	Tony Bryan	Stock			Windmill, couldn't measure.
54	Tony Bryan	Stock	90	K f	Flows 0.5 gpm.
55	Tony Bryan	Stock	92	K f	Flows 9 gpm.
56	Effie Gow	Domestic	300	K l	Broken out around casing, flowing
57	Effie Gow	Garden	270	K l	Couldn't measure, reported 100+ gpm. H2S Used by Rev. Brown to irrigate garden.
58	F. A. Heck	Stock	100+	K f	Flows 4 gpm.
59	F. A. Heck	Stock	118	K f	Flows 2.8 gpm H2S
60	F. A. Heck	Stock			Windmill, couldn't measure.
61	Earl Darrow	Stock	525	K l	Pumpjack, couldn't measure.
62	F. A. Heck	Stock			Couldn't measure, flowing est. 2 gpm into covered tank.

Water Wells in Edgemont Project Area

Map #	Owner	Use	Depth	Probable Aquifer	Remarks
63	Tony Bryan	Stock	100+	K f	Flows 1.5 gpm.
64	Leonard McElhaney	Stock			Flows 5 gpm H2S, may flow more through big valve.
65	" "	?			2 wells, one windmill, SWL 15', neither apparently used.
66	" "	Stock			Valve at well head shut off except for small line to H. Dodson's stock tank. Reported by Keene as flowing 270 gpm. in 1970
67	Leonard McElhaney	Stock			Flows 25 gpm. H2S.
68	" "	Domestic Stock	230 230	K l K l	Piped to house, couldn't measure. Flows 6 gpm.
69	H. P. Heck	Stock	130	K f	Flows 1.2 gpm.
70	H. P. Heck	Stock	375	K f, K l	Flows 1.0 gpm.
71	Ed Benton	Domestic		K f	Pumped to house, reported to barely flow
72	Ed Benton	Stock	212	K f	Yard water, Flows 13 gpm H2S
73	Ed Benton	Stock	560	K l	Flows 1.6 gpm.
74	Ed Benton	Stock	305	K f	Casing rusted out, flows, couldn't measure
75	Ed Benton	Stock	430	K f	Windmill, reported to pump dry
76	Ed Benton	Stock	420	K f	Broken out around casing, est. 7 or 8 gpm.
77	Darrell Heldman	Stock	400	K f	Broken out around casing, est. 5 gpm.
78	" "	"	410	K f	Pump jack, Keene reports SWL 30'
79	B. Childers	Domestic	337	K f	Couldn't measure, pump set at 250'
80	" "	Stock	650	K l	Pump jack, Keene reports SWL 100'
81	" "	"	440	Kl	Flows 4 gpm, sl. H2S
82	" "	"	200	K f	Flows 9 gpm., H2S
83	" "	"	270	K f	Pump jack, couldn't measure.

Water Wells in Edgemont Project Area

Map #	Owner	Use	Depth	Probable Aquifer	Remarks
84	Dick Miller	Stock	155	K f	Flows 0.25 gpm.
85	Tubbs Ranch	Domestic	415	K f	Pumped to house, Reported SWL 30'
86	Tubbs Ranch	Stock	360	K f	Pump jack, SWL reported 20'
87	Tubbs Ranch	Appears abandoned	380	K f	Plugged with wooden plug. Reported SWL 20'
88	Tubbs Ranch	Appears abandoned	320	K f	Two wells, one may be caved in, one SWL 10'
89	Porter & Benton	Pipeline	860	K l	Submersible pump, runs extensive pipeline. SWL reported 5'
90	B. Childers	Stock	Oil test		SWL 1.0 '
91	Carl Reutter	Stock	150	K f	Windmill SWL 34'
92	Carl Reutter	Domestic	298	K f	Pumped to house, Keene reports SWL 132'
93	Bob Runge	Domestic	200	K l	Two wells, couldn't measure, Keene reports SWL 80'
94	Bob Runge	Stock	200+	K l	Flows 0.75 gpm.
95	Wayne Jackson	Pipeline	~~880~~ 860	K f	Barely flows, submersible pump to pipeline.
96	Billy Stearns	Domestic	560	K l	Flows 4.8 gpm.
97	Billy Stearns	Stock		K l	Uranium test cased to 200', hole reported to be caving below that & sealing off flow. Flows.
98	Billy Stearns	Stock	Oil test		Leaking around top of casing, flows est 2 g
99	Gerald Darrow	Domestic	420	K l	Flows 2.2 gpm.
100	" "	Stock	530	K l	Flows 150 gpm (by Hodson) apparently used to fill water trucks.
101	" "	Morresy Pipeline	665	K l	Pipeline serves ranches west, submersible pump. Hodson reports flow 3 gpm.
102	Lloyd Darrow	Domestic	267	K l	Will flow est. 100 gpm. Sells water
103	Lloyd Darrow	Stock	350	K l	Flows 1.3 gpm.

Water Wells in Edgemont Project Area

Map #	Owner	Use	Depth	Probable Aquifer	Remarks
104	Lloyd Darrow	Stock		K l	Jensen jack, reported SWL 6'
105	Lloyd Darrow	Stock		K l	Not visited, reported SWL 8 to 10'
106	Lloyd Darrow	Stock			Flows 3.5 gpm.
107	Earl Darrow	Domestic	90	K f	Pumped into house, flow est. 1 gpm.
108	Chet Taylor	Domestic	90	K f	Taylor lives here part of time. Info reported by Earl Darrow. Flow rep. 1 gpm
109	Vivian Cook	Domestic	220	Kl	Reported SWL 22'
110	Vivian Cook	Stock	240	K l	Reported SWL 30'
111	Vivian Cook	Not used	100	K f	Owner plans to develop, reported SWL 5'
112	Miles Spencer	Stock	120	K f	Windmill, couldn't measure.
113	Miles Spencer	Stock			Back up well for Spencer pipeline.
114	No info				Forest Service.
115	Bud Hollenbeck	Domestic		K f	Flows 3 gpm.
116	Bud Hollenbeck			K f	Flows 2.75 gpm. At Dewey Post Office.
117	Bud Hollenbeck	Stock Garden			Submersible Pump. SWL 27'
118	Bud Hollenbeck	Stock	Oil test		Flowing out of casing at ground level
119	Bud Hollenbeck	Stock			Submersible pump, reported SWL 6'
120	Forest Service	Stock			Pumpjack, couldn't measure.
121	Bud Hollenbeck	Stock	430	K l	Will flow?? est. 100 gpm.
122	Bud Hollenbeck	Stock			Windmill, couldn't measure.
123	Bud Hollenbeck	Stock			Pump jack, couldn't measure.
124	Bud Hollenbeck	Stock			Not visited, reported windmill.
125	Bud Hollenbeck	Stock			Casing rusted off. Flows at ground level.
126	Francis Carr	Domestic		K l	Flows, couldn't measure.
127	Francis Carr	Stock	Oil test	K l	Casing rusted off, flows at ground level.

Water Wells in Edgemont Project Area

Map #	Owner	Use	Depth	Probable Aquifer	Remarks
128	Francis Carr	Stock	Oil test	K l	Couldn't measure, est. 5 gpm.
129	There are several old oil tests in this area. The ones reported as being used are reported above. There appears to be some flow from some of these but the casings seem to be bad and all there is now are some marshy areas. Some use of water for stock from these is possible.				
130	Dick Miller	Domestic	155	K f	?
131	Dick Miller	Stock	110	K f	Flows 0.8 gpm
132	Dick Miller	Stock	300	K l	Flows est. 2 gpm
133	Dick Miller	Stock	300	K l	Not contacted. Information from Keene
134	Roberts & Daniels	Stock	860		

#	S.	to Electricity	Dia.	Condition	Setting, Capacity, Age, etc.	Use	Requirement	
1	S	300 ft.	4"	25 yrs. - fair	none			
2	D.S.I.	300 ft.	5"	45 yrs. - poor	none			casing rusted out - flowing around casing
3	S	1/2 mile	4"	10 yrs.	none			oil test open hole from top of F. R.
4	S.I.	700 ft.	3"	10 yrs. - poor	none			oil test flowing around casing
5	S	2 miles	5"	10 yrs. - fair	none			oil test - open hole from top of FR
6	S	1 mile	12"	20 yrs.	none			
7 FR	D	on site	6"	20 yrs.	jet pump at 25 ft.			
7 LAK	S.I.	" "	5½"	40 yrs. - poor	none			
8 FR	D.I.	on site		45 yrs. - poor	jet pump in basement			
8 LAK	S.I.	on site	6"	45 poor	none			
9	S	1 mile	6"	10 yrs.	none			
10	S	2 miles	-	2 yrs. - good	pump jack			
11	S	1/2 mile	8"	10 yrs.	none			oil test
12	S	2000 ft.	4½"	10 yrs. - poor	none			open hole from top FR
13	D.S.I.	on site	5"	20 yrs. - fair	none			
14	S	1/2 mile	4"	poor	none			first pump test stopped flow - well not used since flow stopped
15	S	on site	4"	fair	cylinder type			

Well #	D. S.	Distance to Electricity	Well Dia.	Age and Condition	Pump Information-Type Setting, Capacity, Age, etc.	Season of Use	Water Requirement	Remarks
16	S	on site	4½	1 yr. - good	no pump installed yet			
17	S	2 miles	UNK.		windmill			
18	D.S.I.	on site	4"	48 yrs.	pressure pump			
19	S	1 mile	6"	16 yrs. - fair	pump jack			
20	D.S.I.	on site	6"	51 yrs. - poor	shallow well jet pump			casing rusted out - was repaired
21	S	1½ mile	7"	65 yrs.	none			oil test
22	S	on site	3"	10 yrs. - good	cylinder type			
23	S	1 mile	6"		none			
24	D.S.	on site	3"		none			
25	S	2 miles	4½"		windmill			
26	S	1 mile	5"		windmill			
27	S	on site	12"		submersible pump			serues pipeline
28	S	1/2 mile	6"	poor	none			
29	S	1/2 mile	5"	poor	none			casing rusted out
30	D.I.	on site	6"	24 yrs.	deep well jet pump set @ 80 ft			

Well #	D. S.	Distance to Electricity	Well Dia.	Age and Condition	Pump Information-Type Setting, Capacity, Age, etc.	Season of Use	Water Requirement	Remarks
30	S	on site	6"	cleaned 1977 22 years	none			
31	D.S.I.	on site	5½"	28 yrs.	none			
32	D.S.I.	on site	6"		pump type unknown			
33	D.S.	on site	5"	32 yrs.	none			
34	S	1 mile	2½"		none			2 wells - one does not flow and is not used
35		2 miles	8	poor	windmill			
36	S	1½ mile	4"	poor	none			
37		2½ miles	5½	poor	cylinder type			
38	S	½ mile	4'	26 yrs.	none			
39	S	½ mile	5"	poor	windmill			
40	D.S.I.	on site	6"	8 yrs.	none			} piped together
40	D.S.I.	on site	6"	31 yrs. poor	none			}
41	D.S.I.	on site	6"		submersible			serves pipeline
42	D.S.I.	on site	5"	33 yrs. poor	none			casing rusted out and repaired
43	D	on site	4"	poor	submersible			

Well #	D. S.	Distance to Electricity	Well Dia.	Age and Condition	Pump Information-Type Setting, Capacity, Age, etc.	Season of Use	Water Requirement	Remarks
44	S	1/2 mile	6"	20 yrs.	none			
45	S	on site	4"	8 yrs. poor	none			
46	D.S.	1/2 mile	6"	18 yrs. poor	none			oil test - leaking around casing
47	D.S.I.	on site	6"	18 yrs. fair	none			
48	S	on site	2½"	10 yr.	none			
49	S	1 mile	4"	3 yrs.	none			
50 N	S	2 miles	4"	40 yrs. poor	none			
50 S	S	2 miles	6"	5 yrs. poor	none			surface casing only ?
51	S	1 mile	10"	80 yrs. poor	none			repaired 1930's ?
52	S	1/2 mile	2½"		none			
53	S	1 mile	6"		windmill			
54	S	1500 ft.	6"		none			
55	S	2000 ft.	6"		none			
56	D.S.I.	on site	3"	10 yrs. poor	submersible			leaking around casing
57	S.I.	1/2 mile	4"		none			

Well #	D. S.	Distance to Electricity	Well Dia.	Age and Condition	Pump Information-Type Setting, Capacity, Age, etc.	Season of Use	Water Requirement	Remarks
58	S	100 ft.	6"		none			
59	S	1500 ft.	4"	poor	none			
60	S	1 mile	UNK.		windmill			
61	U	3 miles	5"		pump jack			
62	S	1½ mile	6"	1 yr. good	none			well replaced 1977
63	S	2000 ft.	5"		none			
64	S	1/2 mile	2½"	poor	none			
65	U	1/2 mile	6"	poor	none			
66	S	Approx. ½ mile	5"		none			
67	S	Approx. ½ mile	5"	poor	none			
68	D	on site	4"		none			
68	S.I.	on site	4"		none			
69	S	400 ft.	6"	18 yrs.	none			
70	S	2000 ft.	4"	7 yrs. poor	none			open hole from top Fall River
71	D	on site	5"		pump type unknown			

Well #	D. S.	Distance to Electricity	Well Dia.	Age and Condition	Pump Information-Type Setting, Capacity, Age, etc.	Season of Use	Water Requirement	Remarks
72	S.I.	on site	6"	32 yrs. poor	none			
73	D.S.I.	on site	5"	2 yrs. good	submersible			
74	S	1/2 mile	5"	30 yrs. poor	none			casing rusted out
75	S	Approx. 1 mile	5"		windmill			pumps dry
76	S	Approx. 1½ mile	7"	18 yrs. poor	none			casing rusted out
77	S	Approx. 1½ Mile	5"	poor	none			casing rusted out
78	D.S.	on site	5"		cylinder			
79	D.S.I.	on site	6"		submersible set at 250'			
80	S	Approx. 3000 ft.	6"		cylinder			
81	S	Approx. 1½ mile	4"		none			
82	S	Approx. 1½ mile	4½"		none			
83	S	Approx. 1 mile	6"		cylinder			
84	S	Approx. 1 mile	2"		none			
85	D	on site						
86	S	1/2 mile	4"	poor	cylinder			stopped flowing when well #66 flowing uncontrolled about 1970

Well #	D. S.	Distance to Electricity	Well Dia.	Age and Condition	Pump Information-Type Setting, Capacity, Age, etc.	Season of Use	Water Requirement	Remarks
87	U	3/4 mile	4"	poor	none			same as 86
88	S.U.	1500 ft.	8"	poor	none			was used with pump jack in 1977 - not used in 1978
88	S	on site	6"		pump type unknown probably submersible			serues pipeline
89	D.S.	on site	6"	good	submersible			serues pipeline
90	S.U.	on site	6"		none			oil test
91	S	1 mile	5"		windmill			
92	D.S.I.	on site	4½"		submersible			
93	D.S.I.	on site	2"		submersible			
93	S.U.	on site	6"		none			
94	S	on site	5"		none			
95	D.S.I.	on site	10"		submersible			serues pipeline
96	D.S.I.	on site	5"		none			
97	S	1 mile	4"	poor	none			cased to 200"
98	S	2 miles	10'	poor	none			oil test
99	D.S.I.	on site	4"		none			

Well #	D. S.	Distance to Electricity	Well Dia.	Age and Condition	Pump Information-Type Setting, Capacity, Age, etc.	Season of Use	Water Requirement	Remarks
100	S		8"		none			
101	D S	on site	7"		submersible			serues extensive pipeline
102	DSI	on site	5"	fair	none			
103	S	1 mile	4"		none			
104	S	1 mile	$4\frac{1}{2}$"		Jensen jack			
105	S	3 miles	4"		pump jack			
106	S	1/2 mile	4"		none			
107	DSI	on site	5"	poor	none			
108	DSI	on site	6"	poor	none			
109	DSI	on site	6"		submersible - set @ 90'			
110	SI	on site	$6\frac{1}{2}$"		submersible			
111	SU	200 ft.	4"		none			
112	S	1 mile	$4\frac{1}{2}$		windmill			
113	S	2 miles	UNK		windmill			
114	S U	3 miles	UNK		windmill			

D. S.	Distance to Electricity	Well Dia.	Age and Condition	Pump Information-Type Setting, Capacity, Age, etc.	Season of Use	Water Requirement	Remarks
DSI	on site	3½"		jet pump			
U	on site	1"		none			
S.I.	on site	6"		submersible pump			
S	1500 ft.	9½	poor	none			oil test
S	on site	5"		submersible pump			
S	on site	2"		pump jack			
S	1½ mile	5"		none			
S	5 miles	7"		windmill			
S	4½ mile	6"		cylinder			
S	5 miles	4"		windmill			
S	1½ miles	6"	poor	none			casing rusted off
DST	on site	6½"		none			
S	2 miles	6"	poor	none			oil test - casing rusted off
S	2½ miles	2"	poor	none			oil test

Well #	D. S.	Distance to Electricity	Well Dia.	Age and Condition	Pump Information-Type Setting, Capacity, Age, etc.	Season of Use	Water Requirement	Remarks
130	U	on site	UNK		none			covered up by owner H_2S is not used
131	S	200 ft.	3"		none			
132	S.I.	on site	approx.5"		pump type unknown			
133	U	1500 ft.	6"		none			
134	S.U.	on site	1"		UNK			

SOURCE B

DRAFT ENVIRONMENTAL STATEMENT FOR EDGEMONT URANIUM MINE TABLE 2.5.2-1

(Tennessee Valley Authority, 1979)

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Table 2.5.2-1

Summary of Wells Within a Four-Mile (6.5 km.) Radius of the TVA Burdock, No. 1 Shaft Site

Well No.: Based on the Federal system of township and range. Each township within the project area is assigned a letter in consecutive order beginning with "A" in the northeast corner and ending with "F" in the southern part. Similarly, wells are numbered in consecutive order within a township--for example: B-1, B-2, etc. Location: Number based on township, range, section, 1/4 section, and 1/4 section. Aquifer: Qa, Quaternary alluvial deposits; Kf, Cretaceous, Fall River Formation; Kl, Cretaceous, Lakota Formation; Jm, Jurassic, Morrison Formation; Js, Jurassic, Sundance Formation; Trs, Triassic, Spearfish Formation; PmK, Permian, Minnekahta Limestone. Depth: Given in feet (ft.) and meters (m.) below land surface. Use Rate and Flow Rate: In gallons per minute (gpm) and liters per second (l/s). Elevation of Land Surface and Elevation of Water Surface: In feet (ft.) and meters (m.) above sea level. Superscript a indicates flow rate less than 1 gpm. Superscript b indicates estimated water surface elevations.

	Well No.	Latitude	Longitude	Location	Aquifer	Depth (ft.)	Depth (m.)	Use Rate (gal/min)	Use Rate (l/s)	Flow Rate (gal/min)	Flow Rate (l/s)	Elevation Land Surf. (ft.)	Elevation Land Surf. (m.)	Elevation Water Surf. (ft.)	Elevation Water Surf. (m.)	Remarks
62	B-1	43°30'00"	103°58'57"	6-1-27Db	Qa	50	15	30	1.9	-	-	3715	1132	3700	1128	
52	B-2	43°29'58"	103°58'57"	6-1-27Db	Qa	46	14	30	1.9	-	-	3715	1132	3763	1128	
41	B-3	43°29'10"	104°02'43"	6-1-31Bd	-	-	-	-	-	12	.8	3605	1099	3610^b	1100	
58	B-4	43°29'09"	104°03'40"	6-1-33Bc	Kl	550	168	-	-	2	.1	3630	1106	3630^b	1106	
45	B-5	43°28'51"	103°59'06"	6-1-34Dc	Kl	350	107	-	-	-	-	3663	1116	-	-	Flowed until Triangle mine de-watered. 1/3 h.p. pump.
16	D-1	43°28'20"	103°56'47"	7-1-1Bd	Kl	330	101	-	-	-	-	3905	1190	3747	1146	
63	D-2	43°28'32"	103°57'34"	7-1-2Aa	Kf	180	55	10	.6	-	-	3749	1143	-	-	Water contains iron.
15	D-3	43°28'36"	103°58'15"	7-1-2Bb	Kl	495	151	-	-	a	-	3705	1129	3705^b	1129	Unused.
64	D-4	43°28'28"	103°58'20"	7-1-2Bc	Kl	280	85	5	.3	-	-	3658	1127	3674	1120	Water contains iron.
14	D-5	43°28'01"	103°58'22"	7-1-2Cc	Kl	470	143	-	-	a	-	3679	1121	3680^b	1122	Unused.
13	D-6	43°28'38"	103°59'42"	7-1-3Bb	Kl	500	152	-	-	2	.1	3660	1116	3661^b	1116	A.E.C. water analysis.
12	D-7	43°28'02"	104°00'00"	7-1-4Dd	Kl	805	245	-	-	1	.06	3645	1111	3646^b	1111	
42	D-8	43°28'17"	104°01'19"	7-1-5Ac	Kl	600	183	-	-	25	1.6	3600	1097	3610^b	1100	Flow rate in 1969, 30 gpm (1.9 l/s).
51	D-9	43°27'30"	103°58'52"	7-1-9Ad	Kl	550	168	-	-	16	1.0	3615	1102	3620^b	1103	Water contains iron & sulphur.
18	D-10	43°27'03"	104°00'54"	7-1-9Cc	Kf	527	161	-	-	8	.5	3700	1128	3701^b	1128	

TABLE 2.5.2-1 (continued)

D-14 not in database

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	Well No.	Latitude	Longitude	Location	Aquifer	Depth (ft.)	Depth (m)	Use Rate (gal/min)	Use Rate (l/s)	Flow Rate (gal/min)	Flow Rate (l/s)	Elevation Land Surf. (ft)	Elevation Land Surf. (m)	Elevation Water Surf. (ft)	Elevation Water Surf. (m)	Remarks
1	D-11	43°27'03"	103°59'46"	7-1-9Dd	Kl	600	183	-	-	1	.06	3624	1105	3631	1107	Water contains iron.
61	D-12	43°27'05"	103°57'47"	7-1-11Dc	Kl	525	160	-	-	-	-	3700	1128	-	-	A.E.C. water analysis.
17	D-13	43°28'25"	103°56'53"	7-1-12Bd	Kf	156	48	-	-	-	-	3750	1143	-	-	
	D-14	43°27'04"	103°56'21"	7-1-12Dd	-	-	-	-	-	-	-	3830	1167	-	-	
10	D-15	43°26'55"	103°56'12"	7-1-13Aa	Kl	200	61	-	-	-	-	3740	1140	3662	1116	
656	D-16	43°26'54"	103°58'24"	7-1-14Bb	-	-	-	-	-	8	-	3675	1120	3675[b]	1120	
5	D-17	43°44'45"	103°58'25"	7-1-14Aa	Kl	850	259	-	-	7	.4	3630	1106	3634[b]	1108	Water contains iron.
(651)	D-18	43°25'23"	103°57'48"	7-1-14Db	Kl	280	85	1	.06	-	-	3610	1100	3596	1097	
4	D-19	43°25'30"	103°58'43"	7-1-15Dd	-	2264	690	-	-	-	-	3576	1090	3580[b]	1091	
2	D-20	43°26'15"	103°59'58"	7-1-12Da	Kl	640	195	-	-	16	.9	3565	1086	3560[b]	1085	A.E.C. water analysis.
30	D-21	43°26'10"	104°02'01"	7-1-17Cb	Kf	530	162	-	-	4	.3	3555	1084	3558[b]	1084	A.E.C. water analysis.
19	D-22	43°26'33"	104°03'06"	7-1-18Bc	Kf	740	226	-	-	-	-	3700	1128	-	-	
21	D-23	43°25'40"	104°03'12"	7-1-19Bc	Kf	910	277	-	-	16	.9	3580	1091	3585[b]	1093	
3	D-24	43°25'42"	103°59'31"	7-1-22Bc	-	2400	732	-	-	3	.2	3548	1081	3550[b]	1082	
9	D-25	43°25'59"	103°57'24"	7-1-23Aa	Kf	90	27	-	-	3	.2	3625	1106	3625[b]	1105	Flow rate 1969, 10 gpm (.6 l/s).
7002	D-26	43°26'02"	103°58'26"	7-1-23Ba	Kl	500	152	-	-	5	.3	3574	1089	3574[b]	1089	
7	D-27	43°26'00"	103°58'28"	7-1-23Bb	Kf	200	61	3	.2	-	-	3574	1089	3561	1085	
8002	D-28	43°25'26"	103°57'48"	7-1-23Cc	Kl	500	152	-	-	5	.3	3542	1080	3542[b]	1080	Casing perforated in 10 ft (3 m.) intervals below elevations 3222 (982 m.) and 3384 (1031 m.).
8	D-29	43°25'27"	103°57'44"	7-1-23Cc	Kf	240	73	-	-	1	.06	3542	1080	3542[b]	1080	
503	D-30	43°25'24"	103°57'30"	7-1-23Dd	Js-PmK	1470	448	-	-	5	.3	3550	1082	3550[b]	1082	
516	D-31	43°25'35"	103°57'07"	7-1-24Cb	Js-PmK	2480	756	-	-	6	.4	3577	1090	3578[b]	1091	
70	D-32	43°24'32"	103°55'58"	7-1-25Ca	Kl	375	114	-	-	2	.1	3508	1069	3508[b]	1069	
33	D-33	43°24'45"	103°56'37"	7-1-25Db	Kf	96	29	-	-	1	.06	3510	1070	3510[b]	1070	
54	D-34	43°24'45"	103°56'29"	7-1-25Db	Kf	90	28	-	-	1	.06	3528	1075	3528[b]	1075	

TABLE 2.5.2-1 (continued)

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	Well No.	Latitude	Longitude	Location	Aquifer	Depth (ft)	Depth (m)	Use Rate (gal/min)	Use Rate (l/s)	Flow Rate (gal/min)	Flow Rate (l/s)	Elevation Land Surf. (ft)	Elevation Land Surf. (m)	Elevation Water Surf. (ft)	Elevation Water Surf. (m)	Remarks
69	D-35	43°24'28"	103°56'[illegible]	7-1-25Dc	Kf	130	40	-	-	1	.06	3510	1070	3510[b]	1070	
504	D-36	43°24'30"	103°56'2[illegible]	7-1-25Dd	Kf	450	137	-	-	3	.2	3508	1069	3508[b]	1069	
505	D-37	43°24'42"	103°57'5[illegible]	7-1-26Ca	Kl	260	79	-	-	2	.1	3530	1076	3530[b]	1076	
25	D-38	43°24'47"	103°59'27"	7-1-27Ac	Kf	350	107	-	-	-	-	3560	1085	3560[b]	1085	
24	D-39	43°25'01"	104°00'[illegible]	7-1-22Da	Kf	600	183	-	-	-	-	3576	1090	3553	1083	
23	D-40	43°25'01"	104°02'[illegible]	7-1-29Db	Kf	600	183	-	-	1	.06	3590	1094	3590[b]	1094	
27	D-41	43°23'30"	104°00'[illegible]	7-1-33Dc	Kl	600	183	-	-	-	-	3670	1119	-	-	
26	D-42	43°24'05"	103°57'[illegible]	7-1-35Ac	Kf	350	107	-	-	1	.06	3545	1081	3546[b]	1081	
88	D-43	43°23'44"	103°57'[illegible]	7-1-35Da	Kf	320	98	-	-	-	-	3555	1084	3545	1081	Slight flow in 1969; no flow in 1976.
8802	D-44	43°23'37"	103°57'2[illegible]	7-1-35Dd	Kf	320	98	-	-	-	-	3565	1084	-	-	1968 Flow, 15 gpm (.9 l/s); no flow in 1976.
87	D-45	43°23'10"	103°58'[illegible]	7-1-36Ab	Kf	92	28	-	-	9	.6	3500	1067	3504[b]	1068	
63	D-46	43°23'55"	103°56'[illegible]	7-1-36Ca	Kf	100	30	-	-	1.5	.2	3535	1077	3536[b]	1078	
113	E-1	43°28'08"	103°55'[illegible]	7-2-5Ca	-	40	12	-	-	-	-	3860	1177	-	-	
114	E-2	43°27'11"	103°55'[illegible]	7-2-7[illegible]	-	365	111	-	-	-	-	3755	1145	3475	1059	
506	E-3	43°27'32"	103°54'[illegible]	7-2-8Dc	Js	470	143	-	-	-	-	3970	1210	-	-	Unused.
507	E-4	43°25'57"	103°55'[illegible]	7-2-19Ba	Kl	145	44	-	-	-	-	3640	1109	-	-	
35	E-5	43°25'38"	103°55'[illegible]	7-2-1[illegible]Ca	Kl	148	45	-	-	-	-	3620	1103	-	-	Flow rate in 1969, 2 gpm (.1 l/s); no flow in 1976; unused.
508	E-6	43°25'15"	103°55'2[illegible]	7-2-19Dc	Kl	255	78	-	-	10	.6	3500	1067	3605[b]	1099	
E-7 not in database	E-7	43°25'11"	103°55'[illegible]	7-2-32Aa	-	-	-	-	-	-	-	3600	1097	-	-	
36	E-8	43°26'13"	103°56'[illegible]	7-2-32Db	Kl	330	101	-	-	2	.1	3530	1076	3530[b]	1076	
32	E-9	43°24'27"	103°55'[illegible]	7-2-30Cc	Kf	90	27	-	-	4	-	3522	1074	3522[b]	1074	
31	E-10	43°24'07"	103°55'52"	7-2-31Bc	Kf	104	32	-	-	1.3	.08	3495	1065	3500[b]	1067	

SOURCE C

SOUTH DAKOTA WELL COMPLETION REPORTS

Hydro ID 2

1 of 1

7-1-16

NOTICE OF WELL CONSTRUCTION

Fel Kum

(1) WELL CONSTRUCTION

Location of well: SE 1/4 SE 1/4 Section 16 Township 7S Range 1E

Well owner Peterson & Son, Inc. (Name) Edgemont, SD (Address)

Date well drilling completed 11-17-81 Purpose of well Domestic (domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-380	Blk Sh
380-470	lB gy clst & ss
470-495	Gy ss & clst
495-565	Gy, rd-brn & gn clst
565-580	Gy ss
580-650	Gy clst

Attach sheet if more space is needed

Depth to top of water producing aquifer 555

Depth to static water level flowing

Name of producing aquifer (if known) Lakota

Total depth of drill hole 650

Depth to bottom of casing 650

Casing information: In the space below show kind, size, weight, length per diameter, etc., for production casing and surface casing, if placed.

4" blk iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

slotted 566-608
629-650

If a flowing well, flow of completed well 30

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ______ HP.

Type of pump ______ Capacity of installed pump ______ GPM

Depth of pump placement ______ ft., Date of pump installation ______

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter ..., WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______

tube material ______

______
Name of Pump Installation Contractor

DEC 1981
DIVISION OF
RIGHTS

POWERTECH (USA) INC.

Form No. 4 JUN 16 1951

OFFICE OF STATE ENGINEER
PIERRE, S. DAK.

Hydro ID 8

ARTESIAN WELL REPAIR

OFFICE OF STATE ENGINEER
Pierre, South Dakota

Well No. 24-6R (do not fill in)

Fall River COUNTY.

Location SE of SW ¼ Section 23 Twp. 7S Range 1E

Owner J. E. Stewart Address Dickenson, N. Dak

Depth 240 Drawdown ______ Type Rig Used Repair

Flow (gpm) 2½ Pressure Strong Date Measured June 10, 1951

Grd. Elev. ______ Water Level Below Ground Surface ______

Temperature ______ Character Water (~~soft~~, medium, ~~hard~~)

Date Commenced June 6 Date Completed June 10

Bonded Driller H. P. Norbeck Address Redfield, S. D.

Section 23

X	

CASING DETAIL (old)

Type	Size	Length	Depth
Blk Std	2"	240'	240'

PERFORATIONS

~~Type Size Length Depth~~

Perforations of WATER BEARING SANDS

From 160' To 165'

222' 227'

SOURCE OF INFORMATION

Norbeck Co. Report

Repaired by: H. P. Norbeck

Address Redfield

RECORD OF WELL AFTER REPAIR

Depth 237 Date Completed June 10, 1951

Flow (gpm) 2½ Date Measured June 10, 1951

Water Level Below Ground Surface ______

CASING DETAIL (new)

Type	Size	Length	Depth
Std Blk	3"	31'	37'
driven over old 2" with 600# hammer			
in Copper tube	1¼"	231'	237'

PERFORATIONS

Type	Size	~~Length~~	~~Depth~~
Drilled	¼"	158' to	168'
		220	230

Did you reach bottom on this well? No

If not, how far down did you get? 237'

What do you think caused this well to fail? 2" corroded out permitting water to come up outside

Do you believe the repair was successful? Very

Well flowed only 2 GPM when drilled - this is a Dakota Sandstone well about 2 mi from outc.

13 Recompletion

Still River

NOTICE OF WELL CONSTRUCTION

(1) WELL CONSTRUCTION

Location of well: NW 1/4 NW 1/4 Section 3 Township 7S Range 1E

Well owner Kathryn Spencer (Name) Dewey Route, Edgemont, SD 57735 (Address)

Date well drilling completed 10-22-80 Purpose of well Domestic (domestic, irrigation, municipal, industrial, other)

WELL LOG

(Litho Log Footages)

	Layers, top to top in feet	Description of layer
Ksc →	0-320	Dark gray shale
Kfu →	320-395	Gray mudstone with 10% gray siltstone
	395-445	Gray mudstone with 5%-20% gray vfgss
Klf →	445-490	Green mudstone
	490-520	AA w/10-30% G & GR Vt slst
	520-545	Gray fgss
	545-560	well cemented vf - fgss
	560-575	Gray mudstone with 10% dark brown mudstone
	575-590	AA with 10-20% gray vfgss
	590-615	Gray fine grain sandstone
	615-620	Green mudstone with <5% gray vfgss
	620-625	Green mudstone with 50% brown-red mudstone

Attach sheet if more space is needed

Depth to top of water producing aquifer 580 ft.

Depth to static water level flows ft.

Name of producing aquifer (if known) Lakota

Total depth of drill hole 625 ft.

Depth to bottom of casing 580 ft.

Casing information: in the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

5 1/2" 14 lbs/ft.

Random twenties

Screen information: in the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

45 ft. open hole

If a flowing well, flow of completed well 1.00 G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______, tube material ______.

Name of Pump Installation Contractor

Form # 4 5

DRILLER'S FINAL REPORT

OFFICE OF STATE ENGINEER
Pierre, South Dakota

Well No. ______ (do not fill in)

CUSTER COUNTY

Location: SW NW¼ Section 33 Twp. 6S Range 1E

Owner George Putnam Address Burdock, S. Dak.

Depth 494 Drawdown ______ Type Rig Used cable tool

Flow (gpm) ______ Pressure ______ Date Measured ______

Grd. Elev. ______ Water Level Below Ground Surface ______

Temperature ______ Character Water (soft, medium, hard)

Date Commenced ______ Date Completed 11/12/49

x

Section ______

CASING DETAIL

Type	Size	Length	Depth
	4"	497	494

PERFORATIONS

Type	Size	Length	Depth

SCREEN

Type	Size	Length	Depth

Is there a seal between different size pipes? ___ What kind? ___

WATER BEARING SANDS

From ______ To ______

SOURCE OF INFORMATION

PMA office, Fall River Co.

DRILLER'S LOG

From	To	

~~Bonded~~ Driller Roy Boner (Signature)

Address Hot Springs, S. Dak.

BY-1

PLEASE COMPLETE ENTIRE FORM

1 of 1

WELL DRILLERS REPORT
Division of Water Rights
Department of Water & Natural Resources

6/60

Well Owner:
Name Francis & Paul Jozwick
Address Casper, Wyoming

Well Location:

Mark location with an "X"

North / W / E / 1 mile (grid with X marked in SW quarter)

County Custer

NW ¼ NW ¼ SW ¼ Sec. 30 Twp. 6S Rg. 1E

Proposed Use:
/ / Domestic / / Municipal /X/ Test Holes
/ / Irrigation / / Industrial / / Stock

Method of Drilling:
/X/ Forward Rotary / / Bored / / Jetted
/ / Reverse Rotary / / Cable / / Other

Well Construction:

Diameter of Hole 7 7/8
Depth 680
Casing /X/ Steel / / Concrete
/ / Plastic / / Other
If other, specify ____

Was casing end left open: Yes
Was a well screen installed: No
Describe Well Screen
Diameter ____ Material ____
Slot size ____
Was well gravel packed: No
Was well grouted: Yes
Was water sample taken: No

Remarks: Cased w/14-5# 5 1/2" steel casing. Perforation completion.

Water Level Information:
Static water level ____ below land sur
If flowing: closed in pressure 28 PSI
rate of flow 2 GPI
Controlled by:
/X/ Valve / / Reducers / / Other
If other; specify ____

Well Test Data:
/ / Pumped
/ / Bailed Describe: ____
/ / Other

Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____

Well Log:

Formation	Depth From	Depth To
	0	15
Med. & dk gry sh	15	400
Dk gry sh	400	535
Intbd gry slst & Clst	535	547
Gry-vfgr ss & clst	547	602
Clst	602	610
Vf,fgrss tr clst	610	673
Gry clst	673	680

(Use Back if Necessary)

Date Completed: March 4, 1982

Driller: Contract Rig by
Silver King Mines, Inc. 406
Driller's or Firm's Name License

Edgemont, SD 57735
Address

Signed By ____ Date ____

NOV 1982 DIVISION OF WATER RIGHTS Pierre, SD

SOUTH DAKOTA WELL REHABILITATION REPORT

11-02

Location SE¼ NW¼ Sec 5 Twp 7S Rg 1E

County FALL River

North

Please mark well location with an "X"

W x E

1 mile

Rehabilitation Completion Date 11-15-09

PROPOSED USE:
[X] Domestic [ ] Municipal [X] Stock
[ ] Irrigation [ ] Industrial

Well owner:

Name PuTnam + PuTnam, LLP.

Address 778 CEdar ST.

City, State, Zip Dewey S.D. 57735-5011

Describe original construction if possible.
(Attach original log if available). DRilled 1949
WEll DRilled 580'
CASED 8" To 220'
OPen HoLed To BoTTom

RECEIVED
JAN - 6 2010
WATER RIGHTS PROGRAM

Description of condition of well before rehabilitation:
CASing DeTeraTing Above and BeLow Ground

Description of rehabilitation work completed:
Swabbed Well For 310'. PuT 4" pvc cassing SoLid For 280' 20' of Screen PuT ShaLe Packer aT 220' and TRimmy Line PResre GrouTed Back To SurFace Reduced casing To 1¼" and PuT on Ball ValVe To conTroL Well.

Recasing information: Material P.V.C. Diameter 4 Inches Depth 300 Feet

Describe screen or perforations .25 FacTory SloTTed Screen Location From 280 To 300

From ____ To ____

Grout: [X] YES [ ] NO Describe grouting procedure and grout: PuT Trimmy Line To 220' to ShaLe Packer PResured 44 Bags CemenT Back To SurFace

Well Test Data: Specific capacity ____ Static water level FLowing

If a flowing well GPM 35 Shut in 10 PSI

This well rehabilitation was completed under license # 724 and this report is true and accurate.

Drilling firm: J+M DRilling

Signature of Licensed Representative: Jim McNamara

Signature of Well Owner: Lloyd Putnam

Date: 1-4-2010

1-6-10

115 Replacement

STATE OF SOUTH DAKOTA WELL DRILLERS REPORT

Location NW¼SE¼ Sec 18 Twp 6 S Rg 1 E

County Custer

Please mark well location with an "X"

North / W / E — X (marked in SE quarter) — 1 mile

Well Completion Date Oct 2 1984

PROPOSED USE:
[X] Domestic [ ] Municipal [ ] Test Holes
[ ] Irrigation [ ] Industrial [X] Stock

Method of Drilling:
ROTARY MUD

WELL CONSTRUCTION: 6" to 280'
Diameter of hole 4" inches Depth 360 feet
Casing: [ ] Steel [X] Plastic [ ] Other
Specify 6" YELLOW MINE / 4" SCH 40

Pipe Weight	Diameter	From	To
SCH 200 lb/ft	6 inches	0 feet	280 feet
SCH 40 lb/ft	4 inches	160 feet	360 feet

Was a well screen used? [X] Yes [ ] No
If Not Specify
Screen Type 4" PVC Slot Size 1/64"
Length 80' Diameter 4"
Was Casing left open end? [X] Yes [ ] No
Was a Packer or seal used? [X] Yes [ ] No
If so what material? RUBBER
Was well gravel packed? [ ] Yes [X] No
Was well grouted? [X] Yes [ ] No
Describe grouting procedure PUMPED 35 BAG MIX DOWN INSIDE & UP OUTSIDE
To what depth? 180 Feet
What was grouting material? TYPE II
If cement, how many sacks? 35
Location of packer(s) and screen or perforated pipe 20 ft SCREEN 200-220 PACKER 280 SCREEN 300-360
WAS WELL PLUGGED OR ABANDONED [ ] Yes [X] No
If so how and with what material?

WNR-836 4/82

Well Owner:
Name BUD HOLLENBECK
Address BEULY RT BOX 38 EDGEMONT S.D 57735

Well Log:

Formation	Depth From	Depth To
SHALE	0	80
FALL RIVER	80	220
FUSON	220	240
LAKOTA	240	360

STATIC WATER LEVEL 0 Feet
If flowing: closed in pressure 6 LBS PSI
GPM flow 65 through 6" inch pipe
Controlled by [X] Valve [ ] Reducers [ ] Other
If other; specify
Can well be completely shut off? YES

WELL TEST DATA: Inyan Kara
[ ] Pumped
[ ] Bailed Describe:
[ ] Other

Pumping Level Below Land Surface
___ ft. After ___ Hrs. pumped ___ GPM
___ ft. After ___ Hrs. pumped ___ GPM
___ ft. After ___ Hrs. pumped ___ GPM

NOV 1984 DIVISION OF WATER RIGHTS Pierre, SD

Remarks: THIS IS OFFSET TO OLD WELL THAT WAS LEAKING CEMENTED WELL SHUT. PUMPED 13 BAGS IN AT 160 FT.

This well was drilled under license # 415 and this report is true and accurate.

RABY DRILLING — Drilling Firm
Russell P Raby — Signed by
Oct 18, 1984 — Date

Ltr sent 12-6-84

PLEASE COMPLETE ENTIRE FORM

Hydro ID 747

HAM-4

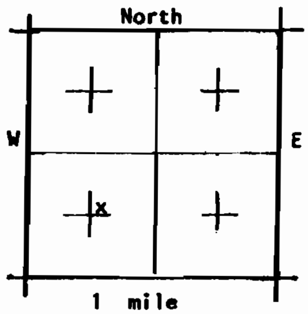
WELL DRILLERS REPORT
Division of Water Rights
Department of Water & Natural Resources

6/60

Well Owner:
Name: Tennessee Valley Authority
Address: ____________

Well Location:

Mark location with an "X"



County: Custer

SW ¼ NE ¼ SW ¼ Sec. 17 Twp. 6S Rg. 1E

Proposed Use:
/ / Domestic / / Municipal /X/ Test Holes
/ / Irrigation / / Industrial / / Stock

Method of Drilling:
/X/ Forward Rotary / / Bored / / Jetted
/ / Reverse Rotary / / Cable / / Other

Well Construction:
Diameter of Hole: 6 1/8
Depth: 750
Casing: /X/ Steel / / Concrete
/ / Plastic / / Other
If other, specify ____________

Was casing end left open: Yes
Was a well screen installed: No
Describe Well Screen
Diameter ______ Material ______
Slot size ______
Was well gravel packed: No
Was well grouted: Yes
Was water sample taken: No

Remarks: Cased w/.219 wall 4 1/2" steel casing.
Open hole completion.

Water Level Information:
Static water level 34' below land surface
If flowing: closed in pressure ____ PSI
rate of flow ____ GPM
Controlled by:
/ / Valve / / Reducers / / Other
If other; specify ____________

Well Test Data:
/ / Pumped
/ / Bailed Describe: ____________
/ / Other

Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ " " ____ " " ____ "
____ " " ____ " " ____ "

Well Log:

Formation	Depth From	Depth To
Alluvium	0	33
Gry shale	33	403
Intbd gry sltst & sh	403	416
Intbd gry vfgr ss & clst	416	485
Br fgr ss	485	507
Gr & rd vfgrss & gry clst	507	550
Rd f,mgrss	550	576
Dr brn clst	576	585
Rd mgrss	585	596
Intbd gry, brn clst & gry slst	596	651
lt ortn f,mge'ss	561	693
brn clst	693	695
O: f, m, cgr ss	695	742
gry clst	742	750

(Use Back if Necessary)

Date Completed: February 9, 1982

Driller:
Silver King Mines, Inc. — Driller's or Firm's Name
405 — License NO.
Edgemont, SD 57735 — Address

Signed By ____________ Date ____________

NOV 1982
DIVISION OF WATER RIGHTS
Pierre, SD

POWERTECH (USA) INC.

 STATE OF SOUTH DAKOTA WELL DRILLERS REPORT

Location SE ¼ NE ¼ Sec 19 Twp 6S Rg 1E

County
Custer

North / W / E / 1 mile

Please mark well location with an "X"

X

Well Completion Date Oct 16 1984

PROPOSED USE:
[ ] Domestic [ ] Municipal [ ] Test Holes
[ ] Irrigation [ ] Industrial [X] Stock

Method of Drilling:
Rotary mud

WELL CONSTRUCTION: to 520 4" to 900
Diameter of hole 6" inches Depth ____ feet
Casing: [ ] Steel [X] Plastic [ ] Other
6" yellow mine
Specify 4" Sch 40 Screen

Pipe Weight	Diameter	From	To
____ lb/ft	6 inches	0 feet	520 feet
____ lb/ft	4 inches	500 feet	900 feet

Was a well screen used? [X] Yes [ ] No
If Not Specify ____
Screen Type PVC Slot Size 1/64
Length 60' Diameter 4"
Was Casing left open end? [X] Yes [ ] No
Was a Packer or seal used? [X] Yes [ ] No
If so what material? Rubber
Was well gravel packed? [ ] Yes [X] No
Was well grouted? [X] Yes [ ] No
Describe grouting procedure Pressure Grout
6" Pipe 0 to 520
To what depth? 520 Feet
What was grouting material? Type II Cement
If cement, how many sacks? 100
Location of packer(s) and screen or perforated pipe Packer 780 Screen 780
To 300 + 840 - 880
WAS WELL PLUGGED OR ABANDONED [ ] Yes [X] No
If so how and with what material?

Well Owner: Morrisey Neville Operation
Name Bernard & Lowham Partners
Address Box 567 Casper Wyo 82602

Well Log:

Formation	From	To
Shale	0	480
Fall River	480	600
Fuson	600	740
Lakota	740	885
Morrison	885	900

STATIC WATER LEVEL 0 Feet
If flowing: closed in pressure 2 PSI
GPM flow 16 through 6" inch pipe
Controlled by [X] Valve [ ] Reducers [ ] Other
If other; specify ____
Can well be completely shut off? yes

WELL TEST DATA:
[ ] Pumped
[ ] Bailed Describe: Inyan Kara
[ ] Other

NOV 1984 DIVISION OF WATER RIGHTS Pierre, SD

Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM

Remarks: Note this is an offset to old well, old well was cemented and pumped 16 bags cement in 200 ft.

This well was drilled under license # 415 and this report is true and accurate.

Rapp Drilling — Drilling Firm
[signature] — Signed by
Oct 18 1984 — Date

[signature] 12-6-84

WNR-836 4/82

Hydro ID 436

NOTICE OF WELL CONSTRUCTION

Custer

(1) WELL CONSTRUCTION

Location of well: NW 1/4 NE 1/4 Section 20 Township 6S Range 1E

Well owner Tennessee Valley Authority (Name) (Address)

Date well drilling completed 8-18-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-430	Blk sh
430-495	lt gy clst & ss
495-520	ln & brn ss
520-530	Gy & brn-gy clst
530-545	Rd-brn & tn ss
545-565	Rd-ppl clst
565-590	Pk, tn & brn ss

Attach sheet if more space is needed

Depth to top of water producing aquifer 505 ft.

Depth to static water level 21.0 ft.

Name of producing aquifer (if known) Fall River

Total depth of drill hole 590 ft.

Depth to bottom of casing 505 ft.

Casing information: in the space below show kind, size, weight, length per diameter, etc., for production casing and surface casing, if used.

4" blk iron 10#/ft

Screen information: in the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 505-590

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.

Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.409 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______

tube material ______.

DEC 1981 DIVISION OF WATER RIGHTS Pierre, SD

Name of Pump Installation Contractor

SOUTH DAKOTA WATER WELL COMPLETION REPORT

Hydro ID 510

1 of 1 10-85

[redacted]on SE ¼ SE ¼ Sec. 12 Twp 7 Rg 1

County: FALL RIVER

North / W / E / 1 mile

Please mark well location with an "X"

Well Completion Date: JUNE 12 1988

PROPOSED USE:
☐ Domestic ☐ Municipal ☐ Test Holes
☐ Irrigation ☐ Industrial ☒ Stock

Method of Drilling: ROTARY AIR + MUD

CASING DATA:
☐ Steel ☒ Plastic ☐ Other
If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SCH 200 LB/FT	5 IN	0 FT	520 FT	7 7/8 IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUT:
Was the well grouted? ☒ YES ☐ NO
To what depth? 280 FT FEET
What is grouting material? CEMENT
If cement, number of sacks? 34 SACKS
Describe grouting procedure: TREMI LINE

What was grout weight? 1 BAG 7 GAL LB/GAL

SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 5 IN Length 80 FEET
Material PVC
Slot Size .064 Set From 300 Feet To 340 Feet
Slot Size .064 Set From 480 Feet To 520 Feet
Slot Size ____ Set From ____ Feet To ____ Feet
Other information

Was a packer or seal used? ☒ YES ☐ NO
If so, what material? NEOPRENE
Describe packer(s) and location? 5 X 8 PACKERS SET AT 280 + 300 FT TOP SCREEN 380 + 420 + 480 FT ABOVE BOTTOM SCREEN

Was well disinfected upon completion? ☐ YES ☐ NO
Explain
Bacteriological analysis ☐ YES ☐ NO
Laboratory sent to

Well Owner:
Name: LESLIE COATS
Address: Dewey Rt. Edgemont, S.D. 57735

Well Log:

Formation	Depth From	Depth To
FALL RIVER	0	180
LAKOTA	180	530
MORRISON	530	540

JUN 1988 DIVISION OF WATER RIGHTS Pierre, SD

STATIC WATER LEVEL 0 Feet
If flowing: closed in pressure 2 PSI
GPM flow Seep through 1 GAL 10 MIN inch pipe
Controlled by ☒ Valve ☐ Reducers ☐ Other
If other, specify
Can well be completely shut in? YES

WELL TEST DATA:
☐ Pumped AIR BAILED
☒ Bailed Describe: 10 GPM
☐ Other
Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM

REMARKS:
3 GPM MEASURED AT 320
10 GPM MEASURED FROM 500 FT SAND.

This well was drilled under license # 415
And this report is true and accurate.
Drilling firm: Raby Drilling + Exp
Signature of License Representative: Russell Raby
Signature of Well Owner:
Date 7-6-88

(1) ... CONSTRUCTION

Location of well SW 1/4 NW 1/4 ... Section ... Township 6S Range 1E

Well owner Tennessee Valley Authority, P. O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 6-26-78 Purpose of well Observation
(domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-20	Brown Soil
20-530	Gray Shale
530-545	Gray Sandstone
545-620	Lt. Gray & Brown Mudstone & Siltstone
620-690	Lt. Gray Sandstone
690-720	Dark Gray Shale w/Light Gray ~~Siltstone~~
720-740	Gray Sandstone
740-770	IB Dark Gray Shale, Gray-Green Mudstone
770-820	Gray Sandstone
820-840	Gray Shale
840-955	IB AA & Yellow-Brown ~~Siltstone-Sandstone~~
955-975	Red & Yellow Sandstone
975-1000	Green w/Variegated Mudstone

Attach sheet if more space is needed

Depth to top of water producing aquifer 840 ft.

Depth to static water level ft.

Name of producing aquifer (if known) Lakota

Total depth of drill hole 1000 ft.

Depth to bottom of casing 966 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

1" Schedual 40 Black Iron

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Torch Slotted 903-966

If a flowing well, flow of completed well G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______

tube material ______

1978
... WATER RIGHTS COMM
Pierre, SD

Name of Pump Installation Contractor

Hydro ID 610

1/4 ___ 1/4 ___ Section 23 Township 6 Range 1E

Well owner Tennessee Valley Authority, P.O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 6-27-78 Purpose of well Observation
(domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-20	Brown Sandy Soil
20-540	Gray Shale
540-605	Gray Siltstone
605-680	LB Gray Sandstone & Gray Shale

Attach sheet if more space is needed

Depth to top of water producing aquifer 605 ft

Depth to static water level ___ ft

Name of producing aquifer (if known) Fall River

Total depth of drill hole 680 ft

Depth to bottom of casing 672 ft

Casing information in the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used

1" Schedual 40 Black Iron

Screen information: in the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Torch Slotted 630-672

If a flowing well, flow of completed well ___ G.P.M

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ___ HP ___

Type of pump ___ Capacity of installed pump ___ G.P.M

Depth of pump placement ___ ft, Date of pump installation ___

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ___ ft., tube diameter ___

tube material ___

1978 WATER RIGHTS COMM. Pierre, SD

Name of Pump Installation Contractor

Hydro ID 610 BPZ-21 FR

NOTICE OF WELL CONSTRUCTION

(1) WELL CONSTRUCTION

Location of well: SW 1/4 NW 1/4 NE Section 29 Township 6S Range 1E

Well owner: Tennessee Valley Authority, P.O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 6-27-78 Purpose of well Observation
(domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-20	Brown Sandy Soil
20-540	Gray Shale
540-605	Gray Siltstone
605-680	IB Gray Sandstone & Gray Shale

Attach sheet if more space is needed

Depth to top of water producing aquifer 605 ft.

Depth to static water level ______ ft.

Name of producing aquifer (if known) Fall River

Total depth of drill hole 680 ft.

Depth to bottom of casing 672 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

1" Schedual 40 Black Iron

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Torch Slotted 630-672

If a flowing well, flow of completed well ______ G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______,

tube material ______

______
Name of Pump Installation Contractor

COMM
SD

Hydro ID 611

NOTICE OF WELL CONSTRUCTION

(1) WELL CONSTRUCTION

Custer

Location of well: SE 1/4 NE 1/4 Section 20 Township 6S Range 1E

Well owner: Tennessee Valley Authority (Name) (Address)

Date well drilling completed: 10-17-81 Purpose of well: Test (domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-440	Dk brn-gy shale
440-500	Gy & brn mudstone
500-520	Lt red sandstone
520-565	Dk brn & gy-gn mdst
565-600	Red sandstone
600-625	Dk brn mdst-sltst
625-645	Dk brn mdst
645-690	Gy & brn mdst w/int'd rd sltst
690-725	Red ss w/orng cht
725-755	Red sltst
755-800	Red ss w/wht, orng & gy chert pbl cgl

Attach sheet if more space is needed

Depth to top of water producing aquifer 694 ft

Depth to static water level 34.2 ft

Name of producing aquifer (if known) Lakota

Total depth of drill hole 815 ft

Depth to bottom of casing 694 ft

Casing information: In the space below show kind, size, weight, length per diameter, etc., for production casing and surface casing, if used.

0-25' 20" steel
0-695 10 3/4" steel
730-755 8 5/8" steel

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

695-730 8 5/8" Johnson Well
755-800 .030 Screen slot galvanized

If a flowing well, flow of completed well NA G.P.M.

Forward Drilling Company
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump: Pioneer 6" HP 50

Type of pump: Submersible Capacity of installed pump 325 G.P.M.

Depth of pump placement 525 ft., Date of pump installation 12-2-81

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed 525 ft., tube diameter 3/4"

tube material poly

DEC 1981 DIVISION OF WATER RIGHTS Pierre, SD

Great West Pump, Inc.
Name of Pump Installation Contractor

Hydro ID 612

NOTICE OF WELL CONSTRUCTION

(1) WELL CONSTRUCTION

Custer

Location of well: SE 1/4 NE 1/4 Section 20 Township 6S Range 1E

Well owner Tennessee Valley Authority (Name) (Address)

Date well drilling completed 8-14-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-425	Blk sh
425-495	lB gy clst & ss
495-505	Rd & brn ss
505-525	Gy clst
525-530	Rd & orng -brn clst
530-545	Brn & rd-brn ss
545-555	Gy & wht sltst w/fy-gn clst
555-585	Orng, rd & brn ss
585-610	Gy-wht sltst w/gn clst
610-640	Tn-gy ss
640-650	Gy clst & gy wht sltst
650-700	Gy & gn clst
700-730	Tn, orng & rd-brn ss
730-745	lB Gy ss & sltst
745-800	Tn-brn ss

Attach sheet if more space is needed

Depth to top of water producing aquifer 692

Depth to static water level 26.6

Name of producing aquifer (if known) Lakota

Total depth of drill hole 800

Depth to bottom of casing 692

Casing information: In the space below show kind, size, weight, length, per diameter, etc., for production casing and surface casing, if used.

4" blk Iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 692-800

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ______ HP

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______

tube material ______.

______
Name of Pump Installation Contractor

DEC 1981 DIVISION OF WATER RIGHTS PIERRE, SD

Hydro ID 613

NOTICE OF WELL CONSTRUCTION

Custer

(1) WELL CONSTRUCTION

Location of well: SE 1/4 NE 1/4 Section 21 Township 6S Range 1E

Well owner Tennessee Valley Authority (Name) (Address)

Date well drilling completed 8-14-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-430	Blk sh
430-510	lB gy clst & ss
510-600	Tn-gy & rd-brn ss w/ gy, gn & rd clst

Attach sheet if more space is needed

Depth to top of water producing aquifer 504 ft.

Depth to static water level 26.2 ft.

Name of producing aquifer (if known) Fall River

Total depth of drill hole 580 ft.

Depth to bottom of casing 504 ft.

Casing information: In the space below show kind, size, weight, length per diameter, etc., for production casing and surface casing, if used.

4" blk iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 504-580

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump _______ HP

Type of pump _______ Capacity of installed pump _______ G.P.M.

Depth of pump placement _______ ft., Date of pump installation _______

(3) WATER SURFACE MEASURING TUBE

- On some wells an air-tight water surface measuring tube is required: See Section 46, 406 of Chapter 46.4 WELL CONSTRUCTION STANDARDS.
- Show exact vertical length of water surface measuring tube, when installed _______ ft.

tube material _______

Name of Pump Installation Company

DEC 1981
DIVISION OF WATER RIGHTS
Pierre, SD

Hydro ID 614

6.1dl-2#

NOTICE OF WELL CONSTRUCTION

(1) WELL CONSTRUCTION

Custer

Location of well: SE 1/4 NE 1/4 ____ Section 20 Township 6S Range R1

Well owner Tennessee Valley Authority (Name) (Address)

Date well drilling completed 9-14-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-440	Blk sh
440-505	lB gy clst & ss
505-565	RD & yw-brn ss w/rd-br & gy clst
565-575	Rd-brn clst
575-600	Rd 7 rd-brn ss-siltsto
600-620	lB gy clst & ss

Attach sheet if more space is needed

Depth to top of water producing aquifer 609 ft.

Depth to static water level 32.2 ft.

Name of producing aquifer (if known) Lakota

Total depth of drill hole 620 ft.

Depth to bottom of casing 609 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4" blk Iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 609-620

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ____ HP

Type of pump ____ Capacity of installed pump ____ G.P.M.

Depth of pump placement ____ ft., Date of pump installation ____

(3) WATER SURFACE MEASURING TUBE

-On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

-Show exact vertical length of water surface measuring tube, when installed ____ ft., tube diameter ____

tube material ____.

Name of Pump Installation Contractor

DEC 1 1981
DIVISION OF
WATER RIGHTS
Pierre, SD

Hydro ID 615

1 of 1

NOTICE OF WELL CONSTRUCTION

1 WELL CONSTRUCTION

Custer

Location of well: SE 1/4 NE 1/4 ____ Section 20 Township 6S Range 1E

Well owner Tennessee Valley Authority (Name) (Address)

Date well drilling completed 8-13-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-435	Blk sh
435-505	Intbd gy clst, ss
505-525	Lt tn & brn ss
525-550	IB gy clst-ss
550-590	IB rd brn & gy sltst & clst
590-600	Rd & brn ss
600-620	IB gy-gn & rd-brn sltst & clst
620-645	Gy-wht sltst
645-685	IB gy-wht sltst & pk sltst
685-695	Pk & brn ss w/gy clst
695-800	Brn, orng, tn, pk, rd & yw ss

Attach sheet if more space is needed

Depth to top of water producing aquifer 712 ft.

Depth to static water level 39.7 ft.

Name of producing aquifer (if known) Lakota

Total depth of drill hole 800 ft.

Depth to bottom of casing 712 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4" blk Iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 712-800

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.

Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ______ HP

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

(3) WATER SURFACE MEASURING TUBE

- On some wells an air-tight water surface measuring tube is required. See Section 46.40B of Chapter 46.6, MINIMUM WELL CONSTRUCTION STANDARDS.
- Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______

tube material ______

DEC 1981 DIVISION OF WATER RIGHTS Pierre, SD

Name of Pump Installation Contractor

Hydro ID 616

NOTICE OF WELL CONSTRUCTION

CUSTER

1) WELL CONSTRUCTION

Location of well: SE 1/4 NE 1/4 ____ Section 20 Township 6S Range R1

Well owner Tennessee Valley Authority
(Name) (Address)

Date well drilling completed 9-15-81 Purpose of well Observation
(domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-465	Blk sh
465-530	IB gy clst & ss
530-550	Rd & yw-brn ss
550-605	IB gn sltst & gn-gy clst
605-645	Gy clst w/gy-wht sltst
645-680	Gy ss
680-720	Gy w/gn clst
720-760	IB rd & yw-brn ss, gy sltst & rd-brn & brngy clst
760-835	Tn ss

Attach sheet if more space is needed

Depth to top of water producing aquifer 735 ft.

Depth to static water level 45.8 ft.

Name of producing aquifer (if known) Lakota

Total depth of drill hole 835 ft.

Depth to bottom of casing 735 ft.

Casing information: In the space below show kind, size, weight, lengths and diameter, etc., for production casing and surface casing, if used.

4" blk iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 735-835

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ____ HP ____

Type of pump ____ Capacity of installed pump ____ G.P.M.

Depth of pump placement ____ ft., Date of pump installation ____

(3) WATER SURFACE MEASURING TUBE

- On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.
- Show exact vertical length of water surface measuring tube, when installed ____ ft., tube diameter ____ tube material ____.

DEC 1981
DIVISION OF WATER RIGHTS

Name of Pump Installation Contractor

Hydro ID 617

NOTICE OF WELL CONSTRUCTION

~~Fall River~~ Custer

(1) WELL CONSTRUCTION

Location of well: SW 1/4 NE 1/4 Section 20 Township 6S Range 1E

Well owner Tennessee Valley Authority (Name) (Address)

Date well drilling completed 9-15-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-450	Blk sh
450-520	lB gy clst & ss
520-555	Rd-brn & gy clst w/gy ss
555-570	Rd & brn ss
570-625	lB gy sltst & gy, gn & rd clst
625-655	Gy ss
655-740	lB gy slst w/gy-gn & brn clst
740-810	Tn, yw & rd-brn ss

Attach sheet if more space is needed

Depth to top of water producing aquifer 715 ft.

Depth to static water level 21.4 ft.

Name of producing aquifer (if known) Lakota

Total depth of drill hole 810 ft.

Depth to bottom of casing 715 ft.

Casing information: In the space below show kind, size, weight, lengths, bore diameter, etc., for production casing and surface casing, if used.

4" blk iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 715-810

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ____ HP

Type of pump ____ Capacity of installed pump ____ G.P.M.

Depth of pump placement ____ ft., Date of pump installation ____

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.6, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ____ ft., Tube diameter ____

tube material ____.

DEC 1981 [illegible]ION OF [illegible] RIGHTS

____
Name of Pump Installing Contractor

POWERTECH (USA) INC.

Hydro ID 622

~~Fall River~~ Custer

DWM-50

NOTICE OF WELL CONSTRUCTION

(1) WELL CONSTRUCTION

Location of well: NE 1/4 NE 1/4 ____ Section 20 Township 6S Range 1E

Well owner Tennessee Valley Authority (Name) ____ (Address)

Date well drilling completed 8-17-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-420	Blk sh
420-490	lB gy clst & ss
490-585	lB gy, pk & orng sltst & rd-brn & gn clst
585-615	Gy-gn & rd-brn clst
615-650	Gy-wht sltst
650-690	Gy & gn clst
690-735	Gy w/rd & ywbrn ss w/brn-gy clst
735-778+	Tn & yw-brn ss

Attach sheet if more space is needed

Depth to top of water producing aquifer 714 ft.

Depth to static water level 49.7 ft.

Name of producing aquifer (if known) Lakota

Total depth of drill hole 780 ft.

Depth to bottom of casing 714 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4" blk iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 714-780

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ____ HP ____

Type of pump ____ Capacity of installed pump ____ G.P.M.

Depth of pump placement ____ ft., Date of pump installation ____

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ____ ft., tube diameter ____, tube material ____.

____
Name of Pump Installation Contractor

Hydro ID 622 DWM-52 2 of 2

Custer

NOTICE OF WELL CONSTRUCTION

(1) WELL CONSTRUCTION

Location of well: NE 1/4 NE 1/4 ____ Section 20 Township 6S Range R1

Well owner Tennessee Valley Authority (Name) (Address)

Date well drilling completed 8-17-81 Purpose of well Observation (domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-420	Blk sh
420-500	lB gy clst & ss
500-580	Gy, rd & tn ss w/gy & brn clst

Attach sheet if more space is needed

Depth to top of water producing aquifer 503 ft.

Depth to static water level 34.2 ft.

Name of producing aquifer (if known) Fall River

Total depth of drill hole 580 ft.

Depth to bottom of casing 503 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4" blk iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 503-580

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ____ HP ____

Type of pump ____ Capacity of installed pump ____ G.P.M.

Depth of pump placement ____ ft, Date of pump installation ____

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ____ ft., tube diameter ____,

tube material ____.

Name of Pump Installation Contractor

Hydro ID 623

6. 1 of 1 2-1

NOTICE OF WELL CONSTRUCTION

~~Fall River~~
Custer

(1) WELL CONSTRUCTION

Location of well: NE 1/4 NE 1/4 Section 2 Township 6S Range R1

Well owner Tennessee Valley Authority
(Name) (Address)

Date well drilling completed 8-17-81 Purpose of well Observation
(domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-420	Blk sh
420-500	1B gy clst & ss
500-580	Gy, rd & tn ss w/gy & brn clst

Attach sheet if more space is needed

Depth to top of water producing aquifer 503 ft.

Depth to static water level 34.2 ft.

Name of producing aquifer (if known) Fall River

Total depth of drill hole 580 ft.

Depth to bottom of casing 503 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4" blk iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 503-580

If a flowing well, flow of completed well NA G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ________ HP ________

Type of pump ________ Capacity of installed pump ________ G.P.M.

Depth of pump placement ________ ft., Date of pump installation ________

(3) WATER SURFACE MEASURING TUBE

- On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.
- Show exact vertical length of water surface measuring tube, when installed ________ ft., tube diameter ________ tube material ________.

DEC 1 81
DIVISION OF WATER RIGHTS
Pierre, SD

____
Name of Pump Installation Contractor

POWERTECH (USA) INC.
Hydro ID 631

SOUTH DAKOTA WATER WELL COMPLETION REPORT

07-92

Location SW ¼ SW ¼ Sec 23 Twp 6S Rg 1E

County Custer

North

Please mark well location with an "X"

W E

X

1 Mile

Well Completion Date Feb 98

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ~~Non Septic~~ ft. from ~~Non Septic~~ (identify source). NONE

PROPOSED USE:
☒ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☐ Monitoring well

METHOD OF DRILLING:
Air Rotary

CASING DATA: ☒ Steel ☒ Plastic ☐ Other
If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
15.5 LB/FT	5 IN	0 FT	70 FT	7⅞ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
Cement	8	6 gal lb./gal	0 ft.	30 ft.
		lb./gal	ft.	ft.

Describe grouting procedure Pumped

SCREEN: ☒ Perforated pipe ☐ Manufactured
Diameter 5 IN Length 40 FEET
Material Steel
Slot Size ¼ × 6 Set From 30 Feet to 70 Feet
Other information

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO
If so, what material? Rubber packer @ 30ft
Describe packer(s) and location?

DISINFECTION: Was well disinfected upon completion?
X YES, How: Chlorinated
___ NO, Why Not?

Laboratory sent to for water quality analysis

Well Owner: Lloyd & John Putnam
Business Name: Putnam & Putnam
Address: HC 59 Box 22
Edgemont SD 57735

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Sand & Gravel	0	75
Shale	75	80

STATIC WATER LEVEL 20 Feet
If flowing: closed in pressure ___ PSI
GPM flow ___ through ___ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other
Reduced Flowrate ___ GPM
Can well be completely shut in?

WELL TEST DATA:
☐ Pumped Describe: Air Lift
☐ Bailed ~~150~~ 15-20 gpm
☒ Other

Pumping Level Below Land Surface
___ ft. After ___ Hrs. pumped ___ GPM
___ ft. After ___ Hrs. pumped ___ GPM
If pump installed, pump rate ___ GPM

REMARKS

FEB 1999 WATER RIGHTS PROGRAM Pierre, SD

This well was drilled under license # 603
And this report is true and accurate.
Drilling firm Uptmiller Drilling
Signature of License Representative: Craig Uptmiller
Signature of Well Owner or Equitable Property Holder: Putnam & Putnam Partnership by John A Putnam
Date: 01.22.99

Hydro ID 657

NOTICE OF WELL CONSTRUCTION

WELL CONSTRUCTION

CUSTER

Location of well: NW 1/4 NE 1/4 Section 20 Township 6S Range 1E

Well owner: Tennessee Valley Authority (Name) (Address)

Date well drilling completed: 8-18-81 Purpose of well: Observation (domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-430	Blk sh
430-500	lB gy clst & ss
500-550	Gy & rd-brn ss
550-580	Gy wht sltst w/gy-gn clst
580-595	Rd, orng & yw-brn & gy ss
595-605	Gy wht sltst & gy-gn clst
605-660	Gy ss w/gy sltst & gn clst
660-690	Gy wht sltst & gn clst
690-700	Gy w/orng ss
700-745	lB brn & gy, tr yw ss brn & gy clst
745-800	Brn-gy & rd ss

Attach sheet if more space is needed

Depth to top of water producing aquifer: 715 ft.

Depth to static water level: 42.4 ft.

Name of producing aquifer (if known): Lakota

Total depth of drill hole: 800 ft.

Depth to bottom of casing: 715 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4" blk iron 10#/ft

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

open hole 715-800'

If a flowing well, flow of completed well: NA G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump: ______ HP

Type of pump: ______ Capacity of installed pump: ______ G.P.M.

Depth of pump placement: ______ ft., Date of pump installation: ______

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, Minimum WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______

tube material ______.

DEC 1981 DIVISION OF WATER RIGHTS Pierre, SD

Name of Pump Installation Contractor

Well owner Tennessee Valley Authority, P. O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 7-26-78 Purpose of well Test
(domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-30	Brown & Gray Soil
30-95	Brown-Gray Mudstone, Siltstone
95-135	IB Lt. Gray Sandstone, and Gray Mudstone
135-205	Variegated Mudstone & Siltstone
205-280	Tan & Gray Sandstone
280-305	Gray & Green Mudstone
305-335	Gray Sandstone
335-400	IB Brown-Gray Mudstone, Gray Sandstone
400-665	Gray, Brown & Green Mudstones
665-780	IB Red-Brown Sandstone and Gray & Green Claystone
780-840	Black Shale & Gray-Green Claystone
840-880	Red Siltstone-Mudstone

Attach sheet if more space is needed

Depth to top of water producing aquifer 665 ft.

Depth to static water level + 240 ft.

Name of producing aquifer (if known) Sundance

Total depth of drill hole 880 ft.

Depth to bottom of casing 780 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

5½" 14# Steel Casing

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Torch Slotted 666-780

If a flowing well, flow of completed well 4 G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______,

tube material ______

______
Name of Pump Installation Contractor

1978
STATE WATER RIGHTS COMM
Pierre SD

NOTICE OF WELL CONSTRUCTION

Range 1E

Owner: Tennessee Valley Authority, P. O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 11-7-79 Purpose of well Observation
(domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to low in feet	Description of layer
0-20	Weathered Brown Clay and Silt
20-250	Dark Gray Shale
250-375	Interbedded Gray Claystone, Lt. Gray Sandstone
375-410	Dark Gray Claystone
410-505	Lt. Gray-White Siltstone and Green Claystone
505-550	Red-Brown Sandstone w/Gray Mudstone

Attach sheet if more space is needed

Depth to top of water producing aquifer 504 ft.

Depth to static water level ______ ft.

Name of producing aquifer (if known). Lakota

Total depth of drill hole 550 ft.

Depth to bottom of casing 504 ft.

Casing information in the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4½" Schedual 40 Black Iron

Screen information. In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Open Hole 504-550

If a flowing well, flow of completed well est. 40 G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______, tube material ______

______
Name of Pump Installation Contractor

1978
STATE WATER RIGHTS COM.
Pierre, SD

Hydro ID 664

...CONSTRUCTION

Range

Owner: Tennessee Valley Authority, P. O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed: 11-7-78 Purpose of well: Observation
(domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to four in feet	Description of layer
0-20	Weathered Brown Clay and Silt
20-250	Dark Gray Shale
250-360	Gray Sandstone w/Lt. Med. Gray Claystone & Lt. Gray Siltstone

Attach sheet if more space is needed

Depth to top of water producing aquifer: 315 ft.

Depth to static water level: ft.

Name of producing aquifer (if known): Fall River

Total depth of drill hole: 360 ft.

Depth to bottom of casing: 315 ft.

Casing information in the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4½" Schedual 40 Black Iron

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Open Hole 315-360

If a flowing well, flow of completed well: est. 2 G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______

tube material ______

Name of Pump Installation Contractor

[Stamp:] 1978 STATE WATER RIGHTS COMM. Pierre, S.D.

Hydro ID 668

NOTICE OF WELL CONSTRUCTION

(1) WELL CONSTRUCTION

Location of well NW 1/4 NE 1/4 Section 15 Township 7S Range 1E

Well owner Tennessee Valley Authority - Box 49 - Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 1-31-77 Purpose of well Test, Dewatering
(domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0 - 15	Alluvium & brn sh
15 - 240	Dk gy fissile sh
240 - 340	Dk gy sh, md gy clst
340 - 365	Md gy-gn clst
365 - 420	Wh-lt gy sltst-vfgrss
420 - 445	Lt gn & gy clst
445 - 475	AA w/tr lt gy & brn vf-fgrss
475 - 485	Gy fgrss
485 - 500	AA w/brn mdst
`0 - 560	Pk & org calc cem vfgrss
560 - 574	Lt-dk gy mdst

Attach sheet if more space is needed

Depth to top of water producing aquifer 280, 480 ft.

Depth to static water level Flowing ft.

Name of producing aquifer (if known) Fall River, Lakota

Total depth of drill hole 574 ft.

Depth to bottom of casing 480 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

Schedule 40 Blk Iron 10" diameter
0 - 280
335 - 480

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Johnson Well Screen Stainless Steel .030 slot size
10" diam 280 - 335
8" diam 480 - 555

If a flowing well, flow of completed well 35 G.P.M.

Forward Drilling Co.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump Pioneer # P 300 34T 6" HP 50

Type of pump submersible Capacity of installed pump 300 G.P.M.

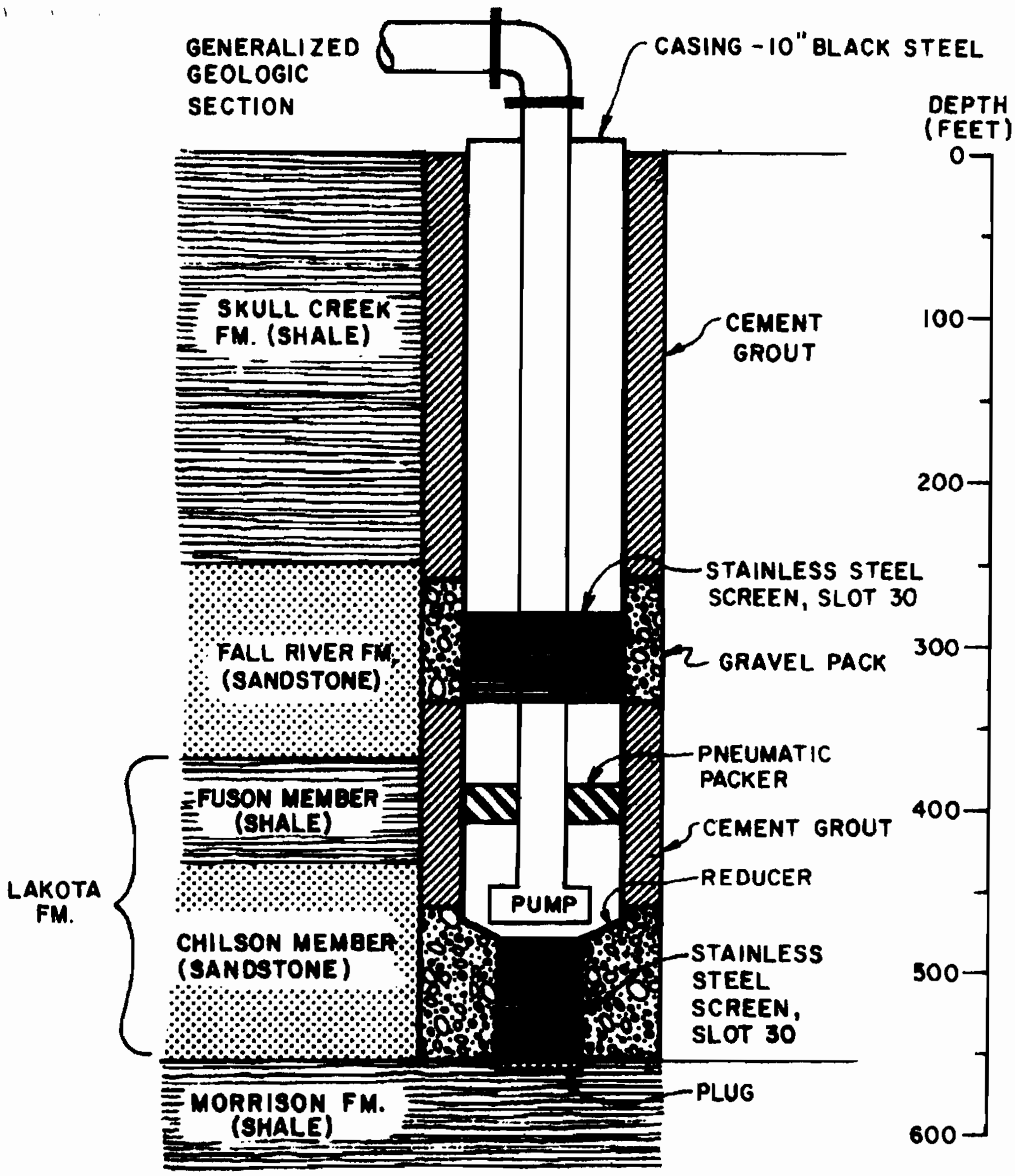
Depth of pump placement 455 ft, Date of pump installation Feb. 10, 1977

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46 408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft, tube diameter ______, tube material ______

Forward Drilling Co.
Name of Pump Installation Contractor



Source: Analysis of Aquifer Tests Conducted at the Proposed Burdock Uranium Mine Site, Burdock, South Dakota, WR-28-1-520-109, TVA, Boggs and Jenkins, May 1980.

Figure 2 : Burdock Well Profile

NOTICE OF WELL CONSTRUCTION

Township ___ Range 1E

Well Owner Tennessee Valley Authority, P. O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 10-25-78 Purpose of well Observation
(domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-25	Brown Weathered Shale
25-235	Gray Shale
235-265	AA with Lt. Gray Sandstone Siltstone
265-335	Brown Mudstone with Gray Sandstone & Gray-Green Mudstone
335-355	Gray Shale & Sandstone Siltstone
355-370	Tan-Gray Siltstone
370-390	Gray & Green Shale
390-405	Dark Brown Mudstone
405-440	Lt. Green Claystone-Siltstone
440-475	White Siltstone, Sandstone
475-485	Green Mudstone
485-495	Tan Mudstone-Siltstone
495-510	Gray Sandstone, Brown Mudstone
510-550	Red-Brown SS

Attach sheet if more space is needed

Depth to top of water producing aquifer 510 ft.

Depth to static water level ___ ft.

Name of producing aquifer (if known) Lakota

Total depth of drill hole 550 ft.

Depth to bottom of casing 510 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4½" Black Iron Schedual 40

Screen information: In the space below show length of screen below bottom casing, diameter and kind of screen or casing perforations.

Open Hole 510-550

If a flowing well, flow of completed well est. 35 G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ___ HP ___

Type of pump ___ Capacity of installed pump ___ G.P.M.

Depth of pump placement ___ ft., Date of pump installation ___

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ___ ft., tube diameter ___

tube material ___

Name of Pump Installation Contractor

1978
REC'D
STATE WATER
RIGHTS COMM
Pierre, SD

Hydro ID 670

NOTICE OF WELL CONSTRUCTION

FILED

Township ____ Range 1E

Well Owner: Tennessee Valley Authority, P. O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 10-19-78 Purpose of well Observation
(domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-20	Weathered Brown Clay & Silt
20-250	Dark Gray Shale
250-260	Interbedded Gray Claystone & Lt. Gray Sandstone
260-355	Gray Clay Stone
355-375	Lt. Gray-White Siltstone Gray Claystone
375-390	Gray & Green Shale
390-395	Dark Brown Mudstone

Attach sheet if more space is needed

Depth to top of water producing aquifer 377 ft.

Depth to static water level ____ ft.

Name of producing aquifer (if known) Lakota-Fuson

Total depth of drill hole 395 ft.

Depth to bottom of casing 377 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4½" Schedual 40 Black Iron

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Open Hole 377-395

If a flowing well, flow of completed well < 1 G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ____ HP ____

Type of pump ____ Capacity of installed pump ____ G.P.M.

Depth of pump placement ____ ft., Date of pump installation ____

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ____ ft., tube diameter ____

tube material ____

____
Name of Pump Installation Contractor

[Stamp: ... 1978 ... STATE WATER RIGHTS COMM. Pierre, SD]

NOT... OF WELL CONSTRUCTION

...ED

Owner: Tennessee Valley Authority, P. O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 10-18-78 Purpose of well Observation
(domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-10	Weathered Brown Clay & Silt
10-250	Dark Gray Shale
250-260	Interbedded Gray Claystone & Lt. Gray Sandstone
260-295	Med. & Lt. Gray Claystone
295-300	AA w/trace green & Red-Brown Claystone
300-335	Lt. Gray Sandstone, Medium & Lt. Gray Claystone
335-350	Gray-Green Mudstone, Gray Shale & Sandstone

Attach sheet if more space is needed

Depth to top of water producing aquifer 300' ft.

Depth to static water level ft.

Name of producing aquifer (if known) Fall River

Total depth of drill hole 350 ft.

Depth to bottom of casing 300' ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used

4½" Schedual 40 Black Iron

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Open Hole 300-350

If a flowing well, flow of completed well est. 2 G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ______ HP ______

Type of pump ______ Capacity of installed pump ______ G.P.M.

Depth of pump placement ______ ft., Date of pump installation ______

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required! See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ______ ft., tube diameter ______

tube material ______

______
Name of Pump Installation Contractor

1978
...WATER RIGHTS COMM...
Pierre, SD

Hydro ID 673

NOTICE OF WELL CONSTRUCTION

Township 7 Range 1E

Well owner Tennessee Valley Authority, P. O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed 11-6-78 Purpose of well Observation
(domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-260	Dark Gray Shale
260-280	Gray Shale & Sandstone
280-350	Gray Sandstone-Siltstone
350-355	Dark Brown Shale
355-395	Gray Shale & Sandstone
395-420	Gray-Green Mudstone

Attach sheet if more space is needed

Depth to top of water producing aquifer 400 ft.

Depth to static water level ft

Name of producing aquifer (if known) Lakota-Fuson

Total depth of drill hole 420 ft.

Depth to bottom of casing 400 ft.

Casing information: In the space below show kind, size, weight, length per diameter, etc., for production casing and surface casing, if used.

4½" Schedual 40 Black Iron

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Open Hole 400-420

If a flowing well, flow of completed well G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump HP

Type of pump Capacity of installed pump G.P.M.

Depth of pump placement ft., Date of pump installation

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required: See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ft, tube diameter

tube material

1978
STATE WATER
RIGHTS COMM
Pierre, SD

Name of Pump Installation Contractor

NOTICE OF WELL CONSTRUCTION

Sec ____ Township ____ Range 11

Well owner: Tennessee Valley Authority, P. O. Box 49, Edgemont, South Dakota
(Name) (Address)

Date well drilling completed: 11-6-78 Purpose of well: Observation
(domestic, irrigation, municipal, industrial, other)

WELL LOG

Layers, top to top in feet	Description of layer
0-10	Orange-Brown Weathered Shale
10-270	Dark Gray-Black Shale
270-280	AA w/Lt. Gray Siltstone Sandstone
280-390	Interbedded Dark Gray Carb. mudstone, Gray & Tan Sandstone
390-430	Dark Brown Mudstone w/Green-Gray Claystone
430-455	Green w/Brown & Gray Claystone
455-470	Dark Brown-Gray Mudstone, trace Green Claystone; Tan Sandstone
470-500	Green Claystone w/White Lt. Tan Siltstone-Sandstone
500-525	Gray-Brown Mudstone w/Tan Sandstone
525-570	Gray Sandstone w/Gray-Brown Mudstone

Attach sheet if more space is needed

Depth to top of water producing aquifer 525 ft.

Depth to static water level ____ ft.

Name of producing aquifer (if known) Lakota

Total depth of drill hole 570 ft.

Depth to bottom of casing 525 ft.

Casing information: In the space below show kind, size, weight, lengths per diameter, etc., for production casing and surface casing, if used.

4½" Schedual 40 Black Iron

Screen information: In the space below show length of screen below bottom of casing, diameter and kind of screen or casing perforations.

Open Hole 525-570

If a flowing well, flow of completed well est. 35 G.P.M.

Silver King Mines, Inc.
Name of Drilling Contractor

(2) PUMP INSTALLATION

Company name and size of pump ____ HP

Type of pump ____ Capacity of installed pump ____ G.P.M.

Depth of pump placement ____ ft., Date of pump installation ____

(3) WATER SURFACE MEASURING TUBE

On some wells an air-tight water surface measuring tube is required! See Section 46.408 of Chapter 46.4, MINIMUM WELL CONSTRUCTION STANDARDS.

Show exact vertical length of water surface measuring tube, when installed ____ ft., tube diameter ____

tube material ____

Name of Pump Installation Contractor

1978
STATE WATER RIGHTS COMM
Pierre, SD

POWERTECH (USA) INC.

Hydro ID 676

SOUTH DAKOTA WATER WELL COMPLETION REPORT

 07-92

Location NE ¼ SW ¼ Sec. 34 Twp 6S Rg 1E

County Custer

North

Please mark well location with an "X"

Long -103.986774 W E

Lat 43.481733

Well Completion Date 9/26/2007

1 Mile

Well Owner: Powertech

Business Name: Same

Address: 145 N. Chicago Avenue, Suite C
Hot Springs, SD 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
See attached boring log		

RECEIVED
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WATER RIGHTS PROGRAM

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from ______ (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING:
4¼ ID. HSA

CASING DATA: ☐ Steel ☒ Plastic ☐ Other
If other describe PVC

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
___ LB/FT	2 IN	2½ Above FT	12½ below FT	8½ IN
___ LB/FT	___ IN	___ FT	___ FT	___ IN
___ LB/FT	___ IN	___ FT	___ FT	___ IN

STATIC WATER LEVEL 17.65 Feet
If flowing: closed in pressure Not flowing PSI
GPM flow ______ through ______ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other ______
Reduced Flowrate ______ GPM
Can well be completely shut in? ______

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
		lb./gal	~~1 ft. 10½~~	
		lb./gal	1 ft.	9½ ft

Describe grouting procedure [redacted] Tremie pipe

WELL TEST DATA:
☐ Pumped Describe: Developed using a bailer
☒ Bailed Well did not bail down.
☐ Other

Pumping Level Below Land Surface
______ ft. After ______ Hrs. pumped ______ GPM
______ ft. After ______ Hrs. pumped ______ GPM
If pump installed, pump rate ______ GPM

SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 2 IN Length 10 FEET
Material PVC
Slot Size 0.010 Set From 12½ Feet to 22½ Feet
Other information ______

REMARKS
Well Designation: DB-GW676

This well was drilled under license # 678
And this report is true and accurate.
Drilling firm American Engineering Testing, Inc
Signature of License Representative:
Signature of Well Owner or Equitable Property Holder:
X
Date: 11/2/07

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO
If so, what material? 2' Bentonite
Describe packer(s) and location? Above Sand Pack

DISINFECTION: Was well disinfected upon completion?
___ YES, How:
X NO, Why Not? Not for human or domestic use

Laboratory sent to for water quality analysis

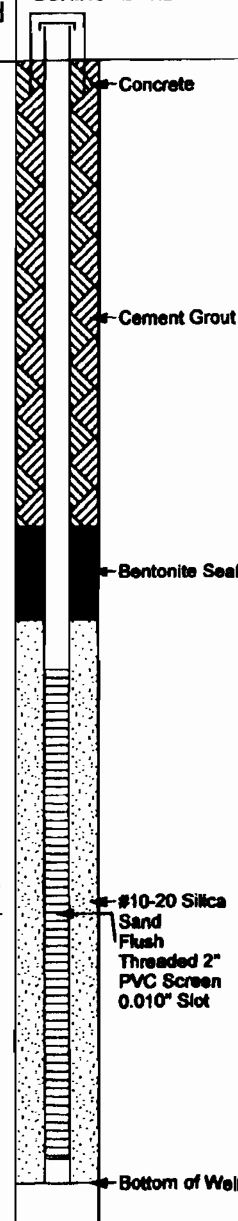
AMERICAN ENGINEERING TESTING, INC.

BORING/WELL CONSTRUCTION LOG

PROJECT NUMBER	18-02617	BORING/WELL NUMBER	B-4/DB-GW676
PROJECT NAME	Dewey Burdock Monitor Well Installation	DATE DRILLED	9/25/07
LOCATION	Burdock, South Dakota	CASING TYPE/DIAMETER	2" ID Schedule 40 PVC
DRILLING METHOD	4.25" ID HSA	SCREEN TYPE	2" ID Schedule 40 PVC Slotted 0.010"
SAMPLING METHOD	Continuous	PACKING TYPE	#10-20 Silica Sand
GROUND ELEVATION		GROUT TYPE	Cement
TOP OF CASING		DEPTH TO WATER	17.50
LOGGED BY	CH	GROUND WATER ELEVATION	
REMARKS	Well was completed with a 4" Pro Top		

HNU (ppm)	Blow Count	RECOVERY (inches)	SAMPLER TYPE	INTERVAL	DEPTH (ft. BGL)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	GW LEVEL
			CSTS 1			CS		**TOPSOIL**, with organics, dark brown, dry	
								SANDY SILT, red, dry	
			CSTS 2		1				
					2				
					3				
			CSTS 3		4				
					5				
					6				
					7				
					8				
			CSTS 4		9				
					10				
					11				
					12				
			CSTS 5		13			**SILTY SANDY GRAVEL**, with cobbles, red to brown, dry to moist	
			CSTS 6		14			Same wet at 17.5 feet	
					15				
					16				
					17				∇
					18				
			CSTS 7		19			Same saturated	
					20				
					21				
					22				
					23			End of Boring	

BORING ABANDONED



AET_ENV1 18-02617 MW.GPJ AET_ENV.GDT 11/2/07

AMERICAN
ENGINEERING
TESTING, INC.

CONSULTANTS
• GEOTECHNICAL
• MATERIALS
• ENVIRONMENTAL

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PROGRAM

January 11, 2008

Mr. Ken Buhler
Department of Environment and Natural Resources (DENR)
Water Rights Division
Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

Subject: South Dakota Water Well Completion Reports
Wells Installed for Powertech
Burdock, South Dakota
AET No. 18-02617

Dear Mr. Buhler:

Enclosed please find the well completion reports for five groundwater monitoring wells, DB-GW675, DB-GW676, DB-GW677, DB-GW678 & DB-GW679 .The wells were completed to obtain information on the potential shallow groundwater impacts from previous uranium mining within the project area prior to initiating new uranium production activities within the Dewey-Burdock, South Dakota area. If you have any questions or need any additional information please contact me at (605) 388-0029.

Sincerely,

Clarke L. Knigge, CPRR
Environmental Scientist
Project Manager

CLK

attachments

pc: Mr. Cory Foreman, RESPEC

Y:\wp8\Environmental\Correspondence\18-02617 MW Completion Report.wpd

1745 Samco Road • Rapid City, SD 57702 • 605-388-0029 • Fax 605-388-0064 • www.amengtest.com
Chanhassen • Duluth • Mankato • Marshall • Rochester • St. Paul, MN/Pierre • Rapid City • Sioux Falls, SD/La Crosse • Wausau, WI

NOTES: Hydro ID 676 JOB #

B-4 DB-GW 676

6" TOPSOIL W/ ORGANICS - DK BROWN, DRY

TO 5' → SANDY SILT, RED, DRY

TO 10' → SILTY SAND, RED, DRY

SAME TO 13'

@ 13' → SILTY SANDY GRAVEL W/ COBBLES, RED TO BROWN, DRY TO MOIST

SAME TO 20'; WET @ 17.5'

Same to 22½' Sat.

Hydro ID 677

SOUTH DAKOTA WATER WELL COMPLETION REPORT

 07-92

Location SW ¼ SW ¼ Sec 4 Twp 7S Rg 1E

County Fall River

Please mark well location with an "X"

Long -104.0131
Lat 43.464791

Well Completion Date 9/25/2007

1 Mile

Well Owner: Powertech
Business Name: Same
Address: 145 N. Chicago Avenue, Suite C
Hot Springs, SD 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
See Attached Boring Log		

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LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from ______ (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING:
4¼ HSA

CASING DATA: ☐ Steel ☒ Plastic ☐ Other
If other describe PVC

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
LB/FT	2 IN	2½ above FT	4 below FT	8½ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
		lb./gal	ft	ft
		lb./gal	ft	ft

Describe grouting procedure Top 1' filled w/Concrete

SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 2 IN Length 10 FEET
Material PVC
Slot Size 0.010 Set From 4 Feet to 14 Feet
Other information

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO
If so, what material? 2' Bentonite Plug
Describe packer(s) and location? Above Sand Pack

DISINFECTION: Was well disinfected upon completion?
____ YES, How: ____
X NO, Why Not? Not for Human or Domestic Animal use

Laboratory sent to for water quality analysis

STATIC WATER LEVEL ≈ 9 Feet
If flowing: closed in pressure Not flowing PSI
GPM flow ______ through ______ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other ______
Reduced Flowrate ______ GPM
Can well be completely shut in? ______

WELL TEST DATA:
☐ Pumped
☒ Bailed
☐ Other
Describe: Developed utilizing a bailer. Well did not bail down

Pumping Level Below Land Surface
______ ft. After ______ Hrs. pumped ______ GPM
______ ft. After ______ Hrs. pumped ______ GPM
If pump installed, pump rate ______ GPM

REMARKS
DB-GW677

This well was drilled under license # 678
And this report is true and accurate.
Drilling firm American Engineering Testing
Signature of License Representative: [signature]
Signature of Well Owner or Equitable Property Holder: X [signature]
Date: 11/2/07

POWERTECH (USA) INC.

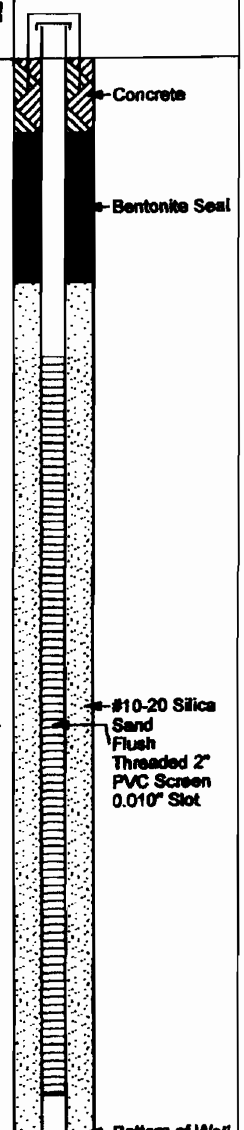
AMERICAN ENGINEERING TESTING, INC.

BORING/WELL CONSTRUCTION LOG

PROJECT NUMBER	18-02617	BORING/WELL NUMBER	B-2/DB-GW677
PROJECT NAME	Dewey Burdock Monitor Well Installation	DATE DRILLED	9/25/07
LOCATION	Burdock, South Dakota	CASING TYPE/DIAMETER	2" ID Schedule 40 PVC
DRILLING METHOD	4.25" ID HSA	SCREEN TYPE	2" ID Schedule 40 PVC Slotted 0.010"
SAMPLING METHOD	Continuous	PACKING TYPE	#10-20 Silica Sand
GROUND ELEVATION		GROUT TYPE	Cement
TOP OF CASING		DEPTH TO WATER	9.00
LOGGED BY	CH	GROUND WATER ELEVATION	

REMARKS Well was completed with a 4" Pro Top

HNU (ppm)	Blow Count	RECOVERY (inches)	SAMPLER TYPE	INTERVAL	DEPTH (ft. BGL)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	GW LEVEL
			CSTS 1		0			SANDY SILT, medium grain, tan	
					1				
					2	CL			
					3				
			CSTS 2		4			SANDY SILT	
					5				
			CSTS 3		6			SILTY SAND, poorly sorted	
					7				
			CSTS 4		7.5			SILTY SAND, tan	
					8				
			CSTS 5		9			SAND, very fine grained, tan, wet	▽
					10				
					11				
					12				
			CSTS 6		12.5			SHALE(Belle Fourche), dark gray, fissile	
					13				
					14				



AET_ENVI 18-02617 MW.GPJ AET_ENVI.GDT 11/2/07

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TESTING, INC.

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• ENVIRONMENTAL

January 11, 2008

Mr. Ken Buhler
Department of Environment and Natural Resources (DENR)
Water Rights Division
Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

Subject: South Dakota Water Well Completion Reports
Wells Installed for Powertech
Burdock, South Dakota
AET No. 18-02617

Dear Mr. Buhler:

Enclosed please find the well completion reports for five groundwater monitoring wells, DB-GW675, DB-GW676, DB-GW677, DB-GW678 & DB-GW679 .The wells were completed to obtain information on the potential shallow groundwater impacts from previous uranium mining within the project area prior to initiating new uranium production activities within the Dewey-Burdock, South Dakota area. If you have any questions or need any additional information please contact me at (605) 388-0029.

Sincerely,

Clarke L. Knigge, CPRR
Environmental Scientist
Project Manager

CLK

attachments

pc: Mr. Cory Foreman, RESPEC

Y:\wp8\Environmental\Correspondence\18-02617 MW Completion Report.wpd

DB-GW677

Location south of Putnam house

Construction Details

Total Depth	14.5'
Screen Inverval	4.5 – 14.5'
Sand pack	3 – 14.5'
Bentonite	1 – 3'
Cement	0 – 1'

Water Level ~9' below surface

Lithology

0 – 4 ft	med tan, sandy silt
4 – 6 ft	sandy silt
6 – 7.5 ft	cobbles in silty sand, poorly sorted
7.5 – 9 ft	tan, silty sand
9 – 12.5 ft	wet, tan, very fine grained sand
12.5 -14.5 ft	dark gray, fissile shale (Belle Fourche Fm)

Hydro ID 678

SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 4 07-92

Location SW ¼ NE ¼ Sec 9 Twp 7S Rg 1E

County Fall River

Please mark well location with an "X"

Long -104.001135

Lat 43.459121

Well Completion Date 9/25/2007

North / W / E — 1 Mile

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from ______ (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING: 4 1/4 ID HSA

CASING DATA: ☐ Steel ☒ Plastic ☐ Other
If other describe PVC

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
LB/FT	2 IN	2 1/2 above FT	4 below FT	8 1/2 IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
		lb./gal	ft	ft
		lb./gal	ft	ft

Describe grouting procedure Top 1' filled w/ Concrete

SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 2 IN Length 10 FEET
Material PVC
Slot Size 0.010 Set From 4 Feet to 14 Feet
Other information ______

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO
If so, what material? 2' Bentonite
Describe packer(s) and location? Above Sand Pack

DISINFECTION: Was well disinfected upon completion?
____ YES, How:
Laboratory sent to for water quality analysis ____ X NO, Why Not? Well not used for human or domestic animal consump

Well Owner: Powertech
Business Name: Same
Address: 145 N. Chicago Avenue, Suite C
Hot Springs, SD 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
See Attached Log		

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STATIC WATER LEVEL ≈ 9.6 Feet
If flowing: closed in pressure Not flowing PSI
GPM flow ______ through ______ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other ______
Reduced Flowrate ______ GPM
Can well be completely shut in? ______

WELL TEST DATA:
☐ Pumped
☒ Bailed
☐ Other
Describe: Developed using a bailer. Well did not bail down

Pumping Level Below Land Surface
______ ft. After ______ Hrs. pumped ______ GPM
______ ft. After ______ Hrs. pumped ______ GPM
If pump installed, pump rate ______ GPM

REMARKS
Well Designation DB-GW678

This well was drilled under license # 678
And this report is true and accurate.
Drilling firm American Eng. Testing, Inc.
Signature of License Representative: [signature]
Signature of Well Owner or Equitable Property Holder: X [signature]
Date: 11/2/07

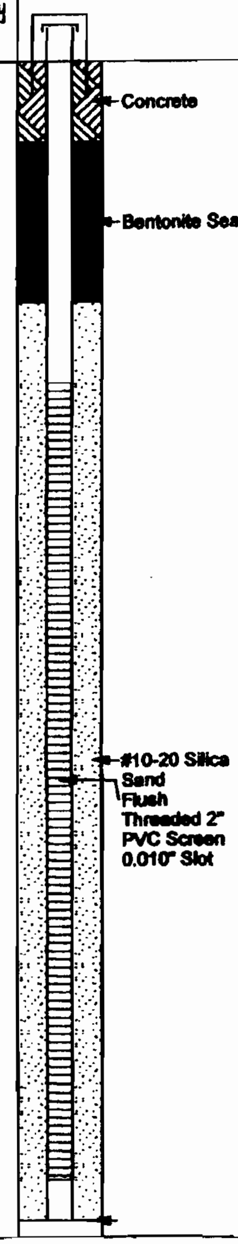
AMERICAN ENGINEERING TESTING, INC.

BORING/WELL CONSTRUCTION LOG

PROJECT NUMBER 18-02617
PROJECT NAME Dewey Burdock Monitor Well Installation
LOCATION Burdock, South Dakota
DRILLING METHOD 4.25" ID HSA
SAMPLING METHOD Continuous
GROUND ELEVATION
TOP OF CASING
LOGGED BY CH
REMARKS Well was completed with a 4" Pro Top

BORING/WELL NUMBER B-3/DB-GW678
DATE DRILLED 9/25/07
CASING TYPE/DIAMETER 2" ID Schedule 40 PVC
SCREEN TYPE 2" ID Schedule 40 PVC Slotted 0.010"
PACKING TYPE #10-20 Silica Sand
GROUT TYPE Cement
DEPTH TO WATER ~8.00
GROUND WATER ELEVATION

HNU (ppm)	Blow Count	RECOVERY (inches)	SAMPLER TYPE	INTERVAL	DEPTH (ft. BGL)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	GW LEVEL
			CSTS 1		0–4			**SILTY SAND**, very fine grained, red	
			CSTS 2		4–9			**SILTY SAND**, very fine grained, red	
			CSTS 3		9–14			**SILTY SAND**, very fine grained with 1-inch beds of medium to course sand	



AET_ENVI 18-02617 MW.GPJ AET_ENVI.GDT 11/2/07

AMERICAN ENGINEERING TESTING, INC.

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WATER RIGHTS PROGRAM

CONSULTANTS
• GEOTECHNICAL
• MATERIALS
• ENVIRONMENTAL

January 11, 2008

Mr. Ken Buhler
Department of Environment and Natural Resources (DENR)
Water Rights Division
Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

Subject: South Dakota Water Well Completion Reports
Wells Installed for Powertech
Burdock, South Dakota
AET No. 18-02617

Dear Mr. Buhler:

Enclosed please find the well completion reports for five groundwater monitoring wells, DB-GW675, DB-GW676, DB-GW677, DB-GW678 & DB-GW679 .The wells were completed to obtain information on the potential shallow groundwater impacts from previous uranium mining within the project area prior to initiating new uranium production activities within the Dewey-Burdock, South Dakota area. If you have any questions or need any additional information please contact me at (605) 388-0029.

Sincerely,

Clarke L. Knigge, CPRR
Environmental Scientist
Project Manager

CLK

attachments

pc: Mr. Cory Foreman, RESPEC

Y:\wp8\Environmental\Correspondence\18-02617 MW Completion Report.wpd

1745 Samco Road • Rapid City, SD 57702 • 605-388-0029 • Fax 605-388-0064 • www.amengtest.com
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DB-GW678

Location along Pass Creek west of Burdock

Construction Details

Total Depth	14.5'
Screen Inverval	4.5 – 14.5'
Sand pack	3 – 14.5'
Bentonite	1 – 3'
Cement	0 – 1'

Water Level ~8' below surface

Lithology

0 – 9 ft	very fine grained, red, silty sand
9 – 14 ft	dominantly vfg silty sand with 1" beds of med to coarse sand (did not penetrate shale)

POWERTECH (USA) INC.

Hydro ID 679

SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 4 07-92

Location NW ¼ SE ¼ Sec 27 Twp 6S Rg 1E

County Custer

Please mark well location with an "X"

Long -103.985091

Lat 43.499534

Well Completion Date 9/26/2007

North / W / E / 1 Mile

Well Owner: Powertech

Business Name: Same

Address: 145 N. Chicago Avenue, Suite C Hot Springs, SD 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
See attached boring log		

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LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from ______ (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING:
4¼ ID HSA

STATIC WATER LEVEL 31.28 Feet

If flowing: closed in pressure Not flowing PSI

GPM flow ______ through ______ inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other ______

Reduced Flowrate ______ GPM

Can well be completely shut in? ______

CASING DATA: ☐ Steel ☒ Plastic ☐ Other

If other describe PVC

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
___ LB/FT	~~2~~ IN	~~19~~ FT	~~39~~ FT	~~8½~~ IN
___ LB/FT	2 IN	2' above FT	19 below FT	___ IN
___ LB/FT	___ IN	___ FT	___ FT	___ IN

WELL TEST DATA:
☐ Pumped ☒ Bailed ☐ Other
Describe: Well developed using a bailer. Well did not bail down

Pumping Level Below Land Surface
______ ft. After ______ Hrs. pumped ______ GPM
______ ft. After ______ Hrs. pumped ______ GPM
If pump installed, pump rate ______ GPM

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
		lb./gal	1 ft.	16 ft.
		lb./gal	ft.	ft.

Describe grouting procedure Tremie pipe placement

SCREEN: ☐ Perforated pipe ☒ Manufactured

Diameter 2 IN Length 20 FEET

Material PVC

Slot Size 0.010 Set From 19 Feet to 39 Feet

Other information ______

REMARKS

Well Designation: DB-GW679

This well was drilled under license # 678

And this report is true and accurate.

Drilling firm American Engineering Testing, Inc

Signature of License Representative: [signature]

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO

If so, what material? 2' Bentonite

Describe packer(s) and location? Above Sand Pack

DISINFECTION: Was well disinfected upon completion?
___ YES, How: ______
X NO, Why Not? Well not used for human or domestic animals

Laboratory sent to for water quality analysis ______

Signature of Well Owner or Equitable Property Holder:
X [signature]

Date: 11/7/07

1-15-08

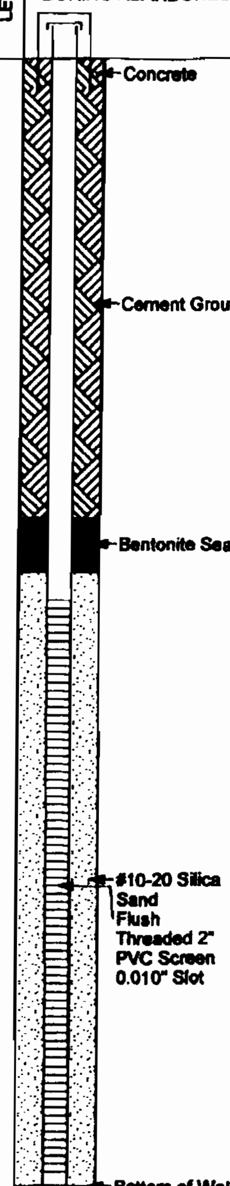
AMERICAN ENGINEERING TESTING, INC.

BORING/WELL CONSTRUCTION LOG

PROJECT NUMBER	18-02817	BORING/WELL NUMBER	B-5/DB-GW679
PROJECT NAME	Dewey Burdock Monitor Well Installation	DATE DRILLED	9/25/07
LOCATION	Burdock, South Dakota	CASING TYPE/DIAMETER	2" ID Schedule 40 PVC
DRILLING METHOD	4.25" ID HSA	SCREEN TYPE	2" ID Schedule 40 PVC Slotted 0.010"
SAMPLING METHOD	Continuous	PACKING TYPE	#10-20 Silica Sand
GROUND ELEVATION		GROUT TYPE	Cement
TOP OF CASING		DEPTH TO WATER	
LOGGED BY	CH	GROUND WATER ELEVATION	
REMARKS	Well was completed with a 4" Pro Top		

HNU (ppm)	Blow Count	RECOVERY (inches)	SAMPLER TYPE	INTERVAL	DEPTH (ft. BGL)	U.S.C.S.	GRAPHIC LOG	MATERIAL DESCRIPTION	GW LEVEL
			CSTS 1		0			**TOPSOIL**, dark brown, dry	
					0.5			**SANDY SILT**, red, dry	
			CSTS 2						
			CSTS 3		4			**SILTY SAND**, red to tan, dry to moist	
			CSTS 4						
			CSTS 5						
			CSTS 6		17			**SAND WITH GRAVEL**, red moist	
					17.5			**COBBLES**, no recovery	
			CSTS 7		19			**SILTY SAND TO SAND** red to tan, moist	
			CSTS 8						
			CSTS 9		24			**SAND with GRAVEL**, red, moist	
			CSTS 10		27			**SANDY LEAN CLAY**, red moist	
			CSTS 11		29			**SAND WITH GRAVEL**, red moist 6 inch gray layer of sand at 30 feet	
			CSTS 12						
			CSTS 13		36.5			**SHALE**, black, moist	
					39.5				

BORING ABANDONED



AET_ENVI 18-02817 MW.GPJ AET_ENVI.GDT 11/2/07

AMERICAN ENGINEERING TESTING, INC.

CONSULTANTS
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• ENVIRONMENTAL

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WATER RIGHTS PROGRAM

January 11, 2008

Mr. Ken Buhler
Department of Environment and Natural Resources (DENR)
Water Rights Division
Joe Foss Building
523 East Capitol
Pierre, South Dakota 57501-3181

Subject: South Dakota Water Well Completion Reports
Wells Installed for Powertech
Burdock, South Dakota
AET No. 18-02617

Dear Mr. Buhler:

Enclosed please find the well completion reports for five groundwater monitoring wells, DB-GW675, DB-GW676, DB-GW677, DB-GW678 & DB-GW679 .The wells were completed to obtain information on the potential shallow groundwater impacts from previous uranium mining within the project area prior to initiating new uranium production activities within the Dewey-Burdock, South Dakota area. If you have any questions or need any additional information please contact me at (605) 388-0029.

Sincerely,

Clarke L. Knigge, CPRR
Environmental Scientist
Project Manager

CLK

attachments

pc: Mr. Cory Foreman, RESPEC

Y:\wp8\Environmental\Correspondence\18-02617 MW Completion Report.wpd

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B-5 Hydro ID 679B - GW679

6" Topsoil - Dk Brn, Dry

To 5' Sandy Silt, Red, Dry

To 10' Silty Sand, Rd to Tan, Dry to moist

To 15 Same Red

To 17 Same

17-17½ Sand w/ Gravel, Red, moist

17½-18 cobbles, no recovery

TO 25 Silty Sand to Sand, Rd to Tan, moist

To 27 Sand w/ gravel, Red, moist

To 29 Sandy loam Clay, Red, wet

To 30 Sand w/ gravel, Red, moist, 6" Gray layer of Sand.

To 35 Sand w/ gravel, Red, moist sat @ 34.

To 36½ Same

To 39 Shale, Dk Black, moist

COMPLETED BY: REVIEWED BY:

NE 1/4 SW 1/4

Hydro ID 680

SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 11 07-92

Location ~~SW~~ ¼ ~~NW~~ ¼ Sec 11 Twp 7S Rg 1E

County Fall River

Please mark well location with an "X"

North / W / E — X marked in section grid — 1 Mile

Well Completion Date 12-19-07

Well Owner: ~~[illegible]~~ ~~[illegible]~~ Powertec

Business Name: Powertech USA Inc

Address: P.O. Box 723
Hot Springs S.D 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Skull Creek Sh	0'	122'
Fall River SS	122'	250'
Fuson Sh	250'	317'
Lakota SS	317'	436'

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from NONE Present (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING: Mud Rotary

CASING DATA: ☐ Steel ☒ Plastic ☐ Other
If other describe ______

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SDR 21 LB/FT	6 IN	0 FT	426 FT	8¾ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	95.3	15.1 lb./gal	426 ft.	0 ft.
		lb./gal	ft.	ft.

Describe grouting procedure pump

SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 4½ IN Length 10 FEET
Material PVC
Slot Size .025 Set From 436 Feet to 426 Feet
Other information Set With K Packer

WAS A PACKER OR SEAL USED? ☑ YES ☐ NO
If so, what material? 6" K Packer
Describe packer(s) and location? Packer 406'

DISINFECTION: Was well disinfected upon completion?
___ YES, How:
X NO, Why Not? NA

Laboratory sent to for water quality analysis: Respec

STATIC WATER LEVEL 29 Feet
If flowing: closed in pressure NA PSI
GPM flow ______ through ______ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other ______
Reduced Flowrate ______ GPM
Can well be completely shut in? YES

WELL TEST DATA:
☐ Pumped Describe: Airlift AT 385'
☐ Bailed
☑ Other

Pumping Level Below Land Surface
______ ft. After ______ Hrs. pumped 240 cubic Feet GPM
______ ft. After ______ Hrs. pumped ______ GPM
If pump installed, pump rate ______ GPM

REMARKS Well DB-07-11-11C
lithology attached.

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This well was drilled under license # 745
And this report is true and accurate.
Drilling firm DAVIS Drilling Inc
Signature of License Representative: Stan Davis
Signature of Well Owner or Equitable Property Holder: [signature] Powertech (USA) Inc
Date: 12-31-07

1-14-08

POWERTECH (USA) INC.

Hydro ID 680

PowerTech (USA) Inc.

DRILLED WITH: AIR [ ] WATER [X] HOLE NO. DB07-11-11C

T.D. 450' LOCATION: Section 11 T7S R1E 10' SE of 11-4C

BIT SIZE 6¾" to 3" (cores) 4½" bit.

SAMPLE LOG BY LE LEASE: (PROJECT) Dewey Burdock

DATE 10/10/07 COUNTY Fall R. County STATE SD

DEPTH	LITHOLOGY	CARBON	PYRITE	UT Reduction	Alteration %: Primary Oxidation	Reduction	Secondary Oxidation	SAMPLE DESCRIPTION (Amounts in Percent, %) — L=Limonite (Lmn), SOX Surf. Oxidation, Rd. Reduced, Rdt. Reduction, P=Pyrite (Pyr), P_T=Pyrite Tarnish, POX=Primary Oxid., BSOX=Base of Surf. Oxid., 2OX=Secondary Oxid., Tz=Transition Zone, fld=Feldspar; T=Trace, 1=Minor, 2=Moderate, 3=Abundant; C=Carbon, K=Kaolin, B=Bleached, Cht=Chert
0								0-5' silty CLAYSTONE, red brown
								5-100' SHALE, dk. gray - grayish black
10								
20								
30								
40								
50								
60								
70								
80								
90								
100								

PAGE 1 OF 5

POWERTECH (USA) INC.

PowerTech (USA) Inc.

Hydro ID 680

DRILLED WITH: AIR ☐ WATER ☐ HOLE NO. DB07-11-11C

T.D. ______ LOCATION: ______

BIT SIZE ______

SAMPLE LOG BY ______ LEASE: (PROJECT) ______

DATE ______ COUNTY ______ STATE ______

DEPTH	LITHOLOGY	CARBON	PYRITE	OTHER Mineralization	Alteration % Primary Oxidation	Bleaching	Reduction	Secondary Oxidation	SAMPLE DESCRIPTION (Amounts in Percent, %)
100									
110									
120									120-135' silty SHALE, dk. gray
130									
140									135-210' sandy SILTSTONE, silty fine gr. SANDSTONE, grayish brown, poorly sorted, varying; alternating sandy & silty layers,
150									
160									
170									
180									
190									
200									

L=Limonite (Lmn), SOX Surf. Oxidation, Rd. Reduced, Rdt. Reduction, P= Pyrite (Pyr), P_T = Pyrite Tarnish, POX= Primary Oxid., BSOX= Base of Surf. Oxid., SOX= Secondary Oxid., Tn= Transition Zone, fld= Feldspar, T=Trace, 1=Minor, 2=Moderate, 3=Abundant, C=Carbon, K=Kaolin, B=Bleached, Cht=Chert

PAGE 2 OF 5

POWERTECH (USA) INC.

Hydro ID 680

PowerTech (USA) Inc.

DRILLED WITH: AIR [ ] WATER [ ] HOLE NO. DB07-11-11C

T.D. ________ LOCATION: ________

BIT SIZE ________

SAMPLE LOG BY ________ LEASE: (PROJECT) ________

DATE ________ COUNTY ________ STATE ________

DEPTH	LITHOLOGY	CARBON	PYRITE	OTHER MINERALIZATION	Alteration % Primary Oxidation	Reduction	Secondary Oxidation	SAMPLE DESCRIPTION (Amounts in Percent, %)
								L=Limonite (Lmn); SOX Surf. Oxidation; Rd. Reduced; Rdt. Reduction; P=Pyrite (Pyr); P_T=Pyrite Tarnish; POX=Primary Oxid.; BSOX=Base of Surf. Oxid.; SOX=Secondary Oxid.; Tz=Transition Zone; fld=Feldspar; T=Trace; 1=Minor; 2=Moderate; 3=Abundant; C=Carbon; K=Kaolin; B=Bleached; Cht=Chert
200								
210								210-250' sl. silty fine gr. SANDSTONE, brownish gray, mod sorted, subang-subrnd, - mostly well sorted w/ some interbedded silty layers, reduced
220								
230								
240								
250								CORE INTERVAL 250 - 255'8"
								255'8"-320' SHALE with interbedded SILTSTONE (mudstone), mostly reddish gray & mod. brown
260								
270								
280								
290								
300								

POWERTECH (USA) INC.

PowerTech (USA) Inc.

Hydro ID 680

DRILLED WITH: AIR ☐ WATER ☐ HOLE NO. DB07-11-11C

T.D. ______ LOCATION: ______

BIT SIZE ______

SAMPLE LOG BY ______ LEASE: (PROJECT) ______

DATE ______ COUNTY ______ STATE ______

DEPTH	LITHOLOGY	CARBON	PYRITE	OTHER Mineralization	Alteration % Primary Oxidation	Reduction	Secondary Oxidation	SAMPLE DESCRIPTION (Amounts in Percent, %) L=Limonite (Lm) SOX Surf. Oxidation Rd. Reduced Rdt. Reduction P=Pyrite (Pyr) P_T=Pyrite Tarnish POX=Primary Oxid. BSOX=Base of Surf. Oxid. 2OX=Secondary Oxid. Tz=Transition Zone fld=Feldspar T=Trace 1=Minor 2=Moderate 3=Abundant C=Carbon K=Kaolin B=Bleached Cht=Chert
300								
310								
320								320-360' fine gr. SANDSTONE, lt. brown-grayish brown, well sorted, ang-subrnd, ~ more silty from 335-360' = mod sorted, mostly reduced <5% ox.
330								
340								
350								
360								360-410' mostly SHALE with some silt interbeds, med. gray
370								
380								
390								
400								

PAGE 4 OF 5

POWERTECH (USA) INC.

PowerTech (USA) Inc.

DRILLED WITH: AIR ☐ WATER ☐ HOLE NO. DG07-11-11C

T.D. ______ LOCATION: ______

BIT SIZE ______ ______

SAMPLE LOG BY ______ LEASE: (PROJECT) ______

DATE ______ COUNTY ______ STATE ______

DEPTH	LITHOLOGY	CARBON	PYRITE	OTHER	Alteration %: Primary Oxidation	Reduction	Secondary Oxidation	SAMPLE DESCRIPTION (Amounts in Percent, %) — L=Limonite (Lmn), SOX Surf. Oxidation, Rd. Reduced, Rdt. Reduction, P=Pyrite (Pyr), P_T=Pyrite Tarnish, POX=Primary Oxid., BSOX=Base of Surf. Oxid., 2OX=Secondary Oxid., Tn=Transition Zone, fld=Feldspar, T=Trace, 1=Minor, 2=Moderate, 3=Abundant, C=Carbon, K=Kaolin, B=Bleached, Cht=Chert
400								
410								CORE INTERVAL 410'-420'
420								CORE INTERVAL 420-430'
430								CORE INTERVAL 430-440'
440								CORE INTERVAL 440'-450'
450								TD 450' END OF HOLE
460								
470								
480								
490								
500								

PAGE 5 OF 5

Hydro ID 680

PowerTech (USA) Inc.

DRILLED WITH: AIR ☐ WATER ☒ HOLE NO. DB07-11-11C

T.D. 450' LOCATION: Sec 11, T7S, R1E 10' SE of 11-4C

BIT SIZE 6¼" to 3" cored 4.5" bit

SAMPLE LOG BY DT LEASE: (PROJECT) Dewey Burdock

DATE 10/09/07 COUNTY Fall River STATE SD

DEPTH	LITHOLOGY	CARBON	PYRITE	OTHER Alteration	Primary Oxidation	Reduction	Secondary Oxidation	SAMPLE DESCRIPTION (Amounts in Percent, %) L=Limonite (Lm) SOX Surf. Oxidation Rd. Reduced Rdt. Reduction P= Pyrite (Pyr) P_T = Pyrite Tarnish POX= Primary Oxid. BSOX = Base of Surf. Oxid. 2OX = Secondary Oxid. Tn = Transition Zone fld = Feldspar T = Trace 1 = Minor 2 = Moderate 3 = Abundant C=Carbon K=Kaolin B=Bleached Cht=Chert
250.0								CORE interval starts @ 249,1" grey, fine-grained, subrounded, pyritic clean, well-sorted, trace silt, qtz ss. colorless qtz grains. Heavy pyrite @ 250,4" to 250,5.5"
								At 250,9" contact black + dark gray fissile shale + mudstone.
2510								
2520								
2530								
2540								254,4" Increase in plastic clay content and decrease in fissility
2550								255,2" grades quickly back to fissile shale and mudstone.
								255,9" TD of core run.
2560								
2570								
2580								
2590								CONFIDENTIAL
2600								

PAGE 1 OF CORE

Powertech (USA) Inc.

PowerTech (USA) Inc.

DRILLED WITH: AIR [ ] WATER [ ] HOLE NO. DB07-11-11C

T.D. ______ LOCATION: ______

BIT SIZE 6¼"

SAMPLE LOG BY ______ LEASE: (PROJECT) ______

DATE ______ COUNTY ______ STATE ______

DEPTH	LITHOLOGY	CARBON	PYRITE	OTHER Mineralization	Alteration %: Primary Oxidation	Reduction	Secondary Oxidation	SAMPLE DESCRIPTION (Amounts in Percent, %)
410								410'-413 lt.gray-gray low fissility SHALE/CLAYSTONE
								*410' 7½" - 410' 10½" SILTSTONE layer - well cemented
4110								
4120								
4130								413'-419'10" lt.gray-gray SHALE, subparallel fissility, v. low strength
4140								
4150								
4160								
4170								
4180								CONFIDENTIAL
4190								
								*TOTAL RUN LENGTH 10'4" recovered 9'10"
4200								

Legend: L=Limonite (Lim); SOX Surf. Oxidation; Rd. Reduced; Rdt. Reduction; P=Pyrite (Pyr); PT=Pyrite Tarnish; POX=Primary Oxid.; BSOX=Base of Surf. Oxid.; 2OX=Secondary Oxid.; Tn=Transition Zone; fld=Feldspar; T=Trace; 1=Minor; 2=Moderate; 3=Abundant; C=Carbon; K=Kaolin; B=Bleached; Cht=Chert

PAGE 2 OF CORE

PowerTech (USA) Inc.

DRILLED WITH: AIR ☐ WATER ☐ HOLE NO. DB07-11-11C

T.D. ______ LOCATION: ______

BIT SIZE ______

SAMPLE LOG BY ______ LEASE: (PROJECT) ______

DATE ______ COUNTY ______ STATE ______

Legend: L = Limonite (Lm); SOX Surf. Oxidation; Rd. Reduced; Rdt. Reduction; P = Pyrite (Pyr); P_T = Pyrite Tarnish; POX = Primary Oxid.; BSOX = Base of Surf. Oxid.; 2OX = Secondary Oxid.; Tn = Transition Zone; fld = Feldspar; T = Trace; 1 = Minor; 2 = Moderate; 3 = Abundant; C = Carbon; K = Kaolin; B = Bleached; Cht = Chert

Columns: DEPTH | LITHOLOGY | CARBON | PYRITE | OTHER Alteration | Alteration %: Primary Oxidation, Reduction, Secondary Oxidation | SAMPLE DESCRIPTION (Amounts in Percent, %)

Depth	Sample Description
420	420-424' lt. gray-gray SHALE, subparallel fissility, v. low strength
4210	
4220	← low angle slip plane 422'1" ← 422'6" slip plane ~45°
4230	
4240	424-500' dk silty, fine gr. SANDSTONE lt. gray lt. brownish gray, - mod-well sorted, subang-subrnded, mostly subrnded, mostly well - cemented, mod. cemented 425-425'3" + 426'-426'5.5", - ss/shale interbedded from 424'-425'3", continuous carbon layers - from 426-426'5.5", scat. pyrite
4250	
4260	
4270	
4280	CONFIDENTIAL
4290	
4300	* TOTAL RUN LENGTH 16'7" recovered 16'0"

PAGE 3 OF CORE

Powertech (USA) Inc.

PowerTech (USA) Inc.

DRILLED WITH: AIR [ ] WATER [ ] HOLE NO. DB07-11-11C

T.D. ____ LOCATION: ____

BIT SIZE ____

SAMPLE LOG BY ____ LEASE: (PROJECT) ____

DATE ____ COUNTY ____ STATE ____

DEPTH	LITHOLOGY	CARBON	PYRITE	OTHER Mineralization	Alteration % Primary Oxidation	Reduction	Secondary Oxidation	SAMPLE DESCRIPTION (Amounts in Percent, %) L=Limonite (Lmn); SOX Surf. Oxidation; Rd. Reduced; Rdt. Reduction; P=Pyrite (Pyr); P_T=Pyrite Tarnish; POX=Primary Oxid.; BSOX=Base of Surf. Oxid.; 2OX=Secondary Oxid.; Tz=Transition Zone; fld=Feldspar; T=Trace; 1=Minor; 2=Moderate; 3=Abundant; C=Carbon; K=Kaolin; B=Bleached; Cht=Chert
430								430-431' SAMPLE WASHED AWAY
4310								431-432'6" v.sl.silty, fine gr. SANDSTONE, lt.gray - lt.brownish gray,
								- well-sorted, subang-subrnded, mostly subrnded, well-cemented, scat. pyrite
4320								
								432'6" - 438'5" silty, v.fine gr. SANDSTONE, lt.gray - lt. brownish gray,
4330								- mod.sorted, subang-subrnded, mod. cemented - poorly cemented, scat. pyrite,
								- thin, continuous, low-angle carbon stringers 432'9" - 433'6"
4340								- calcite cement ? - will need to test w/ acid, coated qtz. grains ->
								- translucent "root beer" colored coating, low-angle bedding evident by
4350								- alternating dk & lt. layers in sands.
								~ 200 μR/hr 435-436', 40 μR/hr rest of sands
4360								
4370								
4380								* bottom 8" SAA, but mostly fine gr. SS
								438'5" - 440'0" SAMPLE WASHED AWAY
4390								
4400								

CONFIDENTIAL

PAGE 4 OF CORE

POWERTECH (USA) INC.

Hydro ID 680

PowerTech (USA) Inc.

DRILLED WITH: AIR ☐ WATER ☐ HOLE NO. DB07-11-11C

T.D. ______ LOCATION: ______

BIT SIZE ______

SAMPLE LOG BY ______ LEASE: (PROJECT) ______

DATE ______ COUNTY ______ STATE ______

DEPTH	LITHOLOGY	CARBON	PYRITE	OTHER Alteration	Alteration % Primary Oxidation	Reduction	Secondary Oxidation	SAMPLE DESCRIPTION (Amounts in Percent, %) L=Limonite (Lmn) SOX Surf. Oxidation Rd. Reduced Rdt. Reduction P=Pyrite (Pyr) P_T=Pyrite Tarnish POX=Primary Oxid. BSOX=Base of Surf. Oxid. 2OX=Secondary Oxid. Tn=Transition Zone fld=Feldspar T=Trace 1=Minor 2=Moderate 3=Abundant C=Carbon X=Kaolin B=Bleached Cht=Chert
440								440 - 440'6" CORE WASHED AWAY
								440'6" - 441'10" fine gr. SANDSTONE, lt. gray - lt. brownish gray, mod-well - sorted, subang - subrounded, mostly subrounded, well-cemented, thin, continuous - carbon layers
4410								
4420								441'10" - 448'10" fine-med. gr. SANDSTONE, lt brownish gray - med. gray, poorly - sorted, ang - subrounded, sort. coarse gr. sand in 441'10" -> 444'0", med-coarse - gr. SANDSTONE 444'0" -> 446'1", dominant coarse gr. at bottom, sort. pyrite, - fine gr SS 446'1" - 447'3", med gr. SS 447'3" - 448'10"
4430								- lots of chert = coarse grains - angular
4440								* med-coarse gr SS (444'0" - 446'1")
								- 20 µR/hr - all core
4450								
4460								* fine gr. SS (446'1" - 447'3")
4470								* med gr. SS w/ smt - abundant coarse gr. (447'3" - 448'10")
								- carbon/coal stringer @ 447'10"
4480								
								448'10" - 449'7" CORE LOSS
4490								CONFIDENTIAL
								* TOTAL RUN LENGTH 9'7" recovered 8'6"
4500								

PAGE 5 OF CORE

POWERTECH (USA) INC.

Hydro ID 681

SOUTH DAKOTA WATER WELL COMPLETION REPORT

 07-92

Location NE ¼ NW ¼ Sec 32 Twp 6S Rg 1E
County CUSTER

Please mark well location with an "X"

North / W / E — 1 Mile

Well Completion Date 1-27-08

Well Owner: Powertech
Business Name: Powertech USA Inc
Address: P.O Box 773
Hot Springs S.D 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Skull Creek Shale	0	470'
Fall River Sandstone	470'	585'

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from NONE Present (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING:
Mud Rotary

CASING DATA: ☐ Steel ☒ Plastic ☐ Other
If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SDR 21 LB/FT	6 IN	0 FT	585 FT	8¾ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	96	15.2 lb./gal	585 ft	0 ft
		lb./gal	ft	ft

Describe grouting procedure pump

SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 3 IN Length 15 FEET
Material PVC
Slot Size .020 Set From 600 Feet to 585 Feet
Other information Set K Packer

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO
If so, what material? 6" K Packer
Describe packer(s) and location? Packer 575'

[1] **DISINFECTION:** Was well disinfected upon completion?
____ YES, How:
Laboratory sent to for water quality analysis ✓ NO, Why Not? NA
Respec

STATIC WATER LEVEL 0 Feet
If flowing: closed in pressure 6.1 PSI
GPM flow 10 through 2 inch pipe
Controlled by ☒ Valve ☐ Reducers ☐ Other
Reduced Flowrate ____ GPM
Can well be completely shut in? YES

WELL TEST DATA:
☐ Pumped Describe: Air lift at 575'
☐ Bailed
☒ Other
Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

REMARKS Dewey Burdock 32-3C

RECEIVED
FEB 22 2008
WATER RIGHTS PROGRAM

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm DAVIS Drilling Inc
Signature of License Representative: Stan Davis
Signature of Well Owner or Equitable Property Holder: PowerTech
Date: 2/18/08

POWERTECH (USA) INC.

7S

Hydro ID 682

SOUTH DAKOTA WATER WELL COMPLETION REPORT

07-92

ocation SE ¼ NW ¼ Sec 11 Twp 6S Rg 1E

ounty Fall River

lease mark well location with an "X"

North

W X E

1 Mile

Well Completion Date 2-21-08

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723 Hot Springs SD 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Skull Creek Shale	0	145
Fall River Sandstone	145	310
Fuson Shale	310	335
Lakota	335	460

OCATION:

istance from nearest potential pollution source (septic tank, abandoned well, eed lot, etc.)? ____ ft. from NONE present (identify source).

PROPOSED USE:

☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☑ Monitoring well

METHOD OF DRILLING: Mud, Rotary

CASING DATA: ☐ Steel ☑ Plastic ☐ Other

If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
DR 17 LB/FT	4 IN	0 FT	450 FT	6 3/4 IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	67	15.4 lb./gal	0 ft.	450 ft.
		lb./gal	ft.	ft.

Describe grouting procedure Pump

SCREEN: ☐ Perforated pipe ☑ Manufactured

Diameter 2 IN Length 10 FEET

Material PVC

Slot Size .020 Set From 460 Feet to 450 Feet

Other information Set K Packer

WAS A PACKER OR SEAL USED? ☑ YES ☐ NO

If so, what material? 4" K Packer

Describe packer(s) and location? Packer 440'

DISINFECTION: Was well disinfected upon completion?

____ YES, How:

X NO, Why Not? NA

aboratory sent to for water quality analysis

Resper

STATIC WATER LEVEL 54.2 Feet

If flowing: closed in pressure ____ PSI

GPM flow ____ through ____ inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other

Reduced Flowrate ____ GPM

Can well be completely shut in? Yes

WELL TEST DATA:

☐ Pumped Describe: Airlift at 435'

☐ Bailed

☑ Other

Pumping Level Below Land Surface

____ ft. After ____ Hrs. pumped ____ GPM

____ ft. After ____ Hrs. pumped ____ GPM

If pump installed, pump rate ____ GPM

REMARKS Dewey Burdock 7-11-2

RECEIVED MAR 24 2008 WATER RIGHTS PROGRAM

This well was drilled under license # 745

And this report is true and accurate

Drilling firm Davis Drilling Inc

Signature of License Representative: Stan Davis

Signature of Well Owner or Equitable Property Holder: Power Tech

Date: 3/5/08

POWERTECH (USA) INC.

Hydro ID 683

SOUTH DAKOTA WATER WELL COMPLETION REPORT

 07-92

Location NW ¼ SE ¼ Sec. 29 Twp 6S Rg 1E

County CUSTER

Please mark well location with an "X"

NE1/4 SW1/4

(North / W / E / 1 Mile)

Well Completion Date 3-4-08

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from NONE PRESENT (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING: Mud Rotary

CASING DATA: ☐ Steel ☒ Plastic ☐ Other

If other describe ____

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SDR 17 LB/FT	4 IN	0 FT	635 FT	6 ¼ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	77	15.2 lb./gal	0 ft.	635 ft.
		lb./gal	ft.	ft.

Describe grouting procedure pump

SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 2 IN Length 15 FEET
Material PVC
Slot Size .020 Set From 650 Feet to 635 Feet
Other information Set K Packer

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO
If so, what material? 4" K Packer
Describe packer(s) and location? Packer 625'

DISINFECTION: Was well disinfected upon completion?
____ YES, How:
X NO, Why Not? NA

Laboratory sent to for water quality analysis
Respec

Well Owner: Powe. Tech
Business Name: Powertech USA INC
Address: P.O. Box 723
Hot Springs SD 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Skull Creek Shale	0	530
Fall River S.S.	530	650

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STATIC WATER LEVEL 81.9 Feet
If flowing: closed in pressure ____ PSI
GPM flow ____ through ____ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other ____
Reduced Flowrate ____ GPM
Can well be completely shut in? Yes

WELL TEST DATA:
☐ Pumped Describe: Air lift at 620'
☐ Bailed
☒ Other

Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

REMARKS
Dewey Burdock 7-29-T

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm Davis Drilling Inc
Signature of License Representative: Stan Davis

Signature of Well Owner or Equitable Property Holder: PowerTech

Date: 3/18/08

13-24

POWERTECH (USA) INC.

Hydro ID 684

SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NE ¼ SW ¼ Sec 11 Twp 7S Rg 1E

County Fall River

Please mark well location with an "X"

North / W / E — X — 1 Mile

Well Completion Date 2-13-08

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723 Hot Springs SD 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Skull Creek Shale	0	102'
Fall River Sandstone	102'	238'
Fuson Shale	238'	300'
Lakota Sandstone	300'	423'

RECEIVED MAR 1 1 2008 WATER RIGHTS PROGRAM

LOCATION: Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from NONE Project (identify source).

PROPOSED USE: ☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes ☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING: Mud Rotary

CASING DATA: ☐ Steel ☒ Plastic ☐ Other

If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SDR 17 LB/FT	4 IN	0 FT	413 FT	6¾ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	66	15.2 lb./gal	0 ft.	413 ft.
		lb./gal	ft.	ft.

Describe grouting procedure pump

SCREEN: ☐ Perforated pipe ☒ Manufactured

Diameter 2 IN Length 10 FEET

Material PVC

Slot Size .020 Set From 423 Feet to 413 Feet

Other information Sil K Packer

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO

If so, what material? 4" K Packer

Describe packer(s) and location? Packer 403'

DISINFECTION: Was well disinfected upon completion?

___ YES, How:

X NO, Why Not? NA

Laboratory sent to for water quality analysis Respec

STATIC WATER LEVEL 28.8 Feet

If flowing: closed in pressure ____ PSI

GPM flow ____ through ____ inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other

Reduced Flowrate ____ GPM

Can well be completely shut in? Yes

WELL TEST DATA:

☐ Pumped ☐ Bailed ☒ Other — Describe: Air lift AT 400'

Pumping Level Below Land Surface

____ ft. After ____ Hrs. pumped ____ GPM

____ ft. After ____ Hrs. pumped ____ GPM

If pump installed, pump rate ____ GPM

REMARKS DEWEY Burdock 11-14 C

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm DAVIS Drilling Inc

Signature of License Representative: Steve Davis

Signature of Well Owner or Equitable Property Holder: Power Tech

Date: 2/27/08

3-17-08

POWERTECH (USA) INC.

Hydro ID 685

SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NW ¼ NE ¼ Sec 32 Twp 6S Rg 1E

County Custer

North

Please mark well location with an "X"

W E

X

1 Mile

Well Completion Date 2-4-08

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from NONE Presel (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING:
Mud Rotary

CASING DATA: ☐ Steel ☒ Plastic ☐ Other

If other describe 0

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SDR 17 LB/FT	4 IN	595 FT	580 FT	6¾ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	77	15.2 lb./gal	0 ft.	580 ft.
		lb./gal	ft.	ft.

Describe grouting procedure pump

SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 2 IN Length 15 FEET
Material PVC
Slot Size .020 Set From 595 Feet to 580 Feet
Other information Set K Packer

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO
If so, what material? 4" K Packer
Describe packer(s) and location? Packer 570'

DISINFECTION: Was well disinfected upon completion?
____ YES, How:
X NO, Why Not? NA

Laboratory sent to for water quality analysis
Reiper

Well Owner: Powertech
Business Name: Powertech USA Inc
Address: P.O. Box 723
Hot Springs S.D. 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Skull Creek Shale	0	473'
Fall River Sandstone	473'	595'

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STATIC WATER LEVEL 0 Feet
If flowing: closed in pressure 6 PSI
GPM flow 15 through 2 inch pipe
Controlled by ☒ Valve ☐ Reducers ☐ Other
Reduced Flowrate ____ GPM
Can well be completely shut in? Yes

WELL TEST DATA:
☐ Pumped Describe: Air lift at 570'
☐ Bailed
☐ Other

Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

REMARKS Dewey Burdock 32-4C

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm Davis Drilling Inc
Signature of License Representative: Stan Davis

Signature of Well Owner or Equitable Property Holder: PowerTech

Date: 2/27/08

POWERTECH (USA) INC.

7S

Hydro ID 686

SOUTH DAKOTA WATER WELL COMPLETION REPORT

 07-92

Location [redacted] ¼ [redacted] ¼ Sec [redacted] Twp 6S Rg 1E

County NE SW 11 North

Fall River

Please mark well location with an "X"

W X E

1 Mile

Well Completion Date

2-24-08

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from NONE Present (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING:
Mud Rotary

CASING DATA: ☐ Steel ☒ Plastic ☐ Other

If other describe ______

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SDR 17 LB/FT	4 IN	0 FT	419 FT	6 3/4 IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	70	15.2 lb./gal	0 ft.	418 ft.
	/	lb./gal	ft.	ft.

Describe grouting procedure Pump

SCREEN: ☐ Perforated pipe ☒ Manufactured

Diameter 2 IN Length 10 FEET

Material PVC

Slot Size .020 Set From 418 Feet to 428 Feet

Other information Set K Packer

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO

If so, what material? 4" K Packer

Describe packer(s) and location? Packer 408'

DISINFECTION: Was well disinfected upon completion?
______ YES, How: ______
X NO, Why Not? NA

Laboratory sent to for water quality analysis
Respec

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723
Hot Springs S.D 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Skull Creek Shale	0	120
~~Fuson~~ Fall River SS	120	255
Fuson Shale	255	315
Lakota Sand Stone	315	428

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WATER RIGHTS PROGRAM

STATIC WATER LEVEL 32.6 Feet

If flowing: closed in pressure ______ PSI

GPM flow ______ through ______ inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other ______

Reduced Flowrate ______ GPM

Can well be completely shut in? Yes

WELL TEST DATA:
☐ Pumped Describe: Airlift At 405'
☐ Bailed
☒ Other

Pumping Level Below Land Surface
______ ft. After ______ Hrs. pumped ______ GPM
______ ft. After ______ Hrs. pumped ______ GPM

If pump installed, pump rate ______ GPM

REMARKS Dewey Burdock 7-11-15

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm DAVIS Drilling Inc

Signature of License Representative:
Stan Davis

Signature of Well Owner or Equitable Property Holder:
PowerTech

Date: 3/5/08

POWERTECH (USA) INC.

Hydro ID 687

SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NE ¼ NW ¼ Sec 32 Twp 6S Rg 1E

County Custer

Please mark well location with an "X"

North / W / E — 1 Mile (X marked in NE ¼ NW ¼)

Well Completion Date 2-6-08

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from NONE Present (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☑ Monitoring well

METHOD OF DRILLING: Mud Rotary

CASING DATA: ☐ Steel ☒ Plastic ☐ Other

If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SDR 17 LB/FT	4 IN	0 FT	590 FT	6 3/4 IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	60	15.2 lb./gal	590 ft.	0 ft
		lb./gal	ft.	ft

Describe grouting procedure pump

SCREEN: ☐ Perforated pipe ☑ Manufactured

Diameter 2 IN Length 15 FEET

Material PVC

Slot Size .020 Set From 605 Feet to 590 Feet

Other information Sch K Packer

WAS A PACKER OR SEAL USED? ☑ YES ☐ NO

If so, what material? 4" K Packer

Describe packer(s) and location? Packer 580'

DISINFECTION: Was well disinfected upon completion?
____ YES, How:
✓ NO, Why Not? NA

Laboratory sent to for water quality analysis Rispric

3-7-08

Well Owner: Powertech

Business Name: Powertech USA Inc

Address: P.O. Box 723
Hot Springs S.D. 57747

WELL LOG:

FORMATION	DEPTH FROM	TO
Skull Creek Shale	0	480'
Fall River Sandstone	480'	605'

RECEIVED
MAR - 6 2008
WATER RIGHTS PROGRAM

STATIC WATER LEVEL 0 Feet

If flowing: closed in pressure 3 PSI

GPM flow 5 through 2 inch pipe

Controlled by ☑ Valve ☐ Reducers ☐ Other

Reduced Flowrate ____ GPM

Can well be completely shut in? Yes

WELL TEST DATA:
☐ Pumped Describe: Air lift at 580'
☐ Bailed
☑ Other

Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM

If pump installed, pump rate ____ GPM

REMARKS DEWEY Burdock 7-32-5

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm DAVIS Drilling INC

Signature of License Representative: [signature]

Signature of Well Owner or Equitable Property Holder: PowerTech

Date: 2/27/08

POWERTECH (USA) INC.

Hydro ID 688 7S

SOUTH DAKOTA WATER WELL COMPLETION REPORT

 07-92

Location NE ¼ SW/ ¼ Sec 11 Twp 6S Rg 1E

County Fall River

North

Please mark well location with an "X"

W | X | E

Well Completion Date 4-1-08

1 Mile

Well Owner: Powe- Tech

Business Name: Powe- Tech USA Inc

Address: P.O. Box 723 Hot Springs S.D 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Skull Creek	0	128
Fall River	128	255

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from None Present (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING: Mud & Rotary

CASING DATA: ☐ Steel ☒ Plastic ☐ Other

If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SDR 17 LB/FT	6 IN	0 FT	245 FT	8 3/4 IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	45	15.2 lb./gal	0 ft	245 ft
		lb./gal	ft	ft

Describe grouting procedure Pump

SCREEN: ☐ Perforated pipe ☒ Manufactured

Diameter 3 IN Length 10 FEET

Material PVC

Slot Size .020 Set From 245 Feet to 255 Feet

Other information Set K Packer

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO

If so, what material? 6" x 3" K Packer

Describe packer(s) and location? Packer set at 235

DISINFECTION: Was well disinfected upon completion?

____ YES, How:

X NO, Why Not? NA

Laboratory sent to for water quality analysis Reiper

STATIC WATER LEVEL 39 Feet

If flowing: closed in pressure ____ PSI

GPM flow ____ through ____ inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other

Reduced Flowrate ____ GPM

Can well be completely shut in? Yes

WELL TEST DATA:
☐ Pumped Describe: Air lift at 230'
☐ Bailed
☐ Other

Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM

If pump installed, pump rate ____ GPM

RECEIVED APR 28 2008 WATER RIGHTS PROGRAM

REMARKS Dewey Burdock 8-11-17

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm Davis Drilling

Signature of License Representative: Stan Davis

Signature of Well Owner or Equitable Property Holder:

Date: 4/22/08

POWERTECH (USA) INC.

Hydro ID 689

SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NE ¼ NW ¼ Sec 32 Twp 6S Rg 1E

County Custer

Please mark well location with an "X"

North / W / E — 1 Mile

Well Completion Date 3-11-08

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723 Hot Springs, S.D. 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Skull Creek Shale	0	475
Fall River S.S.	475	620
Fuson Shale	620	665
Lakota SS	665	715

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from None Present (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING: Mud + Rotary

CASING DATA: ☐ Steel ☒ Plastic ☐ Other
If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SR 17 LB/FT	6 IN	0 FT	715 FT	8¾ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	86	15.2 lb./gal	0 ft.	715 ft
		lb./gal	ft.	ft

Describe grouting procedure Pump

SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 3 IN Length 15 FEET
Material PVC
Slot Size .020 Set From 730 Feet to 715 Feet
Other information Set K Packer

WAS A PACKER OR SEAL USED? ☐ YES ☐ NO
If so, what material? 6" K Packer
Describe packer(s) and location? Packer Set at 705'

DISINFECTION: Was well disinfected upon completion?
____ YES, How:
✓ NO, Why Not? NA

Laboratory sent to for water quality analysis
Ponies

STATIC WATER LEVEL 0 Feet
If flowing: closed in pressure 23.5 PSI
GPM flow 45 through 2 inch pipe
Controlled by ☒ Valve ☐ Reducers ☐ Other
Reduced Flowrate ____ GPM
Can well be completely shut in? Yes

WELL TEST DATA:
☐ Pumped Describe: Air Lift at 700'
☐ Bailed
☒ Other

Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

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WATER RIGHTS PROGRAM

REMARKS
DEWEY Burdock
8-32-10 → ~~7-32-10~~

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm Davis Drilling, Inc
Signature of License Representative: [signature]
Signature of Well Owner or Equitable Property Holder: Powertech
Date: 3/18/08

POWERTECH (USA) INC.

7S

Hydro ID 690

SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NE ¼ SW ¼ Sec 11 Twp 6S Rg 1E

County Fall River

Please mark well location with an "X"

Well Completion Date 4-15-08

Well Owner: Power Tech
Business Name: Power-Tech USA Inc
Address: P.O. Box 723
Hot Springs S.D 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Skull Creek	0	115
Fall River	115	245
Fuson	245	310
Lakota	310	455
Morrison	455	560
UNKPAPA	560	621

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from NONE Present (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING: Mud + Rotary

STATIC WATER LEVEL 0 Feet
If flowing: closed in pressure 41 PSI
GPM flow 14 through 2 inch pipe
Controlled by ☒ Valve ☐ Reducers ☐ Other
Reduced Flowrate ____ GPM
Can well be completely shut in? Yes

CASING DATA: ☒ Steel ☐ Plastic ☐ Other
If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
18 LB/FT	6 IN	0 FT	621 FT	8¾ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

WELL TEST DATA:
☐ Pumped Describe: Air lift at 605'
☐ Bailed
☐ Other

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
Cmt	104	15.2 lb./gal	0 ft.	621 ft.
		lb./gal	ft.	ft.

Describe grouting procedure Pump

Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

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SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 3 IN Length 10 FEET
Material PVC
Slot Size .020 Set From 621 Feet to 631 Feet
Other information Set K Packer

REMARKS DEWEY Burdock
8-11-18

WAS A PACKER OR SEAL USED? ☑ YES ☐ NO
If so, what material? 6" X 3' K Packer
Describe packer(s) and location? Packer Set AT 611

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm Davis Drilling
Signature of License Representative: Stan Davis

DISINFECTION: Was well disinfected upon completion?
____ YES, How:
X NO, Why Not? NA

Laboratory sent to for water quality analysis
Repore

Signature of Well Owner or Equitable Property Holder:

Date: 5/5/08

POWERTECH (USA) INC.

Hydro ID 691

SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NE ¼ NW ¼ Sec 32 Twp 6S Rg 1E

County Custer

North

Please mark well location with an "X"

W E

Well Completion Date 3-10-08

1 Mile

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 773

Hot Springs S.D 57747

WELL LOG:

FORMATION	DEPTH FROM	TO
Skull Creek Shale	0	475
Fall River S.S	475	505

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from None Present (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING:
Mud Rotary

STATIC WATER LEVEL 0 Feet
If flowing: closed in pressure 6.5 PSI
GPM flow 6 through 2 inch pipe
Controlled by ☒ Valve ☐ Reducers ☐ Other
Reduced Flowrate ______ GPM
Can well be completely shut in? Yes

CASING DATA: ☐ Steel ☒ Plastic ☐ Other
If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SDR 17 LB/FT	6 IN	0 FT	490 FT	8¾ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

WELL TEST DATA:
☐ Pumped Describe: Airlift AT 475'
☐ Bailed
☒ Other
Pumping Level Below Land Surface
______ ft. After ______ Hrs. pumped ______ GPM
______ ft. After ______ Hrs. pumped ______ GPM
If pump installed, pump rate ______ GPM

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GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	107	15.2 lb./gal	0 ft.	490 ft.
		lb./gal	ft.	ft.

Describe grouting procedure Pump

REMARKS
DEWEY Burdock
8-32-9C

SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 3 IN Length 15 FEET
Material PVC
Slot Size .020 Set From 490 Feet to 505 Feet
Other information Set K Packer

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm DAvis Drilling INC
Signature of License Representative: Glen Davis

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO
If so, what material? 6" K Packer
Describe packer(s) and location? Packer set AT 480'

DISINFECTION: Was well disinfected upon completion?
______ YES, How:
X NO, Why Not? NA

Laboratory sent to for water quality analysis
Rispic

3-1-08

Signature of Well Owner or Equitable Property Holder: PowerTech

Date: 3/3/08

7S

4-14-08

Hydro ID 692

SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NE ¼ SW ¼ Sec 11 Twp 6S Rg 1E

County Fall River

Please mark well location with an "X"

North / W / E / 1 Mile — X marked in grid

Well Completion Date 4-16-08

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723 Hot Springs S.D 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Skull Creek	0	125
Fall River	125	250
Fuson	250	325
Lakota	325	335

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from NONE Present (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING: Mud + Rotary

CASING DATA: ☐ Steel ☒ Plastic ☐ Other
If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SDR 17 LB/FT	6 IN	0 FT	325 FT	8¾ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	58	15.2 lb./gal	0 ft.	325 ft
		lb./gal	ft.	ft

Describe grouting procedure pump

SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 3 IN Length 10 FEET
Material PVC
Slot Size .020 Set From 325 Feet to 335 Feet
Other information Set K Packer

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO
If so, what material? 6" X 3" K Packer
Describe packer(s) and location? Packer Set at 315

DISINFECTION: Was well disinfected upon completion?
___ YES, How:
X NO, Why Not? NA

Laboratory sent to for water quality analysis
Respec

STATIC WATER LEVEL 39.6 Feet
If flowing: closed in pressure ____ PSI
GPM flow ____ through ____ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other
Reduced Flowrate ____ GPM
Can well be completely shut in? Yes

WELL TEST DATA:
☐ Pumped Describe: Airlift at 310
☐ Bailed
☐ Other
Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

REMARKS DEWEY Burdock
8-11-19

This well was drilled under license # 745
And this report is true and accurate.
Drilling Firm Davis Drilling
Signature of License Representative: [signature]

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Signature of Well Owner or Equitable Property Holder: [signature]
Date: 3/5/08

POWERTECH (USA) INC.

Hydro ID 693

SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NE ¼ NW ¼ Sec 32 Twp 6S Rg 1E

County: Custer

Please mark well location with an "X"

North / W / E — X — 1 Mile

Well Completion Date: 3-8-08

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723, Hot Springs S.D. 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Skull Creek Shale	0	475
Fall River S.S	475	620
Fuson Shale	620	670
Lakota S.S	670	765
Morrison Shale	765	865
UNKPAPA S.S	865	910

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LOCATION: Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from None Present (identify source).

PROPOSED USE: ☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes ☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING: Mud Rotary

STATIC WATER LEVEL 0 Feet

If flowing: closed in pressure 55 PSI

GPM flow 2 through 2 inch pipe

Controlled by ☒ Valve ☐ Reducers ☐ Other

Reduced Flowrate ____ GPM

Can well be completely shut in? Yes

CASING DATA: ☒ Steel ☒ Plastic ☐ Other

If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
18 LB/FT	6 IN	0 FT	910 FT	8 3/4 IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

WELL TEST DATA: ☐ Pumped ☐ Bailed ☒ Other — Describe: Airlift AT 845'

Pumping Level Below Land Surface ____ ft. After ____ Hrs. pumped ____ GPM

____ ft. After ____ Hrs. pumped ____ GPM

If pump installed, pump rate ____ GPM

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	219	15.7 lb./gal	0 ft.	910 ft.
		lb./gal	ft.	ft.

Describe grouting procedure: Pump MDS Cements

REMARKS

Dewey Burdock 8-32-11

SCREEN: ☐ Perforated pipe ☒ Manufactured

Diameter 3 IN Length 20 FEET

Material PVC

Slot Size .020 Set From 910 Feet to 930 Feet

Other information: Set K Packer

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm: Davis Drilling Inc

Signature of License Representative: Stan Davis

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO

If so, what material? 6" K Packer

Describe packer(s) and location? Packer set 890'

DISINFECTION: Was well disinfected upon completion?

____ YES, How: ____

X NO, Why Not? NA

Laboratory sent to for water quality analysis: Respec

Signature of Well Owner or Equitable Property Holder: PowerTech

Date: 3/18/08

POWERTECH (USA) INC.

Hydro ID 694

SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NW ¼ NW ¼ Sec 15 Twp 7S Rg 1E

County Fall River

Please mark well location with an "X"

North / W / E — X (NW corner) — 1 Mile

Well Completion Date 3-22-08

Well Owner: Power Tech
Business Name: Power Tech USA Inc
Address: P.O. Box 723
Hot Springs S.D 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Skull Creek Shale	0	295
Fall River S.S	295	392

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from None Present (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING:
Mud + Rotary

CASING DATA: ☐ Steel ☒ Plastic ☐ Other
If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SDR 17 LB/FT	6 IN	0 FT	377 FT	8 3/4 IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
Cmt	59	15.2 lb./gal	0 ft	377 ft
		lb./gal	ft	ft

Describe grouting procedure pump

SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 3 IN Length 15 FEET
Material PVC
Slot Size .020 Set From 377 Feet to 392 Feet
Other information Set K Packer

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO
If so, what material? 6" x 4" K Packer 4" x 3" Bell
Describe packer(s) and location? Packer Set AT 367'

DISINFECTION: Was well disinfected upon completion?
____ YES, How:
X NO, Why Not? NA

Laboratory sent to for water quality analysis
Kesper

STATIC WATER LEVEL 0 Feet
If flowing: closed in pressure 7 PSI
GPM flow 2 through 2 inch pipe
Controlled by ☒ Valve ☐ Reducers ☐ Other
Reduced Flowrate ____ GPM
Can well be completely shut in? Yes

WELL TEST DATA:
☐ Pumped Describe: Air lift AT 360'
☐ Bailed
☐ Other

Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

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REMARKS Dewey Burdock

8-15-3

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm Davis Drilling
Signature of License Representative: Stan Davis
Signature of Well Owner or Equitable Property Holder: [signature]
Date: 4-1-08

4-7-08

POWERTECH (USA) INC.

SE Hydro ID 695

 07-92

SOUTH DAKOTA WATER WELL COMPLETION REPORT

Location SW ¼ SE ¼ Sec 32 Twp 6S Rg 1E

County Custer

Please mark well location with an "X"

North / W / E — X marked in SE quarter — 1 Mile

Well Completion Date 3-20-08

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723
Hot Springs SD 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Skull Creek Shale	0	415
Fall River S.S	415	508

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from None Present (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING:
Mud & Rotary

CASING DATA: ☐ Steel ☒ Plastic ☐ Other

If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SDR 17 LB/FT	6 IN	0 FT	493 FT	8¾ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	106.4	15.1 lb./gal	0 ft.	493 ft.
		lb./gal	ft.	ft.

Describe grouting procedure Pump

SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 3 IN Length 15 FEET
Material PVC
Slot Size .020 Set From 493 Feet to 508 Feet
Other information Set K Packer

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO
If so, what material? 6" x 4" K-Packer 4" X3" bell
Describe packer(s) and location? Packer Set at 483'

DISINFECTION: Was well disinfected upon completion?
___ YES, How:
X NO, Why Not? N/A

Laboratory sent to for water quality analysis
Respec

STATIC WATER LEVEL ? Feet
If flowing: closed in pressure 13 PSI
GPM flow 3 through 2 inch pipe
Controlled by ☒ Valve ☐ Reducers ☐ Other
Reduced Flowrate / GPM
Can well be completely shut in? Yes

WELL TEST DATA:
☐ Pumped Describe: Air lift AT 480'
☐ Bailed
☐ Other

Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate

REMARKS
Dewey Burdock
8-32-13

RECEIVED APR - 7 2008 WATER RIGHTS PROGRAM

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm Davis Drilling
Signature of License Representative: [signature]
Signature of Well Owner or Equitable Property Holder: [signature]
Date: 4-1-08

POWERTECH (USA) INC.

Hydro ID 696

SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NW ¼ NW ¼ ¼ Sec 15 Twp 7S Rg 1E

County Fall River

North

Please mark well location with an "X"

W E

Well Completion Date 3-21-08

1 Mile

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723 Hot Springs S.D 57747

WELL LOG:

FORMATION	DEPTH FROM	TO
Skull Creek Shale	0	295
Fall River S.S	295	425
Fuson Shale	425	475
Lakota	475	587

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from NONE Present (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING: Mud & Rotary

CASING DATA: ☐ Steel ☒ Plastic ☐ Other

If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SDR 17 LB/FT	6 IN	0 FT	572 FT	8¾ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
Cmt	86	15.1 lb./gal	0 ft.	572 ft
		lb./gal	ft.	ft

Describe grouting procedure pump

SCREEN: ☐ Perforated pipe ☒ Manufactured

Diameter 3 IN Length 15 FEET

Material PVC

Slot Size .020 Set From 572 Feet to 587 Feet

Other information Set K Packer

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO

If so, what material? 6" X 4" K Packer 4" X 3" bell

Describe packer(s) and location? Packer set at 562'

DISINFECTION: Was well disinfected upon completion?

____ YES, How:

X NO, Why Not? NA

Laboratory sent to for water quality analysis Respec

STATIC WATER LEVEL 0 Feet

If flowing: closed in pressure 15 PSI

GPM flow 60 through 2 inch pipe

Controlled by ☒ Valve ☐ Reducers ☐ Other

Reduced Flowrate ____ GPM

Can well be completely shut in? Yes

WELL TEST DATA:

☐ Pumped Describe: AirLift At 560

☐ Bailed

☐ Other

Pumping Level Below Land Surface

____ ft. After ____ Hrs. pumped ____ GPM

____ ft. After ____ Hrs. pumped ____ GPM

If pump installed, pump rate ____ GPM

RECEIVED APR - 7 2008 WATER RIGHTS PROGRAM

REMARKS Dewey Burdock

8-15-2

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm Davis Drilling

Signature of License Representative: Stan Davis

Signature of Well Owner or Equitable Property Holder: [signature]

Date: 4-1-08

Powertech (USA) Inc.

4-2-08

SE Hydro ID 697

SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location SW ¼ SE ¼ Sec 32 Twp 6S Rg 1E

County Custer

Please mark well location with an "X"

North / W / E — X (1 Mile)

Well Completion Date 3-18-08

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from NONE Project (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING: Mud of Rotary

CASING DATA: ☐ Steel ☒ Plastic ☐ Other

If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SDR 17 LB/FT	6 IN	0 FT	667 FT	8¾ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
Cmt	112	13.0 lb./gal	0 ft	667 ft
		lb./gal	ft	ft

Describe grouting procedure Pump, Mix, Cellophane

SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 3 IN Length 15 FEET
Material PVC
Slot Size .020 Set From 667 Feet to 682 Feet
Other information \ Set in Packer

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO
If so, what material? 6" x 4" K Packer 4" x 3" bell
Describe packer(s) and location? Packer set at 657

DISINFECTION: Was well disinfected upon completion?
____ YES, How:
X NO, Why Not? NA

Laboratory sent to for water quality analysis: Bicycle

Well Owner: Power Tech
Business Name: Power Tech USA Inc
Address: P.O. Box 723
Hot Springs SD 57747

WELL LOG:

FORMATION	DEPTH FROM	TO
Skull Creek Shale	0	415
~~Fuson~~ Fall River	415	550
Fuson Shale	550	635
Lakota S.S	635	682

STATIC WATER LEVEL 0 Feet
If flowing: closed in pressure 40 PSI
GPM flow 30 through 2 inch pipe
Controlled by ☒ Valve ☐ Reducers ☐ Other
Reduced Flowrate ____ GPM
Can well be completely shut in? Yes

WELL TEST DATA:
☐ Pumped Describe: Airlift at 650'
☐ Bailed
☐ Other
Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

RECEIVED APR - 7 2008 WATER RIGHTS PROGRAM

REMARKS Dewey Burdock 8-32-12

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm Davis Drilling Inc
Signature of License Representative: [signature]
Signature of Well Owner or Equitable Property Holder: [signature]
Date: 4-1-08

POWERTECH (USA) INC.

Hydro ID 698

SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location SW ¼ NE ¼ Sec 2 Twp 7S Rg 1E

County Fall River

Please mark well location with an "X"

North / W / E — X — 1 Mile

Well Completion Date 3-25-08

Well Owner: Power Tech

Business Name: Power Tech USA Inc.

Address: P.O. Box 723

Hot Springs S.D 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Skull Creek Shale	0	75
Fall River S.S	75	205

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from NONE Present (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING: Mud & Rotary

STATIC WATER LEVEL 34.36 Feet

If flowing: closed in pressure ____ PSI

GPM flow ____ through ____ inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other ____

Reduced Flowrate ____ GPM

Can well be completely shut in? Yes

CASING DATA: ☐ Steel ☒ Plastic ☐ Other

If other describe ____

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SDR 21 LB/FT	6 IN	0 FT	180 FT	8 ¾ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

WELL TEST DATA:
☐ Pumped Describe: Airlift AT 165'
☐ Bailed
☐ Other

Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

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GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	35	15.6 lb./gal	0 ft.	180 ft.
		lb./gal	ft.	ft.

Describe grouting procedure pump

SCREEN: ☐ Perforated pipe ☒ Manufactured

Diameter 3 IN Length 25 FEET

Material PVC

Slot Size .020 Set From 180 Feet to 205 Feet

Other information Set K Packer

REMARKS Dewey Burdock

8-2-1

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO

If so, what material? 6" X 3" K Packer

Describe packer(s) and location? Packer Set at 170'

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm Davis Drilling

Signature of License Representative: Steve Davis

DISINFECTION: Was well disinfected upon completion?
____ YES, How: ____
X NO, Why Not? NA

Laboratory sent to for water quality analysis
Respec

Signature of Well Owner or Equitable Property Holder: [signature]

Date: 4/22/08

POWERTECH (USA) INC.

4/14-08

Hydro ID 703

SOUTH DAKOTA WATER WELL COMPLETION REPORT

 07-92

Location SW ¼ SW ¼ Sec 1 Twp 7S Rg 1E

County Fall River

Please mark well location with an "X"

North / W / E — X — 1 Mile

Well Completion Date 4-18-08

Well Owner: Power Tech
Business Name: Power Tech USA Inc
Address: P.O. Box 723
Hot Springs S.D 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Fall River	0	100
Fuson	100	150
Lakota	150	305
Morrison	305	410
UNK PAPA	410	525

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? 200 ft. from Septic Tank (identify source).

PROPOSED USE:
☒ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☐ Monitoring well

METHOD OF DRILLING:
Mud & Rotary

CASING DATA: ☒ Steel ☐ Plastic ☐ Other
If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
18 LB/FT	6 IN	0 FT	475 FT	8¾ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	82	15.3 lb./gal	0 ft	475 ft
		lb./gal	ft	ft

Describe grouting procedure pump

SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 3 IN Length 50 FEET
Material PVC
Slot Size .020 Set From 475 Feet to 525 Feet
Other information Set K Packer

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO
If so, what material? 6" X 3" K Packer
Describe packer(s) and location? Packer Set at 465'

DISINFECTION: Was well disinfected upon completion?
____ YES, How:
X NO, Why Not? NA

Laboratory sent to for water quality analysis

5-20-08

Respic

STATIC WATER LEVEL 110 Feet
If flowing: closed in pressure ____ PSI
GPM flow ____ through ____ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other
Reduced Flowrate ____ GPM
Can well be completely shut in? Yes

WELL TEST DATA:
☐ Pumped Describe: Air lift at 4/6
☐ Bailed
☐ Other

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Pumping Level Below Land Surface
____ ft. After ____ Hrs. pumped ____ GPM
____ ft. After ____ Hrs. pumped ____ GPM
If pump installed, pump rate ____ GPM

REMARKS DEWEY Burdock
8-1-7

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm Davis Drilling Inc
Signature of License Representative: Stan Davis

Signature of Well Owner or Equitable Property Holder:

Date: 5/5/08

Hydro ID 704 Unkpapa

SOUTH DAKOTA WATER WELL COMPLETION REPORT

1 of 1 07-92

Location NW ¼ NW ¼ Sec. 5 Twp 7S Rg 1E

County Fall River

North

Please mark well location with an "X"

W X E

1 Mile

Well Completion Date 4-29-08

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723 Hot Springs S.D 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Skull Creek	0	455
Fall River	455	600
Fuson	600	655
Lakota	655	735
Morrison	735	890
Unk Papa	890	955

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from None Present (identify source).

PROPOSED USE:
☒ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☐ Monitoring well

METHOD OF DRILLING: Mud & Rotary

CASING DATA: ☒ Steel ☐ Plastic ☐ Other

If other describe ______

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
18 LB/FT	6 IN	0 FT	915 FT	8¾ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	203	153 lb./gal	0 ft	915 ft
		lb./gal	ft	ft

Describe grouting procedure Mud Cementing

SCREEN: ☐ Perforated pipe ☒ Manufactured

Diameter 3" IN Length 40 FEET

Material PVC

Slot Size .020 Set From 915 Feet to 955 Feet

Other information Sit K Packer

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO

If so, what material? 3' x 6" K Packer

Describe packer(s) and location? Packer Set 905

DISINFECTION: Was well disinfected upon completion?

____ YES, How: ______

X NO, Why Not? NA

Laboratory sent to for water quality analysis Respec

STATIC WATER LEVEL 0 Feet

If flowing: closed in pressure 42 PSI

GPM flow ½ through 2 inch pipe

Controlled by ☒ Valve ☐ Reducers ☐ Other ______

Reduced Flowrate ______ GPM

Can well be completely shut in? Yes

WELL TEST DATA:
☐ Pumped Describe: Air lift at 900'
☐ Bailed
☐ Other

Pumping Level Below Land Surface
______ ft. ______ hrs. pumped ______ GPM
______ ft. ______ hrs. pumped ______ GPM
If pump installed, pump rate ______ GPM

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REMARKS Dewey Burdock 6-5-1

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm David Drilling Inc

Signature of License Representative: Stan Davis

Signature of Well-Owner or Equitable Property Holder: [signature]

Date: 5/5/08

POWERTECH (USA) INC.

Hydro ID 705

SOUTH DAKOTA WATER WELL COMPLETION REPORT

 97-92

Location NE ¼ NE ¼ Sec 21 Twp 6S Rg 1E

County Custer

North

Please mark well location with an "X" (X in NE corner of grid)

W E

1 Mile

Well Completion Date 12-5-09

Well Owner: PowerTech

Business Name: PowerTech USA Inc

Address: P.O. Box 723 Hot Springs S.D 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Skull Creek	0	150
Fall River	150	328
Lakota (Fuson Chilson)	328	480
Morrison	480	550
Unkpapa	550	600

LOCATION:

Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ____ ft. from NONE PRESENT (identify source).

PROPOSED USE:

☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☑ Monitoring well

METHOD OF DRILLING: MUD Rotary SS 2200

CASING DATA: ☐ Steel ☒ Plastic ☐ Other

If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SDR 17 LB/FT	6 IN	0 FT	428 FT	8¾ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	80	15.1 lb./gal	0 ft	428 ft
		lb./gal	ft	ft

Describe grouting procedure PUMP

SCREEN: ☐ Perforated pipe ☑ Manufactured

Diameter 3 IN Length 30 FEET

Material PVC

Slot Size .020 Set From 428 Feet to 458 Feet

Other information 10' Blank 418-428

WAS A PACKER OR SEAL USED? ☑ YES ☐ NO

If so, what material? K-Packer

Describe packer(s) and location? SET AT 418

DISINFECTION: Was well disinfected upon completion?

✓ YES, How: Bleach

___ NO, Why Not? 1 gallon

Laboratory sent to for water quality analysis

STATIC WATER LEVEL 115 Feet

If flowing: closed in pressure ____ PSI

GPM flow ____ through ____ inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other

Reduced Flowrate ____ GPM

Can well be completely shut in?

WELL TEST DATA:

☐ Pumped Describe: Air lift at 410'

☐ Bailed 5 GPM's

☐ Other

Pumping Level Below Land Surface

____ ft. After ____ Hrs. pumped ____ GPM

____ ft. After ____ Hrs. pumped ____ GPM

If pump installed, pump rate ____ GPM

REMARKS Well Was Overdrilled * Set CMT plug 460-600 * DEWEY Burdock 9-21-1

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm Davis Drilling Inc

Signature of License Representative: Stan Davis

Signature of Well Owner or Equitable Property Holder:

Date: 12/15/09

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POWERTECH (USA) INC.

Hydro ID 706

SOUTH DAKOTA WATER WELL COMPLETION REPORT

 07-92

Location NE ¼ NE ¼ Sec 21 Twp 6S Rg 1E

County CUSTER

Please mark well location with an "X"

North / W / E — X (NE corner) — 1 Mile

Well Completion Date 12 5. 09

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723 Hot Springs S.D 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Skull Creek	0	150
Fall River	150	316
Lakota (Fuson / Chilson)	316	328

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from NONE PRESENT (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☑ Monitoring well

METHOD OF DRILLING: Mud Rotary SS 2200

CASING DATA: ☐ Steel ☒ Plastic ☐ Other

If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SDR17 LB/FT	6 IN	0 FT	284 FT	8¾ IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	56	15.1 lb./gal	0 ft	284 ft
		lb./gal	ft	ft

Describe grouting procedure PUMP

SCREEN: ☐ Perforated pipe ☒ Manufactured

Diameter 3 IN Length 30 FEET

Material PVC

Slot Size .020 Set From 284 Feet to 314 Feet

Other information 10' Blank 274-284

WAS A PACKER OR SEAL USED? ☑ YES ☐ NO

If so, what material? K - Packer

Describe packer(s) and location? SET AT 274'

DISINFECTION: Was well disinfected upon completion?
✓ YES, How: Bleach 1 gallon
___ NO, Why Not?

Laboratory sent to for water quality analysis

STATIC WATER LEVEL 110 Feet

If flowing: closed in pressure ______ PSI

GPM flow ______ through ______ inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other

Reduced Flowrate ______ GPM

Can well be completely shut in?

WELL TEST DATA:
☐ Pumped Describe: Airlift at 274 5-10 GPM's
☐ Bailed
☐ Other

Pumping Level Below Land Surface
______ ft. After ______ Hrs. pumped ______ GPM
______ ft. After ______ Hrs. pumped ______ GPM

If pump installed, pump rate ______ GPM

REMARKS

DEWEY Burdock 9-21-2

This well was drilled under license # 745

And this report is true and accurate.

Drilling firm Davis Drilling Inc

Signature of License Representative: Stan Davis

Signature of Well Owner or Equitable Property Holder: [redacted]

RECEIVED DEC 28 2009 WATER RIGHTS PROGRAM

Date: 12/15/09

POWERTECH (USA) INC.

Hydro ID 707 NE

SD EForm - 1621LD V1
11-02

SOUTH DAKOTA WATER WELL COMPLETION REPORT

Location ¼ ~~NW~~ ¼ Sec 34 Twp 6S Rg 1E

County Custer County

Please mark well location with an "X"

North / W / E

Well Completion Date
May 5, 2011

1 Mile

Distance to nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ft. from Unknown (identify source)

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test holes
☐ Irrigation ☐ Industrial ☐ Institutional ☑ Monitoring well

METHOD OF DRILLING:
3.25" HSA to 40.0' 4.25"HSA? 4.25"?

CASING DATA: ☐ Steel ☑ Plastic ☐ Other
If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
LB/FT	2.00 IN	0.0 FT	30.0 FT	3.25 IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA:

Grout Type	No. of Sacks	Grout Weight	From	To
Cement	8	Lb/gal	0.0 Ft	26.0 Ft
Bentonite	1	Lb/gal	26.0 Ft	28.0 Ft

Describe grouting procedure

SCREEN: ☐ Perforated pipe ☑ Manufactured
Diameter 2.00 Inches Length 10.0 Feet
Material Sch 40 PVC
Slot Size 0.010" Set From 30.0 Feet to 40.0 Feet
Other information 12-20 Silica Sand from 28' to 40'

WAS A PACKER OR SEAL USED? ☐ Yes ☑ No
If so, what material?
Describe packer(s) and location

DISINFECTION: Was well disinfected upon completion?
☐ Yes, How?
☑ No, Why Not? Monitoring well only.
Lab to which water quality sample sent for analysis

Well Owner: ...
Business Name: Powertech, Inc.
Address: 145 N Chicago Street
City, State, Zip: Hot Springs SD 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Topsoil - Silty Lean Clay with sand, brown, moist (CL)	0	0.5'
Silty Sand, red-brn, dry (SM	0.5'	12'
Silty Lean Clay, red-brn, moist (CL)	12'	21'
Silty Gravel with sand, lt brn, moist to wet @35' (GM)	21'	40'

STATIC WATER LEVEL ______ FEET
If flowing: closed in pressure ______ PSI
GPM flow ______ through ______ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other
Reduced flow rate ______ GPM
Can well be completely shut in?

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WELL TEST DATA:
☐ Pumped Describe: NA
☐ Bailed
☐ Other
Pumping Level Below Land Surface
Ft. After Hrs. pumped GPM
Ft. After Hrs. pumped GPM
If pump installed, pump rate: GPM

REMARKS
Monitoring well 11-34-4

This well was drilled under license # 678 and this report is true and accurate.
Drilling firm: American Engineering Testing, Inc.
Signature of License Representative: [signature]

Signature of Well Owner or Equitable Property Holder:

Date:

SOIL BORING AND MONITORING WELL LOG

Hydro ID 707

JOB NO. 17-1211 VERTICAL SCALE 1" = 5' BORING NO. 11-34-4 WELL NO. 2 of 3 MW-11-34-4

PROJECT Power tech

Boring No.	Date	Time
Boring Started	5-5-11	10:55
Boring Completed	11	15:00
Finished Pulling Casing	NA	NA
Boring Filled		ND
Depth to Frost		

Method of Advancing Boring

Continuous Sampling From — To —

_____ In. Flite Auger To _____

3 1/4 In. Hollow Stem Auger to 40

_____ In. Casing To _____

_____ In. Casing To _____

P. D. or C. O. Tube From _____ To _____

Jet With Water From _____ To _____

Jet with Drilling Mud From _____ To _____

Remarks

State Plane NAD27

441813 1032064

Inst. (ppm)

STANDPIPE ELEVATION _____

Well Construction

Flush Mount/Standup

Grout from 26' to 0'.

8 bags of Grout used footing

2" PVC Riser Pipe, from 30' to +1.5'.

Bentonite from 28' to 26'.

_____ buckets used

1 bags used

12-20 Silica Sand Pack

Sand from 40' to 28'.

7 bags of sand

Flush Threaded 2" PVC Screen

.010" Screen Size Opening

from 40' to 30'.

Bottom of Well 40.0

Natural Material

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	WATER LEVEL	WATER ELEVATION

START 10:55 COMPLETE 15:00

METHOD 4 1/4 HSA to 40'

CREW CHIEF/LOGGER:

POWERTECH (USA) INC.

GEOTECHNICAL FIELD DATA SHEET

Project Number: 17-1211 Date: 5-5-11 Boring Number: 11-34-4

Project Location: Dewey Crew Chief: B.Th

Boring Start Time: 10:55 Boring Completion Time: 15:00

Data Reviewed by:

Depth of Layer	Sample No./Depth	Set	[illegible] FT	[illegible]	[illegible]	[illegible]	[illegible] SOIL CLASSIFICATION
		BLOWS [illegible]					
-.5'	1						Topsoil- silty sand brn moist
	1						organics (SM)
-5'-	1						silty sand - Reddish Brn
	1						Dry (SM)
12.0-	1						silty clay Reddish Brn moist c.
21.0 -	1						silty sand [illegible] Lt tan
	1						moist to wet @ 35.0' (SM)
	1						EOB 40.0'
	1						
	1						setwell
	1						1-10' SC
	1						3-10' R
	1						1-5' R
	1						7 Bags sand 12-20
	1						1 Bag Bent chips
	1						
	1						
	1						
	1						

Method of Advancing Boring

Continuous Sampling From: ______ To: ______

______ In. Flite Auger To: ______

4½ In. Hollow Stem Auger To: 40

Jet With Drilling Mud From: ______ To: ______

Water Level Checks After Completion of Boring

	Date	Time	Casing in Grnd	W.L.	Cav
At Completion	5-5-11	10:55	—	32	3
1st Recheck					
2nd Recheck					

Additional space

RC GEOT 0001 1/04

POWERTECH (USA) INC.

Hydro ID 708

SD EForm - 1631LD V1

11-02

SOUTH DAKOTA WATER WELL COMPLETION REPORT

Location ¼ ~~NW~~ SW ¼ Sec ~~34~~ 3 Twp ~~6S~~ 7S Rg 1E

County ~~Custer County~~ Fall River

Please mark well location with an "X"

North / W / E / 1 Mile

Well Completion Date ~~May 5, 2011~~ May 4, 2011

Distance to nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ft. from Unknown (identify source)

Well Owner: ...

Business Name: Powertech, Inc.

Address: 145 N Chicago Street

City, State, Zip: Hot Springs SD 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
~~Topsoil - Silty Lean Clay with sand, brown, moist (CL)~~	~~0~~	~~0.5'~~
~~Silty Lean Clay with sand, brn (CL)~~	~~0.5'~~	~~20'~~
~~Silty Gravel with sand, brn, wet (GM)~~	~~20'~~	~~22'~~

sl silty CLAY, dry, roots 0 - 22'
silty, sandy, clayey, GRAVEL, wet 22-28'
competent SHALE 28-30'

PROPOSED USE:

- [ ] Domestic/Stock
- [ ] Irrigation
- [ ] Municipal
- [ ] Industrial
- [ ] Business
- [ ] Institutional
- [ ] Test holes
- [x] Monitoring well

METHOD OF DRILLING:
4.25" HSA to ~~22.0'~~ 30'

CASING DATA: [ ] Steel [x] Plastic [ ] Other

If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
LB/FT	2.00 IN	0.0 FT	~~22.0~~ 20 FT	4.25 IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA:

Grout Type	No. of Sacks	Grout Weight	From	To
Cement	1	Lb/gal	~~0.0~~ Ft	~~8.0~~ Ft
Bentonite	1	Lb/gal	~~8.0~~ Ft	~~10.0~~ Ft

0 to 15 ft
15 to 20 ft

Describe grouting procedure

STATIC WATER LEVEL FEET

If flowing: closed in pressure PSI

GPM flow through inch pipe

Controlled by [ ] Valve [ ] Reducers [ ] Other

Reduced flow rate GPM

Can well be completely shut in?

WELL TEST DATA:

- [ ] Pumped Describe: NA
- [ ] Bailed
- [ ] Other

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Pumping Level Below Land Surface

Ft. After Hrs. pumped GPM

Ft. After Hrs. pumped GPM

If pump installed, pump rate: GPM

SCREEN: [ ] Perforated pipe [x] Manufactured

Diameter 2.00 Inches Length 10.0 Feet

Material Sch 40 PVC

Slot Size 0.010" Set From ~~12.0 Feet to 22.0 Feet~~ 20 to 30 Feet

Other information 12-20 Silica Sand from ~~10' to 22'~~ 20 to 30 Feet

REMARKS
Monitoring well ~~11-3-2~~ 11-3-3

WAS A PACKER OR SEAL USED? [ ] Yes [x] No

If so, what material?

Describe packer(s) and location

DISINFECTION: Was well disinfected upon completion?

- [ ] Yes, How?
- [x] No, Why Not? Monitoring well only.

Lab to which water quality sample sent for analysis

This well was drilled under license # 678 and this report is true and accurate.

Drilling firm: American Engineering Testing, Inc.

Signature of License Representative: B. B. Hos

Signature of Well Owner or Equitable Property Holder:

Date:

Hydro ID 708

SOIL BORING AND MONITORING WELL LOG

2 of 3

JOB NO. 17-1211 VERTICAL SCALE 1" = 5' BORING NO. 11-3-3 WELL NO. MW-11-3-3

PROJECT powertech

Boring No.	Date	Time
Boring Started	5-4-11	10:55
Boring Completed	11	15:00
Finished Pulling Casing	NA	NA
Boring Filled		NA
Depth to Frost		

Method of Advancing Boring

Continuous Sampling From — To —

In. Flite-Auger To

3 1/4 In. Hollow Stem Auger to 30

In. Casing To

In. Casing To

P. D. or C. O. Tube From To

Jet With Water From To

Jet with Drilling Mud From To

Remarks

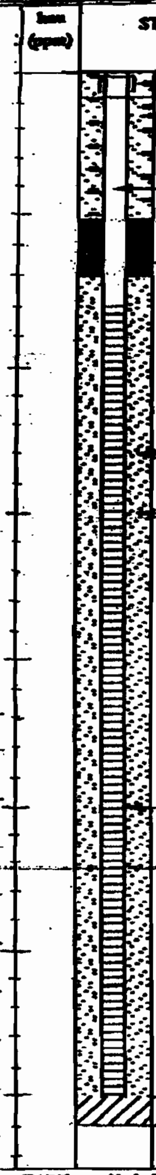
State Plane NAD 27

N 434098 E 1030383

Ions (ppm)

STANDPIPE ELEVATION

Well Construction



Flush Mount/Standup

Grout from 15' to 0'

8 bags of grout used

2" PVC Riser Pipe, from 20' to +2.5'

Bentonite from 20' to 15'

buckets used

1 bags used

12-20 Silica Sand Pack

Sand from 30' to 20'

7 bags of sand

Flush Threaded 2" PVC Screen

.010" Screen Size Opening

from 30' to 20'

Bottom of Well 30.0

Natural Material

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	WATER LEVEL	WATER ELEVATION

START 10:55 COMPLETE 15:00

METHOD 4 1/4 HSA to 30'

CREW CHIEF/LOGGER:

POWERTECH (USA) INC.

Hydro ID 708

PowerTech (USA) Inc.

DRILLED WITH: AIR [ ] WATER [ ] HOLE NO. DB11-3-ALLUV-3

T.D. 30 LOCATION: 434097.55, 1030382.506 State Plane NAD27

BIT SIZE 4" FA

SAMPLE LOG BY LE LEASE: (PROJECT) Dewey Burdock

DATE 5/4/11 COUNTY Fall River STATE SD

DEPTH	LITHOLOGY	CARBON	PYRITE	OTHER Alteration	Alteration % Primary Oxidation	Reduction	Secondary Oxidation	SAMPLE DESCRIPTION (Amounts in Percent, %)
								L=Limonite (Lim) SOX Surf. Oxidation Rd. Reduced Rdt. Reduction P=Pyrite (Pyr) P_T=Pyrite Tarnish POX=Primary Oxid. BSOX=Base of Surf. Oxid. 2OX=Secondary Oxid. Tz=Transition Zone fld=Feldspar T=Trace 1=Minor 2=Moderate 3=Abundant C=Carbon K=Kaolin B=Bleached Cht=Chert
								0-22'
								cl silty CLAY, orangish brown, dry, root roots
10								
20								22-28'
								silty, sandy, clayey, GRAVEL, pinks/whites/grays, nickel sized angular qtzites & cherts, wet
30								28'-30
								competent GRAVEROUS-gray
								TD @ 28' * drilled out to 8½" w/ 4¼" HSA * converted to mw.
40								
50								
60								

Powertech (USA) Inc.

Hydro ID 709

SD EForm - 1621LD V1

11-02

SOUTH DAKOTA WATER WELL COMPLETION REPORT

Location ¼ NW ¼ Sec ~~34~~ 15 Twp ~~6S~~ 7S Rg 1E

County ~~Custer County~~ Fall River

North

Please mark well location with an "X"

W E

Well Completion Date: May 9, 2011

1 Mile

Distance to nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ft. from Unknown (identify source)

PROPOSED USE: ☐ Domestic/Stock ☐ Irrigation ☐ Municipal ☐ Industrial ☐ Business ☐ Institutional ☐ Test holes ☑ Monitoring well

METHOD OF DRILLING: 4.25" HSA to 38.0'

CASING DATA: ☐ Steel ☑ Plastic ☐ Other

If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
LB/FT	2.00 IN	0.0 FT	~~38.0~~ 28 FT	4.25 IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA:

Grout Type	No. of Sacks	Grout Weight	From	To
Cement	7	Lb/gal	0.0 Ft	24.0 Ft
Bentonite	1	Lb/gal	~~24.0 Ft~~	~~26.0 Ft~~

26 to 28 Ft

Describe grouting procedure

SCREEN: ☐ Perforated pipe ☑ Manufactured

Diameter 2.00 Inches Length 10.0 Feet

Material Sch 40 PVC

Slot Size 0.010" Set From 28.0 Feet to 38.0 Feet

Other information 12-20 Silica Sand from ~~26' to 38'~~ 28 to 38'

WAS A PACKER OR SEAL USED? ☐ Yes ☑ No

If so, what material?

Describe packer(s) and location

DISINFECTION: Was well disinfected upon completion? ☐ Yes, How? ☑ No, Why Not? Monitoring well only.

Lab to which water quality sample sent for analysis

Well Owner: ...

Business Name: Powertech, Inc.

Address: 145 N Chicago Street

City, State, Zip: Hot Springs SD 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Topsoil - Silty Lean Clay with sand, brown, moist (CL)	0	0.5'
Silty Lean Clay with sand, brn (CL)	0.5'	35'
Silty Gravel with sand, brn, wet (GM)	35'	38'

STATIC WATER LEVEL FEET

If flowing: closed in pressure PSI

GPM flow through Inch pipe

Controlled by ☐ Valve ☐ Reducers ☐ Other

Reduced flow rate GPM

Can well be completely shut in?

WELL TEST DATA:

☐ Pumped Describe: NA

☐ Bailed

☐ Other

RECEIVED

NOV 09 2011

WATER RIGHTS PROGRAM

Pumping Level Below Land Surface

Ft. After Hrs. pumped GPM

Ft. After Hrs. pumped GPM

If pump installed, pump rate: GPM

REMARKS

Monitoring well 11-15-4

This well was drilled under license # 678 and this report is true and accurate.

Drilling firm: American Engineering Testing, Inc.

Signature of License Representative: [signature]

Signature of Well Owner or Equitable Property Holder:

Date:

POWERTECH (USA) INC.

SOIL BORING AND MONITORING WELL LOG

NO. 17-12-11 Hydro ID 709 VERTICAL SCALE 1" = 5' BORING NO. SB- 11-15-4 WELL NO. 2 of MW- 11-15-4

PROJECT powertech

Boring No.	Date	Time
Boring Started	5-9-11	9:15
Boring Completed	11	
Finished Pulling Casing	11	12:30
Boring Filled		
Depth to Frost		

Method of Advancing Boring

Continuous Sampling From — To —

____ In. Flite Auger To ____

4 1/4 In. Hollow Stem Auger to 35.0'

____ In. Casing To ____

____ In. Casing To ____

P. D. or C. O. Tube From ____ To ____

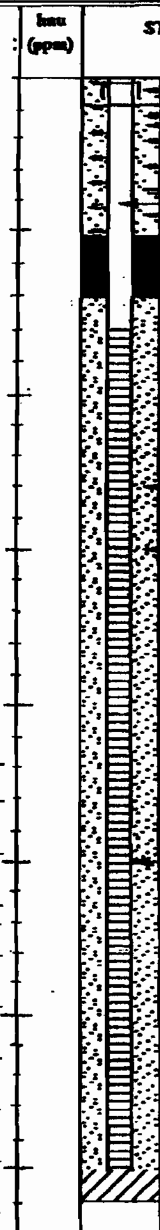
Jet With Water From ____ To ____

Jet with Drilling Mud From ____ To ____

Remarks

State Plane NAD 27

N 426607 E 1029415



STANDPIPE ELEVATION ____

Well Construction

Flush Mount/Standup

Cement grout from 0' to 24.5'.

7 bags of Redi-Mix used

2" PVC Riser Pipe, from 28' to +2'.

Bentonite from 28' to 26'.

____ buckets used

1 bags used

#12-20 Silica Sand Pack

Sand from 28' to 25'.

6 bags of sand

Flush Threaded 2" PVC Screen

.010" Screen Size Opening

from 35' to 25'.

Bottom of Well 35.0

Natural Material 35.0'

WATER LEVEL MEASUREMENTS

DATE	TIME	SAMPLED DEPTH	CASING DEPTH	WATER LEVEL	WATER ELEVATION

START 9:15 COMPLETE 12:30

METHOD 4 1/4 HSA to

CREW CHIEF/LOGGER:

POWERTECH (USA) INC.

Hydro ID 709

PowerTech (USA) Inc.

DRILLED WITH: AIR [ ] WATER [ ] HOLE NO. DB11-15-ALLUV-4

T.D. 40' LOCATION: 426606.639, 1029414.805 State Plane NAD27

BIT SIZE 4" FA

SAMPLE LOG BY LE LEASE: (PROJECT) Dewey Burdock

DATE 5/4/11 COUNTY Fall River STATE SD

DEPTH	LITHOLOGY	CARBON	PYRITE	OTHER	Alteration % Primary Oxidation	Reduction	Secondary Oxidation	SAMPLE DESCRIPTION
								0-35' silty, sandy, CLAY, lt-med brown, dry, scat roots, (Alluv)
10								
20								
30								↗32' damp
								35-40' silty, sandy, clayey, GRAVEL, med brown, quartzite & chert pebbles, wet, (Alluv)
40								weathered GRANEROS @ 40' = TD
50								↗hole drilled out to 8¼" w/ 4¼ HSA & converted to MW.
60								
70								

L = Limonite (Lmn); SOX Surf. Oxidation; Rd. Reduced; Rdt. Reduction; P = Pyrite (Pyr); P_T = Pyrite Tarnish; POX = Primary Oxid.; BSOX = Base of Surf. Oxid.; 2OX = Secondary Oxid.; Tz = Transition Zone; fld = Feldspar (Amounts in Percent, %) T = Trace; 1 = Minor; 2 = Moderate; 3 = Abundant; C = Carbon; K = Kaolin; B = Bleached; Cht = Chert

POWERTECH (USA) INC.

4-24-08

Hydro ID 3026

SOUTH DAKOTA WATER WELL COMPLETION REPORT

 07-92

Location NW ¼ SE ¼ Sec 1 Twp 7S Rg 1E

County Fall River

North

Please mark well location with an "X"

W | E

X

Well Completion Date 3-26-08

1 Mile

Well Owner: Power Tech

Business Name: Power Tech USA Inc

Address: P.O. Box 723 Hot Springs S.D 57747

WELL LOG:

FORMATION	DEPTH FROM	DEPTH TO
Fall River	0	55
Fuson	55	80
Lakota	80	166

LOCATION:
Distance from nearest potential pollution source (septic tank, abandoned well, feed lot, etc.)? ______ ft. from NONE Present (identify source).

PROPOSED USE:
☐ Domestic/Stock ☐ Municipal ☐ Business ☐ Test Holes
☐ Irrigation ☐ Industrial ☐ Institutional ☒ Monitoring well

METHOD OF DRILLING: Mud + Rotary

CASING DATA: ☐ Steel ☒ Plastic ☐ Other
If other describe

PIPEWEIGHT	DIAMETER	FROM	TO	HOLE DIAMETER
SDR21 LB/FT	6 IN	0 FT	166 FT	8¾" IN
LB/FT	IN	FT	FT	IN
LB/FT	IN	FT	FT	IN

GROUTING DATA

Grout Type	No. of Sacks	Grout Weight	From	To
CMT	34	15.2 lb./gal	0 ft.	166 ft.
		lb./gal	ft.	ft.

Describe grouting procedure Pump

STATIC WATER LEVEL 138 Feet
If flowing: closed in pressure ______ PSI
GPM flow ______ through ______ inch pipe
Controlled by ☐ Valve ☐ Reducers ☐ Other
Reduced Flowrate ______ GPM
Can well be completely shut in? Yes

WELL TEST DATA:
☐ Pumped Describe: Air lift at 150'
☐ Bailed
☐ Other
Pumping Level Below Land Surface
______ ft. After ______ Hrs. pumped ______ GPM
______ ft. After ______ Hrs. pumped ______ GPM
If pump installed, pump rate ______ GPM

RECEIVED
APR 28 2008
WATER RIGHTS PROGRAM

SCREEN: ☐ Perforated pipe ☒ Manufactured
Diameter 3 IN Length 30 FEET
Material PVC
Slot Size .020 Set From 166 Feet to 196 Feet
Other information Set K Packer

WAS A PACKER OR SEAL USED? ☒ YES ☐ NO
If so, what material? 6" x 3" K Packer
Describe packer(s) and location? Packer set at 156

DISINFECTION: Was well disinfected upon completion?
______ YES, How:
X NO, Why Not? NA

Laboratory sent to for water quality analysis
Respec

REMARKS
Dewey Burdock
8-1-6

This well was drilled under license # 745
And this report is true and accurate.
Drilling firm Davis Drilling
Signature of License Representative: Stan Davis

Signature of Well Owner or Equitable Property Holder:

Date: 4/22/08

Hydro ID Cross Reference

Count	Powertech ID	Hydro ID	Log Date
1	DB07-11-2	682	5/24/2007
2	DB07-11-11C	680	10/16/2007
3	DB07-11-14C	684	11/2/2007
4	DB07-11-15	686	11/4/2007
5	DB07-29-7	683	11/19/2007
6	DB07-32-3C	681	11/27/2007
7	DB07-32-5	687	11/17/2007
8	DB08-32-10	689	1/26/2008
9	DB08-1-6	3026	3/24/2008
10	DB08-1-7	703	no date
11	DB08-2-1	698	3/21/2008
12	DB08-5-1	704	4/19/2008
13	DB08-11-17	688	3/25/2008
14	DB08-11-18	690	4/1/2008
15	DB08-11-19	692	4/4/2008
16	DB08-15-2	696	3/11/2008
17	DB08-15-3	694	3/19/2008
18	DB07-32-4C	685	12/4/2007
19	DB08-32-9C	691	1/15/2008
20	DB08-32-11	693	2/8/2008
21	DB08-32-12	697	2/26/2008
22	DB08-32-13	695	3/7/2008
23	DB09-21-1	705	11/19/2009
24	DB09-21-2	706	11/24/2009
25	DB-GW675	675	n/a
26	DB-GW676	676	n/a
27	DB-GW677	677	n/a
28	DB-GW678	678	n/a
29	DB-GW679	679	n/a
30	DB-11-34-ALLUV-4	707	n/a
31	DB-11-3-ALLUV-3	708	n/a
32	DB-11-15-ALLUV-4	709	n/a

SOURCE D

SOUTH DAKOTA OIL AND GAS RECORDS

Department of Environment & Natural Resources

Oil and Gas Search for: *api_no_ like '40 047 20045'*		
Page 1 of 1	**Download Database** (Excel spreadsheet format)	**Page:** 1

Record 1 of 1

Well Information

API No:	40 047 20045	**County:**	FALL RIVER
Well Name:	PETRO LEWIS 5-22 PETERSON	**Location:**	SWNW 22-7S-1E
Permit No:	606	**Total Depth:**	2545
Operator Name:	PETRO-LEWIS CORPORATION	**Bottom Hole:**	Minnelusa
Permit Date:	10-21-1970	**KB Elevation:**	3542
Spud Date:	11-17-1970	**Ground Elevation:**	3534
Plug Date:	11-27-1970	**Latitude:**	43.429484
		Longitude:	-103.992869
Well Field	WILDCAT	**Status**	P&A
Class:	DRY HOLE	**Type:**	DRY HOLE

Formation Tops

Formation	Depth (ft.)
Fall River	324
Lakota	452
Morrison	700
Sundance	848
Goose Egg	1441
Spearfish	1704
Minnekahta	1704
Opeche	1738
Minnelusa	1815
Converse	1838
Red Marker	2237
2nd Leo	2353

Page 1 of 1 (goto top)	**Page:** 1

COUNTY:	**FALL RIVER**
LEGAL LOCATION:	**SWNW 22-7N-1E**
API NO:	**40 047 20045**
PERMIT NO:	**606**
WELL NAME:	**PETRO-LEWIS #5-22 PETERSON**
OPERATOR:	**PETRO-LEWIS CORPORATION**
PERMIT ISSUED:	**10/21/1970**
PERMIT CLOSED:	**12/29/1971**
FILE LOCATION:	**7N-1E-12 SWNW**

TARGET CODES:

WELL HISTORY / CHECKLIST

PERMIT TO DRILL / INTENT TO DRILL

WELL INSPECTION / SCOUT REPORTS

OPERATOR'S TECHNICAL REPORTS / MAPS

ADMINISTRATIVE / SUNDRY REPORTS

CORRESPONDENCE

SURETY

MISCELLANEOUS

WELL HISTORY / CHECKLIST

Well History

Well Name Petro-Lewis #5-22 Peterson Permit No. 606

Location SWNW 22-7S-1E Fall River Date of Permit 10-21-70

Elev. 3534' Gr. API No. 40 047 20045

Confidential From To

Logs Received Dual Induction-Laterlog, Sonic-Gamma Ray

Cuttings Received Cores Received

Drill Stem Records

Cap Plug and Marker Set

Surface Restored

Plugging Affidavit Signed Date

Bond Released YES Date 12-29-71

Summary of Scout Reports

11-27-70 FVS Logging. Drilled to T.D.

6-21-71 RL Site approved.

WELL HISTORY

Well Name Petro Lewis #5-22 Peterson Permit Number 606

Location SW NW 22-7S-1E Date of Permit Oct 22, 1970

Elevation 3542 KB API Number

Confidential Yes From 11-27-70 To 5-27-71

Logs Received Dual Ind, Sonic Gamma-Ray, Sample

Cuttings Received Yes Cores Received

Drill Stem Records Ran Dst - No Copy 12-8-70

Cap Plug and Marker Set Approved June 23, 1971

Surface Restored Approved June 23, 1971

Plugging Affidavit Signed Date

Bond Released Date

Summary of Scout Reports

No Cuttings 29 Apr. 1971

PERMIT TO DRILL / INTENT TO DRILL

State Pub. Co., Pierre

APPLICATION FOR PERMIT TO:

S. Dak. Oil & Gas Board
FORM 2

☒ DRILL ☐ DEEPEN ☐ PLUG BACK ☐ SINGLE ZONE

☐ OIL WELL ☐ GAS WELL ☐ MULTIPLE ZONE

FARM OR LEASE NAME: Peterson

WELL NO: 5-22

FIELD AND POOL, OR WILDCAT: Wildcat

NO. ACRES IN LEASE:

OPERATOR: PETRO-LEWIS CORPORATION

ADDRESS: 1224 Denver Club Building, Denver, Colorado, 80202

LOCATION (In feet from an established corner of the legal subdivision)*: 1980' FNL, 660'FWL, SW-NW Section 22, T7S, R1E
Fall River County, South Dakota

¼ ¼ SEC. TWP. RGE: SW-NW Sec. 22, T7S, R1E

COUNTY: Fall River

NAME AND ADDRESS OF SURFACE OWNER: Mrs. M. Lenore Peterson

ELEVATION: 3534' Gr.

NO. OF WELLS ETC.:

PROPOSED DEPTH: 2490'

ROTARY OR CABLE TOOLS: Rotary

NAME AND ADDRESS OF CONTRACTOR: Will follow

APPROXIMATE DATE WORK WILL START: October 21, 1970

IF LEASE PURCHASED WITH ANY WELLS DRILLED, FROM WHOM PURCHASED (Name and address)

PROPOSED CASING AND CEMENTING PROGRAM

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	NEW OR SECOND HAND	DEPTH	SACKS OF CEMENT
12-1/4"	8-5/8"	24#	New	165' Minimum	To Surface

DESCRIBE PROPOSED OPERATIONS. IF PROPOSAL IS TO DEEPEN OR PLUG BACK, GIVE DATA ON PRESENT PRODUCTIVE ZONE AND PROPOSED NEW PRODUCTIVE ZONE. GIVE BLOW OUT PREVENTER PROGRAM IF ANY

We propose to drill this well with rotary tools to an approximate depth of 2490' to test the Leo Sand. If commercial production is encountered a 5-1/2" OD 14# oil string will be run and cemented with sufficient cement to displace 1000'.

Certified Surveyors plat attached (3 copies)
Blanket drilling bond #1672873

SIGNED: R. J. Doubek
R. J. Doubek

TITLE: Manager of Operations DATE: 10/?/70

DO NOT WRITE BELOW THIS LINE

PERMIT NO: 66

CHECKED BY: School and Public Lands Date

APPROVAL DATE: October 2_, 1970 Secretary

CONDITIONS:

☐ COMPLETE SET OF SAMPLES, AND CORES IF TAKEN, MUST BE SUBMITTED.

☐ SAMPLES, AND CORES IF TAKEN, BELOW DEPTH, MUST BE SUBMITTED.

INSTRUCTIONS

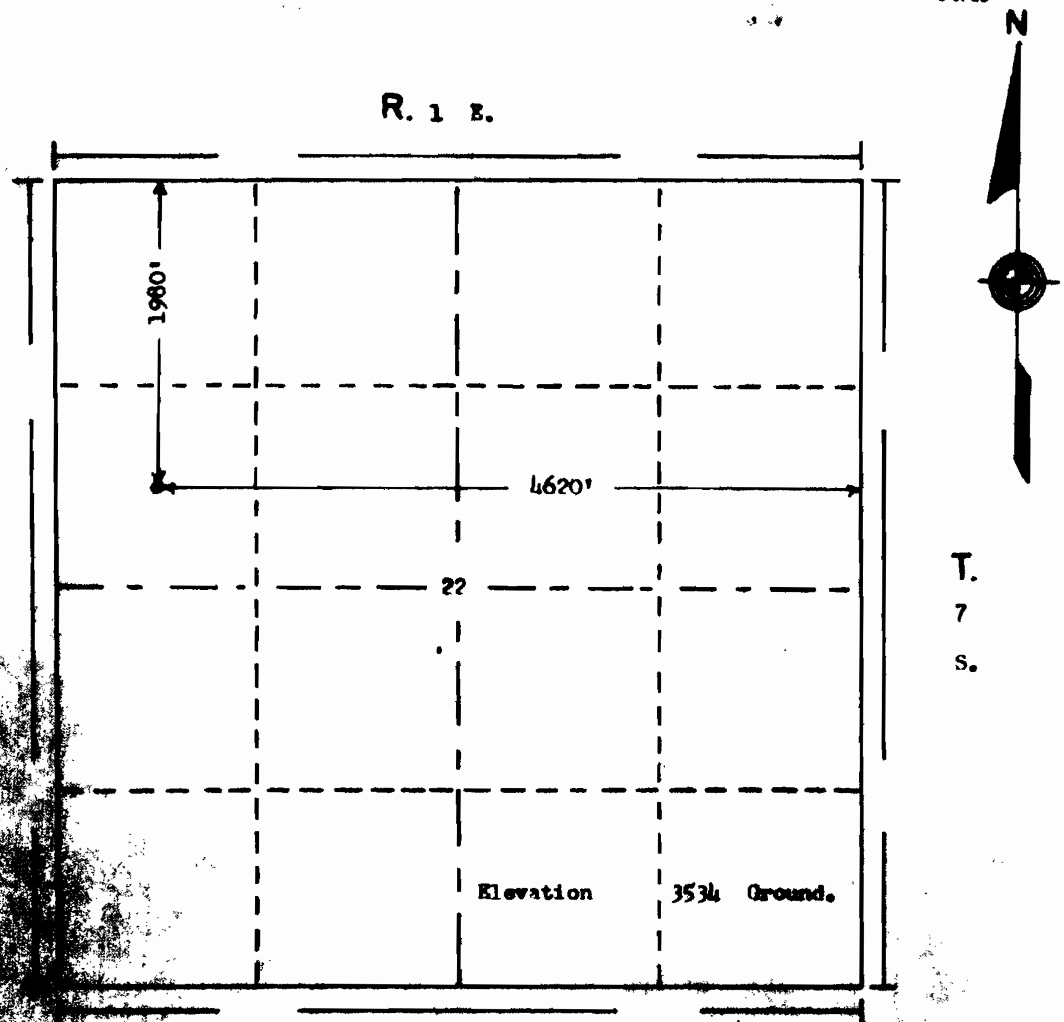
General: This form is designed for submitting proposals to perform certain well operations, as indicated, on all types of lands and leases for appropriate action by either a Federal or a State agency, or both, pursuant to applicable Federal and/or State laws and regulations. Consult **applicable Federal or State regulations, or appropriate officials, concerning approval of the proposal before operations are started.**

If the proposal is to redrill to the same reservoir at a different subsurface location or to a new reservoir, use this form with appropriate notations.

If the well is to be, or has been, directionally drilled, so state and show by attached sheets, if necessary, the coordinate location of the hole in any present or objective productive zones.

File 3 copies of this form with Secretary, Oil & Gas Board, Pierre.

(*Sample location: 660' South and 660' East of the Northwest Corner of Section 16.)



Scale··· 1" = 1000'

[illegible] Elevation Company, Inc. of Denver, Colorado
[illegible] in accordance with a request from Owen Stevens
[illegible] Petro Lewis Corporation
[illegible]ed the location of #231 Driftwood Area
[illegible] 1980'FN & 4620'FE Section 22 Township 7 S.
[illegible] 1 E. of the Black Hills Meridian
[illegible] Fall River County, South Dakota

I hereby certify that this plat is an accurate representation of a correct survey showing the location of
#231 Driftwood Area

Date: 7-[illegible]-70

Licensed Land Surveyor No. 1212 PE
State of South Dakota

STATE PUB. CO., PIERRE

S. Dak. Oil & Gas Board
FORM 1

ORGANIZATION REPORT

Full Name of the Company, Organization, or Individual

Petro-Lewis Corporation

Post Office Address (Box or Street Address)

1224 Denver Club Building, Denver, Colorado, 80202

Plan of Organization (State whether organization is a corporation, joint stock association, firm or partnership, or individual)

Corporation

If a reorganization, give name and address of previous organization

(1) If foreign corporation, give State where incorporated	(2) Name and postoffice address of State agent	(3) Date of permit to do business in state
		May 28, 1970

Principal Officers or Partners (if partnership) NAME	TITLE	POSTOFFICE ADDRESS
SEE THE ATTACHED SHEET...		

DIRECTORS NAME	POSTOFFICE ADDRESS
SEE THE ATTACHED SHEET	

Executed this the 7th day of October 19 70

State of Colorado

County of Denver

R. J. Doubek
Signature of Affiant R. J. Doubek

Before me, the undersigned authority, on this day personally appeared R. J. Doubek known to me to be the person whose name is subscribed to the above instrument, who being by me duly sworn on oath states, that he is duly authorized to make the above report and that he has knowledge of the facts stated herein, and that said report is true and correct.

Subscribed and sworn to before me this 7th day of October 1970.

SEAL

My commission expires Nov. 3, 1971

Betty J. Byrom
Notary Public in and for Denver
County, Colorado

DO NOT WRITE BELOW THIS LINE

PETRO-LEWIS CORPORATION

Attachment to Annual Corporate Report
Attachment dated May 15, 1970

Current Officers of the Corporation:

Title:	Name:	Street Address:	City:	State:
President	Jerome A. Lewis	3680 South Downing	Englewood	Colorado
Vice-President	Don E. Mettler	5741 East Nassau Place	Englewood	Colorado
Vice-President	Dwight C. Moorhead	1437 South Fairfax	Denver	Colorado
Vice-President	David A. Frawley	7343 E. Jefferson Drive	Denver	Colorado
Vice-President	Hal H. Wolfe	800 Lotus Way	Broomfield	Colorado
Vice-President	Herbert G. Allen			Colorado
Vice-President	Jim H. Hanlon	2195 Urban Drive	Lakewood	Colorado
Secretary-Treasurer	Robert B. Huffman	3162 South Gaylord	Englewood	Colorado

Current Directors of the Corporation:

Name:	Street Address:	City:	State:
Jerome A. Lewis	3680 South Downing	Englewood	Colorado
Don E. Mettler	5741 East Nassau Place	Englewood	Colorado
Ted P. Stockmar	15 Cherry Street	Denver	Colorado
W. Dale Schouweiler	5212 Indiana	Fort Wayne	Indiana
Cortlandt S. Dietler	888 Logan Street	Denver	Colorado
Carl K. Erpf	960 Park	New York	New York
James W. Vickers	346 North	Wichita	Kansas

WELL INSPECTION / SCOUT REPORTS

JUN 25 1971

Number 2

SCOUT REPORT
South Dakota Geological Survey

Date Scouted 6-21-71

Operator Petro-Lewis Permit Number 606

Farm/Lease Name #5-22 Peterson API Number 40 047 20045

SWNW Sec. 22, T. 7S, R. 1E, Fall River County

Elev. 3534, Est. T.D. 2490, Actual T.D. 2545, Spudded 11-18-70

Contractor A. L. Schlaikjer Geologist Al Nelson

WORK IN PROGRESS:

DEVELOPMENTS SINCE LAST VISIT:

FORMATION TOPS:

PLUGGING RECORD: Date Plugged 11-27-70

CASING RECORD:

4 1/2 From 0 To 367 Feet ____ From ____ To ____ Feet

____ From ____ To ____ Feet ____ From ____ To ____ Feet

REMARKS:
Site approved. Converted to water well, good running well. Area restored and policed.

SCOUTED BY Ross Lamphere Fred V Steece

Ross Lamphere, Ass't. Geologist Fred V. Steece, Principal Geologist

Number 1

SCOUT REPORT
South Dakota Geological Survey

Date Scouted 11-27-70

Operator Petro-Lewis   Permit Number 606

Farm/Lease Name # 5-22 Peterson   API Number 40 047 20045

SWNW Sec. 22, T. 7S, R. 1E, Fall River County

Elev. 3534 Gr., Est. T.D. 2490, Actual T.D. 2545, Spudded 11-18-70

Contractor A. L. Schlaikjer   Geologist Al Nelson

WORK IN PROGRESS:

Logging

DEVELOPMENTS SINCE LAST VISIT:

Drilled to T.D.

DST #1-2381-2395: IHP 1111, FH 1106, IF 20, FF20, IF 30, FF 75, SIP 963, SIP$_2$ 907, Flow, 15 min, SIP. 15 min, Flow$_2$ 45 min, SIP$_2$ 15 min, BHT 96°, mud wt. 9.5, visiosity 60; tool opened w/very weak blow and remained op 5 min, tool op w/very weak blow 1/4" under water, remained for 10 min, then intermittant blow. Rec: 140 fluid; 60' GCM w/sulfur smell, 80' water w/scum of oil and sulfur smelling gas; water flow throughout test; Resistivity: water 40.62 pf cl content 18,000ppm mud pit spl 2.6 @ 60 0f cl content 2,500 ppm.

FORMATION TOPS: (Al Nelson)

Fall River------324	Goosegg------1441	2nd Converse------1961-1991
Fuson------------452	ForelleLs----1599	3rd Converse-----2076-2094
Lakota-----------469	Glendo-------1618	4th Converse-----2154-2165
Morrison---------700	Minnekahta---1704	Red Marker-------2237-2247
Sundance---------848	Opeche-------1738	2nd Leo----------2353
Lak--------------966	Minnelusa----1815	Des Moines-------2416
Basal Sund Sd----1061	1st Converse-1838	
Spearfish--------1174	Massive Anhydrite 1911-1942	

PLUGGING RECORD: Date Plugged 11-27-70

40 sax--2410-2300 Leo
30 sax--1850-1750 Converse
30 sax--1130-1030 Basal Sand

CASING RECORD:

___ From ___ To ___ Feet   ___ From ___ To ___ Feet

___ From ___ To ___ Feet   ___ From ___ To ___ Feet

REMARKS:

Plugged back to Morrison, 4 1/2 casing ran to 367 and well completed as water well for Peterson farm; flows approx. 25.35 gal per min.

SCOUTED BY Fred V Steece

Fred V. Steece, Principal Geologist

Petro-Lewis # 5-2 Peterson
SW NW 22-7S-1E Fall River
1980 FNL and 4620 FEL

PERMIT:	606 (10-21-70)
API:	40 047 20045
ELEV:	3534 Gr 3542 KB
CONTR:	A.L. Schlaikjer 662-7244
GEOL:	Al Nelson Edgemont Rambo Motel
ENGR:	W.J. McPeters
SPUD:	11-18-70 (1:15 AM)
EST T.D.:	2490
CASING:	8 5/8 - 167
CORES:	None
DST'S:	2381-2395
LOGS:	DIL & Sonic GR
T.D.:	2545 Drlr 2544 Log
PLUG:	11-27-70

10-29-70
No activity, location staked, but no work done.

11-19-70
Phone call from Al Nelson saying well was started and that he would let me know when ready to plug. Said, Petrolewis plans 3 tests in Edgemont area.

11-26-70
Nelson called saying would be logging late tonite, ready to plug in A.M.

Plug Program:
40 sax — 2410-2300 Leo
30 sax — 1850-1750 Converse
30 sax — 1130-1030 Red Sand

Plan to run 360 — 4½ casing and convert to water well. Schlumberger w/ do this before they tear down.

(Leo Sand)
DST #1 - 2391-2395:
HHP 1111, FH 1106, IF 20 FF 20, IF 30, FF 75, SIP, 963, SIP₂ 907, Flow 1-5 min, SIP 1 - 15 min, Flow 2 - 45 min, SIP₂ - 15 min, BHT 96°, mud wt 9.5, viscosity 60; Tool opened with a very weak flow and remained op 5 min, tool open very weak flow ¼" underwater remained for 10 min, then intermittent flow. Bypassed tool to see if plugged; Rec 140 fluid; 60' ~~gas~~ GCM w/ sulfur smell, 80' water w/ scum of oil & sulfur smelling gas; Water flowed throughout test.

Resistivity: water .4 @ 62 °F Cl content 18,000 ppm
mud pit spl 2.6 @ 60 °F
Cl content 2500 ppm

Formation - ops.

Kd	324	
Fuson	~~447~~ 452	
Lakota	~~508~~ 469	
Morr.	700	
Sund	848	
Lak	966	
Basal Sd.	1061	
Spear	1174	
Goosegg	1441	
Forelle Lime	1599	
Glendo Sh	1618	
Mk	1704	
Opeche	1738	
Minnelusa	1815	
1st Converse	1838	
Massive Anhydrite	1911	
Base "	1942	
2D Converse	1961	1991
3D Conv	2076	-2094
4th Conv	2154	-2165
Basal Conv	2226	
Red Mark	2237	-2247
2D Leo	2353	-
Des Moines	2416	
TD	2540	Drlr
	2544	Log

Site Insp.
Converted to H_2O well
is a good running well.
Area is restored
not real level. area
policed.

OPERATOR'S TECHNICAL REPORTS / MAPS

PHONE 522-1206 AREA 303 **VIRG'S TESTERS, INC.** BOX 712 STERLING, COLORADO

Contractor	A. L. Schlaikjer, Inc.	Top Choke	1"
Rig No.	4	Bottom Choke	9/16"
Spot	SW-NW	Size Hole	7 7/8"
Sec.	22	Size Rat Hole	None
Twp.	7 S	Size & Wt. D. P.	3½" 13.30
Rng.	1 E	Size Wt. Pipe	None
Field	Wildcat	I. D. of D. C.	2¼"
County	Fall River	Length of D. C.	542'
State	South Dakota	Total Depth	2395'
Elevation	3534' "Ground"	Interval Tested	2381-2395
Formation	"2nd Leo" Sand	Type of Test	Straight

Tool Open @ 10:00 A. M.

Flow #1 5 Min. SIP #1 15 Min. Flow #2 45 Min SIP #2 15 Min.

Flow #3 ____ Min. SIP #3 ____ Min. Flow #4 ____ Min. SIP #4 ____ Min.

B. H. T. 96° Gravity

Mud Wt. 9.0 Viscosity 60

TOOL SEQUENCE

2373

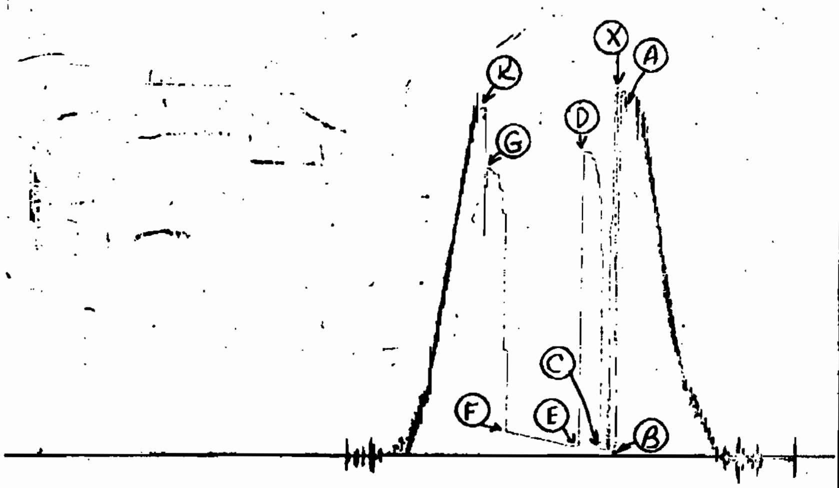
2381

TD 2395

Operator Petro-Lewis Corp.

Address See Distribution

T- 0786 R- 4153-N



PRD Make Kuster AK-1

No. 4153 Cap. 2000 @ 2361

Press		Field	Corrected
IH	A	1111	1102 ✓
FH	K	1106	1100 ✓
Flow #1-IF	B	20	4 ✓
FF	C	20	21 ✓
SIP #1	D	963	969 ✓
Flow #2-IF	E	30	31 ✓
FF	F	75	76 ✓
SIP #2	G	907	914 ✓
Flow #3-IF	H	None	Taken
FF	I	"	"
SIP #3	J	"	"
Pressure Below Bottom Packer Bled To			

Our Tester: Lloyd Welty

Witnessed By: S. A. Nelson

Well Name and No. Peterson #5-22

Ticket No. 0786

Date 11-25-70

RECOVERY IN PIPE

DID WELL FLOW - Gas No Oil No Water No

140' Total fluid
60' Gas-cut mud with a sulphur smell - .29 Bbl.
80' Water with a scum of oil & sulphur smelling gas - .39 Bbl.

REMARKS:

1st Flow - Very weak blow throughout period.
2nd Flow - Tool opened with a very weak blow (¼" under water), remained for 10 minutes, then decreased to intermittent blow for remainder of test.
By-passed tool after 50 minutes (point "X") to see if it was plugged.

Well had 3" to 4" water flow from anulus throughout test. 3' fillup on bottom.

Breakdown of Shut-in curves not practical because of very bad stair-stepping on Shut-in curves, caused by tight formation.

TIGHT HOLE

DST No. 1

No. Final Copies 10

Phone 522-1206 **VIRG'S TESTERS, INC.** Box 712 - Sterling, Colo.

Fluid Sample Report

Date 11-25-70 Ticket No. 0786

Company Petro-Lewis Corp.

Well Name & No. Peterson #5-22 DST No. 1

County Fall River State South Dakota

Sampler No. 02 Test Interval 2381-2395

Pressure in Sampler 11 PSIG BHT 96 °F

Total Volume of Sampler: 2150 cc.

Sample: 2150 cc.

Oil: 10 cc.

Water: 2140 cc.

Mud: None cc.

Gas: None cu. ft.

Other: None

Resistivity

Water: .4 @ 62° of Chloride Content 17,200 ppm.

Mud Pit Sample 2.6 @ 60° of Chloride Content 2,550 ppm.

Gas/Oil Ratio ______ Gravity ______ °API @ ______ °F

Where was sample drained Rig Floor

Remarks:

DISTRIBUTION OF FINAL DST REPORTS

Company Operating Well Petro-Lewis Corp. Tkt. No. 0786

Lease Peterson Well No. 5-22 Field Wildcat

County Fall River State South Dakota Sec. 22 Twp. 7 S Rng. 1 E Spot SW-NW

DST. No. 1 Date of Test 11-25-70 Interval Tested 2381-2395

BE SURE AND SHOW CORRECT ADDRESS AND NUMBER OF COPIES. STATE ADDRESS TO WHICH ORIGINAL CHART WILL BE MAILED.

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1 copy: Al Nelson, 408 Majestic Bldg., Denver, Colo. 80202

Our Tester ______ Approved by ______

G. ALLAN NELSON
CONSULTING PETROLEUM GEOLOGIST
ROOM 408, MAJESTIC BLDG. CODE 303
255-7750 Res. 322-0325
DENVER, COLORADO, 80202

1971

GEOLOGICAL WELL REPORT

PETRO-LEWIS
#5-22 PETERSON

C SW NW SEC. 22, T. 7 S., R. 1 E.
FALL RIVER COUNTY, SOUTH DAKOTA

(Wildcat)

INDEX

WELL DATA

LOCATION:	4620' from the East line and 1980' from the North line, C SW NW of Section 22, Township 7 South, Range 1 East, Fall River County, South Dakota.
ELEVATION:	3534 ground (before and after grading). 3542 kelly bushing (7.6' from ground to K.B.). (Surveyed by Powers, 7-24-70).
TYPE WELL:	Wildcat (Driftwood Canyon Prospect).
SPUD DATE:	1:15 A. M., November 18, 1970.
COMPLETION DATE:	Approximately 5:00 P. M., November 27, 1970 (Finished plugging).
CASING RECORD:	Ran 4 joints of new 8 5/8" surface casing, totalling 167', 8 round, 20 pound. Cemented with 100 sax regular cement with 3% Calcium chloride (Plug down at 10:15 A. M., November 18, 1970. Cement circulated). Pipe set at 177 K. B.
TOTAL DEPTH:	2545 Driller. 2544 Schlumberger.
DEEPEST FORMATION PENETRATED:	Pre-Second Leo Sand (Des Moines or older).
DEPTH DATUM:	3542 K. B.
WELL STATUS:	Plugged and abandoned (Landowner ran pipe into Dakota Sand to complete as flowing water well from Dakota-Lakota).
MUD PROGRAM:	Mixed mud while drilling surface hole to combat lost circulation in river bed sands and gravels; mixed gel. Came out from under surface with native mud and gel and water and a 32-33 vis. Make-up water from nearby Beaver Creek.

-2-

WELL DATA (Continued)

Jetted pits at 953 in Sundance in order to convert to red bed type mud. Added 4 sacks of Caustic, 2 sacks of Soda Ash, and 6 sacks of Stabil-Vis. Requirements: 32-35 vis., wt. low as possible. On first trip below surface at 1086 in Sundance hole was flowing a 2" stream of water.

HOLE SIZE: 12 1/4" from surface to 178.
7 7/8" from 178 to 2545 T. D.

CORES: (None).

DRILL-STEM TEST: D.S.T. #1 2379-93 P. D. (Second Leo Sand).

LOGS: Ran Schlumberger Dual Induction-Laterolog first, running a logarithmic 5" and a logarithmic 2" from 2544 T. D. up above the Minnekahta. Then dropped back to bottom and came up to 1736 just above base of Opeche with another logarithmic 5" (repeat) and a linear 2". From above the Minnelusa ran a linear 2" and a linear 5" to base of surface casing at 177 K. B.

Second logs run consisted of the Borehole Compensated Sonic Log with Gamma Ray-Caliper Logs. Ran 5" Sonic, etc., from 2544 T. D. up above Minnelusa to 1732. Then ran a 5" repeat over same interval to see if variance was above 2%. Sonic was repeating good in Minnelusa so continued all the way out to base of surface casing at 177 K. B., running a 5" and 2".

At approximately 1700 added 2 sacks of C.M.C. (Driscose) to lower water loss to 10 cc. or less going into Minnelusa Converse section. At 2206 in lower Converse added 1320 gallons of #2 Diesel to speed drilling and prevent drill column getting stuck in hole. At approximately 2150 added 2 sacks of C.M.C. to lower water loss to 5 cc. or less for drilling Leo Section of Minnelusa. In this part

WELL DATA (Continued)

of section vis. was 38-40, wt. 9.9, Ph. 9.5 or more. Raised vis. to 72 for D.S.T. of Second Leo Sand.

Raised vis. with Gel and detergent for logging at 2545 T. D. Could not get vis. above 44 due to Dakota-Lakota water flow in upper hole; had no problems logging.

Mud furnished by American Mud Company, Gillette, Wyoming. Mud checks on location made every 1-2 days by engineer, Dick Myers, Gillette.

Est. mud bill at 2540, 5' above T. D.: $3,344.35.

Logging truck and personnel from Gillette, Wyoming. Engineer: Mr. Golas. (Calculations in rear of report).

PLUGGING RECORD:

40 sacks from 2420 to 2300 across Red Marker.
30 sacks from 1850 to 1750 across top of Converse.
30 sacks from 1130 to 1030 across Basal Sand of Sundance.
Cementing by Halco.
Finished plugging at approximately 5:00 P.M., November 27, 1970. (Left Dakota-Lakota open for flowing water well for landowner; contractor ran pipe into Dakota).

CONTRACTOR AND RIG EQUIPMENT:

Schlaikjer Drilling Company, Newcastle, Wyoming.
Pusher: C. W. McPeters, part owner.
Rig. No. 4.
Spencer-Harris 6000 - Made in 1969 (trailer-mounted rig).
Spencer-Harris 97' derrick (pulls doubles) and trailer.
Bethlehem S-45E with 15" double T. W. in Hydromatic.

WELL DATA (Continued)

1	335 H.P. Cummins Diesel engine powering drawworks.
1	D-300 Emsco mud pump, 7 1/4" x 14", with 5 1/2" liners.
2	6-71 (twins) G.M.C. engines with H.D. gear box, 300 H.P., powering mud pump.
	Space-Saver Cameron S.S. 8" blow-out preventer with 2 valve Cameron hydraulic closing unit.
19	5 1/2" O.D. drill collars with 2 1/4" bore.
6,000'	3 1/2" I.F. Reed drill pipe with square shoulder tool joints.
	Caterpillar D-315 generator with 25 K.W. gas engine standby.
	32' trailer house.
1	auxiliary 4 x 6 Gardner-Denver mud-mixing pump.
	New General Electric 2-way radio system on rig, in pusher's car, and in Newcastle office.

SAMPLE STORAGE: Samples were shipped to American Stratigraphic in Casper where library cut will be made. Operator's complimentary cut will be sent to South Dakota Geological Survey as required.

DRILLING TIME RECORDS: Original copy of Geolograph 1' drilling time charts is on file in Denver office of G. A. Nelson.

LOG FORMATION TOPS

All depths are measured from 3542 K. B.

FORMATION	DEPTH	DATUM
LOWER CRETACEOUS	Surface	
MOWRY SHALE	Surface	
MUDDY SAND (NEWCASTLE)	(Behind pipe in surface hole)	
SKULL CREEK SHALE	(Behind pipe in surface hole)	
DAKOTA FORMATION (FALL RIVER FORMATION)	324	+3218
FUSON SHALE (FUSON MEMBER OF LAKOTA FORMATION)	452	
LAKOTA SANDS	469	+3073
UPPER JURASSIC	700	+2842
MORRISON FORMATION	700	+2842
SUNDANCE FORMATION	832	+2710
REDWATER SHALE MEMBER	832	
LAK MEMBER	966	
TENTATIVE HULETT SAND	1061	
BASE OF SAND	1092	
TENTATIVE STOCKADE BEAVER SHALE	1092	
TENTATIVE TOP OF BASAL SAND	1144	
TRIASSIC	1174	+2368
SPEARFISH FORMATION	1174	+2368
PERMIAN	1441	+2101

LOG FORMATION TOPS (Continued)

FORMATION	DEPTH	DATUM
GOOSE EGG FORMATION	1441	+2101
FORELLE LIME MEMBER	1594	
GLENDO SHALE MEMBER	1618	
MINNEKAHTA LIME MEMBER	1704	+1838
OPECHE SHALE MEMBER	1738	
MINNELUSA FORMATION (REWORKED MINNELUSA)	1815	+1727
UPPER MINNELUSA (PERMIAN)	1815	+1727
FIRST CONVERSE SAND	1838	+1704
MASSIVE ANHYDRITE	1911	
BASE ANHYDRITE	1942	
SECOND CONVERSE SAND	1961	
BASE OF SAND	1991	
TENTATIVE TOP OF THIRD CONVERSE SAND	2089	+1453
BASE OF SAND	2094	
FOURTH CONVERSE SAND	2154	+1388
BASE OF SAND	2165	
BASAL CONVERSE SAND	2226	
RED MARKER	2237	+1305
BASE RED MARKER	2247	
PENNSYLVANIAN	2247	+1295
MIDDLE MINNELUSA (LEO SECTION)	2247	+1295
VIRGIL	2247	+1295
MISSOURI	2353	+1189
SECOND LEO SAND	2354	+1188

LOG FORMATION TOPS (Continued)

FORMATION	DEPTH	DATUM
BASE OF SANDS	2396	
DES MOINES (?)	2416	+1126
TOTAL DEPTH DRILLER	2545	
TOTAL DEPTH SCHLUMBERGER	2544	

SAMPLE LITHOLOGIC DESCRIPTION

All depths are from 3542 K. B.

All sample depths following have been corrected for lag, and then matched to drilling time breaks wherever possible. *Sample lithology is then matched to log lithology so all lithology following matches log.

All shows are underlined with a solid line. Possible shows are shown with a dashed line.

DEPTH	LITHOLOGY
Surface	LOWER CRETACEOUS
Surface	MOWRY SHALE
	(Surface pipe to 177 K. B.; Muddy Sand or Newcastle Sand probably behind surface pipe).
	(Samples below are caught and described every 30').
180-200	Silty shale, steel gray, very soft Skull Creek; muddy cave: sandstone, gray, dark gray, shaly, dirty, limy, glauconitic, biotitic, very hard and tight; trace light gray inoceramus prism veinlet on same gray shale; trace sandstone, light gray, very fine, soft, porous; no fluorescence.
200-32	Same shale.
232-64	Same dark steel gray, very soft shale.
264-324	Same shale; trace light brown inoceramus prisms; trace loose pyrite.
324 (+3218)	DAKOTA FORMATION (FALL RIVER FORMATION)
324-28	Abundant sandstone, light gray, lot of sandstone laminated with black silty shale, no show, slightly dirty, very fine to fine, well-cemented, poor visible porosity, hard to soft, also gray; sandstone, fine, soft, porous, no show, white, friable; loose pyrite, crystalline to sandy with embedded sand grains; all with no fluorescence.

328-54	Shaly siltstone, light gray with thin blackish shaly laminations; sandstone, fine, slightly sugary, visible porosity, some glauconite, no show, soft, also very fine, light gray, few carbonaceous spots; also dark gray, very shaly siltstone; sandstone has spotty white cementation; no fluorescence; in stoppered shell vial Dakota cuttings above 354 are cut in C. Tet. solution with no fluorescence in resulting solution; this indicates no oil in samples.
354-78	Abundant shaly siltstone, dark gray; some friable, porous sand as above, no show; first traces of waxy clay, tannish light gray, grayish brown and gray (possibly Fuson); lot of small black carbonaceous spots and streaks in siltstone, no visible porosity, no show, no fluorescence.
378-452	Same dark gray shaly siltstone and fine light gray sandstone as above with good porosity, soft, white clay spots, no show; limited same waxy clay, tannish gray mottled with black (Fuson?); very shaly siltstone, gray mottled blackish, hard, tight; gray waxy clay.
452	FUSON SHALE
452-55	Abundant very soft clay, waxy, light gray, tannish light gray, whitish; grayish light green, very waxy, very soft; part sandy where light gray.
455-469	Same whitish, light gray clay; also mostly grayish purple and red.
469 (+3073)	LAKOTA SANDS
469-98	Abundant snow white sandstone, highly kaolinitic with abundant white waxy clay cementation, no show, non-calcareous, very fine to fine, no visible porosity, mushy soft, abundant pyrite, few fine grains (Lakota top marked by extremely fast drilling).
498-522	Same as above, mostly loose sand grains, clear, very fine to fine to fine-plus, unconsolidated, few medium grains; very abundant pyrite; limited light gray sandstone, no show, fine, cleaner, friable, porous; all with no fluorescence; shale breaks of very waxy clay, bluish white, very pale green; trace chert, smoky gray with tiny white spots, very coarse, subangular.

522-45	Traces sandstone, slightly tannish light gray possibly stained, very fine to mostly fine, excellent visible porosity, friable, no fluorescence; abundant very sandy lime, grayish tan, very hard, dense, earthy; abundant loose pyrite, limited medium crystalline, mostly very sandy with embedded sand grains, very fine to fine, part all fine-plus; abundant chert, light gray translucent, tan; loose clear quartz sand grains, fine to medium to medium-plus.
545-77	All very dark gray shale (sand on log), slightly waxy, almost black, part slightly sandy; traces conglomeratic sandstone, clean, very sugary, fine to medium, no show; trace loose clear chert, coarse, angular, also frosted, milky white; ironstone (?) stringer, tannish brown, part very sandy, dense, very hard (Morrison-type shale).
577-620	Same greenish black shale, slightly waxy, very soft; trace chert, clear, angular, very coarse; traces brown sand, very fine, very well-cemented, no show, no visible porosity, very hard, tight, limy.
620-48	Abundant pebbles, mostly very coarse-plus, subangular, brown, milky white, clear angular; loose pyrite (pebbles surface cave?); same shale.
648-62	(Poor sample, mostly cave).
662-700	Loose chert, clear, pink opaque, yellow, subangular, very coarse to pebble size; loose sand grains, very poorly sorted very fine, fine, medium, coarse, very coarse, mostly clear; abundant loose pyrite.
700 (+2842)	JURASSIC
700 (+2842)	MORRISON FORMATION
700-42	Abundant pale green waxy clay, very soft, with embedded tan lime spots.
742-74	Same green clay; increasing tan dense lime.
774-803	Same green clay, becoming dark gray; limited limestone stringers, tan with green spots; traces sandstone, gray, light gray, very fine to fine, no show, no visible porosity, hard, tight, limy cementation.
803-32	Limestone, very light tan, cream, very dense, very hard; traces dark brown limestone, highly microfossiliferous, hard; trace sandstone, cream, very limy, very fine, very well-cemented, scat-

	tered orange grains, no visible porosity, hard, tight.
832 (+2710)	SUNDANCE FORMATION
832	REDWATER SHALE MEMBER
832-33	Trace dark gray shaly siltstone, highly glauconitic with dark green grains, very soft; trace shaly siltstone, greenish gray, highly glauconitic, very fine and finer grains.
833-86	(Missing samples).
886-920	Silty shale, dark gray, very soft; very shaly sand to siltstone, dark gray, very, very fine where sand, very silty, highly biotitic and glauconitic, very soft, no porosity.
920-40	Waxy shale, pale green, very soft; dense limestone stringer, light gray, very hard; sandstone, light gray, very fine and finer, limy, scattered dark green glauconite grains, slightly soft.
940-66	Same waxy green shale; same very, very fine sandstone, cream, limited glauconite, no show, soft to slightly soft, no porosity.
966	LAK MEMBER OF SUNDANCE
966-70	Very shaly sand, dark orange, very fine and finer, excellent sorting, no visible porosity, no show, slightly soft; very silty shale, orange red, soft.
970-98	Same sand, orange brown, very fine, no show, soft.
998-1002	Waxy shale, dark gray to blackish.
1002-52	Black waxy shale, very soft.
1052-61	TENTATIVE HULETT SAND
1061-76	(Circulated 20" sample at 1076 before trip for bit in prospective zone). Traces light gray sandstone, very, very fine, excellent sorting, no show, friable, porous; also slightly greenish light gray sandstone, very fine to very, very fine, excellent sorting, no show, glauconitic, porous, soft to slightly soft where more cemented, no fluorescence.
1076-92	Same as above, becoming slightly shalier grayish; trace very pale green waxy shale laminations on sand; all with no show; trace light gray sandstone, very fine, excellent sorting, no show, well-cemented but porous, soft; all with no fluorescence.

1092	TENTATIVE STOCKADE BEAVER SHALE
1092-1144	(Shale on log).
1144	TENTATIVE TOP OF BASAL SAND OF SUNDANCE
1144-74	Sandstone, clean, friable, excellent visible porosity; traces tannish light gray sandstone, very fine, excellent sorting, spotty clay cementation in part.
1174 (+2368)	TRIASSIC
1174 (+2368)	SPEARFISH FORMATION
1174-1207	Smooth shale, red, part silty, all soft.
1207-37	Abundant silty shale, brownish red, finely biotitic, few small light gray spots.
1237-68	Same silty shale, orange red, brownish red, finely biotitic, soft to slightly soft.
1268-1304	Same shale, traces sandy.
1304-36	Same shale, trace greenish gray large spot.
1336-67	Same shale and silty shale.
1367-97	Same shale; trace fibrous white anhydrite veinlet in shale.
1397-1441	Same silty shale, brownish red, orange red; traces loose white fibrous anhydrite; traces white anhydrite inclusions in shale.
1441 (+2101)	PERMIAN
1441 (+2101)	GOOSE EGG FORMATION
1441-48	(7' of slower drilling). (Probably anhydrite --none visible in samples).
1448-61	Silty shale, brick red; small round light green spots in smooth red shale.
1461-81	Silty shale, brick red.
1481-96	Anhydrite, white, orange white, dense, hard.
1496-1524	Silty shale, orange red, white anhydrite inclusions; anhydrite, white, grayish white, dense, hard; white fibrous anhydrite trace, veinlet.
1524-94	Same shale, orange red, few small round light green spots; anhydrite interbeds, white, gray, dense, as above.
1594	FORELLE LIME MEMBER OF GOOSE EGG

1594-98	Abundant anhydrite, white mottled violet dense, hard; trace dolomite, bright orange adjacent to cream, dense, hard.
1598-1604	Anhydrite, white mottled with purple, dense, hard, becoming very shaly dark purple.
1604-14	Trace tan lime, dense, flaky; traces pink dolomitic lime to limy dolomite.
1614-18	Traces limestone, dolomitic limestone, cream, dense, very hard; trace dark tan dense lime.
1618	GLENDO SHALE MEMBER OF GOOSE EGG
1618-25	Shale, silty, finely sandy, dark orange, soft to hard.
1625-41	Same shale, very silty, few anhydrite inclusions and streaks.
1641-48	Same shale.
1648-59	Same shale; trace whitish anhydrite inclusion.
1659-67	Same as above; few white anhydrite inclusions, few small light green round spots.
1667-77	Same orange red silty shale with few white anhydrite inclusions.
1677-90	Same as above, trace anhydrite as veinlet on shale.
1690-1708	(Missing due to no circulation for sample just before trip at 1708 in nonprospective zone).
1704 (+1838)	MINNEKAHTA LIME MEMBER OF GOOSE EGG
1708-13	Limestone, cream to white chalky soft grading into tannish brown dense hard; trace light red slightly chalky limestone; trace dark orange anhydrite, very hard.
1713-22	Pink dense limestone, hard; tannish pink limestone, dense, hard; also lime, chalky white to dense tan.
1722-38	(Missing).
1738	OPECHE SHALE MEMBER OF GOOSE EGG
1738-40	Silty shale, brownish red, reddish brown.
1740-49	(Poor sample, mostly cave).
1749-59	Silty shale, orange, orange red, soft to slightly soft.
1759-69	Silty shale, brick red, soft.
1769-79	Silty shale, brick red, soft to slightly soft, few greenish gray spots.

1779-89	Top 4' white anhydrite, microcrystalline, soft, to dense gray; bottom 6' same silty shale as above, few white anhydrite inclusions, small round green spots also; trace very sandy anhydrite to anhydritic sand trace, light gray, fine to fine-plus grains which powder under pressure.
1789-1815	Same brick red silty shale with few green small round spots; abundant white anhydrite, microcrystalline, part dense gray, hard.
1815 (+1727)	MINNELUSA FORMATION (REWORKED MINNELUSA)
1815 (+1727)	UPPER MINNELUSA (PERMIAN)
1815-16	Trace very shaly sand, fine, orange, soft, no show, no visible porosity; trace dark brown possibly stained sand, very quartzitic, very fine, excellent sorting, no visible porosity, very hard and tight, tiny pyrite specks, very well-cemented, to quartzite, no fluorescence.
1816-27	(No consolidated sand). Loose sand grains, light orange clear, poorly sorted very fine to fine to medium to medium-plus, also all clear, subround to round.
1827-33	Trace grayish tan possibly stained sand, very fine, well sorted, very well-cemented, no visible porosity, dolomitic cementation in part, trace pyrite speck; traces very anhydritic sandstone, conglomeratic, very poorly sorted very fine to fine to medium grains, light orange grains, * like those disintegrated just above, in white anhydrite matrix, no show, very well-cemented, no visible porosity, hard to slightly soft; all with no fluorescence.
1833-38	Trace same shaly sand as above, very fine to fine grains in orange red shaly matrix, no visible porosity, very well-cemented, no show, slightly soft, light orange clear grains when disintegrated, no fluorescence.
1838 (+1704)	FIRST CONVERSE SAND
1838-43	(Fast drilling of 1+"/ft. suggests soft, porous sand). (Poor sample, mostly Sundance cave due to water-flow from Dakota-Lakota thinning mud or mudcake). Traces white anhydritic sandstone, very fine, clear grains, soft, no show, to fine, sugary, clean, excellent visible porosity, non-

	calcareous, loosely consolidated; traces dark red very shaly sandstone, very fine, well-cemented, less porous, no show, same as white sand but abundant red silty shale spots; all with no fluorescence.
1843-52	Same as above, mostly clean, white, light gray sugary sandstone, very anhydritic cementation, non-calcareous, fine to fine-plus, clear round to subround grains, excellent visible porosity, traces red shaly sandstone, very fine; all with no show, no fluorescence.
1852-56	(Slower drilling, tighter sand). (Poor sample due to abundant Sundance cave from water flow uphole). Traces same white sandstone, no show, fine, friable, no show, excellent visible porosity, no fluorescence.
1856-70	(Mostly very rapid drilling like very soft, porous sand). (Very poor sample, all cave, no visible sand or sand grains).
1870-94	(Same rapid drilling like very soft, porous sand). (Very poor sample, all cave, no visible sand nor sand grains).
1894-1911	(Top slower drilling like tight sand or anhydrite-dolomite; bottom fast drilling like soft, porous sand).
1911	MASSIVE ANHYDRITE
1911-21	Anhydrite, all hard, white finely crystalline to denser tannish cream, grading into very anhydritic dolomite, pinkish tan, and chalky white limestone; also white anhydrite mottled with orange to reddish denser anhydrite.
1921-29	Anhydrite, snow white, microcrystalline, slightly soft, to denser gray, hard, with tiny round white spots embedded; trace red silty shale on white anhydrite; trace white anhydrite with red shaly anhydritic dolomite.
1929-42	(Circulated 20" sample at 1945 just before trip for bit). Very dense hard anhydrite, white to denser orange red to purplish red; also chalky dolomite, dark pink, silty, limy where whiter, all purplish pink, slightly soft.
1942	BASE OF ANHYDRITE
1942-45	(Missing due to intentionally not circulating longer).

1945-56	(Poor sample, mostly cave following trip at 1945). Dolomite, anhydritic dolomite, tan, cryptocrystalline, distinctive tiny red silty shale spots scattered in part.
1956-60	(Missing).
1960-61	Tan anhydritic dolomite; mostly pink slightly silty anhydritic dolomite with light red shaly streaks, few small clear finely crystalline anhydrite spots.
1961	SECOND CONVERSE SAND
1961-65	Trace sandstone, light orange, very fine to fine, well-cemented but soft, no show, anhydritic cementation, light orange clear grains, no fluorescence, trace dolomitic cementation, porous, few small white spots.
1965-85	(1965 top of best porosity, breakdown to less than 1"/ft. from 1965 to 1968, same from 1970 to 1977, and from 1980 to 1985). (Very poor sample, mostly Sundance cave). Trace sandstone, white, very fine, friable, excellent visible porosity, no show; trace reddish orange sandstone, very fine, excellent sorting, shaly, no visible porosity, no show, silty; all with no fluorescence; trace same light orange sandstone; loose grains very fine to fine, light orange clear, subround. Increasing sandstone, <u>tannish</u> light gray, <u>possibly stained</u>, as above, very fine, well-sorted, porous, friable, becoming less sorted very fine to fine, slightly dolomitic cementation, slightly yellowish, clear grains slightly yellowish, subround to round; trace pink silty well-cemented, soft; all with no fluorescence; sandstone, light orange white, very fine to fine, friable, soft, excellent visible porosity, no show, no fluorescence. (Representative cuttings from Second Converse Sand were cut in C. Tet. in stoppered shell vial; resulting solution had no fluorescence, indicating no oil in cuttings).
1985-88	(Drills like sand but slower than above, suggesting less porous sand). (Poor sample, abundant cave). Trace sandstone, pinkish light gray, very fine, good sorting, porous, friable, no show, few tiny white spots like clay; traces sandstone, snow white with abundant clay cementation, no

	porosity, no show, non-calcareous, very fine to fine-plus, clear grains, round, friable.
1988-91	Trace fairly clean light gray sandstone, sugary very fine to fine-plus, excellent visible porosity, friable, no show.
1991	BASE OF SECOND CONVERSE SAND
1991-2006	Trace very anhydritic dolomite to dolomitic lime, grayish brown, slightly cherty, with tiny black spots of possible microfossils; trace light brown limestone, hard, brittle, dense; trace chalky limestone, light brown, mottled with light green shale, highly microfossiliferous with tiny round "bugs."
2006-18	Limestone, silty, chalky, grayish tan to tannish gray with small blackish spots, also tannish light gray to whitish chalkier with same black spots, slightly soft to hard and brittle where grayer (* good pre-Second Converse Sand marker bed).
2018-26	(Slower drilling, harder). (Poor sample, unusable, all cave).
2026-41	(Poor sample, cave). Traces very anhydritic dolomite, light to dark greenish brown, cryptocrystalline, intermingled with snow white anhydrite, microcrystalline; trace dark brown limestone, cherty, dense, with trace round microfossil fragment.
2041-46	Silty dolomite to limestone, tan, light tan, grayish tan denser, part lighter tan anhydritic denser; trace very dense limestone, cherty, tannish brown, highly microfossiliferous with cream "bugs" in brown limestone matrix, with encrusting waxy; trace chalky limestone, green shaly.
2046-59	Silty limestone, dolomitic, chalky, dark tan, light tan, cream, slightly soft where chalky to hard where dark tan.
2059-69	Anhydrite, white to tannish white, finely crystalline, denser dark gray.
2069-75	Abundant orange red dolomite (?) with anhydrite inclusions; top anhydrite, white to brown; trace brown limestone, slightly silty, hard, brittle; bottom faster drilling possibly sandstone with some porosity: loose sand grains, very fine to fine, clear.
2075-86	Anhydritic dolomite, greenish dark tan, dense, cryptocrystalline, slightly limy on fresh surface,

	hard, brittle, part siltier, greenish gray, slightly soft to soft.
2086-89	Snow white anhydrite.
2089	TENTATIVE THIRD CONVERSE SAND
2089-94	Abundant greenish white quartzite, also gray, grading into greenish white sandstone and white sandstone, very fine, excellent sorting, all very well-cemented, no visible porosity, very hard and tight where quartzitic to soft where greenish white silty to white silty; trace white sandstone, very fine to fine, anhydritic; all with no show; non-calcareous, anhydritic; less of shaly light red sandstone mottled with same white sandstone, few fine grains; all with no fluorescence.
2094	BASE OF THIRD CONVERSE SAND
2094-2115	Abundant anhydrite, snow white finely crystalline to denser tan to limited brown dolomitic; shale break, brick red; trace very shaly sand, light red with pale green spot, very silty, very soft, no show, no visible porosity, very fine sand grains in a silty shale matrix.
2115-25	Same brown and white anhydrite; shaly sandstone streaks as above, red and white mottled, very fine, hard, tight, no show, no visible porosity.
2125-54	Same white anhydrite with brown to gray denser parts.
2154 (+1388)	FOURTH CONVERSE SAND
2154-65	Abundant well-cemented sand, 50% white, pinkish white, anhydritic-looking, very fine, excellent sorting, no visible porosity, no show, slightly soft to some hard; 50% same sand but light red to dark pink, no show; white more anhydritic spot in red sand; all possibly slightly dolomitic, no fluorescence; trace white sandstone, cleaner, very fine, soft, porous, no show.
2165	BASE OF FOURTH CONVERSE SAND
2165-66	Anhydrite, white, gray denser; silty limestone, pinkish tan, soft to hard, white anhydrite spot, few dark purple silty shale streaks; dense brown

	dolomite grading into chalky limestone, tannish cream.
2166-76	Traces limestone to dolomite, creamy white, slightly soft to hard; silty dolomite to limy dolomite, pinkish cream, purplish shaly streaks, soft to slightly soft, becoming anhydritic dolomite, reddish purple, dense, hard.
2176-89	(Missing).
2189-92	Very anhydritic dolomite, few small limy spots, pink to light red with few small red silty shale spots, very cherty and hard, brittle, semi-crystalline, trace clear crystalline anhydrite veinlet on dolomite.
2192-2201	Abundant brick red shale, silty shale, smooth, with small round green spots; anhydrite, white, denser pink, light red; cream dolomite to limy dolomite, becoming very anhydritic dolomite as above, pink, light red, few yellow spots.
2201-12	Abundant anhydrite, snow white, finely crystalline.
2212-24	Anhydritic dolomite, tannish pink, small reddish spots, cherty, hard, brittle.
2224-26	Anhydrite, white to denser gray; abundant brick red shale with small green round spots, soft; anhydritic dolomite, pink, cherty, to limestone, hard, brittle.
2226	BASAL SAND OF CONVERSE
2226-37	Traces sandstone, white, pinkish white, very fine, few fine grains, no show, well-cemented, soft, anhydritic to traces of dolomitic cementation, no fluorescence, poor or less visible porosity, purplish part.
2237 (+1305)	RED MARKER
2237-47	(All faster drilling 3"-4"/ft.). Shale, smooth, brick red, also silty; trace white anhydrite veinlet in shale; small round green spots in red shale. Typical shiny, splintery Red Marker, platy, very soft.
2247	BASE OF RED MARKER
2247 (+1295)	PENNSYLVANIAN

2247 (+1295) MIDDLE MINNELUSA (LEO SECTION)

2247 (+1295) VIRGIL

2247-56	(Faster drilling from 2250 to 2256 like well-cemented sand). Trace light red sand (cave?), very fine to fine, no show, slightly soft, poor porosity, pinkish clear grains; remainder of interval anhydritic dolomite, cream chalky to hard tan dense, dolomite is slightly limy. Trace sand, brown possible staining, very fine, excellent sorting, friable, porous, very limy, no rainbows on acid, no fluorescence.
2256-66	(Dries like anhydrite and dolomite--poor sample).
2266-77	(Poor sample, mostly Red Marker cave; drills slow like anhydrite and dolomite). Traces very well-cemented sand, purplish white, very fine, few fine grains, no show; trace snow white sandstone (cave?), very well-cemented, very fine, white clay cementation, slightly soft, no show; trace tannish gray possibly stained sandstone, very fine to fine to fine-plus, friable, porous, clear grains, clay cementation; all with no fluorescence. (All sand may be cave).
2277-79	Traces anhydritic dolomite, tan, cherty, hard, dark tan; traces sandstone, white, cream-white, very fine, silty, soft, no show, possibly porous, no fluorescence, few fine grains, anhydritic cementation.
2279-81	(Missing due to no circulation for sample at 2281 just before trip for bit in slow drilling).
2281-85	Silty dolomite, gray, very silty, limy, some black spots; sandstone streaks, white, light gray, very fine, well-cemented, few black shale spots, no show, no visible porosity, soft.
2285-90	(Slightly faster drilling like sand). Traces white sandstone, very fine, good sorting, well-cemented, poor to no visible porosity, no show, slightly salt and pepper with few blackish grains scattered, soft; trace cleaner white sandstone, less cemented, no show, porous, friable, very fine, excellent sorting; all with no fluorescence (shale break on log).
2290-93	Dolomite, part slightly limy, tan to brown, flaky, no show, no porosity.
2293-2302	(Slightly faster drilling). Trace chalky cream dolomite, slightly soft to soft, limy.

2302-05	Same dark tan dolomite as 2290 to 2293, limy.
2305-10	(Slightly faster drilling, like sand). Traces sandstone, white, very anhydritic-looking, abundant white cementation, silty, very fine, few fine grains, angular to subround, few purplish shaly spots, no show, soft; traces white sand, very fine, few fine grains, no show, silty, white, possibly some porosity.
2310-16	Same dark tan dolomite as 2290 to 2293.
2316-26	(Very poor unusable sample, almost all cave, not screened). (All drills very slow like hard dolomite, possibly anhydrite also).
2326-36	Dolomite, anhydritic dolomite, brown where more anhydrite, also dark gray dense to dark gray siltier.
2336-47	(Very poor sample, almost all cave). (All drills slow like dolomite above). Traces white sandstone, probably in streaks, light gray, no show, well-cemented, very fine; part less cemented very fine to fine friable with porosity (cave?).
2347-51	(Circulated 20" sample at 2351 before trip for bit). Anhydrite, white to tan, finely crystalline, grading into dark tan dolomite and limy dolomite.
2351-53	Same as above.
2353 (+1189)	MISSOURI
2353-54	(Highly radioactive shale on log).
2354 (+1188)	SECOND LEO SAND
2354-57	Loose sand grains, very fine, clear, also fine; trace clean sandstone, light gray, very fine, good visible porosity, friable, no show.
2357-60	(Drills 4" to 5"/ft.). Traces well-cemented sand, very fine, no show, poor visible porosity, soft, light gray, white, slightly silty, no fluorescence; loose sand grains, very fine, fine, clear grains, round to subround.
2360-64	(Circulated 20" sample at 2365). Limited sandstone, white, light gray, well-cemented, shaly, very fine, no show; part less cemented with some porosity, friable, no show; 2% light brown possibly stained, cleaner less cemented, very fine, soft, porous; all with no fluorescence (5±"/ft.).
2364-65	(Circulated 30" sample at 2365). Same well-cemented sand, very fine, no show, few fine grains, anhy-

	dritic-looking cementation; trace same cleaner sand, very fine, very light brownish possibly stained, porous, friable.
	* All above sand from 2354 to 2365 has no hydrocarbon cut nor fluorescence after cutting representative cuttings in C. Tet. in stoppered shell vial.
2365-66	Traces clean sandstone (probably above 2365), friable, excellent visible porosity, no show, light gray, so soft disintegrates when picked up with tweezers; trace friable white sandstone, abundant white cementation like clay, very fine to abundant fine, porous, clear grains, no show, loosely consolidated, non-calcareous; trace same well-cemented sand, very fine sand as above; all with no fluorescence; trace white sandstone, very fine, excellent sorting, well-cemented, no show, soft; trace light tan possibly stained sandstone, fine to very fine, limy, porous, friable.
2366-73	Dolomite stringer, grayish dark tan; greenish gray anhydritic dolomite to dolomitic lime; trace sandstone, light tan possibly stained, no live oil on freshly broken surface, friable, excellent visible porosity, salt and pepper with scattered dark gray shale grains, clear to slightly frosted grains, non-calcareous.
2373-75	(Circulated 20" sample at 2378). 75% jet black shale, coaly, strong hydrocarbon odor.
2375-78	25% gray chalky dolomite.
	* Representative sand cuttings from 2354 to 2373 were cut in C. Tet. with no fluorescence in resulting solution, indicating no live oil in cuttings.
2378-82	(Top 2' are 2"/ft., bottom 2' are 1"/ft.). Abundant sandstone, light to medium tan oil staining when wet, dries to fair or better tan stain, definite abundant tiny brown live oil spots scattered, 80% fair yellowish fluorescence to 20% with good bright yellow fluorescence, anhydritic to dolomitic cementation, silty, very fine, good visible porosity, friable.
2382-93	(Circulated 20" sample at 2393). Abundant sandstone, light gray with tannish cast plus tiny dark brown live oil spots scattered, limy cementation, very fine to fine more sugary, friable, excellent visible porosity, acid cuts immediate rainbows, clear subround quartz grains; sandstone soaked with tan oil stain in very fine, cemented sand-

stone, some spotty white cementation like clay, tiny dark brown live oil stains scattered, acid brings out tiny dark brown oil bubbles, fair or better visible porosity, soft to slightly soft. * Representative cuttings of show zone were cut in C. Tet. in cork stoppered shell vial: there was no fluorescence in solution until several hours later when it was a faint grayish to yellowish.

2393-96	(Sand on log).
2396	BASE OF SECOND LEO SANDS
2396-2404	Chalky limy dolomite to dolomitic lime, cream-tan, denser tan also, few grayish streaks; limited associated anhydrite, finely crystalline white.
2404-15	Slightly silty dolomite, very finely sandy, grayish dark tan, minute pyrite specks.
2415-17	Coaly black shale, hard, brittle (probably a radioactive shale marker on log).
2416	DES MOINES (?)
2417-26	Abundant red shale in fast drilling breaks, orange red, silty to finely sandy, abundant small round light green spots in shale, with few anhydrite inclusions; remainder anhydritic dolomite, gray, few small limy streaks, part dark gray very shaly with few dark green spots; limited very sandy dolomite, limy, gray, flaky; limited sand streaks, gray, very well-cemented, no show, no porosity, hard, tight, very fine to fine; trace white sandstone, lot cleaner, very fine to fine, well-cemented, no show, possibly porous, soft (cave?).
2426-29	(Fast drilling shale break at 2429 to 2430). Same anhydritic dolomite, light grayish tan with dark gray shaly spots, minute pyrite specks, also dark tan with blackish spots, trace gray very sandy.
2429-30	Possibly jet black coaly shale (highly radioactive shale on log).
2430-35	Same as from 2426 to 2429.
2435-46	Shale break from 2440 to 2441, orange red smooth plain to silty; same anhydritic dolomite, gray to tan, less of silty limy dolomite, light gray, chalky; few sandstone streaks, grayish brown, slightly quartzitic-looking, very fine, very well-cemented, no show, poor to no visible poros-

	ity, part slightly soft; trace gray sandstone, very shaly and well-cemented, no show, no visible porosity, very fine to fine.
2446-53	Dolomite, limy dolomite, grayish tan to tan, cryptocrystalline, some associated white anhydrite, hard, brittle, few pyrite specks.
2453-55	Faster drilling plus shale on log.
2455-56	Sandstone stringer, white, fine, no show, very well-cemented, no visible porosity, same but shalier tannish gray, soft where white.
2456-59	Abundant sandstone, (possibly Third Leo Sand), snow white, very fine, fine, good sorting, no show, porous, anhydritic-looking, dolomitic to anhydritic cementation, part hard and tight, grayish yellow to yellow fluorescence, probably from dolomitic cementation, soft, part all fine grained.
2459-73	No odor in fresh sackfull, same sandstone as above; part softer, cleaner, more porous, trace more porous with slight tannish possible staining, same fair or better fluorescence; trace fine sandstone, sugary, friable, excellent visible porosity; becoming gray slightly quartzitic, poorly sorted fine to few medium grains, hard, tight.
2473-85	Abundant anhydrite, snow white, grayish where denser; abundant red shale, orange red, plain, silty, soft to slightly soft, few small light gray round spots.
2485-91	(Missing due to no circulation for sample before trip at 2491).
2491-2501	Mostly shaly dolomite, gray, dark gray, tannish dark gray, part limy, with abundant associated snow white anhydrite, finely crystalline; thin sand beds, white, light gray, fine, fairly clean, good visible porosity, no show, slightly soft, some black carbonaceous streaks; also dark gray shaly sand, soft, fine, porous to nonporous, black carbonaceous streaks; all with no fluorescence.
2501-10	Faster drilling sand, traces sand, white, very well-cemented, no show, very fine, no visible porosity to limited porosity, soft to slightly soft, possible faint grayish fluorescence.
2510-14	Limy dolomite to dolomitic lime, tannish brown, silty, blackish spots in part, also light gray; tan dense dolomitic lime to limy dolomite, hard, brittle.

2514-18	(Missing due to no circulation for sample just before trip at 2518).
2518-26	* First chert, trace, smoky gray translucent, very coarse and angular, also light brown translucent; sandstone, white, light gray, very well-cemented, poor visible porosity, very fine, well-sorted, slightly soft, part light gray less cemented; part white hard and tight; all limy, all with no show; limy dolomite, very light tan, cherty, hard, brittle, also dark tan limy dolomite, cryptocrystalline; white anhydrite; sand in top 7'.
2526-31	Brick red shale break with few small round light green spots; dolomite, sandy dolomite, gray, dark gray, mottled blackish in part, part limy dolomite; same chert; sandstone streaks, shaly, quartzitic, light gray to gray, very well-cemented, no show, no visible porosity, slightly soft.
2531-38	Chert, tan, milky white, angular, coarse; same quartzitic sandstone streaks, brownish gray; finely sandy limy dolomite to dolomitic lime, tannish brown.
2538-43	(Circulated 30" sample at 2543 T. D.). Chert, angular, very coarse, tan to light gray milky; limy dolomite to limestone, tannish brown, dense plain to cryptocrystalline; sandstone, white, very fine, very well-cemented, no show, no visible porosity, light gray, tannish light gray tighter, slightly limy, becoming brown quartzitic, good yellow fluorescence from limy mineralization.
2545	TOTAL DEPTH DRILLER
2544	TOTAL DEPTH SCHLUMBERGER

Samples examined and described on location by G. Allan Nelson.

DRILL-STEM TEST

D.S.T. #1 2379-2393 P. D. * (Corrected uphole 2' by matching lithology and drilling time to log).
(2381-2395 drillers depths at time test was run).
Zone tested: Lower of 2 Second Leo Sand benches.
November 25, 1970. Open hole conventional test.
Top packer at 2371 corrected.
Bottom packer at 2379 corrected.
Top choke 1". Bottom choke 9/16".
Hole size 7 7/8". 3 1/2" drill pipe.
2 1/4" I.D. of drill collars; 542' of drill collars.
Mud wt. 9.5. Vis. 60.
Packers held and did not leak. No cushion.

Tool opened with a very weak blow and remained open 5"; very weak blow throughout period. Tool reopened with a very weak blow (1/4" under water); remained for 10", then intermittent blow throughout rest of test. (By-passed tool after 50" to see if it was plugged--before opening. Well had 3" to 4" water flow from annulus throughout test--from Dakota-Lakota. 3' fillup on bottom).

Recovered: 60' gas-cut mud with a sulfur smell=.29 bbl.
80' water with scum of oil and sulfur smelling gas=.39 bbl.
140' Total Fluid

Pressures following are office-corrected:

	Initial hydrostatic	-	1102
	Final hydrostatic	-	1100
5"	Initial flow	-	4 to 21
45"	Final flow	-	31 to 76
15"	Initial shut-in	-	969
15"	Final shut-in	-	914

Fluid Sample Report:

Pressure in sampler	-	11 psig
BHT	-	96° F.
Total volume of sampler	-	2150 cc.
Sample	-	2150 cc.
Oil	-	10 cc.
Water	-	2140 cc.
(No mud or gas)		

DRILL-STEM TEST (Continued)

Resistivity -
Water - .4 @ 62° = 17,200 ppm chlorides
Mud pit sample - 2.6 @ 60° = 2,550 ppm chlorides

Testing done by Virg's Testers, Gillette, Wyoming.
Tester: Lloyd Welty.

Checked periodically during test for combustability; would not burn. No gas to surface.

SCHLUMBERGER LOG CALCULATIONS

Calculations were performed by Mike Golas, Schlumberger engineer on location.

DEPTH	Rt	POROSITY (from Sonic)	Rw	Sw	FORMATION
1062	29	22%	1.6 @ 80°	100%	Tentative Hulett Sand
1074	33	23	"	"	"
1078	31	23	"	"	"
1866	50	18	1.3 @ 88°	78%	First Converse Sand
1871	45	17	"	90	"
1878	55	16	"	"	"
1885	40	18	"	"	"
1966	45	15	"	100%	Second Converse Sand
1970	35	17	"	"	"
1980	35	17	"	"	"
2376	35	6	.34 @ 88°	"	Second Leo Sand
2378	26	25	("way too high")	42	"
2380	35	10	.34 @ 88°	92	"
2382	42	5	"	100	"
2384	30	6	"	"	"
2386	21	6	"	"	"
2388	25	9	"	"	"
2458	6.5	11	"	"	Pre-Second Leo
2460	5.5	14	"	"	"
2462	6.5	8	"	"	"
2464	6.0	7	"	"	"
2466	5.0	15	"	"	"
2468	6.5	10	"	"	"

HOLE DEVIATION SURVEYS

Surveys were made using a TOTCO instrument with a 7^{o} maximum.

DEPTH	DEVIATION	FORMATION
178	1/4^{o}	Skull Creek
1086	1	Tentative Hulett Sand
1691	1	Glendo Shale
1939	1	Massive Anhydrite
2188	1	Pre-Fourth Converse
2282	1 (?)	Upper Leo
2352	1	Basal Virgil

BIT RECORD

12 1/4" bit from surface to 178. All bits below 178 are 7 7/8".

RUN NO.	MAKE	TYPE	FROM	TO	FEET	HOURS	FORMATION AT BASE OF RUN
1A	HTC	OSC3 (RR)	0	178	178	5 1/2	Skull Creek
1	"	OSC1GJ	178	1086	908	18	Tentative Hulett
2	"	"	1086	1707	621	14	Minnekahta
3	"	OSC1G	1707	1939	232	11 1/4	Massive Anhydrite
4	Reed	YS1G	1939	2091	152	12 1/2	Third Converse
5	-	-	2091	2189	98	13 1/4	Pre-Fourth Converse
6	HTC	OWV	2189	2282	93	"	Upper Leo
7	Reed	YMG	2282	2352	70	13	Basal Virgil
8	"	"	2352	2395	43	5 1/2	Second Leo Sand
9	-	-	2395	2493	98	14	Pre-Second Leo
10	-	-	2493	2520	27	3	"
11	-	-	2520	2545 T.D.	25	3 1/4	"

DRILLING PROGRESS SUMMARY

Drilling depths as of 7 A. M. each date.

DATE	NO. OF DAYS	P.D. DEPTH	FORMATION AT P. D.	STATUS
Nov. 17, 1970	-	-	-	Rigging up rotary tools.
18	1/2	105	Skull Creek	Drilling surface hole.
19	1 1/2	821	Morrison	Drilling.
20	2 1/2	1681	Goose Egg	"
21	3 1/2	2040	Upper Minnelusa	"
22	4 1/2	2189	"	Trip for bit.
23	5 1/2	2284	Middle Minnelusa	Drilling.
24	6 1/2	2374	"	"
25	7 1/2	2395	"	Starting out to put tool on -- D.S.T. #1.
26	8 1/2	2493	"	Trip for bit.
27	9 1/2	2545 T.D.	"	Logging.

(Finished plugging at 5:00 P. M., November 27).

Respectfully submitted,

G. Allan Nelson

G. Allan Nelson, Consultant
Denver, Colorado
January 26, 1971

Hydro ID 3

WELL NO. 5-22

STATE South Dak. COMPANY Petro-Lewis
COUNTY Fall River FARM Peterson WELL NO. # 5-22
1620' FEL & 1980'
SEC. 22 FNL, C SW NW
7S. 1E. 2544 Schlum.
Schlaikjer
Nov. 18, 1970
Nov. 27, 1970
Wildcat - Driftwood Canyon
3542 K.B.
D & A. Prospect.
Ran 4 jts. of [illegible] 8 5/8" sfc casg, totaling [illegible], 8 rd., 20# Cem. w/ [illegible]
[illegible]
[illegible]
[illegible] nelson

Petro-Lewis Peterson

1441 +2101 Permian, [illegible] Egg Fm.
1500
1600
1534 Forelle Lime Member of Goose Egg
1618 Glendo Shale Member of G. E.
1762 1704 Minnekahta Lime Member
+1838 Pink dns Ls. of Goose Egg
1738 (many) Opeche Shale Member
Slty sh, [illegible], slt to sd
Slty sh, brick red, [illegible]
Sltst, slty, brick red, [illegible]
[illegible]
1800 Sd & red slty sh, [illegible]
1815 +1727 Minnelusa Fm. (Pennsylv. [illegible])
Upper Minnelusa (Permian)
[illegible]
1838 First Converse Sd.
+1704 (V pr spl.) (Same) [illegible]
(Same [illegible]) [illegible]
1900 (Top [illegible])
1911 Massive Anhydrite
Anhy, [illegible]
1942 Base of Anhydrite, [illegible]
Dolo, anhyd, [illegible]
1961 Second Converse Sd. [illegible]
[illegible]
1931 Base [illegible] Converse Sd.
[illegible]
[illegible]
[illegible] anhyd dolo [illegible]
[illegible]
Anhy, [illegible]
Anhyd dolo, [illegible]
2080 2094 [illegible]
Base of Third Converse Sd.
Same [illegible] anhy, [illegible]
Same wh anhy w/ [illegible] dusk. pt.s.
2154 Fourth Converse Sand [illegible]
+1388 2165 Base Fourth Converse Sd.
2200 (Loss)
[illegible]
Abd anhy, [illegible]
2226 Basal Sand of Converse
2237 [illegible] Red Marker
2247 +1295 [illegible] Base Red Marker [illegible]
[illegible]
[illegible]
[illegible] well cem [illegible]
2300 Dolo, [illegible]
[illegible]
[illegible]
Dolo: anhydrite dolo, [illegible]
[illegible] wh ss. (cave?)
2353 +1189 [illegible]
2364 S.O. +1188 Second Leo Sd.
[illegible]
Abd ss, [illegible]
2396 2216 Base of Second Leo Sd.
Base [illegible]
Abd red sh, anhydrite, dolo.
[illegible]
[illegible]
[illegible]
Same ss, [illegible]
Abd anhy, wh, [illegible] red sh.
[illegible]
2500 [illegible]
Erhst. chert, ss, wh, [illegible]
Chrt [illegible]
2545 [illegible]
wh, [illegible]
no porosity.
T.D. Driller
2544 T.D. Schlumberger

* Spls. examined & described by C. Allan Nelson, Consult. [illegible], Denver

Anhydrite
Pyrite
Fossils
Chert
Pebbles
Muddy Sand (Newcastle) (behind sfc pipe)
Skull Creek Shale (behind sfc pipe)

ALL PLOTTED LITHOLOGY BELOW CORRECTED TO MATCH LOGS

324
+3218
Dakota Fm. (Fall River Fm.)
Shly sltst, lt gy w/ blsh lams; ss, fn, sl sgry, v.s. porsty.
Abdt shly sltst, dk gy; some tnsh parts sdy; sl trcs cly.
Same dk gy shly sltstn. & fn lt gy ss. a.b. w/ gd porsty, sft, wh cly spts; Hd wxy cly, tnnsh gy, gy.

452
Fuson Shale (Fuson Member of Lakota Fm.)

469
+3073
Lakota Sands
Abdt grn wh ss, wly kaol w/ abdt wh wxy cly cem. S.a.b. porsty loose sd grns, v abdt pyrt; wxy cly, sl wh. Trcs ss. sl thnsh lt gy pas strd; abdt pyrt; abdt chrt. Sd. only; v dk gy sh, sl wxy, slmst blk; trcs. lt gy wht. ss.
Same gnsh blk sh, sl wxy, trc chrts, clr angle & kao. Trcs brn sd, v.f. & wll srtd, poor porsty, sl lmy. Abdt pebbles, mstly v crs, (sd cave?); loose pyrt.
(Cave)
Loose chert, clr v crs to pebble size; loose sd grns v.f., fn, med, crs, v crs.

700
+2842
Morrison Fm.
Abdt pale gn wxy cly, w/ smbd tan lime spts.

Same gn cly, bcmg dk gy; Hd ls, stgrs; trcs ss, v.f., tn Ls; v lt tan, crm, v dns; trc ss, crm, v lmy, v wll-cem.

832
+2710
Sundance Fm. – Redwater Shale Member
(Mssg spls.)

Slty sh, dk gy; v slty sd, fol sltst, dk gy; v. v.f. whr sd, lt blu, glauc. Wxy sh, pale gn; dns ls, lt gy ss, lt gy, v.f. ss; Same wxy gn sh, crm.

966
LAK Member of Sundc.
Some sd., orsh brn, v.f., u.s.

Blk wxy sh, v sft

1061
Top of Hulett Sand
Trcs lt gy sd, v, v.f., tnsh, pas s.a.b., sl shly gysh, trc wxy sh.

c.1092
Base of Sand – Top of Stockade Beaver Shale

Smooth sh, red, part slty, sl srt

+2366

ADMINISTRATIVE / SUNDRY REPORTS

S. Dak. Oil & Gas Board
FORM 7

PLUGGING RECORD

Operator: Petro-Lewis Corporation		Address: 1224 Denver Club Building, Denver, Colorado. 80202	
Name of Lease: Peterson	Well No.: 5-22	Field & Reservoir: Wildcat	
Location of Well: 1980' FNL and 660' FWL, SW-NW Section 22, T7S, R1E		Sec-Twp-Rge or Block & Survey	County: Fall River

Application to drill this well was filed in name of	Has this well ever produced oil or gas	Character of well at completion (initial production): Oil (bbls/day)	Gas (MCF/day)	Dry?
Petro-Lewis Corporation	No	----	----	Yes

Date plugged:	Total depth	Amount well producing when plugged: Oil (bbls/day)	Gas (MCF/day)	Water (bbls./day)
11/27/70	2544' Logger	----	----	---

Name of each formation containing oil or gas. Indicate which formation open to well-bore at time of plugging	Fluid content of each formation	Depth interval of each formation	Size, kind & depth of plugs used indicate zones squeeze cemented, giving amount cement.

CASING RECORD

Size pipe	Put in well (ft.)	Pulled out (ft.)	Left in well (ft.)	Give depth and method of parting casing (shot, ripped etc)	Packers and shoes
8-5/8"	167'	None	167'		

Was well filled with mud-laden fluid, according to regulations?	Indicate deepest formation containing fresh water.

In addition to other information required on this form, if this well was plugged back for use as a fresh water well, give all pertinent details of plugging operations to base of fresh water sand, perforated interval to fresh water sand, name and address of surface owner, and attach letter from surface owner authorizing completion of this well as a water well and agreeing to assume full liability for any subsequent plugging which might be required.

USE REVERSE SIDE FOR ADDITIONAL DETAIL

Executed this the 15th day of February, 19 71

State of Colorado

County of Denver

R. J. Doubek
R. J. Doubek Signature of Affiant

Before me, the undersigned authority, on this day personally appeared R. J. Doubek known to me to be the person whose name is subscribed to the above instrument, who being by me duly sworn on oath states, that he is duly authorized to make the above report and that he has knowledge of the facts stated therein, and that said report is true and correct.

Subscribed and sworn to before me this 15th day of February, 19 71.

SEAL

Elsie J. Stone Elsie J. Stone

My commission expires September 24, 1974

Notary Public in and for Denver County, Colorado

DO NOT WRITE BELOW THIS LINE

Approved December 29, 1971
Date

OIL AND GAS BOARD OF THE STATE OF SOUTH DAKOTA

[signature], Secretary

Date Dec. 28, 1971

Duncan McGregor
State Geologist

Note: File 2 copies of this form with Secretary, Oil & Gas Board, Pierre.

FEB 1971 RECEIVED SECRETARY OF STATE

S. Dak. Oil & Gas Board
FORM 4

WELL COMPLETION OR RECOMPLETION REPORT AND LOG

FARM OR LEASE NAME: Peterson
WELL NO.: 5-22
FIELD AND POOL, OR WILDCAT: Wildcat
NO. ACRES IN LEASE:
¼ ¼ SEC. TWP. RGE.: SW-NW Section 22, T7S, R1E
COUNTY: Fall River
DATE ISSUED: -----

TYPE OF COMPLETION
☐ Oil Well ☐ Gas Well ☐ Dry Hole
☐ New Well ☐ Work-Over ☐ Deepen ☐ Plug Back ☐ Same Zone ☐ Diff Zone

OPERATOR: Petro-Lewis Corporation
ADDRESS: 1224 Denver Club Building, Denver, Colorado, 80202
LOCATION (In feet from nearest lines of section or legal subdivision where possible)*
Surface: 1980' FNL and 660' FWL, SW-NW, Section 22, T7S, R1E
Top prod. interval: Fall River County, South Dakota
At total depth

PERMIT NO.	DATE ISSUED	PREVIOUS PERMIT NO.
606	10/21/70	----

DATE SPUDDED	DATE T. D. REACHED	DATE COMPL. (Ready to Prod.)	ELEVATIONS (DF, RKB, RT, GR, etc.)*	ELEV. CASINGHEAD FLGE.
11/17/70	11/27/70	P&A 11/27/70	Gr. Elev. 3534'	-----

TOTAL DEPTH (MD & TVD)	PLUG. BACK T. D. (MD & TVD)	IF MULTIPLE COMPL., HOW MANY*	INTERVALS DRILLED BY	ROTARY TOOLS	CABLE TOOLS
2544' Logger	-------	----	→	XXXX	-----

PRODUCING INTERVAL(S), THIS COMPLETION. TOP, BOTTOM, NAME (MD & TVD)*: Dry Hole
DATE DIRECTIONAL SURVEY SUBMITTED: None

TYPE ELECTRIC AND OTHER LOGS RUN (Circle those filed): Dual Induction Laterolog, Compensated Borehole Sonic - Gamma Ray
WAS WELL CORED: No

CASING RECORD (Report all strings set in well)

CASING SIZE	DEPTH SET (MD)	HOLE SIZE	WEIGHT LBS./FT.	PURPOSE	SACKS CEMENT	AMOUNT PULLED
8-5/8"	167' KB	12-1/4"	20#	Surface casing	100 sx.	None

LINER RECORD / TUBING RECORD

SIZE	TOP (MD)	BOTTOM (MD)	SACKS CEMENT*	SCREEN (MD)	SIZE	DEPTH SET (MD)	PACKER SET (MD)
None					None		

PERFORATION RECORD / ACID, SHOT, FRAC., CEMENT SQUEEZE, Etc.

DEPTH INTERVAL (MD)	HOLES PER FT.	SIZE AND TYPE	PURPOSE	AMOUNT AND KIND OF MATERIAL USED	DEPTH INTERVAL (MD)
None				None	

PRODUCTION

DATE FIRST PRODUCTION	PRODUCING METHOD (Flowing, gas lift, pumping—size & type of pump)	WELL STATUS (Prod. or shut-in)
Dry Hole	-----	P&A 11/27/70

DATE OF TEST	HOURS TESTED	CHOKE SIZE	PRODUCTION FOR TEST	OIL, Bbls.	GAS, Mcf.	WATER, Bbls. & %	OIL GRAVITY-API (Corr.)
			→				

FLOW. TUBING PRESSURE	CASING PRESSURE	CALCULATED 24-HOUR RATE	OIL, Bbls.	GAS, Mcf.	WATER, Bbls. & %	GAS-OIL RATIO
		→				

DISPOSITION OF GAS (Sold, used for fuel, vented, etc.)
TEST WITNESSED BY

LIST OF ATTACHMENTS

I hereby certify that the foregoing and attached information is complete and correct as determined from all available records

SIGNED R. J. Doubek TITLE Manager of Operations DATE 2/15/71
R. J. Doubek

DO NOT WRITE BELOW THIS LINE
*See Instructions On Reverse Side

Approved ________ Date

OIL AND GAS BOARD OF THE STATE OF SOUTH DAKOTA
________ Secretary

S. Dak. Oil & Gas Board
FORM 6

SUNDRY NOTICES AND REPORT ON WELLS

FARM OR LEASE NAME: Peterson

WELL NO.: 5-22

☐ OIL WELL ☐ GAS WELL ☐ ______ ☒ DRY

FIELD AND POOL, OR WILDCAT: Wildcat

OPERATOR: Petro-Lewis Corporation

NO. ACRES IN LEASE:

ADDRESS: 1224 Denver Club Building, Denver, Colorado, 80202

LOCATION (In feet from nearest lines of section of legal subdivision, where possible): 1980' FNL and 660' FWL, SW-NW Section 22, T7S, R1E Fall River County, South Dakota

¼ ¼ SEC. TWP. RGE: SW-NW Section 22, T7S, R1E

ELEVATIONS (DF., R.K.B., R.T., Grd., etc.; how determined): Gr. Elev. 3534'

COUNTY: Fall River

INDICATE BELOW BY CHECK MARK NATURE OF REPORT, NOTICE OR OTHER DATA

NOTICE OF INTENTION TO:				SUBSEQUENT REPORT OF:			
TEST WATER SHUT-OFF		SHOOT OR ACIDIZE		WATER SHUT-OFF		SHOOTING OR ACIDIZING	
FRACTURE TREAT		REPAIR WELL		FRACTURE TREATMENT		REPAIRING WELL	
MULTIPLE COMPLETE		PULL OR ALTER CASING				ALTERING CASING	
ABANDON	XXX			(Note: Report results of multiple completion on Well Completion or Recompletion and Log Form—Form 4)			

DESCRIBE PROPOSED OR COMPLETED OPERATIONS (Clearly state all pertinent details, and give pertinent dates, including estimated date of starting any proposed work)

T. D. 2544' Logger

Date of Work 11/27/70

We propose to plug and abandon this well as follows:

40 sx. cement from 2300'-2420'
30 sx. cement from 1750'-1850'
30 sx. cement from 1030'-1130'

(Contractor will run pipe to complete as water well for landowner. Pipe will be set at 350'. (Dakota).

I hereby certify that the foregoing as to any work or operation performed is a true and correct report of such work or operation.

SIGNED R. J. Doubek TITLE Manager of Operations DATE 2/15/71
R. J. Doubek

DO NOT WRITE BELOW THIS LINE

Approved ______ Date

OIL AND GAS BOARD OF THE STATE OF SOUTH DAKOTA

CONDITIONS, IF ANY: ______, Secretary

See Instructions On Reverse Side

252627282930311 234567 FEB 1971 ... OF ... STATE

CORRESPONDENCE

AMERICAN STRATIGRAPHIC COMPANY

17 NORTH 31ST STREET • BILLINGS, MONTANA 59101 • PHONE 259-7647

November 18, 1971

NOV 22 1971

South Dakota Geological Survey
Attn: Dr. Duncan McGregor
Science Center, University
Vermillion, South Dakota 57069

Gentlemen:

Sample cuts on the following wells are being sent to you today:

Petro-Lewis Corp. #14-14 Childers
14-8S-2E, Fall River Co., S. D.

Petro-Lewis Corp. #5-22 Peterson
22-7S-1E, Fall River Co., S. D.

Petro-Lewis Corp. #3-7 Trotter-Federal
7-9S-2E, Fall River Co., S. D.

Very truly yours,

Fred McCotter
Manager

SOUTH DAKOTA GEOLOGICAL SURVEY
Science Center, University
Vermillion, South Dakota 57069
624-4471
Western Field Office
615 Birch Ave.
Rapid City, South Dakota 57701
(605)394-2229

JUN 24 1971

June 23, 1971

Dr. Duncan J. McGregor
State Geologist
South Dakota Geological Survey
Science Center USD
Vermillion, South Dakota 57069

Dear Dunc,

On June 21, 1971 we inspected the sites of the following oil tests and find that they have been satisfactorily restored. The wells are as follows:

Permit

606 Petro-Lewis #5-22 Peterson, SWNW 22-17N-1E, Fall River County
614 Petro-Lewis #14-14 Childers, SESW 14-8S-2E, Fall River County
631 Webb Resources #11-16 Zuehlke, SESE 11-11-4E, Fall River County

As soon as all other requirements have been met I recommend the release of bond.

Sincerely

Fred

Fred V. Steece
Principal Geologist

FVS/dme
cc: Petro-Lewis Corporation

Webb Resources, Inc.

January 13, 1971

Mr. Fred V. Steece
Western Field Office
615 Birch Ave.
Rapid City, South Dakota

Dear Fred:

I am enclosing the following logs:

1 Sonic log - Gamma ray and 1 Dual Induction-Laterolog for Petro-Lewis 5-22 Peterson well, Fall River County

1 Induction-Electrical log and 1 Sonic log - Gamma ray for Lee Banks #1-23 Federal-Richards in Butte,County

1 Microlaterolog and 1 Sonic log - Gamma ray for Consolidated #1 Tribal well in Corson County

1 Induction-electrical log for Consolidated #1 Tribal well in Corson County.

Sincerely,

(Mrs.) Ruth Lynch
Accounting Clerk

For the State Geologist

Encl.

Small logs

DEC 16 1970

Western Field Office
615 Birch Avenue
Rapid City, South Dakota 57701
((605)394-2229

December 15, 1970

Mrs. M. Lenore Peterson
Star Route
Edgemont, South Dakota

Dear Mrs. Peterson,

Thank you for your letter of December 11, 1970 regarding the Webb Resources #5-22 Peterson oil test, located on your land in SW 1/4 NW 1/4 Sec. 22, T. 7S., R. 1E., Fall River county, South Dakota. The letter is fine as far as it goes, however it is incomplete.

I have enclosed the original and three carbon copies of a suggested substitution to your letter. If you approve of this please date and sign the original and two carbon copies and send them to:

South Dakota Oil and Gas Board, Capitol Office Building, Pierre, South Dakota 57501

Mr. J. W. Grimes, Chief Engineer, South Dakota Water Resources Comm., Capitol Office Building, Pierre, South Dakota 57051

Fred V. Steece, Principal Geologist, Geological Survey, Western Field Office, 615 Birch Avenue, Rapid City, South Dakota 57701

The other copy is for your files.

Sincerely

Fred V. Steece
Principal Geologist

FVS/dme
cc: Dr. Duncan J. McGregor
State Geologist

DEC 15 1970

Western Field Office
615 Birch Avenue
Rapid City, South Dakota 57701
(605) 394-2229

December 14, 1970

Mr. J. W. Grimes
Chief Engineer
South Dakota Water Resource Comm.
Capitol Office Building
Pierre, South Dakota 57501

Dear Joe,

Friday, December 11, 1970, I spoke with Don Driscol on the telephone with regard to an oil test in Fall River county that has recently been converted to a water well. The well is the Petro-Lewis #5-22 Petersen located in SWNW 22-7S-1E Fall River (permit 608). The well was drilled from November 18 to November 27, 1970 and completed as a water well in the Fall River Formation on November 28, 1970. The well has 167 feet of 8 5/8 surface casing cemented from top to bottom and was completed with 389 feet of 4 1/2 inch casing suspended inside the larger casing. The original depth of the well was 2545 feet and was plugged back to 1030, which plugs through the Basal Sundance sand and allows the well to take advantage of the maximum sand development of the Fall River and Lakota. The plugging record is as follows:

40 sax--2410-2300 across the Leo sand
30 sax--1860-1750 across the Converse sand
30 sax--1130-1030 across the Basal Sundance sand

If there is further information you need on this well, please let me know.

Sincerely

Fred V. Steece

Fred V. Steece
Principal Geologist

cc: Dr. Duncan J. McGregor
State Geologist

Miss Alma Larson
Secretary, Oil and Gas Board

SURETY

State Pub. Co., Pierre

S. Dak. Oil & Gas Board
FORM 3

BOND NO. 1672873

BOND

KNOW ALL MEN BY THESE PRESENTS,

That we: PETRO-LEWIS CORPORATION, 1224 Denver Club Building, Denver, Colorado 80202

of the County of: Denver in the State of: Colorado

as Principal, and THE TRAVELERS INDEMNITY COMPANY

of Hartford, Connecticut

as surety, authorized to do business in the State of South Dakota as surety, are held and firmly bound unto the State of South Dakota in the sum of ~~[illegible]~~; $20,000.00), lawful money of the United States, for which payment, well and truly to be made, we bind ourselves, and each of us, and each of our heirs, executors, administrators or successors, and assigns jointly and severally, firmly by these presents.

The condition of this obligation is that whereas the above bounden principal proposes to drill a well or wells for oil, gas, or stratigraphic purposes in and upon the following described land situated within the State, to wit:

ANY AND ALL LOCATIONS WITHIN THE STATE OF SOUTH DAKOTA

(May be used as blanket bond or for single well)

NOW, THEREFORE, if the above bounden principal shall comply with all of the provisions of the laws of this State and the rules, regulations and orders of the Oil and Gas Board of the State, especially with reference to the proper plugging of said well or wells, and filing with the Oil and Gas Board of this State all notices and records required by said Board, and the restoration of the surface, in the event said well or wells do not produce oil or gas in commercial quantities, or cease to produce oil or gas in commercial quantities, then this obligation shall be terminated by the Board, the same shall be and remain in full force and effect.

Penal sum of

TWENTY THOUSAND AND NO/100 ($20,000.00) DOLLARS- - - - - - - - - - - - - -

Witness our hands and seals, this ______ day of ______

PETRO-LEWIS CORPORATION

By D. A. Frawley
Principal

Witness our hands and seals, this 17th day of July, 1970

g. a. Talbert, Inc.
SURETY BONDS AND INSURANCE
TWELVE HUNDRED LINCOLN STREET
DENVER, COLORADO 80203
AREA CODE 303 / 292-1330

THE TRAVELERS INDEMNITY COMPANY

By A Talbert
G. A. Talbert, Attorney-in-Fact
Surety

(If the principal is a corporation, the bond should be executed by its duly authorized officers, with the seal of the corporation affixed. When principal or surety executes this bond by agent, power of attorney or other evidence of authority must accompany the bond.)

DO NOT WRITE BELOW THIS LINE

Approved October 21, 1970
Date

OIL AND GAS BOARD OF THE STATE OF SOUTH DAKOTA

[illegible], Secretary

Countersigned in South Dakota

By Francis P. Schmid
Francis P. Schmid
Agent at Rapid City, South Dakota 57701

Note: File 3 copies of this form with Secretary, Oil & Gas Board, Pierre.

MISCELLANEOUS

NO MISCELLANEOUS
INFORMATION FOR THIS WELL
AS OF 5/18/2011

Department of Environment & Natural Resources
Tomorrow... Today

Oil and Gas Search for: *api_no_ like '40 047 05093'*		
Page 1 of 1	***Download Database*** (Excel spreadsheet format)	**Page:** 1

Record 1 of 1

Well Information

API No:	40 047 05093	**County:**	FALL RIVER
Well Name:	SUPERIOR OIL 1 PETERSON 44-15	**Location:**	SESE 15-7S-1E
Permit No:	382	**Total Depth:**	2264
Operator Name:	SUPERIOR OIL COMPANY	**Bottom Hole:**	Minnelusa
Permit Date:	02-18-1965	**KB Elevation:**	3585
Spud Date:	02-20-1965	**Ground Elevation:**	3576
Plug Date:	03-05-1965	**Latitude:**	43.436899
		Longitude:	-103.977905
Well Field	WILDCAT	**Status**	P&A
Class:	DRY HOLE	**Type:**	DRY HOLE

Formation Tops

Formation	Depth (ft.)
Dakota Mud	185
Lakota	371
Morrison	471
Sundance	670
Minnekahta	1518
Opeche	1557
Minnelusa	1645
Red River	2108

Page 1 of 1 (goto top) | **Page:** 1

COUNTY:	**FALL RIVER**
LEGAL LOCATION:	**SESE 15-7N-1E**
API NO:	**40 047 05093**
PERMIT NO:	**382**
WELL NAME:	**SUPERIOR OIL #1 PETERSON (44-15)**
OPERATOR:	**THE SUPERIOR OIL COMPANY**
PERMIT ISSUED:	**02/18/1965**
PERMIT CLOSED:	**10/21/1966**
FILE LOCATION:	**7N-1E-15 SESE**

TARGET CODES:

WELL HISTORY / CHECKLIST

PERMIT TO DRILL / INTENT TO DRILL

WELL INSPECTION / SCOUT REPORTS

OPERATOR'S TECHNICAL REPORTS / MAPS

ADMINISTRATIVE / SUNDRY REPORTS

CORRESPONDENCE

SURETY

MISCELLANEOUS

WELL HISTORY / CHECKLIST

WELL HISTORY

Well Name Superior Oil #1 Peterson 44-15 Permit No. 382

Location SESE 15-7S-1E - Fall River Date of Permit 2-18-65

Elev. 3576 Gr. API No.

Confidential From To

Logs Received

Cuttings Received Cores Received

Drill Stem Records

Cap Plug and Marker Set

Surface Restored

Plugging Affidavit Signed Date

Bond Released Date 10-21-66

Summary of Scout Reports

2-19-65 First report

2-24-65 Spudded 2-20-65

3-4-65 Plugged

3-5-65 Planned to convert test to water well

4-9-65 Pits not filled - Rig still on location

5-25-65 Mud pits not filled - Rig moved from location

7-30-65 Pits not filled

7-1-66 Pits not filled

Hydro ID 4

Superior #1 (44-15) Peterson
660 FSL, 660 FEL
SE SE, -15-7S-1E
Fall River Co

Surface + mineral owner.
F.A. Peterson
Edgemont, So.Dak.

Contractor: Barnhart Drilling Co.
Casper, Wyo.

Elev: 3576 gr
3585 K.B.

Est T.D. 2500 1st Sd.

Permit: 2-18-65 #382.

Plan to Set 500' 8 5/8, Core + test 1st Sd. + Run Dual Induction-Laterolog + GRS

---

water flowed about 400

Crane #7 Reinhart.

971' 8 5/8

March 2, 1965

Coring at 2175'

@ 2179

986.54 of 8 5/8
w/ 450 sx + Cem.
+ 125 sack
Cemented 971

Dave Benson - Geol.

2-19-65

John Ryan of P.I.
Called + Said Barnhart
Was Contractor + they were on location.

2-20-65

Dighe Called at 11:00 A.M. Said Barnhart was Contractor + had spudded at 1:30 AM 2-20-65
~~Dick Wagner Geol.~~
Don Brause - Eng.-pusher.
(wayne will not be out until reach minnelusa

Not Tite
nothing will be tite.

Feb 24, 1965

@ 974

[illegible]

me
Top log E.
Dak 185
Lak 371
mor 471
Sun 670
l 771. top Sun land.

Sample. top

mk. - 1527
ml - 1652

Lak + Sun flowed.

1st Sd being Cored.

est. T.D. 2500

PERMIT TO DRILL / INTENT TO DRILL

State Pub. Co., Pierre

APPLICATION FOR PERMIT TO:

S. Dak Oil & Gas Board
FORM 2

☒ DRILL ☐ DEEPEN ☐ PLUG BACK ☐ SINGLE ZONE

☒ OIL WELL ☐ GAS WELL ☐ MULTIPLE ZONE

FARM OR LEASE NAME: Peterson

WELL NO.: #1 (44-15)

FIELD AND POOL, OR WILDCAT:

NO. ACRES IN LEASE: 2846.03

¼ ¼ SEC. TWP RGE: SE SE 15-7S-1E

COUNTY: Fall River

OPERATOR: The Superior Oil Company

ADDRESS: P. O. Box 200, Casper, Wyoming

LOCATION (In feet from an established corner of the legal subdivision)*: 660' FSL & 660' FEL Sec. 15-7S-1E

NAME AND ADDRESS OF SURFACE OWNER: F. A. Peterson, Edgemont, South Dakota

ELEVATION: 3576 G.L.

PROPOSED DEPTH: 2500'

NO. OF WELLS ETC:

ROTARY OR CABLE TOOLS: Rotary

NAME AND ADDRESS OF CONTRACTOR: Unknown

APPROXIMATE DATE WORK WILL START: 2-22-65

IF LEASE PURCHASED WITH ANY WELLS DRILLED, FROM WHOM PURCHASED (Name and address)

PROPOSED CASING AND CEMENTING PROGRAM

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	NEW OR SECOND HAND	DEPTH	SACKS OF CEMENT
12-1/4"	8-5/8"	24#	New	500	300

DESCRIBE PROPOSED OPERATIONS. IF PROPOSAL IS TO DEEPEN OR PLUG BACK, GIVE DATA ON PRESENT PRODUCTIVE ZONE AND PROPOSED NEW PRODUCTIVE ZONE. GIVE BLOW OUT PREVENTER PROGRAM IF ANY

(1) The Superior Oil Company proposes to drill a 2500' 1st Leo Sand test at the above location.
(2) Will set 8-5/8" csg. at 500' & cmt. to surface.
(3) Will drill 7-7/8" hole to total depth.
(4) Will catch 10' samples from base of surface to TD.
(5) Expect to core & test the 1st Leo Sand plus any other zones that have significant shows.
(6) Will run Dual Induction-Laterolog & GRS logs from TD to base of surf. csg.
(7) Should commercial production be encountered, 5-1/2" casing will be cemented through the productive zone.

SIGNED J. P. Dirks TITLE District Engineer DATE 2-11-65

DO NOT WRITE BELOW THIS LINE

PERMIT NO. 29

CHECKED BY Bernard Linn 2/17/65
School and Public Lands Date

APPROVAL DATE Feb 17 1965 — Secretary

CONDITIONS:

☐ COMPLETE SET OF SAMPLES, AND CORES IF TAKEN, MUST BE SUBMITTED.

☐ SAMPLES, AND CORES IF TAKEN, BELOW ... DEPTH, MUST BE SUBMITTED.

INSTRUCTIONS

General: This form is designed for submitting proposals to perform certain well operations, as indicated, on all types of lands and leases for appropriate action by either a Federal or a State agency, or both, pursuant to applicable Federal and/or State laws and regulations. Consult applicable Federal or State regulations, or appropriate officials, concerning approval of the proposal before operations are started.

If the proposal is to redrill to the same reservoir at a different subsurface location or to a new reservoir, use this form with appropriate notations.

If the well is to be, or has been, directionally drilled, so state and show by attached sheets, if necessary, the coordinate location of the hole in any present or objective productive zones.

File 3 copies of this form with Secretary, Oil & Gas Board, Pierre.

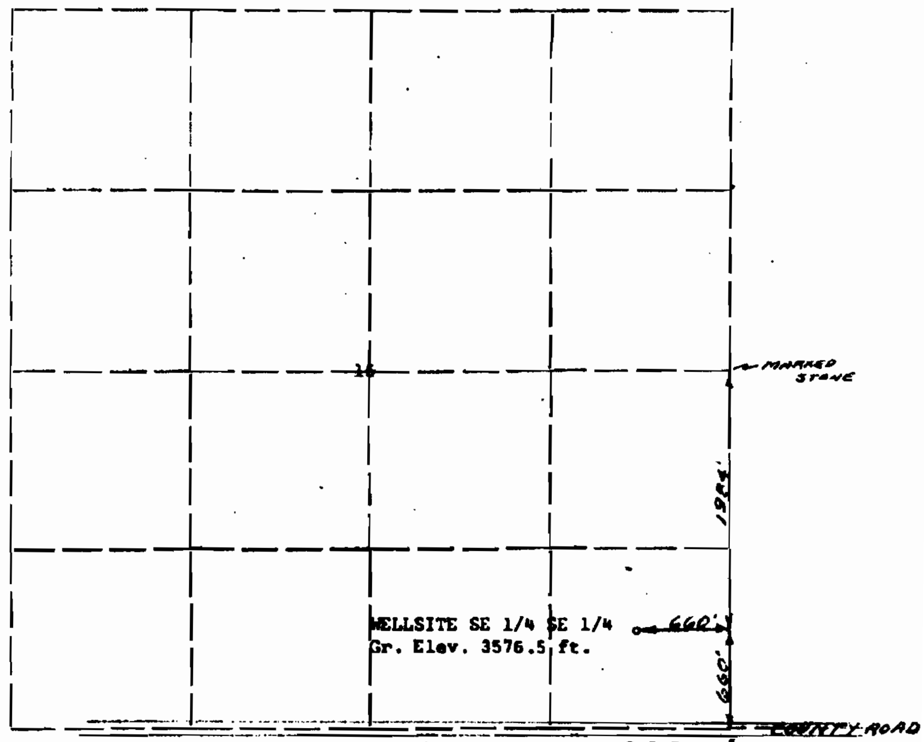
(*Sample location: 660' South and 600' East of the Northwest Corner of Section 16.)

TRI-STATE COMPANY

`X 727 746-47

NEWCASTLE, WYOMING

N. W. Corner N. E. Corner



S. W. Corner S. E. Corner

I, Lawrence T. Price, of Newcastle, Wyoming, Certify

that in accordance with a request from J. P. Dujka

of Casper, Wyoming, for The Superior Oil Company

P. O. Box 200, Casper, Wyoming

I made a survey (date) February 9 19 65

for the location and elevation of the Peterson No. 1 (44-15) oil

wellsite

As shown on above map, the well site is in center SE 1/4 SE1/4

Section 15, Township 7 South ~~XXXX~~ Range 1 East ~~XXXX~~

Fall River County, South Dakota ~~Wyoming~~. Elevation is 3576.5 feet

above mean sea level before dozing.

Licensed Surveyor No. 1311

WELL INSPECTION / SCOUT REPORTS

POWERTECH (USA) INC.

Confidential

Hydro ID 4

Permit No. 382

10 of 83

STATE GEOLOGICAL SURVEY

Scout Report

Date Scouted 7/1/66

Owner Superior Oil Company

Designation of well #1 Peterson (44-15)

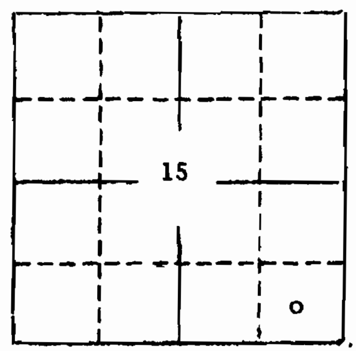
Location: Sec. 15 T. 7 N. S. R. 1 E. W.

Fall River County, S. D. Total depth 2264 feet

Casing Record:

8 5/8 971 Ft. ______ Ft.

______ Ft. ______ Ft.



Work in progress at time of visit:

None

Developments since last visit:

None

Remarks and recommendations:

Pits not filled

Scouted by Earl Cox, Geologist

Approved by Duncan J. McGregor

Duncan J. McGregor, State Geologist

Permit No. 382

STATE GEOLOGICAL SURVEY

Scout Report

Date Scouted July 30, 1965

Owner Superior Oil Company

Designation of well #1 Peterson (44-15)

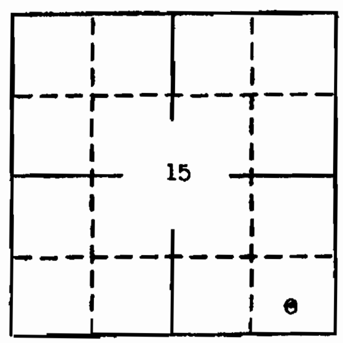
Location: Sec. 15 T. 7 N. S. R. 1 E.W.

Fall River County, S. D. Total depth 2264 feet

Casing Record:

8 5/8 971 Ft. ______ Ft.

______ Ft. ______ Ft.



Work in progress at time of visit:

None

Developments since last visit:

None

Remarks and recommendations:

Pits not filled

Scouted by Earl Cox, Geologist

Approved by Duncan J. McGregor, State Geologist

Permit No. 382

STATE GEOLOGICAL SURVEY

Scout Report

Date Scouted May 25, 1965

Owner Superior Oil Company

Designation of well #1 Peterson (44-15)

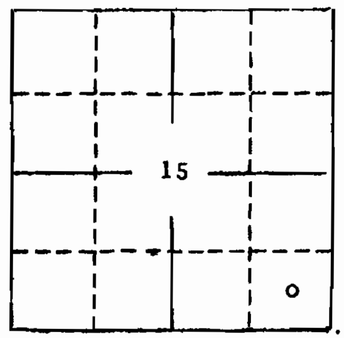
Location: Sec. 15 T. 7 ~~N~~. S. R. 1 E. ~~W~~.

Fall River County, S. D. Total depth 2,264 feet

Casing Record:

8 5/8 971 Ft. ______ Ft.

______ Ft. ______ Ft.



Work in progress at time of visit:

None

Developments since last visit:

Rig moved from location

Remarks and recommendations:

Mud pits not filled

Scouted by Earl Cox, Geologist

Approved by Duncan J. McGregor, State Geologist

Hydro ID 4

Permit No. 13 of 63 382

STATE GEOLOGICAL SURVEY

Scout Report

Date Scouted April 9, 1965

Owner Superior Oil Company

Designation of well #1 Petersen (44-15)

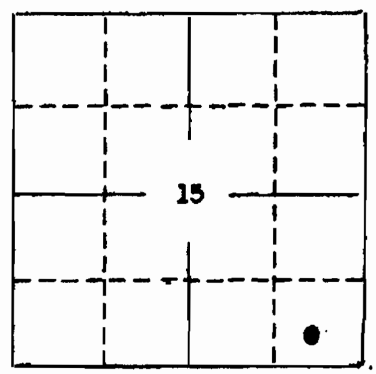
Location: Sec. 15 T. 7 ~~N~~. S. R. 1 E. ~~W~~.

Fall River County, S. D. Total depth 2264 feet

Casing Record:

8 5/8 971 Ft. ______ Ft.

______ Ft. ______ Ft.



Work in progress at time of visit:

None, well is flowing at about 10 gpm

Developments since last visit:

A three-inch control valve is in place on the well head.

Remarks and recommendations:

Pits have not been filled.
Rig is still over location.

Scouted by Earl Cox, Geologist

Approved by Duncan J. McGregor

Duncan J. McGregor, State Geologist

Permit No. 382

STATE GEOLOGICAL SURVEY

Scout Report

Date Scouted March 5, 1965

Owner Superior Oil Company

Designation of well #1 Peterson (44 - 15)

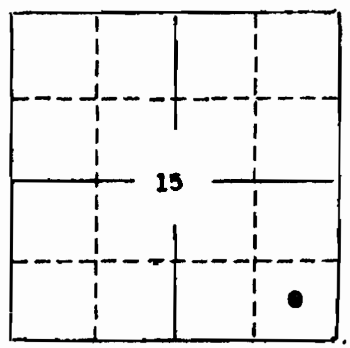
Location: Sec. 15 T. 7 ~~N~~. S. R. 1 E. ~~W~~.

Fall River County, S. D. Total depth 2264 feet

Casing Record:

8 5/8 971 Ft. ______ Ft.

______ Ft. ______ Ft.



Work in progress at time of visit:

An artesian flow at the base of the surface casing flushed out the top of the cement plug resulting in a 20-30 gpm flow of fresh water.

Developments since last visit:

Remarks and recommendations:

The flow is contained by a valve at the surface and it is planned to convert the test to a water well.

Scouted by Earl Cox, Geologist

Approved by Duncan J McGregor

Duncan J. McGregor, State Geologist

Permit No. 382

STATE GEOLOGICAL SURVEY

Scout Report

Date Scouted March 4, 1966

Owner Superior Oil Company

Designation of well #1 Peterson (44 - 15)

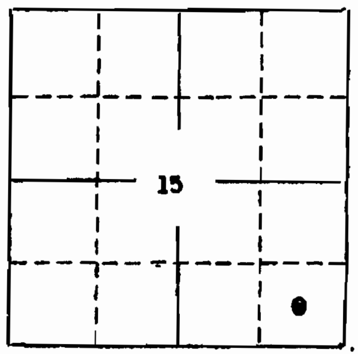
Location: Sec. 15 T. 7 ~~N~~. S. R. 1 E. ~~W~~.

Fall River County, S. D. Total depth 2264 feet

Casing Record:

8 5/8 971 Ft. ______ Ft.

______ Ft. ______ Ft.



Work in progress at time of visit:
Plugged as follows:

25 sacks 1970-1920 3rd Converse sand
35 sacks 1715-1645 Top Minnelusa
30 sacks Base surface casing 1020-950

Developments since last visit:
Core #1 2175-2221 anhydrite, Core #2 2221-22644, anhydrite essentially. Leo Sand very tight. No permeability or porosity. Run sonic-gamma ray log and dual induction laterolog (971-T.D.). Run E-log and micro-log prior to setting surface casing. Water flow of about 40 gpm at 890-905 and also a flow after drilling out from under surface casing.

Remarks and recommendations:
Tentative log tops:

Minnekahta	- 1518	3rd converse	- 1942
Opeche	- 1557	Red marker	- 2108
Minnelusa	- 1645	Base of 1st Leo	- 2254
2nd Converse	- 1777	T. D.	- 2264

Scouted by Earl Cox, Geologist

Approved by Duncan J. McGregor
Duncan J. McGregor, State Geologist

Permit No. 392

STATE GEOLOGICAL SURVEY

Scout Report

Date Scouted March 2, 1965 ?

Owner Superior Oil Co.

Designation of well #1 Peterson

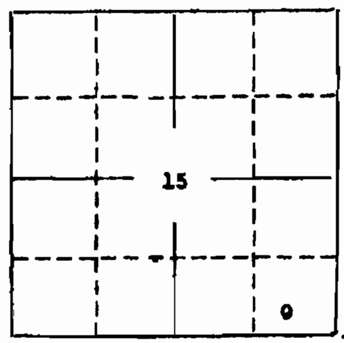
Location: Sec. 15 T. 7 ~~N~~. S. R. 1 E. ~~W~~

Fall River County, S. D. Total depth 2179 feet

Casing Record:

8 5/8 971 Ft. ______ Ft.

______ Ft. ______ Ft.



Work in progress at time of visit:

Coring at 2179 (1st Leo Sand)

Developments since last visit:

Set 971' of 8 5/8" surface casing with 375 sacks.
Drilled from 974-2175.
Cored from 2175-2179.

Artesian flows were encountered in the Lakota and Sundance.

Remarks and recommendations:

E log tops:
Dakota - 185
Lakota - 371
Morrison - 471

Sundance - 670
Top Sundance Sand - 771

Sample Tops:
Minnekahta - 1527
Minnelusa - 1652

Scouted by Earl Cox, Geologist

Approved by Duncan J. McGregor
Duncan J. McGregor, State Geologist

Elevations: 3576 gd; 3585 K.B.

Hydro ID 4

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Permit No. 382

STATE GEOLOGICAL SURVEY

Scout Report

Date Scouted Feb. 24, 1965

Owner Superior Oil Co.

Designation of well #1 Peterson (44-15)

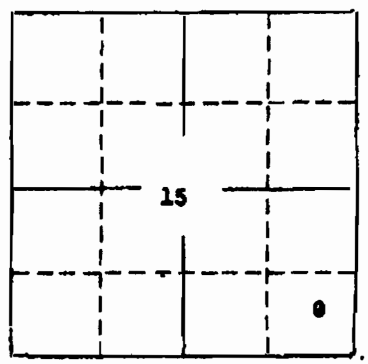
Location: Sec. 15 T. 7 ~~N~~. S. R. 1 E. ~~W~~.

Fall River County, S. D. Total depth 974 feet

Casing Record:

______ Ft. ______ Ft.

______ Ft. ______ Ft.



Work in progress at time of visit:

Drilling at 974'.

Developments since last visit:

Spudded 2-20-65.
Drilled from 0 - 974.
Run electric log to locate water sands.

Remarks and recommendations:

Over 900 feet of surface casing will be set to case off artesian flows.

Scouted by Earl Cox, Geologist

Approved by Duncan J. McGregor

Duncan J. McGregor, State Geologist

Permit No. 382

STATE GEOLOGICAL SURVEY

Scout Report

FIRST REPORT

Date Scouted Feb. 19, 1965

Owner Superior

Designation of well #1 (44-15) Peterson

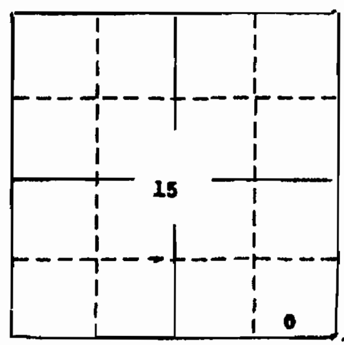
Location: Sec. 15 T. 7 ~~N.~~ S. R. 1 E. ~~W.~~

Fall River County, S. D. Total depth 0 feet

Casing Record:

_____ Ft. _____ Ft.

_____ Ft. _____ Ft.



Work in progress at time of visit:

Petroleum Information informed me by phone that Barnhart Drilling Company was the contractor and they were on location.

Developments since last visit:

Remarks and recommendations:

Scouted by Earl Cox, Geologist

Approved by Duncan J. McGregor, State Geologist

8:45 AM

March 4, 1965

Don Braun Called. Had Reached 2264 & found the sand very tite & no Shows. Plan to log & then plug

Peterson phone 662-6222

Sonic log - gamma Ray Run 100 ✓ Microlog or surface

Dual induction laterolog.

Formation log tops

MK - 1518

gp - 1557

mol - 1645

2nd Conner 1777

3rd " 1942

Red marker - 2108

Base of Lakota 2254

T.D. 2264

3rd Conn 1970 - 1920

3rd Conn. 1970 - 1920 25 sx

T. mol 1715 - 1645 35 sx

Fox Hills 1020 - 950 30 sx

90 sx

~~7:30 - 8:00~~ 7:45 A.M to Check plug.

462 - 7244

Room 7.

Don Braun

Core #1 2175 - 2228 mostly Pulls. Rec 44'

Core #2 2228 - 2264 Only dirt essentially

Good water at 850 - 905 or 925 1st flow 1 bbl/min

plug Fox Hills Cm

30 sx - ~~[illegible]~~ 1020 - ~~[illegible]~~ 950

25 sx 3rd Conn 1970 - 1920

35 sx top Mol 1645 - 1715

970 Cm Strat will prove Samples

March 5, 1965

Braun called at 10:00 AM I finally got hold of him at about 7:00 P.M. ~~He~~ Got a flow of water ~~[illegible]~~ ~~[illegible]~~ flowing a 2" stream I an estimated 20 g/m. He put valve at surface & shut in.

a sand zone immediately below surface had apparently broke loose. (a flow was observed when drilled out from under surface) Rig had been torn down & part hauled off for repair. We decided to put steel Baker plug at base of casing & put 10' - Cement on top of it.

March 6, 1965

Called Brauer @ 8:30 am
He said he was quite
some water was coming
from base of surface. Said
Ranche wants to stop present
flow. I said couldn't
be done but would
see McGregor about it.
Brauer said an alternative
that would save them
money would be to pump
60 sx down hole and
shut in after reaching
the sand. This would
leave about 100' of
cement in casing & the
rancher would have
to drill it out. I
said this would be
a satisfactory alternative,
and work would be
done in week or 10 days
after they evaluate each.

Apr 19, 1965

Most laid down. Nothing
removed. Pits not filled or
fenced. Head & valve was
on wellhead & was
flowing about 5-10 gpm

May 25, 1965

Rig gone from location
pits not filled

July 30, 1965

no change

Sept. 2, 1965

no change. water from
well running into
mud pits.

July 1, 1966

no change

9-9-66

no change

using cement would cost
about 500 & using steel
plug about 1000.

Duyka - pronounced Dika

3-8-65

Called McGregor, Don [illegible],
Francis Peterson, and Mr
Dujka and all agreed to
convert plan to a water well.
I will get letter from
Peterson that he request
a conversion

3-17-65

Called Peterson as he had
not sent back signed letter
saying he wants to convert to
a water well. He said had
reduced [illegible] put valve on
& ran it for a week & then
had dropped to 6 gpm. He
was going to sign letter & return.

Hydro ID 4 Permit No. 382 (21 of 60)

Superior #1 Peterson

SE 1/4 SE 1/4, sec 15, T 7S, R. 1E
Fall River Co

Geological
spudded
Elev - 3576 , 35__ KB
Contractor - Burkhart Drill Co

2-1965

P.I. told Earl that driller moved site.

2-24-65

Spudded ... Drilled to 479 & ran E-logs to locate water sands. Over 900' of surface csg will be set to case off artesian flows

3-2-65

Set 471 feet of 8 5/8 surface with 500 sacks & drilled to 2175 Cored from 2175 2179 (1st Sec). Flows were encountered in K1 & Lakota

(over)

Hydro 16 4 — 22 of 63

471, Lindeman 670,

sample tops – Minnekahta 1515

Minnelusa – 1652

3-4-64

Plugged: Core #1 2211-2221
Core #2 2221-2264 anhydrite
essentially for sand anhydrite
no perm or pore ...
... (971 TD)
...
at the flow of about 45 gpm at 870-
905 + also a flow after drilling out
from under surface csg

Tops:
Minnekahta 1515 2nd Converse 1842
opeche – 1557 red marker 2108
Minnelusa – 1645 ... 1st Leo 22..
2nd Converse 1777 TD 2264

3-5-64

artesian flow at base of surface csg ...
... plug resulting in a flow of ... gpm. Flow contained by valve + well ...
... water well.

3-10-64

Letter from ... to ... water well

-- -- 5

Received 2 copies of letter from Vernon Peterson with ... surface plug out of hole ... could ... ... well
Also 2 copies of core analyses

4-9-65

Well flowing at about 10 gpm ... in place. Pits are filled & rig ... location

5-10-65

Letter from ... ... because pits not filled even though ... has assumed responsibility for well

5-25-65

Rig moved from location. Pits not filled.

7-30-65

Pits not filled

10-7-65

Letter from ... ... was ... and water running ... pits

Letter from Earl [illegible] saying a release from Peterson is needed
Pits not filled 7-1-66

9-28-66
Received release signed by Peterson for pits

9-30-66
Letter from Earl saying OK to release bond

WELL: [illegible] #1 [illegible]

LOCATION:

LOGS RECD:

TOPS:

GEOLOGIC: 2 copies [illegible]

ELECTRIC, FIELD:

FINAL: 2 copies [illegible]
1 copy [illegible]

RADIO, FIELD:

FINAL: 2 copies [illegible]

OTHERS: 3 copy [illegible] analyses

CUTTINGS RECD: 5/10/55

CORES RECD: 2 copies of core analyses [illegible]

DRILL STEM DATA RECD: ~~[illegible]~~

CAP PLUG CHECKED: converted to water well.

MUD PITS FILLED: Peterson signed release.

PLUGGING AFFIDAVIT SIGNED:
1 photocopy each of form 4 & 7 [illegible]

BOND RELEASED: to Ruth for [illegible] signature 10-20

10-21-66

OPERATOR'S TECHNICAL REPORTS / MAPS

Hydro ID 4

Preliminary Report

CORE LABORATORIES, INC.
Petroleum Reservoir Engineering
DALLAS, TEXAS

THE SUPERIOR OIL COMPANY
MAR 11 1965
ENGINEERING
CASPER

Page No. ______

CORE ANALYSIS RESULTS

Company SUPERIOR OIL COMPANY Formation MINNELUSA File RP-4-1363

Well NO. 1 PETERSON Core Type DIAMOND CONV. Date Report 3-4-65

Field WILDCAT Drilling Fluid WATER BASE Analysts JMM

County FALL RIVER State S. DAKOTA 3576 Gr Location SE SE 15-7S-1E

Lithological Abbreviations

SAND-SD	DOLOMITE-DOL	ANHYDRITE-ANHY	SANDY-SDY	FINE-FN	CRYSTALLINE-XLN	BROWN-BRN	FRACTURED-FRAC	SLIGHTLY-SL/
SHALE-SH	CHERT-CH	CONGLOMERATE-CONG	SHALY-SHY	MEDIUM-MED	GRAIN-GRN	GRAY-GY	LAMINATION-LAM	VERY-V/
LIME-LM	GYPSUM-GYP	FOSSILIFEROUS-FOSS	LIMY-LMY	COARSE-CSE	GRANULAR-GRNL	VUGGY-VGY	STYLOLITIC-STY	WITH-W/

SAMPLE NUMBER	DEPTH FEET	PERMEABILITY MILLIDARCYS	POROSITY PER CENT	RESIDUAL SATURATION PER CENT PORE OIL	RESIDUAL SATURATION PER CENT PORE TOTAL WATER	SAMPLE DESCRIPTION AND REMARKS
1	2217-18	0.16	2.7	7.4	63.1	SD, GRY, V/FN-FN, CALC.
2	18-19	0.24	2.6	0.0	65.5	SD, GRY, V/FN-FN, CALC.
3	2183	0.10	2.2	0.0	77.2	SD, GRY, V/FN-FN, SL/DOL.
4	2212	0.10	1.3	0.0	84.5	SD, GRY, V/FN-FN, SL/DOL.
5	2221	<0.1	0.5	0.0	40.0	SD, GRY, V/FN-FN, SL/CALC.
6	2239	0.10	2.8	0.0	68.0	SD, GRY, FN-MED, SL/CALC.
7	2249	0.10	1.9	0.0	47.3	SD, GRY, FN-MED, SL/CALC.

Superior Oil Company, 44-15 Petersen Description by: D. A. Bentzin
C SE SE Section 15, T 7 S, R 1 E
Fall River County, South Dakota

Elevation: 3576G, 3585KB

974- 980	Shaly siltstone, dark reddish brown, calc, NS.
980- 990	Siltstone, aa, NS.
990-1000	Siltstone, aa, NS.
1000-1010	Siltstone, dark reddish brown, calc, NS.
1010-1020	Siltstone, dark reddish brown, calc, NS.
1020-1030	Siltstone, dark reddish brown, calc, NS.
1030-1040	Shaly siltstone, dark reddish brown, calc, NS.
1040-1050	Shaly siltstone, dark reddish brown, calc, NS.
1050-1060	Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS.
1060-1070	Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS.
1070-1080	Shaly siltstone, dark reddish brown, calc, NS.
1080-1090	Shaly siltstone, dark reddish brown, calc, NS.
1090-1100	Shaly siltstone, dark reddish brown, calc, NS.
1100-1110	Shaly siltstone, dark reddish brown, calc, NS.
1110-1120	Shaly siltstone, dark reddish brown, calc, NS.
1120-1130	Shaly siltstone, dark reddish brown, calc, NS.
1130-1140	Shaly siltstone, dark reddish brown, calc, NS.
1140-1150	Shaly siltstone, dark reddish brown, calc, NS.
1150-1160	Shaly siltstone, dark reddish brown, calc, NS.
1160-1170	Shaly siltstone, dark reddish brown, calc, NS.
1170-1180	Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS.
1180-1190	Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS.
1190-1200	Shaly siltstone, dark reddish brown, calc, NS.
1200-1210	Shaly siltstone, dark reddish brown, calc, NS.
1210-1220	Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS.
1220-1230	Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS.
1230-1240	Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS.
1240-1250	Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS.

Superior Oil Company, 44-15 Petersen
C SE SE Section 15, T 7 S, R 1 E
Fall River County, South Dakota
Page 2

1250-1260	Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS.
1260-1270	Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS.
1270-1280	Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS.
1280-1290	Shaly siltstone, dark reddish brown, calc, with 10% anhydrite, NS.
1290-1300	Shaly siltstone, dark reddish brown, calc, with 10% anhydrite, NS.
1300-1310	Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS.
1310-1320	Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS.
1320-1330	Shaly siltstone, dark reddish brown, calc, with 25% anhydrite, NS.
1330-1340	Shaly siltstone, dark reddish brown, slightly calc, with 30% anhydrite, NS.
1340-1350	Anhydrite, white, crystalline with shaly siltstone aa, NS.
1350-1360	Anhydrite, white, crystalline with shaly siltstone aa, NS.
1360-1370	Anhydrite, white, crystalline, decreasing with siltstone as above, NS.
1370-1380	Shaly siltstone, dark reddish brown, calc, with 25% anhydrite, NS.
1380-1390	Shaly siltstone, dark reddish brown, calc, with 25% anhydrite, NS.
1390-1400	Shaly siltstone, dark reddish brown, calc, with 10% anhydrite, NS.
1400-1410	Anhydrite, white, crystalline with shaly siltstone aa, NS.
1410-1420	Anhydrite and shaly siltstone, aa, 50-50, NS.
1420-1430	Anhydrite and shaly siltstone, aa, 50-50, NS.
1430-1440	Shaly siltstone, dark reddish brown, slightly calc, with minor anhydrite, NS.
1440-1450	Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS.
1450-1460	Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS.
1460-1470	Shaly siltstone, dark reddish brown, slightly calc, with minor anhydrite, NS.

Superior Oil Company, 44-15 Petersen
C SE SE Section 15, T 7 S, R 1 E
Fall River County, South Dakota
Page 3

1470-1480	Shaly siltstone, dark reddish brown, slightly calc, with minor anhydrite, NS.
1480-1490	Shaly siltstone, dark reddish brown, slightly calc, with minor anhydrite, NS.
1490-1500	Shaly siltstone, dark reddish brown, slightly calc, with minor anhydrite, NS.
1500-1510	Shaly siltstone, dark reddish brown, slightly calc, with minor anhydrite, NS.
1510-1520	Shaly siltstone, dark reddish brown, calc, with minor anhydrite, NS.
1520-1530	40% Shaly siltstone, aa, with 10% white anhydrite and 20% dolomite, pink, very fine granular to dense, slow effervescence, NS.
1530-1540	Shaly siltstone, anhydrite and dolomite, aa, in equal parts. The dolomite is varicolored - white, pink, tan, NS.
1540-1550	Sample aa, with minor calcareous purple shale, NS.
1550-1560	Sample aa, with minor calcareous purple shale, NS.
1560-1570	Sample aa, with no purple shale, NS.
1570-1580	Sample aa, NS.
1580-1590	Sample aa, NS.
1590-1600	Sample aa, NS.
1600-1610	Silty shale to siltstone, reddish brown, slightly calc, with minor anhydrite, NS.
1610-1620	Silty shale to siltstone, reddish brown, slightly calc, with minor anhydrite, NS.
1620-1630	Silty shale to siltstone, reddish brown, slightly calc, with minor anhydrite, NS.
Note	The Opeche lithology is similar to the pre-Minnekahta with the exception that the silt grains seem generally smaller.
1630-1640	Shaly siltstone, reddish brown, calc, with minor anhydrite, NS.
1640-1650	Sample aa, with sandy siltstone, reddish brown, slightly calc, soft and sandstone, gray to pink, fine grained, non-calc poor porosity, NS.
1650-1660	Sample aa, with sandstone, pink to white, fine to medium grained, fair sorting, slightly calc, poor porosity, grains appear to have secondary overgrowths, NS.
1660-1670	Sandy siltstone, reddish brown, and sandstone aa, NS.
1670-1680	Sample aa, with sandy siltstone predominant, NS.
1680-1690	Sample aa, with sandstone increasing to 30%, NS.

Superior Oil Company, 44-15 Petersen
C SE SE Section 15, T 7 S, R 1 E
Fall River County, South Dakota
Page 4

1690-1700	Sample aa, with sandstone increasing to 30%, with minor anhydrite, NS.
1700-1710	Sample aa, with sandstone increasing to 30%, with minor anhydrite, NS.
1710-1720	Sample aa, with sandstone increasing to 30%, with minor anhydrite, NS.
1720-1730	60% Anhydrite, white, crystalline with silty shale, reddish brown and minor sandstone, NS.
1730-1740	Sample aa, NS.
1740-1750	Dolomite, white to pink, dense, with anhydrite aa, NS.
1750-1760	Dolomite, white to pink to gray, dense, with anhydrite aa, NS.
1760-1770	Sandy siltstone, reddish brown, calc, with minor anhydrite, NS.
1770-1780	Sandy siltstone, reddish brown, calc, with minor anhydrite, NS.
1780-1790	Sandy siltstone, reddish brown, calc, with minor sandstone, white to pink, fine grained, angular, well sorted, poor porosity anhydrite cement, NS.
1790-1800	Sandy siltstone and sandstone aa, with anhydrite, NS.
1800-1810	Shale, reddish brown with siltstone and anhydrite aa, NS.
1810-1820	Limestone, mottled gray, dense, with lithology aa, NS.
1820-1830	Limestone, mottled gray, dense, with lithology aa, NS.
1830-1840	Shaly siltstone, reddish brown, slightly calc, with limestone and anhydrite aa, NS.
1840-1850	Sample aa, NS.
1850-1860	Sample aa, with minor white sandstone, fine grained, poor porosity, NS.
1860-1870	Limestone aa, with shaly siltstone and anhydrite aa, NS.
1870-1880	Limestone aa, with shaly siltstone and anhydrite aa, NS.
1880-1890	Limestone aa, with shaly siltstone and anhydrite aa, NS.
1890-1900	Shaly siltstone increasing in proportion to limestone and anhydrite with minor sandstone, white very fine grained, angular, no porosity, grains are anhydrite encased, NS.
1900-1910	Sample aa, NS.
1910-1920	Shaly siltstone to silty shale, reddish brown, soft calc, and anhydrite, white, granular with minor limestone, pink, dense, NS.
1920-1930	60% Shaly siltstone aa, 30% anhydrite aa, 10% limestone aa, NS.

Superior Oil Company, 44-15 Petersen
C SE SE Section 15, T 7 S, R 1 E
Fall River County, South Dakota
Page 5

1930-1940	Sample aa, NS.
1940-1950	Silty shale, reddish brown, slightly calc, soft with minor anhydrite, NS.
1950-1960	Silty shale, reddish brown, slightly calc, soft with minor anhydrite and sandstone, white, very fine grained, non-calc, tight, NS.
1960-1970	Silty shale and minor anhydrite aa, no sandstone, NS.
1974	Lost circulation - No sample 1970-1980.
1980-1990	75% cave, 25% sample aa, NS.
1990-2000	75% cave, 25% sample aa, NS.
2000-2010	75% cave, 25% sample aa, NS.
2010-2020	30% cave and silty shale, reddish brown, non-calc, soft with minor anhydrite and limestone, NS.
2020-2030	Sample aa, with sandstone, pink, fine to very fine grained, sub-angular, fair sorting dolomite cement, poor porosity, NS.
2030-2040	Sandstone aa, NS.
2040-2050	Sandstone aa, except very fine to medium grained sub-rounded poor sorting, poor porosity, NS.
2050-2060	Sandstone aa.
2060-2070	Anhydrite, white, with minor dolomite, pink and gray, dense and sandstone aa, with one chip shaly siltstone, red, slightly calc, hard, NS.
2070-2080	Sample aa, with 10% siltstone aa, NS.
2080-2090	Sample aa, with 10% siltstone aa, NS.
2090-2100	Anhydrite and limestone aa, NS.
2100-2110	Anhydrite and limestone aa, with sandstone white to lavender, very fine to fine grained, poor sorting, slightly calc to non-calc, NS.
2110-2120	Dolomite, tan to grey, dense; anhydrite, white, crystalline, shale, red, soft; sandstone white to levender, very fine to fine grained, poor sorting, slightly calc to non-calc, tight, NS.
2120-2130	Sample aa, with sandstone white, very fine to fine grained, fair sorting, rounded, slight effervescence, fair porosity, NS.
2130-2140	Dolomite and shale aa, with white sandstone aa, NS.
2140-2150	Increasing white sandstone with shale aa, NS.
2150-2160	Shale aa, with dolomite aa and decreasing sandstone aa, with minor black shale, soft, slightly calc, NS.
2160-2170	Sample aa, with increasing black shale and limestone, NS.
2170-2175	Sample aa, NS.
2175-2221	Core #1, see detailed description.
2221-2264	Core #2, see detailed description.
	Total Depth 2264'.

The Superior Oil Company, #44-15 Peterson
C SE SE Section 15, T 7 S, R 1 E
Fall River County, South Dakota

CORE #1 2175-2221 Cored 46 feet, Recovered 44 feet.

2175-76	Dolomite, black, finely crystalline, tight, NS.
2176-77	Anhydrite and dolomite, mottled light and dark gray, coarsely crystalline, tight, NS.
2177-78	Anhydrite, light to dark gray, tight, NS.
2178-79	Anhydrite, aa, with reddish-brown dolomite mottling, tight, NS.
2179-80	Dolomite, light gray, finely crystalline with minor clear anhydrite crystals and black shale mottling, NS.
2180-81	Dolomite, light gray, dense, mottled with clear anhydrite and red spots, NS. Some of the anhydrite has the curved shape of shell fragments.
2181-82	Sample aa, NS.
2182-83	Sandstone, gray, very fine-grained, subrounded, dolomitic and anhydritic cement, hard and tight, NS.
2183-84	Sample aa, NS.
2184-85	Anhydrite, mottled white and gray, tight, NS.
2185-86	Shale, dark gray, anhydritic, NS.
2186-87	Anhydrite, gray, very finely crystalline, dolomitic and very silty, NS.
2187-88	Anhydrite, light gray, sandy, very fine grained, NS.
2188-89	Sandstone, light gray, very fine to medium-grained, poorly sorted, dolomitic and anhydritic, tight, NS.
2189-90	Sandstone, light gray, very fine to medium-grained, poorly sorted, dolomitic and anhydritic, tight, NS.
2190-91	Sandstone, light gray, very fine to medium-grained, poorly sorted, dolomitic and anhydritic, tight, NS.
2191-92	Sandstone, light gray, very fine to medium-grained, poorly sorted, dolomitic and anhydritic, tight, NS.
2192-93	Sandstone, light gray, very fine to fine-grained, anhydritic cement, tight, NS.
2193-94	Anhydritic, gray with white dolomite mottling, tight, NS.
2194-95	Anhydrite, gray and white mottled, NS.
2195-96	Anhydrite, gray and white mottled, NS.
2196-97	Anhydrite, gray and white mottled, NS.

Superior, #44-15 Peterson
Core #1
Page 2

2197-98	Anhydrite, gray and white mottled, NS.
2198-99	Anhydrite, gray and white mottled, NS.
2199-2200	Anhydrite, gray and white mottled, NS.
2200-01	Anhydrite, gray and white mottled, NS.
2201-02	Anhydrite, gray and white mottled, NS.
2202-03	Anhydrite, aa, mottled with reddish-brown dolomite, tight, NS.
2203-04	Sample aa, NS.
2204-05	Sample aa, NS.
2205-06	Anhydrite, mottled light and dark gray, NS.
2206-07	Anhydrite, mottled light and dark gray, NS.
2207-08	Anhydrite, mottled light and dark gray, with minor dolomite, NS.
2208-09	Anhydrite, mottled light and dark gray and black, with minor dolomite, NS.
2209-10	Anhydrite, aa, with ¼-inch tan dolomite layers, no dip, tight, NS.
2210-11	Dolomite, gray, finely crystalline, with veinlets of black anhydrite, tight, NS.
2211-12	Thin laminae of black anhydrite and light gray sandy dolomite, tight, NS.
2212-13	Sandstone, black, very fine-grained, with anhydrite cement, tight, NS.
2213-14	Anhydrite, mottled light and dark gray with tan dolomite mottling, NS.
2214-15	Dolomite, tan to light gray, mottled with dark gray anhydrite, tight, NS.
2215-16	Black shale, anhydritic with gray anhydrite laminae, NS.
2216-17	Black shale, anhydritic, NS.
2217-18	Dolomite, light gray, very finely crystalline, very sandy, very fine to fine-grained, NS.
2218-19	Sandstone, light gray, very fine to medium-grained, subrounded, fair sorting, dolomite cement, tight, NS.

The Superior Oil Company, #44-15 Peterson
C SE SE Section 15, T 7 S, R 1 E
Fall River County, South Dakota

CORE #2 2221-2264 Cored 43 feet, Recovered 43 feet.

2221-22	Sandstone, gray, very fine to medium-grained, sub-rounded, fair sorting, dolomitic and anhydritic cement, tight, NS.
2222-23	Sandstone, dark gray, very fine to fine-grained, good sorting, anhydritic cement, tight, NS.
2223-24	Anhydrite, mottled gray, NS.
2224-25	Anhydrite, mottled gray, NS.
2225-26	Anhydrite, mottled gray, NS.
2226-27	Anhydrite, mottled gray, NS.
2227-28	Anhydrite, mottled gray, NS.
2228-29	Anhydrite, mottled gray, NS.
2229-30	Anhydrite, mottled gray, NS.
2230-31	Anhydrite, mottled gray, NS.
2231-32	Anhydrite, mottled gray, NS.
2232-33	Anhydrite, mottled gray, NS.
2233-34	Dolomite, gray, dense with spots of anhydrite; yellow fluorescence in hairline fractures; very slight and very slow cut with acetone. Strong sulfur odor.
2234-35	Dolomite, aa, tight, NS. Sulfur odor.
2235-36	Dolomite, aa, tight with increasing amount of anhydrite, NS.
2236-37	Anhydrite, gray, dense, NS.
2237-38	Dolomite and anhydrite, gray, very finely crystalline, very sandy, fine to very fine grains, slight porosity, NS.
2238-39	Sandstone, fine to medium-grained, rounded to sub-rounded, fair sorting, dolomitic and anhydritic cement. Trace of porosity. NS.
2239-40	Anhydrite, gray, very sandy, tight, NS.
2240-41	Anhydrite, gray, very sandy, tight, NS.
2241-42	Anhydrite, gray, very sandy, tight, NS.
2242-43	Anhydrite, gray, very sandy, tight, NS.
2243-44	Sandstone, gray, very fine to fine-grained, sub-rounded, fair sorting, dolomitic and anhydritic cement, tight, NS.

Superior, #44-15 Peterson
Core #2
Page 2

2244-45	Sandstone, aa, tight, NS.
2245-46	Sandstone, gray, fine to medium-grained, anhydritic cement, tight, NS.
2246-47	Anhydrite, black, silty, tight, NS.
2247-48	Anhydrite, black, silty, tight, NS.
2248-49	Anhydrite, gray, dolomitic, tight, NS.
2249-50	Sandstone, gray, very fine to fine-grained, sub-rounded, anhydritic cement, tight, NS.
2250-51	Sandstone, gray, very fine to fine-grained, sub-rounded, anhydritic cement, tight, NS.
2251-52	Sandstone, gray, very fine to fine-grained, sub-rounded, anhydritic cement, tight, NS.
2252-53	Sandstone, gray, very fine to fine-grained, sub-rounded, anhydritic cement, tight, NS.
2253-54	Sandstone, gray, very fine to fine-grained, sub-rounded, anhydritic cement, slight porosity, NS.
2254-55	Anhydrite, mottled gray, dense, with streaks of tan dolomite and very fine-grained pyrite, tight, NS.
2255-56	Anhydrite, mottled gray, dense with streaks of tan dolomite, tight, NS.
2256-57	Sample aa, NS.
2257-58	Sample aa, NS.
2258-59	Sample aa, NS.
2259-60	Dolomite, light gray, dense, tight, NS.
2260-61	Dolomite, light gray, dense, tight with small spots of anhydrite, NS.
2261-62	Sample aa, NS.
2262-63	Sample aa, with minor spots of very finely crystalline pyrite, NS.
2263-64	Sample aa, NS.

Hydro ID 4

FILE .... 37 of 63

SOUTH DAKOTA STATE GEOLOGICAL SURVEY

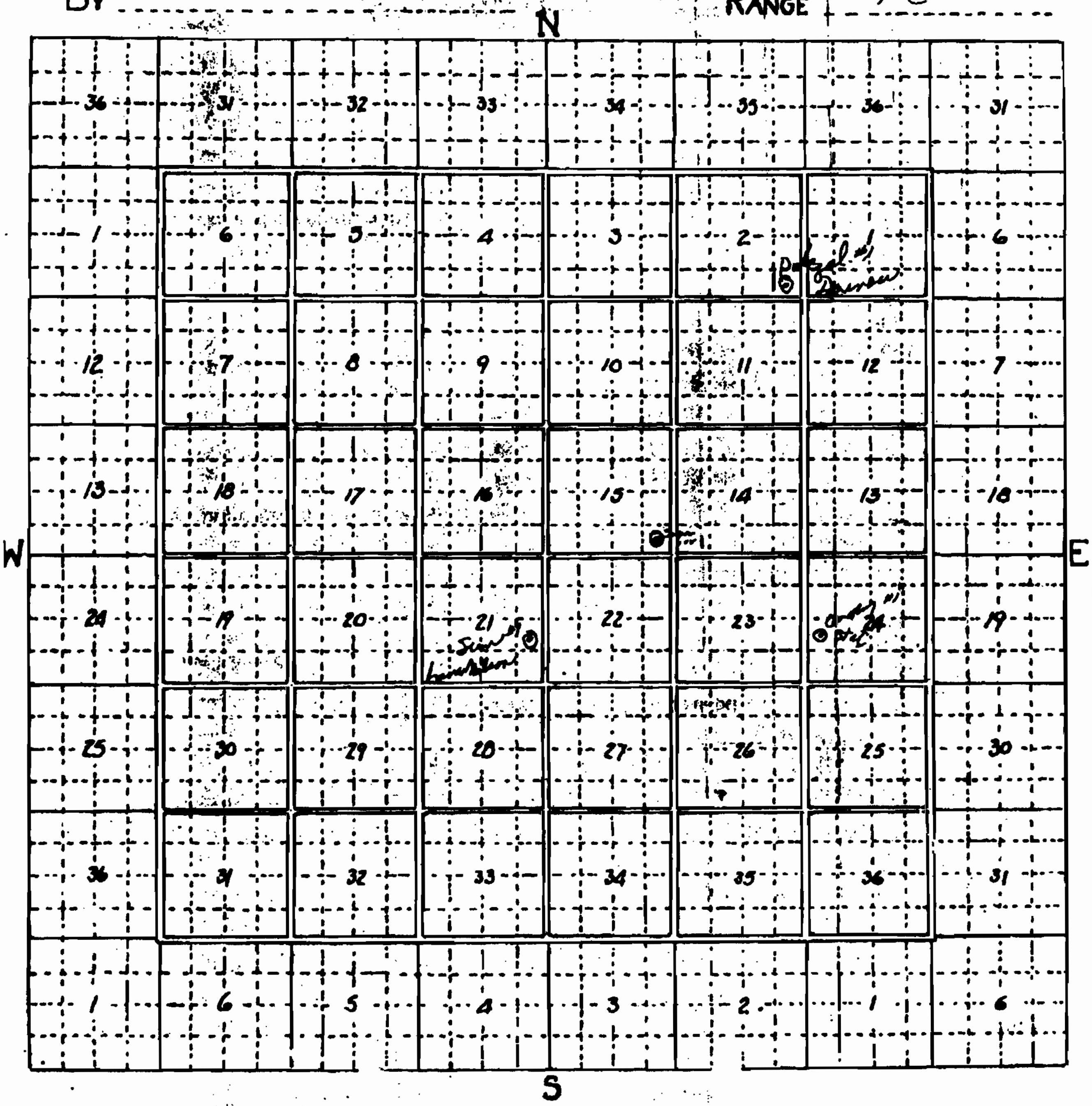
COUNTY ....

DATE ....

BY ....

TOWNSHIP 7S

RANGE 1E



ADMINISTRATIVE / SUNDRY REPORTS

MAR 2 5 1965

STATE PUB. CO., PIERRE

S. Dak. Oil & Gas Board
FORM 7

PLUGGING RECORD

Operator	Address
The Superior Oil Company	P. O. Box 200, Casper, Wyoming

Name of Lease	Well No.	Field & Reservoir
Peterson	1 (44-15)	Wildcat

Location of Well	Sec-Twp-Rge or Block & Survey	County
660' FSL & 660' FEL	C SE SE 15-7S-1E	Fall River

Application to drill this well was filed in name of	Has this well ever produced oil or gas	Character of well at completion (initial production): Oil (bbls/day)	Gas (MCF/day)	Dry?
The Superior Oil Co.	No			Yes

Date plugged:	Total depth	Amount well producing when plugged: Oil (bbls/day)	Gas (MCF/day)	Water (bbls/day)
March 5, 1965	2264'			

Name of each formation containing oil or gas. Indicate which formation open to well-bore at time of plugging	Fluid content of each formation	Depth interval of each formation	Size, kind & depth of plugs used. Indicate zones squeeze cemented, giving amount cement

CASING RECORD

Size pipe	Put in well (ft.)	Pulled out (ft.)	Left in well (ft.)	Give depth and method of parting casing (shot, ripped etc)	Packers and shoes
8-5/8"	971	None	971		Guide shoe @ 971, float collar @ 937 & basket @ 688'.

Was well filled with mud-laden fluid, according to regulations?	Indicate deepest formation containing fresh water
Yes	Bsl. Sundance Sd.

In addition to other information required on this form, if this well was plugged back for use as a fresh water well, give all pertinent details of plugging operations to base of fresh water sand, perforated interval to fresh water sand, name and address of surface owner, and attach letter from surface owner authorizing completion of this well as a water well and agreeing to assume full liability for any subsequent plugging which might be required.

Mr. Earl J. Cox of the State Geological Survey supervised the plugging operations.
This well was plugged & abandoned in the following manner:
Plug #1 - Equalized through open end DP 25 sx reg. cmt. from 1970' to 1920'
Plug #2 - Equalized through open end DP 35 sx reg. cmt. from 1715' to 1645'
Plug #3 - Equalized through open end DP 30 sx reg. cmt. w/2% $CaCl_2$ from 1020' to 950'
Removed csg. head & capped well as requested by land owner in attached letter.
The pits have been fenced and the location will be cleaned & leveled when the pits dry up.

USE REVERSE SIDE FOR ADDITIONAL DETAIL

Executed this the 18th day of March, 19 65
State of Wyoming
County of Natrona

J. P. Dujka — Signature of Affiant

Before me, the undersigned authority, on this day personally appeared J. P. Dujka known to me to be the person whose name is subscribed to the above instrument, who being by me duly sworn on oath states, that he is duly authorized to make the above report and that he has knowledge of the facts stated therein, and that said report is true and correct.

Subscribed and sworn to before me this 18th day of March, 19 65

SEAL

My commission expires June 10, 1967

Notary Public in and for [illegible]
County, [illegible]

DO NOT WRITE BELOW THIS LINE

Approved 12-21-66
Date

OIL AND GAS BOARD OF THE STATE OF SOUTH DAKOTA
[signature], Secretary

Approved for release of bond
Date Oct 10, 1966
[signature]
State Geologist

Dist: State Board (2)
State Geologist (1)

Note: File 2 copies of this form with Secretary, Oil & Gas Board, Pierre.

S. Dak. Oil & Gas Board
FORM 4

WELL COMPLETION OR RECOMPLETION REPORT AND LOG

FARM OR LEASE NAME: Peterson

WELL NO.: 1 (44-15)

TYPE OF COMPLETION: ☐ Oil Well ☐ Gas Well ☒ Dry Hole
☐ New Well ☐ Work-Over ☐ Deepen ☐ Plug Back ☐ Same Zone ☐ Diff Zone

FIELD AND POOL, OR WILDCAT: Wildcat

OPERATOR: The Superior Oil Company

NO. ACRES IN LEASE: 2846.03

ADDRESS: P. O. Box 200, Casper, Wyoming

LOCATION (In feet from nearest lines of section or legal subdivision where possible)*
Surface: 660' FSL & 660' FEL Sec. 15.
Top prod. interval:
At total depth: 660' FSL & 660' FEL Sec. 15

¼ ¼ SEC. TWP. RGE.: C SE SE 15-7S-1E

COUNTY: Fall River

PERMIT NO.	DATE ISSUED	PREVIOUS PERMIT NO	DATE ISSUED
[illegible]	2-18-65		

DATE SPUDDED	DATE T. D. REACHED	DATE COMPL. (Ready to Prod.)	ELEVATIONS (DF, RKB, RT, GR, etc.)*	ELEV. CASINGHEAD FLGE
2-20-65	3-3-65	P & A 3-5-65	3585' KB	

TOTAL DEPTH (MD & TVD)	PLUG. BACK T. D. (MD & TVD)	IF MULTIPLE COMPL., HOW MANY*	INTERVALS DRILLED BY	ROTARY TOOLS	CABLE TOOLS
2264' MD			→	0' to 2264'	

PRODUCING INTERVAL(S), THIS COMPLETION, TOP, BOTTOM, NAME (MD & TVD)*

DATE DIRECTIONAL SURVEY SUBMITTED:

TYPE ELECTRIC AND OTHER LOGS RUN (Circle those filed): IES, Microlog, Dual Induction - LL & GRS (All filed)

WAS WELL CORED: Yes

CASING RECORD (Report all strings set in well)

CASING SIZE	DEPTH SET (MD)	HOLE SIZE	WEIGHT LBS./FT.	PURPOSE	SACKS CEMENT	AMOUNT PULLED
8-5/8"	971	12-1/4"	24#	Surface	625	None

LINER RECORD

SIZE	TOP (MD)	BOTTOM (MD)	SACKS CEMENT*	SCREEN (MD)

TUBING RECORD

SIZE	DEPTH SET (MD)	PACKER SET (MD)

PERFORATION RECORD

DEPTH INTERVAL (MD)	HOLES PER FT.	SIZE AND TYPE	PURPOSE

ACID, SHOT, FRAC., CEMENT SQUEEZE, Etc.

AMOUNT AND KIND OF MATERIAL USED	DEPTH INTERVAL (MD)

PRODUCTION

DATE FIRST PRODUCTION	PRODUCING METHOD (Flowing, gas lift, pumping—size & type of pump)	WELL STATUS (Prod. or shut in)

DATE OF TEST	HOURS TESTED	CHOKE SIZE	PRODUCTION FOR TEST	OIL, Bbls.	GAS, Mcf.	WATER, Bbls. & %	OIL GRAVITY-API (Corr.)
			→				

FLOW TUBING PRESSURE	CASING PRESSURE	CALCULATED 24-HOUR RATE	OIL, Bbls.	GAS, Mcf.	WATER, Bbls. & %	GAS-OIL RATIO
		→				

DISPOSITION OF GAS (Sold, used for fuel, vented, etc.)

TEST WITNESSED BY

LIST OF ATTACHMENTS: 1 copy all E-Logs, 1copy Core Analysis, 1copy ltr. from land owner

I hereby certify that the foregoing and attached information is complete and correct as determined from all available records

SIGNED [signature] J. P. Dujka TITLE District Engineer DATE 3-15-65

DO NOT WRITE BELOW THIS LINE
*See Instructions On Reverse Side

Approved [illegible] Date

OIL AND GAS BOARD OF THE STATE OF SOUTH DAKOTA
[signature], Secretary

Dist: State Board (3) w/1 copy all attachments.
State Geologist (1) w/2 copies all attachments.

41 of 63

INSTRUCTIONS

General: This form is designed for submitting a complete and correct well completion report and log on all types of lands and leases to either a Federal agency or a State agency, or both, pursuant to applicable Federal and/or State laws and regulations. Supplemental instructions by local Federal and/or State offices will govern the use of this form.

If not filed prior to the time this summary record is submitted, copies of all currently available logs (drillers, geologists, sample and core analysis, all types electric, etc.), formation and pressure tests, and directional surveys, should be attached hereto, to the extent required by applicable Federal and/or State laws and regulations. All attachments should be listed on this form, see last blank.

If this well was directionally drilled, show both the location at the surface and at total depth from nearest lines, where possible; also show the locations at the top and at the bottom of any zone for which production data are reported in space 33, and any zone open for injection or disposal. Use this reverse side if more space is needed. (MD-Measured Depth, TVD-True Vertical Depth)

*Indicate which elevation is used as reference (where not otherwise shown) for depth measurements given in other spaces on this form and in any attachments.

If this well is completed for separate production from more than one zone (multiple-zone completion), so state in the correct space and show the producing interval, or intervals, top(s), bottom(s) and name(s) (if any) for only the zone reported in the blanks under PRODUCTION. Submit a separate completion report on this form for each interval (zone) to be separately produced.

"Sacks Cement": Attached supplemental records for this well should show the details of any multiple stage cementing and the location of the cementing tool.

File 3 copies of this form with Secretary, Oil and Gas Board, Pierre.

SUMMARY OF WATER ZONES AND NON-COMMERCIAL OIL OR GAS ZONES

(Note: If well was directionally drilled, show both measured and true vertical depths for zones and markers listed)

KIND OF FORMATION	DEPTH TO TOP		DEPTH TO BOTTOM		CONTENTS; PRODUCTIVE RATE, IF KNOWN
	MEAS. DEPTH	TRUE VERT. DEPTH	MEAS. DEPTH	TRUE VERT. DEPTH	
Lakota Sd.	371		425		30 bbls. wtr./hr.
Sundance Sd.	771		905		25 bbls. wtr./hr.
Bsl. Sundance Sd.	966		1007		15 bbls. wtr./hr.

GEOLOGIC MARKERS

NAME	DEPTH TO TOP	
	MEAS. DEPTH	TRUE VERT. DEPTH
Dakota	185'	
Lakota	371'	
Morrison	471'	
Sundance	670'	
Sundance Sd.	771'	
Minnekahta	1518'	
Opeche	1557'	
Minnelusa	1845'	
Red Marker	2108'	

Hydro ID 4

CORRESPONDENCE

SOUTH DAKOTA GEOLOGICAL SURVEY

SCIENCE CENTER, UNIVERSITY OF SOUTH DAKOTA CAMPUS, VERMILLION, 57069, PHONE 624-4471

WESTERN FIELD OFFICE, 208 GAY BUILDING, BELLE FOURCHE, BOX 187, 57717, PHONE 892-3121

Western Field Office
October 12, 1966

OCT 13 1966

Mr. Merlin J. Tipton
Assistant State Geologist
State Geological Survey
Vermillion, South Dakota

Dear Tip:

In going through my files, I find that my records show the following oil tests have meet all requirements and can now be released from bond coverage:

Superior #1 Peterson (44-15)
Fall River County, South Dakota

Gulf #1 Dahlke
Jones County, South Dakota

Gulf #1 Sandy
Jones County, South Dakota

Gulf #1 Wolf-State
Lyman County, South Dakota.

Sincerely,

Earl Cox

Earl Cox
Senior Geologist

EC:rk

DUNCAN J. McGREGOR
DIRECTOR AND STATE GEOLOGIST
VERMILLION

MERLIN J. TIPTON
ASSISTANT STATE GEOLOGIST
VERMILLION

EARL J. COX
SENIOR GEOLOGIST
BELLE FOURCHE

SOUTH DAKOTA GEOLOGICAL SURVEY

SCIENCE CENTER, UNIVERSITY OF SOUTH DAKOTA CAMPUS, VERMILLION, 57069, PHONE 624-4471

WESTERN FIELD OFFICE, 208 GAY BUILDING, BELLE FOURCHE, BOX 187, 57717, PHONE 892-3121

SEP 30 1966

Western Field Office
September 29, 1966

Dr. Duncan McGregor
State Geologist
State Geological Survey
Vermillion, South Dakota

Re: Superior #1 Peterson (44-15)
SESE-15-7S-1E
Fall River County, South Dakota
Permit No. 382

Dear Duncan:

I have received a copy of the RELEASE, signed by Francis Peterson, and the letter showing two copies of the RELEASE has been sent you by Superior Oil Company.

My records show all required samples, logs and records have been received by your office. The RELEASE, completes all requirements and it is recommended the bond covering this location be terminated.

Sincerely,

Earl Cox

Earl Cox
Engineering-Petroleum Geologist

EC:rk

THE SUPERIOR OIL COMPANY
SUPERIOR BUILDING
P. O. BOX 200
CASPER, WYOMING 82601

SEP 28 1966

September 26, 1966

State Geological Survey
Science Center
University of South Dakota Campus
Vermillion, South Dakota

Re: Peterson No. 1 (44-15)
C SE SE Sec. 15-7S-1E
Fall River Co., South Dakota
Permit No. 382

Gentlemen:

Attached are two (2) copies of a letter agreement executed by Mr. Francis A. Peterson releasing us from all surface damages in connection with the drilling of the above referenced well.

We shall appreciate your approval of our abandonment of this location and the attendant release from bond requirement.

Very truly yours,

THE SUPERIOR OIL COMPANY

J. P. Dyjka

JPD:sm

Attached

cc w/attach.: Mr. Earl Cox
South Dakota Geological Survey
Western Field Office
Belle Fourche, South Dakota

THE SUPERIOR OIL COMPANY

SUPERIOR BUILDING
P. O. BOX 200
CASPER, WYOMING 82601

September 20, 1966

RST ______
JC ______
EJW ______
______
______
FILE ______

THE SUPERIOR OIL COMPANY
SEP 26 1966
ENGINEERING
CASPER

THE SUPERIOR OIL COMPANY
SEP 26 1966
LAND DEPARTMENT
CASPER, WYOMING

Mr. Francis A. Peterson
Edgemont, South Dakota

Re: Peterson #1 (44-15)
C SE SE 15-7S-1E
Fall River County, South Dakota
Permit #382

Dear Mr. Peterson:

Reference is made to Assignment and Agreement dated March 16, 1965 whereby we assigned to you the well in the SE SE 15-7S-1E and you assumed the responsibility for the well.

Regarding the reserve mud pit used in connection with said well, you have informed us that you wish to use it for a reservoir and will take it over, relieving us of any further clean up work or concern about surface damages of any kind arising out of the drilling of the well mentioned above.

If you agree with the foregoing, please sign in the space provided below and return one copy of this letter to us in the enclosed self-addressed envelope.

Very truly yours,

THE SUPERIOR OIL COMPANY

R S Troost

R. S. Troost
District Landman

RST/b
enc.

ACCEPTED AND AGREED TO
THIS 23 DAY OF Sept., 1966.

Francis A. Peterson
FRANCIS A. PETERSON

SEP 13 1966

SOUTH DAKOTA GEOLOGICAL SURVEY

SCIENCE CENTER, UNIVERSITY OF SOUTH DAKOTA CAMPUS, VERMILLION, 57069, PHONE 624-4471

WESTERN FIELD OFFICE, 208 GAY BUILDING, BELLE FOURCHE, BOX 187, 57717, PHONE 892-3121

Western Field Office
September 12, 1966

Mr. Robert Schoon
Geologist
State Geological Survey
Vermillion, South Dakota

Dear Bob:

Would you check the file on the Superior #1 Peterson, in Fall River County, and see if Superior has sent us a copy of the RELEASE, signed by the land owner.

Sincerely,

Earl Cox

Earl Cox
Engineering-Petroleum Geologist

EC:rk

PS. Also have you rec'd samples from the Texaco #1-X Martinson, Fall River County

E Cox

205

DUNCAN J. McGREGOR
DIRECTOR AND STATE GEOLOGIST
VERMILLION

MERLIN J. TIPTON
ASSISTANT STATE GEOLOGIST
VERMILLION

EARL J. COX
SENIOR GEOLOGIST
BELLE FOURCHE

NOV 1 1965

Western Field Office
October 29, 1965

Mr. J. P. Dujka
Superior Oil Company
P. O. Box 200
Casper, Wyoming

Re: Superior #1 Peterson (44-15)
SESE-15-7S-1E
Fall River County, So. Dakota
Permit No. 382

Dear Mr. Dujka:

Thank you for your October 27 letter. A release from Mr. Peterson will meet all requirements covering cleaning up of the above location. If a copy of the release is sent to me, it will expedite bond termination.

Sincerely,

Earl Cox

Earl Cox
Engineering-Petroleum Geologist

EC:sm

Western Field Office
October 7, 1965

Mr. J. P. Dujka
Superior Oil Company
P. O. Box 200
Casper, Wyoming

Re: Superior #1 Peterson (44-15)
SESE-15-7S-1E
Fall River County, So. Dakota
Permit No. 382

Dear Mr. Dujka:

I visited the above location September 2 and found that the wellhead valve was open and water was running into the mud pit.

As you plan to fill the pit after it dries up, you may wish to contact the landowner and have him either close the valve or divert the water so it will not enter the pit.

Sincerely,

Earl Cox

Earl Cox
Engineering-Petroleum Geologist

EC:an

July 13, 1965

Mr. Earl Cox
State Geological Survey
P. O. Box 187
Belle Fourche, South Dakota 57717

Dear Earl:

I am enclosing the electric log and dual induction laterolog on the Superior Peterson #1 (44-15) well in Fall River County, and carbon copies of the scout reports that Bob Schoon turned in last week.

Sincerely yours,

Janet J. McDonough
Senior Stenographer

Enclosures

MAY 13 1965

SOUTH DAKOTA

State Water Resources Commission

STATE OFFICE BUILDING

PIERRE, SOUTH DAKOTA

May 12, 1965

Mr. Francis A. Peterson
Edgemont, South Dakota 57735

Re: Superior #1 Peterson (44-15)
SE¼ SE¼ 15-7S-1E
Fall River County, S.D.
Permit No. 38[illegible]

Dear Mr. Peterson:

In as much as the requirements for converting your oil test well to a water well have been done, as specified by the State Geological Survey, the Water Resources Commission hereby assumes jurisdiction of the well as a water well.

Sincerely,

J.W. JAMES

JWC/BM/bw
cc: Dr. Duncan McGregor, State Geologist, Vermillion, S.D.
Mr. Earl Cox, Belle Fourche, S.D.
Oil and Gas Board, Pierre, S.D.

MAY 11 1965

Western Field Office
Belle Fourche, South Dakota
May 10, 1965

Mr. Joe Grimes
Water Resources Commission
State Office Building
Pierre, South Dakota

Re: Superior #1 Peterson (44-15)
SE SE-15-7S-1E
Fall River County, South Dakota
Permit No. 382

Dear Mr. Grimes:

The above oil test is on land owned by Francis A. Peterson. He made arrangements to convert the test to a water well. The well has 971 feet of 8 5/8 inch surface casing, cemented with 575 sacks of cement. The base of the casing is just above the lowest Sundance sand. Immediately below the sand is a cement plug. Additional plugs were placed so as to isolate the Minnelusa sands in the hole. A three inch control valve is in place on the wellhead and when last visited, the well was flowing about 10 gpm of fresh water.

Enclosed is a letter from Mr. Peterson asking that conversion of the oil test to a water well be approved. Peterson agrees to assume full liability for any subsequent plugging that might be required.

If the Water Resources Commission will accept jurisdiction of this test as a water well, please so inform the Oil and Gas Board with a copy of your letter to the State Geologist.

Sincerely,

Earl Cox

Earl Cox
Engineering-Petroleum Geologist

EC:sn

cc: Secretary, Oil and Gas Board w/enc.
State Geologist w/enc.

P.S. to Duncan: Even though the Water Resources Commission accepts jurisdiction the pits have not been filled at this location and it is suggested that we not approve the bond release until they have been filled. Earl

THE SUPERIOR OIL COMPANY

SUPERIOR BUILDING
P. O. BOX 200
CASPER, WYOMING 82602

May 7, 1965

State Geological Survey
Science Center
University of South Dakota Campus
Vermillion, South Dakota

Re: Peterson #1 (44-15)
C SE SE 15-7S-1E
Fall River County
South Dakota
Permit #382

Gentlemen:

Attached are two copies each of the core and sample description on the above test.

Today we received a copy of the transmittal letter from American Stratigraphic Company showing they have sent you the samples for this well. As stated on the plugging record, the mud pits have been fenced and will be filled and leveled when they dry up.

If you need any further information or reports, please let us know.

Yours very truly,

THE SUPERIOR OIL COMPANY

J. P. Dujka

RLH/jr

cc: Mr. Earl Cox
South Dakota State Geological Survey
Western Field Office
Belle Fourche, South Dakota

MAY 7 1965

AMERICAN STRATIGRAPHIC COMPANY

17 NORTH 31st ST. • BILLINGS, MONTANA • ALPINE 9-7647

May 4, 1965

State of South Dakota Geological Survey
Science Center
Vermillion, South Dakota

Attention: Dr. Duncan McGregor
State Geologist

Gentlemen:

We are shipping you today via motor freight samples on the following well:

Superior, #1 Peterson
15-7S-1E
Fall River County, South Dakota.

Very truly yours,

AMERICAN STRATIGRAPHIC COMPANY

Fred McCotter

Fred McCotter be
Manager

FMc/be
cc: Mr. Jerry Davis, Superior Oil Company, Box 200, Casper, Wyoming.

SOUTH DAKOTA
STATE GEOLOGICAL SURVEY
SCIENCE CENTER
University of South Dakota Campus
VERMILLION 57069
Phone 624-4471

DUNCAN J. McGREGOR
Director and State Geologist

MERLIN J. TIPTON
Assistant State Geologist

Western Field Office
Belle Fourche, South Dakota
April 15, 1965

Mr. J. P. Dujka
Superior Oil Company
P.O. Box 200
Casper, Wyoming

Re: Superior #1 Petersen (44-15)
SE¼SE¼-15-7S-1E
Fall River County, So. Dakota
Permit No. 382

Dear Mr. Dujka:

In checking our files, at Vermillion, I find we still need two copies each of the core and sample description on the above test. These records should be sent in within thirty days of completion of the test.

Before the bond can be released, the rig must be removed from the location, the samples sent in and the mud pits either filled or a release obtained from Mr. Peterson.

This letter is merely to inform you of the status of our files and to outline our requirements. It is hoped Superior will see fit to do additional work in South Dakota and be assured of our future cooperation.

Sincerely,

Earl Cox

Earl Cox
Engineering-Petroleum Geologist

EC:sn

Edgemont, South Dakota
March 10, 1965

Mr. Joe Grimes
Water Resource Commission
Pierre, South Dakota

Re: Superior #1 Peterson(44-15)
SE¼SE¼-15-7S-1E
Fall River County, So. Dakota
Permit No. 382

Dear Mr. Grimes:

I wish to convert the above oil test, on my land, to a water well. The water to be used will come from the sand zone immediately below the surface casing. A cement plug is in place, immediately below the water zone. The lower portion of the hole has been plugged according to specifications of the State Geological Survey.

Should conversion of the oil test to a water well be approved, I agree to assume full liability for any subsequent plugging that might be required.

Sincerely,

Francis A. Peterson

Francis A. Peterson

MAR 10 1965

SOUTH DAKOTA
STATE GEOLOGICAL SURVEY
SCIENCE CENTER
University of South Dakota Campus
VERMILLION 57069
Phone 624-4471

DUNCAN J. McGREGOR
Director and State Geologist

MERLIN J. TIPTON
Assistant State Geologist

Western Field Office
Belle Fourche, South Dakota
March 9, 1965

Mr. Francis A. Peterson

Edgemont, South Dakota

Re: Superior #1 Peterson(44-15)
SE¼SE¼-15-7S-1E
Fall River County, So. Dakota
Permit No. 382

Dear Mr. Peterson:

Enclosed is a letter and three copies made out to Mr. Grimes, of the Water Resource Commission, stating you wish to convert the above oil test to a water well. Please sign the original and all copies, and return to me in the stamped, addressed envelope.

As soon as you get the valve in place, at the wellhead, please let me know so it can be inspected. An envelope is enclosed for your use.

Sincerely,

Earl Cox

Earl Cox
Engineering-Petroleum Geologist

EC:sn

Edgemont, South Dakota
March 4, 1965

Dr. Duncan McGregor
State Geologist
State Geological Survey
Vermillion, South Dakota

Re: Superior #1 Peterson (44-15)
SE¼SE¼-15-7S-1E
Fall River County, So. Dak.
Permit No. 382

Dear Sir:

The above oil test on my land is to be plugged and abandoned. It is requested that the test be plugged in a manner so that I can easily go back into it at a future date and perforate the casing and tap the artesian water flow that is behind the casing.

To be specific, it is requested that approval be granted to weld or screw a cap on the top of the surface casing in place of the abandonment marker. It is also requested that the ten sack surface plug not be placed.

Should the test be plugged in the above manner, I agree to assume full liability for any subsequent plugging that might be required.

Sincerely,

F. A. Peterson
Francis A. Peterson

Hydro ID 4

FEB 24 1965

SOUTH DAKOTA

State Water Resources Commission

STATE OFFICE BUILDING

PIERRE, SOUTH DAKOTA

February 23, 1965

Mr. F. A. Peterson
Edgemont, South Dakota

Dear Mr. Peterson:

I have been advised that the Superior Oil Company has obtained a Permit to Drill for Oil and Gas on your land in Section 13, T 7 S, R 1 E.

Occasionally, owners of land consider converting abandoned oil wells into water wells. Please advise me whether or not you intend to convert the oil well drill hole on your land into a water well if water is encountered and the drill hole is abandoned as an oil well.

If you are considering making a water well out of the abandoned oil well drill hole, special considerations are necessary to comply with the State's oil and water laws. The abandoned oil hole must be properly plugged and the water well properly constructed. All conversion work will be at your expense. The cost will vary, depending upon the characteristics of the drill hole, but such cost will be in the neighborhood of $5,000 or more. Usually another driller and drill rig will have to be arranged for. This other drill rig and casing and other materials will have to be on hand to take over immediately after the special oil well plugging is completed, because the drill hole cannot be left open for any appreciable length of time without spoiling it. Approval of plans for construction of the water well will be required, and a bond covering proper constructin may be required. Also, a water right may be required. All of these arrangements take considerable time to accomplish.

Please advise me immediately if you plan to convert the oil well drill hole into a water well. We both hope that a producing oil well results from the drill hole on your land; however, if not and you are planning on a water well, we must start making arrangements now.

Sincerely,

J.W. GRIMES
Chief Engineer

JWG/bm
cc Oil & Gas Board, State Capitol, Pierre, S.D.
Dr. Duncan McGregor, State Geologist, University of S.D.
Vermillion, South Dakota

SURETY

NO SURETY INFORMATION FOR THIS WELL AS OF 5/18/2011

MISCELLANEOUS

2205 / 2264 Superior Oil Co. #1 Peterson
15-7 S-1 E, Fall River Co.

0 / 2205 " "

5/10/65

THE SUPERIOR OIL COMPANY
SUPERIOR BUILDING
P. O. BOX 200
CASPER, WYOMING 82602

Department of Environment
& Natural Resources
...Today

Oil and Gas Search for: *api_no_ like '40 047 20065'*		
Page 1 of 1	Export Options (temporarily unavailable)	**Page:** 1

Record 1 of 1

Well Information

API No:	40 047 20065	**County:**	FALL RIVER
Well Name:	PRC 21-14 PETERSON	**Location:**	NENW 14-7S-1E
Permit No:	741	**Total Depth:**	2266
Operator Name:	POWER RESOURCES CORPORATION	**Bottom Hole:**	Minnelusa
Permit Date:	12-03-1975	**KB Elevation:**	3647
Spud Date:	12-11-1975	**Ground Elevation:**	3639
Plug Date:	12-26-1975	**Latitude:**	43.447765
		Longitude:	-103.968121
Well Field	WILDCAT	**Status**	P&A
Class:	DRY HOLE	**Type:**	DRY HOLE

Formation Tops

Formation	Depth (ft.)
Morrison	322
Spearfish	890
Goose Egg	1178
Minnekahta	1425
Opeche	1465
Minnelusa	1569
Red Marker	1984
2nd Leo	2100

Page 1 of 1 (goto top)	**Page:** 1

COUNTY:	**FALL RIVER**
LEGAL LOCATION:	**NENW 14-7N-1E**
API NO:	**40 047 20065**
PERMIT NO:	**741**
WELL NAME:	**PRC #21-14 PETERSON**
OPERATOR:	**POWER RESOURCES CORPORATION**
PERMIT ISSUED:	**12/03/1975**
PERMIT CLOSED:	**01/23/1976**
FILE LOCATION:	**7N-1E-14 NENW**

TARGET CODES:

WELL HISTORY / CHECKLIST

PERMIT TO DRILL / INTENT TO DRILL

WELL INSPECTION / SCOUT REPORTS

OPERATOR'S TECHNICAL REPORTS / MAPS

ADMINISTRATIVE / SUNDRY REPORTS

CORRESPONDENCE

SURETY

MISCELLANEOUS

WELL HISTORY / CHECKLIST

BOND RELEASE CHECKLIST

Well Name & Location PRC #21-14 Peterson NENW 14-7S-1E, Fall River County	Permit # 741 API #40 047 20065
Bond # 4288541 Date Issued Dec. 3, 1975	Date released Aug. 25, 1976

Surface Restoration

✓ Pits filled

✓ Site level

// — Site policed

— Dry-hole marker solid, sealed, correctly inscribed

— No dry-hole marker desired, letter in WFO files from surface owner

// (Converted to water well, owner's responsibility) FK

Paperwork Filed

— Form 4 (Completion or Recompletion Report)

— Form 6 (Sundry Notices and Report on Wells)

✓ Form 7 (plugging Report)

Geological Information Filed

✓ Well Logs: IES, SNP, DIL, GR, NEUT, CALIP, Cement Bond, Temp, Micro, Laterlog, SM Dens. BCSL

— DST charts and reports

✓ Geologist's Report

— Results of coring and core analyses

✓ Set of 10-foot sample cuttings (check with Bob Schoon) have been received at Vermillion 1-15-76 Jus

DATE 8-25-76 CHECKED BY Jus

2

PERMIT CHECKLIST

Well Name and Location:	
PRC #21-14 Peterson NENW 14-7S-1E, Fall River	Permit # 741 API #40 047 20065 Bond # 4288541

Paperwork Filed with WFO

- ✓ Organization Report
- ✓ Application
- ✓ Bond
- ✓ Permit fee

The Following Papers sent to Operator:

- ✓ Permit (Form 2a)
- ✓ Receipt for $100 permit fee
- ✓ Cover letter explaining material sent

Permit Fee Filed:

- ✓ Permit fee w/Cash Receipts Transmittal Form sent to State Treasurer

Notification of New Permit sent to:

- ✓ Dr. Duncan J. McGregor
- ✓ Mr. Vern W. Butler
- ✓ Dr. Allyn Lockner
- ✓ Mr. George Kane

DATE Dec. 3, 1975 CHECKED BY Jean Miller

PERMIT TO DRILL / INTENT TO DRILL

3

State Pub. Co., Pierre

APPLICATION FOR PERMIT TO:

S. Dak. Oil & Gas Board
FORM 2

☒ DRILL ☐ DEEPEN ☐ PLUG BACK

☐ SINGLE ZONE

☒ OIL WELL ☐ GAS WELL ☐ MULTIPLE ZONE

FARM OR LEASE NAME: M. Lenore Peterson

WELL NO: ~~12-14~~ # 21-14

FIELD AND POOL, OR WILDCAT: Wildcat

NO. ACRES IN LEASE: 971.32

¼ ¼ SEC. TWP. RGE: NENW 14-7S-1E

COUNTY: Fall River

OPERATOR: Power Resources Corporation

ADDRESS: 1660 S. Albion St. Suite 827 Denver, Colorado 80222

LOCATION (In feet from an established corner of the legal subdivision.*):
660 ft. North
1983 ft West
Section 14-7S.-1E

NAME AND ADDRESS OF SURFACE OWNER: M. Lenore Peterson, Star Route, Edgemont, So. Dakota 57735

ELEVATION: 3639 GR

PROPOSED DEPTH: 2500

NO. OF WELLS, ETC.: None

ROTARY OR CABLE TOOLS: Rotary

NAME AND ADDRESS OF CONTRACTOR: Farnsworth and Kaiser, P.O. Box 940, Newcastle, Wyoming

APPROXIMATE DATE WORK WILL START: December 3, 1975

IF LEASE PURCHASED WITH ANY WELLS DRILLED, FROM WHOM PURCHASED (Name and address): — NO —

PROPOSED CASING AND CEMENTING PROGRAM

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	NEW OR SECOND HAND	DEPTH	SACKS OF CEMENT
12¼"	8⅝"	28	Second hand	150	150

DESCRIBE PROPOSED OPERATIONS. IF PROPOSAL IS TO DEEPEN OR PLUG BACK, GIVE DATA ON PRESENT PRODUCTIVE ZONE AND PROPOSED NEW PRODUCTIVE ZONE. GIVE BLOW OUT PREVENTER PROGRAM IF ANY.

Drill a 7 7/8" hole from bottom of surface casing to estimated total depth of 2500. Will test ~~[illegible]~~ the Leo zones of Minnelusa formation. Drill stem test any zones with shows of oil & gas. If commercial production indicated will set 5½" casing 100 feet below prospective pay zone, perforate, and complete.

SIGNED: Richard A. Benham TITLE: Vice President-Land DATE: Nov. 28 1975

DO NOT WRITE BELOW THIS LINE

PERMIT NO.: 741

CHECKED BY: Fred V. Steece, Supervisor

APPROVAL DATE: December 3, 1975

School and Public Lands Date

CONDITIONS:
COMPLETE SET OF SAMPLES, AND CORES IF TAKEN, MUST BE SUBMITTED.
SAMPLES, AND CORES IF TAKEN, BELOW ... DEPTH, MUST BE SUBMITTED.

SOUTH DAKOTA
STATE GEOLOGICAL SURVEY
WESTERN FIELD OFFICE

DEC 1975
RECEIVED
WELL FIELD OFFICE

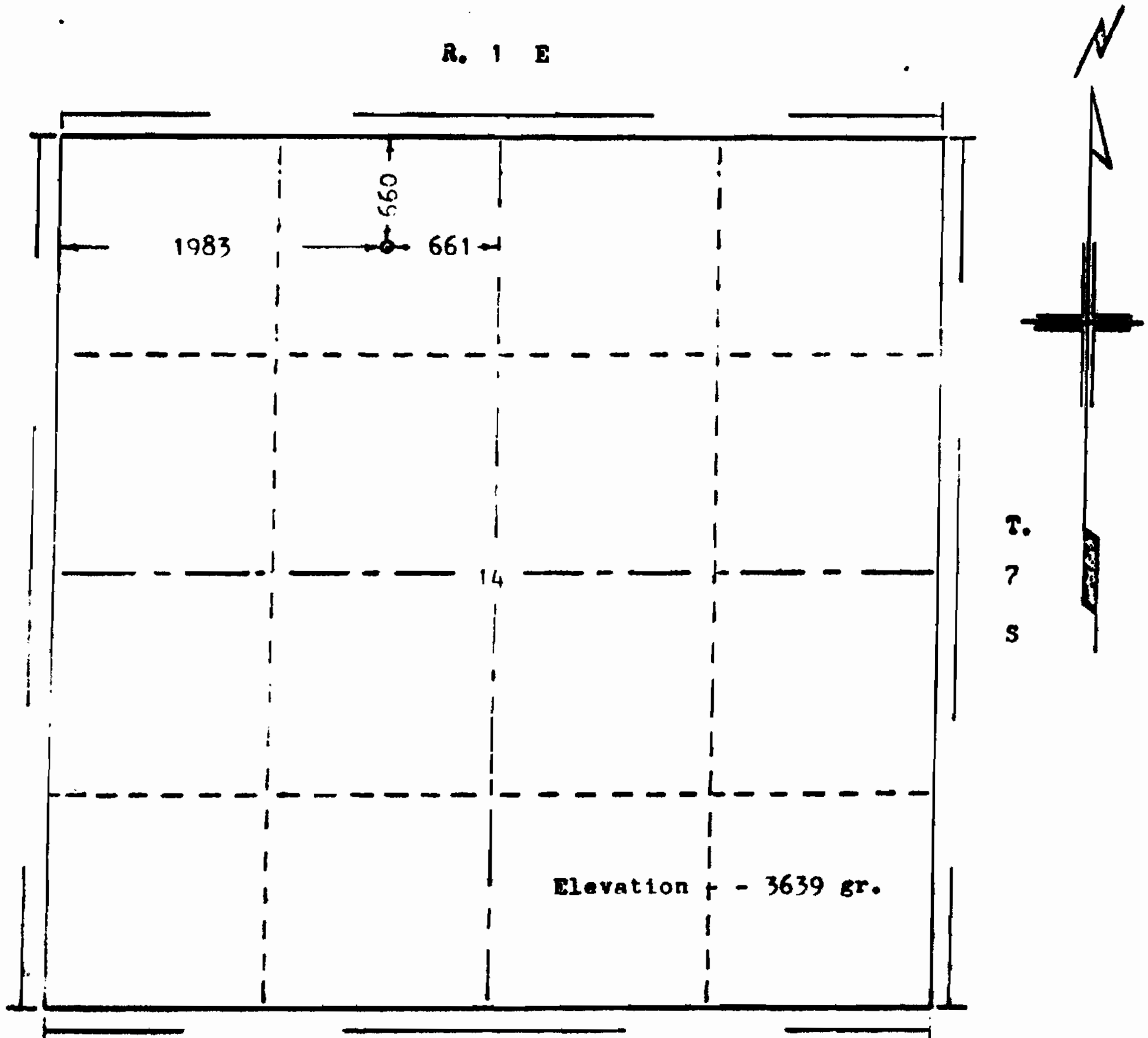
INSTRUCTIONS

General: This form is designed for submitting proposals to perform certain well operations, as indicated, on all types of lands and leases for appropriate action by either a Federal or a State agency, or both, pursuant to applicable Federal and/or State laws and regulations. Consult applicable Federal or State regulations, or appropriate officials, concerning approval of the proposal before operations are started.

If the proposal is to redrill to the same reservoir at a different subsurface location or to a new reservoir, use this form with appropriate notations.

If the well is to be, or has been, directionally drilled, so state and show by attached sheets, if necessary, the coordinate location of the hole in any present or objective productive zones.

(*Sample location: 660' South and 660' East of the Northwest Corner of Section 16.)



Scale: 1" = 1000'

#21-14 Jus

Thomas E. Nelson, of Casper, Wyoming
has in accordance with a request from Mr. Bassham
for Power Resources Corporation
determined the location of ~~#12-14~~ M. Lenore Peterson
to be C NE NW Section 14, Township 7 South
Range 1 East of the Black Hills Meridian
Fall River County, South Dakota

DEC 1975
FIELD
OFFICE

I hereby certify that this plat is an
accurate representation of a correct
survey showing the location of
~~#12-14~~ M. Lenore Peterson
#21-14 Jus

Date: 11-29-75

T. Nelson
Licensed Land Surveyor No. 1200
State of South Dakota

S. Dak. Oil & Gas Board
FORM 1

ORGANIZATION REPORT

Full Name of the Company, Organization, or Individual: Power Resources Corporation

Post Office Address (Box or Street Address): 1660 S. Albion St. Suite 827, Denver Colo. 80222

Plan of Organization (State whether organization is a corporation, joint stock association, firm or partnership, or individual): Corporation

If a reorganization, give name and address of previous organization: NONE

(1) If foreign corporation, give State where incorporated	(2) Name and postoffice address of State agent	(3) Date of permit to do business in state
WYOMING	C T Corporation System 319 S. Coteau St. Pierre, So. Dakota 57501	December 1995

Principal Officers or Partners (if partnership) NAME	TITLE	POSTOFFICE ADDRESS
Robert V. Bailey	President	1660 S. Albion Suite 827 Denver Colo 80222
Milton O. Childers	Executive Vice President	" " "
Richard A. Bassham	Vice President Land	" " "
John F. Trotter	Secretary - Treasurer	307 Conroy Bld Casper, Wy 82601

DIRECTORS NAME	POSTOFFICE ADDRESS
Robert V. Bailey	1660 S. Albion Suite 827 Denver Colo 80222
Milton O. Childers	" " " " " "
Richard A. Bassham	" " " " " "
John F. Trotter	307 Conroy Bldg Casper, Wy 82601
Clovis E. Rodelander	152 N. Durbin " "

Executed this the 28 day of November, 1975

Richard A Bassham
Signature of Affiant

State of WYOMING
County of NATRONA

Before me, the undersigned authority, on this day personally appeared Richard A. Bassham known to me to be the person whose name is subscribed to the above instrument, who being by me duly sworn on oath states, that he is duly authorized to make the above report and that he has knowledge of the facts stated herein, and that said report is true and correct.

Subscribed and sworn to before me this day of November 1975

Richard A. Bassham Jr.
Notary Public in and for NATRONA County, Wyoming

SEAL

Richard A. Bassham Jr. — Notary Public. County of Natrona, State of Wyoming. My Commission Expires June 20, 1978

DO NOT WRITE BELOW THIS LINE

Approved 12-3-75
Date

Oil and Gas Board of the State of South Dakota
Fred V Steece
Supervisor / WFO
Secretary

DEC 1975 RECEIVED WESTERN FIELD OFFICE

WELL INSPECTION / SCOUT REPORTS

4

SOUTH DAKOTA GEOLOGICAL SURVEY
Western Field Office

SCOUT REPORT

Number 2

Date Scouted 7-27-76

Operator Power Resources Corporation

Permit Number 741

Farm/Lease Name #21-14 Peterson

API Number 40 047 20065

NENW Sec. 14 T. 7S R. 1E County Fall River

Elev. 3639 Est. T.D. - Actual T.D. 2284 Spudded 12-11-75

Contractor Farnsworth & Kaiser Geologist Al Nelson

SCOUT'S OBSERVATION:

Open pipe at surface with mud all around it remains at site. Bags of cement and other refuse strewn about. No indication of completion as water well.

DST RECORD:

FORMATION TOPS:

PLUGGING RECORD:

DATE PLUGGED/COMPLETED

CASING RECORD:

From To

From To

SITE INSPECTION:

Approved X

Not Approved

REMARKS: No open mud pits. Water well piping is probably subsurface. Mess probably belongs to the rancher.

SCOUTED BY James E. Ellithorpe Fred V Steece

James E. Ellithorpe, Field Assistant   Fred V. Steece, Supervisor

Hydro ID 5

1/ PRC #21-14 Peterson 12-26-75

NENW 14-7S-1E Fall River

660 FNL & 1983 FWL

PERMIT: 741 (12-3-75)

API: 40 047 20065

ELEV: 3639 Gr.

CONTR: Farnsworth & Newcastle Kaiser

GEOL: Al Nelson

ENGR:

SPUD: 12-11-75

EST T.D.: 2500 (Leo)

CASING: 8 5/8 - 160 (@ 152)

CORES: None

DST'S: None

LOGS: BCSL, DIL

T.D.: 2269 (Drl) 2267 (Log)

PLUG: 12-26-75

Al Nelson called for plugging approval. We worked out following plug program

40 sax: 2020-1900 Red marker

40 sax: 1600-1500 Top Conv

30 sax: 950-850 Basal Sundance

no surface plug as well will be completed as a water well.

Formation Tops (Nelson)

Fuson	178
Morrison	339
Sundance	571
Basal Sd	862

1/ Power Resources Corp, Denver
John Trotter & George Wolff, principals

Spearfish	877
Goose Egg	1180
Minnekahta	1428
Minnelusa	1571
# 1st Conv	1571
Anhydrite	1648
2nd Conv	1696
# Red Marker	1988
2d Leo	2099
TD	2269

7-27-76

Visited site to see if converted to water well. Impossible to tell, site is a mess.

OPERATOR'S TECHNICAL REPORTS / MAPS

Hydro ID 5

G. ALLAN NELSON
CONSULTING PETROLEUM GEOLOGIST
ROOM 408, MAJESTIC BUILDING
(303) 623-7760 RES. 322-0325
DENVER, COLORADO 80202

GEOLOGICAL WELL REPORT

POWER RESOURCES CORPORATION

#21-14 LENORE PETERSON

NE NW SEC. 14, T.7S., R.1E.,

FALL RIVER COUNTY, SOUTH DAKOTA

Wildcat

WELL DATA

Location: 1983' from the West line and 660' from the North line, C NE NW Sec. 14, Township 7 South, Range 1 East, Fall River County, South Dakota.

Elevation: 3639 ground.
3647 K.B.

Type Well: Wildcat.

Spud Date: 10:00 P.M., December 11, 1975.

Completion Date: 9:00 P.M., December 26, 1975.

Casing Record: Ran 8 5/8" surface casing. Sot at 152 ground. Cemented with 125 sacks of regular cement with 3% Calcium chloride. Pipe set at 152 ground. 24# casing.

Total Depth: 2269 Driller.
2267 Schlumberger.

Deepest Formation Penetrated: Lower Leo Section.

Depth Datum: 3647 K.B.

Well Status: Plugged and abandoned(left as water well for landowner).

Mud Program: Drilled out from under surface with water. Continued drilling with native mud down to 1070 in Spearfish red beds. Converted to a red bed between between 1070 and 1283 in the Goose Egg formation after setting stuck at 1283. Added 1 sack of soda ash, 5 Rayvan, 4 caustic soda, 1 can suf-drill, and 25 sacks of gel. Above 1283 a water-flow was continually thinning mud, particularly when mud pump was shut down on trips for bit.
Between 1625 in the Converse Massive Anhydrite and 1729 in middle Converse tourly treatment was Gel, 1 sack caustic soda, 1 soda ash, 1 Rayvan, and mud weight was 9.4-9.6 and vis. was 36 to 37.
At 2045 to 2078 in upper Leo wt. was 9.7 and vis. was 46, with tourly treatments of 1 sack of soda ash, 1 Rayvan, 1 caustic soda, and 4 CMC to get water loss down to 5 cc. or less before Second Leo was reached at approximately 2100.
At 2105 in Second Leo Sand main objective wt. was 10.0, vis. 36, and water loss 6.0 . Water flow from up the hole continued to create problems in maintain-good quality mud.
Logs were run without any hole trouble. Wt. was 10.3, vis. 85, and water loss 7.2.
Mud furnished by Pro-Mud, Casper; Phil Hogan, engineer.

WELL DATA (Con.)

Hole Size: 12¼" from surface to 168.
7 7/8" from 168 to 2269 T.D. Driller.

Cores: (None).

Drill-Stem Tests: (None).

Logs: Schlumberger Borehole Compensated Sonic Log was run from T.D. up to base of surface casing on a 5" scale 40-70-100, and on a 5" scale 40-90-140 from T.D. up to 1400 above Minnekahta. Gamma Ray Log and Caliper Log were also run with Sonic Log. Two repeats were run from T.D. up to 1980 first and then from T.D. up to 1400 on a 40-90-140 scale.
Dual Induction Laterolog was run second and did not work. 8 hours were spent waiting for a second tool to arrive. A 2" scale was run from T.D. to base of surface pipe, and a 5" scale over same interval was also run, with a repeat from T.D. up to 1900.
Engineer: Don Marquez, Gillette.

Plugging Record: 40 sacks from 2020 to 1900 across the Red Marker.
30 sacks from 1600 to 1500 across top of the First Converse Sand.
30 sacks from 950 to 850 acorss Basal Sand of the Sundance.
Cementing by Halco, Gillette
(No plug in surface pipe since left as water well).

Contractor and Rig Equipment: Farnsworth & Kaiser, Newcastle, Wyoming.
U-34 rig.
3½" IF drill pipe.
5¾" drill collars totaling 341'.
Mud pump GD FXQ with 6" liners and 16" stroke.
Radios on rig and at Newcastle base plus in pusher's pickup.
Mud pump trailer-mounted.
Rig trailer-mounted.
Buzz Farnsworth, pusher-owner.

Sample Storage: One cut of samples were sent to American Stratigraphic in Casper.
One cut of samples were sent to the South Dakota Geologic Survey in Vermillion.

Drilling Time Records: Original copy of Star Recording 1' drilling time charts is on file in Denver office of G.A. Nelson.

LOG FORMATION TOPS

All depths are measured from 3647 K.B.

FORMATION	DEPTH	DATUM
LOWER CRETACEOUS	(In first samples at 184 K.B.)	
TENTATIVE FUSON SHALE (LAKOTA TOP INDETERMINATE)	178	
UPPER JURASSIC	339	
MORRISON FORMATION	339	
SUNDANCE FORMATION	571	
REDWATER SHALE MEMBER	571	
LAK MEMBER	690	
TENTATIVE HULETT SAND	795	
STOCKADE BEAVER SHALE	817	
BASAL SAND OF SUNDANCE	862	
TRIASSIC	877	
SPEARFISH FORMATION	877	
PERMIAN	1180	
GOOSE EGG FORMATION	1180	
FORELLE LIME MEMBER	1320	
GLENDO SHALE MEMBER	1338	
MINNEKAHTA LIME MEMBER	1428	
OPECHE SHALE MEMBER	1471	
MINNELUSA FORMATION	1571	-2076
UPPER MINNELUSA (PERMIAN)	1571	-2076
FIRST CONVERSE SAND	1571	-2076
BASE OF SAND	1648	
MASSIVE ANHYDRITE	1648	
BASE OF ANHYDRITE	1696	
SECOND CONVERSE SAND	1696	
BASE OF SECOND CONVERSE SAND	1722	
RED MARKER	1988	-1659
BASE OF RED MARKER	1992	

LOG FORMATION TOPS

FORMATION	DEPTH	DATUM
PENNSYLVANIAN	1992	-1663
MIDDLE MINNELUSA (LEO SECTION)	1992	-1663
SECOND LEO SAND	2099	-1548
BASE OF SAND	2130	
TOTAL DEPTH DRILLER (STRAP)	2269	
TOTAL DEPTH SCHLUMBERGER	2267	

SAMPLE LITHOLOGIC DESCRIPTION

All depths are from 3647 K.B.

All sample depths following have been corrected for lag, and then matched to drilling time breaks wherever possible. **Sample li ology is then matched to log lithology so that all lithology following matches log.

All shows are underlined with a solid line. Possible shows are underlined with a dashed line.

DEPTH	LITHOLOGY
LOWER CRETACEOUS	(In first samples caught below surface pipe at 184 K.B.)
TENTATIVE FUSON	178 (LAKOTA TOP INDETERMINATE) (In first samples caught below surface pipe at 184 K.B.)

(Samples following are caught at 10' intervals)

184-86	Abundant variegated clay, red, maroon, dark gray, purple, light green; limited sand, white, no show, no porosity, very well-cemented, very fine to fine, limy, poorly sorted, slightly soft, abundant white clay-fill.
186-97	Same variegated clay; very shaly sand, very silty, very fine, abundant clay cementation, part very fine to fine with poor sorting, no porosity, very soft.
197-204	Same red, maroon, purple waxy clay, also light green, noticeable brownish gray; purple very sandy clay; limited very shaly sand as above.
204-10	(Very fast drilling) Traces pale green sand with abundant waxy clay cementation, very fine, silty, very soft, no show, also white.
210-30	Same as above (fast drilling).
230-34	(Very slow drilling like hard formation) Trace tannish brown very shaly sand, hard, tight, very fine, excellent sorting, no porosity, noncalcareous.
234-41	(Fast drilling) Waxy clay, red, maroon, violet, tan, pale green.
241-52	Same clay, also distinctive very dark chocolate brown; loose sand grains, poorly sorted very fine to fine to medium, subround.
252-59	Same red, violet waxy clay, some dark gray; same loose sand grains, clear, poorly sorted.
259-70	Same clay; traces green shaly sand, very fine to fine, very soft, silty, trace angular med grained orange quartz grain. Same clay; abundant light red very shaly sand, waxy cly cementation, very fine, verynsoft; first trace chert, whitish, light gray, very coarse and coarser, subangular.
270-88	(Top 12' very, very fast drilling like high porosity) Purplish maroon waxy shale, clay, light to dark gray; abundant very shaly sand, light red, very silty, clay cementation, very fine, soft.

SAMPLE LITHOLOGIC DESCRIPTION(Con.)

288-99 (Top 6' very fast drilling) Same as above.
299-311 (Basal 4' hard drilling) Shaly sand, dark green, very hard and tight, very well-cemented, no porosity, ver fine, well-sorted.
311-18 Abundant clay-filled sand, light red, very fine, silty, mushy soft; shale breaks, waxy clay, light green, red.
318-39 Same; green sand, shaly, very fine to fine, tight, no porosity.
339 MORRISON
339-50 Abundant dark gray silty shale, shale, slightly waxy in part.
350-61 Same blackish shale, clay; loose calcite like from veinlet, white, gray, dark gray, in abundance.
361-66 Same shale.
366-78 Same shale, also dark green waxy, few streaks quartzitic sand, shaly, dark green, hard, very well-cemented, very fine, soft in part.
378-92 Increasing greenish dark gray shale, clay, also very dark gray.
Clay, slightly waxy, very dark gray to greenish dark gray, soft.
392-? Same waxy clay, grayish green to greenish dark gray, traces red.
?-414 Same, also very dark gray clay; intermingled with sandy lime stringer(s), white to gray(Very slow drilling in basal part like lime).
414-19 Same clay, very dark gray to greenish dark gray.
419-28 (Fast drilling) Waxy clay, dark gray, greenish gray, soft, grayish green.
428-34 Waxy clay, mostly grayish green, very soft.
434-44 (Very fast drilling) Same.
444-59 Same, also dark gray.
459-69 Waxy clay, dark gray to greenish dark gray.
469-79 Same, with trace white kaolinitic sand, very soft, very fine, no show, excellent sorting.

571 SUNDANCE FORMATION

571 REDWATER SHALE MEMBER
699 LAK MEMBER

699 699-710 Waxy clay, grayish green to greenish gray, dark gray, platy, very soft; sand streaks, greenish light gray, very silty, very, very fine, very soft, poor porosity, scattered fine glauconite.
710-16 Same clay and sand; also light tan sand, very fine, silty, soft, no show, porous, excellent sorting.
716-30 Same gray to green waxy clay, very soft; limited sand, light tan, very fine and finer, soft, porous, excellent sorting, no show.
730-37 Very waxy clay, dark gray, greenish gray, grayish green, very soft; same soft tan sand, very fine, silty, no show; limited orange sand, very fine, well-sorted, shaly, soft, no show.

SAMPLE LITHOLOGIC DESCRIPTION (Con.)

795 TENTATIVE HULETT SAND

817 STOCKADE BEAVER SHALE

823-31 Sandstone, grenish white, very fine, excellent sorting, no show, no porosity, fine glauconite scattered, abundant tiny white spots of clay scattered, soft to very soft, also tiny black specks scattered, limy (Hulett cave).

831-46 Shale, silty shale, gray, greenish gry, platy, very soft, also darker gray; sand streaks, same sand as above, no show, part yellow limonite stained (Hulett cave).

846-57 Same soft waxy shale, grayish green to greenish gray; sand streaks, greenish gray, light gray, no show, poor porosity, very well-cemented, silty, very soft, very fine, excellent sorting, fine glauconite, limy.

857-62 Same alternating shale and sand as above, no show, (Very rapid drilling of 7' in 4") Basal sand of Hulett:

862 BASAL SAND OF SUNDANCE

862-72 sandstone, light greenish gray to yellowish greenish gray, no show, very fine, excellent sorting, porous, very soft, fine glauconite and black specks scattered, no fluorescence.

872-77 Dark gray very waxy shale, very soft; trace also black with pyrite spot; trace tannish gray mottled purplish maroon.

877 TRIASSIC

877 SPEARFISH FORMATION

877-99 (Samples up at 900 in less than 22"; red bed top marked by faster drilling from 2½"/ft. above red bed top to 2"/ft. below red bed top) Abundant brick red silty shale, very silty, very soft, fine black biotite specks scattered; limited smooth red shale; trace white medium crystalline to coarsely crystalline anhydrite.

Page 7

SAMPLE LITHOLOGIC DESCRIPTION (Con.)

1528-34 Plain shale to silty shale, brick red, soft in lower part; top 4' anhydr ite, white, tan, microcrystalline.
1534-44 (Missing).
1544-49 Same red silty shale, soft.
Anhydrite, white, to tan denser to limited orange.
1549-56 Siltyshale, light red, brick red, soft.
1556-71 Same shale.
1571(-2076 MINNELUSA FORMATION
1571(-2076 UPPER MINNELUSA (PERMIAN)

1571-90 (Samplessurfacing off bottom at 1590 in more than 15" and less than 45") (Top 10' very fast drilling like high porosity and bottom 5' fast drilling like good porosity) Abundant sandstone, light yellow, pinkish yellow, soft, no show, good visible poresity, poorly sorted very fine to fine to fine-lpus, anhydritic-looking, clear grains, subround.
1590-93 Anhydrite stringer, white to tan to gray denser, crypto crystalline.
1593-1602 (Fast drilling like very porous sand) Same sand as above, light yellow, pinkish possible from red bed mud contamination, poorly sorted very fine to fine to fine-plus, porous, no show, no fluorescence, friable.
1602-07 (Slower drilling like tight or hard streak) Possible anhydrite stringer, tan denser to white.
1607-15 (Very fast drilling of 1"/ft. like high porosity) Sandstone, light yellow, fair sorting, very fine to fine, clear grains, soft, good visible porosity, no show, anhydritic-looking, trace limy; trace light red shaly sandstone, very fine to mostly fine, abundant tiny red shale specks.
1615-35 Abundant loose sand grains, very poorly sorted, very fine to fine to few medium grains, clear grains, mostly light yellowish to less of light orange coloration(Slower drilling like more cemented, less porosity); sand is cave; white anhydrite, finely crystalline.
Same as above; anhydrite is in top 17' and sand is in bottom 3' of Fast drilling.
1635-45 (Continued fast drilling)Same loose sand grains as above.
1645-48 (Slightly slower drilling like sand is transitional to anhydrite below)
1648 BASE OF FIRST CONVERSE SAND
1648 MASSIVE ANHYDRITE

1648-60 (Slower drilling 11"/ft.) Anhydrite, tannish light gray, finely crystalline.
1696 BASE OF MASSIVE ANHYDRITE

1696 SECOND CONVERSE SAND

1696-98 Abundant sandstone, light orange, orange, very fine, good sorting, porous, soft, no show, traces whitish clay-fill scattered, clear grains but light orange, subround.
1698-1702 Increasingly abundant light orang sand, no show, soft, porous, very fine, well-sorted, anhydritic cementation.

SAMPLE LITHOLOGIC DESRIPTION (Con.)

1702-1722 (Below top 3' very fast drilling begins: 1"/ft.) Same light orange sandstone, very fine to fine, soft, porous, no show, anhydritic cementation, clear light orange grains, fair sorting, noncalcareous.

1722 BASE OF SECOND CONVERSE SAND

1806-13 Snow white sand, no show, well-cemented, poor porosity, very fine to fine, fair sorting, anhydritic-looking cementation, clear grains, soft to slightly soft, no fluorescence.

1813-24 Same white sand as above, no show, poor porosity due to being very well-cemented, abundant white clay-fill, soft.

SAMPLE LITHOLOGIC DESCRIPTION (Con.)

1988(-1659)RED MARKER

1988-92 (At 1990 samples coming off bottom in less than 38") (Red Marker marked by typical faster drilling from 10"/ft. above Marker to 2,4,3"/ft. in it) Abundant shale, shiny, splintery, platy, red, maroon, purplish red, very soft.

1992 BASE OF RED MARKER

1992(-1663)PENNSYLVANIAN

1992(-1663)MIDDLE MINNELUSA (LEO SECTION)

1992-2002 Abundant dolomite, tan to dark tan, anhydritic dolomite, less of red, lighter tan slightly chalky softer, darker tan and reddenser, harder; associated white anhydrite in 20%.

2002-12 (4'bblow top is 4' of faster drilling like possible shale break) Abundant silty shale, brick red, orange red, very soft; same dolomite and anhydritic dolomite and white anhydrite, with dolomite becoming violet to tan with purple shale spots in part; sand streaks, white, very well-cemented, no show, limited, no visible porosity, very fine to fine, clear grains, anhydritic cementation, noncalcareous, soft, possibly a granular anhydrite fast drilling is sd.

2012-22 Dolomite, tan, pink, violet, dense, hard, becoming anhydritic dolomite, tan, finely crystalline; sand streak(s), white, very fine, well-sorted, no show, no porosity, tight, few fine grains, trace mostly fine grained.

2022-32 Very distinctive blackish brown to greenish brown dolomite with tiny blacksih spots which in part are embedded clear sand grains, slightly chalky-looking, noncalcareous, hard; 20% finely crystalline snow white anhydrite with dark greenish brown dolomite and tan dense anhydrite.

2032-41 Same dolomite as above, becoming mostly snow white anhydrite with part tan denser and few brown sandy streaks with no porosity, tight.

2041-52 Same as above.

2052-62 Hard snow white to denser gray anhydrite; hard, dense tan to tannish brown to brown mottled red dolomite and anhydritic dolomite, part slightly crystalline; tannish gray very, very finely sandy dolomite, silty, with dark maroon to purplish maroon shaly spots.

2062-71 Anhydritic dolomite, dark tan, dense, very hard, cryptocrystalline, with anhydrite, snow white, very finely crystalline.

2071-84 Dolomite, anydritic dolomite, tan with purplish tan in part, few purplish red tiny shale spots in part; associated white anhydrite as above; limited violet chalky dolomite.

2084-92 Tan to dark tan anhydritic dolomite, dense, hard, cryptocrystalline, also purplish to maroon shale spots in part; 5% sandstone, light gray to tannish gray, poorly sorted very fine to fine, very well-cemented, no porosity, tight, mostly dolomitic, trace limy, soft to hard, scattered purplish tiny shale spots.

SAMPLE LITHOLOGIC DESCRIPTION (Con.)

2092-99 Anhydritic dolomite, tannish brown, very finely sandy, hard, with associated snow white anhydrite, microcrystalline, limited gray denser.

2099(-1548) SECOND LEO SAND (Very slow drilling like hard formation)(Drills at 19" to 28"/ft. in sand versus 16"/ft. above and below sand)

2099-2113 Abundant sandstone, light gray, very silty, very well-cemented, no show, no visible porosity, tight, poorly sorted, part mostly very fine, part mostly fine with few medium grains, limy to dolomitic; two out of 25 cuttings with traces of yellow fluorescence on each end only, two other cuttings with golden yellow fair fluorescence throughout opposite tan staining in all of of one cutting and tan staining in 50% of other cutting, subround grains, tiny possible oil droplets not detectable after crushing, good yellow fluorescence in 2 stained pieces after crushing.

2113-21 Trace first chert in Leo, light gray, translucent, angualr, very coarse and coarser; same light gray sand, no show, very silty, very well-cemented, also gray more cemented, mostly very fine, few fine grained streaks, limited same sand grayer slightly quartzitic, no fluorescence.

2121-30 Sandstone, very silty, light gray, very fine, excellent sorting, very well-cemented, no show, no porosity, soft, in 40-50%; sandstone, 30-40%, grayish tan staining, very fine to mostly fine, well-cemented, poor or less porosity, soft, noncalcareous; limited gray denser sand, slightly quartzitic, very fine, hard, tight; limited fine to fine-plus sand, white, soft, porous, no show; all with no fluorescence.

*2130 BASE OF SECOND LEO SAND **First jet black coaly shale, coal, mostly brownish black firm to hard, blocky; from 2121 to 2124.

2130-42 All tan dense dolomite, anhydritic dolomite, hard, brittle, tle, with few white anhydrite spots and veinlets, cryptocrystalline.

2142-52 Same as above but darker brown, greenish brown, dense, cryptocrystalline, with 10% snow white anhydrite; trace round white anyhdrite spots in tan dolomite matrix.

2152-63 Same dolomite and minor amounts of anhydrite as above; also silty dolomite to lime, grennish tan, soft.

2163-69 Silty shale, orange redbrick red, soft; abundant very shaly siltstone, medium gray, no show, no porosity, dolomitic to limy, soft to limited hard; white anhydrite veinlet intersecting siltstone, medium crystalline.

2169-82 Second jet black coaly shale, coal, brownish black, firm, slightly soft; silty red shale break(s) as above, soft; mostly dolomite to anhydritic dolomite, tan, gray, dark gray, some brown, mostly dense to cryptocrystalline, anhydrite is from 2171 to 2182.

2182-93 Dolomite, anhydritic dolomite, tan, grayish tan, very cherty, dense, cryptocrystalline in part; grading into very sandy dolomite to very dolimitic sand, tan to grayish tan, very poorly sorted very fine to fine to few medium grains, very well-cemented, no porosity.

SAMPLE LITHOLOGIC DESCRIPTION (Con.)

2193-2202 Same dolomite and anhydritic dolomite, becoming darker brown cryptocrystalline; also chalky dolomite tolime, craem, light tan grayish, light gray; abundant shale, orange red, silty, soft; minor amount of anhydrite, white to brownish denser; shale probaly in faster drilling lower few feet.

2202-12 Same dolomite and abundant red shale as above; increasing snow white anhydrite, very finely crystalline; traces quartzitic sand, white to gray where tighter, very fine, excellent sorting, very well-cemented, no porosity, hard, tight.

2212-21 Abundant snow white anhydrite, part gray denser; abundant orange red silty shale as above, very soft; minority

2221-32 Dolomite to limestone, graysh tan, cryptocrystalline, hard, brittle, trace dark gray irregular streaks, trace fine pyrite specks.
20% brick red shale, orange red, soft, silty; very finely sucrosic silty limy dolomite to limestone, tan, grayish tan, tannish gray, hard; minority snow white anhydrite, microcrystalline to gray denser.

2132-40 Very finely sucrosic dolomite, dark gray, less of brown; 15% white anhydrite; 5% or less limited streak of sand, white, light gray, gray, quartzitic, very well-cemented, no show, no porosity, tight.

2140-54 Sucrosic limestone, dolomitic lime, ver, very finely sandy lime, tan, greenish tan; traces anhydritic sand, white, light gray, no show, no porosity, very well-cemented. very fine, well-sorted; 15% white anhydrite.

2154-63 Same as above, with limestone, becoming same white sand, very fine, well-sorted, very well-cemented, no show, no porosity, anhydritic-looking.

2165- 68½ (Missing because when 45" circulated samples were caught at T.D. no more cuttings were coming since hole was all cleaned out.

2169 TOTAL DEPTH DRILLER(STRAP)

2267 TOTAL DEPTH SCHLUMBERGER

HOLE DEVIATION SURVEYS

Surveys were made using a Sure Shot Model B with a 7° maximum reading.

Depth	Deviation	Formation
160	3/4°	------
268	"	Lakota ?
547	½	Morrison
779	1	Sundance LAK member
1283	1½	Goose Egg
1526	"	Opeche
2162	1 3/4	Lower Leo

BIT RECORD

12¼" bit from surface to 168. All bits below 168 are 7 7/8".

Run No.	Make	Type	From	To	Feet	Hours	Formation @ Base of Run
1	Smith	DTJ RR	168	1037	869	28	Spearfish
2	"	DGJ	1037	1526	489	24 3/4	Opeche
3	HTC	OSC1G Setip	1526	1655	129	9½	Massive Anhydrite.
4	Smith	V2J	1655	1750	95	12½	Pre-Second Converse.
5	HTC	J22 RR	1750	1974	224	37½	Basalmost Converse.
6	"	J33 RR	1974	2162	188	46	Pre-Second Leo Sand.
7	"	J65 RR	2162	2269 T.D.	17'	----	Lower Leo Section.

DRILLING PROGRESS SUMMARY

Drilling depths as of 8 A.M. each day.

Date	No. of Days	P.D. Depth	Fm. @ P.D.	Footage Drilled Last 24 hours	Status
Dec. 8,1975	--	----	----	----	Moving.
9	--	----	----	----	Move & rig up.
10	--	----	----	----	Rig up.
11	--	----	----	----	" " to dril rathole.
15	1	168	------	168	Work on rig.
16	2	391	Morrison	223	Drilling.
17	3	1038	Spearfish	647	Service rig.
18	4	1437	Minnekahta	399	Check B.O.P.
19	5	1665	Massive Anhydrite	228	Drilling.
20	6	1764	Pre-Second Conv.	99	-----
21	7	1882	Lower Converse	118	Drilling.
22	8	1974	Basal Converse	92	Trip for bit.
23	9	2077	Upper Leo	103	Drilling.
24	10	2162	Pre-Second Leo	85	"
25	11	2210	Lower Leo	48	"
26	12				

Page 13 Respectfully submitted, B. Allen Nelson

POWERCO

POWER RESOURCES CORPORATION

Power Resources Corporation
#21-14 M. Lenore Peterson
NE¼NW¼ Sec. 14, T. 7S, R. 1E
Fall River County, S. Dakota
Elevation: Gr. 3639, KB 3647
Well Permit #741

DEC 1975
RECEIVED
WESTERN FIELD OFFICE

DAILY DRILLING REPORT

11/29/75	Surveyed and staked location
12/02/75	Graded location and dug pits
12/08/75	Moving in rotary tools
12/09/75	Moving in and rigging up
12/10/75	Finished rigging up
12/11/75	Prep to spud
12/12/75	Spudded at 10:00 P.M., 12/11/75 Ran 8-5/8" 28# surface casing. Cemented with 125 sacks regular cement with 3% calcium chloride. Plug down at midnight - good returns. Pipe set at 152 Gr. Shut down - waiting on crews.
12/16/75	Drilling @ 397'. 3/4° @ 268'. 8 drill collars. Weight on bit - 15,000#. Rotary speed - 100 rpm.
12/17/75	1037' - Drilling. 3/4° @ 541', 1° @ 779'.
12/18/75	1437' - Drilling. 1¼° @ 1002'. Sample tops: Morrison - 322' Spearfish - 890' Goose Egg - 1178' No shows.
12/19/75	1660' - Drilling. 1¼° - 1526'. Sample Top: Minnekahta - 1425' Drilling in 1st Converse sand. Mud Wt. - 9.4; Visc. - 36.
12/20/75	1765' - Drilling
12/21/75	1890' - Drilling
12/22/75	1974' - Drilling
12/23/75	2078' - Drilling

1660 So. Albion, Suite 827, Denver, Colorado 80222 303 759-5660

POWERCO

POWER RESOURCES CORPORATION

Power Resources Corporation
#21-14 M. Lenore Peterson
NE¼NW¼ Sec. 14, T. 7S, R. 1E
Fall River County, S. Dakota
Elevation: Gr. 3639, KB 3647
Well Permit #741

DAILY DRILLING REPORT cont'd.

12/24/75 2162' - drilling. Sample Top: 2nd Leo - 2100' (+1547)
ss, tite, some oil stn, poor P&P
Drilling to est. total depth of 2285' and log.

DEC 1975
FIELD
OFFICE

1660 So. Albion, Suite 827, Denver, Colorado 80222 303 759-5660

ADMINISTRATIVE / SUNDRY REPORTS

Hydro ID 5

24

JAN 1976 REC WES. FIELD OFFICE

S. Dak. Oil & Gas Board
FORM 7

PLUGGING RECORD

Operator	Address
POWER RESOURCES CORPORATION	1660 So. Albion, Suite 827, Denver, CO 80222

Name of Lease	Well No.	Field & Reservoir
Lenore Peterson	21-14	Wildcat

Location of Well	Sec-Twp-Rge or Block & Survey	County
NENW Sec. 14 - T. 7 S.- R. 1 E.		Fall River

Application to drill this well was filed in name of	Has this well ever produced oil or gas	Character of well at completion (initial production): Oil (bbls/day)	Gas (MCF/day)	Dry?
Power Resources Corporation	No			Yes

Date plugged:	Total depth	Amount well producing when plugged: Oil (bbls/day)	Gas (MCF/day)	Water (bbls/day)
December 2, 1975	2266	None	None	None

Name of each formation containing oil or gas. Indicate which formation open to well-bore at time of plugging	Fluid content of each formation	Depth interval of each formation	Size, kind & depth of plugs used. Indicate zones squeeze cemented, giving amount cement.
Morrison		339	
Basal Sundance Sand		862	950-850 30 Sacks
First Converse Sand		1571	1650-1500 30 Sacks
Base 2nd Converse Sand		1722	1900-2020 40 Sacks
2nd Leo Sand		2099-2113	Traces Yellow Fluorescence

CASING RECORD

Size pipe	Put in well (ft.)	Pulled out (ft.)	Left in well (ft.)	Give depth and method of parting casing (shot, ripped etc)	Packers and shoes
8-5/8	152	-0-	152		

Was well filled with mud-laden fluid, according to regulations?	Indicate deepest formation containing fresh water.

In addition to other information required on this form, if this well was plugged back for use as a fresh water well, give all pertinent details of plugging operations to base of fresh water sand, perforated interval to fresh water sand, name and address of surface owner, and attach letter from surface owner authorizing completion of this well as a water well and agreeing to assume full liability for any subsequent plugging which might be required.

Well plugged back to 850. Land owner, Lenore Peterson, Star Route, Edgemont, So. Dakota, has furnished letter to So. Dakota Geological Survey at Rapid City requesting use of well as a fresh water well. Mr. G. Allen Nelson has presented a detailed Geologic Well Report by letter dated 2 January 1976.

USE REVERSE SIDE FOR ADDITIONAL DETAILS

Executed this the 12th day of January, 19

State of Colorado

County of Denver

R.A. Beesham, V.P.
Signature of Affiant

Before me, the undersigned authority, on this day personally appeared ... known to me to be the person whose name is subscribed to the above instrument, who being by me duly sworn on oath states, that he is duly authorized to make the above report and that he has knowledge of the facts stated therein, and that said report is true and correct.

Subscribed and sworn to before me this 12th day of January, 1976

SEAL

My commission expires My Commission expires Sept. 29, 1979

Mary M. Stripp
Notary Public in and for Denver
County, Denver, Colo.

DO NOT WRITE BELOW THIS LINE

Approved Jan. 23, 1976
Date

Fred V. Steece
OIL AND GAS BOARD OF THE STATE OF SOUTH DAKOTA
Supervisor, Western Field Office

CORRESPONDENCE

Peterson and Son, Inc.
Edgemont, South Dakota 57735
April 21, 1976

Mr. Fred Steece
South Dakota Geological Survey
308 West Boulevard
Rapid City, South Dakota 57701

Dear Sir:

I am writing in regard to your letter of February 26, 1976, Concerning the well converted to our use. We are using the well as a flowing well to water livestock. The well was completed by adding a 8 5/8 inch pipe to the existing casing and reducing this pipe to 4 inches with a one inch outlet. Approximately 100 feet of plastic pipe carries the water to the tank. We have not had the water analyzed.

If you have any further questions, feel free to contact us.

Sincerely,

Debrah Peterson

Debrah Peterson
Secretary

APR 1976
RECEIVED
WESTERN
FIELD
OFFICE

January 7, 1976

JAN 1976
RECEIVED
WESTERN
FIELD
OFFICE

Fred Steece

South Dakota Geologocal Survey

308 West Blvd.

Rapid City, South Dakota 57701

Dear Sir:

I, M. Lenore Peterson, accept full responsibility for the oil test well known as #21-14 Peterson located on my land in NENW¼ Section 14 Township 7S. Range 1E. Fall river County, South Dakota as it is being left for a water well. Relieving Power Resources of their responsibilities with their bond.

The top of the highest plug is 850 feet and it has an 8 5/8" casing to 152 feet below ground level.

Sincerely,

M. Lenore Peterson

M. Lenore Peterson

Star Route

Edgemont, S.D. 57735

cc: John Trotter

December 3, 1975

Mr. P. A. Bassham, Vice President
Power Resources Corporation
1660 S. Albion, Suite 827
Denver, Colorado 80222

Dear Mr. Bassham:

Enclosed is your copy of Permit #741 (form 2a) and approved application to drill (form 2) covering the Power Resources Corporation #21-14 Peterson oil test in Fall River County, South Dakota. A copy of the permit should be posted at the well site. Also enclosed is a receipt for your $100 permit fee. Please make drilling progress reports to the Western Field Office at least weekly.

May I wish you success in your drilling venture and if there is anything I can do to be of help, please let me know.

Sincerely,

Fred V. Steece
Supervisor, Western Field Office

FVS/jlm
cc: Dr. Duncan J. McGregor
Enc. 3

December 3, 1975

Mr. David Volk
State Treasurer
Capitol Office Building
Pierre, S. D. 57501

Dear Mr. Volk:

Enclosed is a check in the amount of $100 from Power Resources Corporation to cover the drilling fee for permit #741 for an oil test in Fall River County. This check is for deposit in the general fund and a Cash Receipts Transmittal form is enclosed for the same amount.

Sincerely,

Fred V. Steece
Supervisor, Western Field Office

FVS/jlm
Enc. 2
cc: Dr. Duncan J. McGregor

SURETY

State Pub. Co., Pierre

S. Dak. Oil & Gas Board
FORM 3

BOND NO. 809878

BOND

KNOW ALL MEN BY THESE PRESENTS,

That we: Energy Reserves Group, Inc.

of the County of: Sedgwick in the State of: Kansas

as Principal, and Seaboard Surety Company

of New York, N. Y.

as surety, authorized to do business in the State of South Dakota as surety, are held and firmly bound unto the State of South Dakota in the sum of (~~$5,000.00~~ $20,000.00), lawful money of the United States, for which payment, well and truly to be made, we bind ourselves, and each of us, and each of our heirs, executors, administrators or successors, and assigns jointly and severally, firmly by these presents.

The condition of this obligation is that whereas the above bounden principal proposes to drill a well or wells for oil, gas, or stratigraphic purposes in and upon the following described land situated within the State, to wit.

Any land situated within State of South Dakota

(May be used as blanket bond or for single well)

---------- Blanket Bond ----------

NOW, THEREFORE, if the above bounden principal shall comply with all of the provisions of the laws of this State and the rules, regulations and orders of the Oil and Gas Board of the State, especially with reference to the proper plugging of said well or wells, and filing with the Oil and Gas Board of this State all notices and records required by said Board, and the restoration of the surface, in the event said well or wells do not produce oil or gas in commercial quantities, or cease to produce oil or gas in commercial quantities, then this obligation shall be terminated by the Board, the same shall be and remain in full force and effect.

Penal sum of

Twenty Thousand and 00/100 Dollars ($20,000.00)

Witness our hands and seals, this 21st day of April, 1976

Energy Reserves Group, Inc.

By [signature]
Vice President R. D. Orr Principal

Witness our hands and seals, this 21st day of April, 1976

Seaboard Surety Company

By [signature]
(James W. Bily)
Attorney-in-fact Surety

(If the principal is a corporation, the bond should be executed by its duly authorized officers, with the seal of the corporation affixed. When principal or surety executes this bond by agent, power of attorney or other evidence of authority must accompany the bond.)

DO NOT WRITE BELOW THIS LINE

OIL AND GAS BOARD OF THE STATE OF SOUTH DAKOTA

Approved May 11, 1976
Date

[signature]
Supervisor

Countersigned in South Dakota
By [signature] McKEAN / STANTON
Agent at Sioux Falls, S.D.
PAUL McKEON

MAY 1976 FIELD OFFICE

Note: File 2 copies of this form with Secretary, Oil & Gas Board, Pierre.

SEABOARD SURETY COMPANY

HOME OFFICE

No.

NEW YORK, NEW YORK

POWER OF ATTORNEY

KNOW ALL MEN BY THESE PRESENTS: That SEABOARD SURETY COMPANY, a corporation of the State of New York, has made, constituted and appointed and by these presents does make, constitute and appoint A. C. Ambro[illegible]a or A. C. Hiebert or James A. Bevan or Robert C. Pr[illegible] or Evelyn Houchin or James W. Bily or Bill Hall or Donald E. Gragg or Leonard A. Colagrossi--

of Wichita, Kansas

its true and lawful Attorney-in-Fact, to make, execute and deliver on its behalf insurance policies, surety bonds, undertakings and other instruments of similar nature as follows: Without Limitations

Such insurance policies, surety bonds, undertakings and instruments for said purposes, when duly executed by the aforesaid Attorney-in-Fact, shall be binding upon the said Company as fully and to the same extent as if signed by the duly authorized officers of the Company and sealed with its corporate seal; and all the acts of said Attorney-in-Fact, pursuant to the authority hereby given, are hereby ratified and confirmed.

This appointment is made pursuant to the following By-Laws which were duly adopted by the Board of Directors of the said Company on December 8th, 1927, and are still in full force and effect:

ARTICLE VIII, SECTION 1:

"Policies, bonds, recognizances, stipulations, consents of surety, underwriting undertakings and instruments relating thereto. [illegible] bonds, recognizances, stipulations, consents of surety and underwriting undertakings of the Company [illegible] and other writings relating in any way thereto or to any claim or loss thereunder, shall be signed in the name and on behalf of the Company

(a) by the Chairman of the Board, the President, a Vice President or a Resident Vice President and by the Secretary, an Assistant Secretary, a Resident Secretary or a Resident Assistant Secretary; or

(b) by an Attorney-in-Fact for the Company appointed and authorized by the Chairman of the Board, the President or a Vice President to make such signature; or

(c) by such other officers or representatives as the Board may from time to time determine.

The seal of the Company shall if appropriate be affixed thereto by any such officer, Attorney-in-Fact or representative."

IN WITNESS WHEREOF, SEABOARD SURETY COMPANY has caused these presents to be signed by one of its Vice-Presidents, and its corporate seal to be hereunto affixed and duly attested by one of its Assistant Secretaries, this 13th day of August, 1975.

Attest: SEABOARD SURETY COMPANY,

By John C. Whiteside
Vice-President

(Seal) Joan Lynch
Assistant Secretary

STATE OF NEW YORK
COUNTY OF NEW YORK } ss.:

On this 13th day of August, 19 75, before me personally appeared John C. Whiteside a Vice-President of SEABOARD SURETY COMPANY, with whom I am personally acquainted, who, being by me duly sworn, said that he resides in the State of New Jersey; that he is a Vice-President of SEABOARD SURETY COMPANY, the corporation described in and which executed the foregoing instrument; that he knows the corporate seal of the said Company; that the seal affixed to said instrument is such corporate seal; that it was so affixed by order of the Board of Directors of said Company; and that he signed his name thereto as Vice-President of said Company by like authority.

State of New York
No. 43-4508755 Qualified in Richmond County
Certificate filed in New York County
(Seal) Commission Expires March 30, 1977

Karen Gavrity
Notary Public

CERTIFICATE

I, the undersigned Assistant Secretary of SEABOARD SURETY COMPANY do hereby certify that the original Power of Attorney of which the foregoing is a full, true and correct copy, is in full force and effect on the date of this Certificate and I do further certify that the Vice President who executed the said Power of Attorney was one of the officers [illegible] by the Board of Directors to appoint an attorney-in-fact as provided in Article VIII, Section 1, of the By-Laws of SEABOARD SURETY COMPANY.

This Certificate may be signed and sealed by facsimile under and by authority of the following resolution of the [illegible] of SEABOARD SURETY COMPANY at a meeting duly called and held on the 25th day of [illegible]

"RESOLVED: (2) that the use of a printed facsimile of the corporate seal of the company and of the signature of an Assistant Secretary on any certification of the correctness of a copy of an instrument executed by the President or a Vice President pursuant to Article VIII, Section 1, of the By-Laws appointing and authorizing an attorney-in-fact to sign in the name and on behalf of the company surety bonds, underwriting undertakings or other instruments described in said Article VIII, Section 1, with like effect as if such seal and such signature had been manually affixed and made, hereby is authorized and approved."

IN WITNESS WHEREOF, I have hereunto set my hand and affixed the corporate seal of the Company to these presents this 21st day of April, 19 76.

Joan Lynch

State Pub. Co., Pierre

S. Dak. Oil & Gas Board
FORM 3

BOND NO. [illegible]

BOND

KNOW ALL MEN BY THESE PRESENTS,

That we POWER RESOURCES CORP.
of the County of DENVER in the State of: COLORADO
as Principal, and HARTFORD ACCIDENT AND INDEMNITY COMPANY
of HARTFORD, CONN.

as surety, authorized to do business in the State of South Dakota as surety, are held and firmly bound unto the State of South Dakota in the sum of ($5,000.00, ~~$20,000.00~~) lawful money of the United States, for which payment, well and truly to be made, we bind ourselves, and each of us, and each of our heirs, executors, administrators or successors and assigns jointly and severally, firmly by these presents.

The condition of this obligation is that whereas the above bounden principal proposes to drill a well or wells for oil, gas, or stratigraphic purposes in and upon the following described land situated within the State to wit:

[illegible] South, R. 1 East, Fall River County, South Dakota
(Say whether a blanket bond or for single well)

Sec. 14: C NE NW

Well Name #21-14 M. Lenore Petersen

NOW, THEREFORE, if the above bounden principal shall comply with all of the provisions of the laws of this State and the rules, regulations and orders of the Oil and Gas Board of the State, especially with reference to the proper plugging of said well or wells, and filing with the Oil and Gas Board of this State all notices and records required by said Board, and the restoration of the surface, in the event said well or wells do not produce oil or gas in commercial quantities, or cease to produce oil or gas in commercial quantities, then this obligation shall be terminated by the Board, the same shall be and remain in full force and effect.

Penal sum of

Five Thousand and no/100------------------------------($5,000.00)

Witness our hands and seals, this 1st day of December 1975
Attest:
[illegible signature], Secretary
[illegible] F. Trotter, Secretary

POWER RESOURCES CORP.
Richard A. Basham, vice president
Richard A. Basham, V. P.
Principal

Witness our hands and seals, this 1st day of December 1975

Hartford Accident and Indemnity Co.
Walt Forbes
Walt Forbes, attorney-in-fact Surety
136 South Wolcott, Casper, Wyo. 82601

(If the principal is a corporation, the bond should be executed by its duly authorized officers, with the seal of the corporation affixed. When principal or surety executes this bond by agent, power of attorney or other evidence of authority must accompany the bond.)

DO NOT WRITE BELOW THIS LINE

Approved 12-3-75
Date

OIL AND GAS BOARD OF THE STATE OF SOUTH DAKOTA
[illegible signature]
Secretary
Supervisor [illegible]

Countersigned in South Dakota
By [illegible]
Agent [illegible]

Note: [illegible] 2 [illegible] of this form with Secretary Oil & Gas Board, Pierre

Hartford Accident and Indemnity Company

000987

HARTFORD, CONNECTICUT

POWER OF ATTORNEY

Know all men by these Presents, That the HARTFORD ACCIDENT AND INDEMNITY COMPANY, a corporation duly organized under the laws of the State of Connecticut, and having its principal office in the City of Hartford, County of Hartford, State of Connecticut, does hereby make, constitute and appoint

WALT FORBES, W. W. BUTLER, SHIRLEY L. McPHERSON, and THOMAS L. MYERS, of CASPER, WYOMING,

its true and lawful Attorney(s)-in-fact, with full power and authority to each of said Attorneys-in-fact, in their separate capacity if more than one is named above, to sign, execute and acknowledge any and all bonds and undertakings and other writings obligatory in the nature thereof on behalf of the company in its business of guaranteeing the fidelity of persons holding places of public or private trust; guaranteeing the performance of contracts other than insurance policies; guaranteeing the performance of insurance contracts where surety bonds are accepted by states and municipalities, and executing or guaranteeing bonds and undertakings required or permitted in all actions or proceedings or by law allowed

in penalties not exceeding the sum of FIVE HUNDRED THOUSAND DOLLARS ($500,000.00) each,

and to bind the HARTFORD ACCIDENT AND INDEMNITY COMPANY thereby as fully and to the same extent as if such bonds and undertakings and other writings obligatory in the nature thereof were signed by an Executive Officer of the HARTFORD ACCIDENT AND INDEMNITY COMPANY and sealed and attested by one other of such officers, and hereby ratifies and confirms all that its said Attorney(s)-in-fact may do in pursuance hereof.

This power of attorney is granted under and by authority of the following By-Law adopted by the Stockholders of the HARTFORD ACCIDENT AND INDEMNITY COMPANY at a meeting duly called and held on the 10th day of February, 1943.

ARTICLE IV

SECTION 8. The President or any Vice-President, acting with any Secretary or Assistant Secretary, shall have power and authority to appoint, for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, one or more Resident Vice-Presidents, Resident Assistant Secretaries and Attorneys-in-fact and at any time to remove any such Resident Vice-President, Resident Assistant Secretary, or Attorney-in-fact, and revoke the power and authority given to him.

SECTION 11. Attorneys-in-fact shall have power and authority, subject to the terms and limitations of the power of attorney issued to them, to execute and deliver on behalf of the Company and to attach the seal of the Company thereto any and all bonds and undertakings, and other writings obligatory in the nature thereof, and any such instrument executed by any such Attorney-in-fact shall be as binding upon the Company as if signed by an Executive Officer and sealed and attested by one other of such Officers.

This power of attorney is signed and sealed by facsimile under and by the authority of the following Resolution adopted by the Directors of the HARTFORD ACCIDENT AND INDEMNITY COMPANY at a meeting duly called and held on the 13th day of March, 1956.

RESOLVED, that, whereas the President or any Vice-President, acting with any Secretary or Assistant Secretary, has the power and authority to appoint by a power of attorney, for purposes only of executing and attesting bonds and undertakings and other writings obligatory in the nature thereof, one or more Resident Vice-Presidents, Assistant Secretaries and Attorneys-in-fact,

Now, therefore the signatures of such officers and the seal of the Company may be affixed to any such power of attorney or to any certificate relating thereto by facsimile, and any such power of attorney or certificate bearing such facsimile signatures or facsimile seal shall be valid and binding upon the Company and any such power so executed and certified by facsimile signatures and facsimile seal shall be valid and binding upon the Company in the future with respect to any bond or undertaking to which it is attached.

In Witness Whereof, the HARTFORD ACCIDENT AND INDEMNITY COMPANY has caused these presents to be signed by its Vice-President, and its corporate seal to be hereto affixed, duly attested by its Secretary, this 17th day of January, 1968.

Attest: HARTFORD ACCIDENT AND INDEMNITY COMPANY

Joseph H. Izor
Secretary

John F. Beardsley
Vice President

STATE OF CONNECTICUT,
ss.
COUNTY OF HARTFORD,

On this 17th day of January, A. D. 1968, before me personally came John F. Beardsley, to me known, who being by me duly sworn, did depose and say, that he resides in the County of Hartford, State of Connecticut; that he is the Vice-President of the HARTFORD ACCIDENT AND INDEMNITY COMPANY, the corporation described in and which executed the above instrument; that he knows the seal of the said corporation; that the seal affixed to the said instrument is such corporate seal; that it was so affixed by order of the Board of Directors of said corporation and that he signed his name thereto by like order.

Robert P. Kloven
Notary Public
My commission expires March 31, 1967

STATE OF CONNECTICUT,
ss.
COUNTY OF HARTFORD,

CERTIFICATE

I, the undersigned, Assistant Secretary of the HARTFORD ACCIDENT AND INDEMNITY COMPANY, a Connecticut Corporation, DO HEREBY CERTIFY that the foregoing and attached POWER OF ATTORNEY remains in full force and has not been revoked; and furthermore, that Article IV, Sections 8 and 11, of the By-Laws of the Company, and the Resolution of the Board of Directors, set forth in the Power of Attorney, is now in force.

Signed and sealed at the City of Hartford. Dated the 1 4 day of December 1975.

J. Rozzell
Assistant Secretary

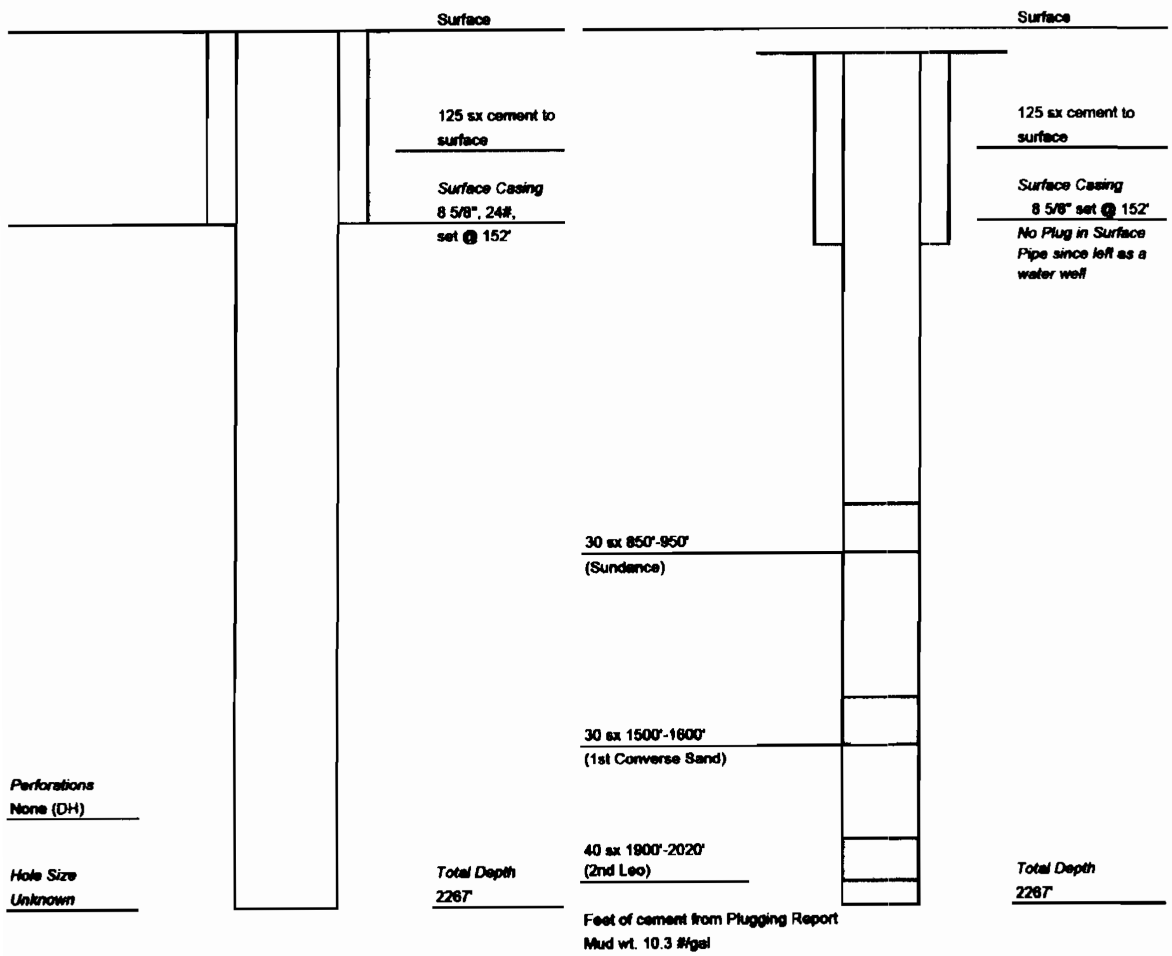
Form [illegible]

MISCELLANEOUS

NO MISCELLANEOUS
INFORMATION FOR THIS WELL
AS OF 5/18/2011

ORIGINAL WELL CONSTRUCTION DURING OPERATION | **PLUGGING AND ABANDONMENT CONSTRUCTION**

API No. 4004720065
14-7S-1E



SOURCE E

DEWEY-BURDOCK GROUNDWATER WELL REPORT

2010 & 2011 FIELD WORK COMPLETED

(Mike Beshore, Powertech (USA) Inc., October 4, 2011)

Dewey Burdock Groundwater Well Report (2010 & 2011 – Field Work Completed):

During the field seasons of 2010 and 2011, Powertech personnel conducted groundwater well work at the Dewey Burdock project area. This work consisted of locating groundwater wells within the Area of Review (AOR), monitoring water levels of selected wells, measuring flow rates of artesian wells, and determining groundwater well construction information by running the down-hole camera and geophysical logging tools. Groundwater wells within the AOR are shown in **Map 1**. The conducted field work is detailed below.

Groundwater Level Measurements:

Groundwater levels were monitored by Powertech personnel on selected groundwater wells, in order to construct groundwater potentiometric surfaces for various aquifers. Standard operating procedures (SOP) for water level measurements under artesian and sub-surface conditions are shown in **Attachment 1**. Groundwater elevation data from the monitoring program are contained within **Table 1**. It should be noted that a significant amount of work had to be completed on many groundwater well surface casings in order to obtain accurate measurements. This was particularly the case for artesian groundwater wells that needed to be fully sealed up and shut in, in order to obtain accurate pressure measurements. Below is a photograph showing an example of well head work completed in order to accurately obtain artesian pressure measurements.

Artesian/Windmill Groundwater Well Flow Rates:

Groundwater wells that free-flow at the ground surface under artesian pressure and by the use of a windmill and their associated flow rates are shown in **Table 2**. This information was provided to Petrotek to incorporate into the project area groundwater flow model. Flow rates of free flowing groundwater wells was obtained by using a 5-gallon bucket, and noting the amount of time it took to fill the bucket, which yielded an estimate of the flow rate. Below are photographs of a typical artesian groundwater well and a flowing windmill within the project area, that are allowed to free-flow to the ground surface.

Groundwater Well Work Completed:

Below is a well by well summary of work completed on groundwater wells during the field season of 2011. Several tasks were completed in order to determine the construction details of many groundwater wells. A tabulated summary of groundwater well status as of September 30, 2011 is included in Table 3.

Hydro ID 5 is former oil test well API 40 047 20065

Groundwater Well Hydro ID 5:

Groundwater well number 5 is located about 0.5 miles south of the Powertech Burdock pump test location. The well is artesian and consists of a 4-inch casing. Originally the well was expected to produce water from the Chilson aquifer, however further investigations utilizing the down-hole camera and geophysical tool actually revealed that the well is screened within the lower Fall River aquifer. The geophysical log and the screened interval were sent to Powertech geologists for sub-surface geologic interpretations. The well consists of 4-inch casing to a depth of 155 feet below the ground surface, and is open hole from 155 to 175 feet.

Groundwater Well Hydro ID 6:

Groundwater well number 6 is located within the project AOR and about 1-mile south of the Powertech Burdock pump test location. This well is non-flowing and consists of a 12-inch steel casing. The static water level in the well is at about 20 feet below ground surface.

The 2-inch down-hole camera was run down the well casing in order to determine the well construction details. As with many groundwater wells in the area, it was very difficult to see the screened interval of the well due to mineralization on the inner casing walls. It appeared from the video that the steel well casing ended at a depth of 135 feet below the ground surface, below which was open bore hole to a total depth of 200 feet below ground surface. These depths correspond to other Fall River wells in the area. The geophysical logging tool was also run down the well casing to its total depth. The logs suggest that sandy facies with good porosity exists from the ground surface to 200 feet below the ground surface.

Groundwater Well Hydro ID 9:

Groundwater well number 9 is located within the AOR and south of the Powertech Burdock pump test area. The status of this well was unknown, and was identified at the ground surface by the presence of upwelling water flow from what was hypothesized to be a broken-off casing (see photo below). Historical documents from TVA identify this well as being screened within the Fall River Aquifer. Conversations with the landowner also help validate that well number 9 is screened within the Fall River Aquifer.

Powertech personnel excavated a small portion of the area near the upwelling water in an attempt to locate the groundwater well. After much effort, the broken off 2-inch groundwater well casing was located about 6 feet below the ground surface. A pipe was then attached to the casing to ensure that artesian pressure would lift the groundwater to the ground surface before repairing the well-head, but water did not flow to the ground surface.

Powertech personnel then constructed a 6-foot long 1-inch drill bit. This tool was used to ream out sulfide mineralization that had accumulated on the inner walls of the well casing. This process increased artesian flow from the well to about 1.0 gallon/minute at the ground surface.

After verifying flow from the well at the ground surface, a 2-inch pipe was placed inside the existing well casing and penetrated into the well about 2-feet. A protective riser was then placed around the 2-inch pipe, and cement was added to the space between the 2-inch well head and the protective riser. Artesian flow of 1 gallon/minute was observed at the ground surface. Below is a photograph of the final well-head configuration.

The excavated area around the well was then replaced and smoothed out to match the existing topography. The landowner can now utilize the groundwater well for stock watering purposes.

Powertech personnel were unable to run a down-hole camera on the well due to mineralization on the inner casing walls. A one inch camera, once obtained, may penetrate into the water well and allow construction details to be ascertained. This effort resulted in verifying the presence of a groundwater well and is now set up so water level measurements can be obtained.

Groundwater Well Hydro ID 37:

Groundwater well number 37 is located outside of the project boundary but within the AOR, about 0.75 miles south-east of the south-east corner of the project boundary. This groundwater well is not artesian and produces stock water by a windmill. The windmill was disassembled by Powertech personnel so access to the well could be obtained.

This groundwater well originally produce water from an unknown aquifer, but further investigations reveal that it produces from the upper Fall River aquifer according to Powertech geologists who interpreted the geophysical log and screened interval obtained from the down-hole camera. The down-hole camera revealed that the well is cased at the surface, but is open-hole from a depth of 93-145 feet below the ground surface.

Groundwater Well Hydro ID 49:

Groundwater well number 49 is located within the Powertech Dewey aquifer pump test area. This well has a construction report associated with it, is screened from a depth of 475-540 feet, and is known to be screened within the upper Fall River aquifer. The total depth of the well was verified to be 540 feet by Powertech personnel.

This groundwater well is artesian, and when first visited had a leaky surface casing. In order to be able to measure artesian pressure and groundwater levels with a high degree of accuracy, the leak in the surface casing had to be fixed, and fitted with valves to isolate the pressure gauge. Below is a photograph of surface casing work completed. There are no leaks at the ground surface, and measured water levels now correlate very well with other surrounding upper Fall River wells.

Groundwater Well Hydro ID 106:

Groundwater well number 106 is located within the AOR just north of the town of Dewey, and north of the Dewey Fault zone. The status of this 7-inch was unknown, and expected to produce from Inyan Kara aquifers. The well is artesian and flows about 0.1 gallons/minute.

The 2-inch down-hole camera was run down the well casing to determine well construction details. The casing walls were very difficult to see due to mineralization and algae growth. It appeared from the video that the steel casing ended at 160 feet below the ground surface, below which was open bore hole to a depth of 196 feet below ground surface. The geophysical logging tool was then run down the well casing to its total depth. The logs show a zone of good porosity below about 175 feet to 196 feet below the ground surface.

Groundwater Well Hydro ID 220:

Groundwater well number 220 is an existing stock well located about 1.5 miles north north-west of the Powertech Dewey pump test location, consisting of a 6-inch surface casing. Flow from the groundwater well is artesian and produces about 0.2 gallons of water per minute to a nearby stock tank. Below is a photograph of well number 220.

The down-hole camera and geophysical logging tool was used by Powertech personnel to investigate the groundwater well. The well was initially screened within an unknown aquifer. Through the use of the down-hole camera, it was determined that the well is screened from at least 463-523 feet below the ground surface. This corresponds to the upper Fall River aquifer according to Powertech geologists. However as can be seen from the down-hole video, the screened interval extends below 523 feet to an unknown depth. At 523 feet the camera could not go any deeper as the casing was broken and caved in.

Groundwater Well Hydro ID 270:

Groundwater well number 270 has been found and is located about 1.5 miles north and west of the Powertech Dewey pump test location. This groundwater well is artesian and produces about 12 gallons/minute from a 2-inch steel casing. Currently the construction details of the groundwater well are unknown, but is expected to produce from the Inyan Kara aquifers.

Powertech personnel excavated the area around the groundwater well to fix the leaky well-head and prepare it for down-hole tools. A new well-head riser pipe was installed and fitted with a valve for artesian water level measurements. The well-head is no longer leaky.

An attempt was made to run a down-hole camera in the well in order to obtain construction details. Due to mineralization on the inner casing walls, the down-hole camera would not enter the well casing. A 1-inch camera must be obtained to penetrate the well casing and obtain construction details.

Groundwater Well Hydro ID 605:

The original groundwater well database provided to Powertech from their consultants identified a ground water well hydro ID 605, which was suppose to be located about 1500 feet east of the TVA Burdock aquifer pump test well 668. There is in fact no groundwater well at this location. There is a vertical 1-inch pipe that comes up from the ground and provides water to a livestock tank. However this pipe comes from groundwater well Hydro ID 668, which provide water to this location via artesian flow from 668. There is no evidence that groundwater well 605 exists.

Groundwater Wells Hydro ID's 622 and 623:

The status of groundwater wells 622 and 623 are known as TVA construction reports exist, and were utilized in the TVA Dewey pump test as observation wells. Powertech personnel verified in the field each of these wells using a tag line to determine well depth, and most maps that show the screened interval are incorrect. Groundwater well 622 is the southern well and is the lower Chilson, as defined by the well depth being 780 feet below the ground surface. Groundwater well 623 is the northern well and is the lower Fall River, as defined by the tag line going to a depth of 580 feet below the ground surface. Furthermore, groundwater levels obtained from surrounding wells correlate perfectly with the above conclusions. Most maps that have been generated to date are labeled incorrectly, and the well symbols need to be revised to show the verified aquifer. Groundwater well 622 is Chilson and well 623 is Fall River.

Groundwater Well Hydro ID 635:

It was originally thought that Hydro ID 635 was an Sundance groundwater well located near the stock reservoir about 750 feet east of groundwater well Hydro ID 5. However, it has been confirmed that this is actually a discharge point from groundwater well Hydro ID 5. Any groundwater quality samples obtained that are labeled as Hydro ID 635 are actually from Hydro ID 5.

According to well construction reports, there was once a Sundance groundwater well in this area. The construction report shows that an oil test well was plugged back and perforated in the Sundance aquifer. Powertech personnel found a solid steel pipe sticking out of the ground about 2000 feet north of the reservoir where the Hydro ID 5 discharge point is located. It is thought that this is the location of the oil test well. The steel pipe needs to be excavated to check if the well has been plugged back to the ground surface.

This is a different oil test, API 40 047 20071, which was plugged and the dry hole marker placed. Excavation is not required. L.S. 3/12/2012

Groundwater Well Hydro ID 642:

Groundwater well number 642 is located in the extreme south-east corner of the project boundary, and was originally hooked up to a windmill for livestock watering purposes. The well is currently not being used for any purpose except for groundwater monitoring. The photograph below shows the windmill structure below which groundwater well 642 is located.

8

Well number 642 consists of a 5-inch steel surface casing that is in good condition. Groundwater level measurements completed by Powertech personnel yield a water level of about 5-feet below the ground surface. Below is a close up photograph of groundwater well 642.

The construction details of groundwater well 642 were initially unknown. Powertech personnel ran down-hole tools on the well to determine construction information. The down-hole camera shown that the 5-inch surface casing extends to a depth of 12 feet below the ground surface, below which is an open hole to a total well depth of 33 feet. Location and geophysical log information was provided to Powertech geologists, and they interpreted the well to be producing water from surface alluvial sediments. However while running the camera down the hole, it was noted that the walls of the borehole consisted of solid-rock. The geophysical log from the hole should be re-examined to make sure the well is not completed in a sandstone formation such as the Fall River or Chilson.

Groundwater Well Hydro ID 651:

The original groundwater well database provided to Powertech from its consultants identified a groundwater well Hydro ID 651. Powertech personnel inspected this area, and confirmed that there is no groundwater well at this location. There is a stock tank at the location, but it originally received water from groundwater well Hydro ID 6 via a trenched pipeline. Inspection of an aerial photograph of this location clearly shows that a pipeline exists from well number 6 to the location of the stock tank, which was originally thought to be a stand-alone well. From conversations with the current landowner, the groundwater well 6 at one time would provide water to the stock tank, but following TVA pumping of aquifers, the well failed to deliver water to the stock tank location.

Groundwater Well Hydro ID 668:

Groundwater well number 668 is located within the project area and within the proposed groundwater aquifer exemption boundary at the location of the TVA Burdock groundwater pumping test.

As can be seen from the above photograph, this groundwater well is in excellent condition and consists of a 10-inch casing. The groundwater well is artesian and provides livestock water for the landowner. This groundwater well was used as the pumping well during the TVA Burdock aquifer test, and so there is a lot of construction information available. The TVA well construction report shows that the well produces groundwater from both the Fall River and Chilson aquifers, but Powertech personnel thought it was important to verify that information by running the down-hole camera and geophysical logging tool.

Powertech personnel ran the down-hole camera on the water well and confirmed that the well is screened at multiple intervals. The upper screen of the well extends from 300 feet to 350 feet below the ground surface. A solid, unscreened interval exists from 350 feet to 495 feet below the ground surface. From 495 feet to 550 feet below the ground surface is the lower screened interval of the well. The total depth of the well is 550 feet.

The geophysical logs ran by Powertech personnel were provided to Powertech geologists for geologic interpretation. It was confirmed that the upper screened interval of the well (300-350 feet) is in fact within the lower Fall River Formation aquifer. The lower screen of the well from 495 to 550 feet intersects the Lower Chilson Member of the Lakota aquifer. The solid casing that runs between the two screened intervals intersects the Fuson Member confining layer.

During the summer of 2011 Powertech personnel installed an inflatable packer within the groundwater well 668, in an attempt to isolate the two screened intervals of the groundwater well and conduct monitoring of the artesian pressures of each screened aquifer. That task and monitoring details are contained within a stand-alone report provided to Powertech engineering.

By Mike Beshore, Powertech (USA) Inc.

October 4, 2011

Dewey Burdock Groundwater Potentiometric Surface Measurements - Collected by Beshore and VanEaton

Hydro ID or Hydro Code	SD State Plane 1983 East (Feet)	SD State Plane 1983 North (Feet)	Screened Formation	Total Depth (Feet)	TOC Elevation (Feet)	Measuring Point Elevation (Feet)	Water Level Elevation (Feet) - Week of 8/30/2010	Water Level Elevation (Feet) - Week of 12/13/2010	Water Level Elevation (Feet) - Week of 1/17/2011	Water Level Elevation (Feet) - Week of 2/21/2011	Water Level Elevation (Feet) - Week of 3/21/2011	Water Level Elevation (Feet) - Week of 4/25/2011
12	995376.8	434378.5	Lakota	805	3641.14	3641.51	3653.19	3653.46	3654.06	3654.26	3654.09	3654.55
14	1002103.3	434723.34	Fall River	300	3669.88	3669.88	Not Measured	3662.91	3663.07	3663.02	3663.05	3663.15
38	992726.9	442289.6	Fall River	494	3638.75	3639.63	3644.96	3646.23	3644.76	3646.61	3646.75	3647.01
49	987330.6	444022.8	Fall River	600	3620.86	3621.27	3648.59	3642.36	3642.34	Not Measured	3644.64	3645.47
436	989848.68	454700.89	Fall River	590	3739.85	3739.85	Not Measured	3707.48	3707.56	3707.31	3707.36	3707.31
609	990133.3	447808.3	Lakota	1000	3700.67	3700.67	3688.5	3688.85	3686.81	3687.76	3687.75	3688.05
610	989998	447969.6	Fall River	680	3704.85	3704.85	3691.75	3691.74	3691.51	3691.45	3691.33	3691.52
611	990233.96	453965.33	Lakota	804	3737.36	3737.36	Not Measured	3691.99	3690.77	3691.03	3691.32	3691.26
612	990153.49	454128.57	Lakota	800	3732.34	3732.34	Not Measured	3694.04	3692.69	3692.9	3693.17	3693.15
613	990523.4	453775.8	Fall River	580	3736.93	3736.93	3700.03	3700.2	3700.25	3700.02	3700	3700.03
615	990571	453708.9	Lakota	800	3741	3741	3689.31	3689.79	3688.49	3688.72	3688.99	3688.99
616	990530.63	453135.16	Lakota	835	3751.04	3751.04	Not Measured	3693.43	3692.16	3692.4	3692.63	3692.6
617	989425.25	453583.39	Lakota	810	3725.55	3725.55	Not Measured	3692.35	3691.11	3691.33	3691.58	3691.53
622	991174.5	454033.8	Lakota	780	3754.91	3754.91	3692.85	3693.33	3692.03	3692.24	3692.5	3692.47
623	991084.6	454311.84	Fall River	580	3753.28	3753.28	3708.51	3708.64	3708.65	3708.5	3708.53	3708.55
628	990894.7	449719.2	Fall River	520	3731.99	3731.99	3694.78	3694.93	3694.77	3694.69	3694.42	3694.68
631	1002575.7	449309.8	Fall River	80	3745.37	3745.37	3716.86	3716.95	3716.92	3717.11	3717.37	3717.41
657	989882.27	454729.93	Lakota	800	3747.58	3747.58	Not Measured	3693.34	3692.06	3692.28	3692.48	3692.53
680	1003476.6	429969.1	Lakota	436	3701.94	3701.94	3661.02	3660.69	3661.06	3661.09	3661.07	3661.45
681	988728.3	443725.3	Fall River	600	3626.99	3630.31	3649.22	3643.89	3644.21	Not Measured	3646.05	3646.63
682	1003538.2	431257.9	Lakota	460	3718.24	3718.24	3665.4	3665.14	3665.49	3665.54	3665.45	3665.75
683	988610.5	446104.7	Fall River	650	3663.66	3666.64	3662.67	3659.52	3658.88	Not Measured	3660.21	3660.57
684	1003590.38	429744.24	Lakota	423	3689.04	3689.04	Not Measured	3661.57	3661.96	3661.96	3661.95	3662.34
685	988088.4	443409.7	Fall River	595	3627.85	3630.35	3666.88	3642.12	3642.58	Not Measured	3645.51	3646.14
686	1003368.77	429749.56	Lakota	428	3692.06	3692.06	Not Measured	3661.23	3661.52	3661.56	3661.48	3661.96
687	988480.18	443724.72	Fall River	608	3623.84	3624.79	Not Measured	3641.48	3641.58	Not Measured	3643.99	3644.39
688	1003425.8	429974.4	Fall River	255	3701.26	3701.26	3663.36	3662.81	3663.09	3663.08	3663.06	3663.37
689	988715	443789.2	Lakota	730	3627.27	3629.69	3684.72	3684.1	3678.86	Not Measured	3684.23	3683.99
691	988762.9	443688.4	Fall River	505	3628.88	3630.29	3646.65	3643.51	3643.58	Not Measured	Not Measured	3646.12
692	1003474.48	430014.33	Lakota	335	3704.98	3704.98	Not Measured	3663.21	3663.54	3663.57	3663.54	3663.83
694	997116.1	426836.1	Fall River	392	3598.29	3600.69	3660.25	3640.12	3641.29	3641.2	3641.28	3641.64
695	990783.4	439312.5	Fall River	508	3597.8	3599.12	3638.98	3634.18	3633.64	3634.95	3634.42	3634.95
696	996936.6	427141.5	Lakota	587	3597.96	3599.91	3641.09	3649.16	3649.78	3649.6	3649.58	3650.74
697	990748.4	439347.4	Lakota	682	3597.69	3600.3	3679.68	3675.76	3670.51	3678.16	3672.58	3672.69
698	1004307.8	435651.1	Fall River	205	3714.25	3714.25	3679.28	3679.45	3679.38	3679.22	3679.21	3679.35
705	997022.63	453314.89	Lakota	460	3826.42	3826.42	Not Measured	3709.77	3709.62	3709.41	3709.53	3709.64
706	996987.91	453276.44	Fall River	316	3824.32	3824.32	Not Measured	3725.19	3725.32	3725.1	3725.29	3725.15
3026	1012037.4	432833.2	Lakota	196	3820.48	3820.48	3680.3	3680.89	3680.78	3680.38	3680.46	3680.58

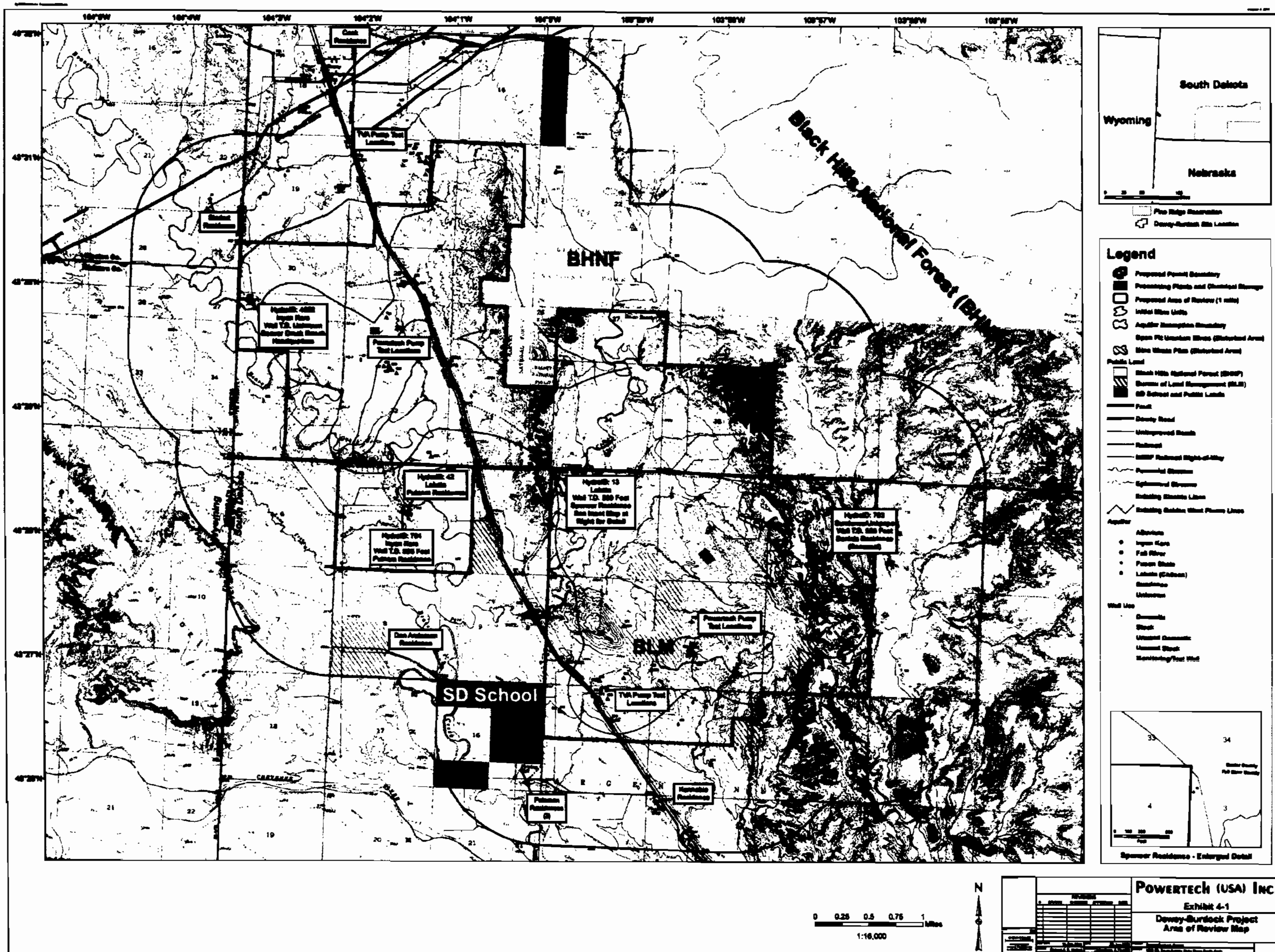
BOLD = OUTLIERS

POWERTECH (USA) INC.

Hydro ID	Township	Range	Section	1/4 - 1/4 Location	Coordinates East	Coordinates North	Screened Location	Well Use	Status	Flow Rate (GPM)	Notes
1	7	1	9	SESE	1027696	429227	Chilson	Stock	Flowing	1.5	
2	7	1	16	SESE	1026724	423922	Chilson	Domestic		4.11	
3	7	1	22	SWNW	1028593	421104	Chilson	Stock	Flowing	3	
4	7	1	15	SESE	1032516	423080	Unknown	Stock	Flowing	5	
5	7	1	14	NENW	1035181	427284	Chilson	Stock	Flowing	1.5	
6	7	1	14	NESE	1037218	425012	Unknown	Stock			
7	7	1	23	NWNW	1033304	422417	Fall River	Domestic		0.056	2 X 40 GPD (Est)
8	7	1	23	SWSE	1036052	418515	Fall River	Domestic		0.14	5 X 40 GPD (Est)
9	7	1	23	NENE	1038003	421806	Fall River	Stock	Flowing	3	
12	7	1	4	SESE	1026978	434378	Chilson	Stock	Flowing	3.3	
13	7	1	3	NWNW	1028360	438470	Chilson	Domestic		0.085	1 X 123 GPD (Est)
14	7	1	2	NWSW	1033704	434723	Fall River	Stock			
15	7	1	2	NENW	1035304	438317	Chilson	Stock			
16	7	1	1	NESW	1041428	434446	Chilson	Domestic			Not In Use
17	7	1	12	SENW	1040223	431329	Fall River	Stock			Windmill - Not In Use
18	7	1	9	SWSW	1022812	428960	Fall River	Domestic		6	
37	7	2	18	NWSW	1044183	423947	Unknown	Stock		2.5	
38	6	1	33	SWNW	1024328	442289	Fall River	Stock	Flowing	1.5	
40	6	1	30	SWNW	1013415	447182	Inyan Kara	Domestic			Not In Use
41	6	1	31	SWNE	1015385	442081	Unknown	Stock			Not In Use
42	7	1	5	SWNE	1021144	436481	Chilson	Domestic		16.2	
43	6	1	34	SWSE	1031123	439436	Chilson	Domestic			Not In Use
49	6	1	32	NWNW	1018932	444022	Fall River	Stock	Flowing	1.2	
51	7	1	9	SENE	1027411	431487	Chilson	Stock	Flowing	12.9	
61	7	1	11	NWSE	1036832	429987	Chilson	Stock			
96	41	60	22	SWSW	1011630	451853	Chilson	Domestic		0.11	4 X 40 GPD
102	6	1	18	SWNE	1016825	458312	Chilson	Domestic		1.5	2 Residents & 2 Gardens
106	6	1	18	NENE	1018099	459625	Unknown	Stock			
107	6	1	18	SWNE	1017018	458158	Fall River	Domestic			Not In Use
108	6	1	18	SWNE	1016478	458698	Fall River	Domestic			Not In Use
109	6	1	17	NENW	1020801	459625	Chilson	Domestic		0.085	1 X 123 GPD (Est)
110	6	1	17	NENE	1023777	459643	Chilson	Stock			
111	6	1	17	NWNE	1022074	459586	Fall River	Stock			
112	6	1	16	SESE	1027864	455881	Fall River	Stock			Windmill - Not In Use
113	7	2	6	NESW	1046437	434417	Unknown	Stock			Not In Use
114	7	2	7	SESW	1045410	428654	Unkpapa	Stock		0.56	40 cows X 20 GPD
115	6	1	18	SENE	1017697	457640	Fall River	Domestic		0.17	2 X 123 GPD
116	6	1	18	SENE	1017992	458111	Fall River	Stock	Flowing	1.5	Dewey Post Office

Hydro ID	Township	Range	Section	1/4 - 1/4 Location	Coordinates East	Coordinates North	Screened Location	Well Use	Status	Flow Rate (GPM)	Notes
117	6	1	8	SWSE	1022177	460796	Unknown	Stock			Not In Use
138	6	1	18	NENE	1017537	459030	Fall River	Domestic		0.75	2 Residents & 10 Horses
147	6	1	17	NESW	1020879	456566	Chilson	Monitor			
220	6	1	19	SENE	1017872	452334	Unknown	Stock	Flowing	0.2	
270	6	1	19	NWSW	1014108	451942	Unknown	Stock	Flowing	0.8	
436	6	1	20	NWNE	1021450	454700	Fall River	Monitor			
506	7	2	8	SWNW	1050129	430704	Unkpapa	Stock			
510	7	1	12	SESE	1042933	428178	Chilson	Stock			
609	6	1	29	SWNE	1021735	447808	Chilson	Monitor			
610	6	1	29	SWNE	1021599	447969	Fall River	Monitor			
611	6	1	20	NWNE	1021835	453954	Chilson	Monitor			
612	6	1	20	NWNE	1021755	454128	Chilson	Monitor			
613	6	1	20	NWNE	1022125	453775	Fall River	Monitor			
614	6	1	20	NWNE	1022185	453769	Fuson	Monitor			
615	6	1	20	NWNE	1022172	453708	Chilson	Monitor			
616	6	1	20	SWNE	1022132	453134	Chilson	Monitor			
617	6	1	20	NENW	1021026	453582	Chilson	Monitor			
618	7	1	2	SENE	1038074	435906	Unknown	Stock			
619	7	1	2	SENW	1034866	436729	Chilson	Stock			
620	6	1	35	NWNW	1033951	443209	Chilson	Stock			
622	6	1	20	NENE	1022776	454033	Chilson	Monitor			
623	6	1	20	NENE	1022686	454311	Fall River	Monitor			
628	6	1	20	SESE	1022496	449718	Fall River	Stock			
631	6	1	23	SWSW	1034177	449309	Fall River	Stock			
635	7	1	14	NENW	1004085	427131	Sundance	Monitor			
637	7	1	11	NESE	1038075	430320	Unknown	Monitor			
638	7	1	2	NENE	1038269	437976	Fall River	Monitor			
639	7	2	7	SENW	1045704	430722	Unknown	Stock			
640	7	1	12	SESE	1043010	427965	Unknown	Stock			
642	7	1	12	SESE	1042926	428042	Unknown	Stock			
645	7	1	16	NENE	1027681	427998	Unknown	Stock			
650	7	1	1	SESE	1043781	433331	Chilson	Stock			
656	6	1	31	SENW	1014230	442000	Unknown	Stock	Flowing	6.25	
657	6	1	20	NWNE	1021483	454729	Chilson	Monitor			
662	7	1	11	SESW	1035381	428928	Unknown	Monitor			
668	7	1	15	NWNE	1031029	427450	Inyan Kara	Stock	Flowing	6.25	Measured @ ST
676	6	1	34	SESW	1030846	439891	Alluvial	Monitor			
677	7	1	4	SWSW	1023527	434077	Alluvial	Monitor			

Hydro ID	Township	Range	Section	1/4 - 1/4 Location	Coordinates East	Coordinates North	Screened Location	Well Use	Status	Flow Rate (GPM)	Notes
678	7	1	9	SWNE	1026522	431925	Alluvial	Monitor			
679	6	1	27	NWSE	1032294	446245	Alluvial	Monitor			
680	7	1	11	NESW	1035078	429969	Chilson	Monitor			
681	6	1	32	NENW	1020330	443725	Fall River	Monitor	Flowing		Shut-In
682	7	1	11	SENW	1035139	431257	Chilson	Monitor			
683	6	1	29	NESW	1020212	446104	Fall River	Monitor			
684	7	1	11	NESW	1035191	429744	Chilson	Monitor			
685	6	1	32	NWNE	1020690	443409	Fall River	Monitor	Flowing		Shut-In
686	7	1	11	NESW	1034970	429749	Chilson	Monitor			
687	6	1	32	NENW	1020081	443724	Fall River	Monitor	Flowing		Shut-In
688	7	1	11	NESW	1035027	429974	Fall River	Monitor			
689	6	1	32	NENW	1020316	443789	Chilson	Monitor	Flowing		Shut-In
690	7	1	11	NESW	1035114	429970	Unkpapa	Monitor	Flowing		Shut-In
691	6	1	32	NENW	1020364	443698	Fall River	Monitor	Flowing		Shut-In
692	7	1	11	NESW	1035075	430014	Chilson	Monitor			
693	6	1	32	NENW	1020327	443661	Unkpapa	Monitor	Flowing		Shut-In
694	7	1	15	NWNW	1028717	426836	Fall River	Monitor	Flowing		Shut-In
695	6	1	32	SESE	1022385	439312	Fall River	Monitor	Flowing		Shut-In
696	7	1	15	NWNW	1028538	427141	Chilson	Monitor	Flowing		Shut-In
697	6	1	32	SESE	1022350	439347	Chilson	Monitor	Flowing		Shut-In
698	7	1	2	NESW	1035909	435651	Fall River	Monitor			
703	7	1	1	SWSE	1041621	434334	Unkpapa	Domestic			Not In Use
704	7	1	5	SWNE	1020966	436647	Chilson	Domestic		1.5	1 Resident & Stock (est)
705	6	1	21	NENE	1028624	453314	Chilson	Monitor			
706	6	1	21	NENE	1028589	453276	Fall River	Monitor			
707	6	1	34	SWNE	1031935	441809	Alluvial	Monitor			
708	7	1	3	SESW	1030254	434094	Alluvial	Monitor			
709	7	1	15	SENW	1029286	426603	Alluvial	Monitor			
3026	7	1	12	NENE	1043638	432833	Chilson	Monitor			
4002	6	1	30	NWSW	1013414	446931	Inyan Kara	Domestic		2.72	
7002	7	1	23	NWNW	1033333	421931	Chilson	Stock		3.45	


Black Hills National Forest (BHNF)
BHNF
BLM
SD School
South Dakota
Wyoming
Nebraska
Legend
POWERTECH (USA) INC.
POWERTECH (USA) INC.
Exhibit 4-1
Dewey-Burdock Project
Area of Review Map
0 0.25 0.5 0.75 1
Miles
1:16,000
N

Hydro ID	Township	Range	Section	1/4 - 1/4 Location	Coordinates East	Coordinates North	Screened Location	Well Use	Total Depth	Screened Interval	Screened Aquifer	Work to Complete
1	7	1	9	SESE	1027696	429227	Chilson	Stock				1 Inch Camera
2	7	1	16	SESE	1026724	423922	Chilson	Domestic	650	566-650		Need Access, Artesian
3	7	1	22	SWNW	1028593	421104	Chilson	Stock				1 Inch Camera
4	7	1	15	SESE	1032516	423080	Unknown	Stock				1 Inch Camera & Access
5	7	1	14	NENW	1035181	427284	Fall River	Stock	175	155-175	Lower Fall River	Complete
6	7	1	14	NESE	1037218	425012	Unknown	Stock	200	135-200		Complete
7	7	1	23	NWNW	1033304	422417	Fall River	Domestic	200			Need Access, Artesian
8	7	1	23	SWSE	1036052	418515	Fall River	Domestic	240			Need Access, Artesian
9	7	1	23	NENE	1038003	421806	Fall River	Stock				1 Inch Camera
12	7	1	4	SESE	1026978	434378	Chilson	Stock	805			1 Inch Camera
13	7	1	3	NWNW	1028360	438470	Chilson	Domestic	625	580-625		Complete
14	7	1	2	NWSW	1033704	434723	Fall River	Stock	300		Lower Fall River	1 Inch Camera
15	7	1	2	NENW	1035304	438317	Chilson	Stock				Ready, Dry Hole
16	7	1	1	NESW	1041428	434446	Chilson	Domestic	330			Remove Shed
17	7	1	12	SENW	1040223	431329	Fall River	Stock				Need Access, Pull Windmill
18	7	1	9	SWSW	1022812	428960	Fall River	Domestic	527			Need Access
37	7	2	18	NWSW	1044183	423947	Fall River	Stock	145	93-145	Upper Fall River	Complete
38	6	1	33	SWNW	1024328	442289	Fall River	Stock	494			Pull Pump
40	6	1	30	SWNW	1013415	447182	Inyan Kara	Domestic				1 Inch Camera & Access
41	6	1	31	SWNE	1015385	442081	Unknown	Stock				Need Access
42	7	1	5	SWNE	1021144	436481	Chilson	Domestic	600			Need Access, Artesian
43	6	1	34	SWSE	1031123	439436	Chilson	Domestic				Need Access
49	6	1	32	NWNW	1018932	444022	Fall River	Stock	600	475-540	Upper Fall River	Complete
51	7	1	9	SENE	1027411	431487	Chilson	Stock				Need Access
61	7	1	11	NWSE	1036832	429987	Chilson	Stock				Ready
96	41	60	22	SWSW	1011630	451853	Chilson	Domestic				Need Access
102	6	1	18	SWNE	1016825	458312	Chilson	Domestic				Need Access
106	6	1	18	NENE	1018099	459625	Unknown	Stock	196	160-196		Complete
107	6	1	18	SWNE	1017018	458158	Fall River	Domestic				Need Access
108	6	1	18	SWNE	1016478	458698	Fall River	Domestic				Need Access
109	6	1	17	NENW	1020801	459625	Chilson	Domestic				Need Access
110	6	1	17	NENE	1023777	459643	Chilson	Stock				Need Access
111	6	1	17	NWNE	1022074	459586	Fall River	Stock				Need Access
112	6	1	16	SESE	1027864	455881	Fall River	Stock				Need Access, Pull Windmill
113	7	2	6	NESW	1046437	434417	Unknown	Stock				Need Access, Pull Windmill
114	7	2	7	SESW	1045410	428654	Unkpapa	Stock				Need Access, Pull Windmill
115	6	1	18	SENE	1017697	457640	Fall River	Domestic				Need Access
116	6	1	18	SENE	1017992	458111	Fall River	Stock				Need Access
117	6	1	8	SWSE	1022177	460796	Unknown	Stock				Pull Pump
138	6	1	18	NENE	1017537	459030	Fall River	Domestic				Need Access
147	6	1	17	NESW	1020879	456566	Chilson	Monitor	750	650-750		Complete
220	6	1	19	SENE	1017872	452334	Unknown	Stock		463-523+	Upper Fall River	Complete
270	6	1	19	NWSW	1014108	451942	Unknown	Stock				1 Inch Camera

Hydro ID	Township	Range	Section	1/4 - 1/4 Location	Coordinates East	Coordinates North	Screened Location	Well Use	Total Depth	Screened Interval	Screened Aquifer	Work to Complete
436	6	1	20	NWNE	1021450	454700	Fall River	Monitor	590	505-590	Lower Fall River	Complete
506	7	2	8	SWNW	1050129	430704	Unkpapa	Stock				Ready
510	7	1	12	SESE	1042933	428178	Chilson	Stock				Need Access, Pull Pump
609	6	1	29	SWNE	1021735	447808	Chilson	Monitor	1000	903-966	Lower Chilson	Complete
610	6	1	29	SWNE	1021599	447969	Fall River	Monitor	680	630-672	Lower Fall River	Complete
611	6	1	20	NWNE	1021835	453954	Chilson	Monitor	804	695-730, 755-800	Middle Chilson, Lower Chilson	Complete
612	6	1	20	NWNE	1021755	454128	Chilson	Monitor	800	692-800	Lower Chilson	Complete
613	6	1	20	NWNE	1022125	453775	Fall River	Monitor	580	504-580	Lower Fall River	Complete
614	6	1	20	NWNE	1022185	453769	Fuson	Monitor	620	609-620	Fuson	Complete
615	6	1	20	NWNE	1022172	453708	Chilson	Monitor	800	712-800	Lower Chilson	Complete
616	6	1	20	SWNE	1022132	453134	Chilson	Monitor	835	735-835	Lower Chilson	Complete
617	6	1	20	NENW	1021026	453582	Chilson	Monitor	810	715-810	Lower Chilson	Complete
618	7	1	2	SENE	1038074	435906	Unknown	Stock				Complete
619	7	1	2	SENW	1034866	436729	Chilson	Stock	288	230-288	Upper Chilson	Pull Pump
620	6	1	35	NWNW	1033951	443209	Chilson	Stock				Need Access, Pull Pump
622	6	1	20	NENE	1022776	454033	Chilson	Monitor	780	714-780	Lower Chilson	Complete
623	6	1	20	NENE	1022686	454311	Fall River	Monitor	580	503-580	Lower Fall River	Complete
628	6	1	20	SESE	1022496	449718	Fall River	Stock	520		Upper Fall River	Need Access, Pull Pump
631	6	1	23	SWSW	1034177	449309	Fall River	Stock	80	30-80	Lower Fall River	Need Access, Pull Pump
635	7	1	14	NENW	1004085	427131	Sundance	Monitor				Not A Well
637	7	1	11	NESE	1038075	430320	Unknown	Monitor				1 Inch Camera
638	7	1	2	NENE	1038269	437976	Fall River	Monitor				Plugged?, Need to Verify
639	7	2	7	SENW	1045704	430722	Unknown	Stock				Ready, Hand Dug Well
640	7	1	12	SESE	1043010	427965	Unknown	Stock				Pull Pump
642	7	1	12	SESE	1042926	428042	Alluvial	Stock	33	12-33	Alluvial	Complete
645	7	1	16	NENE	1027681	427998	Unknown	Stock				Need Access, Pull Pump
650	7	1	1	SESE	1043781	433331	Chilson	Stock				Pull Pump
656	6	1	31	SENW	1014230	442000	Unknown	Stock				Remove Shed to Access
657	6	1	20	NWNE	1021483	454729	Chilson	Monitor	800	715-800	Lower Chilson	Complete
662	7	1	11	SESW	1035381	428928	Unknown	Monitor				1 Inch Camera
668	7	1	15	NWNE	1031029	427450	Inyan Kara	Stock	550	300-350, 495-550	Lower Fall River, Lower Chilson	Complete
676	6	1	34	SESW	1030846	439891	Alluvial	Monitor	22.5	12-22	Alluvial	Complete
677	7	1	4	SWSW	1023527	434077	Alluvial	Monitor	14.5	4-14	Alluvial	Complete
678	7	1	9	SWNE	1026522	431925	Alluvial	Monitor	14.5	4-14	Alluvial	Complete
679	6	1	27	NWSE	1032294	446245	Alluvial	Monitor	39	29-39	Alluvial	Complete
680	7	1	11	NESW	1035078	429969	Chilson	Monitor	436	426-436	Lower Chilson	Complete
681	6	1	32	NENW	1020330	443725	Fall River	Monitor	600	585-600	Lower Fall River	Complete
682	7	1	11	SENW	1035139	431257	Chilson	Monitor	460	450-460	Lower Chilson	Complete
683	6	1	29	NESW	1020212	446104	Fall River	Monitor	650	635-650	Lower Fall River	Complete
684	7	1	11	NESW	1035191	429744	Chilson	Monitor	423	413-423	Lower Chilson	Complete
685	6	1	32	NWNE	1020690	443409	Fall River	Monitor	595	580-595	Lower Fall River	Complete

POWERTECH (USA) INC.

Hydro ID	Township	Range	Section	1/4 - 1/4 Location	Coordinates East	Coordinates North	Screened Location	Well Use	Total Depth	Screened Interval	Screened Aquifer	Work to Complete
686	7	1	11	NESW	1034970	429749	Chilson	Monitor	428	418-428	Lower Chilson	Complete
687	6	1	32	NENW	1020081	443724	Fall River	Monitor	608	593-608	Lower Fall River	Complete
688	7	1	11	NESW	1035027	429974	Fall River	Monitor	255	245-255	Lower Fall River	Complete
689	6	1	32	NENW	1020316	443789	Chilson	Monitor	730	715-730	Middle Chilson	Complete
690	7	1	11	NESW	1035114	429970	Unkpapa	Monitor	631	621-631	Unkpapa	Complete
691	6	1	32	NENW	1020364	443698	Fall River	Monitor	505	490-505	Upper Fall River	Complete
692	7	1	11	NESW	1035075	430014	Chilson	Monitor	335	325-335	Upper Chilson	Complete
693	6	1	32	NENW	1020327	443661	Unkpapa	Monitor	930	910-930	Unkpapa	Complete
694	7	1	15	NWNW	1028717	426836	Fall River	Monitor	392	377-392	Lower Fall River	Complete
695	6	1	32	SESE	1022385	439312	Fall River	Monitor	508	493-508	Lower Fall River	Complete
696	7	1	15	NWNW	1028538	427141	Chilson	Monitor	587	572-587	Middle Chilson	Complete
697	6	1	32	SESE	1022350	439347	Chilson	Monitor	682	667-682	Middle Chilson	Complete
698	7	1	2	NESW	1035909	435651	Fall River	Monitor	205	180-205	Lower Fall River	Complete
703	7	1	1	SWSE	1041621	434334	Unkpapa	Domestic	525	475-525	Unkpapa	Complete
704	7	1	5	SWNE	1020966	436647	Chilson	Domestic				Complete
705	6	1	21	NENE	1028624	453314	Chilson	Monitor	460	428-458	Middle Chilson	Complete
706	6	1	21	NENE	1028589	453276	Fall River	Monitor	316	284-314	Lower Fall River	Complete
707	6	1	34	SWNE	1031935	441809	Alluvial	Monitor	44	30-40	Alluvial	Complete
708	7	1	3	SESW	1030254	434094	Alluvial	Monitor	28	17-27	Alluvial	Complete
709	7	1	15	SENW	1029286	426603	Alluvial	Monitor	40	28-38	Alluvial	Complete
3026	7	1	12	NENE	1043638	432833	Chilson	Monitor	196	166-196	Middle Chilson	Complete
4002	6	1	30	NWSW	1013414	446931	Inyan Kara	Domestic				Need Access, 1 Inch Camera
7002	7	1	23	NWNW	1033333	421931	Chilson	Stock	500			Need Access, Artesian

Powertech (USA) Inc.

Standard Operating Procedure (SOP)

Groundwater Well Water Level Monitoring

This SOP outlines procedures for measuring and documenting artesian and sub-surface water levels within groundwater monitoring wells.

Materials:

- Powertech Groundwater Well Monitoring Data Sheet.
- Electric Logging Water Level Measuring Tape.
- High-Resolution Digital Pressure Gauge.
- Tape Measure with 1/100th foot accuracy.

Personal Protective Equipment (PPE):

- Several potential hazards exist during groundwater well water level monitoring. These include but are limited to pinch-points, pressure, slip/trip/fall, and environmental hazards. Appropriate PPE must always be utilized when conducting groundwater well water level monitoring.

Documentation:

- The person conducting the groundwater well monitoring must completely and accurately fill out the Groundwater Well Monitoring Data Sheet.
- The person conducting the groundwater well monitoring must read and sign the SOP for Groundwater Well Water Level Monitoring. A copy of the signed SOP should be filed at the nearest Powertech Field Office. A copy of the SOP must accompany the person conducting the monitoring in the field.

Procedures:

1. Completely fill in the Powertech Groundwater Well Monitoring Data Sheet.
2. Procedure for pressurized artesian groundwater wells.
   a. Fully shut-in the artesian groundwater well so that there are no leaks that result in the loss of artesian pressure. This may require some tightening or replacement of plumbing fixtures. A closable valve should be fitted to the well head that allows the attachment of the high-resolution digital pressure gauge. This valve and other plumbing fittings should not be removed, so that future measurements can be conducted at the same elevation.
   b. Make sure that all air has been evacuated from the artesian groundwater well. The high-resolution digital pressure gauge can now be installed and turned on. Make sure that the gauge has been reset, or zeroed out.

c. Take an initial pressure measurement in pounds/square-inch (PSI) and document the measurement and time on the Powertech Groundwater Well Monitoring Data Sheet. Pressure measurements should be taken with an accuracy of 0.01 PSI.
d. Continue to take and document pressure measurements until the artesian water well pressure has stabilized. A stabilized artesian pressure measurement is defined as one of the following:
    a. A pressure measurement that reaches a maximum value, and then slightly decreases, but does not exceed the maximum documented value within a period of 15 minutes.
    b. If the pressure measurements DO NOT fluctuate more than 0.04 PSI (or 0.1 feet of water head) over 3 measurements within a 15 minute time period.
e. Make sure to measure the vertical distance between the surveyed control point (Top of Casing or Survey Pin) and the pressure sensor diaphragm on the pressure gauge. This measurement must be taken with an accuracy of 1/100th of a foot.

3. Procedure for sub-surface water level groundwater wells.
    a. Lower the probe of an Electric Logging Water Level Measuring Tape into the groundwater well, and lower at a slow rate. Be careful not to let the probe and tape unwind too quickly as they may come free of the spool and be lost into the well.
    b. Also make sure that the probe sensitivity is adequately adjusted. The deeper the water is in the well, the less sensitivity the probe will require. This is important as condensation in the well could give false readings of the water level in the well.
    c. Measure and document the depth to the water in the well from the top of the well casing. This measurement must be logged with an accuracy of 1/100th of a foot. Make sure to take several measurements to ensure an accurate final water level.

I certify that I have read and understand the content of this Standard Operating Procedure.

Employee Signature: ____ Date: ________________

SOURCE F

RESPEC RESPONSES TO NUCLEAR REGULATORY COMMISSION COMMENTS (REVISION 1)

(Letter from Crystal Hocking, RESPEC, to Mark Hollenbeck, Powertech (USA) Inc., July 22, 2010)

RESPEC
WATER & NATURAL RESOURCES

RSI(RCO)-1853/7-10/20

External Memorandum

To: Mr. Mark Hollenbeck
Powertech (USA) Inc.
310 2nd Avenue
P.O. Box 812
Edgemont, SD 57735

cc: Mr. John Mays, Powertech
Mr. Cory Foreman, RESPEC
Project Central File 1853 — Category A

From: Ms. Crystal Hocking
Staff Geologist
RESPEC
P.O. Box 725
Rapid City, SD 57709

Date: July 22, 2010

Subject: Responses to Nuclear Regulatory Commission Comments (Revision 1)

The purpose of this memorandum is to respond to the five tasks designated by Powertech to help respond to Nuclear Regulatory Commission (NRC) comments regarding the technical report. These tasks were outlined by Mr. John Mays and you at a meeting with RESPEC on June 24, 2010.

Task 1. Check Well 650 and Compare Water Level to Depth to Lakota to Determine Saturated/Unsaturated Conditions at That Location

In an effort to help identify areas where the Lakota Formation is fully saturated, water level measurements of Lakota wells were compared to the elevation of the top of the aquifer. Tables 1 and 2 include well completion and water level measurements for Wells 650, 3026, and 619. Well locations are shown on Figure 1.

The elevation of the top of the Lakota at Well 650, 3,775 feet, was approximated by interpolating the known depth to Lakota at Well 3026 with the location of the outcrop (where the depth equals 0). The average water level measurement is at 3,682 feet elevation, or 92 feet below the approximate top of the Lakota. At the location of Well 3026 (DB08-01-06), the water level is approximately 60 feet below the top of the Lakota Formation. At both of these wells, the Lakota is only partially saturated. At Well 619, the water level in the Lakota is approximately 300 feet above the top of the Lakota Aquifer based on estimates of the Lakota elevation from the sitewide structural contour maps; here the Lakota is fully saturated.

Table 1. Well Completion for Wells 650, 3026, and 619

Hydro I.D. or Hydro Code	650	3026	619
Powertech Borehole I.D.		DB08-01-06	
Formation	Lakota	Lakota	Lakota
Subsurface (SS) or Free-Flowing (FF)	SS	SS	SS
Depth (ft)	Unknown	196	280
Screened Interval (ft)	Unknown	166–196	Unknown
Measuring Point	Top of 8-inch steel casing	Top of 6-inch casing pipe	Top of 5-inch steel coupling on casing
Surveyed Well Casing Elevation (ft)		3,820.48	3,700.12
Stick Up (Well Casing Mark) (ft)		–0.20	0.00
Surveyed Control Point Elevation (ft)	3,821.06		3,698.82
Stick Up (Control Point) (ft)	–0.56		
Calculated Measuring Point Elevation (ft)	3,821.62	3,820.68	3,700.12

In an effort to better delineate where the Lakota Aquifer becomes fully saturated, RESPEC recommends Powertech acquire water levels from two or three additional Lakota wells in close proximity to the outcrop. Recommended wells include Wells 16, 61, and/or 620 (Figure 1). None of these wells have well completion reports, although they are listed in Tennessee Valley Authority (TVA) reports as being completed within the Lakota. Well 16 is listed in the TVA draft Environmental Impact Statement (EIS) as having a water elevation of 3,747 feet, and based on approximations from structure contour maps, the elevation of the Lakota is 3,730 feet or just below the water level of the Lakota. Based on this information alone, it appears that Well 16 is at or very near the area where the Lakota Aquifer becomes fully saturated. From this, it is reasonable to assume that the transition from saturated to unsaturated conditions in the Lakota is located geographically in the central to western portion of the Fall River Formation outcrop. However, because of fluctuations in the water table with time and precipitation patterns, it is highly recommended to take a new water level measurement at Well 16, the only Lakota well located on the Fall River outcrop.

Task 2. Check Field Notes to Verify Data on Existing Potentiometric Surfaces Is Correct

Water level data for wells with questionable data were spot checked to compare field notes with the tabular data. An explanation of the results is provided in the following sections.

— DRAFT —

Table 2. Water Level Measurements for Wells 650, 3026, and 619

Hydro I.D. or Hydro Code	650	3026	619
Powertech Borehole I.D.		DB08-01-06	
Date	**ft above mean sea level**		
2007-09-27			3,679.13
2007-10-02	3,682.35		
2007-11-09	3,682.35		3,679.19
2008-02-20	3,682.13		
2008-03-24	3,681.92		
2008-03-30		3,681.89	
2008-04-22		3,681.77	
2008-05-21		3,682.13	
2008-05-28		3,681.73	
2008-05-30	3,682.00		
2008-06-24		3,681.85	
2008-07-13		3,681.78	
2008-08-19		3,681.63	
2008-09-22		3,681.78	
2008-10-20		3,681.83	
2008-11-18		3,681.85	
2008-12-17		3,682.50	
2009-01-20		3,682.53	
2009-02-24		3,682.50	
Number	5	13	2
Mean Water Level Elevation	**3,682**	**3,682**	**3,679**
Elevation of Top Lakota	**3,775**[(a)]	**3,741**	**3,375**
Difference[(b)]	**-92**	**-59**	**304**

(a) Based on interpolation.

(b) Negative value indicates Lakota Aquifer is unsaturated at well location. Positive value indicates Lakota Aquifer is saturated at well location.

— DRAFT —

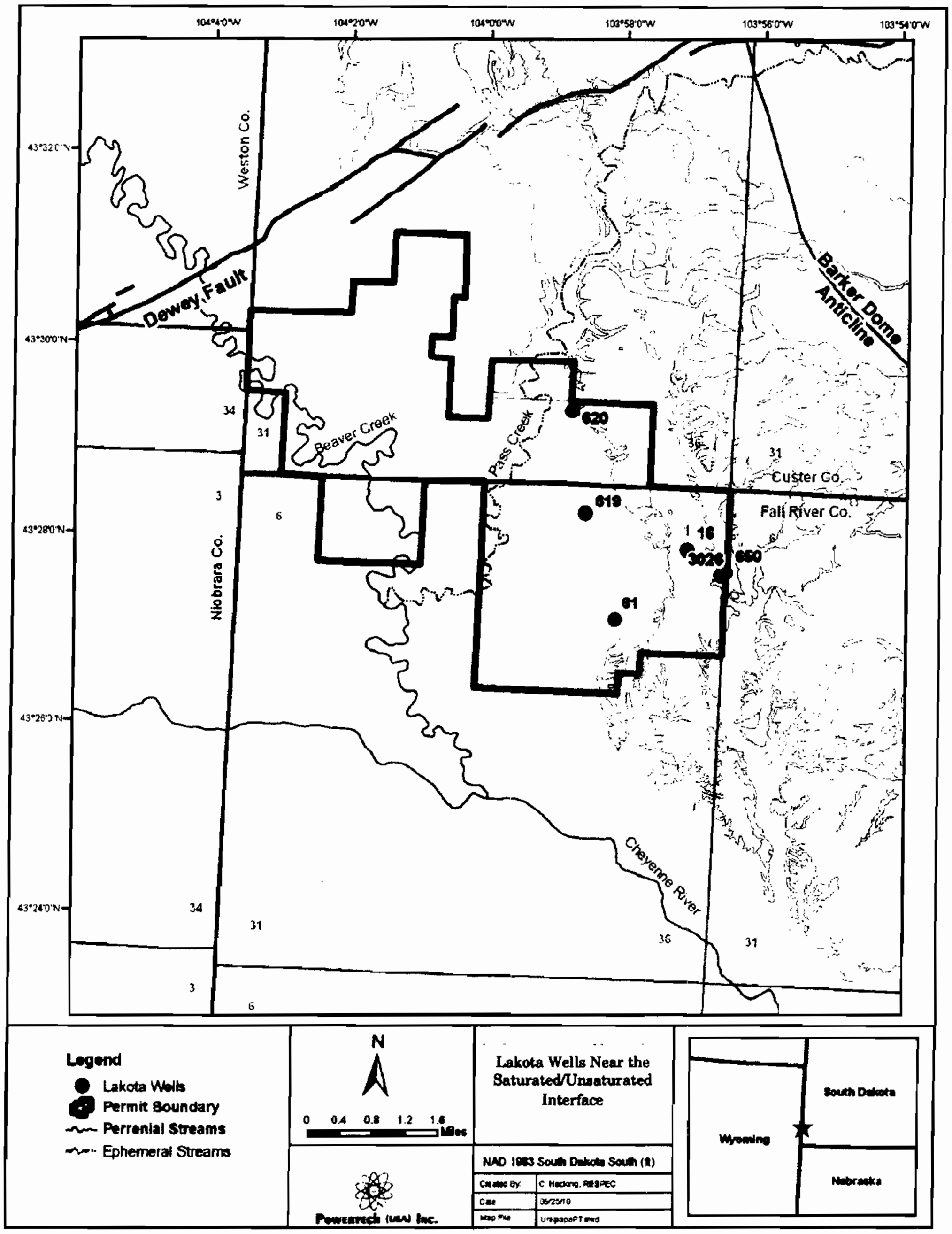


Figure 1. Lakota Wells Near the Saturated/Unsaturated Interface.

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Fall River Aquifer

Well 613 and Well 622. These two wells are both completed to similar depth in the Fall River Formation (well completion reports available) and are located about 700 feet apart. Both wells have a total depth of 580 feet and similar surface elevation with well 613 screened between 504 and 580 feet and well 622 screened between 503 and 580 feet. The average water levels reported on Figure 2.7-14 of the NRC technical report (TR) are correct as compared to original field notes. These two wells have a difference in head of about 8 feet based on recent averages (3,701 and 3,709 feet elevation, respectively); at the time these wells were drilled, they also exhibited a difference of 8 feet (3,711 and 3,719 feet elevation). The difference in head between these two closely spaced wells is likely the result of minor differences in lithology and permeability of the aquifer.

Well 695. The mean water elevation for this well is 3,632 feet and is correct as presented on Figure 2.7-14 of the NRC TR. The pressure has a mean average of 12 pounds per square inch (psi) with individual measurements that range from 12.7 to 13.8 psi. As in all free-flowing wells, psi is converted to feet by the formula:

$$\text{Feet } H_2O \text{ above measuring point} = \text{psi} \times \left(144\,\text{in}^2/\text{ft}^2\right) \times \left(\text{ft}^3/62.43\,\text{lb}\right). \quad (1)$$

Lakota Aquifer

Well 8002. This Lakota stock well has an average elevation of 3,578 feet as presented on Figure 2.7-15 of the TR. This value was not used while generating the water level contours for several reasons. First, this well is a free-flowing artesian that was shut in during measurements; although no leaks were visible, it is possible that this well could not completely be shut in, as it is an older well with multiple fittings at the surface. Over the measurement time interval (September 2007 through February 2009), only 3 pressure measurements were made: 13, 15, and 14.65. Based on field notes, the value of 14.65 psi should be discarded as one of the lines froze during the stabilization period and the sampler was required by the landowner to open the valve to prevent well damage. It is also believed that the other two readings were potentially taken before the well had completely stabilized.

In generating the water level contours, Well 608 to the west was considered to have more reliable readings as this well is nonartesian and was measured with a water level tape. Water levels at Well 608 indeed exceeded estimates at Well 8002; that is unexpected and unlikely given the water gradient decreases toward the southwest. Water level data for Well 696, although not used in the generation of the original potentiometric surface, have an average value of 3,639 feet elevation; this value is extremely close to the potentiometric surface generated by ignoring the data from Well 8002. Therefore, it is our position that this decision to not use data from Well 8002 was sound. It is advisable to verify completion of this well and obtain additional water level measurements.

Well 615. Based on six measurements, the mean potentiometric surface at Well 615 is correctly reported at 3,690 feet elevation. A well completion report for this well is available to verify this well is completed into the Lakota.

— DRAFT —

Well 609. There are a total of 11 measurements for this well, all within ± 2 feet of each other. The value of 3,690 feet elevation on the existing potentiometric surface map is correct. A well completion report for this well is available to verify this well is completed into the Lakota. In addition, Well 610 (completed in the Fall River) is immediately adjacent to this well and has a comparable water level of 3,693 feet.

Well 689. This well was recently installed by Powertech as a monitoring well for the Dewey pump test. It is screened for 15 feet in the upper Lakota Formation. A total of 11 pressure measurements were collected from this well, ranging from 23 to 25 psi. The mean water level of 3,684 feet presented on the potentiometric surface is correct according to our database and field records.

Well 38. Based on the TVA EIS, this stock well is located in Sec. 33, T6S, R1E with a depth of 550 feet and completed in the Lakota. However, data from a well completion report (Figure 2) indicate this well has a depth of 494 feet. The surface elevation at this well is roughly 3,630 feet, making the depth of this well have an elevation of 3,136 feet (assuming the well completion report is correct). Based on structure contour maps, the bottom of the Fall River (top of Fuson) is around 3,130 feet. Based on the depth reported on the well completion form and the structural contour information based on exploration boreholes, this well is now believed to be completed in the Fall River Formation and not the Lakota Formation. The mean water elevation of 3,644 feet measured at this well could be used in the future to slightly modify the potentiometric surface for the Fall River Formation; the measured value is not unreasonable for the Fall River. Since this is a free-flowing well, it is also possible the water level could be higher than measured if shut in for a longer period of time. If potentiometric surfaces are redrawn in the near future, it is recommended to not include Well 38 on the Lakota surface. It is also recommended to log this well to verify completion.

Task 3. Generate Map of Potentiometric Surfaces That has Wells Labeled by Well I.D.

Existing potentiometric surfaces for the Fall River, Lakota, and Unkpapa Aquifers are presented in Figures 3 through 6. Contours have not been modified from previous versions. Figure 5 is a revised potentiometric map of the Lakota that has wells not used in generating contours removed to reduce confusion.

Task 4. Compile Water Level Data and Completion Information Into a Table

Tables 3 through 8 contain the field water level measurements and calculated water table elevations. Tables 3 and 4 contain data for the Inyan Kara Aquifers, Tables 5 and 6 contain alluvial aquifer information, and Tables 7 and 8 contain water level information on the Unkpapa Aquifer.

— DRAFT —

Form # 9

DRILLER'S FINAL REPORT

OFFICE OF STATE ENGINEER
Pierre, South Dakota

Well No. ______ (do not fill in)

CUSTER COUNTY

Location: SW NW Section 33 Twp. 6S Range 1E

Owner George Putnam Address Burdock, S. Dak.

Depth 494 Drawdown ______ Type Rig Used cable tool

Flow(gpm) ______ Pressure ______ Date Measured ______

Grd. Elev. ______ Water Level Below Ground Surface ______

Temperature ______ Character Water (soft, medium, hard)

Date Commenced ______ Date Completed 11/12/49

x

Section ______

CASING DETAIL

Type	Size	Length	Depth
	4"	497	494

PERFORATIONS

Type	Size	Length	Depth

SCREEN

Type	Size	Length	Depth

Is there a seal between different size pipes? ______ What kind? ______

WATER BEARING SANDS

From ______ To ______

SOURCE OF INFORMATION

PMA office, Fall River Co.

DRILLER'S LOG

From	To	

Bonded Driller Roy Bonar (Signature)

Address Hot Springs, S. Dak.

Figure 2. Well Completion Report for Well 38.

— DRAFT —

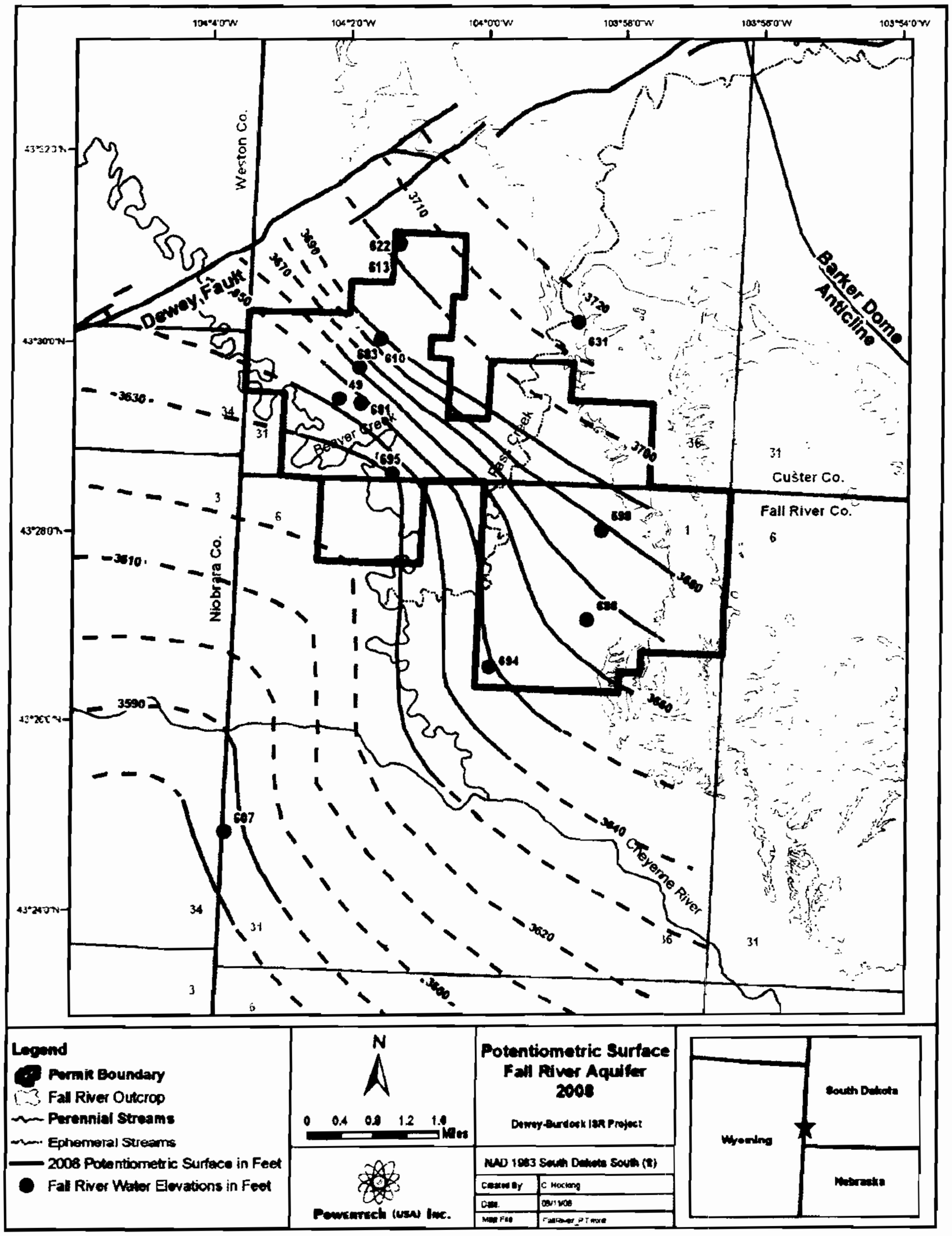

Figure 3. Fall River Aquifer Potentiometric Map With Wells Labeled by Hydro I.D.

— DRAFT —

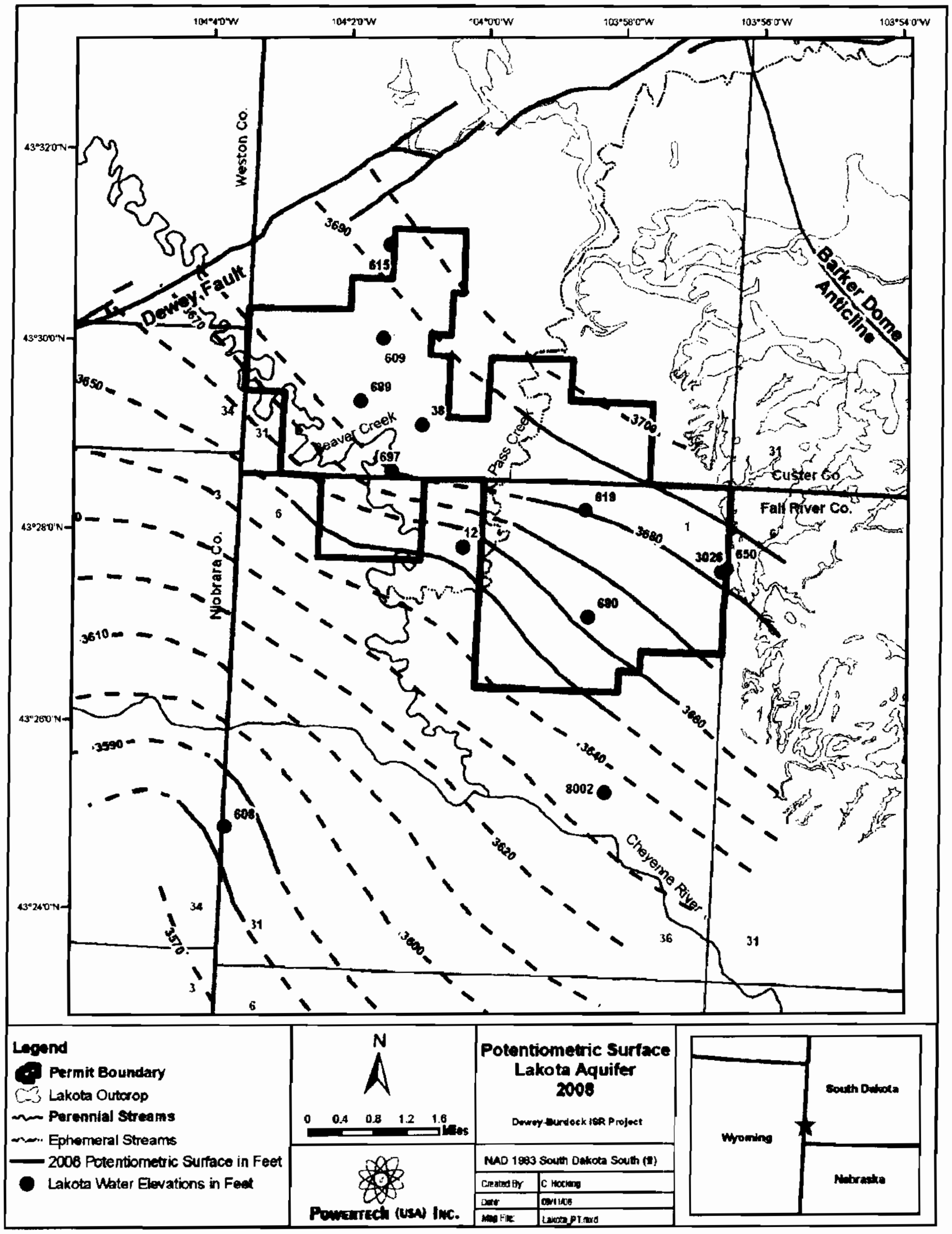

Figure 4. Lakota Aquifer Potentiometric Map With Wells Labeled by Hydro I.D.

— DRAFT —

RSI-1853-10-041

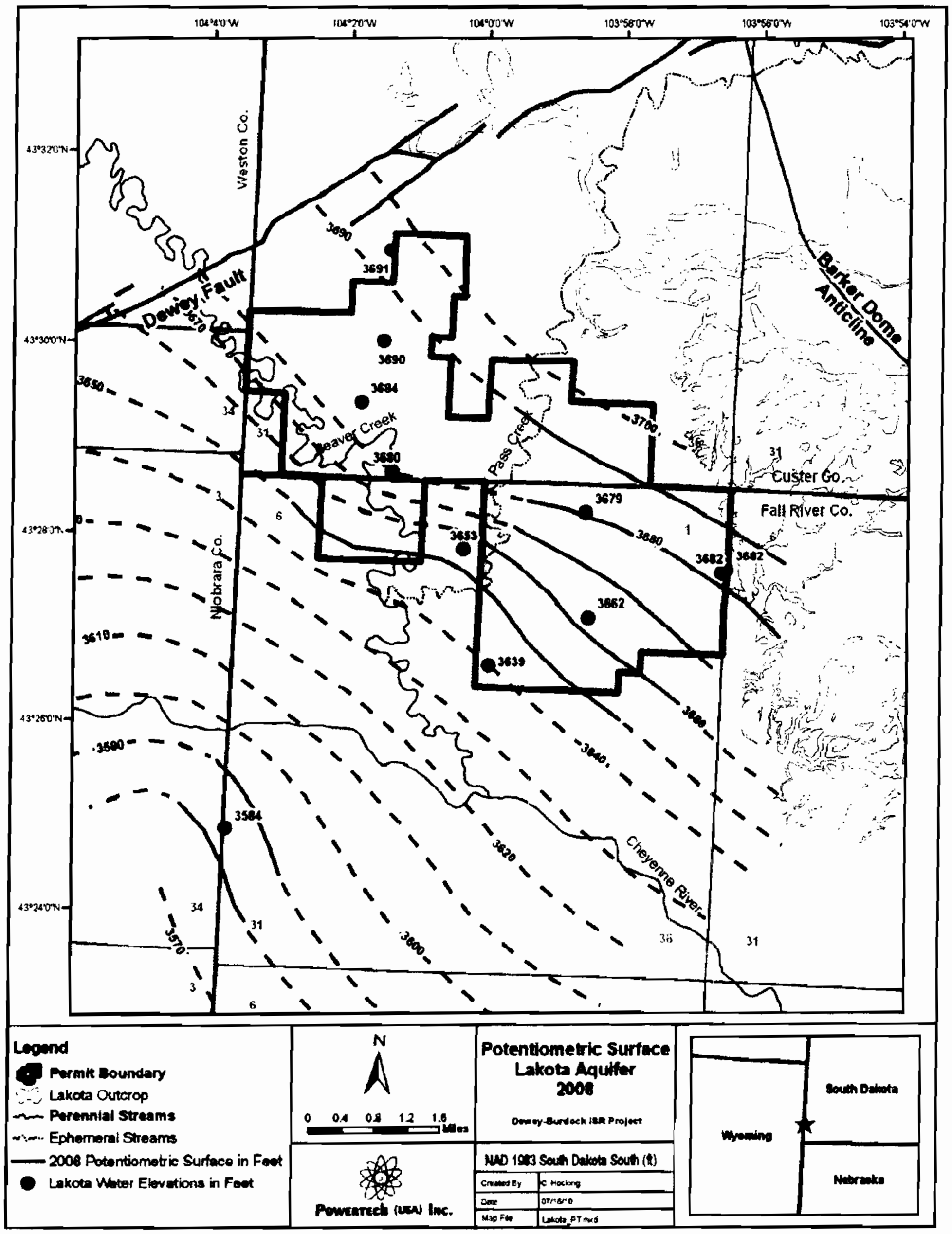

Figure 5. Revised Lakota Aquifer Potentiometric Surface. This map has removed Wells 38 and 8002 and added Well 696 to reflect data that were actually used to generate the contour map.

— DRAFT —

RSI-1853-10-037

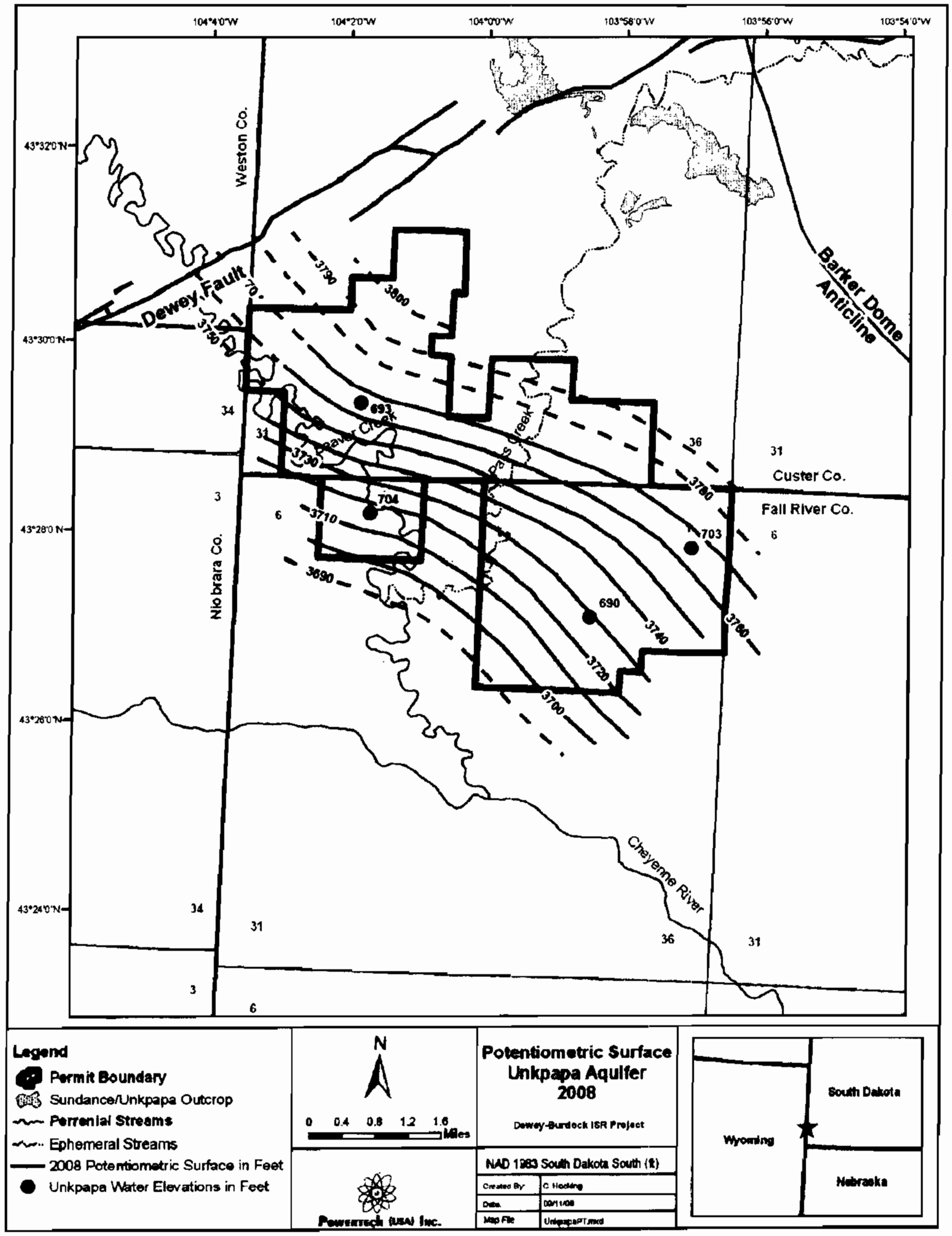

Figure 6. Unkpapa Aquifer Potentiometric Map With Wells Labeled by Hydro I.D.

— DRAFT —

POWERTECH (USA) INC.

Mr. Mark Hollenbeck Page 12 July 22, 2010

683?

Table 3. Inyan Kara Water Level Measurements in Feet or Pounds per Square Inch

Hydro ID or Hydro Code	12	38	43	607	609	609	610	613	614	615	619	622	626	631	650	668	680	681	685	688	689	694	695	696	697	698	3026	5007	5008
Formation	Lakota	Lakota	Fall River	Fall River	Lakota	Lakota	Fall River	Fall River	Fuson Shale	Lakota	Lakota	Fall River	Inyan Kara	Fall River	Lakota	Inyan Kara	Lakota	Fall River	Fall River	Fall River	Lakota	Fall River	Fall River	Lakota	Lakota	Fall River	Lakota	Lakota	Unknown
Depth	305	484	630	unknown	unknown	1000	680	580	620	800	288	600	unknown	98	unknown	unknown	438	603	650	595	255	730	392	508	587	682	205	196	506
Screened Interval	unknown	unknown	unknown	unknown	unknown	953-963	630-672	530-580	609-620	712-800	unknown	530-580	unknown	30-98	unknown	unknown	428-438	530-600	635-650	580-595	245-255	715-730	377-392	493-508	572-587	667-682	185-205	166-196	unknown
Sub-Surface (SS) or Free-Flowing (FF)	FF	FF	FF	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	FF	SS	FF	FF	SS	FF	FF	FF	FF	FF	SS	SS	FF	FF
Targeted Measurement Frequency	Quarterly	Quarterly	Quarterly	Monthly	Monthly	Monthly	Monthly	Quarterly	Quarterly	Monthly	Quarterly	Monthly	Quarterly	Quarterly	Quarterly	Quarterly	Monthly	Monthly	Once	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Quarterly	Quarterly
Measuring Point	End of 2" horizontal steel pipe	Set meter on Black "x" on top of cross member	Black X on concrete slab north side of frame	Top of 2" female coupler on casing	Top of 2" female coupler on casing	Top of female end of 6" steel coupler on casing	Top of female end of 1" steel coupler on casing	Top of 2" female coupler on casing	Top of 5" female coupler on casing	Top of casing	Top of 5" steel coupling on casing	Top of female coupler on casing	Top of pipe	Top of casing	Top of 8" steel casing	Large valve side – middle of 2" pipe	Top of well casing	Top of well casing	Top of well casing	Top of well casing	Top of well casing	Center of 90 elbow	Center of 90 elbow	Center of 90 elbow	Center of 90 elbow	Top of 6" well casing	Top of 6" casing pipe	End of 1" PVC pipe over stock tank	Center of horizontal pipe at valve in yard well
Surveyed Well Casing Elevation, ft	3641.14	3638.75	3628.86	3613.55	3609.25	3700.57	3709.85	3736.03	3741.36	3741.00	3708.12	3752.25	3731.89	3746.37	3821.64	3826.03	3701.94	3625.90	3627.85	3701.25	3627.37	3598.70	3596.80	3597.96	3597.46	3714.25	3820.46	3543.97	
Stick Up (Well Casing Mark), ft	-0.58			-0.07	-0.08	-6.19	-2.49	-0.45	-0.11	-0.54	3.88	-0.49	-1.58	-0.32			2.26	-0.15	-0.13	-0.64	-0.12	-1.71	-2.13	-1.94	-2.56	-0.23	-8.20		
Surveyed Control Point Elevation, ft	3639.51	3637.49	3618.86	3609.88	3608.50	3697.80	3703.79	3735.79	3740.41	3739.83	3698.82	3751.64	3730.36	3745.80	3821.06	3824.11	3701.12	3625.64	3627.43	3700.57	3626.09	3596.79	3596.87	3596.18	3596.67	3713.83	3819.86	3543.42	3543.16
Stick Up (Control Point), ft		-2.15													-0.58	-1.12												-1.43	-1.34
Calculated Measuring Point Elevation, ft	3641.73	3630.64	3618.66	3610.62	3609.34	3700.77	3705.34	3737.58	3741.27	3741.04	3708.12	3753.74	3732.53	3745.10	3821.62	3825.31	3701.66	3627.14	3627.97	3701.50	3627.85	3600.00	3600.93	3598.92	3600.25	3714.48	3820.58	3544.65	3544.50
Units	psi	psi	psi	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet	psi	feet	psi	psi	feet	psi	psi	psi	psi	psi	feet	feet	psi	psi
2007-09-25		2	3.4			-16.299	-12.52	-39.08	-41.13	-49.89			-35.6																
2007-09-26														-29.91														12	
2007-09-27	5.2										-20.98		-36.83																
2007-10-02															-138.27														
2007-10-09																11													
2007-10-26				-26.27		-10.23	-12.53																						
2007-11-09	5	1.9	10	-26.01							-20.92			-29.65	-135.27	11													
2007-11-14						-16.3	-15.22						-37.58	-29.85															
2007-11-19								-36.2	-41.2	-49.88																			
2007-11-27													-36.11			12													
2007-12-11						-10.56	-11.51						-36.31															15	
2008-01-11								-35.8	-41.19	-51.12							-38.96												
2008-01-30				-34.53		-10.93	-10.36										-39												
2008-02-03																	-38.93												
2008-02-05												-43.7																14.68	8.17
2008-02-20						-12.52	-10.74						-36.48	-30.02	135.49														
2008-02-21			9.523	-25.47																									
2008-03-06						-11.22	-42.71	-36.285	-41.25	-58.48				-33.62															
2008-03-09				-35.72												19.65	-36.21												
2008-03-24															-139.7														
2008-03-30																						21.02	14.39		34.2	-34.48	-138.79		
2008-03-31																	-39.15												
2008-04-01										-50.17		-44.64																	
2008-04-21										-50.55		-44.22					-40.5			-39.09									
2008-04-22																							12.9		34.51	-34.5	-138.91		
2008-04-29				-25.41	-25.15	-10.96	-12.7																						
2008-05-08																					24.95								
2008-05-12																		7.63											
2008-05-19						-11.33	-13.02							-32.98									12.72						
2008-05-21																						20.65			34.4		-138.56		
2008-05-28								-36.15	-41.35	-51.07		-44.43								-40.34						-34.8	-138.95		
2008-05-29													-35.58																
2008-05-30															-139.62														
2008-06-01																	-39.62												
2008-06-09				-25.35	-24.69																								
2008-06-10																	-41.12			-31.69									
2008-06-23																							13.06						
2008-06-24																						21.15			34.92	-34.5	-138.83		
2008-06-25								-36.2	-41.35	-51.48		-44.5						6.82		-38.68	25.24								
2008-06-30	4.55	1.87	8.39			-11.69	-12.59									19.35				-39.25									
2008-07-01																		6.46			25.16								
2008-07-13																							13.45				-139.9		
2008-07-14										-51.85		-44.43						6.53			23.58	21.065			34.86	-34.57			
2008-07-28				-25.13	-24.87	-11.61	-13.12													-38.62									
2008-08-13																		5.94		-38.7	23.59		13.58			-34.68	-139.05		
2008-08-20										-51.8		-44.75					-40.92					21.28			34.83				
2008-09-02										-51.97		-44.79					-40.92	5.5			23.52		13.74	17.1		-34.54	-138.9		
2008-09-22																						21			34.5				
2008-09-30																				-38.6									
2008-10-20										-52.13		-42					-49.1	4.5		-38.74	23.1		13.3	17		-34.75	-138.85		
2008-10-21																						21			34.6				
2008-11-17																							13.75	17.2					
2008-11-18										-52.22		-44.22					-39.91	6.2		-38.76	23.3	21			34.6	-34.73	-138.83		
2008-12-16																						21.4	12.4	12.1	34				
2008-12-17										-51.62		-44.93					-42.7	6.4		-37.47	23					-34.5	-138.18		
2009-01-19																	-40.85					17.2	13.1						
2009-01-28										-51.52		-42						6.2		-36.5	24.1			21.3	45.6	-34.82	-138.15		
2009-02-22																							13.7	17.07					
2009-02-24										-51.12		-44.76					-40.7	12		-38.47	24	21.5			34.5	-34.69	-138.16		
n	3	2	4	8	3	11	11	6	6	16	2	13	7	6	5	5	15	11	1	13	11	11	12	6	12	12	13	2	1
Average	4.92	1.95	8.56	-25.53	-24.97	-11.10	-12.46	-36.14	-41.25	-51.19	-20.96	-43.84	-36.67	-30.78	-138.47	11.04	-40.10	6.85	#DIV/0!	-38.25	23.85	20.78	13.36	16.59	35.46	-34.64	-138.76	14.22	8.17

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3.2067 ft/psi
3.28 ft/m
Use throughout

Table 4. Inyan Kara Water Level Measurements in Elevation Above Sea Level

Hydro ID or Hydro Code	12	38	49	607	608	609	610	613	614	615	616	622	626	631
Formation	Lakota	Lakota	Fall River	Fall River	Lakota	Lakota	Fall River	Fall River	Fuson Shale	Lakota	Lakota	Fall River	Inyan Kara	Fall River
Depth	805	494	600	unknown	unknown	1000	890	580	620	800	380	535	unknown	80
Screened Interval	unknown	unknown	unknown	unknown	unknown	933-986	620-673	594-589	808-830	712-808	unknown	533-580	unknown	39-60
SubSurface (SS) or Free-Flowing (FF)	FF	FF	FF	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS	SS
Targeted Measurement Frequency	Quarterly	Quarterly	Quarterly	Monthly	Monthly	Monthly	Monthly	Quarterly	Quarterly	Monthly	Quarterly	Monthly	Quarterly	Quarterly
Surveyed Well Casing Elevation, ft	3641.14		3620.86	3610.55	3603.26	3700.67	3704.85	3738.83	3741.16	3741.00	3700.12	3753.28	3731.09	3743.37
Stick Up (Well Casing Mark), ft	-0.58			-0.37	-3.08	-0.10	-0.48	-0.45	-0.11	-0.54	0.00	-0.46	-0.38	-4.33
Surveyed Control Point Elevation, ft		3637.49	3618.86											
Stick Up (Control Point), ft		-2.75												
Calculated Measuring Point Elevation, ft	3641.72	3635.64	3618.86	3610.62	3609.34	3700.77	3705.34	3737.38	3741.27	3741.54	3700.12	3753.74	3732.55	3765.75
Units	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet
2007-09-25		3644.23	3640.34			3690.47	3692.81	3701.30	3730.14	3691.63			3695.93	
2007-09-26														3715.79
2007-09-27	3653.72										3675.13		3695.72	
2007-10-02														
2007-10-09														
2007-10-26				3584.35		3693.52	3692.87							
2007-11-09	3653.26	3641.05	3641.93	3584.61							3675.19			3716.85
2007-11-14						3693.27	3696.12						3694.86	3715.80
2007-11-19								3701.07	3730.07	3691.85				
2007-11-27													3696.44	
2007-12-11						3693.21	3692.83						3696.24	
2008-01-11								3701.59	3730.08	3693.42				
2008-01-30				3585.69		3689.85	3694.86							
2008-02-03														
2008-02-05												3710.04		
2008-02-20						3688.35	3694.60						3695.07	3718.68
2008-02-21			3641.52	3585.21										
2008-03-04						3689.55	3689.63	3701.68	3730.01	3691.09				3712.58
2008-03-09				3584.90										
2008-03-24														
2008-03-30														
2008-03-31														
2008-04-01										3691.23		3739.10		
2008-04-21										3690.89		3739.52		
2008-04-22														
2008-04-29				3582.21	3584.19	3689.51	3690.54							
2008-05-08														
2008-05-10														
2008-05-12														
2008-05-19						3689.45	3692.32							3713.84
2008-05-21														
2008-05-28								3701.23	3699.95	3695.47		3709.52		
2008-05-29													3695.87	
2008-05-30														
2008-06-01														
2008-06-09				3585.37	3584.65									
2008-06-10														
2008-06-23														
2008-06-24														
2008-06-25								3701.19	3696.65	3690.96		3709.14		
2008-06-30	3652.22	3643.36	3635.80			3684.09	3692.45							
2008-07-01														
2008-07-13														
2008-07-14										3689.80		3739.20		
2008-07-30				3585.40	3584.47	3685.60	3692.22							
2008-08-19														
2008-08-20										3689.74		3739.01		
2008-09-22										3689.57		3738.96		
2008-09-23														
2008-09-30														
2008-10-20										3689.41		3708.74		
2008-10-21														
2008-11-17														
2008-11-18										3689.52		~~[illegible]~~ 3708.61		
2008-12-16														
2008-12-17										3689.82		3708.82		
2009-01-19														
2009-01-20										3689.82 ok		3708.74		
2009-02-23														
2009-03-24										3689.42		3708.98		
n	3	3	4	8	3	11	11	6	6	14	2	13	7	6
Average	3653.06	3644.07	3640.92	3585.88	3584.37	3689.67	3692.86	3701.24	3700.82	3690.24	3675.16	3709.98	3695.87	3714.52

Hydro ID or Hydro Code	653	666	680	681	683	685	686	689	694	695	696	697	698	3026	8002	8003
Formation	Lakota	Inyan Kara	Lakota	Fall River	Fall River	Fall River	Fall River	Lakota	Fall River	Fall River	Lakota	Lakota	Fall River	Lakota	Lakota	Unknown
Depth	unknown	unknown	436	800	650	595	255	730	392	508	587	682	205	196	900	unknown
Screened Interval	unknown	unknown	420-436	380-630	635-650	530-595	245-295	715-730	377-392	483-508	572-587	667-682	189-205	165-186	unknown	unknown
SubSurface (SS) or Free-Flowing (FF)	SS	FF	SS	FF	SS	FF	SS	FF	FF	FF	FF	FF	SS	SS	FF	FF
Targeted Measurement Frequency	Quarterly	Quarterly	Monthly	Monthly	Once	Once	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Monthly	Quarterly	Quarterly
Surveyed Well Casing Elevation, ft			3701.94	3628.89	3663.66	3627.85	3701.26	3627.27	3598.79	3597.83	3597.36	3587.80	3714.26	3620.48		
Stick Up (Well Casing Mark), ft			5.25	-0.15	0.13	-0.12	-0.04	-0.12	-1.71	-3.13	-1.94	-2.56	-0.23	-0.20		
Surveyed Control Point Elevation, ft	3621.06	3624.14													3543.42	3543.16
Stick Up (Control Point), ft	-0.56	-1.17													-1.43	-1.34
Calculated Measuring Point Elevation, ft	3621.62	3625.31	3701.69	3627.14	3663.53	3627.97	3701.30	3627.39	3600.50	3600.93	3599.36	3589.25	3714.49	3620.68	3544.85	3544.50
Units	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet	feet
2007-09-25																
2007-09-26															3574.83	
2007-09-27																
2007-10-02	3602.35															
2007-10-09		3633.58														
2007-10-26																
2007-11-09	3602.33	3633.64														
2007-11-14																
2007-11-19																
2007-11-27		3632.09														
2007-12-11															3575.46	
2008-01-11			3682.69													
2008-01-30			3682.68													
2008-02-03			3682.73													
2008-02-05															3575.64	3563.35
2008-02-20	3602.13															
2008-02-21																
2008-03-04																
2008-03-09		3649.68	3652.41													
2008-03-24	3601.82															
2008-03-30									3648.41	3634.12		3570.14	3680.02	3681.80		
2008-03-31			3663.33													
2008-04-01																
2008-04-21			3660.88				3652.22									
2008-04-22										3633.58		3579.85	3579.58	3681.77		
2008-04-29																
2008-05-08					3624.61			3685.37								
2008-05-10						3645.66										
2008-05-12				3644.75												
2008-05-19										3633.36						
2008-05-21									3648.09			3579.69		3682.10		
2008-05-28							3661.29						3671.68	3681.73		
2008-05-29																
2008-05-30	3602.07															
2008-06-01			3661.85													
2008-06-09																
2008-06-10			3660.56				3668.41									
2008-06-23										3621.06						
2008-06-24									3648.81			3580.83	3671.88	3681.85		
2008-06-25				3642.95 3640.84			3662.48	3663.60								
2008-06-30		3649.65					3662.01									
2008-07-01				3641.99				3665.43								
2008-07-13										3631.85				3681.76		
2008-07-14				3639.69				3621.82	3648.63			3580.80	3579.87			
2008-07-30							3662.68									
2008-08-19				[illegible] 3639.84			3662.69	3661.60		3622.25			3679.89	3681.53		
2008-08-20			3661.08						3648.38			3580.59				
2008-09-22			3660.76	~~[illegible]~~				3661.64		3622.62	3639.83		3679.94	3681.75		
2008-09-23									3648.44			3579.83				
2008-09-30							3662.58									
2008-10-20			3660.58	~~[illegible]~~ 3637.84			3662.56	3660.87		3671.60	3638.11		3675.73	3681.83		
2008-10-21									3648.44			3579.60				
2008-11-17										3632.64	3639.57					
2008-11-18			3661.77	3641.44			3662.54	3661.12	3648.44			3579.60	3679.75	3681.65		
2008-12-16									3649.30	3629.33	3627.81	3578.67				
2008-12-17			3660.96	~~[illegible]~~ 3641.94			3663.83	3660.44					3679.98	3682.59		
2009-01-19			3659.83						3639.80	3632.53						
2009-01-20				3641.44			3662.70	3667.98			3649.03	3727.29	3679.66	3682.53		
2009-02-23										3632.53	3639.13					
2009-03-24			3660.88	3684.61 3654.84			3662.83	3662.73	3649.59			3579.83	3679.80	3682.70		
n	5	3	11	11	1	1	12	11	11	12	6	12	12	13	3	1
Average	3602.15	3639.78	3661.58	3641.76	3659.01	3645.66	3663.05	3662.94	3647.93	3621.81	3638.67	3582.12	3673.84	3681.98	3577.64	3563.35

Water surface elevation (WSE) calculated by subtracting depth measurement from or adding pressure measurement (converted to water head in feet) to measuring point elevation (MPE)
WSE = MPE +/- (measured depth or measured pressure)
Conversion of pressure measurement (psi) to head (ft) uses density of water at 4C
Head (feet of H2O) = Measured Pressure (lb/in²) x 144 (in²/ft²) x 0.01602 (ft³/lb)

need to add 44"?

Table 5. Alluvial Water Level Measurements in Feet Below Measuring Point

Hydro I.D. or Hydro Code	675	676	677	678	679
Targeted Measurement Frequency	Monthly	Monthly	Monthly	Monthly	Monthly
Measuring Point	top of well casing	top of well casing	top of well casing	top of well casing	top of well casing
Distance from Measuring Point to Ground (ft)	2.3	2.4	2.3	2.3	2.3
Approximate Land Elevation From Topographic Map (ft)	3,491	3,662	3,570	3,591	3,717
Calculated Measuring Point Elevation (ft)	3,493.3	3,664.4	3,572.3	3,593.3	3,719.3
Date	ft below measuring point				
9/28/2007	-11.18	-20.14	-11.51	-12.1	-33.6
10/26/2007	-11.04	-20.3	-11.35	-11.73	-33.83
11/9/2007	-10.99	-20.3	-11.25	-11.45	-33.85
11/14/2007					-33.85
11/27/2007	-10.99	-20.37	-11.12	-11.22	
12/11/2007	-10.82	-20.4		-11.15	-33.88
1/11/2008	-10.6	-20.44			-33.87
1/30/2008			-10.17	-10.82	
2/3/2008					-33.88
2/5/2008	-10.37	-20.5	-10.1	-10.81	
3/6/2008	-10.045	-20.53	-9.9	-10.75	-33.93
4/29/2008	-10.42	-20.6	-9.63	-10.38	
5/18/2008					-34.02
6/30/2008		-20.65	-9.45	-10.95	-34.03

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Table 6. Alluvial Water Level Measurements in Elevation Above Mean Sea Level

Hydro ID or Hydro Code	675	676	677	678	679
Formation	Alluvial	Alluvial	Alluvial	Alluvial	Alluvial
Subsurface (SS) or Free-Flowing (FF)	SS	SS	SS	SS	SS
Depth (ft)	14–4	22.5	14.5	14.5	39
Screened Interval (ft)	4–14	12–22	4–14	4–14	29–39
Targeted Measurement Frequency	Monthly	Monthly	Monthly	Monthly	Monthly
Measuring Point	top of well casing	top of well casing	top of well casing	top of well casing	top of well casing
Distance from Measuring Point to Ground (ft)	2.3	2.4	2.3	2.3	2.3
Approximate Land Elevation From Topographic Map (ft)	3,491	3,662	3,570	3,591	3,717
Calculated Measuring Point Elevation (ft)	3,493.3	3,664.4	3,572.3	3,593.3	3,719.3
Date	**ft above mean sea level**				
9/28/2007	3,482.1	3,644.3	3,560.8	3,581.2	3,685.7
10/26/2007	3,482.3	3,644.1	3,561.0	3,581.6	3,685.5
11/9/2007	3,482.3	3,644.1	3,561.1	3,581.9	3,685.5
11/14/2007					3,685.5
11/27/2007	3,482.3	3,644.0	3,561.2	3,582.1	
12/11/2007	3,482.5	3,644.0		3,582.2	3,685.4
1/11/2008	3,482.7	3,644.0			3,685.4
1/30/2008			3,562.1	3,582.5	
2/3/2008					3,685.4
2/5/2008	3,482.9	3,643.9	3,562.2	3,582.5	
3/6/2008	3,483.3	3,643.9	3,562.4	3,582.6	3,685.4
4/29/2008	3,482.9	3,643.8	3,562.7	3,582.9	
5/18/2008					3,685.3
6/30/2008		3,643.8	3,562.9	3,582.4	3,685.3
Mean	**3,483**	**3,644**	**3,562**	**3,582**	**3,685**

— DRAFT —

Table 7. Unkpapa Water Level Measurements in Feet

Hydro I.D. or Hydro Code	690	693	703	704
Targeted Measurement Frequency	Once	Once	Once	Once
Measuring Point	top of casing	top of casing	top of casing	top of casing
Distance from Measuring Point to Ground				2
Surveyed Well Casing Elevation (ft)	3,700.04	3,627.27		
Stick Up (Well Casing Mark) (ft)				
Surveyed Control Point Elevation (ft)	3,699.59	3,626.31		
Stick Up (Control Point) (ft)	0.41			
Calculated Measuring Point Elevation (ft)	3,699.18	3627.27	3,877[a]	3,599[a]
Date	ft above (+) or below (–) measuring point			
5/14/08	29.15	135.77		
5/21/08			–109.96	
5/28/08	30.65			
5/30/08				116.5
6/24/08			–109.4	

(a) Wells were not surveyed. Elevation estimated from topographic map.

Task 5. Generate an Explanation of Water Level Measurement Feasibility for the Wells Listed in the NRC Comments

The wells listed in the NRC review of the TR and an explanation of the feasibility of obtaining a water level measurement from those specific wells is included in Table 9. Figures 7 and 8 display these wells for possible inclusion alongside those wells that are in the current water level monitoring plan. For many of these wells, water level measurements were not easily obtained, but could be obtained with additional work such as pulling a pump and shutting in a well for a period of time. At this time, it is assumed that Powertech will be conducting further field investigations into this matter based on RESPEC's cursory review.

— DRAFT —

Table 8. Unkpapa Water Level Measurements in Elevation Above Sea Level

Hydro I.D. or Hydro Code	690	693	703	704
Formation	Unkpapa	Unkpapa	Unkpapa	Unkpapa
Subsurface (SS) or Free-Flowing (FF)	FF	FF	SS	FF
Depth (ft)	623	930	525	955
Screened Interval (ft)	621–631	910–930	475–525	915–955
Targeted Measurement Frequency	Once	Once	Once	Once
Measuring Point	top of well casing	top of well casing	top of well casing	top of well casing
Distance from Measuring Point to Ground				2
Approximate Land Elevation from topographic map (ft)			3,877	3,599
Calculated Measuring Point Elevation (ft)	3,699.2	3,627.3	3,877	3,599
Date	**ft above mean sea level**			
5/14/08	3,728.3	3,763.0		
5/21/08			3,767.0	
5/28/08	3,729.8			
5/30/08				3,715.5
6/24/08			3,767.6	
Mean	**3,729**	**3,763**	**3,767**	**3,716**

Task 6. Review the Water Rights, Well Completion, and Water Quality for the Well North of Kennobbie's Ranch to Determine Aquifer

Well 4, a stock well located in SESE Sec. 15, T7S, R1E, was brought into question as to which aquifer the well is completed in. A well log indicates this well was originally drilled as on oil exploration well (API# 5093) into the Minnelusa Formation to a depth of 2,264 feet. This log (Figure 9) also indicates the well was plugged and abandoned. RESPEC was not able to find any water rights or well completion information describing how this well was completed as a water well. However, information in Table 2.5.2-1 of the TVA EIS report describes this well (D-19) as being 2,264 feet deep, coinciding with the original drilling depth into the Minnelusa, and with a water level of 3,580 feet elevation.

— DRAFT —

Table 9. Wells for Possible Inclusion in Water Level Measurement Plan (Page 1 of 3)

Aquifer	Well	Free Flowing or Subsurface	Reason for not Measuring Originally	Could be Measured With Minimal Additional Effort	Other Comments
Fall River	7	Unknown	Domestic can not measure without pulling pump	Yes	There is a .las file for this well, so it must be possible to measure
Fall River	8	FF	Domestic can not measure without pulling pump and shutting in for period of time	Maybe	Requires further investigation to determine feasibility
Fall River	17	SS	Stock well would need pump pulled and to stop being use to stabilized	Maybe	Requires further investigation to determine feasibility
Fall River	18	FF	Domestic can not measure without pulling pump and shutting in for period of time	Maybe	Requires further investigation to determine feasibility
Fall River	20	Unknown	Domestic can not measure without pulling pump and shutting in for period of time	Maybe	Requires further investigation to determine feasibility
Lakota	1	FF	Could not be sealed for psi measurement because of leaks caused by corrosion and age	No	Could only be measured if well casing is repaired
Lakota	2	FF	Could not be sealed for psi measurement because of leaks caused by corrosion and age	No	Could only be measured if well casing is repaired
Lakota	13	Unknown	Domestic can not measure without pulling pump; well is no longer used as resident moved	Maybe	Requires further investigation to determine feasibility

— DRAFT —

Table 9. Wells for Possible Inclusion in Water Level Measurement Plan (Page 2 of 3)

Aquifer	Well	Free Flowing or Subsurface	Reason for not Measuring Originally	Could be Measured With Minimal Additional Effort	Other Comments
Lakota	14	SS	Difficult surface access	Maybe	Requires further investigation to determine feasibility
Lakota	16	SS	difficult surface access because of fittings, domestic well would have to be shut in for period	Maybe	Requires further investigation to determine feasibility
Lakota	42	Unknown	Domestic could not measure without pulling pump. Well has been revamped and completed in the Fall River Formation (?)	Yes	We are not sure when or to what formation this well is now completed in.
Lakota	51	FF	Surface casing in poor condition, leaking	No	This well is not measurable under the present condition
Lakota	96	FF	Domestic can not measure without pulling pump and shutting in for period of time	Maybe	Requires further investigation to determine feasibility
Lakota	115	FF	Domestic can not measure without pulling pump and shutting in for period of time; also not measured because of location north of Dewey Fault	Maybe	Requires further investigation to determine feasibility
Lakota	147	SS	Not measured because of location north of Dewey Fault	Yes	This is a 1-inch piezometer that could easily be measured
Lakota	510	FF	Difficult access, would require shut	Maybe	Requires further investigation to determine feasibility

— DRAFT —

Table 9. Wells for Possible Inclusion in Water Level Measurement Plan (Page 3 of 3)

Aquifer	Well	Free Flowing or Subsurface	Reason for not Measuring Originally	Could be Measured With Minimal Additional Effort	Other Comments
Lakota	620	SS	Stock well would need pump pulled and to stop being use to stabilized	Maybe	This well has a good potential for measurement
Lakota	696	FF	Could not be measured at time of potentiometric map generation because of poor or cracked valve fittings. Valves were replaced and RESPEC has record of six measurements from 9/22/08 to 2/22/09	Yes, and it has been	
Lakota	697	FF	This well was inadvertently left off potentiometric maps. It has been measured 12 times between 3/30/08 and 2/24/09.	Yes, and it has been	
Lakota	7002	FF	Because of the age of this well, it is believed that pressurizing may cause a line to rupture	No	Could only be measured if well casing is repaired

This well was sampled three times in 1979 by TVA and once by RESPEC in 2008. Data results are presented in Table 10. In comparison to nearby Well 7 and Well 7002, this well has nearly twice the value of chemical conductivity and sulfates. Conductivity and sulfate values observed at this well are dissimilar from other Inyan Kara wells in the area as well, but values are more compatible with expected water quality for the Minnelusa Aquifer. A detailed statistical comparison of water quality was not conducted at this time.

Based on the available information, it is now reasonable to believe Well 4 may be completed in the Minnelusa Aquifer. It is recommended to try to log this well with a borehole televiewer to confirm the completion of this well.

If you have any further questions or need further explanation of these items, please do not hesitate to contact me.

CMH:llf

— DRAFT —

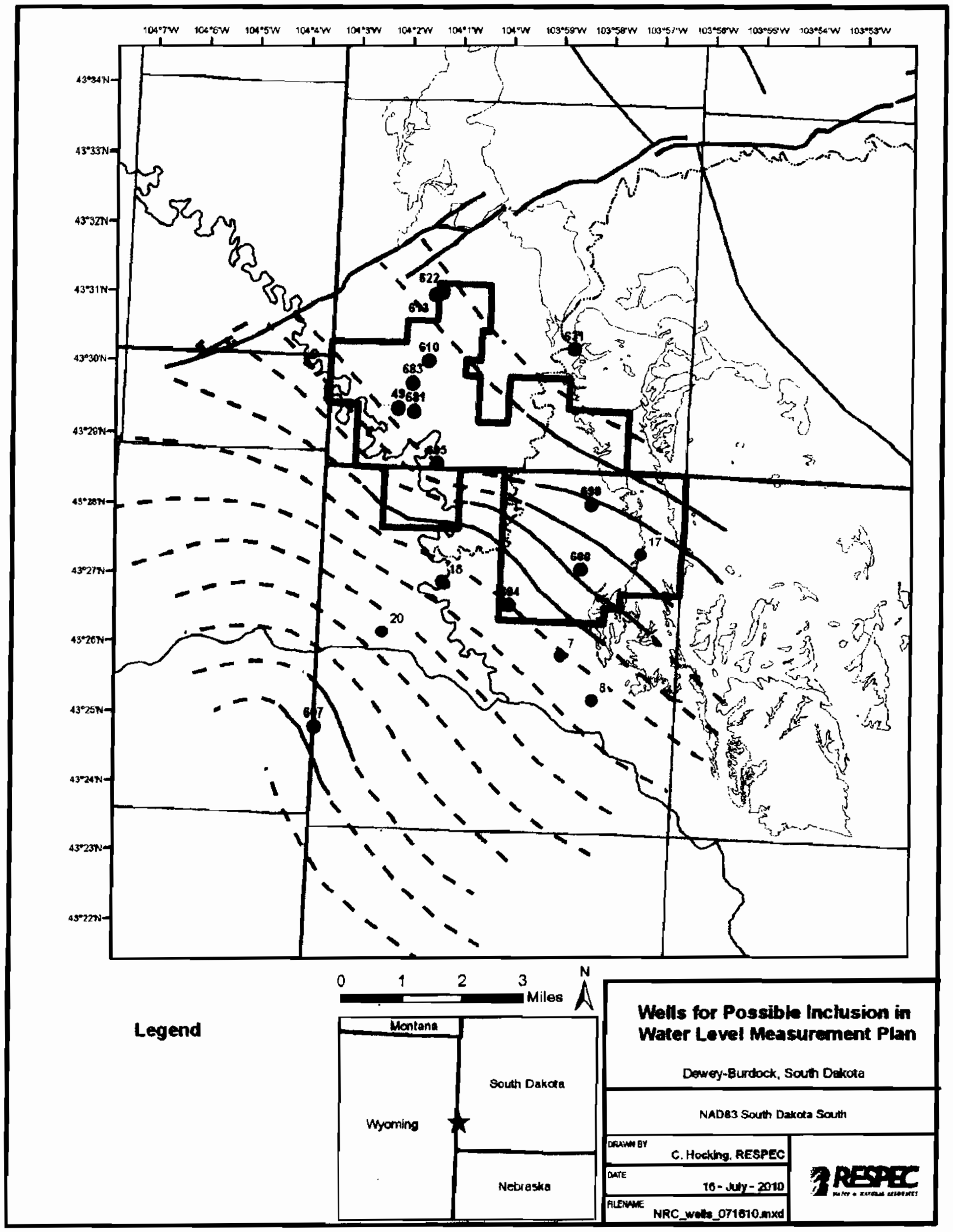


Figure 7. Fall River Aquifer Wells for Possible Inclusion in the Water Level Measurement Plan. Black dots are wells in the current monitoring plan while blue dots are wells not currently included.

— DRAFT —

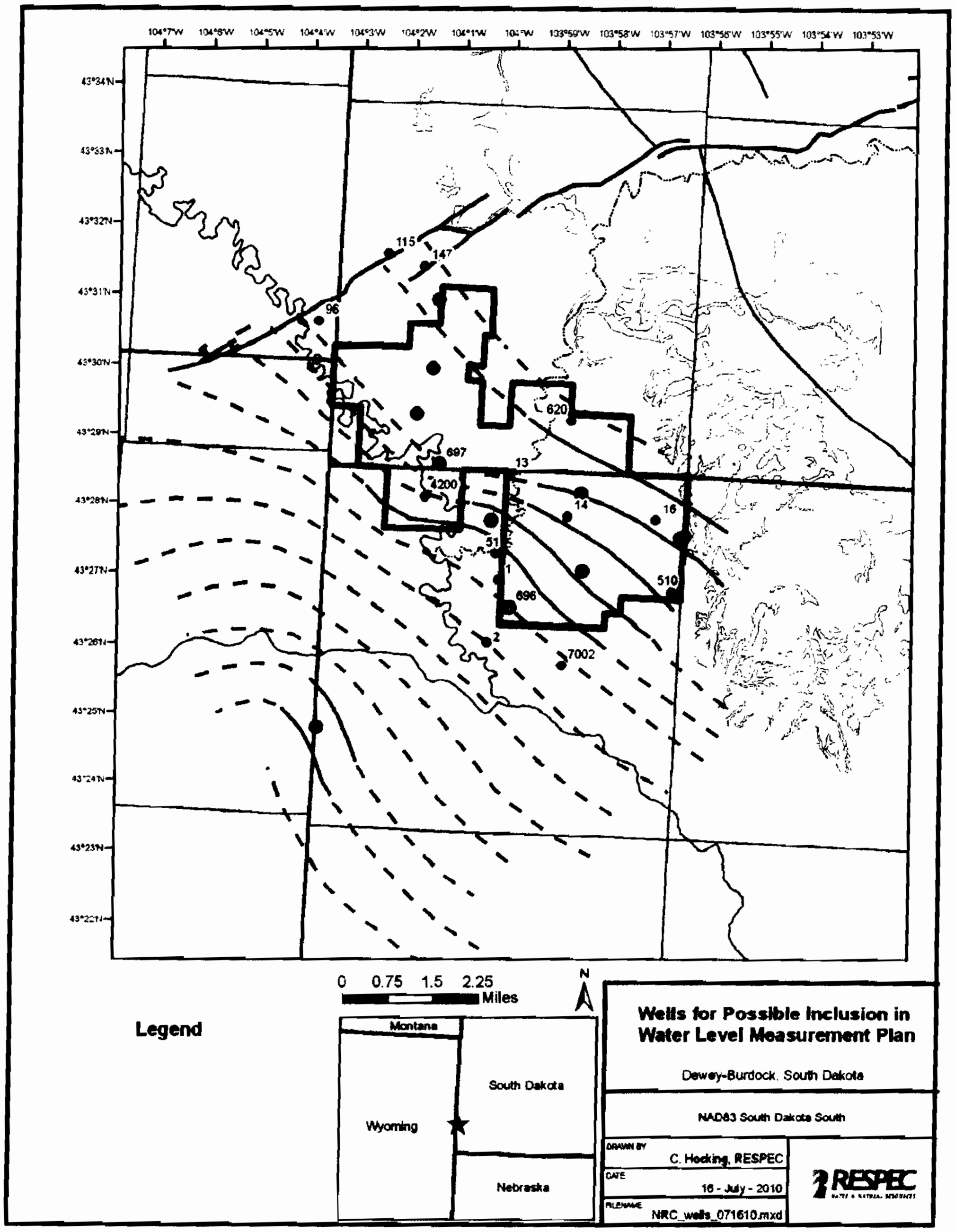


Figure 8. Lakota Aquifer Wells for Possible Inclusion in the Water Level Measurement Plan. Black dots are wells in the current monitoring plan while blue dots are wells not currently included.

— DRAFT —

RECEIVED
FEB 19 1965
STATE WATER RESOURCES COMM.
PIERRE SOUTH DAKOTA

State Pub. Co., Pierre

S. Dak. Oil & Gas Board
FORM 2

APPLICATION FOR PERMIT TO:

☒ DRILL ☐ DEEPEN ☐ PLUG BACK
☐ SINGLE ZONE
☒ OIL WELL ☐ GAS WELL ☐ MULTIPLE ZONE

FARM OR LEASE NAME: Peterson
WELL NO.: #1 (44-15)
FIELD AND POOL, OR WILDCAT:

OPERATOR: The Superior Oil Company
ADDRESS: P. O. Box 200, Casper, Wyoming
NO. ACRES IN LEASE: 2846.03

LOCATION (In feet from an established corner of the legal subdivision.)*
660' FSL & 660' FEL Sec. 15-7S-1E
¼ ¼ SEC. TWP. RGE: SE SE 15-7S-1E
COUNTY: Fall River

NAME AND ADDRESS OF SURFACE OWNER: F. A. Petersen, Edgemont, South Dakota
ELEVATION: 3574 G.L.
PROPOSED DEPTH: 2500'
NO. OF WELLS ETC.:
ROTARY OR CABLE TOOLS: Rotary

NAME AND ADDRESS OF CONTRACTOR: Unknown
APPROXIMATE DATE WORK WILL START: 2-22-65

IF LEASE PURCHASED WITH ANY WELLS DRILLED, FROM WHOM PURCHASED (Name and address)

PROPOSED CASING AND CEMENTING PROGRAM

SIZE OF HOLE	SIZE OF CASING	WEIGHT PER FOOT	NEW OR SECOND HAND	DEPTH	SACKS OF CEMENT
12-1/4"	8-5/8"	24#	New	500	300

DESCRIBE PROPOSED OPERATIONS. IF PROPOSAL IS TO DEEPEN OR PLUG BACK, GIVE DATA ON PRESENT PRODUCTIVE ZONE AND PROPOSED NEW PRODUCTIVE ZONE. GIVE BLOW OUT PREVENTER PROGRAM IF ANY

(1) The Superior Oil Company proposes to drill a 2500' 1st Leo Sand test at the above location.
(2) Will set 8-5/8" csg. at 500' & cmt. to surface.
(3) Will drill 7-7/8" hole to total depth.
(4) Will catch 10' samples from base of surface to TD.
(5) Expect to core & test the 1st Leo Sand plus any other zones that have significant shows.
(6) Will run Dual Induction-Laterolog & GRS logs from TD to base of surf. csg.
(7) Should commercial production be encountered, 5-1/2" casing will be cemented through the productive zone.

SIGNED [signature] TITLE District Engineer DATE 2-11-65

DO NOT WRITE BELOW THIS LINE

PERMIT NO. 382
CHECKED BY [signature] 2/17/65
School and Public Lands
APPROVAL DATE February 18, 1965 [signature] Secretary
CONDITIONS:
☐ COMPLETE SET OF SAMPLES, AND CORES IF TAKEN, MUST BE SUBMITTED.
☐ SAMPLES, AND CORES IF TAKEN, BELOW .... DEPTH, MUST BE SUBMITTED.

STATE SECRETARY OF

INSTRUCTIONS

General: This form is designed for submitting proposals to perform certain well operations, as indicated, on all types of lands and leases for appropriate action by either a Federal or a State agency, or both, pursuant to applicable Federal and/or State laws and regulations. Consult applicable Federal or State regulations, or appropriate officials, concerning approval of the proposal before operations are started.
If the proposal is to re-drill to the same reservoir at a different subsurface location or to a new reservoir, use this form with appropriate notations.
If the well is to be, or has been, directionally drilled, so state and show by attached sheets, if necessary, the coordinate location of the hole in any present or objective productive zone.
File 2 copies of this form with Secretary, Oil & Gas Board, Pierre.
(*Sample location: 660' South and 660' East of the Northwest Corner of Section 16.)

Figure 9. Well Completion Report for Well I.D. #4 (Page 1 of 3).

— DRAFT —

9-063
(December 1949)

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY
WATER RESOURCES DIVISION

SCHEDULED

No. D 7-1-15 dd (center)

OTHER NOS. Superior #1 Peterson (44-15)

WELL LOG

State S. Dak County Fall River Subarea

Owner Superior Oil Company Lease #1 Peterson (44-15)

Location SEE SPECIAL LOG FILE FOR MORE INFORMATION (TD 2264 ft) 660 ft north and 660 ft west of the southeast corner

Drilled by Bamhart Address

Date 2-19 to 3-5-65 Casing diam. plugged & abandoned Land-surf. alt. 3585' Kelly bush 3576

Source of data PI; sonic, caliper, γ-ray, dual induction and composite induction log

(Enter type of well, perforations, yield, and drawdown at end of log)

CORRELATION alt	CORRELATION Cmp	MATERIAL	THICKNESS (feet)	DEPTH (feet) PL
		Dakota		185
	?	Skull Creek		
	187	Inyan Kara		
		Lakota		371
	540	Morrison		
	785	Sundance		771
	1045(?)	Spearfish		
	1522	Minnekahta		1518
	1555	Opeche		1557
	1653	Minnelusa		1645
	.	Red Marker		2108
	2264	TD		
		Cored 2175 to 2221 ft		

RECORD BY DATE SHEET OF

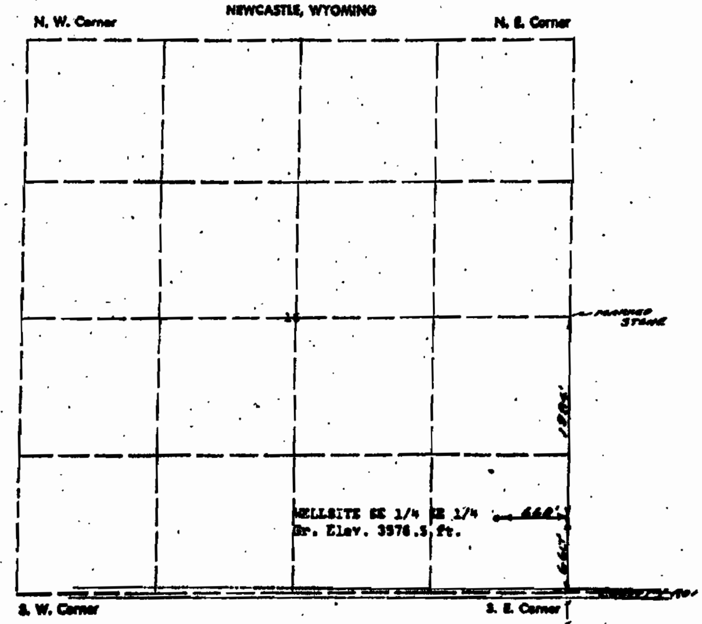
51753
GPO 830-852

Figure 9. Well Completion Report for Well I.D. #4 (Page 2 of 3).

— DRAFT —

ꞮI-STATE COMPA' Y

NEWCASTLE, WYOMING



I, Lawrence T. Price of Newcastle, Wyoming, Certify that in accordance with a request from J. P. Dufke of Casper, Wyoming for The Superior Oil Company P. O. Box 200, Casper, Wyoming

I made a survey (date) February 9 19 62

for the location and elevation of the Peterson No. 1 (44-15) oil wellsite

As shown on above map, the well site is in center SE 1/4 SE1/4

Section 15, Township 7 South Range 1 East

Fall River County, South Dakota Elevation is 3576.5 feet above mean sea level before dozing.

Licensed Surveyor No. 1311

Figure 9. Well Completion Report for Well I.D. #4 (Page 3 of 3).

— DRAFT —

Table 10. Water Quality Data for Well 4 (Page 1 of 4)

	1979-06-15	1979-08-15	1979-09-12	2008-02-12
ALKALIN	80		181	88
ANIONS				53.3
As	0.01		0.01	
B	1		1	
BALANCE	-57.3		-54.9	-2.6
BICARB	73		220	107
B-TDS				1.02
Ca	349		477	
CARB	12		0	5
CATIONS				50.6
Cl	28		26	26
Cond, Field	4,550		4,500	
CONDUCT Lab				4,400
C-SOLIDS				3,600
D-Ag				0.005
D-Al				0.1
D-As				0.001
D-B				0.7
D-Ba				0.1
D-Ca				241
D-Cd				0.005
D-Cr				0.05
D-Cu				0.01
D-Fe				0.03
D-GALPHA				3.5
D-GBETA				14.4
D-GGAMMA				20

— DRAFT —

Table 10. Water Quality Data for Well 4 (Page 2 of 4)

	1979-06-15	1979-08-15	1979-09-12	2008-02-12
D-Hg				0.001
D-K				7.8
D-Mg				87
D-Mn				0.07
D-Mo				0.1
D-Na				716
D-Ni				0.05
DO				
D-Pb				0.001
D-Pb210				1
D-Po210				2.7
D-Ra226				1.1
D-Se				0.001
D-SeIV				0.001
D-SeVI				0.001
D-Si				10.2
D-SOLIDS	4,733		4,117	3,700
D-Th				0.005
D-Th230				0.2
D-U				0.0004
D-V				0.1
D-Zn				0.01
F				0.4
Fe	1.68		1.59	
F-pH				7.83
hardness	1,459		1,392	
K	15		14	

— DRAFT —

Table 10. Water Quality Data for Well 4 (Page 3 of 4)

	1979-06-15	1979-08-15	1979-09-12	2008-02-12
L-pH	8		7.7	7.94
Mg	143		49	
Mn	0.12		0.08	
N	0.64		0.22	
Na	920		743	
NH3				0.8
NO2				0.1
NO3				0.1
ORP				120
Pb	0.05		0.05	
PO4	0.01		0.01	
SAR				10
Se	0.01		0.01	
SiO2	9.4		8.6	
SO4	3,230		2,700	2,440
S-Pb210				1
S-Po210				1
S-Ra226				0.7
S-Th230				0.2
S-U				0.0003
T-Ag				0.005
T-As				0.001
T-B				0.6
T-Ba				0.1
T-Be				0.001
T-Cd				0.005
T-Cr				0.05

— DRAFT —

Table 10. Water Quality Data for Well 4 (Page 4 of 4)

	1979-06-15	1979-08-15	1979-09-12	2008-02-12
T-Cu				0.01
TEMP				11.92
T-Fe				1.32
T-Hg				0.001
T-Mn				0.06
T-Mo				0.02
T-Ni				0.05
T-Pb				0.001
T-Pb210				
T-Po210				
T-Ra222				908
T-Ra226		0.11		
T-Sb				0.003
T-Se				0.002
T-Sr				5.7
TSS	6		5.2	
T-Th230				
T-Tl				0.001
T-U		28		0.0005
TURB				0
T-Zn				0.01
V	0.05		0.05	
Zn	0.01		0.01	

— DRAFT —

SOURCE G

DOMESTIC AND LIVESTOCK WELLS MONITORED DURING FEBRUARY 1982 DEWEY PUMP TEST

(Letter from Gary Cummings, Silver King Mines, Inc., to Peter Martin, Tennessee Valley Authority, April 12, 1982)

D19 820414 007

Silver King Mines, Inc.

P.O. Box 49
Edgemont, South Dakota 57735

RECEIVED
Division of Fuels
APR 14 1982
Uranium Operations Branch
Casper

arms w/

Ewtt
~~dAD~~

April 12, 1982

Peter W. Martin
Technical Engineer
Edgemont Project
Tennessee Valley Authority
P. O. Box 2957
Casper, Wyoming 82602

RE: GWC; 223,82

Dear Pete:

Enclosed you will find the information relating to domestic and livestock wells that were monitored during the Dewey Pump Test.

If you have any questions, please call.

Very truly yours,

SILVER KING MINES, INC.

Gary W. Cummings
Resident Manager

GWC:dlg
Enclosure
cc: R. M. Caywood
D. H. Marks
R. H. Davidson
Mark Boggs

					610	609			40	4002					40U Recompletion?
WELL NUMBERS	119	103	104	39	BPZ 20 FR	BPZ 20 LAK	D-7		40U	40L	102	13	41	48	8Y-1 FR
DATE	FT	GPM	FT	FT	FT	FT	FT		GPM	PSI	GPM	FT	GPM	PSI	PSI
2-16-82	PUMP TEST STARTED															
2-17-82	-	-	-	26.89	Froze	4.88	4.54		-	-	-	-	-	-	-
2-18-82	10.73	.72	9.40	26.93	Froze	14.35	Froze at 4.54		-	-	-	-	-	-	-
2-19-82	-	-	-	26.83	3.91	20.18	4.61		-	-	-	-	-	-	-
2-19-82	-	-	-	-	4:00 PM 3.88	4:00 PM 22.44	-		-	-	-	-	-	-	-
2-20-81	10.69	.75	9.63	26.93	8:20 AM 3.96	8:20 AM 27.59	4.61		-	-	-	-	-	-	-
2-21-82	-	-	-	26.94	1:10 PM 3.95	1:10 PM 35.90	4.83		-	-	-	-	-	-	-
2-22-82	-	-	-	26.84	1:00 PM 3.89	1:00 PM 42.30	4.62		-	-	-	-	-	Stopped Flowing	-
2-23-82	-	-	-	-	3.91	10:30 AM 47.90	-		8:15 AM 1.48 GPM	-	10.80	-	-	-	-
2-23-82	-	-	-	-	-	-	-		2:30 PM .70 GPM	-	-	-	-	-	-
2-24-82	10.77	.70	9.62	Windmill Running	4.70	12:00 noon 54.32	4.78		Dribbles	-	10.90	-	-	-	-
2-25-82	-	-	-	28.43	5.00	10:40 AM 59.64	4.74		Drips	-	10.80	7.10	11.40	-	-
2-26-82	10.70	.72	9.53	-	4.73	12:18 PM 65.20	4.78		No Water	-	10.80	7.35	11.50	-	-
2-27-82	-	-	-	-	-	9:35 AM 69.35	-		-	-	-	-	-	-	-
2-27-82	-	-	-	-	-	3:20 PM 70.81	-		-	-	-	-	-	-	-
2-28-82	-	-	-	-	4.85	10:30 AM 71.00	4.67		-	-	-	-	-	-	-
3-1-82	10.62	.75	9.46	-	4.79	12:30 PM 67.91	4.56		-	-	10.90	5.74	11.40	-	-
3-2-82	-	-	-	-	4.88	1:08 PM 64.82	4.56		-	-	10.90	-	-	-	-
3-3-82	-	-	-	-	5.07	11:50 AM 62.10	4.59		.80	-	10.80	-	-	-	-
3-4-82	10.47	.72	9.52	-	5.29	12:10 PM 59.46	4.70		.80	-	10.80	6.37	11.20	-	-
3-5-82	-	-	-	-	5.49	2:25 PM 56.76	4.75		.92	-	-	-	-	13.54'	-
3-6-82	-	-	-	-	-	11:34 AM 54.89	-		-	-	-	-	-	11.05'	-
3-7-82	-	-	-	-	-	52.60	-		-	-	-	-	-	8.25'	-
3-8-82	10.70	.75	9.48	-	6.00	50.28	4.58		.80	-	10.80	6.63	-	5.54	-
3-10-82	10.42	-	-	-	6.98	46.37	4.58		.50	-	-	-	-	0.80	-
3-11-82	-	-	-	-	-	-	-		Dry	16 GPM 12 PSI	-	-	-	Flow 5 GPM	1.6 GPM 25 PSI
3-12-82	10.18	.77	9.41	-	6.49	42.98	4.61		-	-	9.80	6.86	10.80	Flow 8 GPM	
3-15-82	-	-	-	-	6.73	38.42	4.85		-	14 PSI	-	-	-	Flow 15 GPM	25.8 PSI
3-17-82	-	-	-	-	7.15	36.05	4.99		-	PSI 14.45	-	-	-	5.45 PSI	25.5 PSI
3-19-82	10.50	.72	9.40	-	7.21	2:00 PM 33.48	4.91		-	PSI 15.20	10.6	6.66	-	6.75	25.0
3-22-82	-	-	-	-	7.65	Noon 30.58	5.49		-	PSI 14.75	-	-	-	8.00	25.0
3-24-82	-	-	-	-	7.81	1:00 PM 28.60	4.54		-	PSI 15.75	-	-	-	-	25.25
3-26-82	10.72	.70	9.42	-	7.95	11:45 26.73	4.47		-	PSI 17.25	8.8	9.50	10.5	9.80	25.0
3-30-82	-	-	-	-	7.92	23.38	-		-	PSI 18.40	-	-	-	-	25.0 PSI

626

625

WELL NUMBERS	BPZ LA 22	BPZ FR 22	99	96	106	107	115	147	148	38	49	109	110	111	117
DATE	FT	FT	GPM	GPM	GPM	FT	GPM	FT	FT	GPM	GPM	FT	FT	FT	FT
2-16-82	PUMP TEST STARTED														
2-17-82	70.62	74.92	-	4.00	1.80	1.23	1.15	13.06	-	1.80	2.50	60.35	83.95	8.08	29.78
2-18-82	70.69	74.89	Well in use 1.50	4.00	1.75	1.25	1.15	13.06	-	1.75	Leaks 2.43	60.02	83.68	8.21	29.87
2-19-82	70.63	74.88	-	4.00	1.80	1.27	1.15	13.06	-	1.80	2.38	59.89	83.63	8.13	29.83
2-19-82															
2-20-82	70.74	74.96	1.55	4.00	1.75	1.26	1.15	13.05	-	1.80	2.42	Well in use 60.22	83.65	8.21	29.90
2-21-82	70.75	74.95	-	4.00	1.80	1.55	1.17	13.08	-	1.80	2.35	Well in use 60.60	83.86	8.26	29.94
2-22-82	70.71	74.91	-	9:00 AM 3.90	1.80	1.30	1.17	13.10	-	1.80	2.40	60.32	83.78	8.17	29.89
2-23-82	-	-	-	3.90	-	-	-	-	-	-	2.40	-	-	-	-
2-24-82	70.92	75.10	1.55	3.90	1.80	1.45	1.10	13.35	Water at Surface	1.80	2.40	60.35	83.96	8.33	29.95
2-25-82	70.92	75.09	-	3.90	1.80	1.42	1.10	13.68	Water at Surface	1.80	2.35	60.20	83.94	8.32	30.02
2-26-82	70.87	74.95	1.60	3.90	1.80	1.48	1.15	14.12	Water at Surface	1.80	2.35	Well in use 60.32	83.91	8.25	29.95
2-28-82	70.98	75.00	-	3.70	1.80	1.35	1.20	15.44	0.10'	-	2.35	60.57	84.21	8.29	30.00
3-01-82	70.75	74.87	1.60	3.95	1.80	1.24	1.20	16.32	.60	1.80	2.35	60.15	83.95	8.23	Pump on
3-02-82	70.82	74.85	-	3.95	1.80	1.23	-	17.09	.90	-	2.30	59.83	84.19	8.15	29.77
3-03-82	70.80	74.81	-	3.95	1.80	1.25	1.17	17.93	1.22	-	2.32	59.89	84.27	8.17	29.80
3-04-82	70.84	74.95	1.57	3.95	1.80	1.36	1.20	18.72	1.47	1.80	2.35	59.99	84.31	8.25	29.82
3-05-82	70.97	75.05	-	3.95	1.80	1.42	1.15	19.48	1.74	-	2.32	60.05	84.40	8.30	29.95
3-6-82	-	-	-	-	-	-	-	20.21	-	-	-	-	-	-	-
3-07-82	-	-	-	-	-	-	-	20.85	-	-	-	-	-	-	-
3-08-82	70.99	75.06	1.60	3.95	1.80	1.27	1.20	21.38	1.89	1.80	Leaks 2.35	60.00	84.49	8.31	30.35
3-10-82	70.91	74.98	-	3.75	1.80	1.23	No flow	22.35	1.73	-	-	60.00	84.51	8.16	29.90
3-11-82															
3-12-82	70.78	74.88	1.60	3.95	1.80	1.28	1.10	22.98	1.52	1.80	2.20	60.21	84.60	8.20	29.73
3-15-82	70.51	74.51	-	3.90	1.80	1.52	1.00	23.61	1.43	-	2.25	59.79	84.36	8.11	-
3-17-82	-	-	-	-	-	1.67	.85	23.86	1.41	-	Leaks 2.18	-	-	-	-
3-19-82	70.63	74.67	1.57	3.85	1.80	1.57	Well in use	24.02	1.22	1.80	2.20	59.75	84.40	8.15	
3-22-82	-	-	-	-	-	1.80	1.10	24.05	1.15	-	2.18	-	-	-	-
3-24-82	-	-	-	-	-	1.23	1.12	24.04	.80	-	-	-	-	-	-
3-26-82	70.96	75.00	1.55	3.90	1.80	1.14	1.25	24.06	.76	1.70	2.25	60.02	84.77	8.40	29.92
3-30-82	-	-	-	-	-	-	-	24.02	.13	-	-	-	-	-	-

SOURCE H

ADDITIONAL WATER WELLS IN EDGEMONT PROJECT AREA

(Silver King Mines, Inc., Interoffice Correspondence, Keith Andersen to R.M. Caywood, August 3, 1979)

POWERTECH (USA) INC.

INTEROFFICE CORRESPONDENCE

Company Silver King Mines, Inc. Date August 3, 1979

To: R. M. Caywood

From: Keith E. Andersen Subject: Quarterly Burdock Area Water Levels

Attached are quarterly measurements of Burdock Area water well flow rates and water levels. Wells numbered 135 - 143 are new wells or wells added to our monitoring program by request. Wells numbered 200 - 216 are probable Sundance wells located east of the Burdock Area.

In an effort to obtain all possible information, several measurements of questionable accuracy were made as noted below.

Well No.	Problem
2	Leaking around casing
4	Leaking around casing
7S	Measuring point changes
13	Pipeline use affects flow
33	Measuring point changes
35	Measured inside cylinder drop pipe
36	Leaking around pipeline fittings
37	Measured inside cylinder drop pipe
40	Two wells at different elevations piped together
41	Pump had been operating
42	Leaking around pipeline fittings
52	Measuring point changed
53	Measured through cylinder drop pipe
56	Casing broken out
98	Casing leaking
113	Measured inside cylinder drop pipe
114	Measured inside cylinder drop pipe

Water quality data on these wells is not yet complete.

Keith E. Andersen

Keith E. Andersen, Chief Engineer

F 300 B 4M 7-58

Additional Water Wells In Edgemont Project Area

Well No.	Location
135	T 8 S, R 2 E, Sec. 1 bd
136	T 8 S, R 2 E, Sec. 5 bb
137	T 7 S, R 2 E, Sec. 17 bd
138	T 6 S, R 1 E, Sec. 18 a
139	T 41 N, R 60 W, Sec. 18 dd
140	T 9 S, R 3 E, Sec. 19 bc
141	T 10 S, R 3 E, Sec. 20 aa
142	T 7 S, R 2 E, Sec. 35 bd
143	T 8 S, R 1 E, Sec. 30 dc
200	T 7 S, R 2 E, Sec. 13 ca
201	T 7 S, R 2 E, Sec. 13 ca
202	T 7 S, R 2 E, Sec. 13 ca
203	T 7 S, R 2 E, Sec. 12 cd
204	T 7 S, R 2 E, Sec. 12 cb
205	T 7 S, R 2 E, Sec. 12 ac
206	T 7 S, R 2 E, Sec. 12 ac
207	T 7 S, R 2 E, Sec. 12 aa
208	T 7 S, R 2 E, Sec. 2 bc
209	T 7 S, R 2 E, Sec. 3 da
210	T 7 S, R 2 E, Sec. 2 bd
211	T 7 S, R 2 E, Sec. 12 ba
212	T 8 S, R 3 E, Sec. 8 db
213	T 7 S, R 3 E, Sec. 20 dc
214	T 7 S, R 3 E, Sec. 18 cd
215	T 6 S, R 2 E, Sec. 27 dd
216	T 6 S, R 2 E, Sec. 22 aa
144	T9S, R3E, Sec. 21
145	T8S, R2E, Sec 3 dc
146	T9S, R2E, Sec 21 bc

Additional Water Wells In Edgemont Project Area

No.	Owner	Use	Depth	Probable Aquifer	Remarks
135	Mike Ringer	D,S	360	Lakota	Drilled 1977 - Submersible Pump
136	Ed Dodson	D,S		Spring	Source Uncertain
137	USFS	S			Windmill
138	John Carlson	D	100	Fall River	Drilled 1977, flows, Jet Pump
139	Gerald Darrow	S	620	Lakota	Drilled 1978, flows 20 gpm
140	Ken Barker	D,S			
141	Howard Henderson	S		Spring	Source Uncertain
142	Jack Standen	D,S	280	Fall River	Submersible Pump
143	Jeff Schultz	D,S	1,640	Fall River	Drilled 1962, Submersible Pump @ 440
200	George Hey	D,S	108	Sundance	Water Level 52.7', Submersible Pump
201	George Hey	S	110	Sundance	Pump Jack
202	George Hey	S	200	Sundance	Water Level 16.7'
203	Donald Spencer	D,S	200	Sundance	Submersible Pump at 160
204	Donald Spencer	U	170	Sundance	
205	Mason Miller	U	108	Sundance	Water Level 24.5
206	Mason Miller	D,S	200	Sundance	Water Level 18.4, Jet Pump
207	Mason Miller	D,S			Submersible Pump, Pipeline
208	Mason Miller	S	179	Sundance	Pump Jack
209	Donald Spencer	U	247	Sundance	Water Level 145.2
210	George Hey	S	125	Sundance	Pump Jack
211	Donald Spencer	S	161	Sundance	Pump Jack - Water Level 8.14
212	Carl Reutter	S	2,204		Flows 1.5 gpm, old oil test
213	George Hey	S	100	Sundance	Submersible Pump, Water Level 34.1
214	George Hey	S	270	Sundance	Water Level 39.1
215	Claude Smith	S	900		Water Level 60.7, Submersible Pump, Pipeline
216	Claude Smith	U			Water Level 217.9
144		S,O			Water Level 368.4'

SOURCE I

FOREST SERVICE WELLS AND SPRINGS

(Letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979)

FOREST SERVICE WELLS AND SPRINGS

This list of wells and springs located on U. S. Forest Service land was obtained from the Forest Service office in Newcastle, Wyo. These wells and springs will be visited and an attempt made to determine the aquifer from which they produce. The water on Forest Service land is used by ranches for stock water during the summer months and to supply water for wild life.

Name	Location	
Bennett Canyon Well	T7S, R2E, SW¼, Sec. 7	#114
Driftwood Canyon Well	NW¼, Sec. 16	no match > 2 km
Heck Well	NW¼, Sec. 17	#137 > 2 km
Spencer Well	NE¼, Sec. 7	no match
Bennett # 2 Well	SW¼, Sec. 6	#113
Hey Well	T7S, R3E, SW¼, Sec. 18	> 2 km
Roderick Spring	T7S, R2E, SE¼, Sec. 18	
North Roderick Spring	NE¼, Sec. 17	
North Long Mountain Spring	T7S, R3E, NW¼, Sec. 32	
South Long Mountain Spring	NW¼, Sec. 32	
Dewey Well	T6S, R1E, SW¼, Sec. 5	#120 > 2 km
Cook Well	NW¼, Sec. 9	no match > 2 km
Pass Creek Well	NE¼, Sec. 22	#632 > 2 km
Lower Turkey Spring	T5S, R1E, SW¼, Sec. 32	
Turkey Spring	NE¼, Sec. 32	
Tailend Reservoir Spring	Sec. 15	
Bowl Spring	T5S, R1E, NE¼, Sec. 29	
Bosley Spring	SE¼, Sec. 17	
Barrel Spring	NW¼, Sec. 7	
Sheepwagon Spring	T4S, R1E, SW¼, Sec. 32	
Lower Dugout Spring	NW¼, Sec. 29	
Dugout Spring	NE¼, Sec. 19	
North Spring	Sec. 6	
South Spring	Sec. 6	
Carr Spring	T42N, R60W, SE¼, Sec. 4	
Mix Spring	T43N, R60W, NW¼, Sec. 28	
Pipeline Spring	Sec. 21	
Pollard Spring	NE¼, Sec. 9	

SOURCE J

HYDROGEOLOGIC INVESTIGATIONS AT PROPOSED URANIUM MINE NEAR DEWEY, SOUTH DAKOTA

(Report No. WR28-2-520-128, J. Mark Boggs, Tennessee Valley Authority, October 1983)

SEE APPENDIX 2.7-K FOR THIS SOURCE REPORT

SOURCE K

COORDINATES, ELEVATIONS AND WATER LEVELS FOR BURDOCK PIEZOMETERS

(Letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979)

Coordinates (SKM Grid) and Elevations for Burdock Area Observation Wells

Well	Aquifer	Coordinates		Measuring Point Elevation	Height of Measuring Point Above Ground Level
Original Nine Wells Installed Fall 1976 (Abandoned five Fall 1978)					
B-1 FR 672	Kf	90,856 E	188,869 N	3622.07	- 1.0 ft.
B-2 Aban	Kl	90,808 E	188,859 N	3621.08	0
B-3 FR ?	Kf	93,532 E	190,992 N	3701.16	2.0 ft.
B-3 Aban	Kl	93,583 E	191.005 N	3701.63	1.6 ft.
B-4 Aban	Kl	95,531 E	190,551 N	3679.45	2.58 ft.
B-5 637 Aban	Kl	97,944 E	191,909 N	3731.04	1.9 ft.
B-6 FR 659	Kf	91,925 E	192,493 N	3642.64	0
B-6 660 Aban	Kl	91,874 E	192,472 N	3644.12	0
B-8 661	Kl	100,952 E	193,839 N	3788.58	2.0 ft.
Burdock Well 668	Kf, Kl	91,081 E	189,167 N	3624.16 = GL Elevation	
Four Additional Wells Installed August 1977					
B-7 FR 665	Kf	93,303 E	190,402 N	3671.24	1.75 ft.
B-7 666	Kl	93,279 E	190,373 N	3671.1	2.08 ft.
B-9 FR 646	Kf	91,389 E	187,658 N	3605.42	3.0 ft.
B-9 658	Kl	91,389 E	187,658 N	3605.42	2.6 ft.
Seven Replacement Wells Installed Fall 1978					
B-2 LAK 674	Kf	90,776 E	188,900 N	3621.11	1.3 ft.
B-2 FU 673	Klf	90,767 E	188,841 N	3619.96	0
B-10 FR 671	Kf	91,221 E	189,275 N	3631.19	1.4 ft.
B-10 FU 670	Klf	91,265 E	189,344 N	3630.31	1.6 ft.
B-10 LAK 669	Kl	91,206 E	189,317 N	3631.24	1.6 ft.
B-11 FR 664	Kf	90,805 E	189,721 N	3623.94	0
B-11 LAK 663	Kl	90,843 E	189,739 N	3624.82	1.0 ft.

Source: Letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979

Revised Coordinates and Elevations for Burdock Piezometers

lell	Coordinates		Measuring Point Elevation	Height of Measuring Point to Ground Level
3-1 FR	90,856.22 E	188,868.81 N	3622.07	-1.0
3-2 LAK	90,775.65 E	188,899.89 N	3621.11	1.3 ft.
3-2 Fuson	90,767.34 E	188,841.37 N	3619.96	0'
3-3 FR	93,531.56 E	190,991.69 N	3701.16	2 ft.
3-4	95,530.98 E	190,550.99 N	3679.45	2.58 ft.
3-6 FR	91,924.72 E	192,492.25 N	3642.64	0'
3-6	91,874.49 E	192,471.83 N	3644.12	0'
3-7	93,279.33 E	190,372.99 N	3671.10	2.08 ft.
3-7 FR	93,303.13 E	190,401.62 N	3671.24	1.75 ft.
3-9	91,388.52 E	187,657.99 N	3605.42	3 ft.
3-10 FR	91,220.54 E	189,274.64	3631.19	1.4 ft.
3-10 LAK	91,205.62	189,317.02	3631.24	1.6 ft.
3-10 Fuson	91,265.09	189,343.85	3630.31	1.6 ft.
3-11 LAK	90,842.73	189,738.78	3624.82	1 ft.
3-11 FR	90,805.19	189,720.73	3623.94	0'
Sundance Well	662 5,840.49 E	189,370.12 N	3647.84	3 ft.
Burdock Well	91,081.12	189,167.42	3624.16 = GL Elevation	

Water Level Measurements for Burdock Piezometers

All pressure measurements on 9-21 are 2-2.75 psi lower than previous measurement - gauge may not have been accurate.

B-1	7-20-78	14.25 psi	
	9-21-78	12.25 psi	
	10-13-78	8.80 psi	Burdock well flowing
B-2	7-20-78	16.0 psi	Abandoned 11-10-78
	9-21-78	13.25 psi	
B-3	7-20-78	35.9'	
	8-4-78	36.3'	
	airlifted on 8-4		Abandoned 11-10-78
	8-21-78	36.5	
	9-21-78	36.8	
B-3 FR	7-20-78	37.5	
	8-4-78	37.7	
	airlifted on 8-4		
	8-21-78	37.3	
	9-21-78	37.6	
	10-13-78	38.7	Burdock well flowing
	11-22-78	38.8	
B-4	7-20-78	11.5'	Water Level in Annulus 11.8'
	9-21-78	12.1'	
	10-13-78	13.6	Burdock well flowing
	11-21-78	13.9	Abandoned 12-5-78

Source: Letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979

(Continued - Page 2)

B-5	7-20-78	48.8	
	9-21-78	49.4	
	10-13-78	49.7	Burdock well flowing
	11-21-78	50.0	Abandoned - 12-5-78
B-6	7-20-78	10.3 psi	
	9-21-78	8.25 psi	
	10-13-78	7.75 psi	Burdock well flowing Abandoned 12-5-78
B-6 FR	7-20-78	7.75 psi	
	9-21-78	5.5 psi	
	10-13-78	5.5 psi	Burdock well flowing
B-7	7-20-78	8.9'	
	7-26-78	9.0'	Airlifted
	8-4-78	9.3'	
	8-7-78	9.2'	
	8-21-78	9.2'	Airlifted
	9-21-78	9.3'	Airlifted
	10-13-78	12.6	Burdock well flowing
	11-21-78	11.5	
B-7 FR	7-20-78	17.6'	
	7-26-78	17.4	Airlifted
	8-4-78	12.5'	
	8-8-78	12.4'	
	8-21-78	12.3'	Airlifted
	9-21-78	12.6'	Airlifted
	10-12-78	13.75	Burdock well flowing
	11-21-78	15.5	
B-8	7-20-78	96.25'	
	8-4-78	97.5'	Airlifted
	8-21-78	97.3'	
	9-21-78	97.9'	
B-9	7-20-78	19.2 psi	
	9-21-78	17.0 psi	
	10-13-78	15.0 psi	Burdock well flowing
B-9 FR	7-20-78	17.9 psi	
	9-21-78	16.0 psi	
	10-13-78	15.25 psi	Burdock wel

<u>Outlying Piezometer Wells</u>

Locations:

BPZ 14 & 15 FR	T8S, R2E, sec 23	NE/4	NW/4	NW/4	BPZ 14 #602 BPZ 15 FR #601
BPZ 16 & 17 FR	T7S, R2E, sec 30	SW/4	SE/4	SE/4	BPZ 16 #643 BPZ 17FR #644
BPZ 18 & 19 FR	T40N, R60W, sec 27	SE/4	SE/4	NW/4	BPZ 18 #608 BPZ 19 FR #607
BPZ 20 & 21 FR	T6S, R1E, sec 29	SW/4	NW/4	NE/4	BPZ 20 #609 BPZ 21 FR #610
BPZ 22 & 23 FR	T41N, R60W, sec 9	SW/4	SE/4	SE/4	BPZ 22 #626 BPZ 23 FR #625

Source: Letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979

(Continued - Page 3)

Water Levels:

BPZ 14	7-20-78	130.5'	
	8-7-78	130.2'	Airlifted
	8-22-78	136'	Airlifted
	9-21-78	136.5'	
	10-13-78	136.6	
	11-21-78	135.9	
BPZ-15 FR	7-20-78	59.5'	
	8-7-78	51.5'	Airlifted
	8-9-78	47.7'	
	8-22-78	47.5	Airlifted
	9-21-78	47.7'	Airlifted
	10-13-78	47.8	
	11-21-78	47.5	
BPZ-16	7-20-78	7.0 psi	shut in on this date
	8-9-78		Airlifted
	9-21-78	9.0 psi	
	10-13-78	9.0 psi	
BPZ-17	7-20-78	20.6'	
	8-9-78	20.6'	Airlifted
	8-22-78	21.8'	
	9-21-78	21.9'	
	10-13-78	21.9'	
	11-21-78	22.0'	
BPZ-18	8-7-78	17.5'	
	9-21-78	17.7'	
	10-16-78	17.7	Airlifted
	11-20-78	20.3"	
BPZ-19 FR	8-7-78	21.8'	Airlifted
	8-22-78	18.3'	Airlifted
	9-21-78	18.7'	Airlifted
	10-16-78	21.1	
	11-21-78	19.8	
BPZ-20	7-20-78	4.8'	
	7-31-78	4.75'	Airlifted - much mud
	8-3-78	172.7'	
	8-21-78	83'	Airlifted
	9-20-78	73.3'	Airlifted
	10-12-78	108.5	Airlifted
	11-21-78	89.9	

Source: Letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979

(Continued-Page 4)

BPZ-21 FR	7-31-78	Slight Flow	Airlifted
	8-3-78	15'	
	8-8-78	11.5'	
	8-21-78	6.3'	Airlifted
	9-20-78	7.5'	Airlifted
	10-12-78	9.3	
	11-21-78	8.7	
BPZ-22	7-20-78	65.9'	
	7-31-78	64.5'	Airlifted - much mud
	8-3-78	153.9'	
	8-21-78	89.3'	Airlifted
	9-20-78	76.1'	Airlifted
	10-12-78	85.1'	Airlifted
	11-21-78	70.5'	
BPZ-23 FR	7-20-78	73.2'	
	7-31-78	70'	Airlifted
	8-3-78	72.7'	
	8-21-78	70.3'	Airlifted
	9-20-78	68.6'	Airlifted
	10-12-78	73.8	
	11-21-78	73.3	

Depth of Screen:

BPZ-14	588-630	
BPZ-15 FR	336-378	
BPZ-16	252-294	
BPZ-17 FR	84-126	
BPZ-18	798-882	attempted to set 42' dee
BPZ-19 FR	672-714	
BPZ-20	903-966	
BPZ-21FR	630-672	
BPZ-22	588-630	not pressure grouted
BPZ-23 FR	420-462	

BPZ 14 #602
BPZ 15 FR #601
BPZ 16 #643
BPZ 17FR #644
BPZ 18 #608
BPZ 19 FR #607
BPZ 20 #609
BPZ 21 FR #610
BPZ 22 #626
BPZ 23 FR #625

All wells constructed of 1" blk iron pipe with torch slot screen. Grout pumped down annulus to desired depth with 1" plastic pipe.

Source: Letter from Keith Andersen, Silver King Mines, Inc., to John Hatch, South Dakota Water Rights Commission, January 12, 1979

SOURCE L

CONSTRUCTION AND LOCATION DATA FOR DEWEY PUMP TEST WELLS

(in letter from Keith Andersen, Silver King Mines, Inc., to Steve Stampfli, Office of Surface Mining, South Dakota Department of Water and Natural Resources, March 3, 1982)

WELL #	611 DEWEY TEST WELL	613 D-1 FR	614 D-1 Fu	615 D-1 LK	612 D-2 LK	436 D-3 FR	657 D-3 LK	623 D-4 FR	622 D-4 LK	616 D-5 LK	617 D-6 LK	624 D-7 FR
Hole Number	DWT-99	DWM-51	54	46	47	49	48	52	50	55	56	DXM-1
Date Drilled	10-17-81	7-21-81	9-04-81	7-07-81	7-09-81	7-16-81	7-14-81	7-23-81	7-20-81	9-09-81	9-11-81	7-30-81
Date Completed	10-17-81	8-14-81	9-14-81	8-13-81	8-14-81	8-18-81	8-18-81	8-17-81	8-17-81	9-15-81	9-15-81	7-30-81
Depth Cased	694	504	609	712	692	505	715	503	714	735	715	120
Depth Completed	801	580	620	800	800	590	800	580	780	835	810	120
X-Coord.	80798	80923	80982	80972	80710	80385	80416	81564	81618	81126	80004	76979
Y-Coord.	214898	215036	215035	214972	215068	215595	215658	215330	215281	214090	214495	219008
Collar Elev.	3736.2	3737.3	3741.1	3741.4	3728.5	3738.0	3744.3	3753.5	3751.4	3747.7	3723.3	3723.9
"r"		[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
SWL (12-3-81)	34.16	26.23	32.16	39.68	26.56	21.03	42.37	34.22	49.68	45.86	21.42	Surface

Source: Letter from Keith Andersen, Silver King Mines, Inc., to Steve Stampfli, Office of Surface Mining, South Dakota Department of Water and Natural Resources, March 3, 1982

SOURCE M

BURDOCK MINE AREA HYDROLOGY STATUS REPORT

(Silver King Mines, Inc. Interoffice Correspondence from Keith Andersen to R.M. Caywood, December 18, 1978, provided in a letter from Keith Andersen to John Hatch, South Dakota Water Rights Commission, January 12, 1979)

POWERTECH (USA) INC.

INTEROFFICE CORRESPONDENCE

Company: Silver King Mines, Inc. Date: December 18, 1978

To: R. M. Caywood

From: Keith E. Andersen

Subject: Burdock Mine Area Hydrology Status Report

Uranium ore in economically recoverable quantities has been discovered northwest of Edgemont, South Dakota, near Burdock on lands leased by the Tennessee Valley Authority. The ore is located in the Lakota Formation. Tentative plans call for conventional underground mining techniques which will require dewatering the ore zone during the mining operation. The Lakota Formation and the overlying Fall River Formation are the two principal aquifers supplying domestic water for area ranches. In view of this information, it was apparent that extensive hydrologic investigations would be required in planning the proposed mine.

An attempt has been made to identify all wells and springs having their source in the Fall River or Lakota Formation within approximately a 25 mile radius of the proposed mine. Appended are lists of these wells. The list entitled "Water Wells in the Edgemont Project Area" includes those wells felt most likely to be affected by proposed mine dewatering because of their proximity to the mine and their topographic location along the Cheyenne River Basin. Information on these wells was obtained from personal visits to the wells and with the well owners, Silver King Mines, Inc. files, South Dakota Geological Survey Report #109 "Ground Water Resources of the Western Half of Fall River County, SD" by Jack Keene, and from USGS Hydrologic Atlas "Water Resources of the Powder River Basin and Adjacent Areas, Northeastern Wyoming" by Hodson, Pearl, and Druse. Since completion of this listing in May, 1977, selected wells from this list have been monitered on a quarterly basis. Information on other wells within 25 miles of the proposed mine is as shown on the listings.

In addition to monitering selected existing wells several observation wells have been installed to moniter water levels in the Fall River and Lakota aquifers. Initially nine observation wells were constructed in the Burdock area during the fall of 1976 to moniter water level drawdown during the February, 1977, pump test. Four more wells were installed during August, 1977, to provide additional information for the November, 1977, pump test. To provide additional information on area water levels ten wells were installed during the summer of 1978 at selected locations throughout the project area. Finally, when it appeared that some of the original nine wells were not providing reliable data, five of these wells were cemented off and abandoned and seven replacement wells drilled during the fall of 1978. Information on all of the observation wells is appended.

F 300 B 4M 7-78

A test well was constructed during January, 1977, for the purpose of conducting pump tests and potentially for dewatering use. This well was pumped during the February, 1977, and November, 1977, pump tests.

The well was allowed to free flow after completion until February 11, 1977, the starting date for the first pump test. This flow resulted in pre-pump test drawdown as shown in the attached data. The well was pumped from both aquifers for 337 hours at an average discharge of 261 gpm. The water level in the well stabalized at 433 feet of drawdown after 280 hours. Data from observation well B-2 indicated the static head on the well before it was allowed to flow was about +30 feet. Using a total drawdown of 463 feet the specific capacity of the well was estimated at 0.56 gpm/ft..

Coefficients of transmissibility and storage were estimated from the observation well drawdown data using the time-drawdown graphical solution to the Theis non-equilibrium well formula. It was necessary to estimate the pumping rate from the Fall River and Lakota for this analysis. The Fall River pumping rate was estimated at 100 gpm and the Lakota at 161 gpm. Using these figures, the transmissivity and storage coefficient of the Lakota were estimated at 1600 gpd/ft. and 5.5×10^{-5}, respectively, and at 860 gpd/ft. and 4×10^{-5} for the Fall River.

Since approximately one-half of the domestic wells in the area produce from the Fall River aquifer and since it would be possible to sink a shaft through the Fall River with minimal disturbance to water levels, another pump test was planned to determine if the Fall River and Lakota were hydraulically connected. Four additional observation wells were installed in preparation for this test.

Following the February, 1977, pump test the well was shut in and not allowed to flow at the surface. Water was able to communicate between the aquifers since the well screen was open to both aquifers. During the week of October 25, 1977, the Fall River aquifer was isolated and shut in with a pneumatic packer. The Lakota was allowed to free flow until the pump test, November 14, again resulted in pre-pump test drawdown.

The pump test began at 10:00 a.m. on November 14, and continued until November 17. By the morning of November 17, it appeared that sufficient data had been obtained to determine whether or not leaky aquifer conditions existed in the Burdock area and the initial phase of the test was terminated at 11:30 a.m.. The average pumping rate for this period was 193 gpm. Assuming that the water levels in piezometers B-1 FR and B-2 were the same as the Fall River and Lakota water levels in the well before the pump was installed, the total Lakota drawdown at the end of the initial phase was 267 feet and the total Fall River drawdown was 49 feet. At 11:30 a.m. the pumping rate was increased to 225 gpm in an attempt to provide additional data on the apparent specific capacity of the well and on the rate of drawdown in the Fall River with respect to the head differential between the Fall River and Lakota water levels.

After two hours additional pumping at 225 gpm the Lakota drawdown was 298 feet and the Fall River drawdown was 50 feet. At 1:30 p.m. the pumping rate was increased to 250 gpm. For the next hour the pumping rate fluctuated considerably because the pipeline from the well head to the holding reservoir was not capable of handling the increased flow. The pipeline broke and was repaired several times causing a varying pumping head and varying pumping rate. The pumping rate was cut back to 230 gpm at 3:00 p.m.. The pneumatic packer, which had been set at 200 psi, was pressured to 250 psi at 3:15 p.m. to see what effect this might have on the rate of drawdown in the Fall River. The pump was shutoff at 4:15 p.m. and water level recovery rates monitered.

Time-drawdown data from this pump test indicated a complex hydrologic system in this area, with the effects of both leakage and boundary conditions influencing ground water flow. Early time data indicated a transmissivity of about 1600 gpd/ft. and storage coefficient of about 7.5×10^{-5} for the Lakota, which agreed reasonably well with the values calculated for the first test. Attempts at more detailed analysis of the data were not successful.

Because of the difficulty in analyzing the drawdown data it began to appear that some of the data might be unreliable. To investigate this possibility, cemoton logs were run on wells B-2, B-3, B-4, and B-5. These logs showed the cement grout was not properly placed to isolate the Fall River and Lakota in these wells. These four wells and well B-6 have been abandoned and replaced with seven new wells. Sonic bond logs were run on the new wells, which showed the wells to be properly grouted.

At this time two additional pump tests are planned in the Burdock Area to obtain more reliable hydrologic data on the Lakota and Fall River aquifers. A three-five day test pumping from the Lakota is tentatively scheduled for early January, 1979, followed by a three-five day test pumping from the Fall River.

Keith E. Andersen

Keith E. Andersen, Chief Engineer

SOURCE N

ANALYSIS OF AQUIFER TESTS CONDUCTED AT THE PROPOSED BURDOCK URANIUM MINE SITE, BURDOCK, SOUTH DAKOTA

(Report No. WR28-1-520-109, J. M. Boggs and A.M. Jenkins, Tennessee Valley Authority, May 1980)

SEE APPENDIX 2.7-K FOR THIS SOURCE REPORT

SOURCE O

HYDRO ID 704 RECOMPLETION

(Email from Len Eakin, Powertech (USA) Inc., to Mike Beshore, Powertech (USA) Inc., May 9, 2011)

POWERTECH (USA) INC.

Elizabeth Scheinost

From: Leonard Eakin [leakin@powertechuranium.com]
Sent: Monday, May 09, 2011 4:44 PM
To: Michael Beshore; Frank Lichnovsky; leakin@powertechuranium.com
Cc: escheinost@powertechuranium.com
Subject: re: Putnam Water Well 704
Attachments: _Certification_.htm

For DB08-5-1 the Unkpapa completion date was 4/29/2008. The Unkpapa was cemented off on 1/28/2009 and the Lakota was perf'd by Goodwell on 2/4/2009.

From: "Michael Beshore" <mbeshore@powertechuranium.com>
Sent: Monday, May 09, 2011 4:35 PM
To: "Frank Lichnovsky" <flichnovsky@powertechuranium.com>, leakin@powertechuranium.com
Subject: Putnam Water Well 704

Gents, Could Lisa and myself be provided the following information on well 704. This was the Putnam well that was originally drilled to the Unkpapa, and then cemented up to the Lakota.

Please Provide:
Date Drilled to Unkpapa and the Date Cemented up to the Lakota.

This may have occurred on the same day, but need to make certain so we know what water quality samples are from what.

Thanks, Mike

POWERTECH (USA) INC.

Michael D. Beshore, P.G.
Senior Environmental Coordinator

Powertech (USA) Inc.
P.O. Box 1066
8305 6th Street
Wellington, CO 80549
(970) 282-7777 office
(970) 556-5988 cell
Email: mbeshore@powertechuranium.com
Website: www.powertechuranium.com

Powertech (USA) Inc.

APPENDIX 2.4-A

CULTURAL RESOURCES REPORT

(PLEASE SEE SUPPLEMENTAL SET OF 11 BINDERS)

POWERTECH (USA) INC.

APPENDIX 2.4-B

MEMORANDUM OF AGREEMENT

MEMORANDUM OF AGREEMENT

BETWEEN POWERTECH (USA) INC.

AND THE
ARCHAEOLOGICAL RESEARCH CENTER (ARC), A PROGRAM OF THE SOUTH DAKOTA STATE HISTORICAL SOCIETY, REGARDING THE DEWEY-BURDOCK PROJECT
Located in Custer and Fall River Counties, South Dakota
Establishing Procedures to Avoid or Mitigate Potential Effects on Archeological and Historic Sites pursuant to SDCL 45-6D-14 and SDCL ch. 45-6B

WHEREAS Powertech (USA) Inc. (Powertech) plans to seek a mining permit for the Dewey-Burdock Uranium In Situ Mining Project ("Project") pursuant to the South Dakota Mined Land Reclamation Act (SDCL ch. 45-6B);

WHEREAS the Project consists of construction, operation and reclamation of uranium in situ mining and recovery facilities in Custer and Fall River Counties;

WHEREAS, Powertech has defined the Project's area of potential effect ("APE") as described in Attachment A;

WHEREAS Powertech has determined that the Project may have an affect on archaeological or historic sites that contain or are likely to contain information significant to the state or local history or prehistory, and has consulted, and will continue to consult, with the ARC Archaeologist pursuant to SDCL 45-6D-14 and SDCL ch. 45-6B;

WHEREAS, Powertech has also consulted with the South Dakota Department of Environment and Natural Resources (DENR) regarding the effects of the Project on archaeological or historic properties;

NOW, THEREFORE, Powertech and the ARC agree that the Project shall be implemented in accordance with the following stipulations in order to prevent or mitigate any effect of the Project on archeological or historic sites.

STIPULATIONS

Powertech shall ensure that the following measures are carried out:

I. Archaeological or historic sites threatened or potentially threatened by proposed ground disturbing activity in the current and projected phases of the Project will be investigated prior to the proposed activity to determine their significance or research potential.

II. Historic or archaeological sites located in the remainder of the APE that are not

MP

proposed to be affected, and that were previously identified in the archaeological investigation conducted by Augustana Laboratory ("Augustana") entitled, *A Level III Cultural Resources Evaluation of Powertech (USA) Incorporated's Proposed Dewey-Burdock Uranium Project Locality within the Southern Black Hills, Custer and Fall River Counties, South Dakota* by Kruse *et al.* that was provided to the ARC, will be avoided. If surface disturbance of a site becomes necessary, the ARC will be notified at least 30 days in advance of surface disturbance.

III. Augustana will be authorized to proceed with the evaluation of the selected sites pursuant to the scope of work described in Attachment WWW upon execution of this MOA.

IV. Each quarter during the first year and each year thereafter following the execution of this MOA until it expires or is terminated, Powertech shall provide ARC a summary report detailing work undertaken pursuant to its terms. Such report shall include any scheduling changes proposed, any problems encountered, and any disputes and objections received in Powertech's efforts to carry out the terms of this MOA.

V. DURATION

This MOA will be null and void if its terms are not carried out within five (5) years from the date of its execution. Prior to such time, Powertech may consult with the other signatory to reconsider the terms of the MOA and amend it in accordance with Stipulation VIII below.

VI. UNANTICIPATED DISCOVERIES

If historic or archaeological sites are discovered or unanticipated effects on historic or archeological sites are found during any phase of the Project, Powertech shall temporarily halt any surface disturbing activities in the immediate vicinity and contact ARC. Powertech will not resume its activities in the area until and unless the unanticipated effects or sites are investigated and clearance to proceed is granted by ARC.

VII. REPORTING

Refer to article IV in this MOA.

VIII. DISPUTE RESOLUTION

Should either party to this MOA object at any time to any actions proposed or the manner in which the terms of this MOA are implemented, Powertech and ARC shall consult to resolve the objection. If Powertech determines the objection cannot be resolved, Powertech will:

A. File a petition for a contested case hearing that includes all documentation relevant to the dispute, including Powertech's proposed resolution, with the South

MW

Dakota Board of Minerals and Environment (BME), which is the entity with jurisdiction over such mining activities pursuant to SDCL ch. 45-6B, and including 45-6B-33.3 to -33.8, inclusive . The BME shall timely schedule a hearing on the issues and shall notify all parties of the hearing. All parties shall be allowed to present evidence and argument to the BME at the hearing. Powertech will proceed in accordance with the final decision of the BME.

B. Powertech may not proceed until the BME has issued a final decision on the dispute.

C. Powertech's responsibility to carry out all other actions subject to the terms of this MOA that are not the subject of the dispute remain unchanged.

IX. AMENDMENTS

This MOA may be amended when such an amendment is agreed to in writing by both parties. The amendment will be effective on the date a copy signed by ARC.

X. TERMINATION

If either party to this MOA determines that its terms will not or cannot be carried out, that party shall immediately consult with the other parties to attempt to develop an amendment per Stipulation VIII, above. If within thirty (30) days (or another time period agreed to by both parties) an amendment cannot be reached, either party may terminate the MOA upon written notification to the other signatories.

Execution of this MOA by Powertech and ARC and implementation of its terms constitute evidence that Powertech has taken into account the effects of this Project on potential significant historic and archaeological sites and is committed to working closely with ARC to avoid and/or mitigate any potential affects on such properties.

This MOA does not supersede any future Federal involvement in the Project and does not constitute compliance with Federal laws such as the National Historic Preservation Act or the National Environmental Policy Act.

SIGNATORIES:

Powertech (USA) Inc.

Date 9/10/08

Richard E. Blubaugh
Vice President-Environmental,
Health and Safety Resources

Archaeological Research Center

Date 9.15.08

James Haug
State Archaeologist

ATTACHMENT A

Powertech (USA) Inc.'s Dewey-Burdock Project in Custer and Fall River Counties, South Dakota is outlined by its proposed **Project Boundary** in Figure A (Confidential), following this Attachment. The Project Boundary encompasses the following sections (or portions thereof):

T6S, R1E:
Sections 20, 21, and 27 – 35

T7S, R1E:
Sections 1 – 5, 10 – 12, and 15

The **Area of Potential Effect (APE)** is defined as the areas that would potentially be affected by the surface-disturbing activities of the project and is a much smaller area than the area encompassed by the Project Boundary. The APE is based on known mining resources and is subject to change as additional resources are identified. The APE is depicted in Figure A (Confidential) and is generally described as follows:

T6S, R1E:
Sections (or portions thereof): 28, 29, 32, 33, 35

T7S, R1E:
Sections (or portions thereof): 1 – 3, 10 - 12

FIRST AMENDMENT
TO
MEMORANDUM OF AGREEMENT
BETWEEN POWERTECH (USA) INC.
AND THE
ARCHAEOLOGICAL RESEARCH CENTER (ARC),
A PROGRAM OF THE SOUTH DAKOTA STATE HISTORICAL SOCIETY,
REGARDING THE DEWEY – BURDOCK PROJECT
Located in Custer and Fall River Counties, South Dakota
Establishing Procedures to Avoid or Mitigate Potential Effects on
Archaeological and Historic Sites
pursuant to SDCL 45-6D-14 and SDCL ch. 45-6B

RECITALS

1. The ARC and POWERTECH (USA) INC. ("Powertech") previously entered into a Memorandum of Agreement ("MOA") regarding Powertech's proposed Dewey-Burdock Uranium In-Situ Mining Project ("Project") in Custer and Fall River Counties. South Dakota.

2. The sections containing the lands enclosed within the Project Boundary were described in Attachment A to the MOA.

3. It has come to the attention of Powertech that a minor change in the Project Boundary has resulted in the inclusion of approximately 280 additional acres within the Project Boundary that are not covered by the description in said Attachment A.

4. The parties desire to amend the MOA to include the description of the section containing the additional acres.

NOW, THEREFORE, Powertech and the ARC hereby amend the MOA as follows:

1. **Description of Lands to be Added to Attachment A.** The description of the sections encompassed within the Project Boundary, as described in Attachment A to the MOA, is hereby amended to include Section 14, T7S, R1E, B.H.M., Fall River County, South Dakota.

2. **Ratification.** In all other respects, the MOA is hereby ratified and confirmed.

Dated by Powertech 2/10, 2009.

POWERTECH (USA) INC.

By:

Richard E. Blubaugh, Vice President-
Environmental, Health and Safety
Resources

Dated by the ARC 1.28.09, 2009.

ARCHAEOLOGICAL RESEARCH
CENTER

By:

James Haug, State Archaeologist

APPENDIX 2.5-A

SUPPORT INFORMATION FOR NEWCASTLE, WYOMING METEOROLOGICAL MONITORING SITE

IML Air Science (IML), in Sheridan, Wyoming, operates a meteorological station in Newcastle, Wyoming, which has generated more than 9 years (2002 to present) of hourly meteorological data. Newcastle is approximately 30 miles north-northwest of the Dewey-Burdock project site and provides a better comparison to the Dewey-Burdock permit area than the Chadron site in terms of elevation, surrounding topography and proximity to the southwestern flank of the Black Hills.

The meteorological station at Newcastle is used to supplement the ambient air quality compliance demonstration. The station meets the requirements of Ambient Air Monitoring Guidelines for Prevention of Significant Deterioration (EPA, 1987). Table 1 identifies the instruments and associated specifications at this station. Figures 1 through 8 summarize the historical meteorological data for the Newcastle station.

Table 1: Newcastle MET Station Equipment List (IML, 2011)

Newcastle Met Station

Parameter	Instrument	Range	Accuracy	Threshold	Instrument Height
Wind Speed	RM Young 05305 Wind Monitor AQ	0 to 112 mph	±0.4 mph or 1% of reading	0.9 mph	10 meters
Wind Direction	RM Young 05305 Wind Monitor AQ	0 to 360º	±3º	1.0 mph	10 meters
Temperature	Fenwal Electronics 107 Temperature Probe	-25º to 50º C	±0.2º C @ 0 - 60º C, ±0.4º C @ -35º C	--	2 meters
Precipitation	Met One Tipping Bucket	0 to 12 inches	±0.5% @ 0.5 in/hr rate	0.01 inch	1 meter
Barometric Pressure	Campbell Scientific - 105	600 – 1060 millibar	±0.5 mb @ 20º C	--	2 meters
Relative Humidity	CS 500-L Temp/RH probe	0 – 100% -40º to 60ºC	±3% RH 10% to 90%	--	2 meters
Data Logger	CS CR510	--	--	--	--

The specifications in Table 1 meet or exceed the requirements set forth in NRC Regulatory Guide 3.63, Section C3. All instruments are audited for accuracy on a semi-annual basis. Sample audit records are included as Tables 2 through 5 at the end of this appendix. Data recovery for all parameters at Newcastle exceeded 96% for both long-term (2002 through August 2011) and concurrent-year (7/18/2007 to 7/17/2008) periods.

References:

EPA (U.S. Environmental Protection Agency), 1987, Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD), EPA-450/4-87-007, May 1987.

IML Air Science, 2011, hourly average data from the Wyoming Refining Company Meteorological Monitoring Station, Newcastle, Wyoming, 2002 - 2011.

POWERTECH (USA) INC.

Figure 1

Wyoming Refining

Meteorological Data Summary

1/1/2002 - 8/31/2011

Hourly Data

	Average/Total	Max	Min
Wind Speed (mph)	6.8	31.2	0.0
Sigma-Theta (°)	19.4	86.1	0.0
Temperature (F)	47.2	101.1	-18.5
Relative Humidity (%)	58.5	100.0	6.7
Bar. Pressure (in Hg)	25.6	26.2	24.8
Solar Radiation (w/m^2)	185.4	1,031.0	

Predominant wind direction was from the NE sector,
accounting for 16.6% of the possible winds

Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	84720	81975	96.76%
Wind Direction	84720	81975	96.76%
Sigma-Theta	84720	81975	96.76%
Temperature	30419	30391	99.91%
Relative Humidity	30419	30391	99.91%
Bar. Pressure	30419	30389	99.90%
Solar Radiation	30419	30391	99.91%

Powertech (USA) Inc.

Figure 2

Wyoming Refining

Meteorological Data Summary

7/18/2007 - 7/17/2008

Hourly Data

	Average/Total	Max	Min
Wind Speed (mph)	7.0	27.9	0.2
Sigma-Theta (°)	19.6	83.2	5.5
Temperature (F)	51.9	93.5	12.4
Relative Humidity (%)	55.3	100.0	8.7
Bar. Pressure (in Hg)	25.6	26.0	25.0
Solar Radiation (w/m^2)	246.8	984.0	

Predominant wind direction was from the NE sector,
accounting for 20.7% of the possible winds

Data Recovery

Parameter	Possible (hours)	Reported (hours)	Recovery
Wind Speed	8784	8475	96.48%
Wind Direction	8784	8475	96.48%
Sigma-Theta	8784	8475	96.48%
Temperature	3059	3058	99.97%
Relative Humidity	3059	3058	99.97%
Bar. Pressure	3059	3058	99.97%
Solar Radiation	3059	3058	99.97%

POWERTECH (USA) INC.

Figure 3

10-YR Wind Frequency Distribution
Newcastle, Wyoming
1/1/2002 Hr. 1 to 8/31/2011 Hr. 24

RELATIVE FREQUENCY (% of Recorded Winds) TABLE

	mph						
Wind Direction	0.0- 4.0	4.0- 7.4	7.4-12.1	12.1-19.0	19.0-25.8	25.8-100.0	Row Total
0.0 deg.(North)	1.6	1.4	1.1	0.5	0.1	0.0	4.7
22.5 deg.	4.3	3.5	0.6	0.2	0.0	0.0	8.7
45.0 deg.	7.0	9.0	0.4	0.1	0.0	0.0	16.6
67.5 deg.	3.6	3.1	0.4	0.1	0.0	0.0	7.1
90.0 deg.	1.7	2.2	1.0	0.3	0.0	0.0	5.3
112.5 deg.	1.2	2.0	2.2	0.8	0.1		6.2
135.0 deg.	0.9	1.5	1.7	1.1	0.1		5.3
157.5 deg.	1.0	1.6	1.6	0.7	0.0		5.0
180.0 deg.	1.2	2.2	1.2	0.3	0.0		4.9
202.5 deg.	1.1	1.6	0.5	0.1	0.0		3.4
225.0 deg.	0.9	1.2	0.4	0.2	0.0		2.7
247.5 deg.	0.8	1.4	0.8	0.2	0.0		3.2
270.0 deg.	0.7	1.4	1.2	0.3	0.0		3.7
292.5 deg.	0.7	1.5	2.3	1.0	0.1	0.0	5.6
315.0 deg.	0.7	1.8	3.8	3.3	0.6	0.0	10.2
337.5 deg.	1.0	1.7	2.5	1.9	0.2	0.0	7.3
	28.5	37.1	21.8	11.2	1.4	0.1	100.0

0 mph (0.8%)   INVALID READINGS 2745

NUMBER OF POSSIBLE READINGS 84720   VALID READINGS 81975   DATA CAPTURE 96.76%

Figure 4

1-YR Wind Frequency Distribution
Newcastle, Wyoming
7/18/2007 Hr. 1 to 7/17/2008 Hr. 24

RELATIVE FREQUENCY (% of Recorded Winds) TABLE

mph

Wind Direction	0.0- 4.0	4.0- 7.4	7.4-12.1	12.1-19.0	19.0-25.8	25.8-100.0	Row Total
0.0 deg.(North)	1.7	1.3	0.5	0.4	0.0		3.9
22.5 deg.	4.6	2.5	0.5	0.1			7.6
45.0 deg.	7.6	12.5	0.5	0.1	0.0	0.0	20.7
67.5 deg.	2.0	2.7	0.4	0.2	0.0	0.0	5.3
90.0 deg.	1.5	2.2	0.7	0.4	0.1	0.0	4.8
112.5 deg.	1.0	2.3	2.5	1.1	0.1		6.9
135.0 deg.	0.9	1.4	1.5	1.1	0.0		4.9
157.5 deg.	0.8	1.5	1.3	0.7	0.0		4.4
180.0 deg.	1.2	2.1	1.6	0.3			5.1
202.5 deg.	1.0	1.5	0.5	0.1	0.0		3.2
225.0 deg.	0.8	1.4	0.3	0.3	0.0		2.8
247.5 deg.	0.8	1.5	0.6	0.2	0.0		3.1
270.0 deg.	0.5	1.7	1.4	0.3			3.9
292.5 deg.	0.5	1.4	1.8	1.1	0.0		4.8
315.0 deg.	0.6	1.5	4.8	4.5	0.6		11.9
337.5 deg.	1.0	1.7	2.0	1.7	0.2		6.6
	26.5	39.0	20.7	12.6	1.3	0.1	100.0

0 mph (0.3%) INVALID READINGS 309

NUMBER OF POSSIBLE READINGS 8784 VALID READINGS 8475 DATA CAPTURE 96.48%

Figure 5

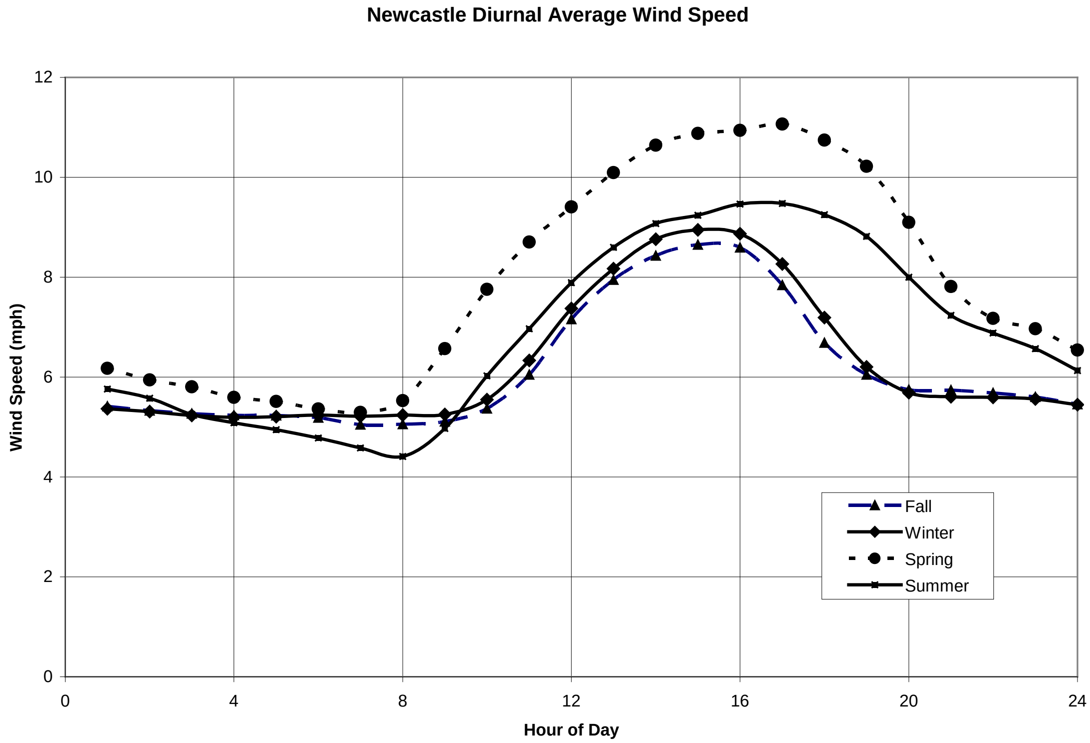


Figure 6

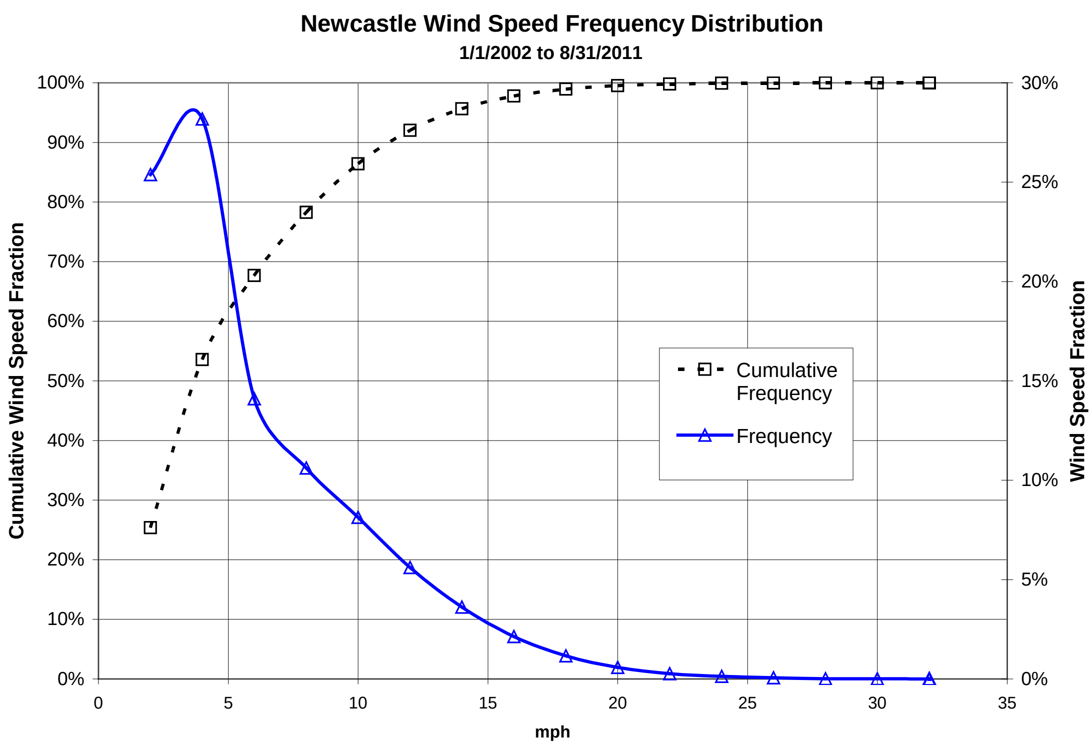


Figure 7

Newcastle Wind Data Summary

1/1/2002 - 8/31/2011

Hourly Data

		Average	Max	Min
Wind Speed (mph)		6.84	31.23	-
Sigma Theta (º)		19.39	86.10	0.00
Wind Direction				
	N	6.71	29.40	-
	NNE	4.60	28.19	0.06
	NE	4.38	27.31	0.03
	ENE	4.35	26.96	-
	E	5.89	27.87	0.04
	ESE	7.75	25.11	0.02
	SE	8.51	23.96	0.19
	SSE	7.69	25.66	0.13
	S	6.38	22.48	0.11
	SSW	5.55	23.26	0.00
	SW	5.90	25.23	0.03
	WSW	6.41	25.18	0.02
	W	7.11	25.77	0.12
	WNW	8.93	27.69	0.04
	NW	11.05	31.23	0.07
	NNW	9.55	29.93	0.06

Predominant wind direction was from the NE sector, accounting for 16.6% of the winds, the average wind direction was 31°.

Data Recovery

		Possible (hours)	Reported (hours)	Recovery
Wind Speed		84720	81975	96.76%
Sigma Theta		84720	81975	96.76%
Wind Direction		84720	81975	96.76%

Figure 8

Stability Class	Wind Direction	Wind Speed (mph) - One Year (Calm = 1.22%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
A	N	0.001298	0.001098					0.002396
	NNE	0.002686	0.001073					0.003759
	NE	0.003297	0.001500					0.004797
	ENE	0.002838	0.001464					0.004302
	E	0.002826	0.001586					0.004412
	ESE	0.002673	0.002733					0.005406
	SE	0.002788	0.003879					0.006667
	SSE	0.003373	0.006319					0.009692
	S	0.003908	0.011101					0.015009
	SSW	0.004531	0.010003					0.014534
	SW	0.003602	0.008869					0.012471
	WSW	0.003106	0.007502					0.010608
	W	0.002202	0.005099					0.007301
	WNW	0.001336	0.003074					0.004411
	NW	0.000993	0.002611					0.003603
	NNW	0.000815	0.001781					0.002596
B	N	0.000127	0.000573	0.001134				0.001835
	NNE	0.000700	0.000561	0.000403				0.001664
	NE	0.001209	0.000878	0.000256				0.002344
	ENE	0.001146	0.000647	0.000232				0.002024
	E	0.000815	0.001500	0.000342				0.002657
	ESE	0.000586	0.002147	0.000695				0.003428
	SE	0.000471	0.002830	0.001439				0.004741
	SSE	0.000356	0.003306	0.003879				0.007542
	S	0.000675	0.004221	0.005148				0.010043
	SSW	0.000586	0.002501	0.002769				0.005855
	SW	0.000496	0.002013	0.002489				0.004998
	WSW	0.000267	0.002269	0.004343				0.006879
	W	0.000331	0.001891	0.004343				0.006565
	WNW	0.000216	0.001171	0.004538				0.005925
	NW	0.000140	0.001122	0.004038				0.005300
	NNW	0.000255	0.000842	0.002586				0.003682
C	N	0.000204	0.000403	0.002830	0.001391			0.004827
	NNE	0.000789	0.001122	0.001134	0.000427			0.003473
	NE	0.001897	0.002245	0.000671	0.000281			0.005093
	ENE	0.001260	0.001781	0.000781	0.000146			0.003968
	E	0.000573	0.002110	0.000988	0.000354			0.004025
	ESE	0.000344	0.002781	0.003733	0.001171			0.008029
	SE	0.000242	0.002135	0.005489	0.002623			0.010489
	SSE	0.000382	0.001793	0.007722	0.002818			0.012715
	S	0.000509	0.003099	0.006026	0.001403			0.011037
	SSW	0.000522	0.001354	0.001891	0.000622			0.004389
	SW	0.000127	0.000586	0.001147	0.000586			0.002445
	WSW	0.000165	0.001013	0.003062	0.000647			0.004886
	W	0.000153	0.001269	0.005807	0.001134			0.008363
	WNW	0.000115	0.000842	0.010308	0.004074			0.015339
	NW	0.000076	0.000927	0.012821	0.008527			0.022351
	NNW	0.000064	0.000744	0.008112	0.005014			0.013934

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Figure 8 (continued)

Stability Class	Wind Direction	Wind Speed (mph) - One Year						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
D	N	0.001311	0.006258	0.007246	0.004916	0.000549	0.000134	0.020414
	NNE	0.005562	0.026215	0.004782	0.002428	0.000207	0.000049	0.039243
	NE	0.011214	0.074706	0.003623	0.001598	0.000085	0.000024	0.091250
	ENE	0.004862	0.020689	0.003599	0.000769	0.000122	0.000024	0.030065
	E	0.001769	0.011260	0.010259	0.002867	0.000220	0.000073	0.026448
	ESE	0.000853	0.007551	0.018408	0.008917	0.000598	0.000037	0.036364
	SE	0.000356	0.003477	0.009478	0.010015	0.001195		0.024522
	SSE	0.000420	0.002403	0.005355	0.005929	0.000293	0.000024	0.014424
	S	0.000586	0.002598	0.002696	0.002062	0.000134		0.008076
	SSW	0.000356	0.001330	0.001805	0.001000	0.000134		0.004626
	SW	0.000140	0.000220	0.000756	0.001598	0.000293	0.000012	0.003019
	WSW	0.000153	0.000915	0.001927	0.001720	0.000232	0.000012	0.004959
	W	0.000267	0.002232	0.003440	0.002171	0.000378	0.000012	0.008502
	WNW	0.000255	0.003525	0.008490	0.007563	0.001549	0.000268	0.021651
	NW	0.000191	0.005306	0.019225	0.027484	0.007453	0.000903	0.060563
	NNW	0.000471	0.006258	0.013443	0.016383	0.002867	0.000244	0.039666
E	N	0.002011	0.003489	0.000317				0.005817
	NNE	0.006313	0.009869	0.000293				0.016475
	NE	0.009623	0.024154	0.000281				0.034057
	ENE	0.004149	0.009222	0.000256				0.013628
	E	0.001286	0.004026	0.000354				0.005665
	ESE	0.000827	0.002598	0.000232				0.003657
	SE	0.000573	0.001415	0.000159				0.002146
	SSE	0.000458	0.001110	0.000207				0.001776
	S	0.000611	0.000756	0.000146				0.001514
	SSW	0.000191	0.000488	0.000134				0.000813
	SW	0.000140	0.000244	0.000037				0.000421
	WSW	0.000140	0.000549	0.000098				0.000787
	W	0.000255	0.001061	0.000207				0.001523
	WNW	0.000356	0.002159	0.000317				0.002833
	NW	0.000573	0.002659	0.000415				0.003647
	NNW	0.001031	0.003281	0.000378				0.004691
F	N	0.007637	0.004428					0.012065
	NNE	0.014612	0.008442					0.023054
	NE	0.016636	0.012955					0.029591
	ENE	0.009865	0.007575					0.017440
	E	0.004595	0.004599					0.009194
	ESE	0.003157	0.002391					0.005548
	SE	0.002393	0.001818					0.004211
	SSE	0.002342	0.001256					0.003599
	S	0.002049	0.001232					0.003281
	SSW	0.002367	0.001220					0.003587
	SW	0.001960	0.001537					0.003497
	WSW	0.002138	0.001671					0.003810
	W	0.001986	0.002110					0.004096
	WNW	0.002838	0.003111					0.005949
	NW	0.003144	0.003562					0.006706
	NNW	0.004519	0.003806					0.008325

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Table 2: Newcastle MET Station Audit 1st Quarter 2007

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 15-Mar-07
Audit Performed by: B. Kelly, C. Medill - IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	digital thermistor
Data acquisition system (DAS):	Campbell Scientific CR510	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.44	3.44	0.00	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)	t<0.2	N/A	N/A	1.0	(3)
WD (degrees)	0	1.5	1	5	(1)
	90	89.9	0	5	(1)
	180	179.2	1	5	(1)
	270	268.7	1	5	(1)
Temperature (°F)	71.6	71.6	0.0	1.8	(1)
ice water bath	32.3	32.1	0.2	1.8	(1)
warm water bath	130.7	129.3	1.4	1.8	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line @ 0905
System on-line @ 1015
Replaced anemometer with new Wind Monitor AQ

Table 3: Newcastle MET Station Audit 3rd Quarter 2007

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 13-Sep-07
Audit Performed by: B. Kelly, C. Medill - IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	digital thermistor
Data acquisition system (DAS):	Campbell Scientific CR510	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.44	3.44	0.00	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)	t<0.2	N/A	N/A	1.0	(3)
WD (degrees)	0	0.1	0	5	(1)
	90	89.9	0	5	(1)
	180	180.8	1	5	(1)
	270	268.1	2	5	(1)
Temperature (°F)	84.6	84.5	0.0	0.9	(1)
ice water bath	32.2	32.0	0.1	0.9	(1)
warm water bath	127.9	126.8	1.1	0.9	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line @ 0834
System on-line @ 0850

Powertech (USA) Inc.

Table 4: Newcastle MET Station Audit 1st Quarter 2008

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining   Audit Date: 12-Mar-08
Audit Performed By: S. Hansen, C. Medill, IML-Air Science

Sensor	Mfr./Model	Serial Number	Reference Device	Serial/ID Number
Vert. Wind Speed 10m:	RM Young Wind Monitor AQ	NA	quartz referenced drive motor	CA02423
Wind Speed (WS):	RM Young Wind Monitor AQ	WM75308	quartz referenced drive motor	IML0853 & IML0858
Wind Direction (WD):	RM Young Wind Monitor AQ	WM75308	transit, compass	Brunton 5080393535
Temperature @ 2 Meters:	RM Young 41342, power aspirated	TS13799	digital thermistor	IML0987
Temperature @ 10 Meters:	RM Young 41342, power aspirated	TS13880	digital thermistor	IML0987
Relative Humidity:	Vaisala HMP50	C4240028	digital psychrometer	Thermo-Hygro 22087796
Barometric Pressure:	Vaisala PTB101B	C4240018	digital barometer	IML0968
Solar Radiation:	LI-COR LI200X	PY57681	Li-Cor	PY54289
Data acquisition system:	CSI CR1000 datalogger	13147	N/A	N/A

Audit Results

		Reference RPM	Reference MPH	DAS Value	|Difference|	Specification	
WS (mph)		0	0.00	0.00	0.00	below threshold	
		300	3.44	3.44	0.00	0.56	(2)
		800	9.16	9.16	0.00	0.56	(2)
		3000	34.35	34.35	0.00	1.72	(2)
		8000	91.60	91.60	0.00	4.58	(2)
			Reference	DAS Value	|Difference|	Specification	
WS start torque (gm-cm)			<.1	N/A	N/A	1.0	(3)
WD (degrees)			0.0	0.3	0.3	5.0	(2)
			90.0	90.4	0.4	5.0	(2)
			180.0	180.2	0.2	5.0	(2)
			270.0	269.8	0.2	5.0	(2)
Temp. (°C): Upper Sensor			49.22	49.36	0.14	0.5	(2)
			5.09	5.34	0.25	0.5	(2)
			18.13	18.16	0.03	0.5	(2)
Temp. (°C): Lower Sensor			49.22	49.33	0.11	0.5	(2)
			5.09	5.39	0.30	0.5	(2)
			18.13	18.10	0.03	0.5	(2)
			Upper Sensor	Lower Sensor	|Difference|	Specification	
Delta T. (°C)			49.36	49.33	0.03	0.10	(2)
			5.34	5.39	0.05	0.10	(2)
			18.16	18.10	0.06	0.10	(2)
			Reference	DAS Value	|Difference|	Specification	
Relative Humidity (%)			32.0	29.6	2.4	7.0	(2)
Solar Radiation (W/m^2)	uncovered		NA	123.8	NA	5.0%	(4)
	covered		NA	0.0	NA	5.0%	(4)
Barometric Pressure ("Hg)			25.51	25.47	0.04	0.09	(2)

		Reference RPM	Reference cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CW)		20	-100.00	-99.63	0.37	25.00	(2)
	U:	60	-300.00	-302.30	2.30	35.00	(2)
		100	-1000.00	-1001.30	1.30	70.00	(2)
		500	-2500.00	-2499.30	0.70	145.00	(2)
		RPM	cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CCW)		20	100.00	98.41	1.59	25.00	(2)
	U:	60	300.00	300.90	0.90	35.00	(2)
		100	1000.00	1001.10	1.10	70.00	(2)
		500	2500.00	2497.30	2.70	145.00	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications
(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

Notes, Recommendations

Datalogger taken off line @ 0852 MST -- returned on-line 1352 MST.
Complettion of AERMOD and solar equipement installation.

POWERTECH (USA) INC.

Table 5: Newcastle MET Station Audit 3rd Quarter 2008

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining   Audit Date: 27-Aug-08
Audit Performed By: C. Medill - IML Air Science

Sensor	Mfr./Model	Serial Number	Reference Device	Serial/ID Number
Vert. Wind Speed 10m:	RM Young Wind Monitor AQ	NA	quartz referenced drive motor	CA02423
Wind Speed (WS):	RM Young Wind Monitor AQ	WM75308	quartz referenced drive motor	IML0853 & IML0858
Wind Direction (WD):	RM Young Wind Monitor AQ	WM75308	transit, compass	Brunton 5080393535
Temperature @ 2 Meters:	Fenwall 107	NA	digital thermistor	IML0987
Relative Humidity:	Vaisala HMP50	C4240028	digital psychrometer	Thermo-Hygro 22087796
Barometric Pressure:	Vaisala PTB101B	C4240018	digital barometer	IML0968
Solar Radiation:	LI-COR LI200X	PY57681	Li-Cor	PY54289
Data acquisition system:	CSI CR1000 datalogger	13147	N/A	N/A

Audit Results

		RPM	MPH	DAS Value	|Difference|	Specification	
WS (mph)		0	0.00	0.00	0.00	below threshold	
		300	3.44	3.44	0.00	0.56	(2)
		800	9.16	9.16	0.00	0.56	(2)
		3000	34.35	34.35	0.00	1.72	(2)
		8000	91.60	91.60	0.00	4.58	(2)
			Reference	DAS Value	|Difference|	Specification	
WS start torque (gm-cm)			<.1	N/A	N/A	1.0	(3)
WD (degrees)			0.0	0.1	0.1	5.0	(2)
			90.0	89.4	0.6	5.0	(2)
			180.0	179.6	0.4	5.0	(2)
			270.0	270.0	0.0	5.0	(2)
			Reference	DAS Value	|Difference|	Specification	
Temp. (°F):			0.93	0.87	0.06	0.5	(2)
			23.28	23.32	0.04	0.5	(2)
			45.41	45.29	0.12	0.5	(2)
			Reference	DAS Value	|Difference|	Specification	
Relative Humidity (%)			27.0	26.9	0.1	7.0	(2)
Barometric Pressure ("Hg)			25.56	25.58	0.02	0.09	(2)
		Reference RPM	Reference cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CW)		20	100.00	100.80	0.80	25.00	(2)
	U:	60	300.00	300.10	0.10	35.00	(2)
		100	1000.00	1001.00	1.00	70.00	(2)
		500	2500.00	2500.00	0.00	145.00	(2)
		RPM	cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CCW)		20	100.00	100.80	0.80	25.00	(2)
	U:	60	300.00	295.30	4.70	35.00	(2)
		100	1000.00	999.10	0.90	70.00	(2)
		500	2500.00	2503.00	3.00	145.00	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications
(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

Notes, Recommendations

Datalogger taken off line @ 0826 MST -- returned on-line 1027 MST.

APPENDIX 2.5-B

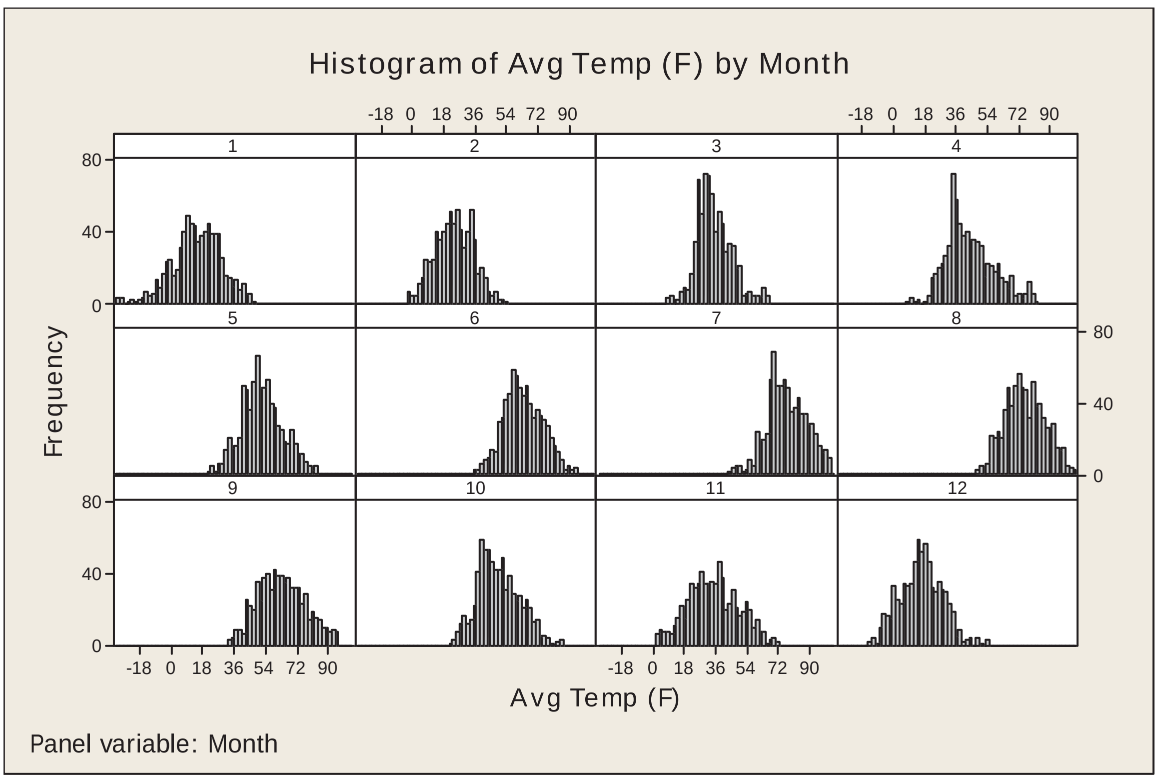
STATISTICAL REPORTS FOR DEWEY-BURDOCK METEOROLOGICAL SITE

POWERTECH (USA) INC.

APPENDIX 2.5-B
STATISTICAL REPORTS FOR DEWEY-BURDOCK METEOROLOGICAL SITE

Descriptive Statistics: Avg Temp (F)

Variable	Month	N	N*	Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Avg Temp (F)	1	744	0	14.792	13.859	-30.000	7.000	15.000	25.000	48.000
	2	696	0	23.520	10.861	-2.000	16.000	24.000	32.000	53.000
	3	720	0	34.550	10.040	7.000	28.000	33.000	40.000	66.000
	4	720	0	43.082	13.914	7.000	34.000	41.000	51.000	81.000
	5	744	0	52.173	11.654	22.000	44.000	51.000	59.000	84.000
	6	720	0	63.306	10.914	35.000	56.000	62.000	71.000	94.000
	7	744	0	76.858	11.231	44.000	69.000	76.000	85.000	102.000
	8	744	0	75.160	11.226	48.000	67.000	74.000	83.000	103.000
	9	720	0	63.747	13.787	34.000	54.000	63.000	73.000	96.000
	10	744	0	49.210	12.055	22.000	40.000	48.000	57.000	86.000
	11	720	0	34.061	14.761	1.000	23.000	34.000	45.000	72.000
	12	744	0	15.073	12.085	-14.000	7.000	15.000	23.000	53.000



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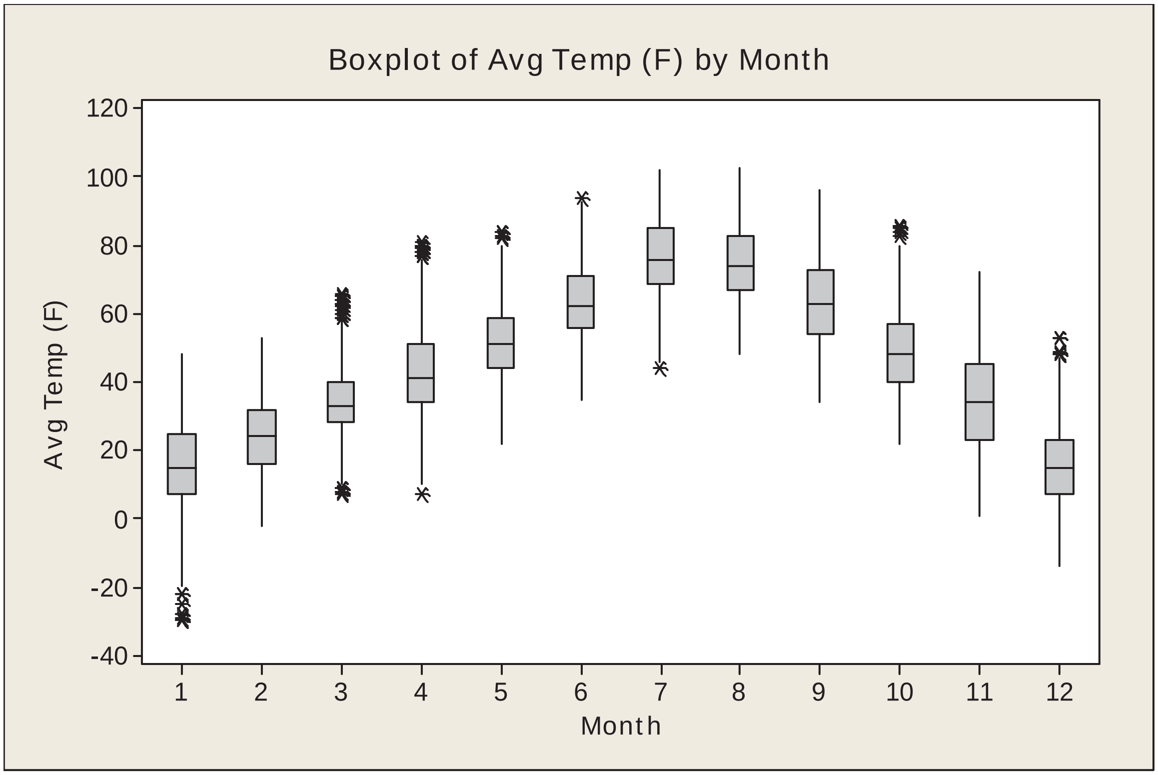
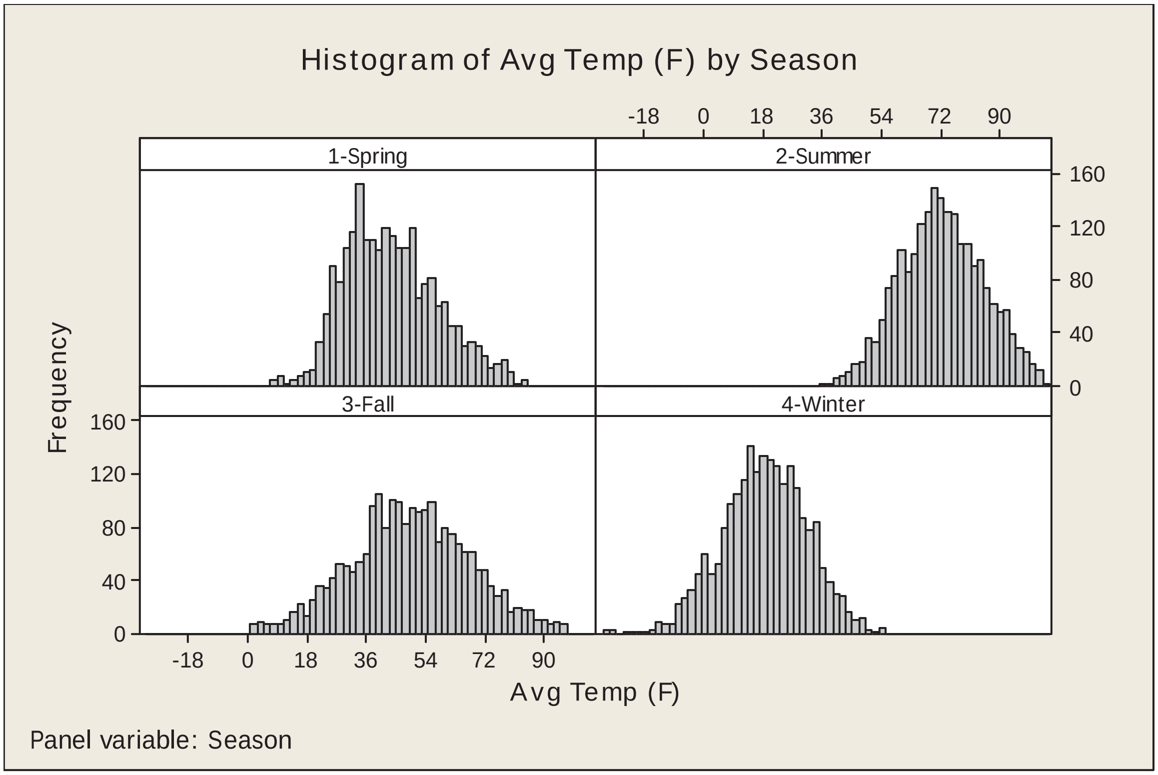
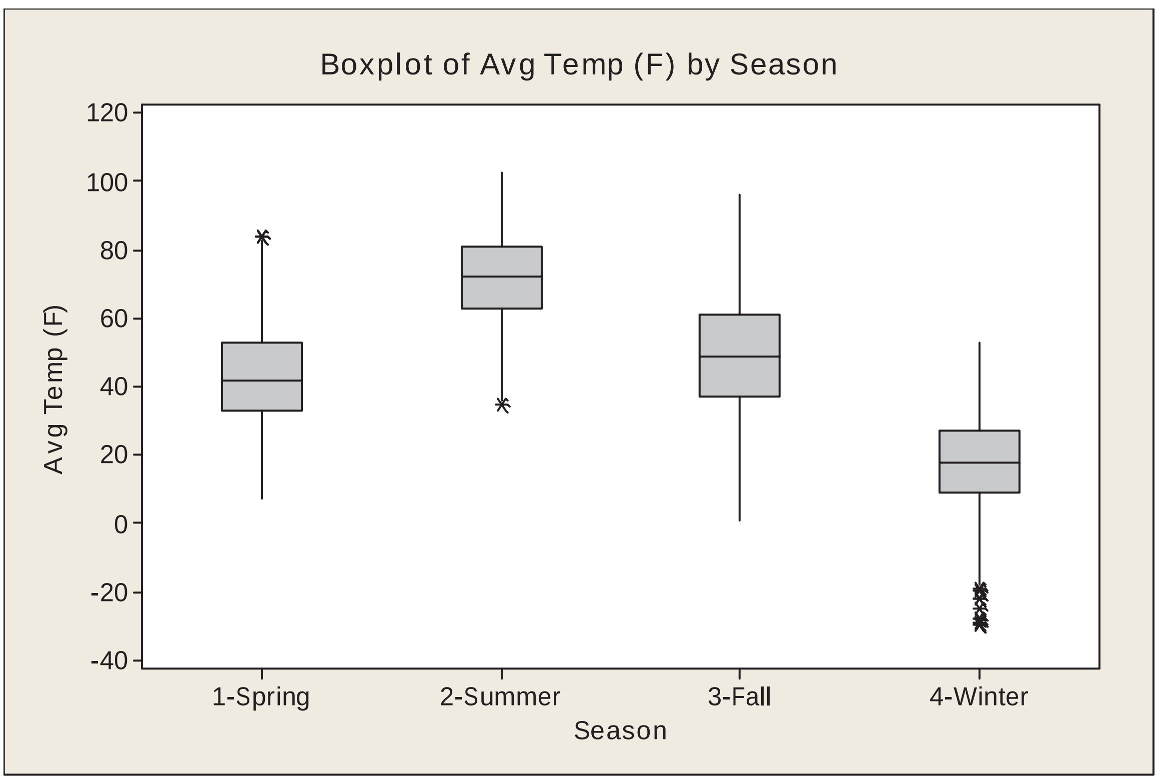


Descriptive Statistics: Avg Temp (F)

Variable	Season	N	N*	Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Avg Temp (F)	1-Spring	2184	0	43.366	13.975	7.000	33.000	42.000	53.000	84.000
	2-Summer	2208	0	71.866	12.636	35.000	63.000	72.000	81.000	103.000
	3-Fall	2184	0	49.008	18.144	1.000	37.000	49.000	61.000	96.000
	4-Winter	2184	0	17.669	12.987	-30.000	9.000	18.000	27.000	53.000



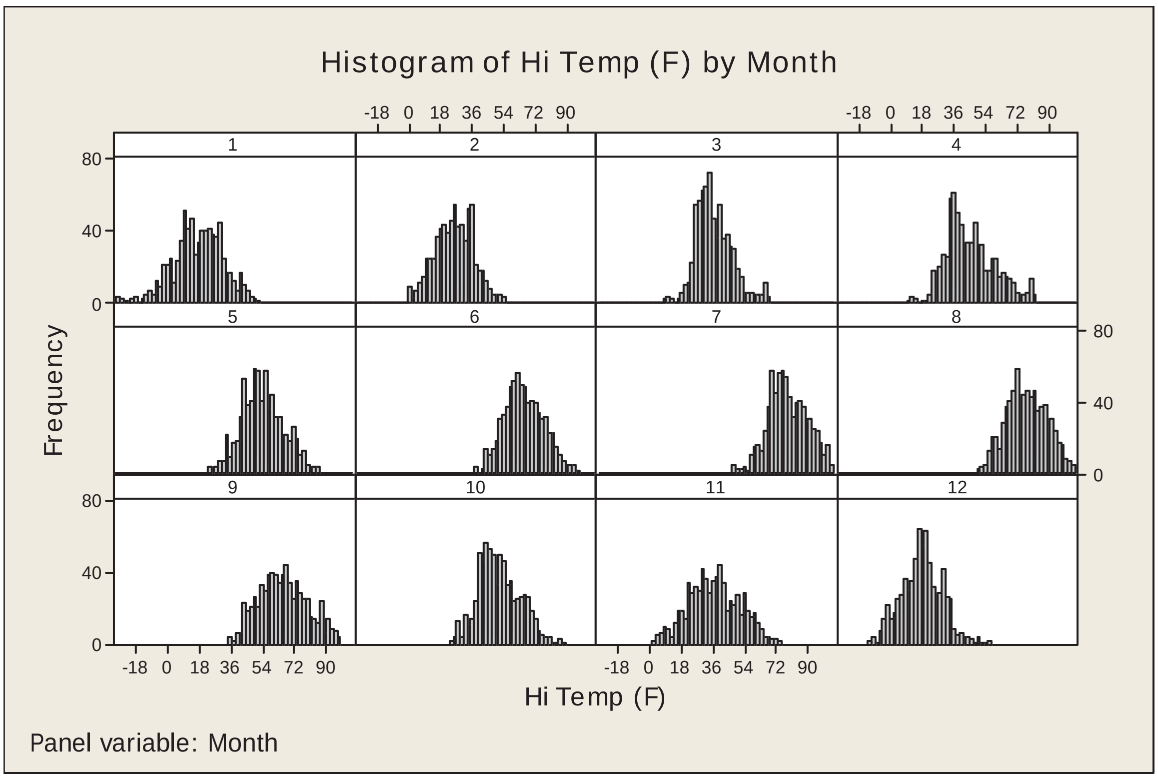
Histogram of Avg Temp (F) by Season
1-Spring
2-Summer
3-Fall
4-Winter
Frequency
Avg Temp (F)
-18
0
18
36
54
72
90
0
40
80
120
160
Panel variable: Season

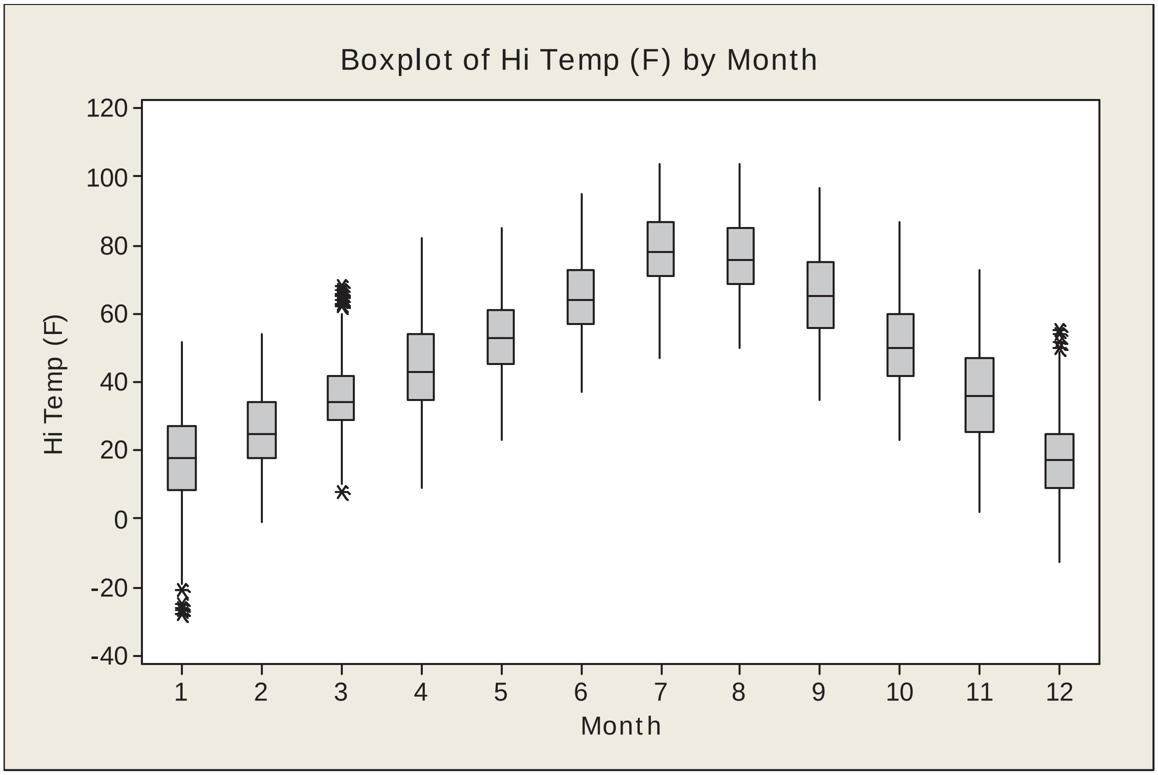


Boxplot of Avg Temp (F) by Season
Avg Temp (F)
120
100
80
60
40
20
0
-20
-40
1-Spring
2-Summer
3-Fall
4-Winter
Season

Descriptive Statistics: Hi Temp (F)

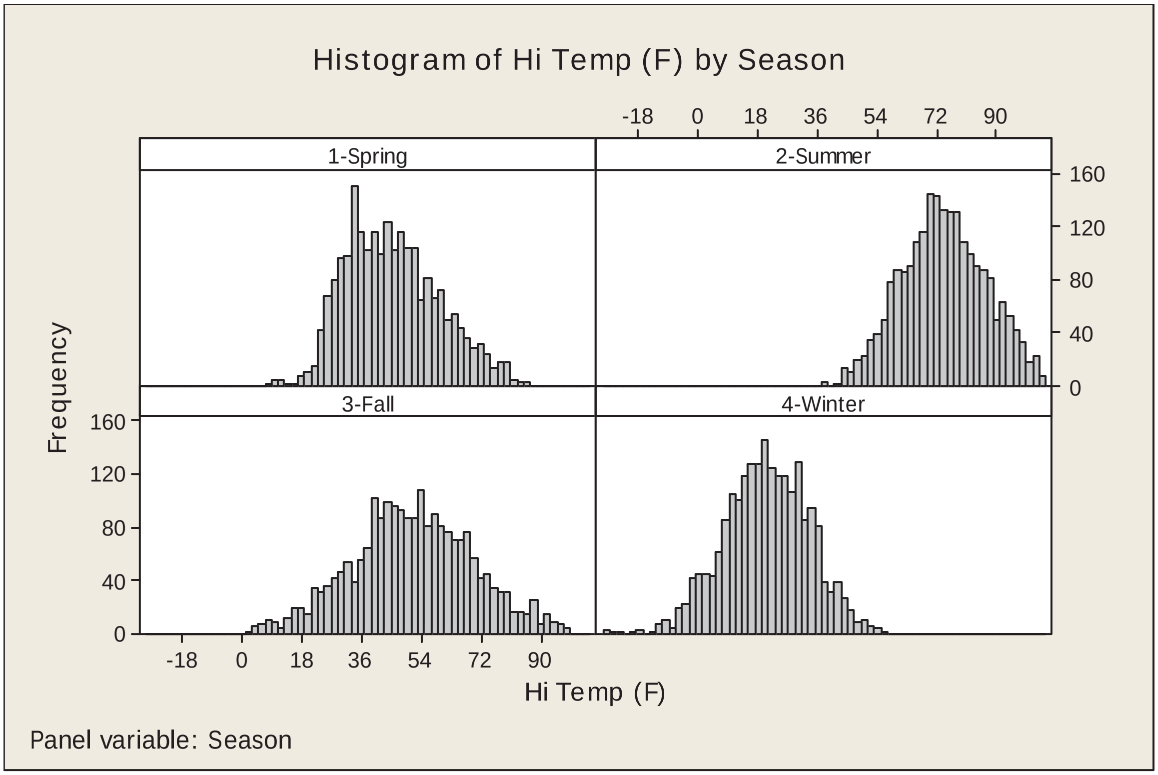
Variable	Month	N	N*	Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Hi Temp (F)	1	744	0	17.176	14.043	-28.000	8.250	18.000	27.000	52.000
	2	696	0	25.307	10.827	-1.000	18.000	25.000	34.000	54.000
	3	720	0	36.100	10.286	8.000	29.000	34.000	42.000	68.000
	4	720	0	44.954	14.008	9.000	35.000	43.000	54.000	82.000
	5	744	0	53.663	11.834	23.000	45.000	53.000	61.000	85.000
	6	720	0	65.026	10.932	37.000	57.000	64.000	73.000	95.000
	7	744	0	78.593	11.209	47.000	71.000	78.000	87.000	104.000
	8	744	0	76.902	11.387	50.000	69.000	76.000	85.000	104.000
	9	720	0	65.635	13.798	35.000	56.000	65.000	75.000	97.000
	10	744	0	51.003	12.020	23.000	42.000	50.000	60.000	87.000
	11	720	0	36.133	14.917	2.000	25.250	36.000	47.000	73.000
	12	744	0	17.262	11.831	-13.000	9.000	17.000	25.000	55.000

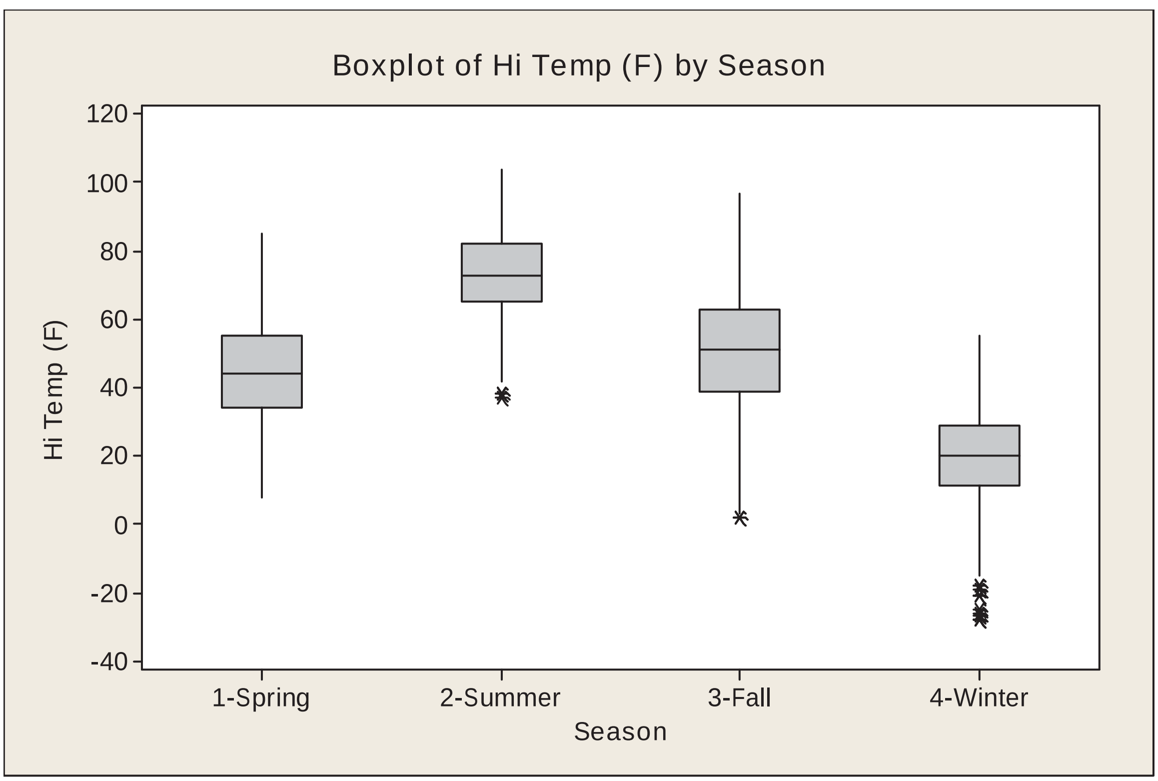




Descriptive Statistics: Hi Temp (F)

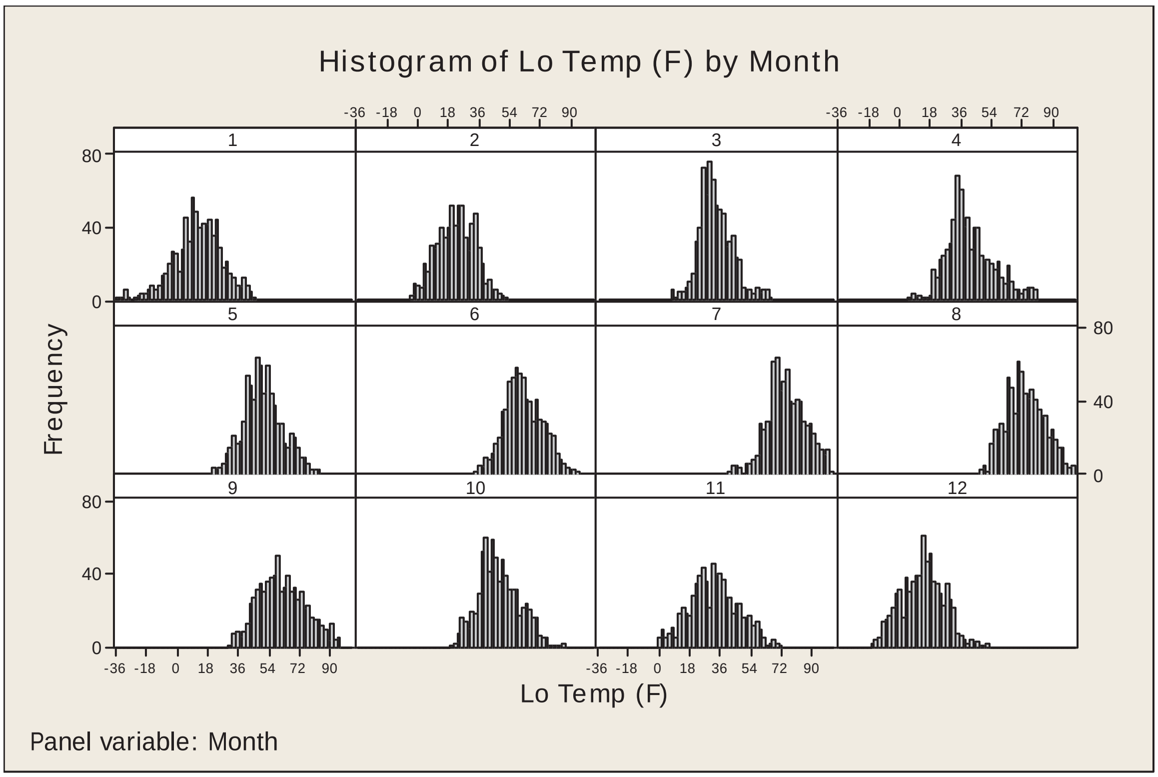
Variable	Season	N	N*	Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Hi Temp (F)	1-Spring	2184	0	45.002	14.101	8.000	34.000	44.000	55.000	85.000
	2-Summer	2208	0	73.599	12.686	37.000	65.000	73.000	82.000	104.000
	3-Fall	2184	0	50.924	18.130	2.000	39.000	51.000	63.000	97.000
	4-Winter	2184	0	19.797	12.896	-28.000	11.000	20.000	29.000	55.000

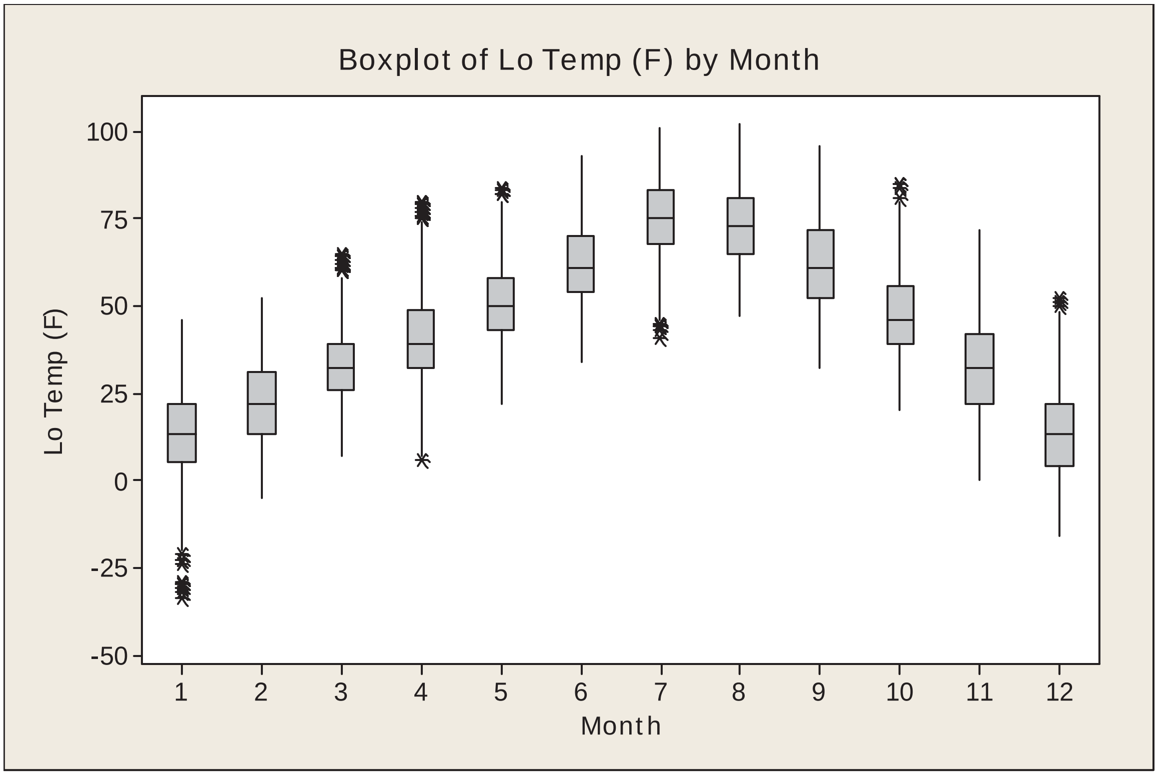

Histogram of Hi Temp (F) by Season
1-Spring
2-Summer
3-Fall
4-Winter
Frequency
Hi Temp (F)
-18 0 18 36 54 72 90
0 40 80 120 160
Panel variable: Season


Boxplot of Hi Temp (F) by Season
Hi Temp (F)
120 100 80 60 40 20 0 -20 -40
1-Spring
2-Summer
3-Fall
4-Winter
Season

Descriptive Statistics: Lo Temp (F)

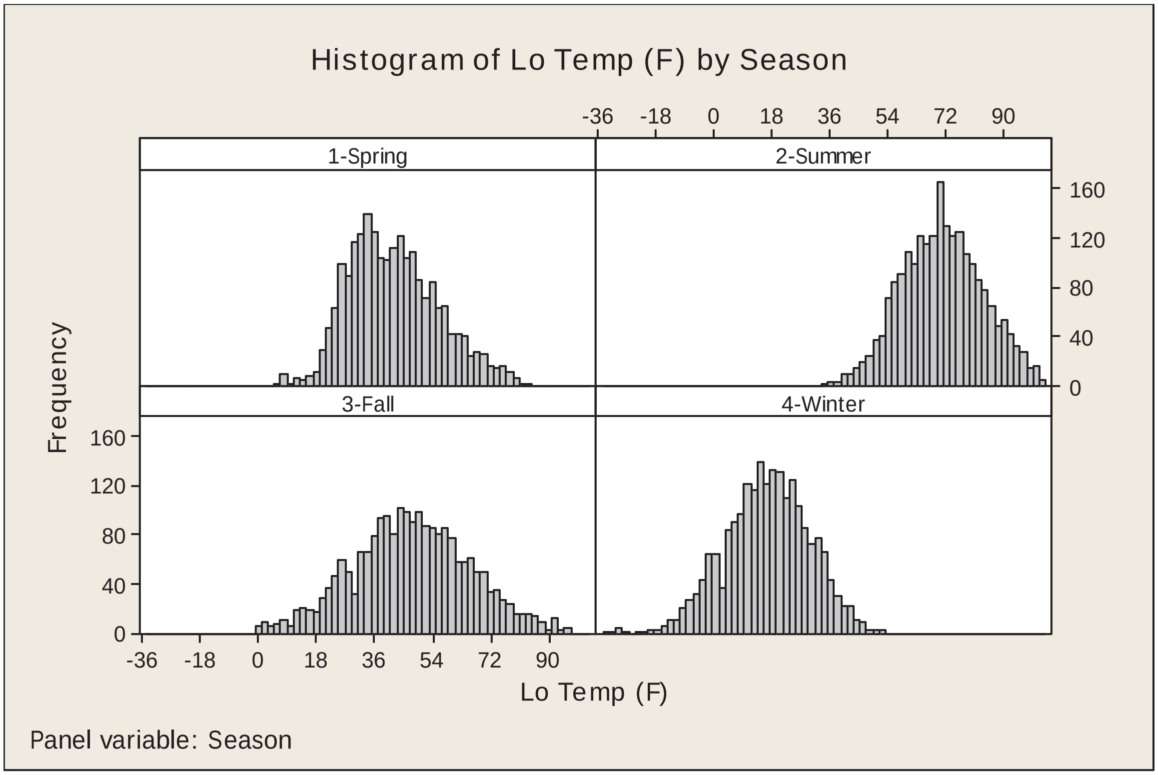
Variable	Month	N	N*	Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Lo Temp (F)	1	744	0	12.538	13.869	-34.000	5.000	13.000	22.000	46.000
	2	696	0	21.797	11.032	-5.000	13.250	22.000	31.000	52.000
	3	720	0	32.993	9.890	7.000	26.000	32.000	39.000	65.000
	4	720	0	41.326	13.840	6.000	32.000	39.000	49.000	80.000
	5	744	0	50.719	11.503	22.000	43.000	50.000	58.000	84.000
	6	720	0	61.635	10.928	34.000	54.000	61.000	70.000	93.000
	7	744	0	75.144	11.330	41.000	68.000	75.000	83.000	101.000
	8	744	0	73.449	11.173	47.000	65.000	73.000	81.000	102.000
	9	720	0	61.931	13.775	32.000	52.000	61.000	72.000	96.000
	10	744	0	47.539	12.074	20.000	39.000	46.000	55.750	85.000
	11	720	0	32.004	14.599	0.000	22.000	32.000	42.000	72.000
	12	744	0	12.957	12.541	-16.000	4.000	13.000	22.000	52.000

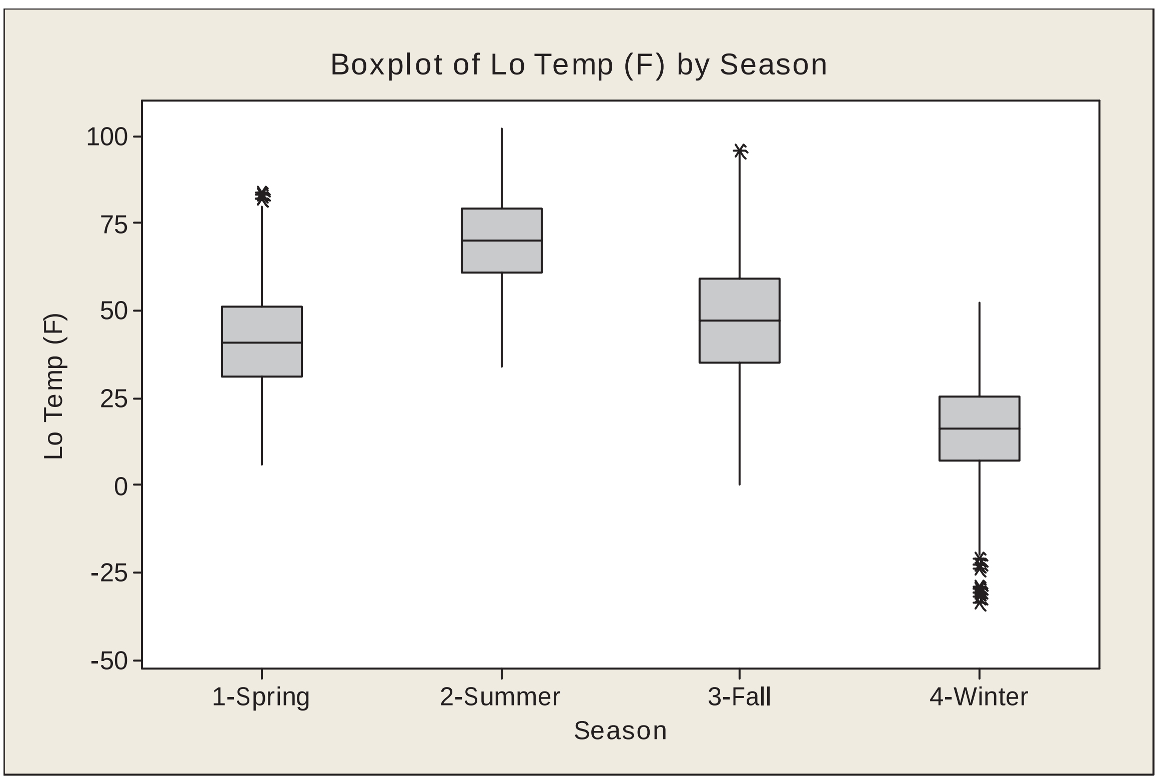




Descriptive Statistics: Lo Temp (F)

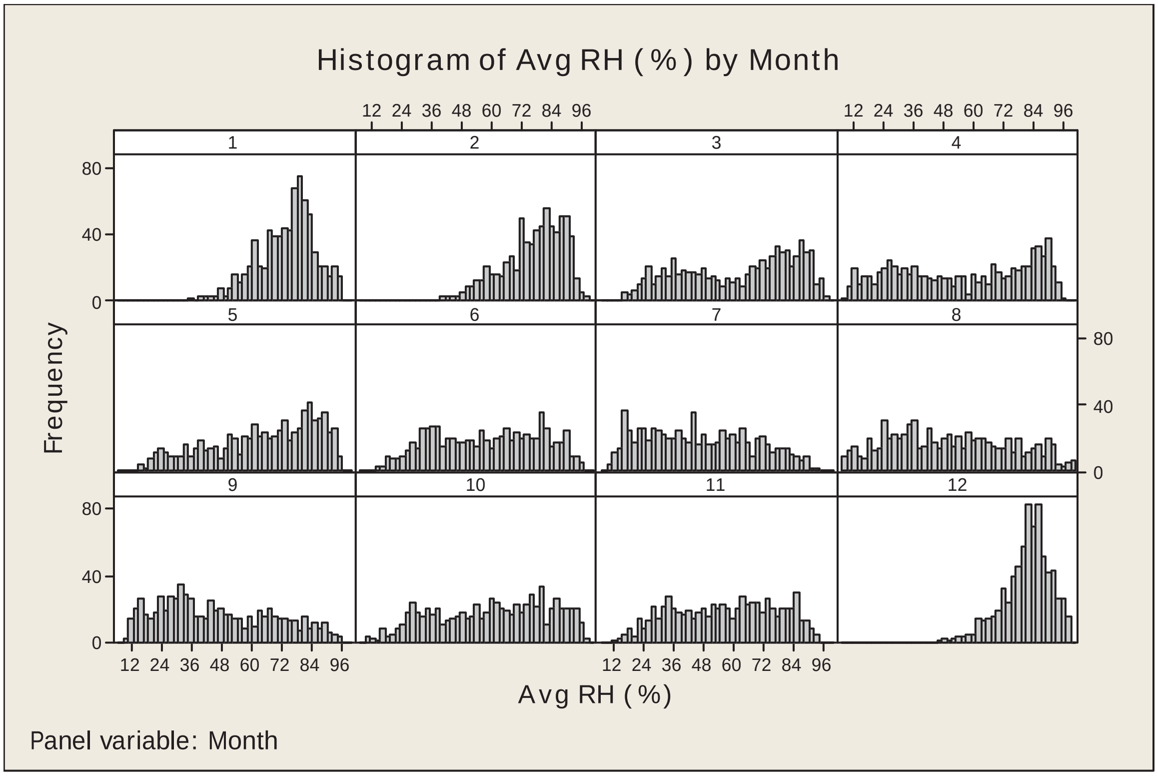
Variable	Season	N	N*	Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Lo Temp (F)	1-Spring	2184	0	41.779	13.896	6.000	31.000	41.000	51.000	84.000
	2-Summer	2208	0	70.168	12.644	34.000	61.000	70.000	79.000	102.000
	3-Fall	2184	0	47.162	18.168	0.000	35.000	47.000	59.000	96.000
	4-Winter	2184	0	15.631	13.250	-34.000	7.000	16.000	25.000	52.000


Histogram of Lo Temp (F) by Season
1-Spring
2-Summer
3-Fall
4-Winter
Frequency
Lo Temp (F)
-36 -18 0 18 36 54 72 90
0 40 80 120 160
Panel variable: Season


Boxplot of Lo Temp (F) by Season
Lo Temp (F)
100 75 50 25 0 -25 -50
1-Spring
2-Summer
3-Fall
4-Winter
Season

Descriptive Statistics: Avg RH (%)

Variable	Month	N	N*	Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Avg RH (%)	1	744	0	74.401	11.316	35.000	67.000	77.000	82.000	96.000
	2	696	0	76.204	12.055	39.000	69.000	78.000	86.000	97.000
	3	720	0	61.858	22.846	15.000	41.000	67.000	82.000	97.000
	4	720	0	55.276	26.033	8.000	31.250	56.500	80.750	95.000
	5	744	0	64.849	21.121	15.000	50.000	69.000	83.000	96.000
	6	720	0	57.286	21.158	13.000	38.000	58.000	76.000	96.000
	7	744	0	45.902	21.533	10.000	27.000	44.000	63.000	94.000
	8	744	0	49.981	23.951	7.000	30.000	49.000	69.000	99.000
	9	720	0	46.239	22.786	9.000	28.000	43.000	65.000	96.000
	10	744	0	59.480	22.502	9.000	40.000	61.000	79.000	97.000
	11	720	0	56.265	20.717	12.000	38.000	57.000	73.000	94.000
	12	744	0	80.942	9.595	46.000	76.000	82.000	87.000	98.000



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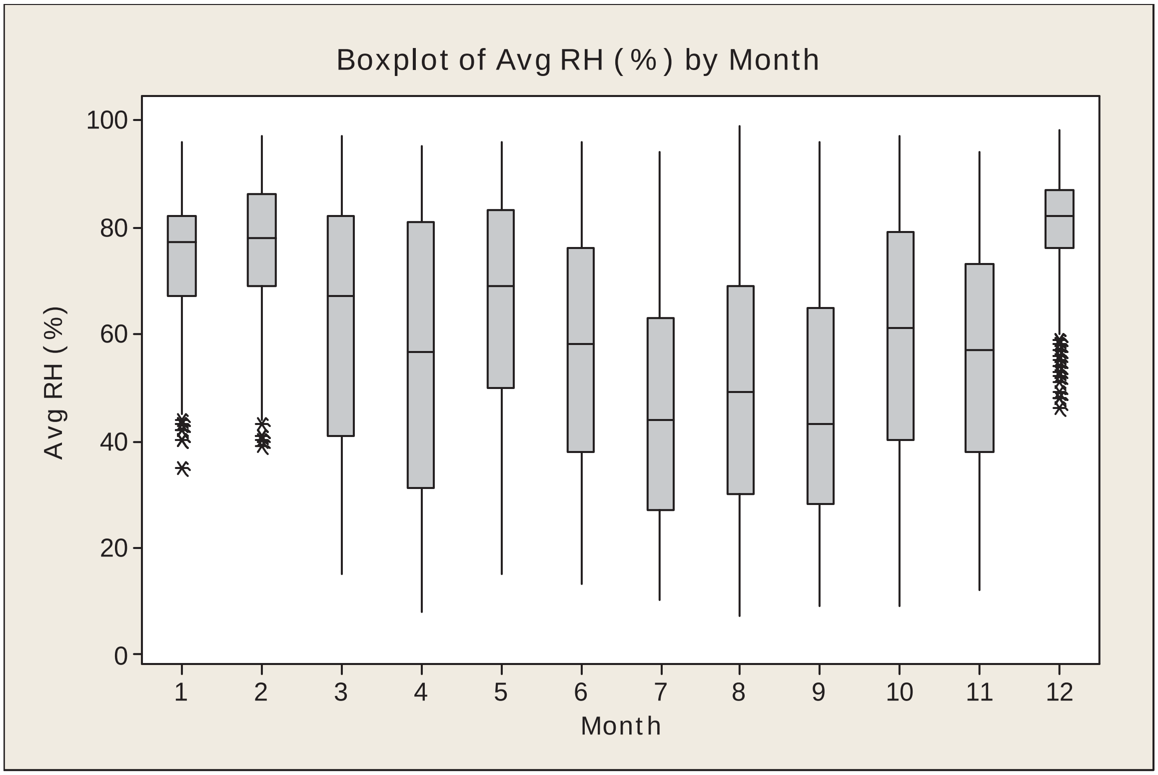
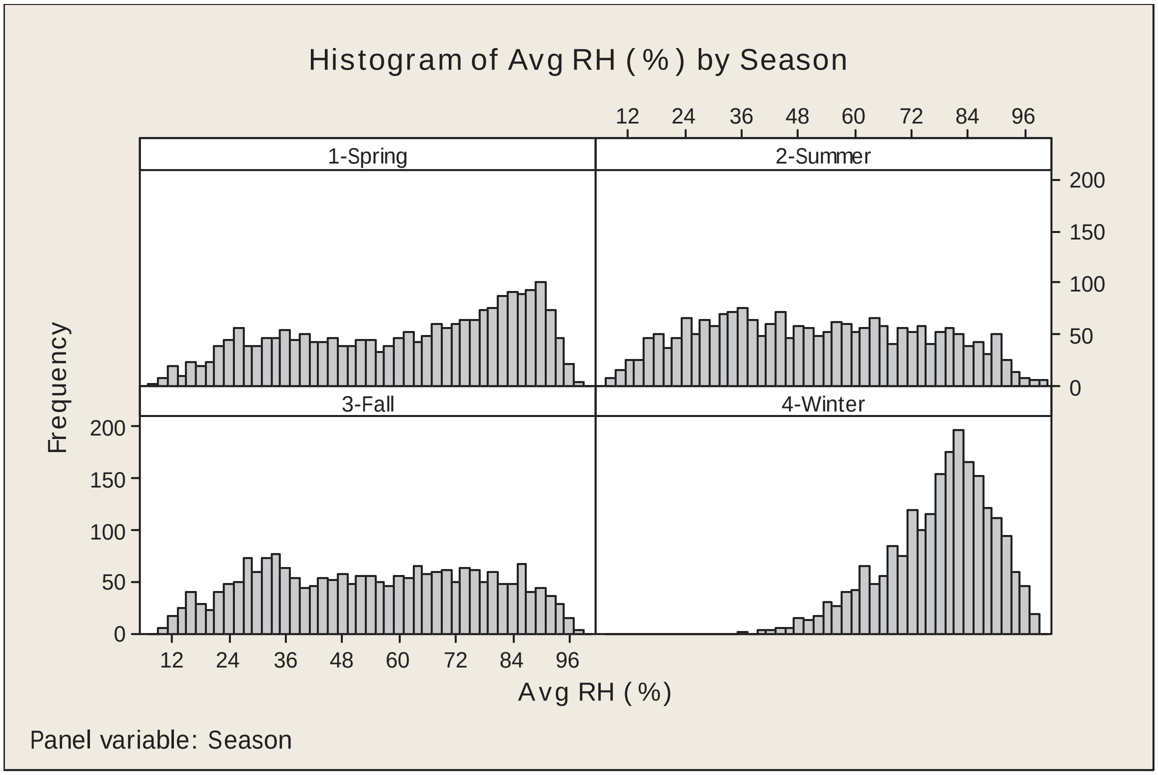
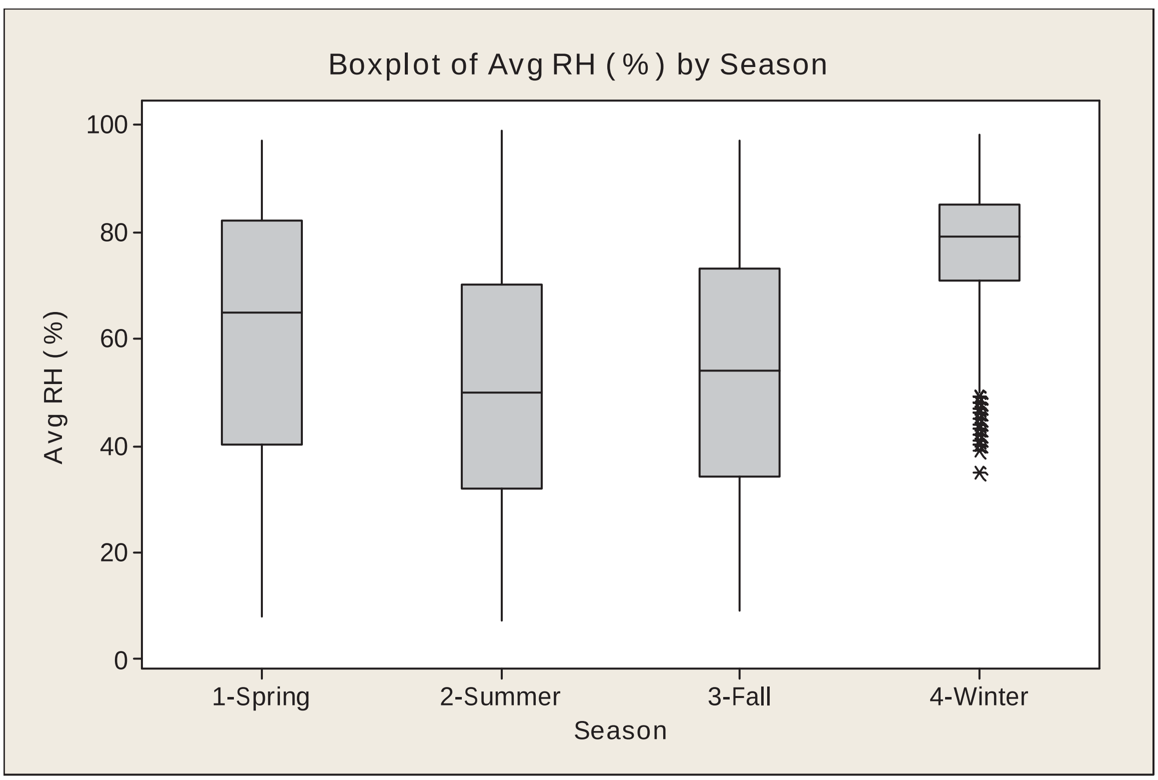


Descriptive Statistics: Avg RH (%)

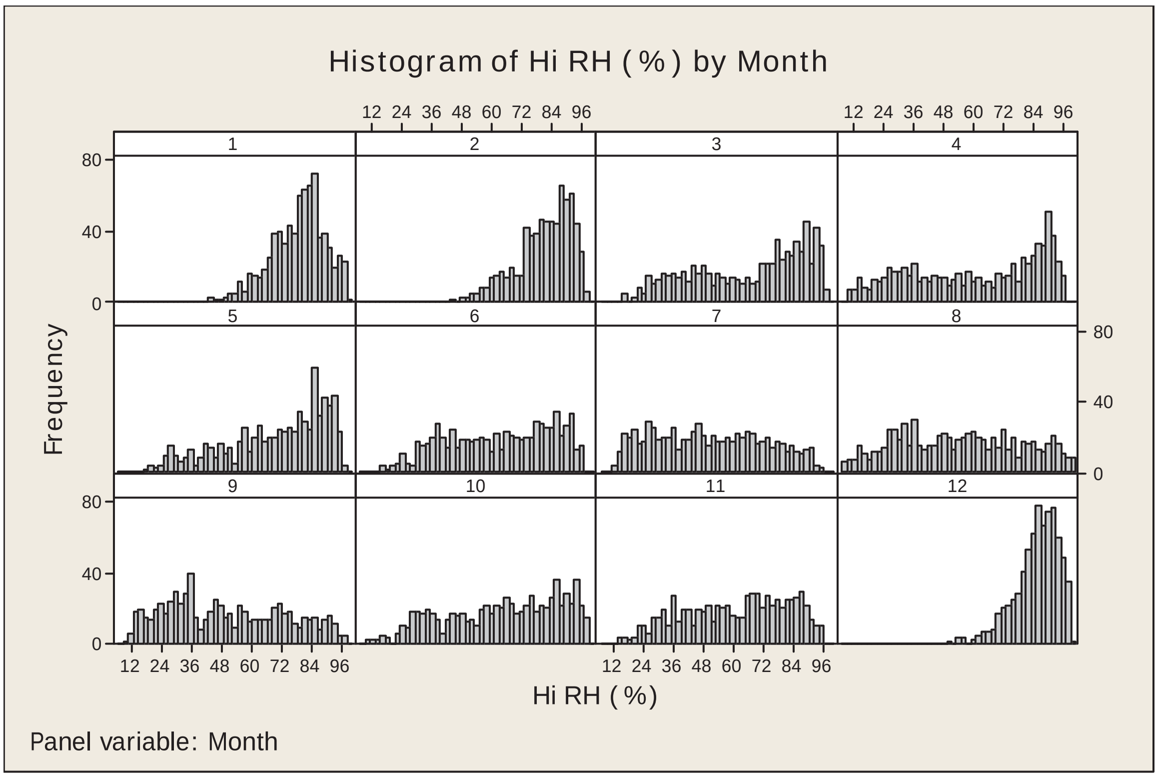
Variable	Season	N	N*	Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Avg RH (%)	1-Spring	2184	0	60.707	23.727	8.000	40.000	65.000	82.000	97.000
	2-Summer	2208	0	50.989	22.739	7.000	32.000	50.000	70.000	99.000
	3-Fall	2184	0	54.055	22.726	9.000	34.000	54.000	73.000	97.000
	4-Winter	2184	0	77.204	11.355	35.000	71.000	79.000	85.000	98.000

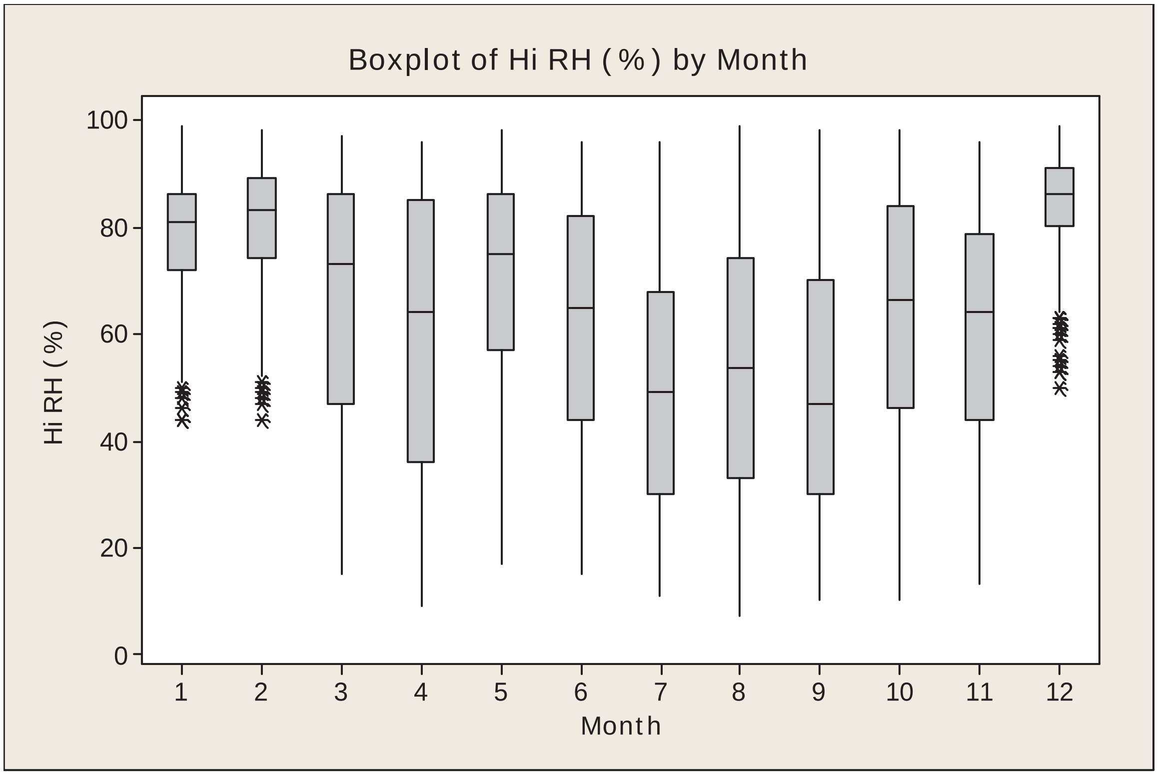

Histogram of Avg RH (%) by Season
1-Spring
2-Summer
3-Fall
4-Winter
Frequency
Avg RH (%)
Panel variable: Season


Boxplot of Avg RH (%) by Season
Avg RH (%)
1-Spring
2-Summer
3-Fall
4-Winter
Season

Descriptive Statistics: Hi RH (%)

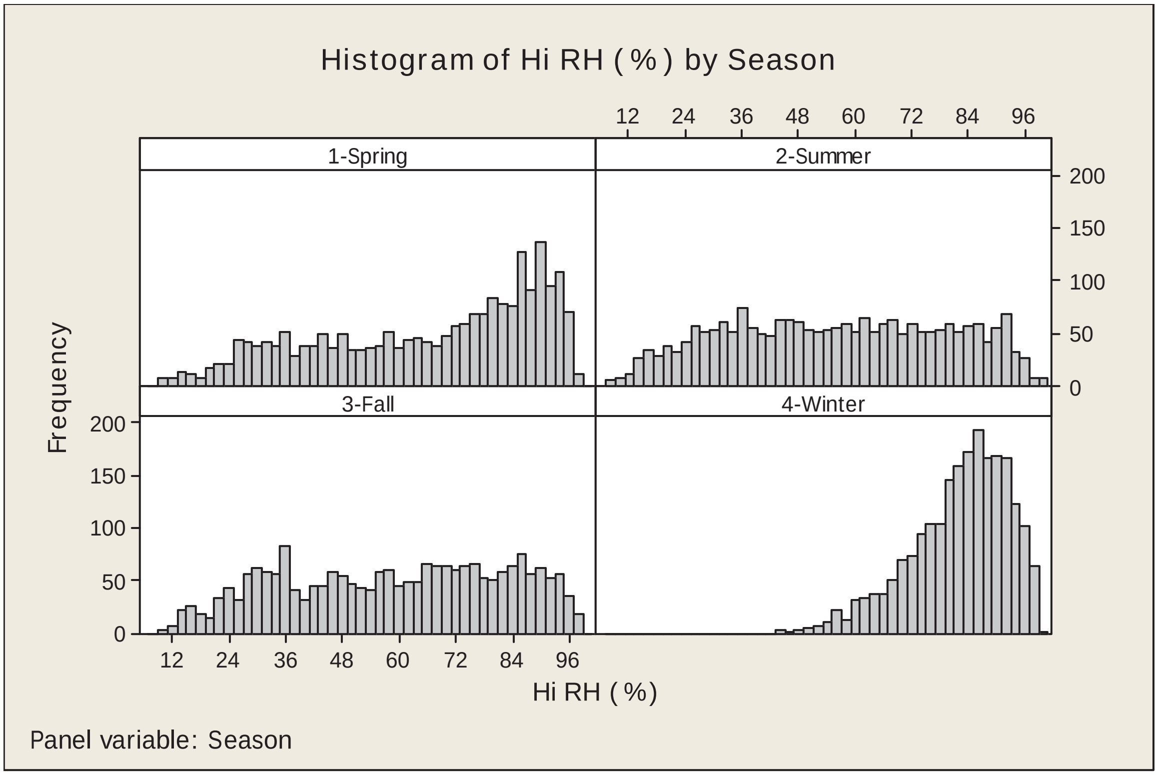
Variable	Month	N	N*	Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Hi RH (%)	1	744	0	79.089	10.652	44.000	72.000	81.000	86.000	99.000
	2	696	0	80.704	10.902	44.000	74.000	83.000	89.000	98.000
	3	720	0	66.451	22.568	15.000	47.000	73.000	86.000	97.000
	4	720	0	60.206	26.101	9.000	36.000	64.000	85.000	96.000
	5	744	0	69.940	20.135	17.000	57.000	75.000	86.000	98.000
	6	720	0	62.814	21.013	15.000	44.000	65.000	82.000	96.000
	7	744	0	49.991	22.415	11.000	30.000	49.000	68.000	96.000
	8	744	0	53.909	24.419	7.000	33.000	53.500	74.000	99.000
	9	720	0	50.150	23.648	10.000	30.000	47.000	70.000	98.000
	10	744	0	63.888	22.670	10.000	46.000	66.500	84.000	98.000
	11	720	0	60.954	20.860	13.000	44.000	64.000	78.750	96.000
	12	744	0	84.997	8.711	50.000	80.000	86.000	91.000	99.000

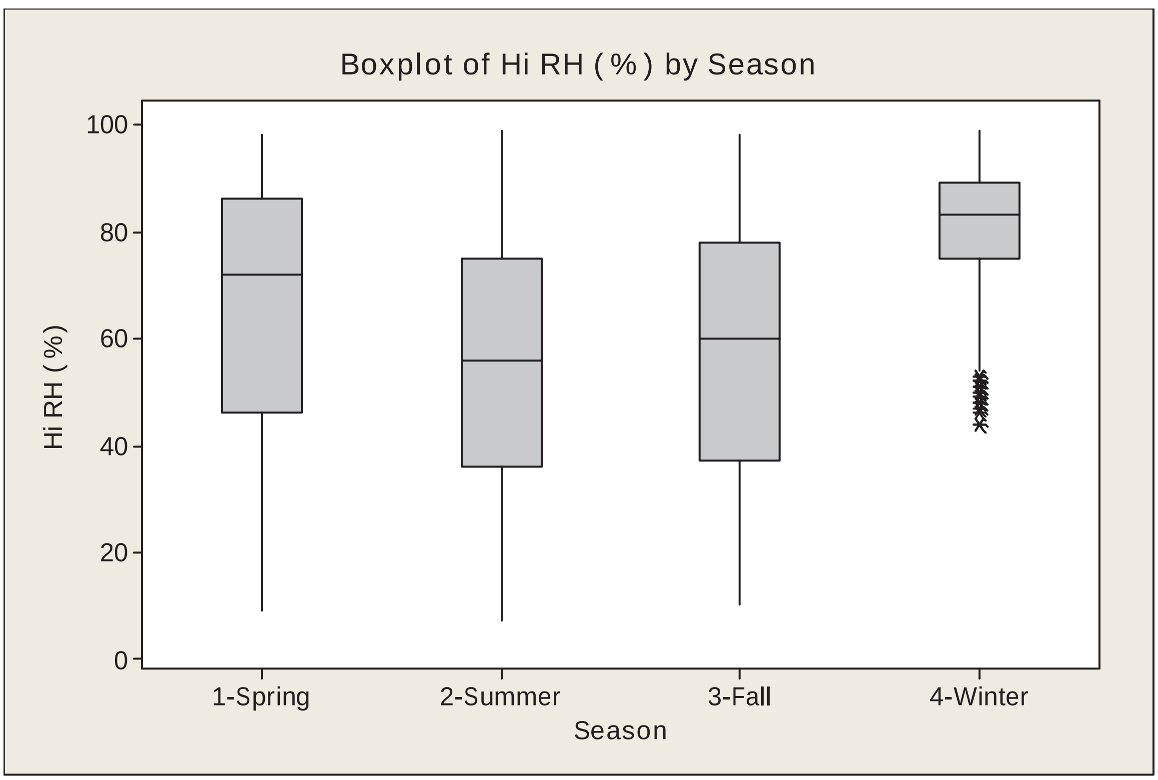




Descriptive Statistics: Hi RH (%)

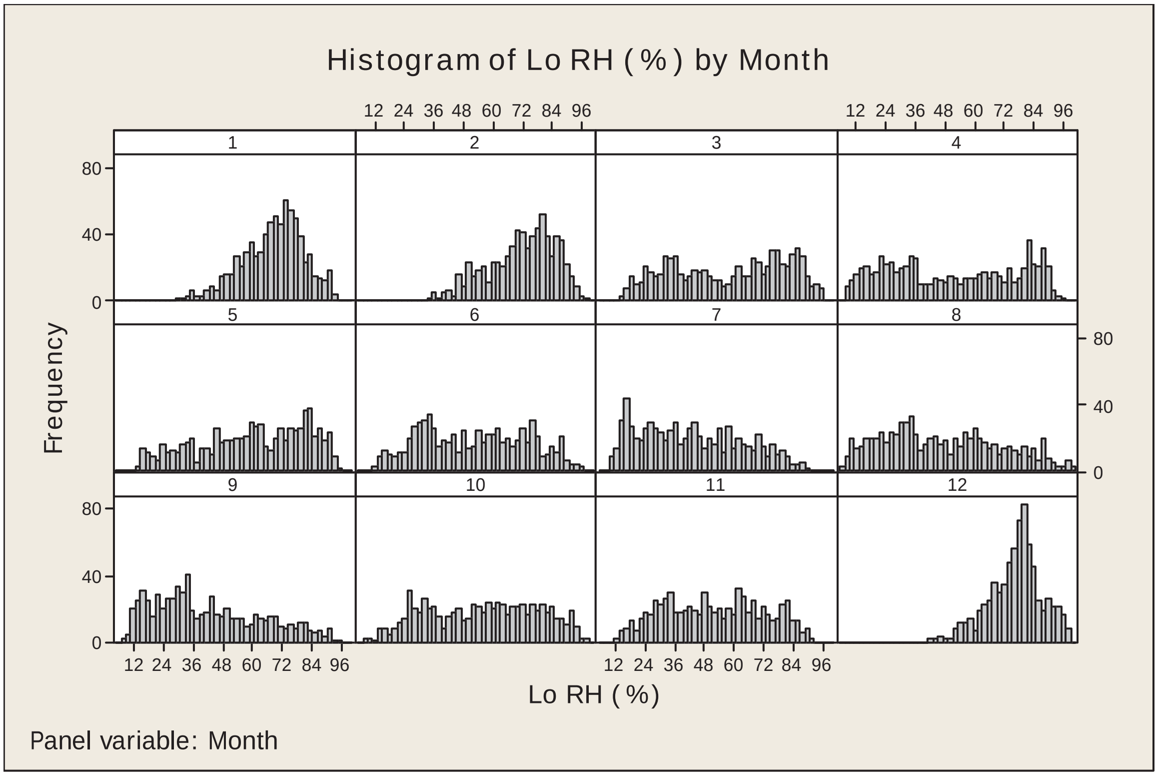
Variable	Season	N	N*	Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Hi RH (%)	1-Spring	2184	0	65.581	23.375	9.000	46.000	72.000	86.000	98.000
	2-Summer	2208	0	55.492	23.286	7.000	36.000	56.000	75.000	99.000
	3-Fall	2184	0	58.392	23.180	10.000	37.000	60.000	78.000	98.000
	4-Winter	2184	0	81.616	10.422	44.000	75.000	83.000	89.000	99.000

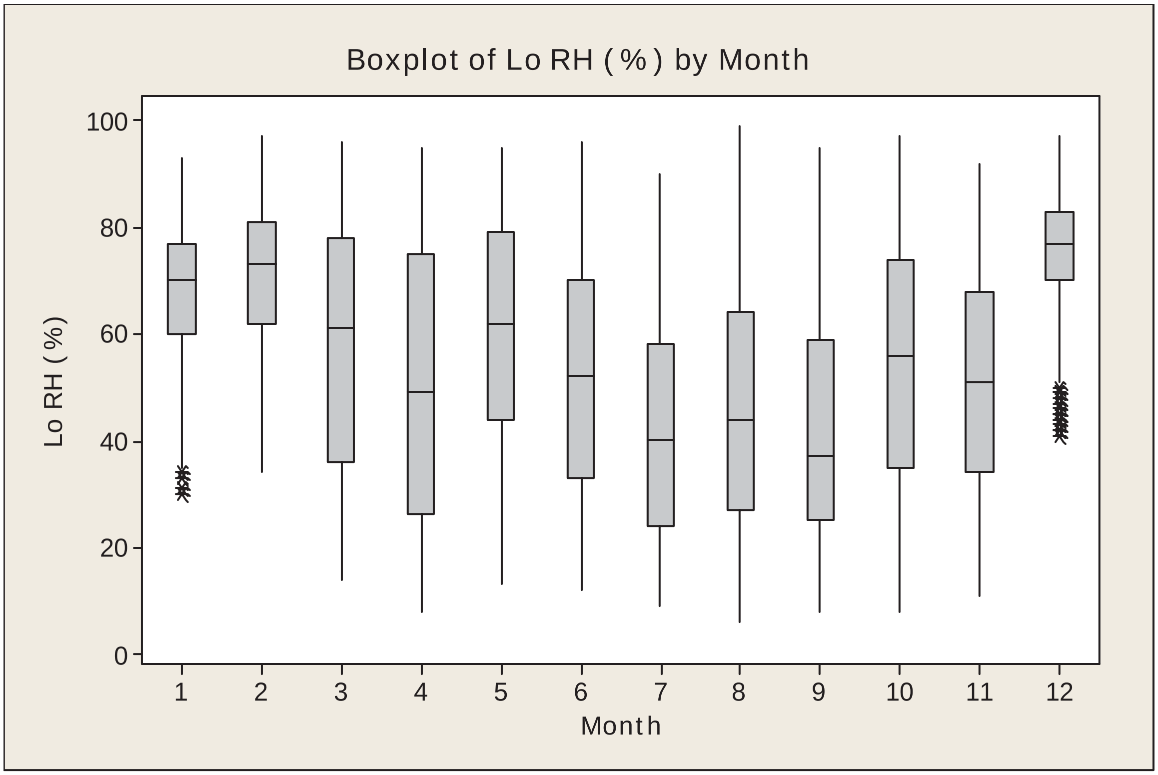

Histogram of Hi RH (%) by Season
1-Spring
2-Summer
3-Fall
4-Winter
Frequency
Hi RH (%)
Panel variable: Season
12
24
36
48
60
72
84
96
0
50
100
150
200


Boxplot of Hi RH (%) by Season
Hi RH (%)
Season
1-Spring
2-Summer
3-Fall
4-Winter
0
20
40
60
80
100

Descriptive Statistics: Lo RH (%)

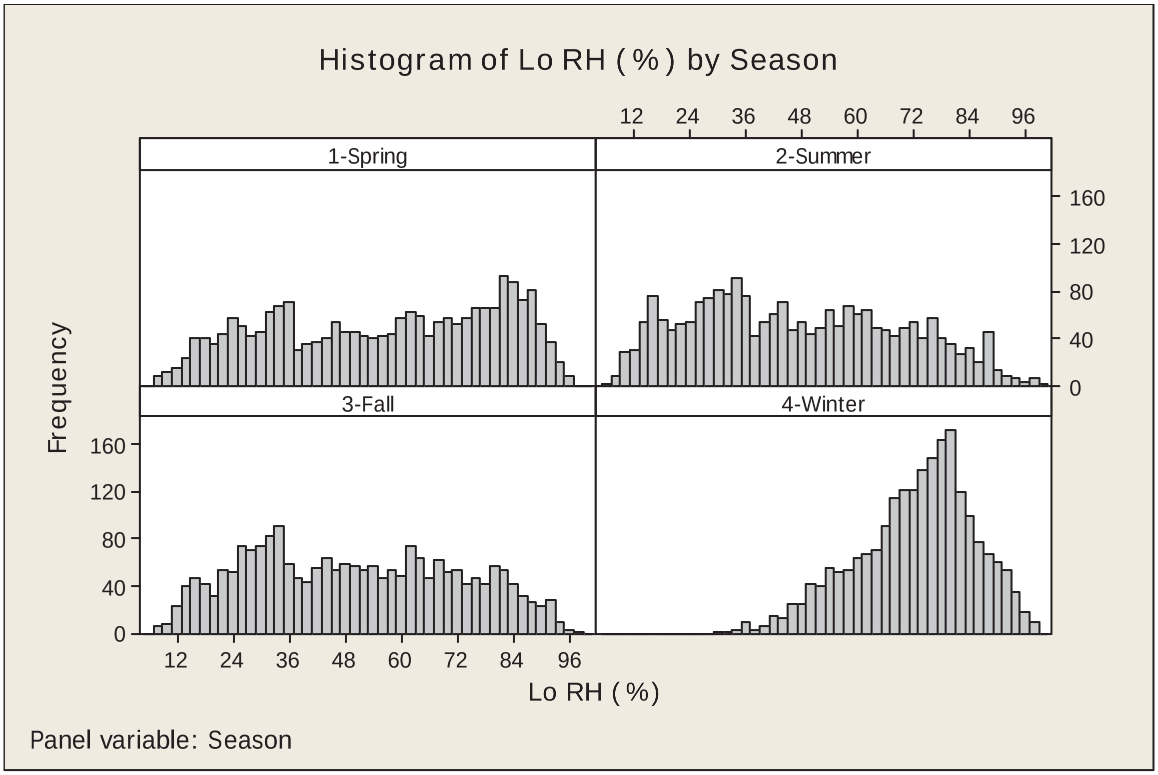
Variable	Month	N	N*	Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Lo RH (%)	1	744	0	68.601	12.330	30.000	60.000	70.000	77.000	93.000
	2	696	0	71.119	13.476	34.000	62.000	73.000	81.000	97.000
	3	720	0	57.353	22.974	14.000	36.000	61.000	78.000	96.000
	4	720	0	50.326	25.874	8.000	26.250	49.000	75.000	95.000
	5	744	0	59.954	21.723	13.000	44.000	62.000	79.000	95.000
	6	720	0	51.854	21.077	12.000	33.000	52.000	70.000	96.000
	7	744	0	42.000	20.728	9.000	24.000	40.000	58.000	90.000
	8	744	0	45.991	23.599	6.000	27.000	44.000	64.000	99.000
	9	720	0	42.293	21.856	8.000	25.000	37.000	59.000	95.000
	10	744	0	54.921	22.251	8.000	35.000	56.000	74.000	97.000
	11	720	0	51.574	20.250	11.000	34.000	51.000	68.000	92.000
	12	744	0	75.931	11.041	41.000	70.000	77.000	83.000	97.000

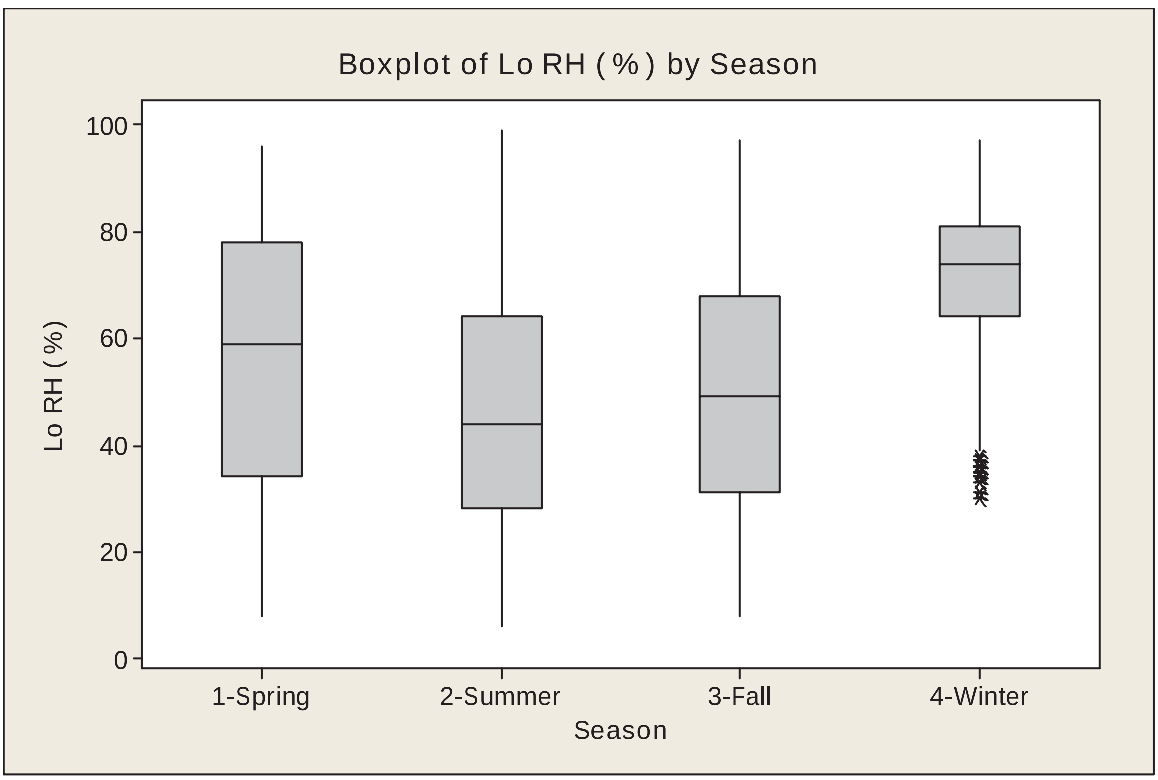




Descriptive Statistics: Lo RH (%)

Variable	Season	N	N*	Mean	StDev	Minimum	Q1	Median	Q3	Maximum
Lo RH (%)	1-Spring	2184	0	55.923	23.906	8.000	34.000	59.000	78.000	96.000
	2-Summer	2208	0	46.558	22.206	6.000	28.000	44.000	64.000	99.000
	3-Fall	2184	0	49.654	22.123	8.000	31.000	49.000	68.000	97.000
	4-Winter	2184	0	71.901	12.669	30.000	64.000	74.000	81.000	97.000


Histogram of Lo RH (%) by Season
1-Spring
2-Summer
3-Fall
4-Winter
Frequency
0
40
80
120
160
12
24
36
48
60
72
84
96
Lo RH (%)
Panel variable: Season


Boxplot of Lo RH (%) by Season
Lo RH (%)
0
20
40
60
80
100
1-Spring
2-Summer
3-Fall
4-Winter
Season

Descriptive Statistics: Precip (Inches)

Variable	Month	N	N*	Sum	Maximum
Precip (Inches)	1	744	0	0.130000	0.050000
	2	696	0	0.210000	0.040000
	3	720	0	0.400000	0.130000
	4	720	0	0.980000	0.330000
	5	744	0	3.80000	0.71000
	6	720	0	1.770000	0.420000
	7	744	0	1.870000	0.460000
	8	744	0	0.870000	0.160000
	9	720	0	0.790000	0.140000
	10	744	0	1.230000	0.220000
	11	720	0	0.100000	0.050000
	12	744	0	0.270000	0.040000

APPENDIX 2.5-C

SUPPORT INFORMATION FOR DEWEY-BURDOCK METEOROLOGICAL MONITORING SITE

The following presents the stability classes and joint frequency distribution for the Dewey-Burdock permit area and describes the methodology used for calculations. Atmospheric stability class can be derived from solar radiation during the daylight hours, and vertical temperature gradient (delta-T) measurements during the nighttime hours according to the SRDT (solar radiation delta-T) method. However, meteorological monitoring at the Dewey-Burdock site included solar radiation but not delta-T. In the absence of the delta-T measurements required by the SRDT method, a possible modification was considered. This modified SRDT approach would assume a positive delta-T (increasing temperature with height) during nighttime hours, thereby producing the most stable class possible and, therefore, the lowest modeled pollutant dispersion.

Another alternative to determine atmospheric stability classes and resulting joint frequency distributions is the sigma theta method. This method is turbulence-based, which uses the standard deviation of the horizontal wind direction (σ_θ) in combination with the scalar mean wind speed. Since σ_θ was not logged, it was necessary to derive this parameter from the hourly variation of 5-minute wind directions.

The procedure for deriving hourly average σ_θ values is outlined as follows:

1. Compute a scalar mean wind direction by averaging 5-minute azimuth angles over four, 15-minute periods for each hour. The choice of 15-minute averaging periods is intended to minimize the effect of wind meander (wind direction changes over longer periods that are non-random and unrelated to turbulence). The use of 5-minute source data further reduces the likelihood of conflicts between scalar and vector averages.
2. Compute a standard deviation of each 15-minute grouping of 5-minute wind directions, based on the differences between the 5-minute readings and the 15-minute mean from step 1 above.
3. Compute an hourly average standard deviation as the geometric average of the four 15-minute standard deviations from step 2 above.

Steps 1 and 2 utilize the Mitsua method: $\bar{\theta} = \frac{1}{N}\sum_{1}^{N} D_i$ (N = 3 in this case)

where
$D_i = \theta_i$; for $i = 1$
$D_i = D_{i-1} + \delta_i + 360$; for $\delta_i < -180$ and $i > 1$
$D_i = D_{i-1} + \delta_i$; for $|\delta_i| < 180$ and $i > 1$
$D_i = D_{i-1} + \delta_i - 360$; for $\delta_i > 180$ and $i > 1$
D_i = undefined; for $\delta_i = 180$ and $i > 1$
$\delta_i = \theta_i - D_{i-1}$; for $i > 1$
θ_i is the azimuth angle of the wind vane for the i^{th} sample

then $$\sigma_\theta = \left\{ \frac{1}{N} \sum_1^N D_i{}^2 - \frac{1}{N} \left(\sum_1^N D_i \right)^2 \right\}^{1/2}$$

In step 3, the hourly average standard deviation can then be calculated from these 15-minute values:

$$\sigma_\theta(1-hr) = \sqrt{\frac{(\sigma_{\theta_1})^2 + (\sigma_{\theta_2})^2 + (\sigma_{\theta_3})^2 + (\sigma_{\theta_4})^2}{4}}$$

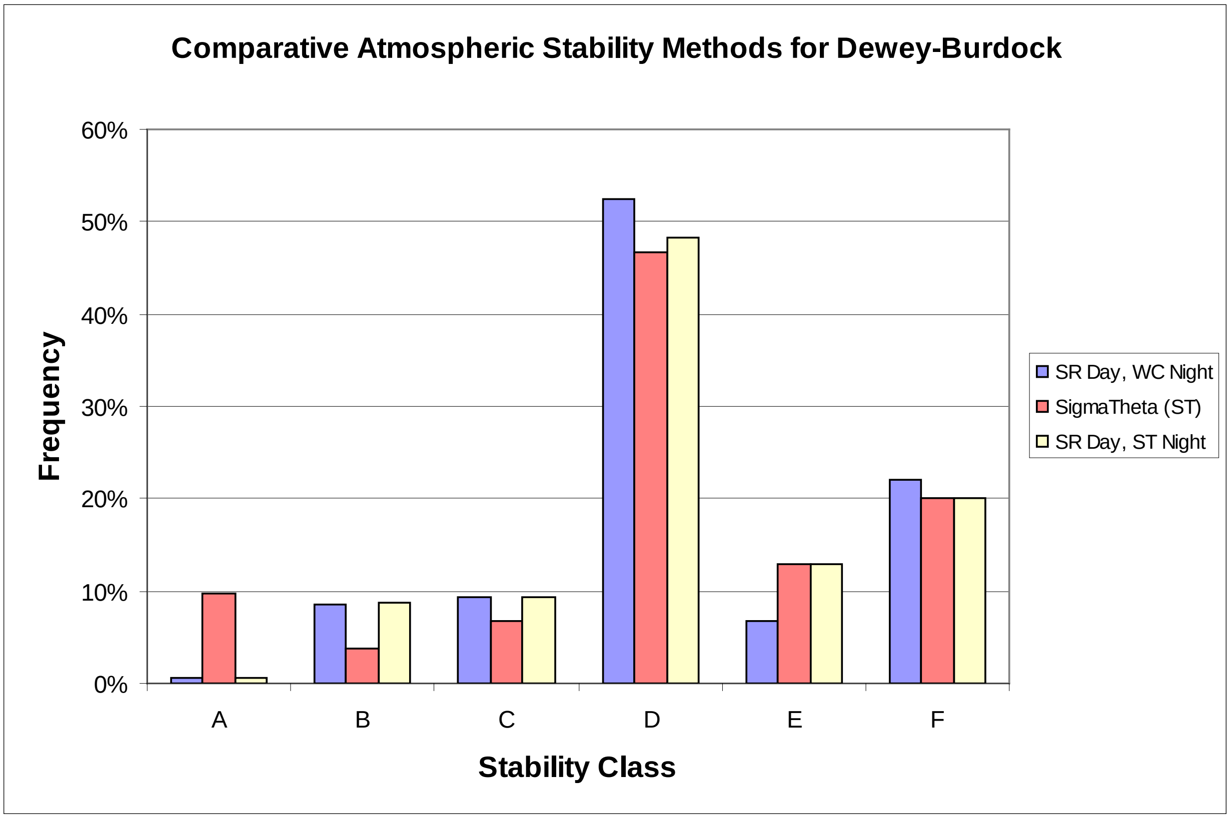
The above procedure, when applied to the Dewey-Burdock wind data, yields hourly σ_θ values similar to the hourly values logged at the nearby Newcastle meteorological station. Newcastle σ_θ values averaged 19.6º during the baseline monitoring year, while the derived σ_θ values from Dewey-Burdock data averaged 18.7º. The sigma theta method of atmospheric stability determination is considered more representative than the modified SRDT method described above, because it requires no simplifying assumptions.

Having developed these hourly σ_θ values, however, the choice remained whether to use the sigma theta method exclusively, or to use a hybrid method that takes advantage of solar radiation (SR) data during the daytime. To facilitate this choice, the two methods were compared along with the modified SRDT method which used SR during the day, and assumed worst-case delta-T (WC) at night. Figure 1 shows the results of this comparison.

The sigma theta method was ruled out since it resulted in a much higher percentage of the hours in the least stable class. Stability class A produces the greatest amount of atmospheric mixing and pollutant dispersion, so the sigma theta method compromises the preference for conservatism. The remaining two methods yield similar results. The hybrid SR/ST method was chosen because it makes use of the greatest amount of monitoring data covering both daytime and nighttime.

Based upon the data and method selections discussed above, the combination of hourly wind speed, wind direction and stability class was used to generate Joint Frequency Distributions (JFDs) for the anticipated release height of 10 meters. The annual JFD in Table 1 was used as the basis for a revised MILDOS-AREA model run. The 1st Quarter JFD in Table 2 reflects January 1, 2008 through March 31, 2008. Table 3 reflects 2nd Quarter (April 1, 2008 through June 30, 2008). Table 4 reflects the 3rd Quarter (July 2007 and 2008 and August 1, 2007 through September 30, 2007). Table 5 reflects the 4th Quarter (October 1, 2007 through December 31, 2007). Each table footer shows the number of hours for which valid data are available, the total number of hours possible, and the number of calm hours during the period represented.

Figure 1: Comparative Atmospheric Stability Methods for Dewey-Burdock



Data recoveries at the 3-meter level exceeded 99%. However, regulatory guidance specifies that wind characteristics should reflect the anticipated release height for modeled emission sources. Therefore, the joint frequency distributions depicted below are based on 10-meter wind data. Joint data recovery (wind speed and wind direction) for the baseline year was 87%, above the recommended minimum of 75% (Reference 3). Individual data recovery was also around 87%, slightly below the recommended 90% for individual parameters (Reference 3). However, the tradeoff between marginal recovery percentage and representative height above the ground appears justified in this case.

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Table 1: Annual (July 18, 2007 to July 17, 2008) Joint Frequency Distribution

Stability Class	Wind Direction	Wind Speed (mph) - One Year (Calm = 1.22%) < 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	Row Total
A	N							
	NNE		0.000131					0.000131
	NE							
	ENE							
	E							
	ESE	0.000274						0.000274
	SE		0.000262					0.000262
	SSE	0.000274	0.000393					0.000667
	S	0.000274	0.000524					0.000798
	SSW	0.000411	0.000786					0.001197
	SW	0.000411	0.000393					0.000804
	WSW	0.000137	0.000786					0.000923
	W	0.000274	0.000393					0.000667
	WNW	0.000411	0.000524					0.000935
	NW							
	NNW							
B	N	0.002740	0.000524					0.003264
	NNE	0.001096						0.001096
	NE	0.001096						0.001096
	ENE	0.000822	0.000262					0.001084
	E	0.000822	0.000131	0.000131				0.001084
	ESE	0.000411	0.000393	0.000655				0.001459
	SE	0.001781	0.001964	0.002095				0.005841
	SSE	0.002603	0.004191	0.001441				0.008234
	S	0.005206	0.003143	0.000524				0.008872
	SSW	0.005069	0.001702	0.000131				0.006902
	SW	0.003562	0.002226	0.000393				0.006181
	WSW	0.003699	0.002881	0.000262				0.006842
	W	0.003836	0.005369	0.001441				0.010646
	WNW	0.004384	0.004191	0.003405				0.011979
	NW	0.004384	0.001833	0.000917				0.007134
	NNW	0.003973	0.001048	0.000131				0.005151
C	N		0.001310					0.001310
	NNE		0.000393					0.000393
	NE		0.000131					0.000131
	ENE		0.000262	0.000131				0.000393
	E		0.001310	0.001702	0.000131			0.003143
	ESE		0.001964	0.003274	0.000131			0.005369
	SE		0.003798	0.004191	0.000131			0.008119
	SSE		0.004845	0.003405				0.008250
	S		0.005500	0.000786				0.006286
	SSW		0.001572	0.000917				0.002488
	SW		0.001702	0.000655				0.002357
	WSW		0.003929	0.001310				0.005238
	W		0.006548	0.001310	0.000393			0.008250
	WNW		0.011524	0.008905	0.000131	0.000393		0.020953
	NW		0.007072	0.004845	0.001441	0.000393		0.013751
	NNW		0.005107	0.001833				0.006941

Table 1: Annual (July 18, 2007 to July 17, 2008) Joint Frequency Distribution (cont'd)

Stability Class	Wind Direction	Wind Speed (mph) - One Year						
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	Row Total
D	N	0.008493	0.010215	0.002226	0.001310	0.000393		0.022637
	NNE	0.007671	0.004976	0.001702	0.000524		0.000131	0.015005
	NE	0.002740	0.002750	0.004060	0.002357	0.000131	0.000393	0.012431
	ENE	0.001781	0.005631	0.012834	0.013751	0.002357	0.002095	0.038449
	E	0.003288	0.007596	0.024227	0.016370	0.001572	0.000655	0.053707
	ESE	0.001644	0.007858	0.011655	0.009691	0.000917		0.031764
	SE	0.001096	0.006024	0.007727	0.002226	0.000262		0.017335
	SSE	0.002740	0.004584	0.004060	0.001441	0.000393		0.013216
	S	0.002740	0.003012	0.001048	0.000131			0.006930
	SSW	0.003425	0.001964	0.001441	0.000393			0.007222
	SW	0.001370	0.000917	0.002095	0.002488	0.000917	0.000131	0.007918
	WSW	0.002329	0.002226	0.002619	0.003274	0.001048	0.000655	0.012151
	W	0.001644	0.003536	0.003274	0.003405	0.001702	0.000131	0.013692
	WNW	0.003699	0.011655	0.018989	0.021870	0.004453	0.000393	0.061059
	NW	0.005617	0.016370	0.038371	0.047669	0.019120	0.003143	0.130289
	NNW	0.006575	0.015191	0.008643	0.005631	0.001833	0.000393	0.038267
E	N	0.006438	0.010084	0.000786				0.017308
	NNE	0.004247	0.004191	0.000131				0.008568
	NE	0.002466	0.002226	0.000655				0.005347
	ENE	0.001370	0.003929	0.002881				0.008180
	E	0.000548	0.006810	0.007203				0.014561
	ESE	0.000274	0.004453	0.003405				0.008131
	SE	0.000548	0.004191	0.002095				0.006834
	SSE	0.000411	0.003667	0.000655				0.004733
	S	0.000411	0.001310					0.001721
	SSW	0.000274	0.001048	0.000524				0.001845
	SW	0.000137	0.001179	0.000262				0.001578
	WSW	0.000822	0.000786					0.001608
	W	0.000959	0.002881	0.001048				0.004888
	WNW	0.001507	0.004584	0.004191				0.010281
	NW	0.001644	0.009429	0.005107				0.016180
	NNW	0.004932	0.009691	0.003667				0.018289
F	N	0.018082	0.006679					0.024761
	NNE	0.019178	0.004715					0.023893
	NE	0.012877	0.003143					0.016020
	ENE	0.007260	0.003798					0.011058
	E	0.006027	0.003274					0.009301
	ESE	0.006164	0.002095					0.008260
	SE	0.004521	0.002226					0.006747
	SSE	0.007808	0.003536					0.011344
	S	0.005480	0.002488					0.007968
	SSW	0.005206	0.001179					0.006384
	SW	0.004384	0.001441					0.005824
	WSW	0.003973	0.001179					0.005151
	W	0.004795	0.002750					0.007545
	WNW	0.008219	0.004191					0.012410
	NW	0.013151	0.006417					0.019568
	NNW	0.017808	0.006941					0.024749

7,636 valid hours out of 8,784

Table 2: 1st Quarter (January 1, 2008 to March 31, 2008) Joint Frequency Distribution

Stability Class	Wind Direction	Wind Speed (mph) - Winter (Calm = 0.6%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
A	N							
	NNE							
	NE							
	ENE							
	E							
	ESE							
	SE							
	SSE							
	S							
	SSW							
	SW							
	WSW							
	W							
	WNW							
	NW							
	NNW							
B	N	0.005197						0.005197
	NNE	0.001890						0.001890
	NE	0.001890						0.001890
	ENE	0.000945						0.000945
	E	0.000945						0.000945
	ESE	0.000945		0.000463				0.001408
	SE	0.001890	0.000463					0.002353
	SSE	0.003307	0.001390					0.004698
	S	0.005670	0.000927					0.006597
	SSW	0.003780	0.000463					0.004243
	SW	0.004252						0.004252
	WSW	0.003307	0.000927					0.004234
	W	0.004725	0.003244					0.007969
	WNW	0.004725	0.001854	0.001390				0.007969
	NW	0.003780	0.000463	0.000927				0.005170
	NNW	0.005670						0.005670
C	N		0.002317					0.002317
	NNE		0.000927					0.000927
	NE		0.000463					0.000463
	ENE		0.000463	0.000463				0.000927
	E			0.003244				0.003244
	ESE		0.001854	0.002317				0.004171
	SE		0.003244	0.003244				0.006487
	SSE		0.004171	0.001854				0.006024
	S		0.002780	0.001390				0.004171
	SSW			0.000927				0.000927
	SW		0.002317					0.002317
	WSW		0.003707	0.000463				0.004171
	W		0.005097	0.000463				0.005561
	WNW		0.010195	0.008341				0.018536
	NW		0.014829	0.004171				0.018999
	NNW		0.007414	0.003244				0.010658

Table 2: 1st Quarter (January 1, 2008 to March 31, 2008) Joint Frequency Distribution (cont'd)

Stability Class	Wind Direction	Wind Speed (mph) - Winter (Calm = 0.6%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
D	N	0.010867	0.010658	0.002317		0.000463		0.024305
	NNE	0.007560	0.006487	0.000927				0.014974
	NE	0.003780	0.001854		0.000927			0.006560
	ENE	0.000945	0.003244	0.009268	0.003707			0.017164
	E	0.001417	0.006024	0.014365	0.008341			0.030148
	ESE	0.001417	0.005561	0.007878	0.000927			0.015783
	SE	0.000945	0.005561	0.005097				0.011603
	SSE	0.003307	0.005561	0.002780	0.000463			0.012112
	S	0.002362	0.003244	0.000463	0.000463			0.006533
	SSW	0.002362	0.002317	0.000927				0.005606
	SW	0.000472	0.000463	0.002780	0.001854			0.005570
	WSW	0.001417	0.002780	0.001390	0.002780		0.001854	0.010222
	W	0.000472	0.005097	0.004171	0.003244	0.002317	0.000463	0.015764
	WNW	0.003307	0.013902	0.024560	0.028267	0.005561	0.000927	0.076523
	NW	0.004252	0.016682	0.052363	0.055607	0.022243	0.001854	0.153001
	NNW	0.006142	0.015292	0.011585	0.008804	0.001390		0.043214
E	N	0.008977	0.013438	0.001854				0.024269
	NNE	0.006615	0.005561					0.012175
	NE	0.002835	0.000463	0.000927				0.004225
	ENE	0.000472	0.002317	0.002317				0.005106
	E	0.001417	0.004634	0.005561				0.011612
	ESE	0.000472	0.002780	0.004634				0.007887
	SE	0.000945	0.003707	0.003244				0.007896
	SSE	0.000945	0.000927					0.001872
	S		0.001390					0.001390
	SSW	0.000472		0.000463				0.000936
	SW	0.000472	0.000927					0.001399
	WSW	0.001890	0.000463					0.002353
	W	0.001417	0.003707	0.002780				0.007905
	WNW	0.001417	0.008804	0.009268				0.019490
	NW	0.002835	0.014365	0.008804				0.026004
	NNW	0.005197	0.013438	0.006024				0.024660
F	N	0.021262	0.008804					0.030066
	NNE	0.027876	0.006024					0.033900
	NE	0.016064	0.004171					0.020235
	ENE	0.010867	0.003244					0.014111
	E	0.006615	0.004634					0.011249
	ESE	0.004725	0.000927					0.005652
	SE	0.006615	0.001854					0.008468
	SSE	0.008977	0.004171					0.013148
	S	0.006142	0.001854					0.007996
	SSW	0.003307	0.000927					0.004234
	SW	0.003780						0.003780
	WSW	0.002835	0.000927					0.003762
	W	0.004252	0.002317					0.006569
	WNW	0.009450	0.006024					0.015474
	NW	0.016537	0.008341					0.024878
	NNW	0.023624	0.009268					0.032892

2,158 valid hours out of 2,184

Table 3: 2nd Quarter (April 1, 2008 to June 30, 2008) Joint Frequency Distribution

Stability Class	Wind Direction	Wind Speed (mph) - Spring (Calm = 0.82%) < 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	Row Total
A	N							
	NNE		0.000458					0.000458
	NE							
	ENE							
	E							
	ESE	0.000965						0.000965
	SE		0.000458					0.000458
	SSE	0.000483	0.000916					0.001398
	S	0.000483	0.001832					0.002314
	SSW	0.000483	0.002289					0.002772
	SW	0.001448	0.000916					0.002364
	WSW	0.000483	0.001832					0.002314
	W	0.000965	0.000916					0.001881
	WNW	0.001448	0.001374					0.002822
	NW							
	NNW							
B	N	0.000965	0.000916					0.001881
	NNE	0.000965						0.000965
	NE	0.000483						0.000483
	ENE	0.001448	0.000916					0.002364
	E	0.000483						0.000483
	ESE			0.001374				0.001374
	SE	0.002896	0.004121	0.003205				0.010222
	SSE	0.001448	0.009615	0.003205				0.014268
	S	0.003861	0.005495	0.000458				0.009813
	SSW	0.002896	0.003663	0.000458				0.007017
	SW	0.003861	0.005495	0.000916				0.010271
	WSW	0.003378	0.008242	0.000916				0.012536
	W	0.000483	0.009158	0.002747				0.012387
	WNW	0.004344	0.006868	0.006868				0.018080
	NW	0.002413	0.001374	0.002289				0.006076
	NNW	0.002413	0.000458					0.002871
C	N		0.001374					0.001374
	NNE							
	NE							
	ENE		0.000458					0.000458
	E		0.002747	0.002289	0.000458			0.005495
	ESE		0.001832	0.006410	0.000458			0.008700
	SE		0.005952	0.003205	0.000458			0.009615
	SSE		0.004579	0.004579				0.009158
	S		0.007326	0.000916				0.008242
	SSW		0.001832	0.001374				0.003205
	SW		0.000916	0.002289				0.003205
	WSW		0.002747	0.000916				0.003663
	W		0.006868	0.002289	0.001374			0.010531
	WNW		0.010073	0.010531	0.000458	0.001374		0.022436
	NW		0.002289	0.004579	0.005037	0.000458		0.012363
	NNW		0.002289	0.001374				0.003663

Table 3: 2nd Quarter (April 1, 2008 to June 30, 2008) Joint Frequency Distribution (cont'd)

Stability Class	Wind Direction	Wind Speed (mph) - Spring (Calm = 0.82%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
D	N	0.003861	0.006868	0.002747	0.001832	0.000458		0.015766
	NNE	0.003378	0.004121	0.001832	0.001374			0.010704
	NE	0.003378	0.004579	0.007326	0.003205	0.000458	0.000916	0.019862
	ENE	0.002413	0.008242	0.013278	0.024725	0.005952	0.007326	0.061937
	E	0.002896	0.006410	0.039835	0.027473	0.005495	0.002289	0.084398
	ESE		0.007784	0.012363	0.011447	0.002289		0.033883
	SE	0.001931	0.008242	0.010531	0.002289	0.000458		0.023451
	SSE	0.000965	0.004121	0.003663	0.002289	0.000916		0.011954
	S	0.001448	0.001374	0.001374				0.004195
	SSW	0.002896	0.000916	0.002747	0.000916			0.007475
	SW	0.001448	0.001374	0.000916	0.002747	0.003205	0.000458	0.010148
	WSW	0.000965	0.001374	0.005037	0.007326	0.002747		0.017449
	W	0.000483	0.003205	0.004579	0.006410	0.000916		0.015593
	WNW	0.001931	0.012821	0.015568	0.019689	0.005495		0.055502
	NW	0.004826	0.016941	0.033883	0.065018	0.023352	0.005952	0.149973
	NNW	0.005309	0.011905	0.008242	0.006868	0.003205	0.001374	0.036902
E	N	0.000965	0.007326					0.008291
	NNE	0.002413	0.003205	0.000458				0.006076
	NE	0.001931	0.000916	0.000458				0.003304
	ENE	0.000965	0.004579	0.005037				0.010581
	E		0.007784	0.007784				0.015568
	ESE		0.004121	0.002289				0.006410
	SE		0.004121	0.002289				0.006410
	SSE		0.002289	0.000458				0.002747
	S	0.000965	0.000458					0.001423
	SSW		0.002289	0.000916				0.003205
	SW		0.001374	0.000458				0.001832
	WSW		0.000916					0.000916
	W	0.000483	0.002289	0.000916				0.003688
	WNW	0.000483	0.000458	0.000916				0.001856
	NW	0.000965	0.005495	0.004579				0.011039
	NNW	0.002413	0.005952	0.001374				0.009739
F	N	0.008687	0.007326					0.016013
	NNE	0.009653	0.002747					0.012400
	NE	0.007722	0.002289					0.010011
	ENE	0.006274	0.004121					0.010395
	E	0.004826	0.002289					0.007116
	ESE	0.005792	0.002747					0.008539
	SE	0.001448	0.001374					0.002822
	SSE	0.001931	0.001374					0.003304
	S	0.002413	0.001832					0.004245
	SSW	0.004826	0.000916					0.005742
	SW	0.000965	0.001374					0.002339
	WSW	0.000965	0.000458					0.001423
	W	0.001931	0.002289					0.004220
	WNW	0.001931	0.003205					0.005136
	NW	0.006757	0.008242					0.014999
	NNW	0.005792	0.002289					0.008081

2,184 valid hrs out of 2,184

Table 4: 3rd Quarter (July 2007 and 2008, August and September 2007) Joint Frequency Distribution

Stability Class	Wind Direction	Wind Speed (mph) - Summer (Calm = 1.4%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
A	N							
	NNE							
	NE							
	ENE							
	E							
	ESE							
	SE		0.000873					0.000873
	SSE	0.000893	0.000873					0.001765
	S	0.001091						0.001091
	SSW	0.001983	0.000873					0.002856
	SW		0.000873					0.000873
	WSW		0.001745					0.001745
	W		0.000873					0.000873
	WNW		0.000873					0.000873
	NW							
	NNW							
B	N		0.000873					0.000873
	NNE							
	NE	0.000893						0.000893
	ENE							
	E	0.001785		0.000873				0.002658
	ESE	0.000893	0.002618	0.000873				0.004383
	SE	0.001091	0.004363	0.007853				0.013307
	SSE	0.004165	0.006981	0.003490				0.014636
	S	0.005752	0.008726	0.002618				0.017096
	SSW	0.003967	0.002618					0.006585
	SW	0.001785	0.002618	0.000873				0.005276
	WSW	0.002876	0.001745					0.004621
	W	0.003769	0.009599	0.004363				0.017731
	WNW	0.004662	0.005236	0.006981				0.016878
	NW	0.001091	0.005236					0.006326
	NNW	0.005950	0.000873	0.000873				0.007696
C	N		0.000873					0.000873
	NNE		0.000873					0.000873
	NE							
	ENE							
	E		0.002618	0.000873				0.003490
	ESE		0.004363	0.004363				0.008726
	SE		0.004363	0.010471				0.014834
	SSE		0.007853	0.006981				0.014834
	S		0.006981	0.000873				0.007853
	SSW		0.002618	0.000873				0.003490
	SW		0.002618					0.002618
	WSW		0.003490	0.004363				0.007853
	W		0.007853	0.001745				0.009599
	WNW		0.015707	0.013962				0.029668
	NW		0.002618	0.007853		0.001745		0.012216
	NNW		0.003490	0.001745				0.005236

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Table 4: 3rd Quarter (July 2007 and 2008, August and September 2007) Joint Frequency Distribution (cont'd)

Stability Class	Wind Direction	Wind Speed (mph) - Summer (Calm = 1.4%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
D	N	0.007340	0.011344	0.003490	0.004363	0.000873		0.027410
	NNE	0.008629	0.006108	0.002618	0.000873		0.000873	0.019100
	NE	0.000893	0.001745	0.009599	0.006108		0.000873	0.019217
	ENE	0.002678	0.007853	0.028796	0.020942			0.060270
	E	0.004464	0.013962	0.031414	0.014834			0.064673
	ESE	0.004662	0.013962	0.027923	0.032286	0.001745		0.080578
	SE	0.001091	0.007853	0.013962	0.006108	0.000873		0.029887
	SSE	0.001091	0.002618	0.004363	0.002618	0.000873		0.011562
	S		0.004363	0.003490				0.007853
	SSW	0.003967	0.000873	0.002618	0.000873			0.008330
	SW		0.001745	0.006108	0.006108			0.013962
	WSW		0.001745	0.004363		0.000873		0.006981
	W	0.000893	0.000873	0.002618		0.001745		0.006128
	WNW	0.002678	0.006981	0.013962	0.027051	0.000873		0.051544
	NW	0.003967	0.006108	0.026178	0.030541	0.010471		0.077265
	NNW	0.004165	0.012216	0.006981	0.002618			0.025980
E	N		0.007853					0.007853
	NNE	0.001785	0.006108					0.007894
	NE	0.001983	0.005236	0.001745				0.008964
	ENE		0.006981	0.001745				0.008726
	E		0.010471	0.016579				0.027051
	ESE	0.000893	0.006108	0.006108				0.013109
	SE		0.002618	0.000873				0.003490
	SSE	0.000893	0.002618	0.001745				0.005256
	S		0.002618					0.002618
	SSW		0.002618	0.000873				0.003490
	SW		0.000873	0.000873				0.001745
	WSW		0.000873					0.000873
	W		0.002618					0.002618
	WNW		0.002618	0.000873				0.003490
	NW		0.006108					0.006108
	NNW	0.001785	0.001745	0.001745				0.005276
F	N	0.005752	0.004363					0.010115
	NNE	0.011109	0.003490					0.014599
	NE	0.007538	0.005236					0.012774
	ENE	0.005950	0.003490					0.009441
	E	0.002678	0.003490					0.006169
	ESE	0.004662	0.002618					0.007280
	SE	0.005356	0.000873					0.006229
	SSE	0.004860	0.007853					0.012713
	S		0.003490					0.003490
	SSW	0.000893	0.000873					0.001765
	SW	0.003769	0.000873					0.004642
	WSW	0.001983	0.000873					0.002856
	W	0.002876	0.001745					0.004621
	WNW	0.004662	0.003490					0.008152
	NW	0.010216	0.003490					0.013707
	NNW	0.003967	0.006108					0.010075

1,146 valid hours out of 2,208

POWERTECH (USA) INC.

Table 5: 4th Quarter (October 1, 2007 to December 31, 2007) Joint Frequency Distribution

Stability Class	Wind Direction	Wind Speed (mph) - Fall (Calm = 2.14%)						Row Total
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	
A	N							
	NNE							
	NE							
	ENE							
	E							
	ESE							
	SE							
	SSE							
	S							
	SSW							
	SW							
	WSW							
	W							
	WNW							
	NW							
	NNW							
B	N	0.003437	0.000466					0.003902
	NNE	0.000982						0.000982
	NE	0.000982						0.000982
	ENE	0.000491						0.000491
	E	0.000491	0.000466					0.000957
	ESE							
	SE	0.000982						0.000982
	SSE	0.002455						0.002455
	S	0.005892						0.005892
	SSW	0.009329	0.000466					0.009794
	SW	0.003437	0.000931					0.004368
	WSW	0.004910						0.004910
	W	0.006383	0.001397					0.007779
	WNW	0.003928	0.003259					0.007187
	NW	0.008838	0.001862					0.010700
	NNW	0.002946	0.002793					0.005739
C	N		0.000466					0.000466
	NNE							
	NE							
	ENE							
	E		0.000466					0.000466
	ESE		0.000931	0.000466				0.001397
	SE		0.001862	0.002793				0.004655
	SSE		0.004190	0.001862				0.006052
	S		0.005587					0.005587
	SSW		0.002328	0.000466				0.002793
	SW		0.001397					0.001397
	WSW		0.005587	0.000931				0.006518
	W		0.006983	0.000931				0.007914
	WNW		0.012104	0.005121				0.017225
	NW		0.006518	0.004190				0.010708
	NNW		0.006518	0.000931				0.007449

Table 5: 4th Quarter (October 1, 2007 to December 31, 2007) Joint Frequency Distribution (cont'd)

Stability Class	Wind Direction	Wind Speed (mph) - Fall (Calm = 2.14%)						
		< 3	4 - 7	8 - 12	13 - 18	19 - 24	> 24	Row Total
D	N	0.011293	0.012570	0.000931	0.000466			0.025259
	NNE	0.011784	0.003724	0.001862				0.017370
	NE	0.001964	0.002328	0.001862	0.000931			0.007085
	ENE	0.001473	0.004190	0.007449	0.008845	0.002328		0.024285
	E	0.004910	0.006983	0.014432	0.013966			0.040292
	ESE	0.001964	0.006983	0.006052	0.004655			0.019655
	SE	0.000491	0.003259	0.004190	0.002328			0.010268
	SSE	0.004910	0.005121	0.005587	0.000931			0.016549
	S	0.005892	0.003724					0.009616
	SSW	0.004910	0.003259					0.008169
	SW	0.002946	0.000466	0.000466	0.000931			0.004808
	WSW	0.005892	0.002793	0.000466	0.001397	0.000466	0.000466	0.011478
	W	0.004419	0.003724	0.001397	0.002328	0.001862		0.013730
	WNW	0.006383	0.010708	0.019553	0.014898	0.004190	0.000466	0.056197
	NW	0.008838	0.020950	0.035382	0.031192	0.016294	0.003259	0.115914
	NNW	0.009820	0.020019	0.006983	0.002793	0.001862		0.041477
E	N	0.012766	0.010708	0.000931				0.024404
	NNE	0.004910	0.002793					0.007703
	NE	0.002946	0.003724					0.006670
	ENE	0.003437	0.003259	0.001862				0.008558
	E	0.000491	0.006052	0.003259				0.009802
	ESE		0.005587	0.001862				0.007449
	SE	0.000982	0.005587	0.001397				0.007965
	SSE		0.008380	0.000931				0.009311
	S	0.000491	0.001397					0.001888
	SSW	0.000491						0.000491
	SW		0.001397					0.001397
	WSW	0.000982	0.000931					0.001913
	W	0.001473	0.002793					0.004266
	WNW	0.003437	0.005587	0.004190				0.013213
	NW	0.001964	0.010242	0.004655				0.016862
	NNW	0.008838	0.013966	0.004655				0.027460
F	N	0.030932	0.005121					0.036053
	NNE	0.024058	0.006052					0.030110
	NE	0.017675	0.001862					0.019538
	ENE	0.005401	0.004190					0.009591
	E	0.008347	0.002793					0.011140
	ESE	0.008838	0.002328					0.011165
	SE	0.004910	0.004190					0.009100
	SSE	0.014239	0.002793					0.017032
	S	0.010802	0.003259					0.014060
	SSW	0.009820	0.001862					0.011682
	SW	0.008838	0.003259					0.012097
	WSW	0.009329	0.002328					0.011656
	W	0.009329	0.004190					0.013519
	WNW	0.015220	0.003724					0.018945
	NW	0.017675	0.004190					0.021865
	NNW	0.031423	0.009777					0.041199

2,148 valid hours out of 2,208

References

1. METEOROLOGICAL CHARACTERIZATION OF THE DEWEY-BURDOCK URANIUM PROJECT AREA FALL RIVER AND CUSTER COUNTIES, SOUTH DAKOTA, Jared Oswald, RESPEC Consulting Services: September 2008.
2. South Dakota Office of Climatology, Edgemont monitoring station: July 2007 to July 2008.
3. Meteorological Monitoring Guidance for Regulatory Modeling Applications, USEPA: February 2000.
4. NRC Regulatory Guide 3.63, Onsite Meteorological Measurement Program for Uranium Recovery Facilities – Data Acquisition and Reporting: March 1988.

POWERTECH (USA) INC.

APPENDIX 2.5-D

Newcastle Meteorological Station Audit Reports

Table 1

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 15-Mar-07
Audit Performed by: B. Kelly, C. Medill - IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	digital thermistor
Data acquisition system (DAS):	Campbell Scientific CR510	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.44	3.44	0.00	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)	t<0.2	N/A	N/A	1.0	(3)
WD (degrees)	0	1.5	1	5	(1)
	90	89.9	0	5	(1)
	180	179.2	1	5	(1)
	270	268.7	1	5	(1)
Temperature (°F)	71.6	71.6	0.0	1.8	(1)
ice water bath	32.3	32.1	0.2	1.8	(1)
warm water bath	130.7	129.3	1.4	1.8	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line @ 0905
System on-line @ 1015
Replaced anemometer with new Wind Monitor AQ

POWERTECH (USA) INC.

Table 2

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 13-Sep-07
Audit Performed by: B. Kelly, C. Medill - IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	digital thermistor
Data acquisition system (DAS):	Campbell Scientific CR510	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.44	3.44	0.00	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)	t<0.2	N/A	N/A	1.0	(3)
WD (degrees)	0	0.1	0	5	(1)
	90	89.9	0	5	(1)
	180	180.8	1	5	(1)
	270	268.1	2	5	(1)
Temperature (°F)	84.6	84.5	0.0	0.9	(1)
ice water bath	32.2	32.0	0.1	0.9	(1)
warm water bath	127.9	126.8	1.1	0.9	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line @ 0834
System on-line @ 0850

POWERTECH (USA) INC.

Table 3

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining Audit Date: 12-Mar-08
Audit Performed By: S. Hansen, C. Medill, IML-Air Science

Sensor	Mfr./Model	Serial Number	Reference Device	Serial/ID Number
Vert. Wind Speed 10m:	RM Young Wind Monitor AQ	NA	quartz referenced drive motor	CA02423
Wind Speed (WS):	RM Young Wind Monitor AQ	WM75308	quartz referenced drive motor	IML0853 & IML0858
Wind Direction (WD):	RM Young Wind Monitor AQ	WM75308	transit, compass	Brunton 5080393535
Temperature @ 2 Meters:	RM Young 41342, power aspirated	TS13799	digital thermistor	IML0987
Temperature @ 10 Meters:	RM Young 41342, power aspirated	TS13880	digital thermistor	IML0987
Relative Humidity:	Vaisala HMP50	C4240028	digital psychrometer	Thermo-Hygro 22087796
Barometric Pressure:	Vaisala PTB101B	C4240018	digital barometer	IML0968
Solar Radiation:	LI-COR LI200X	PY57681	Li-Cor	PY54289
Data acquisition system:	CSI CR1000 datalogger	13147	N/A	N/A

Audit Results

		Reference RPM	Reference MPH	DAS Value	|Difference|	Specification	
WS (mph)		0	0.00	0.00	0.00	below threshold	
		300	3.44	3.44	0.00	0.56	(2)
		800	9.16	9.16	0.00	0.56	(2)
		3000	34.35	34.35	0.00	1.72	(2)
		8000	91.60	91.60	0.00	4.58	(2)
			Reference	DAS Value	|Difference|	Specification	
WS start torque (gm-cm)			<.1	N/A	N/A	1.0	(3)
WD (degrees)			0.0	0.3	0.3	5.0	(2)
			90.0	90.4	0.4	5.0	(2)
			180.0	180.2	0.2	5.0	(2)
			270.0	269.8	0.2	5.0	(2)
Temp. (°C): Upper Sensor			49.22	49.36	0.14	0.5	(2)
			5.09	5.34	0.25	0.5	(2)
			18.13	18.16	0.03	0.5	(2)
Temp. (°C): Lower Sensor			49.22	49.33	0.11	0.5	(2)
			5.09	5.39	0.30	0.5	(2)
			18.13	18.10	0.03	0.5	(2)
			Upper Sensor	Lower Sensor	|Difference|	Specification	
Delta T. (°C)			49.36	49.33	0.03	0.10	(2)
			5.34	5.39	0.05	0.10	(2)
			18.16	18.10	0.06	0.10	(2)
			Reference	DAS Value	|Difference|	Specification	
Relative Humidity (%)			32.0	29.6	2.4	7.0	(2)
Solar Radiation (W/m^2)	uncovered		NA	123.8	NA	5.0%	(4)
	covered		NA	0.0	NA	5.0%	(4)
Barometric Pressure ("Hg)			25.51	25.47	0.04	0.09	(2)

		Reference RPM	Reference cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CW)		20	-100.00	-99.63	0.37	25.00	(2)
	U:	60	-300.00	-302.30	2.30	35.00	(2)
		100	-1000.00	-1001.30	1.30	70.00	(2)
		500	-2500.00	-2499.30	0.70	145.00	(2)
		RPM	cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CCW)		20	100.00	98.41	1.59	25.00	(2)
	U:	60	300.00	300.90	0.90	35.00	(2)
		100	1000.00	1001.10	1.10	70.00	(2)
		500	2500.00	2497.30	2.70	145.00	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications
(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

Notes, Recommendations

Datalogger taken off line @ 0852 MST -- returned on-line 1352 MST.
Complettion of AERMOD and solar equipement installation.

POWERTECH (USA) INC.

Table 4

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining Audit Date: 27-Aug-08

Audit Performed By: C. Medill - IML Air Science

Sensor	Mfr./Model	Serial Number	Reference Device	Serial/ID Number
Vert. Wind Speed 10m:	RM Young Wind Monitor AQ	NA	quartz referenced drive motor	CA02423
Wind Speed (WS):	RM Young Wind Monitor AQ	WM75308	quartz referenced drive motor	IML0853 & IML0858
Wind Direction (WD):	RM Young Wind Monitor AQ	WM75308	transit, compass	Brunton 5080393535
Temperature @ 2 Meters:	Fenwall 107	NA	digital thermistor	IML0987
Relative Humidity:	Vaisala HMP50	C4240028	digital psychrometer	Thermo-Hygro 22087796
Barometric Pressure:	Vaisala PTB101B	C4240018	digital barometer	IML0968
Solar Radiation:	LI-COR LI200X	PY57681	Li-Cor	PY54289
Data acquisition system:	CSI CR1000 datalogger	13147	N/A	N/A

Audit Results

		RPM	MPH	DAS Value	|Difference|	Specification	
WS (mph)		0	0.00	0.00	0.00	below threshold	
		300	3.44	3.44	0.00	0.56	(2)
		800	9.16	9.16	0.00	0.56	(2)
		3000	34.35	34.35	0.00	1.72	(2)
		8000	91.60	91.60	0.00	4.58	(2)

	Reference	DAS Value	|Difference|	Specification	
WS start torque (gm-cm)	<.1	N/A	N/A	1.0	(3)
WD (degrees)	0.0	0.1	0.1	5.0	(2)
	90.0	89.4	0.6	5.0	(2)
	180.0	179.6	0.4	5.0	(2)
	270.0	270.0	0.0	5.0	(2)

	Reference	DAS Value	|Difference|	Specification	
Temp. (°F):	0.93	0.87	0.06	0.5	(2)
	23.28	23.32	0.04	0.5	(2)
	45.41	45.29	0.12	0.5	(2)

	Reference	DAS Value	|Difference|	Specification	
Relative Humidity (%)	27.0	26.9	0.1	7.0	(2)
Barometric Pressure ("Hg)	25.56	25.58	0.02	0.09	(2)

		Reference RPM	Reference cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CW)		20	100.00	100.80	0.80	25.00	(2)
	U:	60	300.00	300.10	0.10	35.00	(2)
		100	1000.00	1001.00	1.00	70.00	(2)
		500	2500.00	2500.00	0.00	145.00	(2)

		RPM	cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CCW)		20	100.00	100.80	0.80	25.00	(2)
	U:	60	300.00	295.30	4.70	35.00	(2)
		100	1000.00	999.10	0.90	70.00	(2)
		500	2500.00	2503.00	3.00	145.00	(2)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

Notes, Recommendations

Datalogger taken off line @ 0826 MST -- returned on-line 1027 MST.

Powertech (USA) Inc.

Addendum to

APPENDIX 2.5-D

Newcastle Meteorological Station Audit Reports

Addendum to Appendix 2.5-D
Newcastle Meteorological Station Audit Reports

Appendix 2.5-D provides select audit records for the Wyoming Refining meteorological station in Newcastle. This addendum fills out the Newcastle audit records to span the entire monitoring period. It also provides audit records for the Antelope Mine, Buckskin Mine and Dry Fork Mine meteorological stations. In all cases, meteorological audits were performed semi-annually in accordance with EPA's Onsite Meteorological Program Guidance for Regulatory Modeling Applications. Semi-annual audits are also required by the Wyoming Department of Environmental Quality (DEQ) in conjunction with air quality monitoring. All meteorological audits were documented and reported to DEQ for each of the four sites since monitoring began. IML was unable to obtain copies of older reports (more than 10 to 15 years old), but the approval of such reports by DEQ provides de facto evidence that regular audits were performed and that meteorological instruments were kept within specification.

Also included in this addendum are standard operating procedures (SOPs) used by IML personnel to assure quality meteorological data. The SOPs prescribe instrument calibration, audit and inspection procedures, as well as data processing and reporting methods.

Newcastle Meteorological Station Audit Reports

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 3-Jan-02
Audit Performed by: K. Fox, T. Mendenhall - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	digital thermistor
Data acquisition system (DAS):	Campbell Scientific CR510	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0	1	1	5	(1)
		90	89	1	5	(1)
		180	181	1	5	(1)
		270	269	1	5	(1)
Temperature (°F)	ice	32.0	31.9	0.1	1.8	(1)
	ambient	47.5	46.8	0.7	1.8	(1)
	warm	98.2	98.1	0.1	1.8	(1)

BOLD difference values exceed performance specifications

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

Notes, Recommendations

Initial Install Audit
System on-line @ 1535, 1/3/02

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 8-Aug-02
Audit Performed by: K. Fox - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	digital thermistor
Data acquisition system (DAS):	Campbell Scientific CR510	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0	2	2	5	(1)
		90	90	0	5	(1)
		180	180	0	5	(1)
		270	271	1	5	(1)
Temperature (°F)	ice	32.7	32.3	0.4	1.8	(1)
	ambient	83.2	84.3	1.1	1.8	(1)
	warm	108.8	108.8	0.0	1.8	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line @ 1135
System on-line @ 1200

Installation:
System on-line @ 1535, 1/3/02

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 21-Jan-03
Audit Performed by: S. Heil, T. Shaw - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	digital thermistor
Data acquisition system (DAS):	Campbell Scientific CR510	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.43	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0	0	0	5	(1)
		90	91	1	5	(1)
		180	180	0	5	(1)
		270	270	0	5	(1)
Temperature (°F)	ice	26.6	26.8	0.2	1.8	(1)
	ambient	31.9	31.9	0.0	1.8	(1)
	warm	116.7	116.9	0.2	1.8	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line @ 1031
System on-line @ 1100

Installation:
System on-line @ 1535, 1/3/02

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 16-Sep-03
Audit Performed by: K. Fox, K. Jahnke - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	digital thermistor
Data acquisition system (DAS):	Campbell Scientific CR510	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0	0	0	5	(1)
		90	92	2	5	(1)
		180	181	1	5	(1)
		270	271	1	5	(1)
Temperature (°F)	ice	33.0	32.8	0.2	1.8	(1)
	ambient	71.2	70.5	0.7	1.8	(1)
	warm	113.3	113.4	0.1	1.8	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line @ 1103
System on-line @ 1129
Clock is on actual time, not Standard time. Will correct from Sheridan

Installation:
System on-line @ 1535, 1/3/02

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 10-Mar-04
Audit Performed by: J. Rogers, K. Jahnke - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	digital thermistor
Data acquisition system (DAS):	Campbell Scientific CR510	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0	1	1	5	(1)
		90	90	0	5	(1)
		180	180	0	5	(1)
		270	271	1	5	(1)
Temperature (°F)	ice	31.8	31.8	0.0	1.8	(1)
	ambient	29.4	29.3	0.1	1.8	(1)
	warm	128.1	127.1	1.0	1.8	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 199
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line @ 1049
System on-line @ 1105

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 2-Sep-04
Audit Performed by: T. Shaw, K. Jahnke - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	digital thermistor
Data acquisition system (DAS):	Campbell Scientific CR510	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.37	0.23	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0	1	1	5	(1)
		90	90	0	5	(1)
		180	180	0	5	(1)
		270	270	0	5	(1)
Temperature (°F)	ambient	84.9	84.0	0.9	1.8	(1)
	ice water bath	38.1	38.4	0.3	1.8	(1)
	warm water bath	94.1	93.7	0.4	1.8	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line @ 1344
System on-line @ 1409

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 23-Mar-05
Audit Performed by: W. Adler, D. Tarver - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	digital thermistor
Data acquisition system (DAS):	Campbell Scientific CR510	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.23	0.23	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0	1	1	5	(1)
		90	91	1	5	(1)
		180	180	0	5	(1)
		270	270	0	5	(1)
Temperature (°F)	ambient	45.3	44.3	1.0	1.8	(1)
	ice water bath	32.7	32.6	0.1	1.8	(1)
	warm water bath	137.0	135.4	1.6	1.8	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line @ 0937
System on-line @ 0958
Direction alignment was off by 12 degrees (pointed at magnetic South).

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 27-Sep-05
Audit Performed by: B. Hanewald, K. Fox - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	digital thermistor
Data acquisition system (DAS):	Campbell Scientific CR510	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.23	0.23	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0	1.1	1	5	(1)
		90	89.6	0	5	(1)
		180	179.5	1	5	(1)
		270	271.7	2	5	(1)
Temperature (°F)	ambient	75.8	76.0	0.2	1.8	(1)
	ice water bath	32.5	32.1	0.4	1.8	(1)
	warm water bath	127.1	126.7	0.4	1.8	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line @ 1645
System on-line @ 1719
Tail is a little chewed up.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 30-Mar-06
Audit Performed by: K. Fox - IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	digital thermistor
Data acquisition system (DAS):	Campbell Scientific CR510	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.23	0.23	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0	4.0	4	5	(1)
		90	86.0	4	5	(1)
		180	179.0	1	5	(1)
		270	271.0	1	5	(1)
Temperature (°F)		77.0	76.8	0.2	1.8	(1)
	ice water bath	32.3	32.3	0.0	1.8	(1)
	warm water bath	120.0	119.7	0.3	1.8	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line @ 1230
System on-line @ 1308
Tail is a little chewed up.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 20-Jul-06
Audit Performed by: B. Kelly, K. Fox - IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	digital thermistor
Data acquisition system (DAS):	Campbell Scientific CR510	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.23	0.23	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0	1.5	2	5	(1)
		90	88.0	2	5	(1)
		180	179.0	1	5	(1)
		270	274.0	4	5	(1)
Temperature (°F)		72.9	72.9	0.0	1.8	(1)
	ice water bath	35.8	35.6	0.2	1.8	(1)
	warm water bath	128.2	127.2	1.0	1.8	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line @ 1433
System on-line @ 1503
Tail is a little chewed up.
Needs rebuilt sensor next trip - WD pot worn

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 15-Mar-07
Audit Performed by: B. Kelly, C. Medill - IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	digital thermistor
Data acquisition system (DAS):	Campbell Scientific CR510	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0	1.5	1	5	(1)
		90	89.9	0	5	(1)
		180	179.2	1	5	(1)
		270	268.7	1	5	(1)
Temperature (°F)		71.6	71.6	0.0	1.8	(1)
	ice water bath	32.3	32.1	0.2	1.8	(1)
	warm water bath	130.7	129.3	1.4	1.8	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line @ 0905
System on-line @ 1015
Replaced anemometer with new Wind Monitor AQ

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining, Newcastle
Audit Date: 13-Sep-07
Audit Performed by: B. Kelly, C. Medill - IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	digital thermistor
Data acquisition system (DAS):	Campbell Scientific CR510	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0	0.1	0	5	(1)
		90	89.9	0	5	(1)
		180	180.8	1	5	(1)
		270	268.1	2	5	(1)
Temperature (°F)		84.6	84.5	0.0	0.9	(1)
	ice water bath	32.2	32.0	0.1	0.9	(1)
	warm water bath	127.9	126.8	1.1	0.9	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1996
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line @ 0834
System on-line @ 0850

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining   Audit Date: 3-Mar-08

Audit Performed By: S. Hansen, C. Medill, IML-Air Science

Sensor	Mfr./Model	Serial Number	Reference Device	Serial/ID Number
Vert. Wind Speed 10m:	RM Young Wind Monitor AQ	NA	quartz referenced drive motor	CA02423
Wind Speed (WS):	RM Young Wind Monitor AQ	WM75308	quartz referenced drive motor	IML0853 & IML0858
Wind Direction (WD):	RM Young Wind Monitor AQ	WM75308	transit, compass	Brunton 5080393535
Temperature @ 2 Meters:	Fenwall 107	NA	digital thermistor	IML0987
Relative Humidity:	Vaisala HMP50	C4240028	digital psychrometer	Thermo-Hygro 22087796
Barometric Pressure:	Vaisala PTB101B	C4240018	digital barometer	IML0968
Solar Radiation:	LI-COR LI200X	PY57681	Li-Cor	PY54289
Data acquisition system:	CSI CR1000 datalogger	13147	N/A	N/A

Audit Results

		RPM	MPH	DAS Value	|Difference|	Specification	
WS (mph)		0	0.00	0.00	0.00	below threshold	
		300	3.44	3.44	0.00	0.56	(2)
		800	9.16	9.16	0.00	0.56	(2)
		3000	34.35	34.35	0.00	1.72	(2)
		8000	91.60	91.60	0.00	4.58	(2)
			Reference	DAS Value	|Difference|	Specification	
WS start torque (gm-cm)			<.1	N/A	N/A	1.0	(3)
WD (degrees)			0.0	0.7	0.7	5.0	(2)
			90.0	89.8	0.2	5.0	(2)
			180.0	179.8	0.2	5.0	(2)
			270.0	269.9	0.1	5.0	(2)
			Reference	DAS Value	|Difference|	Specification	
Temp. (°F):			35.20	35.00	0.20	0.5	(2)
			57.80	57.70	0.10	0.5	(2)
			101.50	100.90	0.60	0.5	(2)
			Reference	DAS Value	|Difference|	Specification	
Relative Humidity (%)			37.0	38.9	1.9	7.0	(2)
Barometric Pressure ("Hg)			25.53	25.47	0.06	0.09	(2)
		Reference RPM	Reference cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CW)		20	100.00	91.10	8.90	25.00	(2)
	U:	60	300.00	110.20	189.80	35.00	(2)
		100	1000.00	126.70	873.30	70.00	(2)
		500	2500.00	NA	NA	145.00	(2)
		RPM	cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CCW)		20	100.00	NA	NA	25.00	(2)
	U:	60	300.00	NA	NA	35.00	(2)
		100	1000.00	NA	NA	70.00	(2)
		500	2500.00	NA	NA	145.00	(2)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

Notes, Recommendations

Datalogger taken off line @ 1015 MST -- returned on-line 1810 MST.
Vertical Wind Speed connector broke during audit.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining — Audit Date: 27-Aug-08
Audit Performed By: C. Medill - IML Air Science

Sensor	Mfr./Model	Serial Number	Reference Device	Serial/ID Number
Vert. Wind Speed 10m:	RM Young Wind Monitor AQ	NA	quartz referenced drive motor	CA02423
Wind Speed (WS):	RM Young Wind Monitor AQ	WM75308	quartz referenced drive motor	IML0853 & IML0858
Wind Direction (WD):	RM Young Wind Monitor AQ	WM75308	transit, compass	Brunton 5080393535
Temperature @ 2 Meters:	Fenwall 107	NA	digital thermistor	IML0987
Relative Humidity:	Vaisala HMP50	C4240028	digital psychrometer	Thermo-Hygro 22087796
Barometric Pressure:	Vaisala PTB101B	C4240018	digital barometer	IML0968
Solar Radiation:	LI-COR LI200X	PY57681	Li-Cor	PY54289
Data acquisition system:	CSI CR1000 datalogger	13147	N/A	N/A

Audit Results

		RPM	MPH	DAS Value	|Difference|	Specification	
WS (mph)		0	0.00	0.00	0.00	below threshold	
		300	3.44	3.44	0.00	0.56	(2)
		800	9.16	9.16	0.00	0.56	(2)
		3000	34.35	34.35	0.00	1.72	(2)
		8000	91.60	91.60	0.00	4.58	(2)
			Reference	DAS Value	|Difference|	Specification	
WS start torque (gm-cm)			<.1	N/A	N/A	1.0	(3)
WD (degrees)			0.0	0.1	0.1	5.0	(2)
			90.0	89.4	0.6	5.0	(2)
			180.0	179.6	0.4	5.0	(2)
			270.0	270.0	0.0	5.0	(2)
			Reference	DAS Value	|Difference|	Specification	
Temp. (°F):			0.93	0.87	0.06	0.5	(2)
			23.28	23.32	0.04	0.5	(2)
			45.41	45.29	0.12	0.5	(2)
			Reference	DAS Value	|Difference|	Specification	
Relative Humidity (%)			27.0	26.9	0.1	7.0	(2)
Barometric Pressure ("Hg)			25.56	25.58	0.02	0.09	(2)
		Reference RPM	Reference cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CW)		20	100.00	100.80	0.80	25.00	(2)
	U:	60	300.00	300.10	0.10	35.00	(2)
		100	1000.00	1001.00	1.00	70.00	(2)
		500	2500.00	2500.00	0.00	145.00	(2)
		RPM	cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CCW)		20	100.00	100.80	0.80	25.00	(2)
	U:	60	300.00	295.30	4.70	35.00	(2)
		100	1000.00	999.10	0.90	70.00	(2)
		500	2500.00	2503.00	3.00	145.00	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications
(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

Notes, Recommendations

Datalogger taken off line @ 0826 MST -- returned on-line 1027 MST.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining — Audit Date: 13-Feb-09

Audit Performed By: D.Barkan, R. Campbell - IML Air Science

Sensor	Mfr./Model	Serial Number	Reference Device	Serial/ID Number
Vert. Wind Speed 10m:	RM Young Wind Monitor AQ	NA	quartz referenced drive motor	
Wind Speed (WS):	RM Young Wind Monitor AQ	WM75308	quartz referenced drive motor	
Wind Direction (WD):	RM Young Wind Monitor AQ	WM75308	transit, compass	
Temperature @ 2 Meters:	Fenwall 107	NA	digital thermistor	IML 0888
Relative Humidity:	Vaisala HMP50	C4240028	digital psychrometer	IML 0891
Barometric Pressure:	Vaisala PTB101B	C4240018	digital barometer	IML 0904
Solar Radiation:	LI-COR LI200X	PY57681	Li-Cor	
Data acquisition system:	CSI CR1000 datalogger	13147	N/A	N/A

Audit Results

	RPM	MPH	DAS Value	|Difference|	Specification	
WS (mph)	0	0.00	0.00	0.00	below threshold	
	300	3.44	3.44	0.00	0.56	(2)
	800	9.16	9.16	0.00	0.56	(2)
	3000	34.35	34.35	0.00	1.72	(2)
	8000	91.60	91.60	0.00	4.58	(2)

	Reference	DAS Value	|Difference|	Specification	
WS start torque (gm-cm)	<.1	N/A	N/A	1.0	(3)
WD (degrees)	0.0	1.0	1.0	5.0	(2)
	90.0	90.1	0.1	5.0	(2)
	180.0	180.3	0.3	5.0	(2)
	270.0	270.1	0.1	5.0	(2)

	Reference	DAS Value	|Difference|	Specification	
Temp. 2 meter (°F):	-0.09	-0.08	0.01	0.5	(2)
	18.20	18.10	0.10	0.5	(2)
	43.80	43.90	0.10	0.5	(2)
Temp. 10 meter (°F):	-0.09	-0.04	0.05	0.5	(2)
	18.20	18.10	0.10	0.5	(2)
	43.80	43.90	0.10	0.5	(2)

	Upper Sensor	Lower Sensor	|Difference|	Specification	
Delta T. (°C)	-0.08	-0.04	0.04	0.10	(2)
	18.10	18.10	0.00	0.10	(2)
	43.90	43.90	0.00	0.10	(2)

	Reference	DAS Value	|Difference|	Specification	
Relative Humidity (%)	73.5	70.5	3.0	7.0	(2)
Barometric Pressure ("Hg)	25.77	25.70	0.07	0.09	(2)

		Reference RPM	Reference cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CW)		20	10.00	10.90	0.90	20.50	(2)
	U:	60	30.00	29.10	0.90	21.50	(2)
		100	50.00	47.40	2.60	22.50	(2)
		500	245.00	246.50	1.50	32.25	(2)

		RPM	cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CCW)		20	-10.00	-9.70	0.30	20.50	(2)
	U:	60	-30.00	-31.60	1.60	21.50	(2)
		100	-50.00	-51.00	1.00	22.50	(2)
		500	-245.00	-253.90	8.90	32.25	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications
(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

Notes, Recommendations

Datalogger taken off line @ 0826 MST -- returned on-line 1027 MST.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining — Audit Date: 30-Jul-09

Audit Performed By: D.Barkan, J. Goldsmith - IML Air Science

Sensor	Mfr./Model	Serial Number	Reference Device	Serial/ID Number
Vert. Wind Speed 10m:	RM Young Wind Monitor AQ	NA	quartz referenced drive motor	IML 0857
Wind Speed (WS):	RM Young Wind Monitor AQ	WM75308	quartz referenced drive motor	IML 0857
Wind Direction (WD):	RM Young Wind Monitor AQ	WM75308	transit, compass	IML 0942
Temperature @ 2 Meters:	Fenwall 107	NA	digital thermistor	IML 1402
Relative Humidity:	Vaisala HMP50	C4240028	digital psychrometer	IML 0890
Barometric Pressure:	Vaisala PTB101B	C4240018	digital barometer	IML 1404
Solar Radiation:	LI-COR LI200X	PY57681	Li-Cor	PY52289
Data acquisition system:	CSI CR1000 datalogger	13147	N/A	N/A

Audit Results

	RPM	MPH	DAS Value	|Difference|	Specification	
WS (mph)	0	0.00	0.00	0.00	below threshold	
	300	3.44	3.43	0.00	0.56	(2)
	800	9.16	9.16	0.00	0.56	(2)
	3000	34.35	34.35	0.00	1.72	(2)
	8000	91.60	91.60	0.00	4.58	(2)

	Reference	DAS Value	|Difference|	Specification	
WS start torque (gm-cm)	<.1	N/A	N/A	1.0	(3)
WD (degrees)	0.0	0.1	0.1	5.0	(2)
	90.0	91.9	1.9	5.0	(2)
	180.0	180.2	0.2	5.0	(2)
	270.0	270.2	0.2	5.0	(2)

	Reference	DAS Value	|Difference|	Specification	
Temp. 2 meter (°F):	0.00	0.02	0.02	0.5	(2)
	24.49	24.66	0.17	0.5	(2)
	48.89	49.40	**0.51**	0.5	(2)
Temp. 10 meter (°F):	0.00	0.01	0.01	0.5	(2)
	24.49	24.66	0.17	0.5	(2)
	48.89	49.40	**0.51**	0.5	(2)

	Upper Sensor	Lower Sensor	|Difference|	Specification	
Delta T. (°C)	0.02	0.01	0.01	0.10	(2)
	24.66	24.66	0.00	0.10	(2)
	49.40	49.40	0.00	0.10	(2)

	Reference	DAS Value	|Difference|	Specification	
Relative Humidity (%)	70.6	69.1	1.5	7.0	(2)
Barometric Pressure ("Hg)	25.75	25.76	0.01	0.09	(2)

		Reference RPM	Reference cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CW)		20	10.00	9.70	0.30	20.50	(2)
	U:	60	30.00	26.70	3.30	21.50	(2)
		100	50.00	46.16	3.84	22.50	(2)
		500	245.00	242.90	2.10	32.25	(2)

		RPM	cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CCW)		20	-10.00	-9.70	0.30	20.50	(2)
	U:	60	-30.00	-29.10	0.90	21.50	(2)
		100	-50.00	-49.80	0.20	22.50	(2)
		500	-245.00	-250.20	5.20	32.25	(2)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

Notes, Recommendations

Datalogger taken off line at 0841 MST and returned on-line 0942 MST.
Adjusted WD alingment, changed bearings.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining — Audit Date: 22-Mar-10
Audit Performed By: D.Barkan, C. Medill - IML Air Science

Sensor	Mfr./Model	Serial Number	Reference Device	Serial/ID Number
Vert. Wind Speed 10m:	RM Young Wind Monitor AQ	NA	quartz referenced drive motor	IML 0855
Wind Speed (WS):	RM Young Wind Monitor AQ	WM75308	quartz referenced drive motor	IML 0856
Wind Direction (WD):	RM Young Wind Monitor AQ	WM75308	transit, compass	IML 0942
Temperature @ 2 Meters:	Fenwall 107	NA	digital thermistor	IML 0888
Relative Humidity:	Vaisala HMP50	C4240028	digital psychrometer	IML 0892
Barometric Pressure:	Vaisala PTB101B	C4240018	digital barometer	IML 0904
Solar Radiation:	LI-COR LI200X	PY57681	Li-Cor	PY54289
Data acquisition system:	CSI CR1000 datalogger	13147	N/A	N/A

Audit Results

	RPM	MPH	DAS Value	|Difference|	Specification	
WS (mph)	0	0.00	0.00	0.00	below threshold	
	300	3.44	3.43	0.00	0.56	(2)
	800	9.16	9.16	0.00	0.56	(2)
	3000	34.35	34.35	0.00	1.72	(2)
	8000	91.60	91.60	0.00	4.58	(2)

	Reference	DAS Value	|Difference|	Specification	
WS start torque (gm-cm)	<.1	N/A	N/A	1.0	(3)
WD (degrees)	0.0	0.1	0.1	5.0	(2)
	90.0	88.9	1.1	5.0	(2)
	180.0	180.2	0.2	5.0	(2)
	270.0	271.0	1.0	5.0	(2)

	Reference	DAS Value	|Difference|	Specification	
Temp. 2 meter (°F):	0.06	0.14	0.08	0.5	(2)
	19.60	19.54	0.06	0.5	(2)
	35.03	35.12	0.09	0.5	(2)
Temp. 10 meter (°F):	0.06	0.13	0.07	0.5	(2)
	19.60	19.59	0.01	0.5	(2)
	35.03	35.15	0.12	0.5	(2)

	Upper Sensor	Lower Sensor	|Difference|	Specification	
Delta T. (°C)	0.14	0.13	0.01	0.10	(2)
	19.54	19.59	0.05	0.10	(2)
	35.12	35.15	0.03	0.10	(2)

	Reference	DAS Value	|Difference|	Specification	
Relative Humidity (%)	33.5	33.1	0.4	7.0	(2)
Barometric Pressure ("Hg)	25.43	25.43	0.00	0.09	(2)

	Reference RPM	Reference cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)	0	0.00	0.00	0.00	below threshold	
(CW)	20	10.00	9.71	0.29	20.50	(2)
U:	60	30.00	29.14	0.86	21.50	(2)
	100	50.00	47.36	2.64	22.50	(2)
	500	245.00	247.78	2.78	32.25	(2)

	RPM	cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)	0	0.00	0.00	0.00	below threshold	
(CCW)	20	-10.00	-9.71	0.29	20.50	(2)
U:	60	-30.00	-30.36	0.36	21.50	(2)
	100	-50.00	-49.47	0.53	22.50	(2)
	500	-245.00	-250.20	5.20	32.25	(2)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

Notes, Recommendations

Datalogger taken off line at 08:30 MST and returned on-line 12:58 MST.
Replaced wind direction tail coupler and wind speed bearings.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining
Audit Date: 20-Aug-10
Audit Performed By: T. Mendenhall, S. Hansen - IML Air Science

Sensor	Mfr./Model	Serial Number	Reference Device	Serial/ID Number
Vert. Wind Speed 10m:	RM Young Wind Monitor AQ	N/A	quartz referenced drive motor	IML 1407
Wind Speed (WS):	RM Young Wind Monitor AQ	WM75308	quartz referenced drive motor	IML 0889
Wind Direction (WD):	RM Young Wind Monitor AQ	WM75308	transit, compass	IML 1405
Temperature @ 2 Meters:	RM Young RTD	NA	digital thermistor	IML 1402
Temperature @ 10 Meters:	RM Young RTD	NA	digital thermistor	IML 1402
Relative Humidity:	Vaisala HMP50	C4240028	digital hygrometer	IML 0892
Barometric Pressure:	Vaisala PTB101B	C4240018	digital barometer	IML 0887
Solar Radiation:	LI-COR LI200X	PY57681	Li-Cor	N/A
Data acquisition system:	CSI CR1000 datalogger	13147	N/A	N/A

Audit Results

		RPM	MPH	DAS Value	|Difference|	Specification	
WS (mph)		0	0.00	0.00	0.00	below threshold	
		300	3.44	3.44	0.00	0.56	(2)
		800	9.16	9.16	0.00	0.56	(2)
		3000	34.35	34.35	0.00	0.56	(2)
		8000	91.60	91.60	0.00	0.56	(2)
			Reference	DAS Value	|Difference|	Specification	
WS start torque (gm-cm)			<1	1	0	1.0	(3)
Crossarm Alignment			235°	241°	6	5.0	
WD (degrees)	Clockwise		0.0	0.1	0.1	5.0	(2)
			90.0	90.6	0.6	5.0	(2)
			180.0	179.9	0.1	5.0	(2)
			270.0	269.1	0.9	5.0	(2)
	Counter Clockwise		0.0	0.9	0.9	5.0	(2)
			90.0	90.4	0.4	5.0	(2)
			180.0	180.1	0.1	5.0	(2)
			270.0	269.8	0.2	5.0	(2)
			Reference	DAS Value	|Difference|	Specification	
Temp. 2 meter (°F):			1.09	1.12	0.03	0.5	(2)
			54.90	54.84	0.06	0.5	(2)
			22.90	22.74	0.16	0.5	(2)
Temp. 10 meter (°F):			1.09	1.10	0.01	0.5	(2)
			54.90	54.91	0.01	0.5	(2)
			22.90	22.80	0.10	0.5	(2)
			Upper Sensor	Lower Sensor	|Difference|	Specification	
Delta T. (°C)			1.12	1.10	0.02	0.10	(2)
			54.84	54.91	0.07	0.10	(2)
			22.74	22.80	0.06	0.10	(2)
			Reference	DAS Value	|Difference|	Specification	
Relative Humidity (%)			19.2	16.7	2.5	7.0	(2)
Barometric Pressure ("Hg)			25.55	25.56	0.01	0.09	(2)

		Reference RPM	Reference cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CW)		20	10.00	9.11	0.89	20.50	(2)
	U:	60	30.00	24.69	5.31	21.50	(2)
		200	100.00	99.49	0.51	25.00	(2)
		500	245.00	248.60	3.60	32.25	(2)

		RPM	cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CCW)		20	-10.00	-10.33	0.33	20.50	(2)
	U:	60	-30.00	-24.91	5.09	21.50	(2)
		200	-100.00	-101.45	1.45	25.00	(2)
		500	-245.00	-248.60	3.60	32.25	(2)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

Notes, Recommendations

Datalogger taken off line at 08:20 MST and returned on-line 09:20 MST.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining
Audit Date: 3-Mar-11
Audit Performed By: S. Hansen, J. Masters -- IML Air Science

Sensor	Mfr./Model	Serial Number	Reference Device	Serial/ID Number
Vert. Wind Speed 10m:	RM Young Wind Monitor AQ	N/A	quartz referenced drive motor	IML 1407
Wind Speed (WS):	RM Young Wind Monitor AQ	WM75308	quartz referenced drive motor	IML 1407
Wind Direction (WD):	RM Young Wind Monitor AQ	WM75308	transit, compass	IML 1405
Temperature @ 2 Meters:	RM Young RTD	NA	digital thermistor	IML 1401
Temperature @ 10 Meters:	RM Young RTD	NA	digital thermistor	IML 1401
Relative Humidity:	Vaisala HMP50	C4240028	digital hygrometer	IML 0890
Barometric Pressure:	Vaisala PTB101B	C4240018	digital barometer	IML 0968
Data acquisition system:	CSI CR1000 datalogger	13147	N/A	N/A

Audit Results

	RPM	MPH	DAS Value	|Difference|	Specification	
WS (mph)	0	0.00	0.00	0.00	below threshold	
	300	3.44	3.44	0.00	0.56	(2)
	800	9.16	9.16	0.00	0.56	(2)
	3000	34.35	34.35	0.00	0.56	(2)
	8000	91.60	91.60	0.00	0.56	(2)
WS start torque (gm-cm)		1.0	t<1.0	N/A	1.0	(3)
WD (degrees)	Clockwise	0.0	0.1	0.1	5.0	(2)
		90.0	90.8	0.8	5.0	(2)
		180.0	180.6	0.6	5.0	(2)
		270.0	268.7	1.3	5.0	(2)
	Counter Clockwise	0.0	0.1	0.1	5.0	(2)
		90.0	90.3	0.3	5.0	(2)
		180.0	180.5	0.5	5.0	(2)
		270.0	270.4	0.4	5.0	(2)
		Reference	DAS Value	|Difference|	Specification	
Temp. 2 meter (°F):		18.91	18.72	0.19	0.5	(2)
		0.27	0.00	0.27	0.5	(2)
		45.70	45.56	0.14	0.5	(2)
Temp. 10 meter (°F):		18.91	18.79	0.12	0.5	(2)
		0.27	0.02	0.25	0.5	(2)
		45.70	45.59	0.11	0.5	(2)
		Upper Sensor	Lower Sensor	|Difference|	Specification	
Delta T. (°C)		18.72	18.79	0.07	0.10	(2)
		0.00	0.02	0.02	0.10	(2)
		45.56	45.59	0.03	0.10	(2)
Relative Humidity (%)		48.7	48.2	0.5	7.0	(2)
Barometric Pressure ("Hg)		25.49	25.51	0.02	0.09	(2)

		Reference RPM	Reference cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CW)		20	10.00	9.72	0.28	20.50	(2)
	U:	60	30.00	29.15	0.85	21.50	(2)
		200	50.00	47.30	2.70	22.50	(2)
		500	250.00	248.60	1.40	32.50	(2)

		RPM	cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CCW)		20	-10.00	-9.72	0.28	20.50	(2)
	U:	60	-30.00	-29.15	0.85	21.50	(2)
		200	-50.00	-49.77	0.23	22.50	(2)
		500	-250.00	-247.30	2.70	32.50	(2)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

Notes, Recommendations

Datalogger taken off line at 12:11 MST and returned on-line 12:59 MST.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Wyoming Refining
Audit Date: 1-Sep-11
Audit Performed By: C. Cottom, J. Masters -- IML Air Science

Sensor	Mfr./Model	Serial Number	Reference Device	Serial/ID Number
Vert. Wind Speed 10m:	RM Young Wind Monitor AQ	N/A	quartz referenced drive motor	IML 0856
Wind Speed (WS):	RM Young Wind Monitor AQ	WM75308	quartz referenced drive motor	IML 0896
Wind Direction (WD):	RM Young Wind Monitor AQ	WM75308	transit, compass	IML 0894
Temperature @ 2 Meters:	RM Young RTD	NA	digital thermistor	IML 1401
Temperature @ 10 Meters:	RM Young RTD	NA	digital thermistor	IML 1401
Relative Humidity:	Vaisala HMP50	C4240028	digital hygrometer	IML 0899
Barometric Pressure:	Vaisala PTB101B	C4240018	digital barometer	IML 0968
Solar Radiation	LI-COR LI200X	PY57681	LI-COR 200X	PY68877
Data acquisition system:	CSI CR1000 datalogger	13147	N/A	N/A

Audit Results

		RPM	MPH	DAS Value	|Difference|	Specification	
WS (mph)		0	0.00	0.00	0.00	below threshold	
		300	3.44	3.44	0.00	0.56	(2)
		800	9.16	9.16	0.00	0.56	(2)
		3000	34.35	34.35	0.00	0.56	(2)
		8000	91.60	91.60	0.00	0.56	(2)
Crossarm Alignment			232.0	230.0	2.0	5.0	(3)
WS start torque (gm-cm)			1.0	t<1.0	N/A	1.0	(3)
WD (degrees)	Clockwise		0.0	0.1	0.1	5.0	(2)
			90.0	91.0	1.0	5.0	(2)
			180.0	180.1	0.1	5.0	(2)
			270.0	269.9	0.1	5.0	(2)
	Counter Clockwise		0.0	0.1	0.1	5.0	(2)
			90.0	90.5	0.5	5.0	(2)
			180.0	180.4	0.4	5.0	(2)
			270.0	269.0	1.0	5.0	(2)
			Reference	DAS Value	|Difference|	Specification	
Temp. 2 meter (°F):			0.20	0.19	0.01	0.5	(2)
			34.46	34.53	0.07	0.5	(2)
			51.50	51.34	0.16	0.5	(2)
Temp. 10 meter (°F):			0.20	0.16	0.04	0.5	(2)
			34.46	34.55	0.09	0.5	(2)
			51.50	51.37	0.13	0.5	(2)
			Upper Sensor	Lower Sensor	|Difference|	Specification	
Delta T. (°C)			0.19	0.16	0.03	0.10	(2)
			34.53	34.55	0.02	0.10	(2)
			51.34	51.37	0.03	0.10	(2)
Relative Humidity (%)			33.9	33.3	0.6	7.0	(2)
Barometric Pressure ("Hg)			25.59	25.59	0.00	0.09	(2)

		Reference RPM	Reference cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CW)		20	10.00	9.72	0.28	20.50	(2)
	U:	60	30.00	29.16	0.84	21.50	(2)
		200	50.00	46.17	3.83	22.50	(2)
		500	250.00	243.00	7.00	32.50	(2)

		RPM	cm/s	DAS Value	|Difference|	Specification	
Vert WS 10 meters (cm/s)		0	0.00	0.00	0.00	below threshold	
(CCW)		20	-10.00	-9.72	0.28	20.50	(2)
	U:	60	-30.00	-29.16	0.84	21.50	(2)
		200	-50.00	-48.60	1.40	22.50	(2)
		500	-250.00	-245.00	5.00	32.50	(2)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

Notes, Recommendations

System taken off-line at 12:36 MST and returned on-line 13:13 MST.

Antelope Mine Meteorological Station Audit Reports

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 17-Feb-97

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Insitu WTS-100	Hg-in-glass thermometer, or t-couple
Barometric Pressure (BP):	Insitu WBS-360	Altimeter
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10 & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00		
		3.44	3.43	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.25	0.10	1.72	(1)
		91.60	91.46	0.14	4.58	(1)
WS start torque (gm-cm)		τ<0.7	N/A	N/A	1.0	(3)
WD (degrees)		0.0	1.0	1.0	5.0	(1)
		90.0	91.2	1.2	5.0	(1)
		180.0	179.9	0.1	5.0	(1)
		270.0	270.1	0.1	5.0	(1)
WD start torque (gm-cm)		τ<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ambient	51.7	52.0	0.3	1.8	(1)
	ice bath	32.0	32.8	0.8	1.8	(1)
	warm bath	102.5	102.2	0.3	1.8	(1)
Precipitation (0.05" equiv.)		92.7	90.0	2.7	9.3	(1)
		92.7	93.0	0.3	9.3	(1)
		92.7	95.0	2.3	9.3	(1)
Pressure (in. Hg)		25.06	25.10	0.04	N/A	N/A

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1220 MST -- returned on-line at 1300 MST.
Wind screen is torn.
Wind direction alignment is OK.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 21-Mar-97

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.05	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		τ<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	1.5	1.5	5.0	(1)
		90.0	89.0	1.0	5.0	(1)
		180.0	180.0	0.0	5.0	(1)
		270.0	271.0	1.0	5.0	(1)
WD start torque (gm-cm)		τ<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ambier	59.4	60.1	0.7	1.8	(1)
	ice bath	37.0	38.1	1.1	1.8	(1)
	warm batl	78.4	78.2	0.2	1.8	(1)
Precipitation (0.04" equiv.)		74.2	74.0	0.2	7.4	(1)
		74.2	74.0	0.2	7.4	(1)
		74.2	74.0	0.2	7.4	(1)
Pressure (in. Hg)		25.25	25.23	0.02	0.25	(2)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1030 MST -- returned on-line at 1455 DST.

Installed new CR10X datalogger, pressure sensor, enclosure, surge protection, precipitation senor cable and wind sensor cable.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 11-Mar-98

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Insitu WTS-100	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Insitu WBS-360	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10 & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.40	0.05	1.72	(1)
		91.60	91.65	0.05	4.58	(1)
WS start torque (gm-cm)		τ<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.3	0.3	5.0	(1)
		90.0	91.5	1.5	5.0	(1)
		180.0	182.2	2.2	5.0	(1)
		270.0	272.1	2.1	5.0	(1)
WD start torque (gm-cm)		τ<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ambient	16.0	14.6	1.4	1.8	(1)
	ice bath	32.0	31.9	0.1	1.8	(1)
	warm bat	119.1	119.8	0.7	1.8	(1)
Precipitation (0.04" equiv.)		74.2	76.0	1.8	7.4	(1)
		74.2	77.0	2.8	7.4	(1)
		74.2	76.0	1.8	7.4	(1)
Pressure (in. Hg)		25.47	25.51	0.04	N/A	N/A

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1310 MST -- returned on-line at 1353 MST.
System time, date and battery voltage are OK.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 18-Aug-98

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Insitu WTS-100	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Insitu WBS-360	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10 & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.40	0.05	1.72	(1)
		91.60	91.65	0.05	4.58	(1)
WS start torque (gm-cm)		$\tau<0.2$	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.1	0.1	5.0	(1)
		90.0	88.0	2.0	5.0	(1)
		180.0	179.0	1.0	5.0	(1)
		270.0	271.0	1.0	5.0	(1)
WD start torque (gm-cm)		$\tau<11.0$	N/A	N/A	11.0	(3)
Temperature (°F)	ambient	78.6	78.5	0.1	1.8	(1)
	ice bath	32.0	32.1	0.1	1.8	(1)
	warm bat	116.2	116.3	0.1	1.8	(1)
Precipitation (0.04" equiv.)		74.2	76.0	1.8	7.4	(1)
		74.2	76.0	1.8	7.4	(1)
		74.2	76.0	1.8	7.4	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 0848 MST -- returned on-line at 0923 MST.
System time, date and battery voltage are OK.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 9-Mar-99

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Insitu WTS-100	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Insitu WBS-360	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10 & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		τ<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	1.3	1.3	5.0	(1)
		90.0	90.6	0.6	5.0	(1)
		180.0	179.8	0.2	5.0	(1)
		270.0	270.8	0.8	5.0	(1)
WD start torque (gm-cm)		τ<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ambient	41.9	42.0	0.1	1.8	(1)
	ice bath	32.0	32.0	0.0	1.8	(1)
	warm bat	177.8	117.0	60.8	1.8	(1)
Precipitation (0.04" equiv.)		74.2	76.0	1.8	7.4	(1)
		74.2	74.0	0.2	7.4	(1)
		74.2	73.0	1.2	7.4	(1)
Pressure (in. Hg)		25.1	25.23	0.13	0.25	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1031 MST -- returned on-line at 1130 MST.
System time, date and battery voltage are OK.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 1-Sep-99

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Insitu WTS-100	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Insitu WBS-360	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10 & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		τ<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	1.6	1.6	5.0	(1)
		90.0	90.5	0.5	5.0	(1)
		180.0	180.0	0.0	5.0	(1)
		270.0	269.0	1.0	5.0	(1)
WD start torque (gm-cm)		τ<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ambient	67.0	66.3	0.7	1.8	(1)
	ice bath	32.2	32.3	0.1	1.8	(1)
	warm bath	85.3	85.3	0.0	1.8	(1)
Precipitation (0.04" equiv.)		74.2	76.0	1.8	7.4	(1)
		74.2	74.0	0.2	7.4	(1)
		74.2	74.0	0.2	7.4	(1)
Pressure (in. Hg)		25.35	25.26	0.09	0.25	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed in EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1255 DST -- returned on-line at 1340 DST.
Battery voltage at 13.38.
System operating in daylight savings time.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 14-Mar-00

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Insitu WTS-100	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Insitu WBS-360	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10 & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.05	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		τ<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	1.3	1.3	5.0	(1)
		90.0	89.0	1.0	5.0	(1)
		180.0	179.0	1.0	5.0	(1)
		270.0	270.0	0.0	5.0	(1)
WD start torque (gm-cm)		τ<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ambient	44.6	44.5	0.1	1.8	(1)
	ice bath	32.0	32.1	0.1	1.8	(1)
	warm bath	112.0	111.0	1.0	1.8	(1)
Precipitation (0.04" equiv.)		74.2	77.0	2.8	7.4	(1)
		74.2	75.0	0.8	7.4	(1)
		74.2	74.3	0.1	7.4	(1)
Pressure (in. Hg)		25.05	25.23	0.18	0.25	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1105 DST -- returned on-line at 1255 DST.
Battery voltage at 13.64.
System operating in daylight savings time.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 12-Sep-00

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Insitu WTS-100	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Insitu WBS-360	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10 & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.05	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		τ<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.6	0.6	5.0	(1)
		90.0	92.5	2.5	5.0	(1)
		180.0	181.9	1.9	5.0	(1)
		270.0	271.7	1.7	5.0	(1)
WD start torque (gm-cm)		τ<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ambient	80.2	79.2	1.0	1.8	(1)
	ice bath	36.7	35.6	1.1	1.8	(1)
	warm bath	97.0	96.0	1.0	1.8	(1)
Precipitation (0.04" equiv.)		74.2	74.0	0.2	7.4	(1)
		74.2	74.0	0.2	7.4	(1)
		74.2	74.0	0.2	7.4	(1)
Pressure (in. Hg)		25.32	25.40	0.08	0.25	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1315 DST -- returned on-line at 1414 DST.
Battery voltage at 13.04.
System operating in daylight savings time.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 29-Aug-01
Audit Performed by: D. Black, W. Adler - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.04	0.00	0.56	(1)
		3.44	3.50	0.06	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		τ<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	1.4	1.4	5.0	(1)
		90.0	91.6	1.6	5.0	(1)
		180.0	181.6	1.6	5.0	(1)
		270.0	270.9	0.9	5.0	(1)
WD start torque (gm-cm)		τ<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ambier	77.6	76.0	1.6	1.8	(1)
	ice bath	32.8	32.8	0.0	1.8	(1)
	warm batt	117.8	116.1	1.7	1.8	(1)
Precipitation (0.04" equiv.)		74.2	73.5	0.7	7.4	(1)
		74.2	73.4	0.8	7.4	(1)
		74.2	73.6	0.6	7.4	(1)
Pressure (in. Hg)		25.25	25.27	0.02	0.25	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1127 MST -- returned on-line at 1240 DST.
Temperature sensor was not working upon arrival. Wire was chewed on and shorted. Spliced wire.
Time was set to Daylight time. At the office, we re-set to Mountain Standard Time. (Time went from 1304 to 1203.)

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 25-Mar-02
Audit Performed by: D. Black, J. Rogers - inl Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.77	3.70	0.07	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		τ<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	1.0	1.0	5.0	(1)
		90.0	90.9	0.9	5.0	(1)
		180.0	180.3	0.3	5.0	(1)
		270.0	269.8	0.2	5.0	(1)
WD start torque (gm-cm)		τ<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ambient	15.6	16.4	0.8	1.8	(1)
	ice bath	32.0	31.2	0.8	1.8	(1)
	warm bath	82.6	81.4	1.2	1.8	(1)
Precipitation (0.04" equiv.)		74.1	71.6	2.5	7.4	(1)
		74.1	72.0	2.1	7.4	(1)
		74.1	72.0	2.1	7.4	(1)
Pressure (in. Hg)		25.3	25.32	0.02	0.25	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1031 MST -- returned on-line at 1101 MST.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 21-Jan-03
Audit Performed by: W. Adler, T. Shaw - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.50	0.06	0.56	(1)
		9.16	9.20	0.04	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		$\tau<0.2$	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.7	0.7	5.0	(1)
		90.0	90.5	0.5	5.0	(1)
		180.0	179.9	0.1	5.0	(1)
		270.0	270.0	0.0	5.0	(1)
WD start torque (gm-cm)		$\tau<11.0$	N/A	N/A	11.0	(3)
Temperature (°F)	ambient	18.6	19.1	0.5	1.8	(1)
	ice bath	79.7	79.1	0.6	1.8	(1)
	warm bath	31.7	32.5	0.8	1.8	(1)
Precipitation (0.04" equiv.)		74.1	74.8	0.7	7.4	(1)
		74.1	74.2	0.1	7.4	(1)
		74.1	73.8	0.3	7.4	(1)
Pressure (in. Hg)		25.34	25.29	0.05	0.25	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1336 MST -- returned on-line at 1421 MST.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 30-Jul-03
Audit Performed by: D. Lindberg, K. Jahnke - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.0	0.0	5.0	(1)
		90.0	90.0	0.0	5.0	(1)
		180.0	180.0	0.0	5.0	(1)
		270.0	270.0	0.0	5.0	(1)
WD start torque (gm-cm)		t<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ambient	83.9	83.2	0.7	1.8	(1)
	ice bath	32.2	32.3	0.1	1.8	(1)
	warm bath	120.6	119.6	1.0	1.8	(1)
Precipitation (0.04" equiv.)		74.1	75.1	1.0	7.4	(1)
		74.1	74.8	0.7	7.4	(1)
		74.1	73.6	0.5	7.4	(1)
Pressure (in. Hg)		25.46	25.43	0.03	0.25	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 0940 -- returned on-line at 1044.
Wind Direction adjusted 15 degrees east of south.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 8-Mar-04
Audit Performed by: W. Adler, T. Shaw - *iml Air Science*

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.13	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.4	0.4	5.0	(1)
		90.0	90.2	0.2	5.0	(1)
		180.0	180.6	0.6	5.0	(1)
		270.0	270.3	0.3	5.0	(1)
WD start torque (gm-cm)		t<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ambient	52.8	51.2	1.6	1.8	(1)
	ice bath	32.6	33.0	0.4	1.8	(1)
	warm bath	86.8	85.7	1.1	1.8	(1)
Precipitation (0.04" equiv.)		74.1	73.2	0.9	7.4	(1)
		74.1	73.4	0.7	7.4	(1)
		74.1	73.2	0.9	7.4	(1)
Pressure (in. Hg)		25.57	25.62	0.05	0.26	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1106 -- returned on-line at 1143.
Precipitation tipping bucket was not registering upon arrival. The connection to the surge protector was re-established and working properly upon departure.
Replaced bearings on wind speed sensor.
The raptor protection needs to be extended another 6 inches.
Will need a new tail next time.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 2-Sep-04
Audit Performed by: K. Jahnke, T. Shaw - *iml Air Science*

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.13	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.30	0.05	1.72	(1)
		91.60	91.51	0.09	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.1	0.1	5.0	(1)
		90.0	89.8	0.2	5.0	(1)
		180.0	180.9	0.9	5.0	(1)
		270.0	270.2	0.2	5.0	(1)
WD start torque (gm-cm)		t<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ambient	71.5	71.0	0.5	1.8	(1)
	ice water bath	33.1	34.0	0.9	1.8	(1)
	warm water bath	126.4	125.5	0.9	1.8	(1)
Precipitation (0.04" equiv.)		74.1	73.2	0.9	7.4	(1)
		74.1	73.2	0.9	7.4	(1)
		74.1	73.2	0.9	7.4	(1)
Pressure (in. Hg)		25.16	25.21	0.04	0.25	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 0947 -- returned on-line at 1024.
The raptor protection needs to be extended another 6 inches.
A new tail will be installed in the next few weeks.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 22-Mar-05
Audit Performed by: W. Adler, D. Tarver - *inl Air Science*

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.32	0.03	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.0	0.0	5.0	(1)
		90.0	90.2	0.2	5.0	(1)
		180.0	181.2	1.2	5.0	(1)
		270.0	270.4	0.4	5.0	(1)
WD start torque (gm-cm)		t<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ambient	42.3	40.9	1.4	1.8	(1)
	ice water bath	33.1	34.2	1.1	1.8	(1)
	warm water bath	125.2	123.9	1.3	1.8	(1)
Precipitation (0.04" equiv.)		74.1	69.0	5.1	7.4	(1)
		74.1	74.0	0.1	7.4	(1)
		74.1	75.5	1.4	7.4	(1)
Pressure (in. Hg)		25.29	25.24	0.05	0.25	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1020 -- returned on-line at 1048.
The raptor protection needs to be extended another 6 inches.
Replaced tail and wind speed bearings.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 27-Sep-05
Audit Performed by: K. Jahnke, T. Shaw - *iml Air Science*

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.45	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.32	0.03	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.7	0.7	5.0	(1)
		90.0	90.8	0.8	5.0	(1)
		180.0	179.9	0.1	5.0	(1)
		270.0	271.0	1.0	5.0	(1)
WD start torque (gm-cm)		t<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ambient	79.6	81.2	1.6	1.8	(1)
	ice water bath	35.8	34.4	1.4	1.8	(1)
	warm water bath	97.3	96.3	1.0	1.8	(1)
Precipitation (0.04" equiv.)		74.1	73.0	1.1	7.4	(1)
		74.1	71.2	2.9	7.4	(1)
		74.1	70.1	4.0	7.4	(1)
Pressure (in. Hg)		25.22	25.28	0.06	0.25	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1020 MST -- returned on-line at 1053 MST.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 7-Mar-06
Audit Performed by: Steven Engel & Tim Mendenhall--IML *Air Science*

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.48	0.05	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.8	0.8	5.0	(1)
		90.0	90.5	0.5	5.0	(1)
		180.0	181.1	1.1	5.0	(1)
		270.0	269.8	0.2	5.0	(1)
WD start torque (gm-cm)		t<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ambient	51.2	51.4	0.2	1.8	(1)
	ice water bath	40.6	41.4	0.8	1.8	(1)
	warm water bath	88.5	87.9	0.6	1.8	(1)
Precipitation (0.04" equiv.)		74.1	78.2	4.1	7.4	(1)
		74.1	76.2	2.1	7.4	(1)
		74.1	77.2	3.1	7.4	(1)
Pressure (in. Hg)		25.08	25.07	0.01	0.25	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1139 MST -- returned on-line at 1245 MST.
Replaced windspeed bearings/ Needs O-ring for Youngs/ Precip bucket needs jewel bearings

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 19-Dec-06
Audit Performed by: Shane Hansen and Steven Engel--IML *Air Science*

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification		
WS (mph)		0.00	0.00	0.00	0.56	(1)	
		3.66	3.66	0.00	0.56	(1)	
		9.16	9.16	0.00	0.56	(1)	
		34.35	34.35	0.00	1.72	(1)	
		91.60	91.60	0.00	4.58	(1)	
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)	
WD (degrees)		0.0	0.4	0.4	5.0	(1)	
		90.0	90.4	0.4	5.0	(1)	
		180.0	179.5	0.5	5.0	(1)	
		270.0	270.4	0.4	5.0	(1)	
WD start torque (gm-cm)		t<11.0	N/A	N/A	11.0	(3)	
Temperature (°F)	ambient	31.9	31.8	0.1	1.8	(1)	
	ice water bath	86.8	87.1	0.3	1.8	(1)	
	warm water bath	75.6	75.7	0.1	1.8	(1)	
Precipitation (0.1" equiv.)		186.0	185.0	1.0	18.5	(1)	Start Precip:1.09
		186.4	185.0	1.4	18.5	(1)	End Precip: 1.51
		186.8	185.0	1.8	18.5	(1)	
Pressure (in. Hg)		25.42	25.40	0.02	0.25	(2)	

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System offline at 0950 mdt and online at 1040 mdt

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 22-Mar-07
Audit Performed by: Kevin Jahnke and Steven Engel--*IML Air Science*

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification		
WS (mph)	0.00	0.00	0.00	0.56	(1)	
	3.44	3.44	0.00	0.56	(1)	
	9.16	9.16	0.00	0.56	(1)	
	34.35	34.35	0.00	1.72	(1)	
	91.60	91.60	0.00	4.58	(1)	
WS start torque (gm-cm)	t<0.2	N/A	N/A	1.0	(3)	
WD (degrees)	0.0	0.4	0.4	5.0	(1)	
	90.0	90.4	0.4	5.0	(1)	
	180.0	179.5	0.5	5.0	(1)	
	270.0	270.4	0.4	5.0	(1)	
WD start torque (gm-cm)	t<11.0	N/A	N/A	11.0	(3)	
Temperature (°F) hot water bath	121.5	120.1	1.4	1.8	(1)	
ice water bath	33.2	33.0	0.2	1.8	(1)	
warm water bath	56.0	56.4	0.4	1.8	(1)	
Precipitation (0.1" equiv.)	182.2	185.2	3.0	18.5	(1)	Start Precip:1.68
	182.6	185.2	2.6	18.5	(1)	End Precip: 2.01
	182.0	185.2	3.2	18.5	(1)	
Pressure (in. Hg)	25.21	25.22	0.01	0.25	(2)	

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System offline at 0948 MST and online at 1107 MST

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Antelope Coal Company
Audit Date:	10-Jul-07
Audit Performed by:	Kevin Jahnke and Steven Engel--IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification		
WS (mph)	0.00	0.00	0.00	0.56	(1)	
	3.44	3.44	0.00	0.56	(1)	
	9.16	9.16	0.00	0.56	(1)	
	34.35	34.35	0.00	1.72	(1)	
	91.60	91.60	0.00	4.58	(1)	
WS start torque (gm-cm)	t<0.2	N/A	N/A	1.0	(3)	
WD (degrees)	0.0	0.1	0.1	5.0	(1)	
	90.0	90.1	0.1	5.0	(1)	
	180.0	180.5	0.5	5.0	(1)	
	270.0	270.0	0.0	5.0	(1)	
WD start torque (gm-cm)	t<11.0	N/A	N/A	11.0	(3)	
Temperature (°F) hot water bath	90.1	89.5	0.6	0.9	(1)	
ice water bath	37.6	37.3	0.3	0.9	(1)	
warm water bath	67.3	67.2	0.1	0.9	(1)	
Precipitation (0.1" equiv.)	181.2	185.2	4.0	18.5	(1)	Start Precip:5.32
	183.4	185.2	1.8	18.5	(1)	End Precip:5.62
	182.6	185.2	2.6	18.5	(1)	
Pressure (in. Hg)	25.43	25.46	0.03	0.25	(2)	

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

Notes, Recommendations

System offline at 1348 MST and online at 1425 MST

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 11-Mar-08
Audit Performed by: Shane Hansen and Steven Engel--IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.44	3.44	0.00	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)	t<0.2	N/A	N/A	1.0	(3)
WD (degrees)	0.0	0.0	0.0	5.0	(1)
	90.0	90.0	0.0	5.0	(1)
	180.0	179.2	0.8	5.0	(1)
	270.0	269.1	0.9	5.0	(1)
WD start torque (gm-cm)	t<11.0	N/A	N/A	11.0	(3)
Temperature (°F) hot water bath	114.9	114.4	0.5	0.9	(1)
ice water bath	32.1	32.6	0.5	0.9	(1)
warm water bath	67.7	67.6	0.1	0.9	(1)
Precipitation (0.1" equiv.)	183.7	185.2	1.5	18.5	(1)
	183.9	185.2	1.3	18.5	(1)
	182.9	185.2	2.3	18.5	(1)
Pressure (in. Hg)	25.31	25.32	0.01	0.25	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System offline at 1202 MST and online at 1250 MST

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 31-Mar-09
Audit Performed by: R. Campbell, M. Butler -- IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR1000	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.44	3.44	0.00	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)	t<0.2	N/A	N/A	1.0	(3)
WD (degrees)	0.0	0.5	0.5	5.0	(1)
	90.0	90.5	0.5	5.0	(1)
	180.0	180.8	0.8	5.0	(1)
	270.0	271.3	1.3	5.0	(1)
WD start torque (gm-cm)	t<11.0	N/A	N/A	11.0	(3)
Temperature (°F) hot water bath	95.3	95.0	0.3	0.9	(1)
ice water bath	31.9	31.9	0.0	0.9	(1)
warm water bath	83.9	83.5	0.3	0.9	(1)
Precipitation (0.1" equiv.)	188.0	185.2	2.8	18.5	(1)
	186.0	185.2	0.8	18.5	(1)
	186.0	185.2	0.8	18.5	(1)
Pressure (in. Hg)	24.98	25.00	0.02	0.09	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System offline at 1200 MST and returned online at 1316 MST.
Replaced bearings, replaced prop

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Antelope Coal Company
Audit Date:	17-Sep-09
Audit Performed by:	R. Campbell, J. Goldsmith -- IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR1000	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	N/A	N/A	0.56	(1)
	3.44	N/A	N/A	0.56	(1)
	9.16	N/A	N/A	0.56	(1)
	34.35	N/A	N/A	1.72	(1)
	91.60	N/A	N/A	4.58	(1)
WS start torque (gm-cm)	t<0.2	N/A	N/A	1.0	(3)
WD (degrees)	0.0	N/A	N/A	5.0	(1)
	90.0	N/A	N/A	5.0	(1)
	180.0	N/A	N/A	5.0	(1)
	270.0	N/A	N/A	5.0	(1)
WD start torque (gm-cm)	t<11.0	N/A	N/A	11.0	(3)
Temperature (°F) hot water bath	110.7	109.3	**1.4**	0.9	(1)
ice water bath	32.3	32.8	0.5	0.9	(1)
warm water bath	71.5	70.8	0.7	0.9	(1)
Precipitation (0.1" equiv.)	187.1	185.2	1.9	18.5	(1)
	184.8	185.2	0.4	18.5	(1)
	185.5	185.2	0.3	18.5	(1)
Pressure (in. Hg)	25.5	25.47	0.03	0.09	(2)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

Notes, Recommendations

System offline at 0807 MST and returned online at 0844 MST.

Wind speed and wind direction audit was not completed due to safety concerns.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 31-Mar-10
Audit Performed By: M. Butler, R. Campbell -- IML Air Science

Sensor	Mfr./Model	Reference Device	Serial ID
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz drive motor	IML 0855
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass	IML 0942
Temperature (T):	Fenwal 107	Digital Thermistor	IML 0888
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer	IML 0904
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette	N/A
Data acquisition system (DAS):	Campbell Scientific CR1000	N/A	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.44	3.44	0.00	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)	t<0.2	N/A	N/A	1.0	(3)
WD (degrees)	0.0	0.1	0.1	5.0	(1)
	90.0	90.4	0.4	5.0	(1)
	180.0	179.5	0.5	5.0	(1)
	270.0	270.3	0.3	5.0	(1)
WD start torque (gm-cm)	t<11.0	N/A	N/A	11.0	(3)
Temperature (°F) hot water bath	148.4	147.7	0.7	0.9	(1)
ice water bath	31.9	32.0	0.1	0.9	(1)
warm water bath	85.5	85.3	0.2	0.9	(1)
Precipitation (0.1" equiv.)	178.6	185.3	6.7	18.5	(1)
	183.0	185.3	2.3	18.5	(1)
	182.6	185.3	2.7	18.5	(1)
Pressure (in. Hg)	25.01	24.99	0.02	0.09	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System taken offline at 08:30 MST and returned online at 09:24 MST.
Changed wind speed bearings.

After Adjustment

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.44	3.44	0.00	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.60	91.60	0.00	4.58	(1)

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 22-Sep-10
Audit Performed By: M. Butler, J. Masters -- IML Air Science

Sensor	Mfr./Model	Reference Device	Serial ID
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz drive motor	IML 0896
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass	IML 0942
Temperature (T):	Fenwal 107	Digital Thermistor	IML 0885
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer	IML 1404
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette	N/A
Data acquisition system (DAS):	Campbell Scientific CR1000	N/A	N/A

Audit Results

	Reference	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0	0.00	0.00	0.00	0.56	(1)
	300	3.44	3.44	0.00	0.56	(1)
	800	9.16	9.16	0.00	0.56	(1)
	3000	34.35	34.35	0.00	1.72	(1)
	8000	91.60	91.60	0.00	4.58	(1)
Crossarm Alignment (°)		266.0	264.0	2.0	5.0	(2)
WS start torque (gm-cm)		1.0	t<1.0	N/A	1.0	(3)
WD (degrees)	Clockwise	0.0	0.2	0.2	5.0	(1)
		90.0	88.7	1.3	5.0	(1)
		180.0	180.4	0.4	5.0	(1)
		270.0	270.7	0.7	5.0	(1)
	Counter Clockwise	0.0	2.1	2.1	5.0	(1)
		90.0	89.6	0.4	5.0	(1)
		180.0	179.6	0.4	5.0	(1)
		270.0	270.1	0.1	5.0	(1)
WD start torque (gm-cm)	Clockwise	11.0	t<11.0	N/A	11.0	(3)
	Counter Clockwise	11.0	t<11.0	N/A	11.0	(3)
Temperature (°F)		32.5	32.9	0.4	0.9	(1)
		70.4	70.5	0.1	0.9	(1)
		92.3	92.2	0.1	0.9	(1)
Precipitation (0.1" equiv.)		186.0	185.3	0.7	18.5	(1)
		183.8	185.3	1.5	18.5	(1)
		183.6	185.3	1.7	18.5	(1)
Pressure (in. Hg)		25.05	25.07	0.02	0.09	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements Version 2.0, 2008
(3)= Manufacturer's Specifications

Notes, Recommendations

System taken offline at 07:42 MST and returned online at 08:26 MST.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 25-Mar-11
Audit Performed By: M. Butler, J. Masters -- IML Air Science

Sensor	Mfr./Model	Reference Device	Serial ID
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz drive motor	IML 0896
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass	IML 0900
Temperature (T):	Fenwal 107	Digital Thermistor	IML 1403
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer	IML 1404
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette	N/A
Data acquisition system (DAS):	Campbell Scientific CR1000	N/A	N/A

Audit Results

	Reference	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0	0.00	0.00	0.00	0.45	(1)
	300	3.44	3.44	0.00	0.45	(1)
	800	9.16	9.16	0.00	0.45	(1)
	3000	34.35	34.35	0.00	0.45	(1)
	8000	91.60	91.60	0.00	0.45	(1)
Crossarm Alignment (°)		85.0	83.6	1.4	5.0	(2)
WS start torque (gm-cm)		1.0	t<1.0	N/A	1.0	(3)
WD (degrees)	Clockwise	0.0	0.1	0.1	5.0	(1)
		90.0	90.7	0.7	5.0	(1)
		180.0	179.7	0.3	5.0	(1)
		270.0	269.1	0.9	5.0	(1)
	Counter Clockwise	0.0	0.1	0.1	5.0	(1)
		90.0	90.2	0.2	5.0	(1)
		180.0	180.9	0.9	5.0	(1)
		270.0	269.7	0.3	5.0	(1)
WD start torque (gm-cm)	Clockwise	11.0	t<11.0	N/A	11.0	(3)
	Counter Clockwise	11.0	t<11.0	N/A	11.0	(3)
Temperature (°F)		32.8	32.7	0.1	0.9	(1)
		51.6	51.6	0.0	0.9	(1)
		122.5	122.4	0.2	0.9	(1)
Precipitation (0.1" equiv.)		170.0	185.3	15.3	18.5	(1)
		178.2	185.3	7.1	18.5	(1)
		178.4	185.3	6.9	18.5	(1)
Pressure (in. Hg)		24.95	25.03	0.08	0.09	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements Version 2.0, 2008
(3)= Manufacturer's Specifications

Notes, Recommendations

System taken offline at 08:22 MST and returned online at 09:06 MST.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Antelope Coal Company
Audit Date: 22-Sep-11
Audit Performed By: Z. Heid, J. Masters -- IML Air Science

Sensor	Mfr./Model	Reference Device	Serial ID
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz drive motor	IML 0896
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass	IML 0894
Temperature (T):	Fenwal 107	Digital Thermistor	IML 1411
Barometric Pressure (BP):	Vaisala PTB 101B	aneroid barometer	IML 0968
Precipitation (Ppt.):	Met One 12" tipping bucket with WY screen	lab grade burette	N/A
Data acquisition system (DAS):	Campbell Scientific CR1000	N/A	N/A

Audit Results

	Reference RPM	Reference MPH	DAS Value	|Difference|	Specification	
WS (mph)	0	0.00	0.00	0.00	0.45	(1)
	300	3.44	3.44	0.00	0.45	(1)
	800	9.16	9.16	0.00	0.45	(1)
	3000	34.35	34.35	0.00	0.45	(1)
	8000	91.60	91.60	0.00	0.45	(1)
Crossarm Alignment (°)		87.0	87.0	0.0	5.0	(2)
WS start torque (gm-cm)		1.0	t<1.0	N/A	1.0	(3)
WD (degrees)	Clockwise	0.0	0.1	0.1	5.0	(1)
		90.0	89.3	0.7	5.0	(1)
		180.0	179.7	0.3	5.0	(1)
		270.0	270.4	0.4	5.0	(1)
	Counter Clockwise	0.0	0.1	0.1	5.0	(1)
		90.0	89.6	0.4	5.0	(1)
		180.0	179.7	0.3	5.0	(1)
		270.0	270.4	0.4	5.0	(1)
WD start torque (gm-cm)	Clockwise	11.0	t<11.0	N/A	11.0	(3)
	Counter Clockwise	11.0	t<11.0	N/A	11.0	(3)
Temperature (°F)		130.0	129.6	0.4	0.9	(1)
		66.2	66.2	0.0	0.9	(1)
		31.9	32.1	0.2	0.9	(1)
Precipitation (0.1" equiv.)		186.0	185.3	0.7	18.5	(1)
		179.4	185.3	5.9	18.5	(1)
		185.2	185.3	0.1	18.5	(1)
Pressure (in. Hg)		25.42	25.40	0.02	0.09	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorological Measurements Version 2.0, 2008
(3)= Manufacturer's Specifications

Notes, Recommendations

System taken offline at 08:01 MST and returned online at 08:33 MST.

Buckskin Mine Meteorological Station Audit Reports

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 10-Feb-97

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	CSci 107 thermistor with 6-plate shield	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Met One, Inc. 12 " tipping bucket	lab grade burette
Data acquisition system (DAS):	CSci CR-10 datalogger with storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.43	0.01	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.44	0.09	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<1.0	N/A	N/A	1.0	(3)
WD (degrees)		0.0	1.7	1.7	5.0	(1)
		90.0	89.0	1.0	5.0	(1)
		180.0	179.0	1.0	5.0	(1)
		270.0	271.0	1.0	5.0	(1)
WD start torque, CW (gm-cm)		N/A	N/A	N/A	9.0	(3)
WD start torque, CCW (gm-cm)		N/A	N/A	N/A	9.0	(3)
Temperature (°F)	ambient	68.0	68.5	0.5	1.8	(1)
	ice bath	32.0	32.0	0.0	1.8	(1)
	warm bath	109.4	109.4	0.0	1.8	(1)
Precipitation (0.05" equiv.)		92.7	94	1.3	9.3	(1)
		92.7	93	0.3	9.3	(1)
		92.7	95	2.3	9.3	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

Replaced wind speed bearings.
Inaccurate styrofoam propeller on anemometer, replaced with correct propeller on 2/17/96.
Heater in precipitation gauge not working.
System taken off-line at 1545 MST -- returned on-line at 1645 MST

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 13-Aug-97

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	CSI 107 thermistor with 6-plate shield	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Met One, Inc. 12 " tipping bucket	lab grade burette
Data acquisition system (DAS):	CSI CR-10 datalogger with storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	5.0	5.0	5.0	(1)
		90.0	90.0	0.0	5.0	(1)
		180.0	180.0	0.0	5.0	(1)
		270.0	270.0	0.0	5.0	(1)
WD start torque, CW (gm-cm)		OK	N/A	N/A	9.0	(3)
WD start torque, CCW (gm-cm)		OK	N/A	N/A	9.0	(3)
Temperature (°F)	ambient	70.6	72.9	**2.3**	1.8	(1)
	ice bath	32.0	32.2	0.2	1.8	(1)
	warm bath	91.3	91.2	0.1	1.8	(1)
Precipitation (0.08" equiv.)		148.3	85.8	**62.5**	14.8	(1)
		148.3	81.0	**67.3**	14.8	(1)
		148.3	82.4	**65.9**	14.8	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System taken off-line at 1530 MST -- returned on-line at 1558MST
Day was sunny and still, ambient temperature reading difference of 2.3°F is not out of control
Precipitation gauge was found to be greatly overestimating precipitation. Gauge was dissassembled and one bucket was found to be filled with a sticky dirt, throwing the balance off the tipping buckets. Gauge was cleaned, and then found to be measuring accurately. It is not known how long gauge was dirty, and overestimating precipitation.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 19-Mar-98

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	CSI 107 thermistor with 6-plate shield	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Met One, Inc. 12 " tipping bucket	lab grade burette
Data acquisition system (DAS):	CSI CR-10 datalogger with storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.43	0.08	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.0	0.0	5.0	(1)
		90.0	90.2	0.2	5.0	(1)
		180.0	179.4	0.6	5.0	(1)
		270.0	271.0	1.0	5.0	(1)
WD start torque, CW (gm-cm)		OK	N/A	N/A	9.0	(3)
WD start torque, CCW (gm-cm)		OK	N/A	N/A	9.0	(3)
Temperature (°F)	ambient	33.1	33.4	0.3	1.8	(1)
	ice bath	32.0	32.5	0.5	1.8	(1)
	warm bath	103.5	104.2	0.7	1.8	(1)
Precipitation (0.04" equiv.)		74.1	76.0	1.9	7.4	(2)
		74.1	74.0	0.1	7.4	(2)
		74.1	74.0	0.1	7.4	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System taken off-line at 1553 MST -- returned on-line at 1625 MST
Installed new wind speed bearings
2.29" precipitation since last reset

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 28-Sep-98

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	CSI 107 thermistor with 6-plate shield	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Met One, Inc. 12 " tipping bucket	lab grade burette
Data acquisition system (DAS):	CSI CR-10 datalogger with storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	2.9	2.9	5.0	(1)
		90.0	89.5	0.5	5.0	(1)
		180.0	180.8	0.8	5.0	(1)
		270.0	272.0	2.0	5.0	(1)
WD start torque, CW (gm-cm)		OK	N/A	N/A	9.0	(3)
WD start torque, CCW (gm-cm)		OK	N/A	N/A	9.0	(3)
Temperature (°F)	ambient	68.4	68.0	0.4	1.8	(1)
	ice bath	32.0	33.2	1.2	1.8	(1)
	warm bath	90.0	89.6	0.4	1.8	(1)
Precipitation (0.04" equiv.)		74.1	74.0	0.1	7.4	(2)
		74.1	74.0	0.1	7.4	(2)
		74.1	74.0	0.1	7.4	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System taken off-line at 0840 MST -- returned on-line at 0903 MST

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 9-Mar-99

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	CSI 107 thermistor with 6-plate shield	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Met One, Inc. 12 " tipping bucket	lab grade burette
Data acquisition system (DAS):	CSI CR-10 datalogger with storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	2.0	2.0	5.0	(1)
		90.0	90.0	0.0	5.0	(1)
		180.0	178.0	2.0	5.0	(1)
		270.0	269.0	1.0	5.0	(1)
WD start torque, CW (gm-cm)		OK	N/A	N/A	9.0	(3)
WD start torque, CCW (gm-cm)		OK	N/A	N/A	9.0	(3)
Temperature (°F)	ambient	41.7	41.6	0.1	1.8	(1)
	ice bath	34.5	34.3	0.2	1.8	(1)
	warm bath	69.9	70.5	0.6	1.8	(1)
Precipitation (0.04" equiv.)		74.1	73.5	0.6	7.4	(2)
		74.1	75.0	0.9	7.4	(2)
		74.1	75.0	0.9	7.4	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System taken off-line at 1620 MST -- returned on-line at 1655 MST
Time was 15 minutes too slow

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 23-Sep-99

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	CSI 107 thermistor with 6-plate shield	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Met One, Inc. 12 " tipping bucket	lab grade burette
Data acquisition system (DAS):	CSI CR-10 datalogger with storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	1.0	1.0	5.0	(1)
		90.0	89.0	1.0	5.0	(1)
		180.0	179.0	1.0	5.0	(1)
		270.0	269.7	0.3	5.0	(1)
WD start torque, CW (gm-cm)		OK	N/A	N/A	9.0	(3)
WD start torque, CCW (gm-cm)		OK	N/A	N/A	9.0	(3)
Temperature (°F)	ambient	82.2	82.1	0.1	1.8	(1)
	ice bath	40.8	40.9	0.1	1.8	(1)
	warm bath	87.0	86.8	0.2	1.8	(1)
Precipitation (0.04" equiv.)		74.1	74.0	0.1	7.4	(2)
		74.1	75.0	0.9	7.4	(2)
		74.1	74.0	0.1	7.4	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed in EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System taken off-line at 1605 MST -- returned on-line at 1640 MST
2.43" precipitation since last reset

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 16-Mar-00

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	CSI 107 thermistor with 6-plate shield	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Met One, Inc. 12 " tipping bucket	lab grade burette
Data acquisition system (DAS):	CSI CR-10 datalogger with storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.5	0.5	5.0	(1)
		90.0	89.2	0.8	5.0	(1)
		180.0	179.5	0.5	5.0	(1)
		270.0	270.3	0.3	5.0	(1)
WD start torque, CW (gm-cm)		OK	N/A	N/A	9.0	(3)
WD start torque, CCW (gm-cm)		OK	N/A	N/A	9.0	(3)
Temperature (°F)	ambient	50.2	50.1	0.1	1.8	(1)
	ice bath	32.0	32.4	0.4	1.8	(1)
	warm bath	111.0	110.8	0.2	1.8	(1)
Precipitation (0.04" equiv.)		74.1	75.0	0.9	7.4	(2)
		74.1	75.0	0.9	7.4	(2)
		74.1	75.0	0.9	7.4	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System taken off-line at 1655 MST -- returned on-line at 1730 MST
Replaced tail and wind speed bearings.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Buckskin Mine
Audit Date:	13-Sep-00

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	CSI 107 thermistor with 6-plate shield	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Met One, Inc. 12 " tipping bucket	lab grade burette
Data acquisition system (DAS):	CSI CR-10 datalogger with storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	211.0	**211.0**	5.0	(1)
		90.0	230.0	**140.0**	5.0	(1)
		180.0	250.0	**70.0**	5.0	(1)
		270.0	273.0	3.0	5.0	(1)
WD start torque, CW (gm-cm)		OK	N/A	N/A	9.0	(3)
WD start torque, CCW (gm-cm)		OK	N/A	N/A	9.0	(3)
Temperature (°F)	ambient	74.5	74.3	0.2	1.8	(1)
	ice bath	32.0	32.9	0.9	1.8	(1)
	warm bath	101.1	100.9	0.2	1.8	(1)
Precipitation (0.04" equiv.)		74.1	76.8	2.7	7.4	(2)
		74.1	74.7	0.6	7.4	(2)
		74.1	74.4	0.3	7.4	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

Notes, Recommendations

System taken off-line at 0801 MST -- returned on-line at 1339 MST
A new PROM upgrading the logger software capabilities was installed in the logger
The system evidentally had taken a lightining strike sometime prior to arrival
Precipitation was not being recorded by logger, and wind direction was not working
Bypassing the "fried" signal surge protection corrected the lack of a precipitation signal reaching the logger
New signal surge protection will be installed during an upcoming visit
Replacement of the wind direction potentiometer an vertical wind direction bearings fixed the erroneous wind direction readings
All sensors were audited again and operating properly at the conclusion of the service

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Buckskin Mine
Audit Date:	10-Mar-04
Audit Performed by:	J. Rogers, K. Jahnke - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	CSI 107 thermistor with 6-plate shield	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Met One, Inc. 12 " tipping bucket	lab grade burette
Data acquisition system (DAS):	CSI CR-10 datalogger with storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.1	0.1	5.0	(1)
		90.0	90.8	0.8	5.0	(1)
		180.0	180.7	0.7	5.0	(1)
		270.0	270.4	0.4	5.0	(1)
WD start torque, CW (gm-cm)		OK	N/A	N/A	9.0	(3)
WD start torque, CCW (gm-cm)		OK	N/A	N/A	9.0	(3)
Temperature (°F)	ambient	38.7	38.4	0.3	1.8	(1)
	ice bath	32.1	32.4	0.3	1.8	(1)
	warm bath	74.2	73.0	1.2	1.8	(1)
Precipitation (0.04" equiv.)		74.1	73.2	0.9	7.4	(2)
		74.1	74.2	0.1	7.4	(2)
		74.1	74.4	0.3	7.4	(2)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

Notes, Recommendations

System taken off-line at 1337 -- returned on-line at 1403.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Buckskin Mine
Audit Date:	2-Sep-04
Audit Performed by:	T. Shaw, W. Adler - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	transit, compass
Temperature (T):	CSI 107 thermistor with 6-plate shield	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Met One, Inc. 12 " tipping bucket	lab grade burette
Data acquisition system (DAS):	CSI CR-10 datalogger with storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.20	0.40	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.2	0.2	5.0	(1)
		90.0	90.0	0.0	5.0	(1)
		180.0	180.1	0.1	5.0	(1)
		270.0	270.1	0.1	5.0	(1)
WD start torque, CW (gm-cm)		OK	N/A	N/A	9.0	(3)
WD start torque, CCW (gm-cm)		OK	N/A	N/A	9.0	(3)
Temperature (°F)	ambient	74.4	73.4	1.0	1.8	(1)
	ice water bath	32.8	32.7	0.1	1.8	(1)
	warm water bath	111.3	111.2	0.1	1.8	(1)
Precipitation (0.04" equiv.)		74.1	75.4	1.3	7.4	(2)
		74.1	75.8	1.7	7.4	(2)
		74.1	74.4	0.3	7.4	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

Notes, Recommendations

System taken off-line at 1551 – returned on-line at 1612.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 31-Mar-05
Audit Performed by: K. Jahnke, D. Tarver - *inl Air Science*

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Precipitation (Ppt.):	Met One 12" tipping bucket with wind screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.1	0.1	5.0	(1)
		90.0	90.0	0.0	5.0	(1)
		180.0	180.8	0.8	5.0	(1)
		270.0	271.4	1.4	5.0	(1)
WD start torque (gm-cm)		t<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ambient	47.0	46.9	0.1	1.8	(1)
	ice water bath	33.7	32.7	1.0	1.8	(1)
	warm water bath	84.5	84.5	0.0	1.8	(1)
Precipitation (0.04" equiv.)		75.0	74.1	0.9	7.4	(1)
		73.8	74.1	0.3	7.4	(1)
		76.2	74.1	2.1	7.4	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1601 -- returned on-line at 1700.
Replaced tail and wind speed bearings.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 30-Sep-05
Audit Performed by: B. Hanewald, T. Shaw - *iml Air Science*

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Precipitation (Ppt.):	Met One 12" tipping bucket with wind screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	-0.5	0.5	5.0	(1)
		90.0	89.9	0.1	5.0	(1)
		180.0	179.8	0.2	5.0	(1)
		270.0	271.8	1.8	5.0	(1)
WD start torque (gm-cm)		t<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ambient	84.5	83.6	0.9	1.8	(1)
	ice water bath	44.8	45.3	0.5	1.8	(1)
	warm water bath	86.6	87.0	0.4	1.8	(1)
Precipitation (0.04" equiv.)		74.8	74.1	0.7	7.4	(1)
		74.6	74.1	0.5	7.4	(1)
		73.8	74.1	0.3	7.4	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1410 -- returned on-line at 1432.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 7-Mar-06
Audit Performed by: B. Hanewald, T. Shaw - *iml Air Science*

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Precipitation (Ppt.):	Met One 12" tipping bucket with wind screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.6	0.6	5.0	(1)
		90.0	90.4	0.4	5.0	(1)
		180.0	179.9	0.1	5.0	(1)
		270.0	270.5	0.4	5.0	(1)
WD start torque (gm-cm)		t<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ambient	50.6	49.2	1.4	1.8	(1)
	ice water bath	81.3	80.6	0.7	1.8	(1)
	warm water bath	38.2	38.2	0.0	1.8	(1)
Precipitation (0.04" equiv.)		73.0	74.1	1.1	7.4	(1)
		74.0	74.1	0.1	7.4	(1)
		74.0	74.1	0.1	7.4	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1440 -- returned on-line at 1512.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 1-Aug-06
Audit Performed by: K. Jahnke & S. Engel - *iml Air Science*

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Precipitation (Ppt.):	Met One 12" tipping bucket with wind screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.2	0.2	5.0	(1)
		90.0	90.1	0.1	5.0	(1)
		180.0	180.2	0.2	5.0	(1)
		270.0	270.1	0.1	5.0	(1)
WD start torque (gm-cm)		t<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ice water bath	33.6	34.3	0.7	1.8	(1)
	warm water bath	70.7	70.9	0.2	1.8	(1)
	hot water bath	115.1	114.7	0.4	1.8	(1)
Precipitation (0.04" equiv.)		74.0	74.1	0.1	7.4	(1)
		74.6	74.1	0.5	7.4	(1)
		74.4	74.1	0.3	7.4	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1009 MST -- returned on-line at 1110 MST.
7 mice found living in logger enclosure. Fixed entry point of enclosure. Prop on RM Young was dinged up a little bit and will need to be replaced next time it is audited.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Buckskin Mine
Audit Date:	23-Mar-07
Audit Performed by:	K. Jahnke & S. Engel - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Precipitation (Ppt.):	Met One 12" tipping bucket with wind screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.5	0.5	5.0	(1)
		90.0	90.5	0.5	5.0	(1)
		180.0	179.9	0.1	5.0	(1)
		270.0	269.9	0.1	5.0	(1)
WD start torque (gm-cm)		t<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ice water bath	32.4	32.5	0.1	1.8	(1)
	warm water bath	52.6	52.8	0.2	1.8	(1)
	hot water bath	116.9	117.4	0.5	1.8	(1)
Precipitation (0.04" equiv.)		191.6	185.2	6.4	18.5	(1)
		194.8	185.2	9.6	18.5	(1)
		191.6	185.2	6.4	18.5	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 0849 MDT -- returned on-line at 0945 MDT.
Prop was replaced
Reloaded program and Adjusted time

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Buckskin Mine
Audit Date:	10-Jul-07
Audit Performed by:	K. Jahnke & S. Engel - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Precipitation (Ppt.):	Met One 12" tipping bucket with wind screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.1	0.1	5.0	(1)
		90.0	90.1	0.1	5.0	(1)
		180.0	180.6	0.6	5.0	(1)
		270.0	270.6	0.6	5.0	(1)
WD start torque (gm-cm)		t<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ice water bath	33.2	33.2	0.0	1.8	(1)
	warm water bath	70.5	70.2	0.3	1.8	(1)
	hot water bath	115.8	114.7	1.1	1.8	(1)
Precipitation (0.04" equiv.)		186.0	185.2	0.8	18.5	(1)
		185.8	185.2	0.6	18.5	(1)
		185.8	185.2	0.6	18.5	(1)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 0847 MST -- returned on-line at 0922 MST.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Buckskin Mine
Audit Date:	12-Mar-08
Audit Performed by:	C. Medill & S. Hansen - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Precipitation (Ppt.):	Met One 12" tipping bucket with wind screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.8	0.8	5.0	(1)
		90.0	90.1	0.1	5.0	(1)
		180.0	180.4	0.4	5.0	(1)
		270.0	269.8	0.2	5.0	(1)
WD start torque (gm-cm)		t<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ice water bath	42.4	42.5	0.1	1.8	(1)
	warm water bath	75.7	75.8	0.1	1.8	(1)
	hot water bath	90.9	90.8	0.1	1.8	(1)
Precipitation (0.04" equiv.)		191.4	185.2	6.2	18.5	(1)
		187.2	185.2	2.0	18.5	(1)
		190.2	185.2	5.0	18.5	(1)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 2030 MST -- returned on-line at 2106 MST.

Replaced broken CS107 temp probe.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Buckskin Mine
Audit Date:	3-Sep-08
Audit Performed by:	S. Hansen & K. Chartier - IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Precipitation (Ppt.):	Met One 12" tipping bucket with wind screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.0	0.0	5.0	(1)
		90.0	89.0	1.0	5.0	(1)
		180.0	182.0	2.0	5.0	(1)
		270.0	269.0	1.0	5.0	(1)
WD start torque (gm-cm)		t<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ice water bath	32.1	31.9	0.2	0.9	(1)
	warm water bath	59.2	59.3	0.1	0.9	(1)
	hot water bath	86.2	85.8	0.4	0.9	(1)
Precipitation (0.01" equiv.)		201.4	185.2	16.2	18.5	(1)
		195.5	185.2	10.3	18.5	(1)
		196.0	185.2	10.8	18.5	(1)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1339 MST & returned on-line at 1420 MST

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Buckskin Mine
Audit Date:	20-Mar-09
Audit Performed by:	R. Campbell, J. Goldsmith - IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor
Precipitation (Ppt.):	Met One 12" tipping bucket with wind screen	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.2	0.2	5.0	(1)
		90.0	90.5	0.5	5.0	(1)
		180.0	179.7	0.3	5.0	(1)
		270.0	270.4	0.4	5.0	(1)
WD start torque (gm-cm)		t<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ice water bath	36.8	36.9	0.1	0.9	(1)
	warm water bath	66.5	65.9	0.6	0.9	(1)
	hot water bath	87.5	87.1	0.4	0.9	(1)
Precipitation (0.01" equiv.)		191.6	185.2	6.4	18.5	(1)
		192.9	185.2	7.7	18.5	(1)
		191.0	185.2	5.8	18.5	(1)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989

(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1236 MST & returned on-line at 1248 MST

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 9-Sep-09
Audit Performed by: R. Campbell, C. Medill - IML Air Science

Sensor	Mfr./Model	Reference Device	Serial ID
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor	IML 0895
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass	IML 0895
Temperature (T):	Fenwal 107	Hg-in-glass thermometer, or thermistor	IML 0888
Precipitation (Ppt.):	Met One 12" tipping bucket with wind screen	lab grade burette	N/A
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.8	0.8	5.0	(1)
		90.0	90.4	0.4	5.0	(1)
		180.0	179.9	0.1	5.0	(1)
		270.0	270.6	0.6	5.0	(1)
WD start torque (gm-cm)		t<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ice water bath	32.9	33.0	0.1	0.9	(1)
	warm water bath	74.5	74.4	0.1	0.9	(1)
	hot water bath	108.2	107.9	0.3	0.9	(1)
Precipitation (0.01" equiv.)		191.4	185.2	6.2	18.5	(1)
		192.0	185.2	6.8	18.5	(1)
		189.0	185.2	3.8	18.5	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 1022 MST and returned on-line at 1055 MST

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 9-Mar-10
Audit Performed by: R. Campbell, S. Warner -- IML Air Science

Sensor	Mfr./Model	Reference Device	Serial ID
Wind Speed (WS):	R.M. Young Wind Monitor AQ	quartz referenced drive motor	IML 0896
Wind Direction (WD):	R.M. Young Wind Monitor AQ	transit, compass	
Temperature (T):	Fenwal 107	Hg-in-glass thermometer	IML 1402
Precipitation (Ppt.):	Met One 12" tipping bucket with wind screen	lab grade burette	N/A
Data acquisition system (DAS):	Campbell Scientific CR-10X & storage module	N/A	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		t<0.2	N/A	N/A	1.0	(3)
WD (degrees)		0.0	0.9	0.9	5.0	(1)
		90.0	90.4	0.4	5.0	(1)
		180.0	179.2	0.8	5.0	(1)
		270.0	270.0	0.0	5.0	(1)
WD start torque (gm-cm)		t<11.0	N/A	N/A	11.0	(3)
Temperature (°F)	ice water bath	32.8	32.6	0.2	0.9	(1)
	warm water bath	54.2	54.7	0.5	0.9	(1)
	hot water bath	64.1	63.9	0.1	0.9	(1)
Precipitation (0.01" equiv.)		188.2	185.2	3.0	18.5	(1)
		189.4	185.2	4.2	18.5	(1)
		187.8	185.2	2.6	18.5	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 15:28 MST and returned on-line at 16:09 MST
Changed wind speed bearings.

After Adjustment

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.44	3.44	0.00	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.60	91.60	0.00	4.58	(1)
WD (degrees)	0.0	0.1	0.1	5.0	(1)
	90.0	90.3	0.3	5.0	(1)
	180.0	180.1	0.1	5.0	(1)
	270.0	269.9	0.1	5.0	(1)

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 17-Sep-10
Audit Performed By: S. Hansen, T. Mendenhall -- IML Air Science

Sensor	Mfr./Model	Serial Number	Reference Device	Serial ID
Wind Speed (WS):	R.M. Young Wind Monitor AQ	37074	quartz drive motor	IML 1407
Wind Direction (WD):	R.M. Young Wind Monitor AQ	37074	transit, compass	IML 1405
Temperature (T):	Fenwal 107	N/A	Hg-in-glass thermometer	IML 1402
Precipitation (Ppt.):	Met One 12" tipping bucket	Illegible	lab grade burette	N/A
Data acquisition system (DAS):	Campbell Scientific CR-10X	19256	N/A	N/A

Audit Results

	Reference RPM	Reference MPH	DAS Value	|Difference|	Specification	
WS (mph)	0	0.00	0.00	0.00	0.56	(1)
	300	3.44	3.44	0.00	0.56	(1)
	800	9.16	9.16	0.00	0.56	(1)
	3000	34.35	34.35	0.00	1.72	(1)
	8000	91.60	91.60	0.00	4.58	(1)
Crossarm Alignment (°)		3.0	3.2	0.2	5.0	(2)
WS start torque (gm-cm)		1.0	t<1.0	N/A	1.0	(3)
WD (°)	Clockwise	0.0	0.1	0.1	5.0	(1)
		90.0	89.6	0.4	5.0	(1)
		180.0	179.4	0.6	5.0	(1)
		270.0	269.8	0.2	5.0	(1)
	Counter Clockwise	0.0	0.2	0.2	5.0	(1)
		90.0	90.5	0.5	5.0	(1)
		180.0	180.7	0.7	5.0	(1)
		270.0	269.2	0.8	5.0	(1)
WD start torque (gm-cm)	Clockwise	11.0	t<11.0	N/A	11.0	(3)
	Counter Clockwise	11.0	t<11.0	N/A	11.0	(3)
Temperature (°F)		32.5	31.9	0.6	0.9	(1)
		127.8	127.2	0.6	0.9	(1)
		68.4	67.9	0.4	0.9	(1)
Precipitation (0.01" equiv.)		189.2	185.2	4.0	18.5	(1)
		190.4	185.2	5.2	18.5	(1)
		186.0	185.2	0.8	18.5	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorlogical Measurements Version 2.0, 2008
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 08:30 MST and returned on-line at 09:22 MST

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 10-Mar-11
Audit Performed By: T. Mendenhall -- IML Air Science

Sensor	Mfr./Model	Serial Number	Reference Device	Serial ID
Wind Speed (WS):	R.M. Young Wind Monitor AQ	37074	quartz drive motor	IML 1407
Wind Direction (WD):	R.M. Young Wind Monitor AQ	37074	transit, compass	IML 1405
Temperature (T):	Fenwal 107	N/A	digital thermistor	IML 0885
Precipitation (Ppt.):	Met One 12" tipping bucket	Illegible	lab grade burette	N/A
Data acquisition system (DAS):	Campbell Scientific CR-10X	19256	N/A	N/A

Audit Results

	Reference RPM	Reference MPH	DAS Value	|Difference|	Specification	
WS (mph)	0	0.00	0.00	0.00	0.45	(1)
	300	3.44	3.44	0.00	0.45	(1)
	800	9.16	9.16	0.00	0.45	(1)
	3000	34.35	34.35	0.00	0.45	(1)
	8000	91.60	91.60	0.00	0.45	(1)
Crossarm Alignment (°)		194.0	192.5	1.5	5.0	(2)
WS start torque (gm-cm)		1.0	t<1.0	N/A	1.0	(3)
WD (°)	Clockwise	0.0	0.1	0.1	5.0	(1)
		90.0	90.0	0.0	5.0	(1)
		180.0	178.8	1.2	5.0	(1)
		270.0	268.8	1.2	5.0	(1)
	Counter Clockwise	0.0	0.2	0.2	5.0	(1)
		90.0	90.4	0.4	5.0	(1)
		180.0	180.1	0.1	5.0	(1)
		270.0	270.9	0.9	5.0	(1)
WD start torque (gm-cm)	Clockwise	11.0	t<11.0	N/A	11.0	(3)
	Counter Clockwise	11.0	t<11.0	N/A	11.0	(3)
Temperature (°F)		34.0	34.2	0.2	0.9	(1)
		84.0	83.9	0.1	0.9	(1)
		117.3	117.5	0.2	0.9	(1)
Precipitation (0.01" equiv.)		188.8	185.2	3.6	18.5	(1)
		187.4	185.2	2.2	18.5	(1)
		187.8	185.2	2.6	18.5	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorlogical Measurements Version 2.0, 2008
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken offline at 09:09 MST and returned online at 09:55 MST.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Buckskin Mine
Audit Date: 16-Sep-11
Audit Performed By: C. Cottom, J. Masters -- IML Air Science

Sensor	Mfr./Model	Serial Number	Reference Device	Serial ID
Wind Speed (WS):	R.M. Young Wind Monitor AQ	37074	quartz drive motor	IML 0896
Wind Direction (WD):	R.M. Young Wind Monitor AQ	37074	transit, compass	IML 0894
Temperature (T):	Fenwal 107	N/A	digital thermistor	IML 1411
Precipitation (Ppt.):	Met One 12" tipping bucket	Illegible	lab grade burette	N/A
Data acquisition system (DAS):	Campbell Scientific CR-10X	19256	N/A	N/A

Audit Results

	Reference RPM	Reference MPH	DAS Value	|Difference|	Specification	
WS (mph)	0	0.00	0.00	0.00	0.45	(1)
	300	3.44	3.44	0.00	0.45	(1)
	800	9.16	9.16	0.00	0.45	(1)
	3000	34.35	34.35	0.00	0.45	(1)
	8000	91.60	91.60	0.00	0.45	(1)
Crossarm Alignment (°)		189.0	191.0	2.0	5.0	(2)
WS start torque (gm-cm)		1.0	t<1.0	N/A	1.0	(3)
WD (°)	Clockwise	0.0	0.2	0.2	5.0	(1)
		90.0	90.4	0.4	5.0	(1)
		180.0	179.8	0.2	5.0	(1)
		270.0	270.0	0.0	5.0	(1)
	Counter Clockwise	0.0	0.1	0.1	5.0	(1)
		90.0	90.8	0.8	5.0	(1)
		180.0	179.2	0.8	5.0	(1)
		270.0	269.3	0.7	5.0	(1)
WD start torque (gm-cm)	Clockwise	11.0	t<11.0	N/A	11.0	(3)
	Counter Clockwise	11.0	t<11.0	N/A	11.0	(3)
Temperature (°F)		0.7	0.8	0.1	0.9	(1)
		24.0	23.4	0.6	0.9	(1)
		42.7	42.4	0.3	0.9	(1)
Precipitation (0.01" equiv.)		172.0	185.2	13.2	18.5	(1)
		184.2	185.2	1.0	18.5	(1)
		185.0	185.2	0.2	18.5	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorlogical Measurements Version 2.0, 2008
(3)= Manufacturer's Specifications

Notes, Recommendations

System was taken off-line at 13:13 MST and returned on-line at 13:42 MST.

Dry Fork Mine Meteorological Station Audit Reports

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 16-May-97

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 064-2, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Met One 12" tipping bucket	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR 10 w/ storage module	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.44	3.43	0.01	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.6	91.6	0.00	4.58	
WS start torque (gm-cm)	t<1.00	N/A	N/A	1.00	(3)
WD (degrees)	0.0	0.1	0.1	5.0	(1)
	90.0	90.7	0.7	5.0	(1)
	180.0	176.0	4.0	5.0	(1)
	270.0	270.2	0.2	5.0	(1)
WD start torque (gm-cm)	t<11.0	N/A	N/A	11.00	(3)
Temperature (C)	28.8	28.0	0.8	1.0	(1)
	2.5	3.0	0.5	1.0	(1)
	32.3	32.2	0.1	1.0	(1)
Precipitation (0.1" equiv.)	92.7	99.0	6.3	8.2	(1)
	92.7	96.3	3.6	8.2	(1)
	92.7	96.0	3.3	8.2	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System not operating upon arrival
Battery voltage at 13.4.
System off-line at 0800 MST and returned on-line at 1054 MST.
New datalogger installed with new program.
Installed new wind speed bearings.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 5-Nov-97

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 064-2, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Met One 12" tipping bucket	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR 10 w/ storage module	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.44	3.44	0.00	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.6	91.6	0.00	4.58	
WS start torque (gm-cm)	$\tau<0.2$	N/A	N/A	1.00	(3)
WD (degrees)	0.0	0.0	0.0	5.0	(1)
	90.0	91.0	1.0	5.0	(1)
	180.0	181.0	1.0	5.0	(1)
	270.0	270.0	0.0	5.0	(1)
WD start torque (gm-cm)	$\tau<5.0$	N/A	N/A	11.00	(3)
Temperature (°C)	16.0	16.1	0.1	1.0	(1)
	44.5	44.2	0.3	1.0	(1)
	9.0	9.3	0.3	1.0	(1)
Precipitation (0.1" equiv.)	92.7	92.0	0.7	8.2	(1)
	92.7	98.0	5.3	8.2	(1)
	92.7	95.0	2.3	8.2	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

Battery voltage at 13.9
System off-line at 1148 MST and returned on-line at 1255 MST.
Removed bug screen from ppt. gauge for winter

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 23-Jun-98

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 064-2, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Met One 12" tipping bucket	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR 10 w/ storage module	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.44	3.44	0.00	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.6	91.6	0.00	4.58	
WS start torque (gm-cm)	τ<0.2	N/A	N/A	1.00	(3)
WD (degrees)	0.0	0.2	0.2	5.0	(1)
	90.0	89.0	1.0	5.0	(1)
	180.0	178.0	2.0	5.0	(1)
	270.0	270.0	0.0	5.0	(1)
WD start torque (gm-cm)	τ<5.0	N/A	N/A	11.00	(3)
Temperature (°C)	26.5	25.6	0.9	1.0	(1)
	32.0	31.1	0.9	1.0	(1)
	0.0	1.6	1.6	1.0	(1)
Precipitation (0.1" equiv.)	74.1	73.0	1.1	8.2	(1)
	74.1	73.0	1.1	8.2	(1)
	74.1	74.0	0.1	8.2	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

Battery voltage at 13.39
System off-line at 1250 MST and returned on-line at 1317 MST.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 30-Dec-98

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 064-2, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Met One 12" tipping bucket	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR 10 w/ storage module	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.44	3.44	0.00	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.6	91.6	0.00	4.58	
WS start torque (gm-cm)	0.2<τ<0.3	N/A	N/A	1.00	(3)
WD (degrees)	0.0	1.0	1.0	5.0	(1)
	90.0	89.0	1.0	5.0	(1)
	180.0	180.0	0.0	5.0	(1)
	270.0	270.0	0.0	5.0	(1)
Temperature (°C)	-1.0	-1.0	0.0	1.0	(1)
	45.1	44.2	0.9	1.0	(1)
	0.1	0.0	0.1	1.0	(1)
Precipitation (0.1" equiv.)	74.1	69.0	5.1	8.2	(1)
	74.1	75.5	1.4	8.2	(1)
	74.1	75.8	1.7	8.2	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line at 0942 MST and returned on-line at 1031MST
Precipitation gauge heater not operable as found; breaker was turned off. Returned breaker to on position
Cleaned precipitation gauge

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 30-Jun-99

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR-21XL	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.44	3.44	0.00	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)	0.2<T<0.3	N/A	N/A	1.00	(3)
WD (degrees)	0.0	0.3	0.3	5.0	(1)
	90.0	89.3	0.7	5.0	(1)
	180.0	179.7	0.3	5.0	(1)
	270.0	271.8	1.8	5.0	(1)
Temperature (°C)	18.6	18.4	0.2	1.0	(1)
	0.0	0.8	0.8	1.0	(1)
	46.3	45.8	0.5	1.0	(1)
Precipitation (0.1" equiv.)	74.1	72.0	2.1	7.4	(1)
	74.1	72.0	2.1	7.4	(1)
	74.1	73.0	1.1	7.4	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line at 1117 MST and on-line at 1143 MST
31.781 since last reset
Battery voltage at 13.86

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 22-Jun-00

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 064-2, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Met One 12" tipping bucket	lab grade burette
Data acquisition system (DAS):	Campbell Scientific CR 10 w/ storage module	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.44	3.44	0.00	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.6	91.6	0.00	4.58	
WS start torque (gm-cm)	$0.2<\tau<0.3$	N/A	N/A	1.00	(3)
WD (degrees)	0.0	0.2	0.2	5.0	(1)
	90.0	89.8	0.2	5.0	(1)
	180.0	180.3	0.3	5.0	(1)
	270.0	269.8	0.2	5.0	(1)
Temperature (°C)	32.1	33.0	0.9	1.0	(1)
	0.3	0.8	0.5	1.0	(1)
	45.6	45.3	0.3	1.0	(1)
Precipitation (0.1" equiv.)	74.1	73.0	1.1	8.2	(1)
	74.1	74.0	0.1	8.2	(1)
	74.1	74.0	0.1	8.2	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line at 1530 MST and returned on-line at 1555MST.
Changed year on DAS from 9- to 00.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 27-Dec-00

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette
Data acquisition system:	Campbell Scientific CR-21XL	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.66	3.66	0.00	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)	0.2<T<0.3	N/A	N/A	1.00	(3)
WD (degrees)	0.0	1.4	1.4	5.0	(1)
	90.0	91.0	1.0	5.0	(1)
	180.0	181.0	1.0	5.0	(1)
	270.0	271.0	1.0	5.0	(1)
Temperature (°C)	6.0	6.3	0.3	1.0	(1)
	0.4	0.5	0.1	1.0	(1)
	20.2	20.1	0.1	1.0	(1)
Precipitation (0.1" equiv.)	74.1	74.0	0.1	7.4	(1)
	74.1	73.0	1.1	7.4	(1)
	74.1	73.0	1.1	7.4	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1989
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line at 1329 MST and on-line at 1358 MST
Battery voltage at 13.8

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 26-Jun-02
Audit Performed by: D. Black, W. Adler - *iml Air Science*

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette
Data acquisition system:	Campbell Scientific CR-21XL	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.44	3.44	0.00	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)	0.2<T<0.3	N/A	N/A	1.00	(3)
WD (degrees)	0.0	0.3	0.3	5.0	(1)
	90.0	90.0	0.0	5.0	(1)
	180.0	180.0	0.0	5.0	(1)
	270.0	271.0	1.0	5.0	(1)
Temperature (°C)	35.8	36.4	0.6	1.0	(1)
	0.6	1.3	0.7	1.0	(1)
	15.7	15.8	0.1	1.0	(1)
Precipitation (0.1" equiv.)	74.1	75.0	0.9	7.4	(1)
	74.1	71.4	2.7	7.4	(1)
	74.1	71.6	2.5	7.4	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line at 1551 MST and on-line at 1620 MST
Battery voltage at 13.092

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 12, Nov. 2002
Audit Performed by: S. Heil, T. Shaw - *iml Air Science*

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette
Data acquisition system:	Campbell Scientific CR-21XL	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.44	3.44	0.00	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)	0.2<T<0.3	N/A	N/A	1.00	(3)
WD (degrees)	0.0	0.0	0.0	5.0	(1)
	90.0	90.6	0.6	5.0	(1)
	180.0	180.0	0.0	5.0	(1)
	270.0	271.4	1.4	5.0	(1)
Temperature (°C)	35.8	34.8	1.0	1.0	(1)
	0.3	0.0	0.3	1.0	(1)
	3.9	4.1	0.2	1.0	(1)
Precipitation (0.1" equiv.)	74.1	74.4	0.3	7.4	(1)
	74.1	73.8	0.3	7.4	(1)
	74.1	74.2	0.1	7.4	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line at 1708 MST and on-line at 1744 MST
Battery voltage at 13.733

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 24-Apr-03
Audit Performed by: S. Heil, K. Jahnke - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette
Data acquisition system:	Campbell Scientific CR-21XL	N/A

Audit Results

	Reference	DAS Value	|Difference|	Specification	
WS (mph)	0.00	0.00	0.00	0.56	(1)
	3.44	3.44	0.00	0.56	(1)
	9.16	9.16	0.00	0.56	(1)
	34.35	34.35	0.00	1.72	(1)
	91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)	0.2<T<0.3	N/A	N/A	1.00	(3)
WD (degrees)	0.0	0.1	0.1	5.0	(1)
	90.0	89.9	0.1	5.0	(1)
	180.0	180.1	0.1	5.0	(1)
	270.0	270.0	0.0	5.0	(1)
Temperature (°C)	N/A	N/A	NA	1.0	(1)
	N/A	N/A	N/A	1.0	(1)
	N/A	N/A	N/A	1.0	(1)
Precipitation (0.1" equiv.)	74.1	70.6	3.5	7.4	(1)
	74.1	72.2	1.9	7.4	(1)
	74.1	72.4	1.7	7.4	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line at 1800 MST and on-line at 1834 MST
Battery voltage at 13.660
Met One temperature sensor was broken during the audit and will require replacement.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Dry Fork Coal Company
Audit Date:	15-Oct-03
Audit Performed by:	T. Shaw, K. Jahnke - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette
Data acquisition system:	Campbell Scientific CR-21XL	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		0.2<T<0.3	N/A	N/A	1.00	(3)
WD (degrees)		0.0	0.3	0.3	5.0	(1)
		90.0	90.1	0.1	5.0	(1)
		180.0	180.2	0.2	5.0	(1)
		270.0	270.3	0.3	5.0	(1)
Temperature (°C)	ambient	12.6	12.5	0.1	1.0	(1)
	ice bath	0.5	1.6	1.1	1.0	(1)
	warm bath	24.2	24.0	0.2	1.0	(1)
Precipitation (0.1" equiv.)		72.8	74.1	1.3	7.4	(1)
		72.2	74.1	1.9	7.4	(1)
		73.2	74.1	0.9	7.4	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line at 1443 MST and on-line at 1505 MST
Battery voltage at 13.685
Replaced propeller

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 11-Jun-04
Audit Performed by: T. Shaw, T. Mendenhall - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette
Data acquisition system:	Campbell Scientific CR-21XL	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.12	0.23	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		0.2<T<0.3	N/A	N/A	1.00	(3)
WD (degrees)		0.0	0.0	0.0	5.0	(1)
		90.0	91.8	1.8	5.0	(1)
		180.0	183.0	3.0	5.0	(1)
		270.0	270.0	0.0	5.0	(1)
Temperature (°C)	ambient	14.9	14.0	0.9	1.0	(1)
	ice bath	0.5	0.9	0.4	1.0	(1)
	warm bath	36.4	36.6	0.2	1.0	(1)
Precipitation (0.1" equiv.)		72.6	74.1	1.5	7.4	(1)
		72.4	74.1	1.7	7.4	(1)
		72.8	74.1	1.3	7.4	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

Notes, Recommendations

System on-line at 1235 MST
Precipitation bucket was not working upon arrival, adjusted reed switch & both set screws.
Precipitation bucket was working upon depature.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 19-Nov-04
Audit Performed by: D. Powers, K. Jahnke - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette
Data acquisition system:	Campbell Scientific CR-21XL	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)				0.00	0.56	(1)
				0.00	0.56	(1)
				0.00	0.56	(1)
				0.00	0.56	(1)
				0.00	0.56	(1)
WS start torque (gm-cm)		0.2<T<0.3	N/A	N/A	1.00	(3)
WD (degrees)				0.0	5.0	(1)
				0.0	5.0	(1)
				0.0	5.0	(1)
				0.0	5.0	(1)
Temperature (°C)	ambient			0.0	1.0	(1)
	ice bath			0.0	1.0	(1)
	warm bath			0.0	1.0	(1)
Precipitation (0.1" equiv.)		74.0	74.1	0.1	7.4	(1)
		74.0	74.1	0.1	7.4	(1)
		74.0	74.1	0.1	7.4	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line at 1200 MST, on-line at 1222 MST.
Installed new read switch on the precipitation bucket.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Dry Fork Coal Company
Audit Date:	14-Jun-05
Audit Performed by:	W. Adler, K. Jahnke - *inl Air Science*

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette
Data acquisition system:	Campbell Scientific CR-21XL	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		0.2<T<0.3	N/A	N/A	1.00	(3)
WD (degrees)		0.0	0.0	0.0	5.0	(1)
		90.0	89.8	0.2	5.0	(1)
		180.0	180.2	0.2	5.0	(1)
		270.0	270.9	0.9	5.0	(1)
Temperature (°C)	ambient	24.4	25.5	1.1	1.0	(1)
	ice bath	0.5	1.0	0.5	1.0	(1)
	warm bath	60.0	59.8	0.2	1.0	(1)
Precipitation (0.1" equiv.)		72.2	74.1	1.9	7.4	(1)
		71.8	74.1	2.3	7.4	(1)
		72.4	74.1	1.7	7.4	(1)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line at 1001 MST, on-line at 1119 MST.

The wind direction was not working upon arrival, stuck between 315 and 345 degrees.

Replaced the wind direction potentimometer, wind direction bearings, wind speed bearings, tail, and nose cone. System running following the repairs.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Dry Fork Coal Company
Audit Date:	12-Dec-05
Audit Performed by:	B. Hanewald, S. Hansen - iml Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette
Data acquisition system:	Campbell Scientific CR-21XL	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		0.2<T<0.3	N/A	N/A	1.00	(3)
WD (degrees)		0.0	0.6	0.6	5.0	(1)
		90.0	90.2	0.2	5.0	(1)
		180.0	179.3	0.7	5.0	(1)
		270.0	269.6	0.4	5.0	(1)
Temperature (°C)	ambient	2.3	2.9	0.6	1.0	(1)
	ice bath	0.3	0.8	0.5	1.0	(1)
	warm bath	13.2	13.0	0.2	1.0	(1)
Precipitation (0.1" equiv.)		73.2	74.1	0.9	7.4	(1)
		71.8	74.1	2.3	7.4	(1)
		71.6	74.1	2.5	7.4	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line at 1553 MST, on-line at 1627 MST.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Dry Fork Coal Company
Audit Date:	12-Apr-06
Audit Performed by:	S.Engel & T.Shaw--- IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette
Data acquisition system:	Campbell Scientific CR-21XL	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		0.2<T<0.3	N/A	N/A	1.00	(3)
WD (degrees)		0.0	0.2	0.2	5.0	(1)
		90.0	90.6	0.6	5.0	(1)
		180.0	181.0	1.0	5.0	(1)
		270.0	270.7	0.7	5.0	(1)
Temperature (°C)	ambient	21.6	20.2	**1.4**	1.0	(1)
	ice bath	2.2	1.2	1.0	1.0	(1)
	warm bath	49.8	48.9	0.9	1.0	(1)
Precipitation (0.1" equiv.)		69.8	74.1	4.3	7.4	(1)
		71.0	74.1	3.1	7.4	(1)
		70.8	74.1	3.3	7.4	(1)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line at 0925 MST, on-line at 0957 MST.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Dry Fork Coal Company
Audit Date:	20-Dec-06
Audit Performed by:	S.Engel & S. Hansen--- IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette
Data acquisition system:	Campbell Scientific CR-21XL	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		0.2<T<0.3	N/A	N/A	1.00	(3)
WD (degrees)		0.0	0.2	0.2	5.0	(1)
		90.0	89.7	0.3	5.0	(1)
		180.0	179.7	0.3	5.0	(1)
		270.0	270.4	0.4	5.0	(1)
Temperature (°C)	ambient	12.0	12.9	0.9	1.0	(1)
	ice bath	0.3	0.0	0.3	1.0	(1)
	warm bath	32.9	32.1	0.8	1.0	(1)
Precipitation (0.1" equiv.)		180.4	185.3	4.8	18.5	(1)
		179.4	185.3	5.8	18.5	(1)
		176.6	185.3	8.7	18.5	(1)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line at 1244 MST, on-line at 1317 MST.

Battery voltage was 14.18 v

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Dry Fork Coal Company
Audit Date:	20-Jun-07
Audit Performed by:	C. Medill & K. Jahnke--- IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette
Data acquisition system:	Campbell Scientific CR-10	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		0.2<T<0.3	N/A	N/A	1.00	(3)
WD (degrees)		0.0	0.6	0.6	5.0	(1)
		90.0	90.4	0.4	5.0	(1)
		180.0	179.8	0.2	5.0	(1)
		270.0	270.1	0.1	5.0	(1)
Temperature (°C)	hot bath	50.9	50.4	0.5	1.0	(1)
	ice bath	1.3	2.1	0.8	1.0	(1)
	warm bath	22.0	22.4	0.4	1.0	(1)
Precipitation (0.1" equiv.)		181.8	185.3	3.4	18.5	(1)
		177.0	185.3	8.3	18.5	(1)
		178.2	185.3	7.1	18.5	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line at 844 MST, on-line at 931 MST.
Tail on R.M. Young was not lined up with cuppler, WD was off by about 40 degrees.
Battery voltage was 11.033 v

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Dry Fork Coal Company
Audit Date:	20-Dec-07
Audit Performed by:	C. Medill & S. Hansen--- IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette
Data acquisition system:	Campbell Scientific CR-10	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.23	0.23	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		>.5	N/A	N/A	<0.5	(3)
WS (mph) after adjustment		0.00	0.23	0.23	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		0.2<T<0.3	N/A	N/A	<0.5	(3)
WD (degrees)		0.0	0.2	0.2	5.0	(1)
		90.0	89.4	0.6	5.0	(1)
		180.0	179.1	0.9	5.0	(1)
		270.0	270.3	0.3	5.0	(1)
Temperature (°C)	hot bath	35.6	35.9	0.3	1.0	(1)
	ice bath	0.1	0.6	0.5	1.0	(1)
	warm bath	20.3	20.2	0.1	1.0	(1)
Precipitation (0.1" equiv.)		175.7	185.3	9.6	18.5	(1)
		173.8	185.3	11.5	18.5	(1)
		173.6	185.3	11.7	18.5	(1)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line at 1602 MST, on-line at 1656 MST.
Start torque was greater than .5 gm-cm so bearings were replaced.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Dry Fork Coal Company
Audit Date:	20-Jun-08
Audit Performed by:	C. Medill & S. Engel--- IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette
Data acquisition system:	Campbell Scientific CR-10	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		>.5	N/A	N/A	<0.5	(3)
WD (degrees)		0.0	0.2	0.2	5.0	(1)
		90.0	89.8	0.2	5.0	(1)
		180.0	180.6	0.6	5.0	(1)
		270.0	270.6	0.6	5.0	(1)
Temperature (°C)	hot bath	47.0	46.6	0.4	1.0	(1)
	ice bath	1.2	1.2	0.0	1.0	(1)
	warm bath	3.9	4.3	0.4	1.0	(1)
Precipitation (0.1" equiv.)		196.4	185.3	11.2	18.5	(1)
		197.2	185.3	12.0	18.5	(1)
		185.4	185.3	0.2	18.5	(1)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line at 0743 MST, on-line at 0835 MST.
16 extra tips for adjustment to bucket.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station:	Dry Fork Coal Company
Audit Date:	14-Nov-08
Audit Performed by:	J. Goldsmith - R. Campbell --- IML Air Science

Sensor	Mfr./Model	Reference Device
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer, or t-couple
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette
Data acquisition system:	Campbell Scientific CR-10	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		>.5	N/A	N/A	<0.5	(3)
WD (degrees)		0.0	0.1	0.1	5.0	(1)
		90.0	88.5	1.5	5.0	(1)
		180.0	179.3	0.7	5.0	(1)
		270.0	270.0	0.0	5.0	(1)
Temperature (°C)	hot bath	30.2	30.2	0.0	1.0	(1)
	ice bath	-0.1	0.2	0.3	1.0	(1)
	warm bath	8.2	8.3	0.1	1.0	(1)
Precipitation (0.1" equiv.)		174.4	185.3	10.9	18.5	(1)
		173.7	185.3	11.6	18.5	(1)
		174.0	185.3	11.3	18.5	(1)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

Notes, Recommendations

System off-line at 0944 MST, on-line at 1105 MST.
No torque due to high winds

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 19-May-09
Audit Performed By: J. Goldsmith -- IML Air Science

Sensor	Mfr./Model	Reference Device	Serial ID
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor	IML 0943
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit	
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer	IML 1403
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette	N/A
Data acquisition system:	Campbell Scientific CR-10	N/A	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		>.5	N/A	N/A	<0.5	(3)
WD (degrees)		0.0	0.2	0.2	5.0	(1)
		90.0	90.7	0.7	5.0	(1)
		180.0	178.7	1.3	5.0	(1)
		270.0	270.7	0.7	5.0	(1)
Temperature (°C)	hot bath	37.1	36.9	0.1	1.0	(1)
	ice bath	0.6	1.0	0.4	1.0	(1)
	warm bath	22.0	22.4	0.4	1.0	(1)
Precipitation (0.1" equiv.)		183.3	185.3	1.9	18.5	(1)
		185.7	185.3	0.4	18.5	(1)
		186.0	185.3	0.8	18.5	(1)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

Notes, Recommendations

System taken offline at 07:34MST and returned online at 09:17 MST.
Changed wind speed bearings
Tipping bucket was broken off hinges, reset the precip bucket and then audited

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 7-Oct-09
Audit Performed By: J. Goldsmith, R. Campbell -- IML Air Science

Sensor	Mfr./Model	Reference Device	Serial ID
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor	IML 0896
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit	IML 0896
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer	IML 1403
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette	N/A
Data acquisition system:	Campbell Scientific CR-10	N/A	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		>.5	N/A	N/A	<0.5	(3)
WD (degrees)		0.0	0.1	0.1	5.0	(1)
		90.0	89.7	0.3	5.0	(1)
		180.0	179.0	1.0	5.0	(1)
		270.0	269.2	0.8	5.0	(1)
Temperature (°C)	hot bath	38.3	38.1	0.2	1.0	(1)
	ice bath	1.8	1.6	0.2	1.0	(1)
	warm bath	26.2	26.1	0.1	1.0	(1)
Precipitation (0.1" equiv.)		177.0	185.3	8.3	18.5	(1)
		177.4	185.3	7.8	18.5	(1)
		176.4	185.3	8.8	18.5	(1)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

Notes, Recommendations

System taken offline at 1125 MST and returned online at 1206 MST.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 9-Jun-10
Audit Performed By: R. Campbell, S. Warner -- IML Air Science

Sensor	Mfr./Model	Reference Device	Serial ID
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor	IML 0856
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit	
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer	IML 0885
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette	N/A
Data acquisition system:	Campbell Scientific CR-10	N/A	N/A

Audit Results

		Reference	DAS Value	|Difference|	Specification	
WS (mph)		0.00	0.00	0.00	0.56	(1)
		3.44	3.44	0.00	0.56	(1)
		9.16	9.16	0.00	0.56	(1)
		34.35	34.35	0.00	1.72	(1)
		91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		>.5	N/A	N/A	<0.5	(3)
WD (degrees)		0.0	1.1	1.1	5.0	(1)
		90.0	89.4	0.6	5.0	(1)
		180.0	179.9	0.2	5.0	(1)
		270.0	269.8	0.2	5.0	(1)
Temperature (°C)	Ice bath	2.8	3.1	0.3	1.0	(1)
	warm bath	22.2	22.0	0.2	1.0	(1)
	hot bath	36.8	36.6	0.2	1.0	(1)
Precipitation (0.1" equiv.)		183.8	185.3	1.4	18.5	(1)
		180.3	185.3	5.0	18.5	(1)
		179.9	185.3	5.4	18.5	(1)

BOLD difference values exceed performance specifications

(1)= Performance specification listed in facilities' Quality Assurance Project Plan

(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995

(3)= Manufacturer's Specifications

Notes, Recommendations

System taken offline at 14:53 MST and returned online at 16:02 MST.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 8-Dec-10
Audit Performed By: K. Jahnke, J. Rogers -- IML Air Science

Sensor	Mfr./Model	Reference Device	Serial ID
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor	IML 0896
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit	IML 0942
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer	T050906
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette	N/A
Data acquisition system:	Campbell Scientific CR-10	N/A	N/A

Audit Results

	Reference RPM	Reference MPH	DAS Value	|Difference|	Specification	
WS (mph)	0	0.00	0.00	0.00	0.56	(1)
	300	3.44	3.44	0.00	0.56	(1)
	800	9.16	9.16	0.00	0.56	(1)
	3000	34.35	34.35	0.00	1.72	(1)
	8000	91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		1.0	t<1.0	N/A	1.0	(3)
WD (degrees)		0.0	0.1	0.1	5.0	(1)
		90.0	90.2	0.2	5.0	(1)
		180.0	180.1	0.1	5.0	(1)
		270.0	270.4	0.4	5.0	(1)
Temperature (°C)		0.0	0.0	0.0	0.5	(1)
		68.4	68.0	0.4	0.5	(1)
		49.1	48.8	0.3	0.5	(1)
Precipitation (0.1" equiv.)		182.0	185.3	3.25	18.5	(1)
		184.5	185.3	0.75	18.5	(1)
		181.6	185.3	3.65	18.5	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

Notes, Recommendations

System taken offline at 12:18 MST and returned online at 12:55 MST.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Coal Company
Audit Date: 28-Apr-11
Audit Performed By: S. Hansen, Z. Heid -- IML Air Science

Sensor	Mfr./Model	Reference Device	Serial ID
Wind Speed (WS):	RM Young Wind Monitor AQ	quartz referenced drive motor	IML 1407
Wind Direction (WD):	RM Young Wind Monitor AQ	Brunton transit	IML 1405
Temperature (T):	Met ONE 2066, naturally aspirated	Hg-in-glass thermometer	IML 0885
Precipitation (Ppt.):	Sierra Misco 099R tipping bucket	lab grade burette	N/A
Data acquisition system:	Campbell Scientific CR-10	N/A	N/A

Audit Results

	Reference RPM	Reference MPH	DAS Value	|Difference|	Specification	
WS (mph)	0	0.00	0.00	0.00	0.56	(1)
	300	3.44	3.44	0.00	0.56	(1)
	800	9.16	9.16	0.00	0.56	(1)
	3000	34.35	34.35	0.00	1.72	(1)
	8000	91.60	91.60	0.00	4.58	(1)
WS start torque (gm-cm)		1.0	t<1.0	N/A	1.0	(3)
Crossarm Alignment		1.00	0.40	0.60	5.0	(3)
WD (degrees)	Clockwise	0.0	0.4	0.4	5.0	(1)
		90.0	90.3	0.3	5.0	(1)
		180.0	179.8	0.2	5.0	(1)
		270.0	269.7	0.3	5.0	(1)
	Counter Clockwise	0.0	0.2	0.2	5.0	(1)
		90.0	90.0	0.0	5.0	(1)
		180.0	179.1	0.9	5.0	(1)
		270.0	270.0	0.0	5.0	(1)
Temperature (°C)		1.6	1.4	0.2	0.5	(1)
		38.9	39.1	0.2	0.5	(1)
		16.1	16.5	0.4	0.5	(1)
Precipitation (0.1" equiv.)		185.2	185.3	0.05	18.5	(1)
		185.6	185.3	0.35	18.5	(1)
		185.0	185.3	0.25	18.5	(1)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Manual for
Air Pollution Measurement Systems, Vol. IV, 1995
(3)= Manufacturer's Specifications

Notes, Recommendations

System taken offline at 12:03 MST and returned online at 12:57 MST.
Temp probe needs replaced.

METEOROLOGICAL STATION AUDIT SUMMARY

Met Station: Dry Fork Mine
Audit Date: 16-Nov-11
Audit Performed By: C. Cottom, Z. Heid -- IML Air Science

Sensor	Mfr./Model	Serial Number	Reference Device	Serial/ID Number
Wind Speed (WS):	RM Young Wind Monitor AQ		quartz drive motor	IML 0855
Wind Direction (WD):	RM Young Wind Monitor AQ		transit, compass	IML 0894
Temperature @ 2 Meters:	RM Young 41342, power aspirated	TS20278	digital thermistor	IML 1402
Temperature @ 10 Meters:	RM Young 41342, power aspirated	TS20279	digital thermistor	IML 1402
Precipitation:	Sierra Misco 099R tipping bucket		lab grade burette	N/A
Data acquisition system:	CSI CR1000 Datalogger	43527	N/A	N/A

Audit Results

	Reference RPM	Reference m/sec	DAS Value	|Difference|	Specification	
WS (m/sec)	0	0.00	0.00	0.00	below threshold	
	300	1.54	1.54	0.00	0.20	(2)
	800	4.10	4.10	0.00	0.20	(2)
	3000	15.36	15.36	0.00	0.20	(2)
	8000	40.96	40.96	0.00	0.20	(2)
Crossarm Alignment		180.0	180.0	0.0	5.0	(2)
WS start torque (gm-cm)		1.0	t<1.0	N/A	1.0	(3)
WD (degrees)	Clockwise	0.0	0.1	0.1	5.0	(2)
		90.0	90.2	0.2	5.0	(2)
		180.0	180.1	0.1	5.0	(2)
		270.0	270.4	0.4	5.0	(2)
	Counter clockwise	0.0	0.1	0.1	5.0	(2)
		90.0	89.8	0.2	5.0	(2)
		180.0	180.5	0.5	5.0	(2)
		270.0	269.9	0.1	5.0	(2)
Temp. (°C): Upper Sensor		0.0	0.0	0.0	0.5	(2)
		9.8	9.9	0.1	0.5	(2)
		12.8	12.8	0.0	0.5	(2)
Temp. (°C): Lower Sensor		0.0	0.0	0.0	0.5	(2)
		9.8	9.8	0.1	0.5	(2)
		12.8	12.8	0.0	0.5	(2)

	DAS Value (in)	Reference (ml)	DAS Equivalent	|Difference|	Specification	
Precipitation (0.1" equiv.)	0.10	194.0	185.3	8.7	18.5	(2)
	0.10	185.0	185.3	0.3	18.5	(2)
	0.10	185.5	185.3	0.2	18.5	(2)
			Average Diff:	3.1	8.2	(2)

		DAS Value				
	Reference (°C)	Lower Sensor	Upper Sensor	ΔT	Specification	
Delta Temperature (°C):	0.0	0.0	0.0	0.03	0.10	(2)
	9.8	9.8	9.9	0.05	0.10	(2)
	12.8	12.8	12.8	0.00	0.10	(2)

BOLD difference values exceed performance specifications
(1)= Performance specification listed in facilities' Quality Assurance Project Plan
(2)= Performance specification listed In EPA Quality Assurance Handbook for Air Pollution Measurement Systems, Vol. IV: Meteorlogical Measurements Version 2.0, 2008
(3)= Manufacturer's Specifications
(4)= EPA On-Site Meteorological Program Guidance for Regulatory Modeling Applications

Notes, Recommendations

System returned on-line at 17:42 MST.
Upgraded to AERMOD system.
Bearings were replaced prior to start up.

Standard Operating Procedures

Standard Operating Procedure
For Meteorological Monitoring Station Audit

1.0 Scope and Application

1.1 Accurate meteorological measurements are critical to interpretation of ambient air pollution data. The proper operation and accuracy of measurements must be assessed on a periodic basis.

1.2 The objective of this procedure is to ensure that recorded meteorological data match readings provided by known inputs within specified limits.

1.3 This procedure applies to meteorological monitoring stations that measure ambient air temperature, wind speed, wind direction, barometric pressure, relative humidity, solar radiation, and precipitation (tipping bucket method).

2.0 Summary of Method

2.1 The accuracy of meteorological measurements is assessed by stimulating meteorological measurement sensors with known inputs. Sensor outputs, as translated and recorded by the system data acquisition system, are compared to the known values. The differences are compared to the specified limits to assess system accuracy.

3.0 Health and Safety Warnings

3.1 General safety precautions related to electrical hazards must be observed at all times when working with electronic equipment. Electrical receptacles and equipment must be properly grounded. Use caution when servicing or operating electrical equipment in wet conditions.

3.2 General precautions for working with heavy equipment and electro-mechanical equipment should be taken.

3.3 Meteorological towers present a serious physical hazard. Great care must be taken when lower, raising, or climbing towers.

4.0 Cautions

4.1 Damage to the instrument may result if caution is not taken to properly install and maintain the device. Follow the manufacturer's instructions for maintenance of all equipment and for safe, secure installation.

5.0 Personnel Qualifications

5.1 Persons performing this SOP must be familiar with the operation of environmental measurement instrumentation.

5.2 Instrumentation skills are necessary for interacting with the data acquisition system.

5.3 Familiarity with electronic and mechanical test equipment is required.

6.0 Equipment

6.1 Quartz-referenced motor, with adaptors

6.2 Starting torque measurement disc and weights

6.3 NIST traceable thermometer, accurate to ±0.1°C

6.4 Two insulated containers (one with ice water and the other with hot water)

6.5 Engineer’s transit

6.6 Class B pipette

6.7 NIST traceable digital pressure standard

6.8 Reference relative humidity sensor/instrument, or psychrometer

6.9 Solar radiation sensor/instrument & independent datalogger

6.10 Field data sheet

6.11 Time piece

6.12 Miscellaneous tools

7.0 Procedure

7.1 Record date and time, station ID, name of person(s) performing the procedure, on field data sheet.

7.2 Compare the datalogger's readings with your own assessment of the ambient weather conditions. Note any anomalies on the field data sheet.

7.3 Check the initial alignment of the wind direction sensor using the transit, being sure to adjust for local declination.

7.4 Record the following information on the audit data: site ID, auditors, date, time, and system components.

7.5 Record the current time as *time system off line* on the field data sheet.

7.6 Remove the appropriate restraints and ***carefully*** lower the tower to a point where sensors are at a safe working height.

7.7 Remove the anemometer propeller. Attach the propeller torque disc to shaft. Measure and record the starting torque in the counter-clockwise direction.

7.8 Attach the anemometer drive motor to the shaft and rotate at speeds corresponding to approximately 3 mph, 9 mph, 30 mph, and 90 mph recording the motor speeds and wind speed readings from the data logger.

7.9 Assess the linearity of the wind direction sensor by physically aligning the body of the anemometer with the base at angles corresponding to 0°, 90°, 180°, and 270°, recording the corresponding readings from the data logger.

7.10 Remove each temperature sensor from its radiation shield and immerse the sensor in an ice water bath along with the reference thermometer. Allow the sensor and thermometer to attain equilibrium and record both measurements.

7.11 Immerse each temperature sensor in a warm water bath (80° - 100°F) along with the reference thermometer. Allow the sensor and thermometer to attain equilibrium and record both measurements.

7.12 Create a reference-temperature midpoint by mixing ice water and warm water. Immerse each temperature sensor in the water bath along with the reference thermometer. Allow the sensor and thermometer to attain equilibrium and record both measurements.

7.13 Inspect all sensors, cables, and mounting hardware. Conduct any repairs or scheduled preventive maintenance **to only those sensors audited to this point**.

7.14 Make sure all cables and mounting hardware are secure. ***Carefully*** raise the tower, secure the base, and equalize the guy wire tensions.

7.15 Mount the independent datalogger (or RH reference) in a safe and secure place, and collocate the audit sensors for solar radiation and relative humidity. Allow the sensors time to equilibrate. Record the solar radiation and RH measurements from the system and the reference.

7.16 Using the pipette, admit water slowly into the inlet of the precipitation gauge (*as found, i.e. do not clean)* until the bucket tips 10 times (0.10” precipitation equivalent). Record the amount of water required for the 10 tips and the amount registered on the data logger. Repeat the procedure two more times.

7.17 Clean the precipitation gauge inlet and perform any indicated adjustments and/or repairs can be performed and noted. If adjustments are made, repeat step 7.15. Note the condition of the gauge prior to, and after the audit. If the ambient temperature is cold enough, assess whether the heater is working.

7.18 Record and compare pressure measurements from the station logger and the pressure standard. Record both values.

7.19 Display and record the data acquisition system time. Record the time displayed by the reference time piece. Note: the data acquisition system operates on Standard Time year round.

7.20 Display and record the data acquisition battery voltage.

7.21 Record any findings, repairs, replacements, and any other anomalies in the field data sheet. Record the time the station was returned to normal operating condition.

8.0 References

8.1 Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV. Meteorological Measurements; EPA/600/4-90/003; August 1989; U.S. Environmental Protection Agency

8.2 Quality Assurance Handbook for Air Pollution Measurement Systems: Volume V. Precipitation Measurement Systems; EPA/600/R-94/038e; April; U.S. Environmental Protection Agency

8.3 On-Site Meteorological Program Guidance for Regulatory Modeling Applications; EPA-450/4-87-013; June, 1987; U.S. Environmental Protection Agency

8.4 Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD); EPA-450/4-87-007; May, 1987; U.S. Environmental Protection Agency

9.0 Attachments

9.1 Meteorological Station Audit Field Data Sheet

IML Air Science
a division of Inter-Mountain Laboratories, Inc.
555 Absaraka, Sheridan, WY 82801

Meteorological Station Audit

Page 1 of 2

Network:

Date: Auditors: DAS time off-line:

Notes; system as found:

Standards

Parameter	Reference Device	Mfr./Model	SN/ID
Wind Speed	Quartz Drive Motor		
Wind Direction Alignment	Compass		
Temperature	Digital Thermistor		
Relative Humidity	Collocated Sensor		
Pressure	Digital Barometer		
Precipitation	Lab Grade Burette	N/A	N/A
Solar Radiation	Collocated Sensor		

Sensors

	Mfr./Model	SN/ID
DAS:		
Wind Speed:		
Wind Direction:		
Temp/Asp 2m:		
Temp/Asp 10m:		
Precipitation:		
Barometric Pressure :		
Relative Humidity:		
Solar Radiation:		

System Audit

Temperature

Height:	2m	10m
Reference	DAS	DAS
°C		
°C		
°C		

Barometric Pressure

ref.
DAS

Relative Humidity

ref. RH	ref. RH Temp
DAS RH	DAS RH Temp

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Wind Speed

starting torque		gm-cm
reference	DAS	after adj.
0 rpm		
rpm mph		
rpm mph		
rpm mph		
rpm mph		

Wind Direction

starting torque ccw: cw: gm-cm			DAS Reading
initial alignment:			
reference	CW	CCW	After Adj
360			
060			
090			
120			
180			
240			
270			
300			

Precipitation (Tipping Bucket)

mls/weight	tips	in. equiv.
	10	0.10
	10	0.10
	10	0.10
Heater working?		
Inspection		
DAS precip start:		
DAS precip end:		

Solar Radiation	Ref	DAS
Covered		
Un-covered		

DAS Day: ______________

DAS Time: ______________

DAS Year: ______________

DAS Battery: ______________

SM Battery OK ? ______________

Enclosure Humidity OK? ______________

WS Channel: ______________

WD Channel: ______________

Ta Channel: ______________

Precip. Channel: ______________

RH Channel: ______________

Pa Channel: ______________

Batt. Channel: ______________

Solar Radiation Channel: ______________

Notes: ____

End System Audit

DAS time on-line: ____

Standard Operating Procedure
For Meteorological Monitoring Station Calibration

1.0 Scope and Application

1.1 Accurate meteorological measurements are critical to interpretation of ambient air pollution data. The proper operation and accuracy of measurements must be assessed on a periodic basis.

1.2 The objective of this procedure is to ensure that recorded meteorological data match readings provided by known inputs within specified limits.

1.3 This procedure applies to meteorological monitoring stations that measure ambient air temperature, wind speed, wind direction, barometric pressure, relative humidity, solar radiation, and precipitation (tipping bucket method).

2.0 Summary of Method

2.1 The accuracy of meteorological measurements is assessed by stimulating meteorological measurement sensors with known inputs. Sensor outputs, as translated and recorded by the system data acquisition system, are compared to the known values. The differences are compared to the specified limits to assess system accuracy. If any differences between reference standard and sensor are discovered, corrective actions must be taken.

3.0 Health and Safety Warnings

3.1 General safety precautions related to electrical hazards must be observed at all times when working with electronic equipment. Electrical receptacles and equipment must be properly grounded. Use caution when servicing or operating electrical equipment in wet conditions.

3.2 General precautions for working with heavy equipment and electro-mechanical equipment should be taken.

3.3 Meteorological towers present a serious physical hazard. Great care must be taken when lower, raising, or climbing towers.

4.0 Cautions

4.1 Damage to the instrument may result if caution is not taken to properly install and maintain the device. Follow the manufacturer's instructions for maintenance of all equipment and for safe, secure installation.

5.0 Personnel Qualifications

5.1 Persons performing this SOP must be familiar with the operation of environmental measurement instrumentation.

5.2 Instrumentation skills are necessary for interacting with the data acquisition system.

5.3 Familiarity with electronic and mechanical test equipment is required.

6.0 Equipment

6.1 Quartz-referenced motor, with adaptors

6.2 Starting torque measurement disc and weights

6.3 NIST traceable thermometer, accurate to ±0.1°C

6.4 Two insulated containers (one with ice water and the other with hot water)

6.5 Engineer’s transit

6.6 Class B pipette

6.7 NIST traceable digital pressure standard

6.8 Reference relative humidity sensor/instrument

6.9 Solar radiation sensor/instrument & independent datalogger

6.10 Field data sheet

6.11 Time piece

6.12 Miscellaneous tools

7.0 Procedure

7.1 Record date and time, station ID, name of person(s) performing the procedure, on field data sheet.

7.2 Compare the datalogger's readings with your own assessment of the ambient weather conditions. Note any anomalies on the field data sheet.

7.3 Check the initial alignment of the wind direction sensor and orientation of mounting crossarm using the transit, being sure to adjust for local declination.

7.4 Record the following information on the calibration data: site ID, auditors, date, time, and system components.

7.5 Record the current time as *time system off line* on the field data sheet.

7.6 Remove the appropriate restraints and ***carefully*** lower the tower to a point where sensors are at a safe working height if calibrating a “tip down” system. For towers where climbing is required to access mounted sensors, put on climbing harness with appropriate safety equipment including fall protection and lanyard. All climbing apparatus must be inspected for safety before each use and all safety guidelines specific to the site must be followed.

7.7 Remove the anemometer propeller. Attach the propeller torque disc to shaft. Measure and record the starting torque in the counter-clockwise direction.

7.8 Attach the anemometer drive motor to the shaft and rotate at speeds corresponding to approximately 3 mph, 9 mph, 30 mph, and 90 mph recording the motor speeds and wind speed readings from the data logger.

7.9 Assess the linearity of the wind direction sensor by physically aligning the body of the anemometer with the base at angles corresponding to 0°, 90°, 180°, and 270°, recording the corresponding readings from the data logger. The checks must be performed in both a clockwise and counterclockwise rotation.

7.10 Remove each temperature sensor from its radiation shield and immerse the sensor in an ice water bath along with the reference thermometer. Allow the sensor and thermometer to attain equilibrium and record both measurements.

7.11 Immerse each temperature sensor in a warm water bath (90° - 110°F) along with the reference thermometer. Allow the sensor and thermometer to attain equilibrium and record both measurements.

7.12 Create a reference-temperature midpoint by mixing ice water and warm water. Immerse each temperature sensor in the water bath along with the reference thermometer. Allow the sensor and thermometer to attain equilibrium and record both measurements.

7.13 Inspect all sensors, cables, and mounting hardware. Conduct any repairs or scheduled preventive maintenance **to only those sensors assessed to this point**.

7.14 Make sure all cables and mounting hardware are secure. ***Carefully*** raise the tower, secure the base, and equalize the guy wire tensions.

7.15 Mount the independent datalogger (or RH reference) in a safe and secure place, and collocate the reference sensors for solar radiation and relative humidity. Allow the sensors time to equilibrate. Record the solar radiation and RH measurements from the system and the reference.

7.16 Using the pipette, admit water slowly into the inlet of the precipitation gauge (*as found, i.e. do not clean)* until the bucket tips 10 times (0.10” precipitation equivalent). Record the amount of water required for the 10 tips and the amount registered on the data logger. Repeat the procedure two more times.

7.17 Clean the precipitation gauge inlet and perform and note any indicated adjustments and/or repairs. If adjustments are made, repeat step 7.16. Note the condition of the gauge prior to, and after the assessment. If the ambient temperature is cold enough, assess whether the heater is working.

7.18 Record and compare pressure measurements from the station logger and the pressure standard. Record both values.

7.19 Display and record the data acquisition system time. Record the time displayed by the reference time piece. Note: the data acquisition system operates on Standard Time year round.

7.20 Display and record the data acquisition battery voltage.

7.21 Record any findings, repairs, replacements, and any other anomalies in the field data sheet. Should any sensor not meet specifications of sensor or calibration criteria, appropriate action must be performed including onsite sensor calibration/adjustment, removal for factory recalibration, or replacement if deemed necessary. Record the time the station was returned to normal operating condition.

8.0 References

8.1 Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV. Meteorological Measurements; EPA/600/4-90/003; August 1989; U.S. Environmental Protection Agency

8.2 Quality Assurance Handbook for Air Pollution Measurement Systems: Volume V. Precipitation Measurement Systems; EPA/600/R-94/038e; April; U.S. Environmental Protection Agency

8.3 On-Site Meteorological Program Guidance for Regulatory Modeling Applications; EPA-450/4-87-013; June, 1987; U.S. Environmental Protection Agency

8.4 Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD); EPA-450/4-87-007; May, 1987; U.S. Environmental Protection Agency

9.0 Attachments

9.1 Meteorological Station Calibration Field Data Sheet

Standard Operating Procedure for Meteorological Data Processing

1.0 Scope and Application

1.1 The objective of this procedure is to ensure that all data collected, processed, and reported by IML Air Science are of similar high quality. The transformation of raw meteorological data to validated, reportable data is critical to the ability of a client to meet QAPP requirements, and to the ability of IML Air Science to meet contractual requirements to the client. This procedure also ensures that time-sensitive work, e.g. quarterly reporting needed to satisfy EPA, state, and network QAPP requirements, is performed.

1.2 This procedure applies to those ambient air monitoring networks for which IML Air Science has been contracted to perform routine meteorological data collection and/or processing.

1.3 This SOP describes the method for handling, reviewing, verifying, and validating data collected by clients' meteorological systems.

2.0 Summary of Method

2.1 Clients are responsible for operation of meteorological systems. Actual data collection/transmittal may be performed by customers' personnel or contracted to IML Air Science.

2.2 Once collected, meteorological data are transmitted to IML headquarters in Sheridan, WY, where the data are processed (imported, reviewed, verified, and validated).

2.3 Each reviewer is responsible for verifying each of the parts that are designated for their review and for completing the log/checklist (Attachment 1) associated with the data package.

2.4 Data qualifiers are used where they are appropriate. Data qualifiers used during data processing and reporting are included in Attachment 2.

3.0 Definitions

3.1 <u>Data processing</u> refers to the generic procedures used to transform raw data into validated data, and the subsequent steps taken to summarize, format, and report validated data.

3.2 <u>Data review</u> refers to the overall process of verifying that a meteorological system is functioning properly, data are being accurately logged and transmitted, and QA/QC procedures are being followed.

3.3 <u>Data verification</u> is the process of evaluating the completeness, correctness, and conformance/compliance of a specific data set against the method, procedural, and/or contractual requirements.

3.4 Data validation is the data-specific process that extends the evaluation of data beyond method, procedural, or contractual compliance to determine the analytical quality of a specific data set. Data validation includes the determination, where possible, of the reasons for any failure to meet method, procedural, or contractual requirements, and an evaluation of the impact of such failure on the overall data set. Data validation applies to activities in the field as well as data processing activities.

3.5 Quality Assurance Project Plan (QAPP) is a document that describes project - specific information such as quality assurance, quality control, and other technical activities that must be implemented to ensure that the results of the work performed will satisfy the stated acceptance criteria.

3.6 Acceptance criteria: the specific quality objectives for a given project, described in the QAPP.

3.7 Screening criteria: suggested or preliminary upper and lower limits for data values based on instrument thresholds, experience, or historical data.

4.0 Personnel Qualifications

4.1 Persons performing this SOP must be familiar with the operation of meteorological measurement instrumentation.

4.2 These persons must also be trained in the use of IML's proprietary database to process and report meteorological data.

4.3 Further, personnel will be trained in general QA/QC requirements and procedures pertaining to the measurement of environmental data.

5.0 Raw Data Requirements

5.1 The reviewer must verify that all information necessary for data review is present. This includes not only raw electronic data files, but other hard copy or electronic information used to review and verify the data.

5.2 Electronic raw data: Comma-delimited text files, spreadsheet files, or similarly formatted files containing raw data to be imported into the processing database.

5.3 QA/QC raw data: These include field notes, audit field sheets, client correspondence, and any other data used to verify proper operation of the system and establish the validity of the data.

6.0 Data Review

6.1 In those cases where Air Science is contracted to initiate data retrieval/transmittal on-site, preliminary data review and verification occurs in the field or at a satellite office. Data are examined for completeness and reasonableness. Meteorological instruments are physically examined on a routine basis to detect failures that could impact data accuracy and validity.

6.2 Data transmitted directly to Air Science is also examined for completeness and reasonableness before import into the processing database.

7.0 Data Verification and Validation

Detailed instructions for users of IML Air Science's meteorological database contain proprietary information. General procedural steps are outlined below. Screening and acceptance criteria used to verify, qualify, and invalidate data are shown in Attachment 3.

7.1 Raw data are imported into a client-specific database to preserve data integrity and eliminate the possibility of data crossover between clients.

7.2 During the import process, records are checked for the proper station (client) ID, and the time stamp is examined to prevent importing duplicate records.

7.3 As an aid to the reporting process, the database allows for the automatic insertion of blank, invalid records in place of missing data. The data reviewer must determine if the data are actually lost, or if an error has occurred during downloading, transmission, or importing that led to the missing records.

7.4 The database has provision for both automatic and manual data flagging and invalidation. It is important to ***perform automatic invalidations prior to manual invalidations***. Reversing this order could result in overwriting a manual invalidation code. Manual invalidation codes should be inserted in reverse order of preference, so that the last code entered is the highest priority (i.e. most accurate diagnostic) code for a given record. Any attempt to manually invalidate one or more already flagged records, will result in a warning and a list of the affected records. The user may cancel the operation at this point to preserve existing flags, or elect to overwrite these records.

7.5 Automated Step 1 flags records indicating instrument failure (logger error codes) or low battery voltage.

7.6 Automated Step 2 flags records with any met values outside pre-established limits (screening criteria).

7.7 Automated Step 3 flags records with either minimal or inordinately large changes in the various met parameters from hour to hour.

7.8 Using professional judgment and experience, the data reviewer must examine the results of Steps 2 and 3 and accept or reject the data. Rejected data are manually coded with the appropriate qualifier.

7.9 After automated results have been evaluated and accepted, the reviewer must verify the overall quality of the dataset by examining field notes, audit results, and any other pertinent documentation.

7.10 Records/data deemed invalid must be manually coded by the reviewer. Qualifiers can be inserted at the field level (i.e. for a particular parameter in a record), or at the record level (i.e. all parameters recorded during the period).

7.11 Additional checks of the data qualifying/invalidation process occur when report products are generated. Irregularities in meteorological summaries, wind roses, and other summary products may lead to a re-examination of the data

8.0 Records Management

8.1 Data transmittal can occur along a variety of routes, and a particular network may use more than one route. Example routes include:

Datalogger → storage module → Air Science PC (direct connect)
Datalogger → field laptop→ office PC→ Air Science PC (disc, e-mail)
Datalogger → Air Science PC (phone or radio telemetry)
Datalogger → Client PC (direct connect, telemetry, etc.) → Air Science PC (disc, e-mail)

8.2 Upon receipt of data at IML offices, an entry is made into a hard-copy or electronic log. Date of receipt, data-range received, date data is QC'd, and any additional notes are recorded.

8.3 Raw data are archived electronically in their original format on the IML network. The network has automated data back-up and recovery functions to prevent data loss.

8.4 Raw data contain a client-specific ID number recognized by the processing database. Raw and processed data for each client are stored separately from that of other clients.

8.5 A common processing database is used by all reviewers in Air Science. This common interface links to the client-specific database and tables needed by the data reviewer to import, process, and report specific data.

9.0 References

9.1 Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV. Meteorological Measurements Version 2.0 (Final); EPA/454/B-08-002; March 2008; U.S. Environmental Protection Agency

9.2 Quality Assurance Handbook for Air Pollution Measurement Systems: Volume V. Precipitation Measurement Systems; EPA/600/R-94/038e; April 1994; U.S. Environmental Protection Agency

9.3 On-Site Meteorological Program Guidance for Regulatory Modeling Applications; EPA-450/4-87-013; June, 1987; U.S. Environmental Protection Agency

9.4 Ambient Monitoring Guidelines for Prevention of Significant Deterioration (PSD); EPA-450/4-87-007; May, 1987; U.S. Environmental Protection Agency

10.0 Attachments

10.1 Meteorological data processing log and checklist

Station: ____________________

Date Rec'd	Dates Recorded	Field Activities/ Audits?	Complete YTD?	Data Archived?	Database Imported?	Database QC'd?	Database Validated?	Notes

10.2 Meteorological data qualifiers

AIRS Numeric	AQS Alpha	Description
0	0	Valid Record
9967	AA	Sample Pressure Out of Limits - 9967 - AA
9968	AB	Technician Unavailable - 9968 - AB
9969	AC	Construction/Repairs in Area - 9969 - AC
9970	AD	Shelter Storm Damage - 9970 - AD
9971	AE	Shelter Temperature Out of Limits - 9971 - AE
9972	AF	Scheduled But Not Collected - 9972 - AF
9975	AI	Insufficient Data (Can't Calculate) - 9975 - AI
9978	AL	Voided by Operator - 9978 - AL
9979	AM	Miscellaneous Void - 9979 - AM
9980	AN	Machine Malfunction - 9980 - AN
9981	AO	Bad Weather - 9981 - AO
9982	AP	Vandalism - 9982 - AP
9983	AQ	Collection Error - 9983 - AQ
9984	AR	Lab Error - 9984 - AR
9985	AS	Poor Quality Assurance Results - 9985 - AS
9986	AT	Calibration - 9986 - AT
9987	AU	Monitoring Waived - 9987 - AU
9988	AV	Power Failure (Powr) - 9988 - AV
9989	AW	Wildlife Damage - 9989 - AW
9992	AZ	QC Audit (Audit) - 9992 - AZ
9993	BA	Maintenance/Routine Repairs - 9993 - BA
9994	BB	Unable to Reach Site - 9994 - BB
9995	BC	Multi-Point Calibration - 9995 - BC
9996	BD	Auto Calibration - 9996 - BD
9997	BE	Building/Site Repair - 9997 - BE

10.3 Meteorological screening and acceptance criteria

Variable	Screening Criteria: Flag data if the value
Wind Speed	- is less than zero or greater than 25 m/s (56 mph)
	- does not vary by more than 0.1 m/s (0.2 mph) for 3 consecutive hours
	- does not vary by more than 0.5 m/s (1.1 mph) for 12 consecutive hours
Wind Direction	- is less than zero or greater than 360 degrees
	- does not vary by more than 1 degree for more than 3 consecutive hours
	- does not vary by more than 10 degrees for 18 consecutive hours
Temperature	- is greater than the local record high
	- is less than the local record low
	(The above limits could be applied on a monthly basis.)
	- is greater than a 5° C change from the previous hour
	- does not vary by more than 0.5° C for 12 consecutive hours
Temperature	- is greater than 0.1° C/m during the daytime
Difference	- is less than – 0.1° C/m during the night time
	- is greater than 5.0° C or less than -3.0° C
Dew Point Temp.	- is greater than the ambient temperature for the given time period
	- is greater than a 5° C change from the previous hour
	- does not vary by more than 0.5° C for 12 consecutive hours
	- equals the ambient temperature for 12 consecutive hours
Precipitation	- is greater than 25 mm (1 inch) in one hour
	- is greater than 100 mm (4 inches) in 24 hours
	- is less than 50 mm (2 inches) in three months
	(The above values can be adjusted based on local climate.)
Pressure	- is greater than 1060 mb (sea level)
	- is less than 940 mb (sea level)
	(The above values should be adjusted for elevations other than sea level.)
	- changes by more than 6 mb in three hours
Radiation	- is greater than zero at night
	- is greater than the maximum possible for the date and latitude

Standard Operating Procedure for Meteorological Monitoring Station Inspection

1.0 Scope and Application

1.1 Accurate meteorological measurements are critical to interpretation of ambient air pollution data. Proper operation must be assessed on a periodic basis.

1.2 The objective of this procedure is to inspect operations of the meteorological sensors and recording device, and conduct repairs as needed.

1.3 This procedure applies to meteorological monitoring stations that measure ambient air temperature, wind speed, and wind direction.

2.0 Summary of Method

2.1 Meteorological measurement sensors are inspected for proper operation, physical condition, and reasonableness.

3.0 Health and Safety Warnings

3.1 General safety precautions related to electrical hazards must be observed at all times when working with electronic equipment. Electrical receptacles and equipment must be properly grounded. Use caution when servicing or operating electrical equipment in wet conditions.

3.2 General precautions for working with heavy equipment and electro-mechanical equipment should be taken.

3.3 Meteorological towers present a serious physical hazard. Great care must be taken when lower, raising, or climbing towers.

4.0 Cautions

4.1 Damage to the instrument may result if caution is not taken to properly install and maintain the device. Follow the manufacturer's instructions for maintenance of all equipment and for safe, secure installation.

5.0 Personnel Qualifications

5.1 Persons performing this SOP must be familiar with the operation of environmental measurement instrumentation.

5.2 Instrumentation skills are necessary for interacting with the data acquisition system.

5.3 Familiarity with electronic and mechanical test equipment is required.

6.0 Equipment

6.1 Meteorological monitoring station log book

6.2 Time piece

6.3 Miscellaneous tools

7.0 Procedure

7.1 Register visit on the meteorological monitoring station log book, noting location, technician, date and time in STANDARD TIME (data acquisition system is not changed for daylight savings time). Verify that the data acquisition clock is accurate.

7.2 Visibly check each sensor for proper operation, lower tower if necessary.

7.3 Compare the datalogger's meteorological parameter outputs with your own assessment of the ambient weather conditions. Note any anomalies on the log book. Conduct any repairs or replacements if necessary.

7.4 Record concluding time of visit on field data sheet, noting any repairs or changes

8.0 References

8.1 <u>Quality Assurance Handbook for Air Pollution Measurement Systems: Volume IV. Meteorological Measurements Version 2.0 (Final)</u>; EPA/454/B-08-002; March 2008; U.S. Environmental Protection Agency

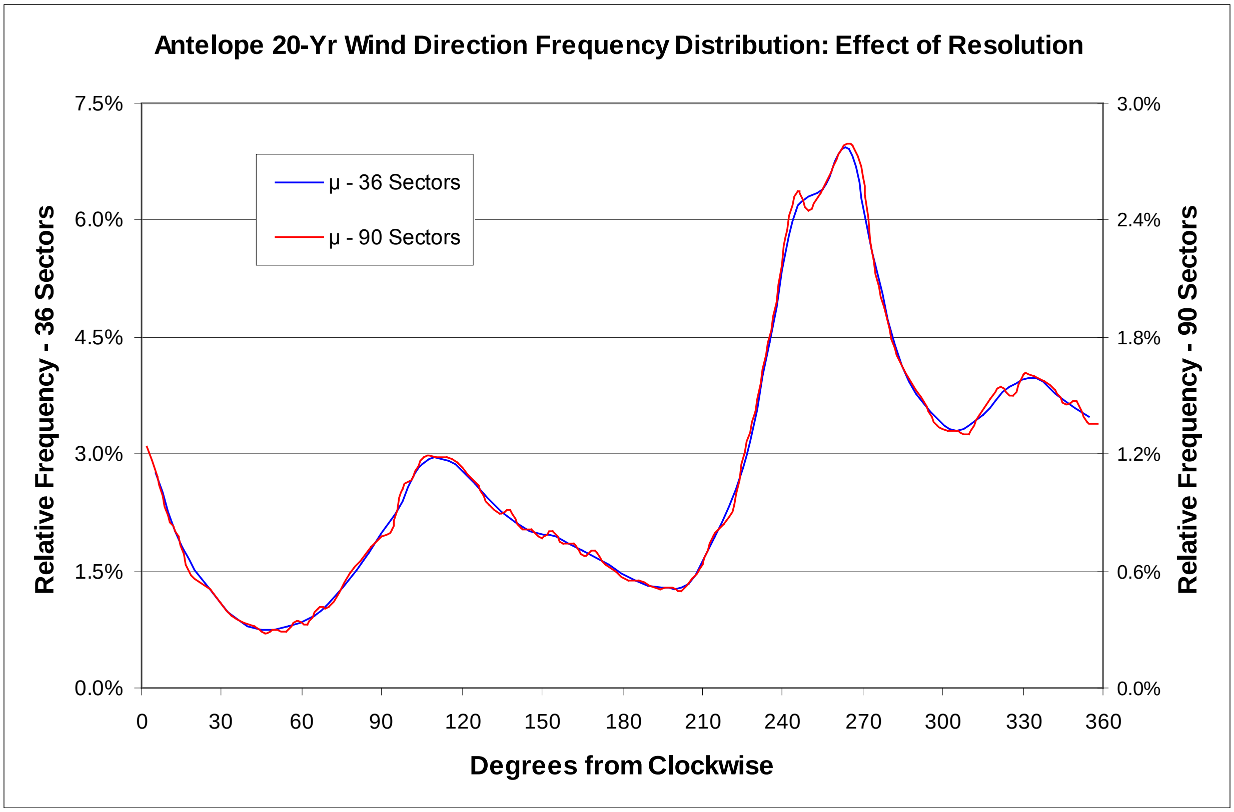
APPENDIX 2.5-E

Statistical Methodology for Assessing Representativeness of Wind Data

In this study, IML Air Science presents a methodology for assessing the degree to which the distribution of wind direction frequencies from one year of monitoring at a particular location represents the long-term wind direction distribution at that same location. The study considers four sites, some having generated more than 20 years of hourly meteorological data. The Dry Fork Mine and Buckskin Mine met stations are located near the Gillette Airport site in the northern Powder River Basin (PRB). The Antelope Mine met station is located in the southern PRB.

To balance the need for sufficiently large sample sizes with the need to minimize the artifacts of discrete classification, wind directions were divided into 36 sectors of 10º each (0º represents true North). Figure 1 compares 20 years of hourly wind direction data split into 90 sectors with the same data distributed among 36 sectors. It shows the latter to be a suitable representation without imparting the granular quality exhibited by the 90-sector distribution.

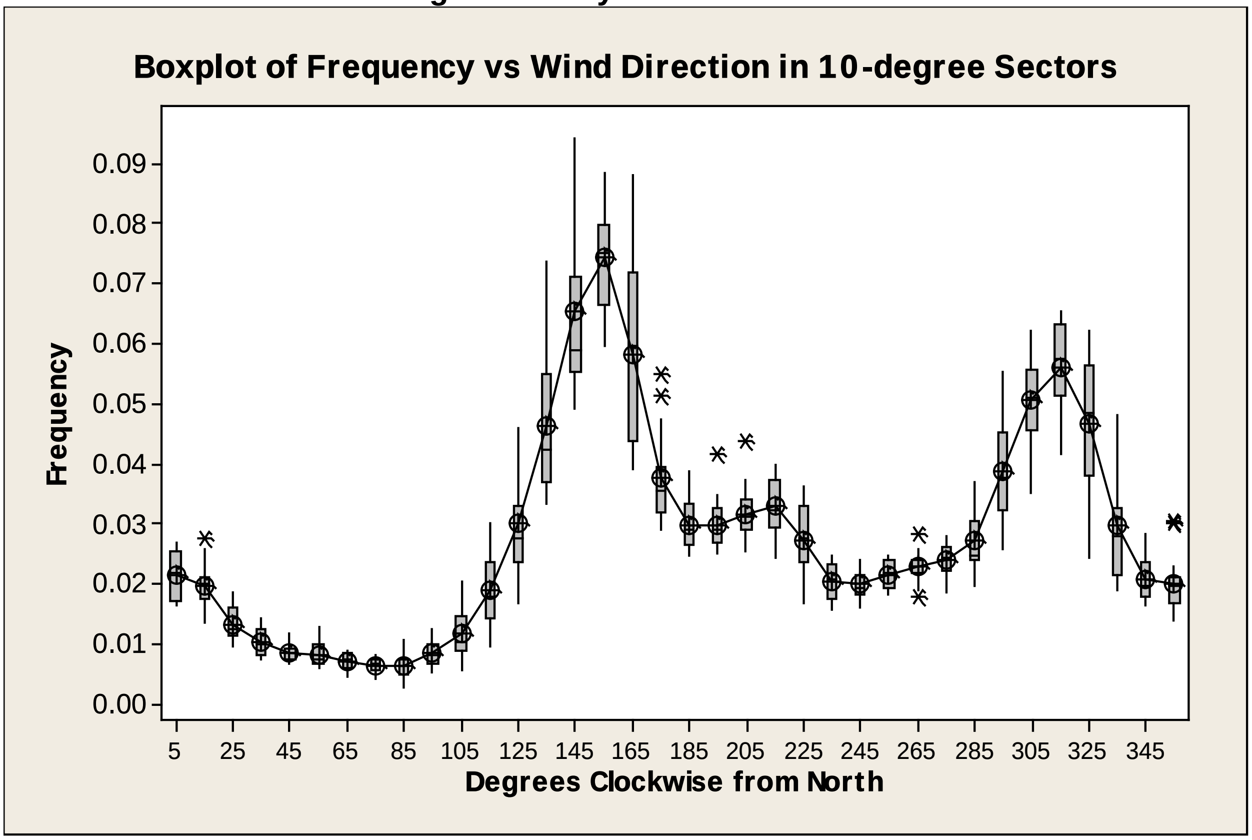
Figure 1 – Antelope 1990-2009



Dry Fork 15 -Year Wind Direction Distribution

Hourly wind directions were compiled from the Dry Fork Mine for the 15-year period from 1/1/1995 through 12/31/2009. Figure 2 shows the distribution of annual wind direction frequencies by sector, in the form of a box plot. The boxes represent frequencies from the 25th percentile to the 75th percentile. The lines represent the entire range of frequencies (excepting outliers), while the asterisks represent outliers.

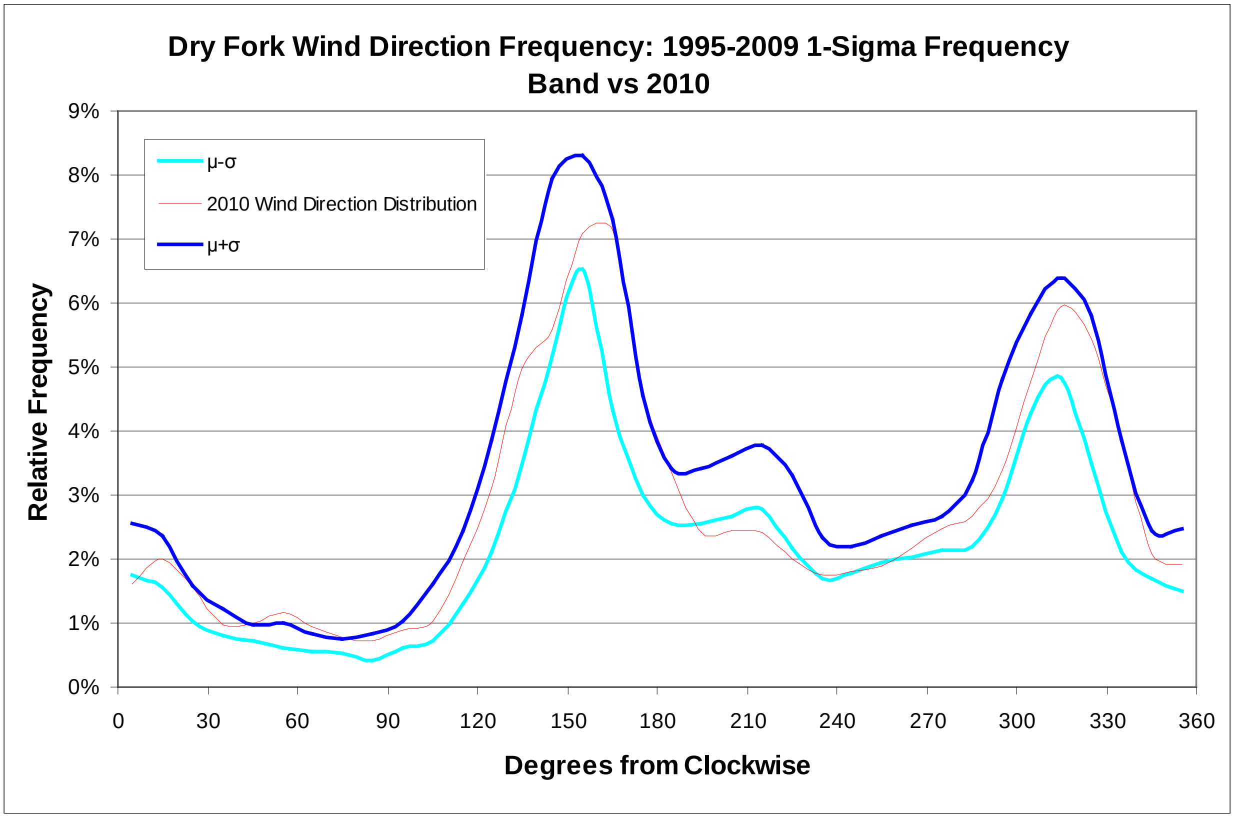
Figure 2 – Dry Fork 1995-2009



Dry Fork Year 2010 Compared to Long-Term Frequency Distribution

Figure 3 presents the Dry Fork 15-year wind direction frequency distribution in the form of a band of frequencies for each direction sector. This band ranges from one standard deviation below the 15-year mean frequency to one standard deviation above the mean frequency. Superimposed on this statistical plot is the 2010 actual direction frequency distribution. Figure 3 shows that nearly all of the 2010 frequencies fall within the 15-year band. This is not surprising, since the probability that the direction frequency for any given sector and year will fall within one standard deviation of the long-term mean is 68% (assuming normally distributed data).

Figure 3 – Dry Fork 1995-2010



More significant than the adherence of one year to the 15-year frequency band is the width and shape of the band itself, which might be regarded as the "signature" for a given site. The narrower and more contoured the frequency band, the more distinctive the signature. It will be shown below that even a slight spatial difference between two monitoring stations can alter this signature significantly.

Hypothesis Testing

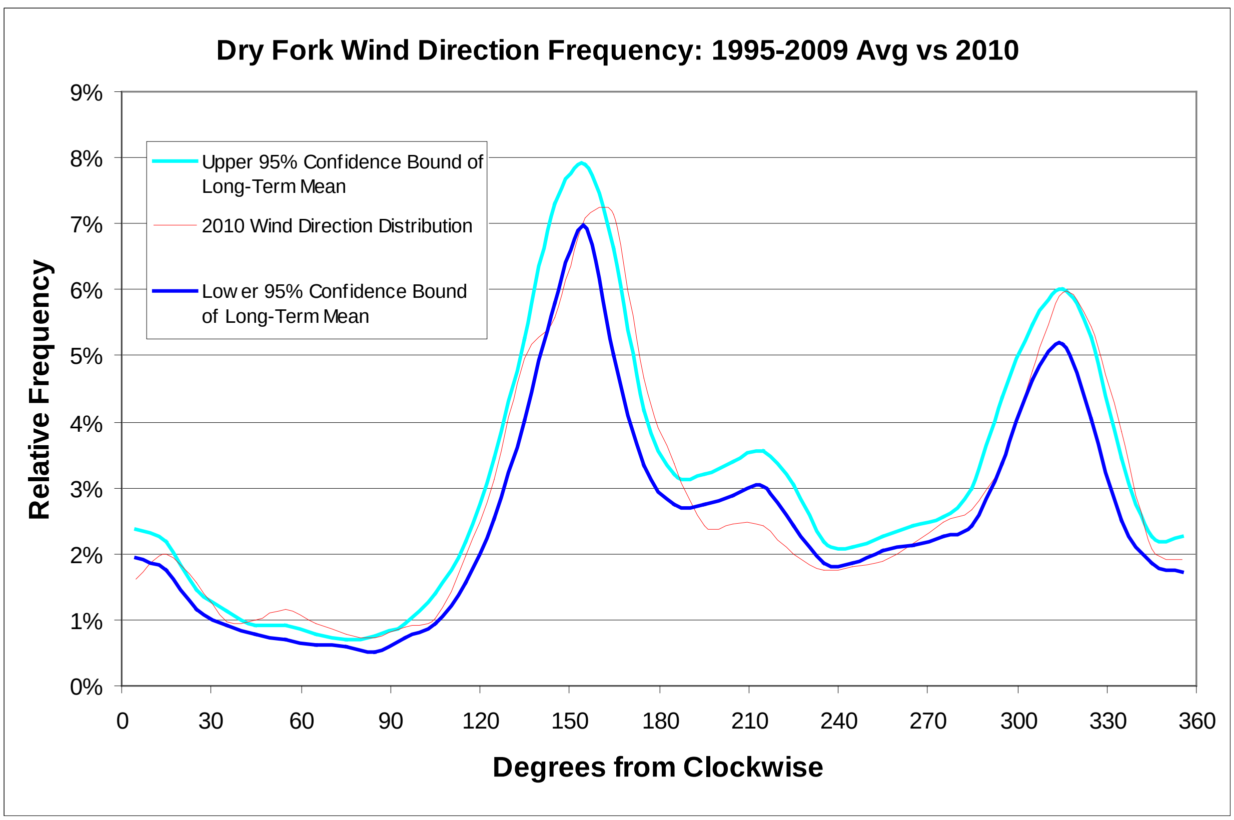
A series of hypothesis tests represents one approach to quantifying the goodness of fit between a one-year wind direction distribution and the long-term distribution. For the Dry Fork Mine example, the one-year direction frequency for each sector can be compared to the set of direction frequencies available from the previous 15 years (long-term). The null hypotheses are that the one-year frequencies do not belong to the long-term or "population" frequencies. Statistically, this can be accomplished through a one-sample t-test for each of the 36 sectors. Each t-test yields a p-value which predicts the probability of wrongly asserting a statistical difference between the one-year direction frequency and the long term frequency. Two such tests on the Dry Fork Mine data are shown below for the direction sectors centered on 5º and 15º respectively.

```
Test of mu = 0.0162367 vs not = 0.0162367
Variable    N      Mean     StDev   SE Mean         95% CI              T      P
5º         15  0.021532  0.004133  0.001067  (0.019243, 0.023821)  4.96  0.000
Test of mu = 0.020063 vs not = 0.020063
Variable    N      Mean     StDev   SE Mean         95% CI              T      P
15º       15  0.019560  0.003950  0.001020  (0.017372, 0.021747)  -0.49  0.629
```

At 5º the one-year (2010) frequency of 0.0162367 falls below the 95% confidence interval (CI) for the long-term mean frequency (0.019243 to 0.023821). A p-value of 0.000 confirms this point to be decidedly outside the CI. One might conclude (with 95% confidence) that 2010 was an atypical year for the direction sector centered on 5º. Conversely, the 15º test shows the 2010 frequency to be well within the 95% confidence interval for the long-term mean. A p-value of 0.629 indicates one cannot conclude any difference between the 2010 and long-term frequencies.

The t-test could be repeated for each of the 36 sectors, with some directions showing no statistical difference and others showing a slight difference. Figure 4 presents the results of a more efficient method, graphing the 95% confidence interval of frequencies as a function of wind direction. The confidence interval is calculated from the standard error of the mean frequency for each sector, and the two-tail t-value at 95% confidence. The 2010 frequency distribution is also shown on Figure 4.

Figure 4 – Dry Fork 1995-2010



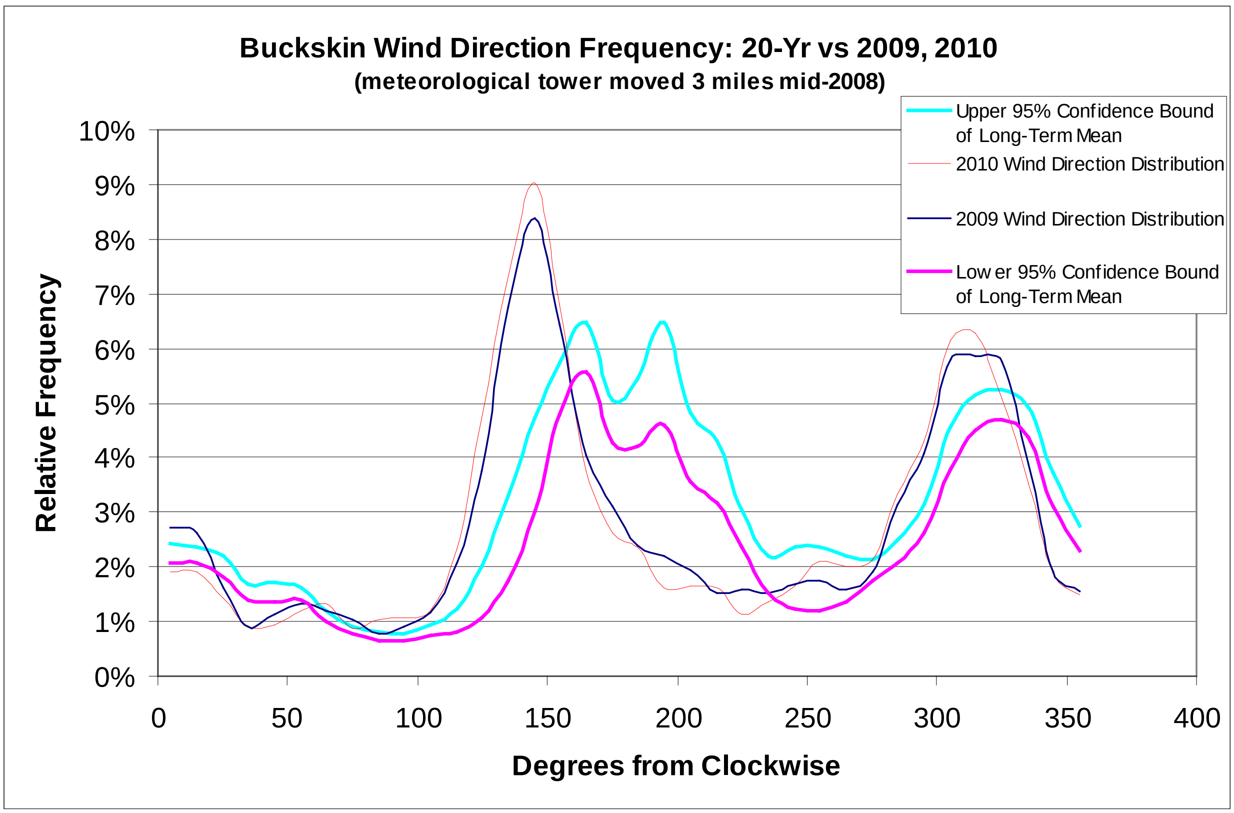
Roughly half of the 36 sectors used to produce Figure 4 show a slight departure of the 2010 frequency from the 95% confidence interval (CI) obtained from the previous

15 years. This result indicates that the occurrence of winds from half of the sectors in 2010 is not significantly different than the long-term occurrence. Moreover, among the sectors failing to meet this standard, the average departure from the 95% CI is only 11.5% of the mean frequency. The time-weighted average of all such departures is a mere 5% of the mean frequency (5 hours out of every 100 hours). Such minor deviations from the long-term pattern, illustrated in Figure 4, tend to confirm the concept of a site signature discussed above.

Influence of Meteorological Station Location

To corroborate the test results from Dry Fork Mine data, a similar study was conducted for the Buckskin Mine. Figure 5 graphs the results, which show a significant departure of annual frequencies in 2009 and 2010 from the 95% CI of long-term (20-year) mean frequencies. This result would tend to refute the applicability of a site signature to the Buckskin Mine. Further investigation, however, revealed that Buckskin moved the meteorological station approximately three miles to the northeast in mid-2008.

Figure 5 – Buckskin 1990-2010



Differences in elevation and terrain between the two sites may account for the change in wind direction patterns (note the similarity between 2009 and 2010 data sets, both of which were collected at the new location).

In order to test this theory, the effect of the met station move was eliminated by shifting the period of analysis back from 1990-2010 to 1986-2007. Figure 6 presents the revised results, with years 2006 and 2007 graphed against the 95% CI for long-term mean direction frequencies. In this case, the confidence interval was developed using data from 1986 through 2005.

Figure 6 – Buckskin 1986-2007

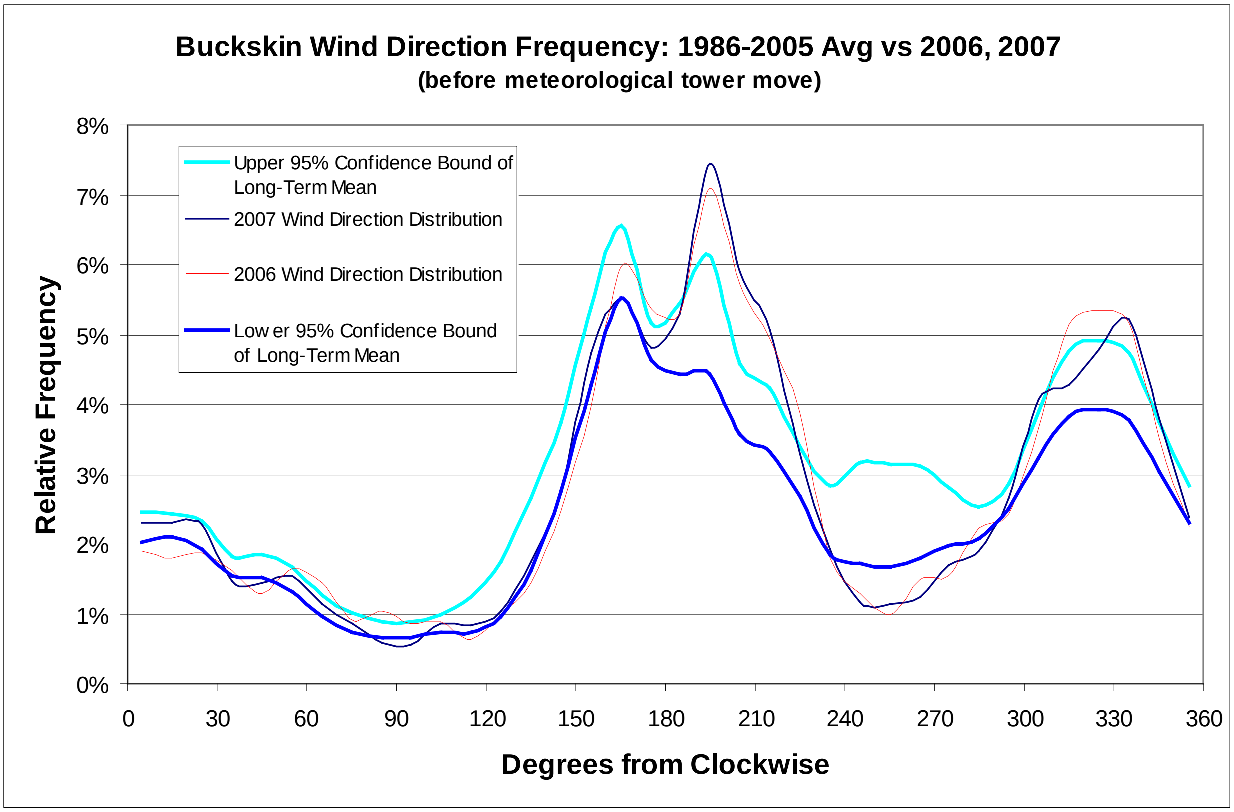


Figure 6 reflects only data collected at the original met station site. It shows a much stronger parallel between short-term and long-term data than Figure 5, which includes both sites. Although the departures from the CI are more pronounced for Buckskin than for Dry Fork (Figure 4), a site signature is certainly more apparent in Figure 6 than in Figure 5. It can be seen that the departures from the CI in Figure 6 actually accentuate that signature.

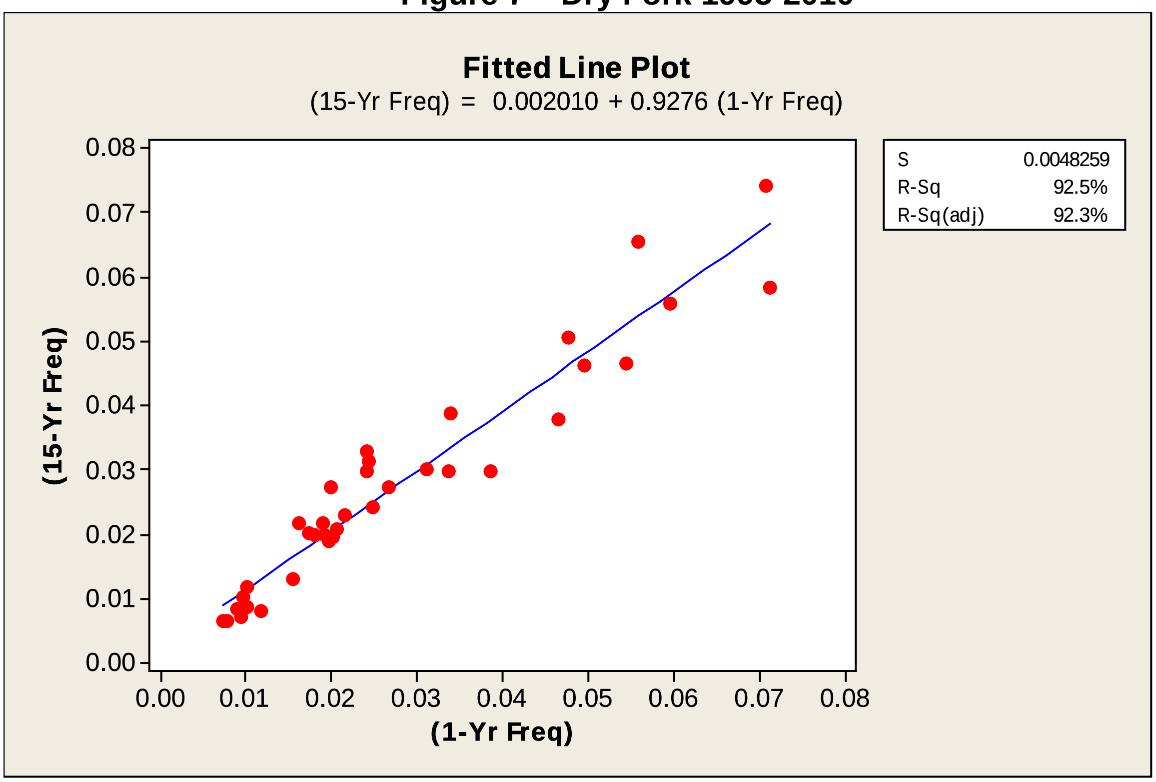
<u>Regression Analysis</u>
Hypothesis testing does not yield a single quantitative measure of how well one data set represents, or fits another. To overcome this limitation, a linear regression analysis was performed on 36 data pairs – each pair containing one value from the Dry Fork 15-year frequency distribution and one from the Dry Fork one-year (2010) distribution. With an R^2 value of 92.5%, the one-year frequency is a good predictor of the 20-year average frequency for any given sector (or vice versa). One interpretation of this result is that 92.5% of the variance in wind frequency between short and long-term data can be explained or predicted by knowing the direction sector (note that each data pair represents a specific sector). The other 7.5% of the frequency variance must be attributed to random differences in wind direction from year to year.

Dry Fork Regression Analysis: (15-Yr Freq) versus (1-Yr Freq)

```
The regression equation is
(15-Yr Freq) = 0.00201 + 0.928 (1-Yr Freq)

Predictor         Coef   SE Coef      T      P
Constant      0.002010  0.001494   1.35  0.187
(1-Yr Freq)    0.92763   0.04531  20.47  0.000

S = 0.00482587   R-Sq = 92.5%   R-Sq(adj) = 92.3%

Analysis of Variance

Source          DF         SS         MS       F      P
Regression       1  0.0097620  0.0097620  419.17  0.000
Residual Error  34  0.0007918  0.0000233
Total           35  0.0105539
```

Figure 7 graphs these data pairs along with the straight line fit and confirms the R^2 value of 92.5%. In the fitted line equation, an intercept of 0 and a slope of 1 would indicate exact linear correlation. The actual, least-squares intercept of 0.00201 and slope of 0.9276 only approach this condition.

Figure 7 – Dry Fork 1995-2010



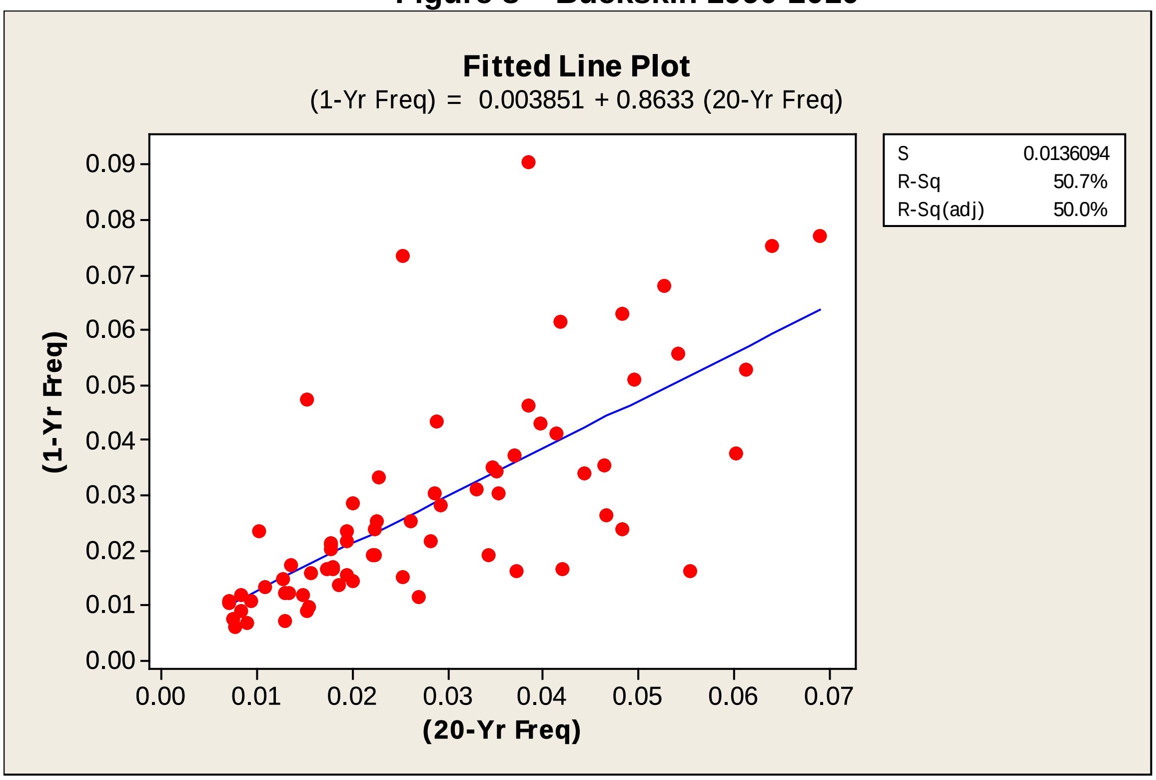
The linear correlation method shows 2010 to be representative of the long term at Dry Fork Mine. At Buckskin, where the met station was moved in 2008, one might expect a much weaker correlation between 2010 data and 1990-2009 data. Indeed that is the case, as shown below.

Buckskin Regression Analysis: (1-Yr Freq) versus (20-Yr Freq)

```
The regression equation is
(1-Yr Freq) = 0.00385 + 0.863 (20-Yr Freq)

Predictor          Coef   SE Coef     T      P
Constant       0.003851  0.003274  1.18  0.244
(20-Yr Freq)     0.8633    0.1025  8.42  0.000

S = 0.0136094   R-Sq = 50.7%   R-Sq(adj) = 50.0%

Analysis of Variance

Source          DF        SS        MS      F      P
Regression       1  0.013138  0.013138  70.94  0.000
Residual Error  69  0.012780  0.000185
Total           70  0.025918
```

An R^2 value of 50% indicates very weak correlation between 1990-2009 data and 2010 data. Figure 8 illustrates this graphically.

Figure 8 – Buckskin 1990-2010



If this analysis is shifted backward in time to avoid data collected after the Buckskin met station move, the correlation improves markedly. Comparing wind direction data from 1986-2005 with either the 2006 or 2007 data sets yields an R^2 value of around 87% (Figures 9 and 10).

Figure 9 – Buckskin 1986-2006

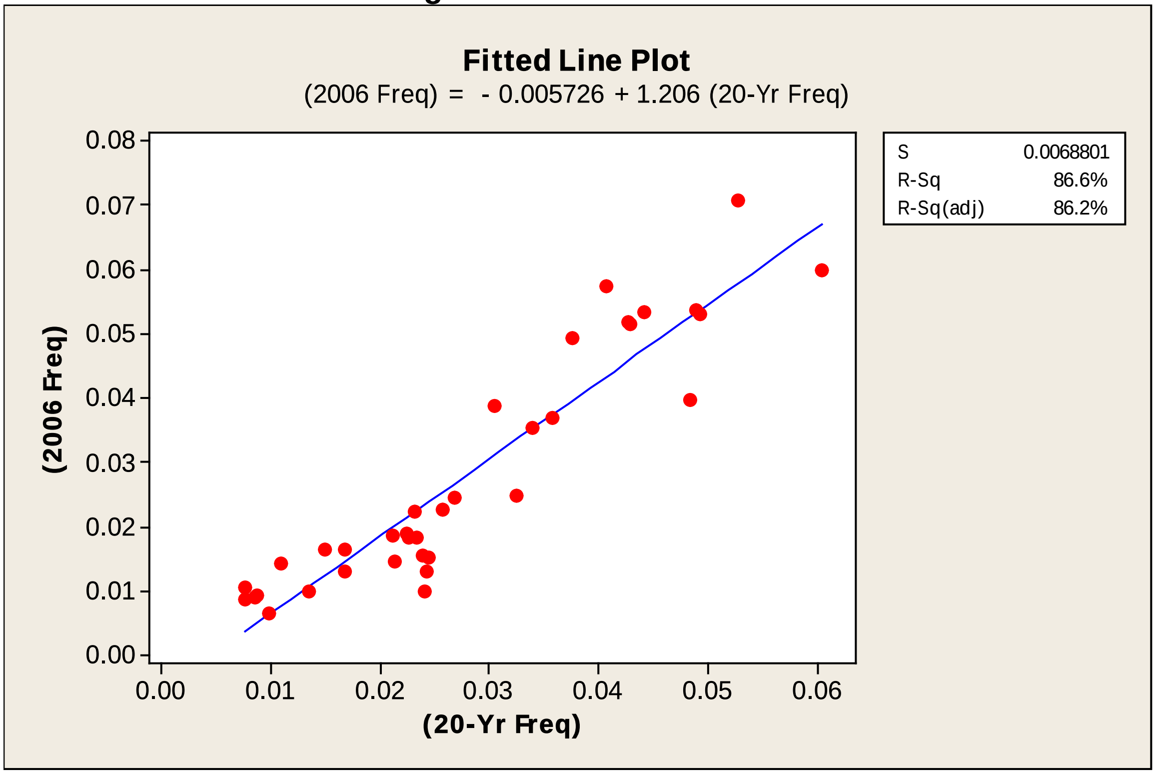
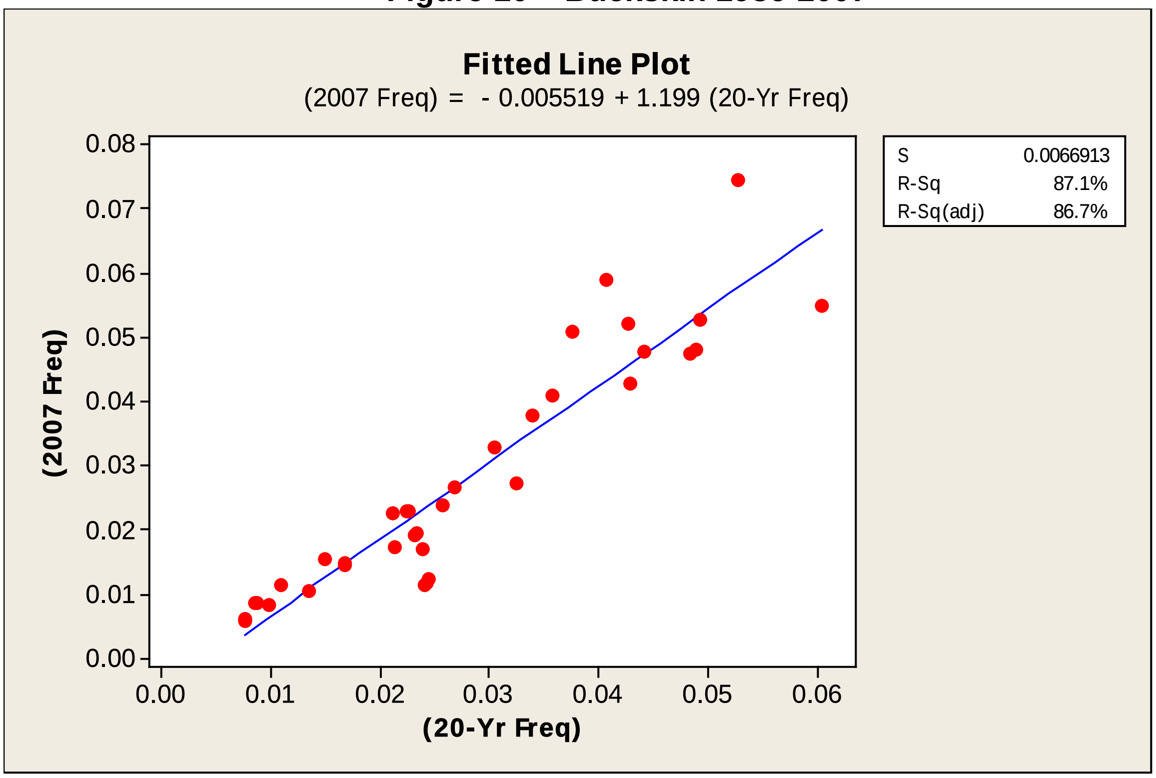


Figure 10 – Buckskin 1986-2007



Other Site Signatures
Wind direction data from Antelope Mine and the Gillette Airport were considered in an attempt to confirm the concept of a site signature and the linear correlation between short and long-term data. The wind data from Antelope Mine (southeast of Wright) spans a period of 21 years (1990 through 2010). For this site, the long-term average was computed from the first 20 years and compared to year 2010. Figure 11 reveals a wind direction signature for Antelope that is distinct from either Dry Fork or Buckskin.

Figure 11 – Antelope 1990-2010

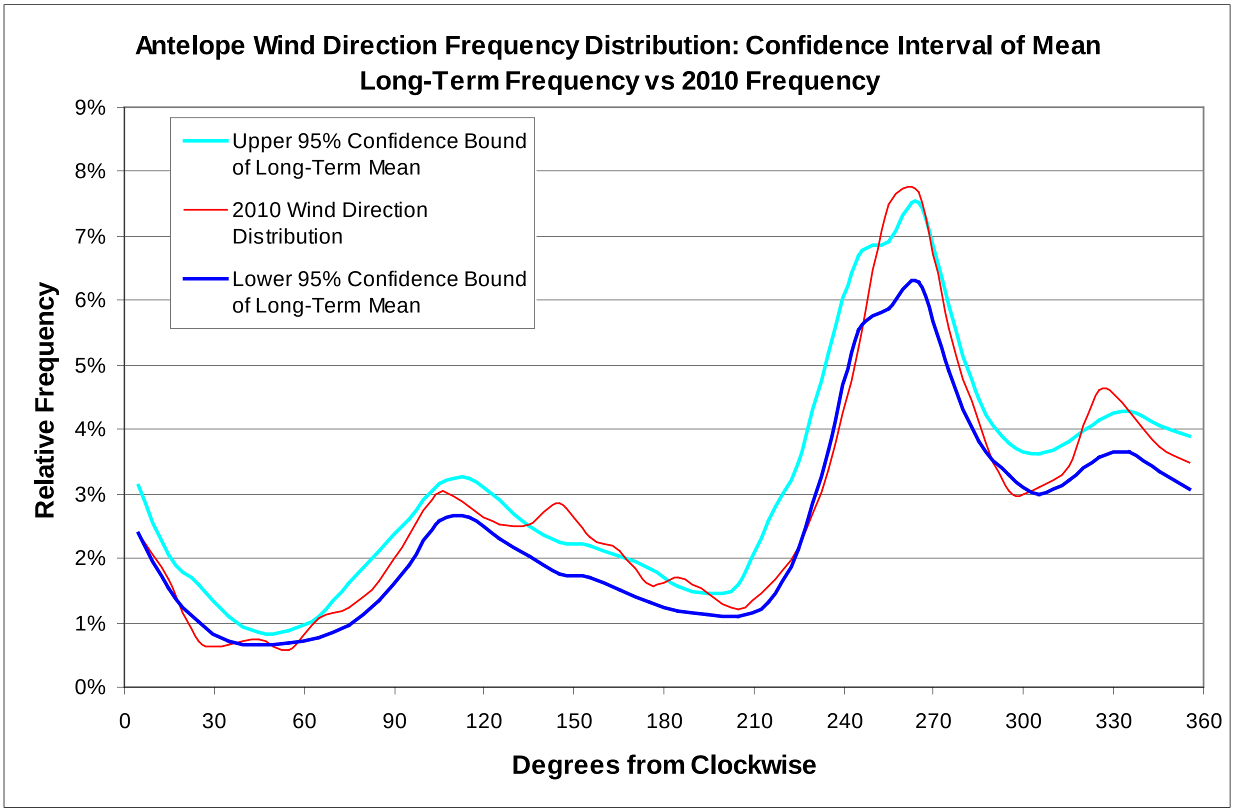


Figure 12 shows a correlation between short and long-term wind direction frequencies at Antelope. The R^2 value of 93.4% is nearly the same as that produced by the Dry Fork correlation, and denotes a strong relationship (or "fit") between 2010 and 1990-2009.

Figures 13 and 14 represent a similar analysis of wind data from the Gillette Airport. Data from a five-year period (2005 to 2009) were compiled to serve as long-term wind direction frequencies and compared to 2010 data. Once again, a site signature is apparent in Figure 13. The R^2 value of 74.2% signifies a weaker correlation, much of which may be explained by poor data resolution. The Gillette Airport wind directions are only available in 10º increments, whereas Antelope, Buckskin and Dry Fork instruments (all operated by IML Air Science) offer 0.1º precision.

Figure 12 – Antelope 1990-2010

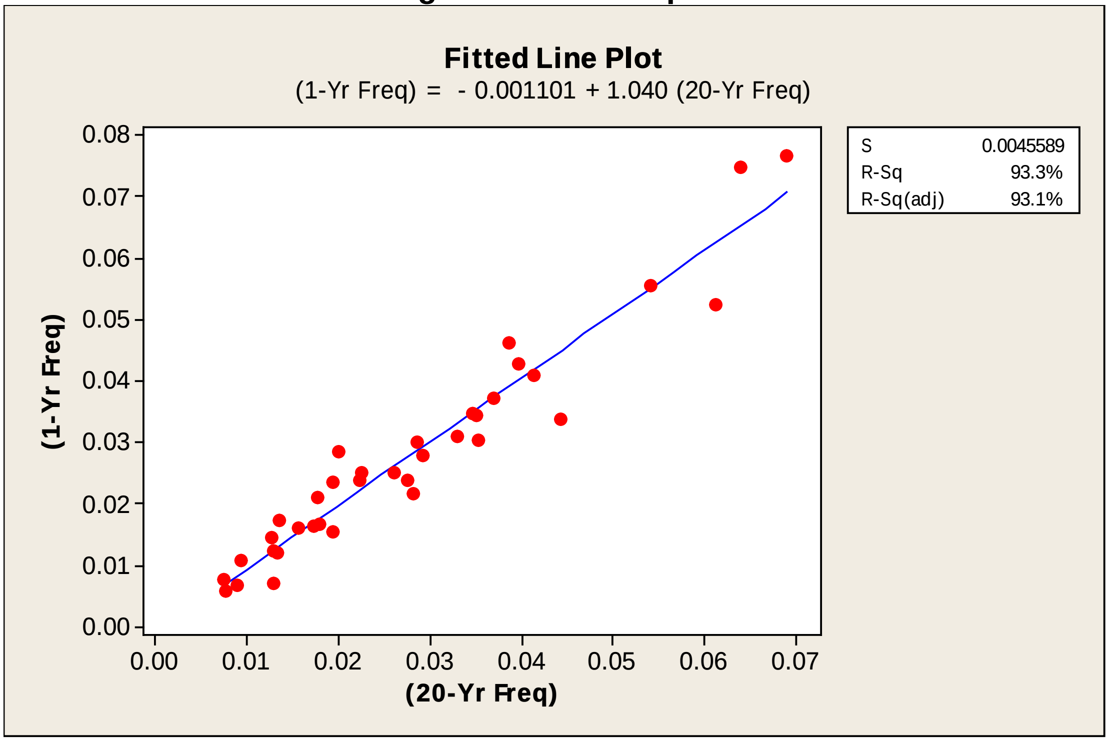


Figure 13 – Gillette AP 2005-2010

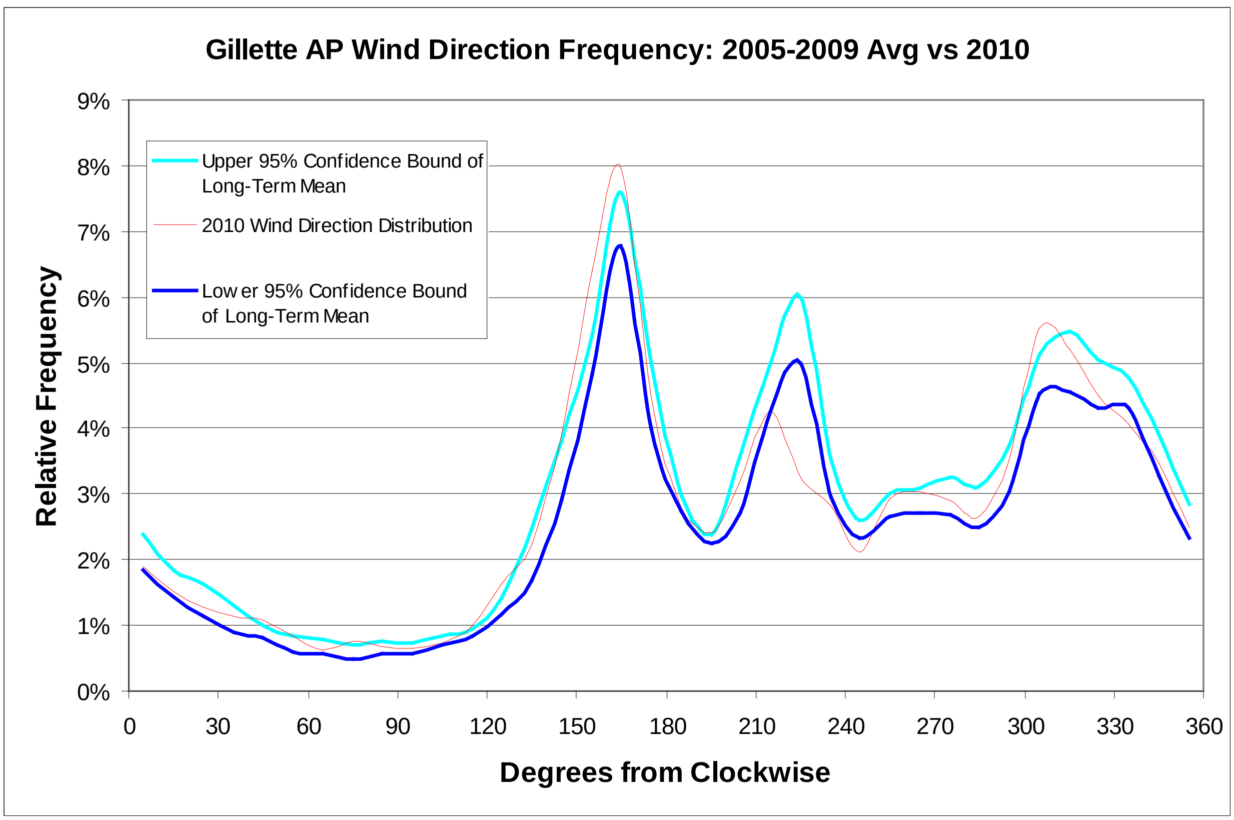
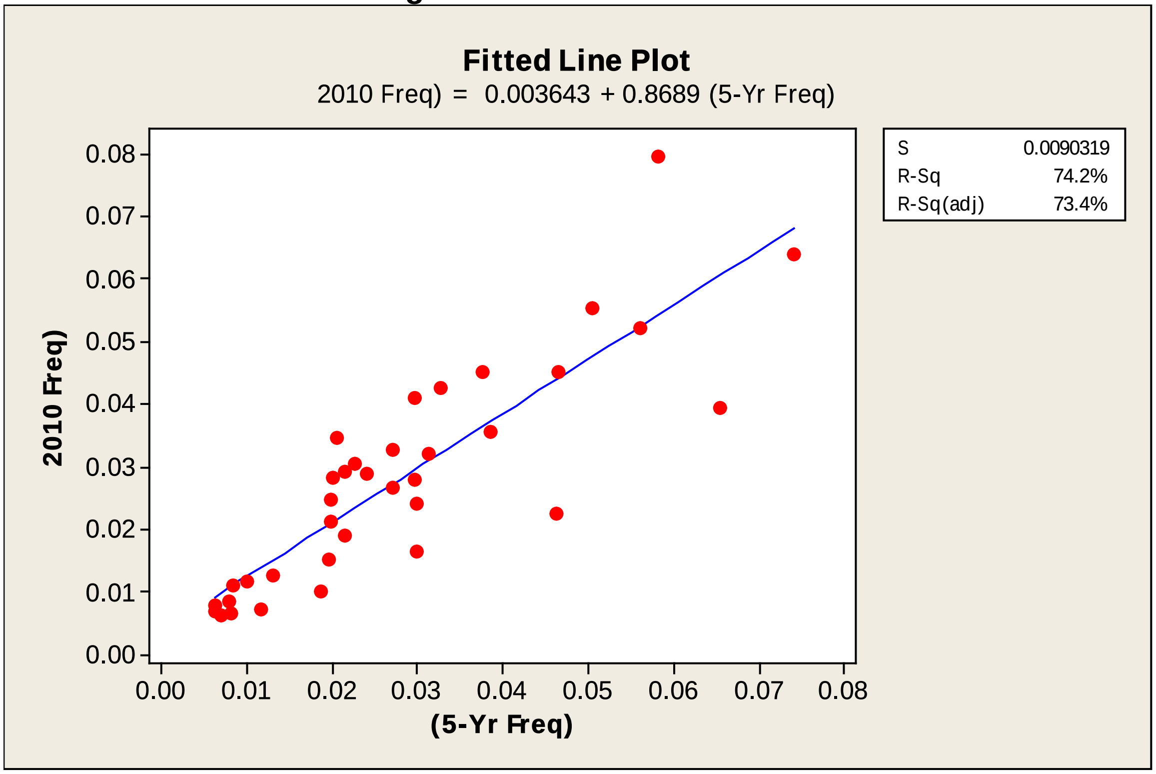


Figure 14 – Gillette AP 2005-2010



Conclusion

This limited study indicates that at least in the Powder River Basin, the location of a wind monitor has greater influence on the distribution of wind directions than does the year in which data are collected. If true, this confirms the need for on-site meteorological monitoring. It also underscores the need to locate the monitoring tower in conditions representative of the anticipated air emission sources. At the same time, it suggests that one year of data is generally adequate to establish a site signature within the tolerance required to assure valid dispersion modeling and to determine appropriate locations for air quality monitoring instruments. Figure 15 shows the site signatures for all four sites in this study to be distinct from one another.

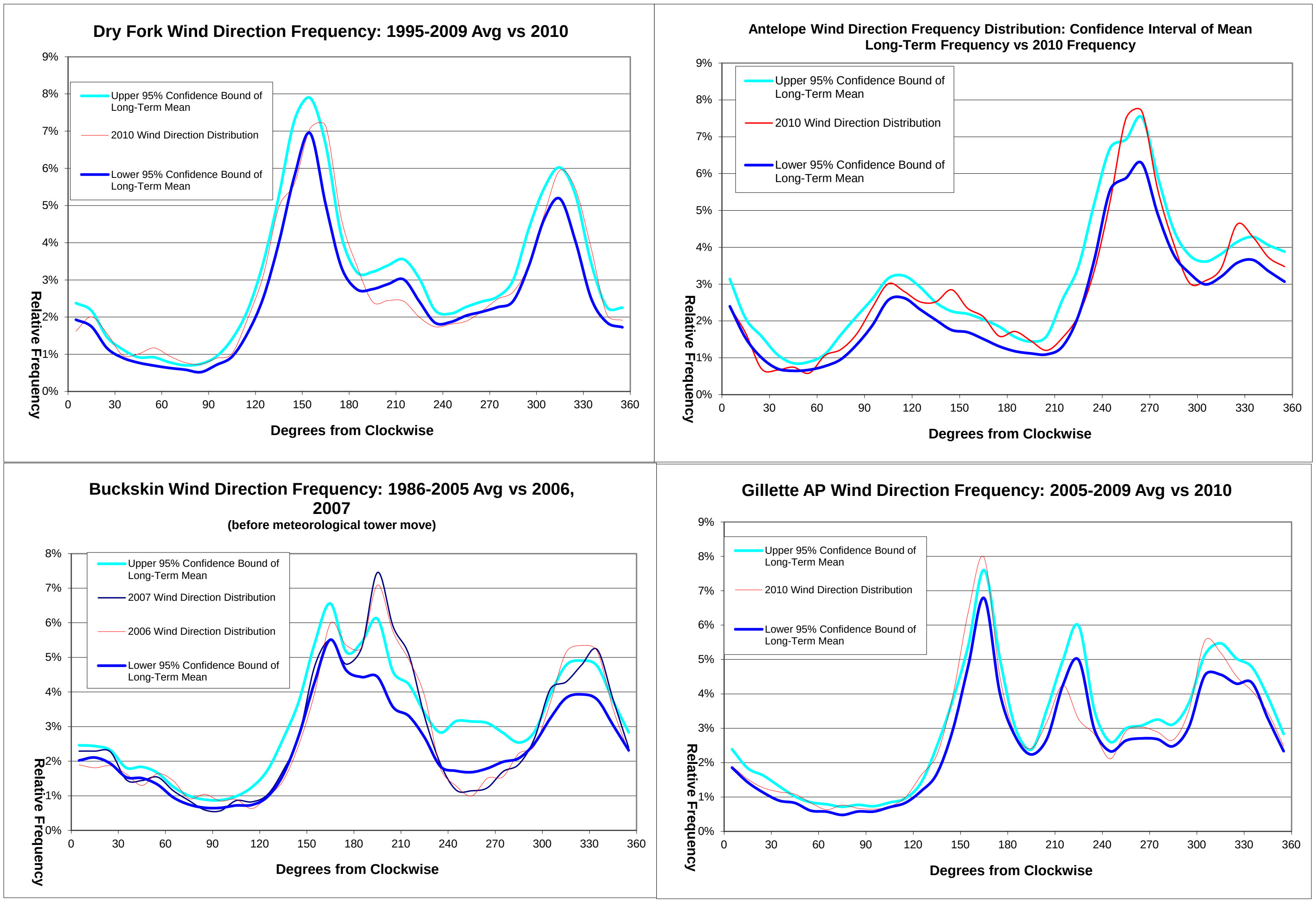


Figure 15 – Comparative Site Signatures

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Addendum to

APPENDIX 2.5-E

Statistical Methodology for Assessing Representativeness of Wind Data

Addendum to Appendix 2.5-E
Statistical Methodology for Assessing Representativeness of Wind Data

The purpose of Appendix 2.5-E was to illustrate minimal temporal variation in wind direction distributions in the Powder River Basin (PRB) of northeastern Wyoming, an area similar in topography and climate to the Dewey-Burdock Project site. At the same time Appendix 2.5-E showed the spatial variation in PRB wind direction distributions to be substantial, even for relatively small geographic displacements. Four sites were chosen to demonstrate these trends:

1. Antelope Coal Mine – 20 years of hourly average wind direction analyzed
2. Buckskin Coal Mine – 20 years of hourly wind direction analyzed
3. Dry Fork Coal Mine – 15 years of hourly wind direction analyzed
4. Gillette Airport – 13 years of hourly wind direction analyzed

The Air Science Division of Inter-Mountain Laboratories operates meteorological monitoring stations at the three mines, according to EPA-approved monitoring protocol. The Gillette Airport meteorological station is operated by the National Weather Service. The most recent full year of monitoring (2010) at these sites was originally chosen to represent short-term wind data in Appendix 2.5-E. In order to more closely tie the analysis in Appendix 2.5-E to the TR RAI 2.5-1(c) response, the following revised analysis replaces year 2010 with the Dewey-Burdock baseline monitoring year of July 18, 2007 through July 17, 2008. Long-term data for the mine sites remain the same as in the original Appendix 2.5-E; eight more years of data were obtained for the Gillette Airport. For each linear regression analysis using the baseline monitoring year for the short-term wind data source, p-values were documented to provide a degree of confidence in the regression results.

The following figures have been revised to reflect the Dewey-Burdock baseline monitoring year as the source of short-term wind direction data. In addition, the linear regression analyses are graphed with basic statistical parameters (including ANOVA and p-value) listed below each graph. As noted in Appendix 2.5-E, poor data resolution offered by the NWS may weaken the Gillette wind direction frequency correlation. Also, the Buckskin correlation is compromised by the meteorological station move in spring 2008 (near, but not at the end of the Dewey-Burdock baseline monitoring year). In both cases, however, unique site signatures and strong correlations between long-term and baseline-year direction frequencies are still apparent.

Results of linear regression analysis are summarized in Table 1.

Table 1 – Long-Term vs. Baseline Year Wind Direction Frequency Regression Analysis

Site	Long-Term Data	Short-Term Data	R^2 Coefficient	p-value
Antelope Mine	1990-2009	Jul 2007 - Jul 2008	95.3%	0.000
Dry Fork Mine	1995-2009	Jul 2007 - Jul 2008	95.7%	0.000
Buckskin Mine	1986-2005	Jul 2007 - Jul 2008	87.0%	0.000
Gillette Airport	1999-2011	Jul 2007 - Jul 2008	93.6%	0.000

Table 1 demonstrates strong correlation between the 2007-2008 baseline-year wind direction frequencies and the longer term at each of these four monitoring sites. All four correlations produced a p-value of 0.000 indicating extremely high confidence in the correlations.

Appendix 2.5-E showed that for the Buckskin site, moving the meteorological monitoring tower a few miles to the north-northeast resulted in a different wind direction signature. The correlation between one year (2010) at the new site and 20 years (1990-2009) at primarily the old site was very weak, with an R^2 value of 50%. To further illustrate the spatial sensitivity of wind direction frequency distributions this addendum compares data from the baseline monitoring year at Buckskin and Gillette. The two sites are approximately eight miles apart. Figure 16 shows a faint linear relationship. The p-value of 0.015 indicates a fairly low probability that the two distributions are completely unrelated; however, the R^2 value of 17.6% does not justify the conclusion that a linear correlation exists. Thus, wind directions for the same time period are distributed differently between these two sites despite their close proximity.

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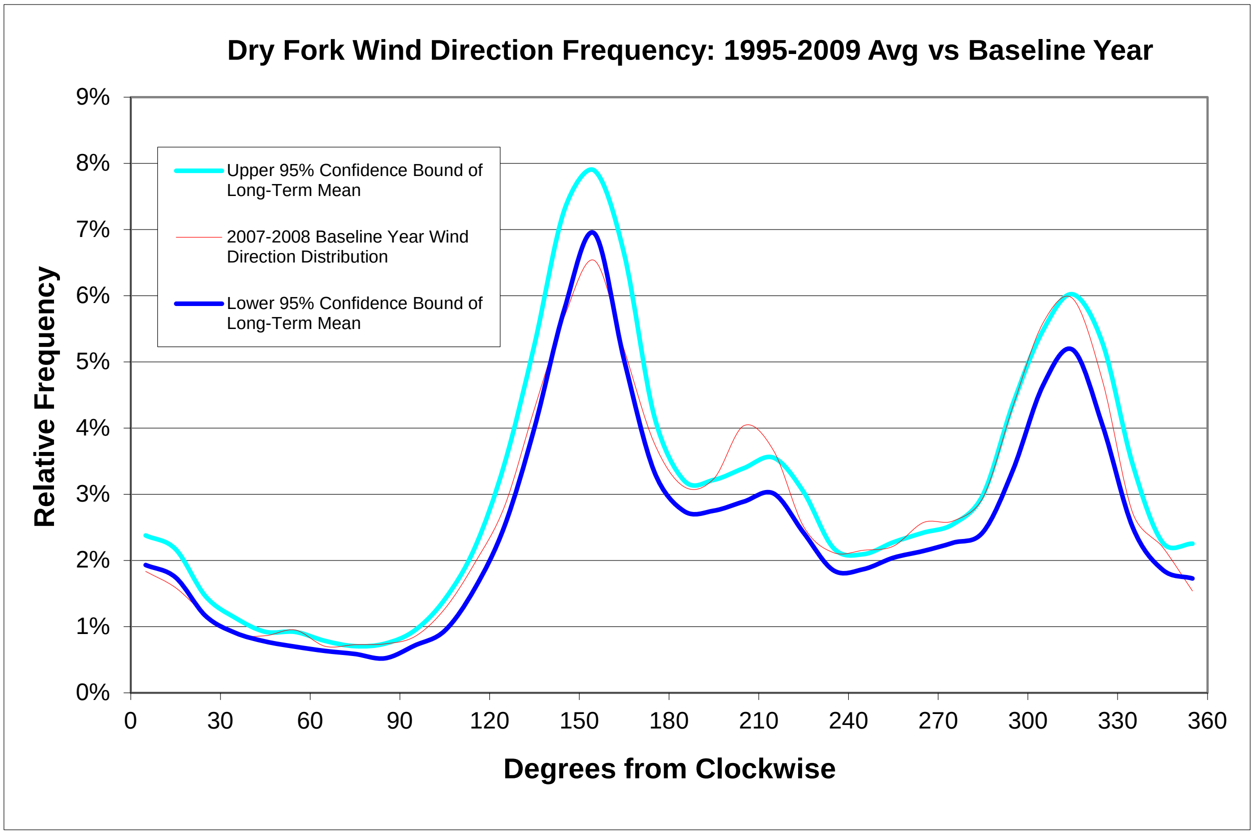
Figure 3 Revised – Dry Fork 1995-2009 95% Confidence Interval



Powertech (USA) Inc.

Figure 4 Revised – Dry Fork 1995-2009 One Standard Deviation Band

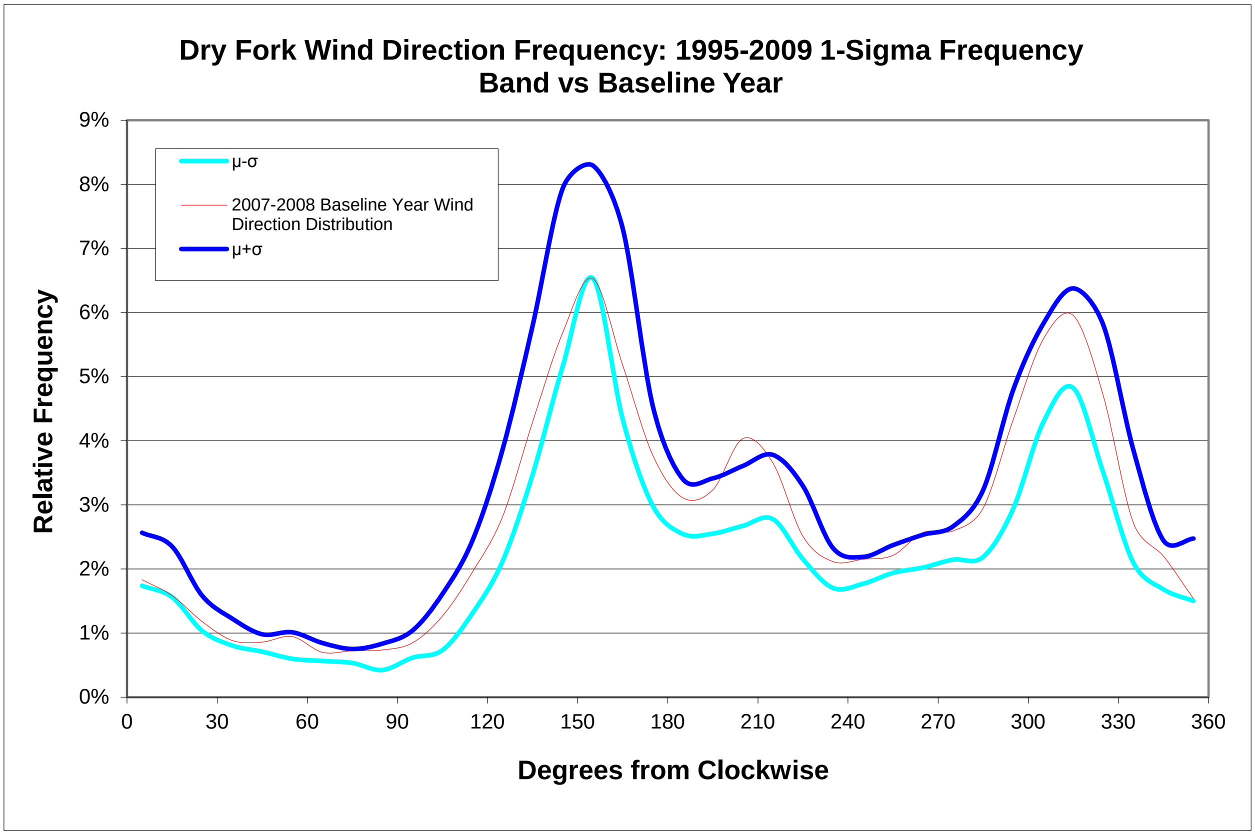


Figure 6 Revised – Buckskin 1986-2005 95% Confidence Interval

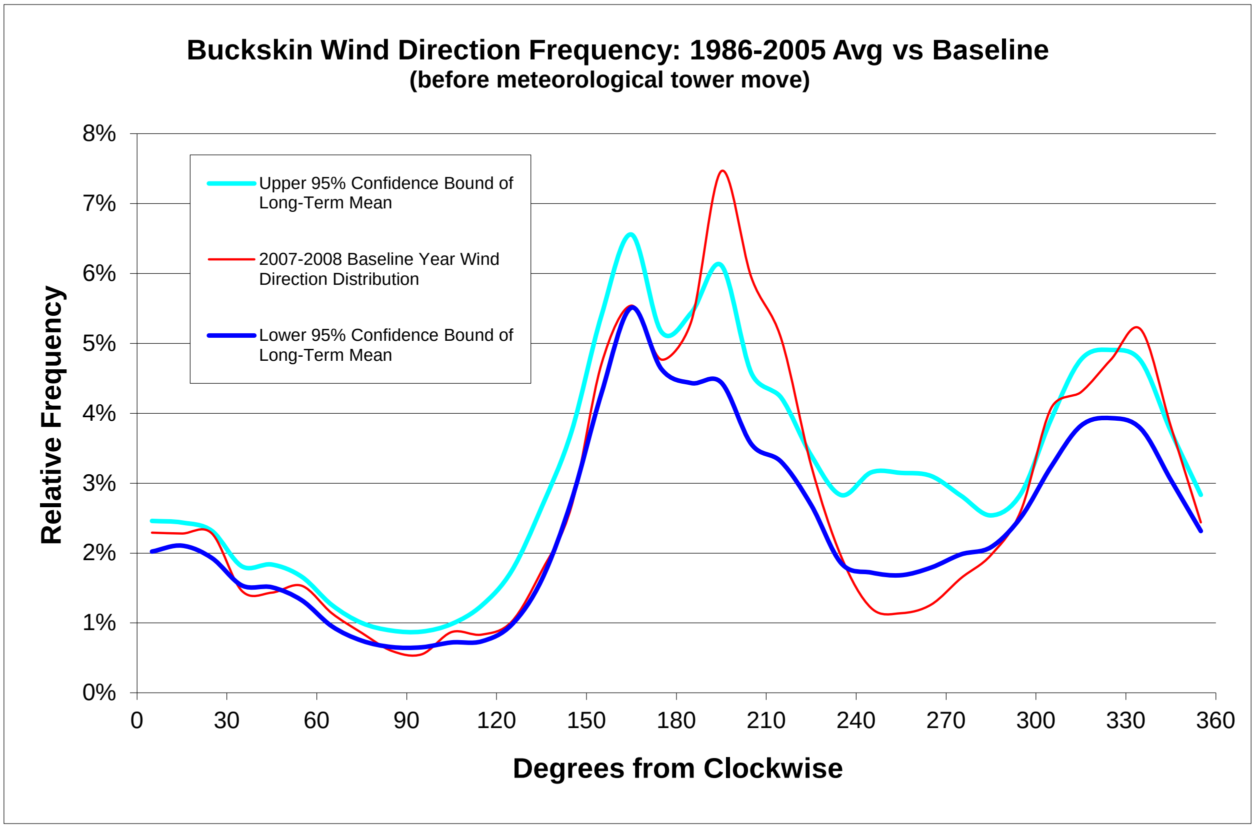
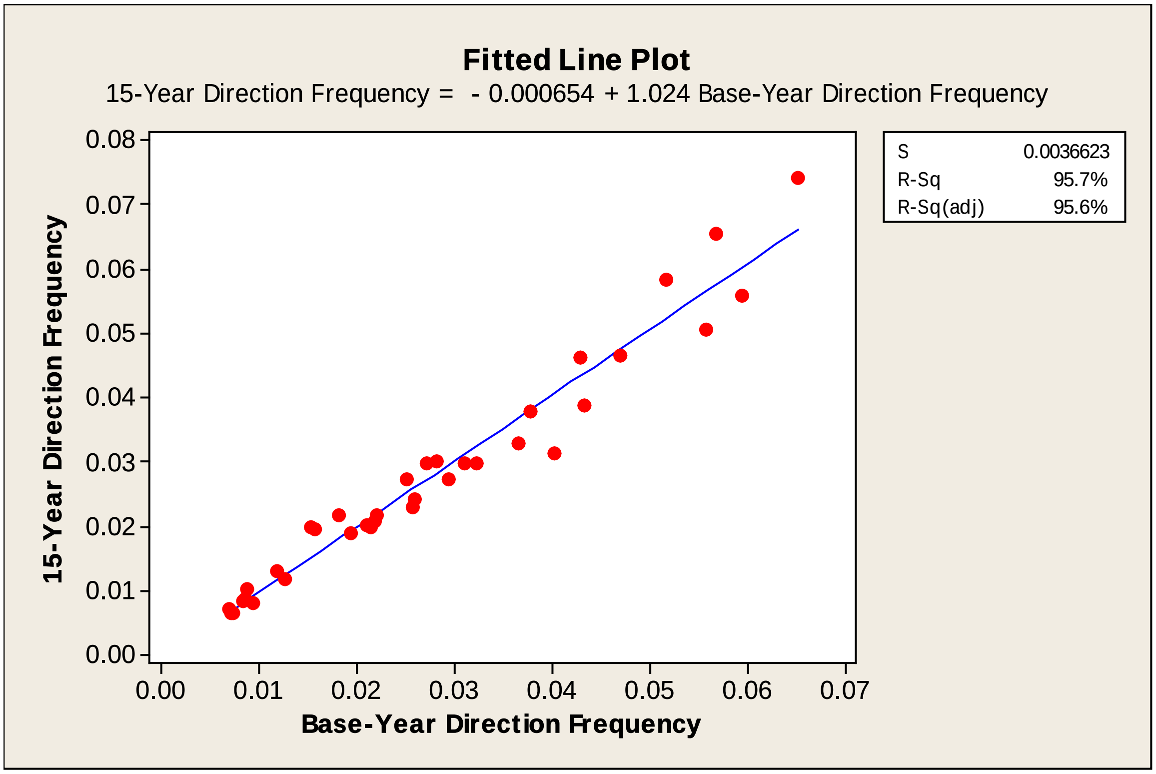


Figure 7 Revised – Dry Fork Regression Analysis



From MINITAB: The regression equation is:

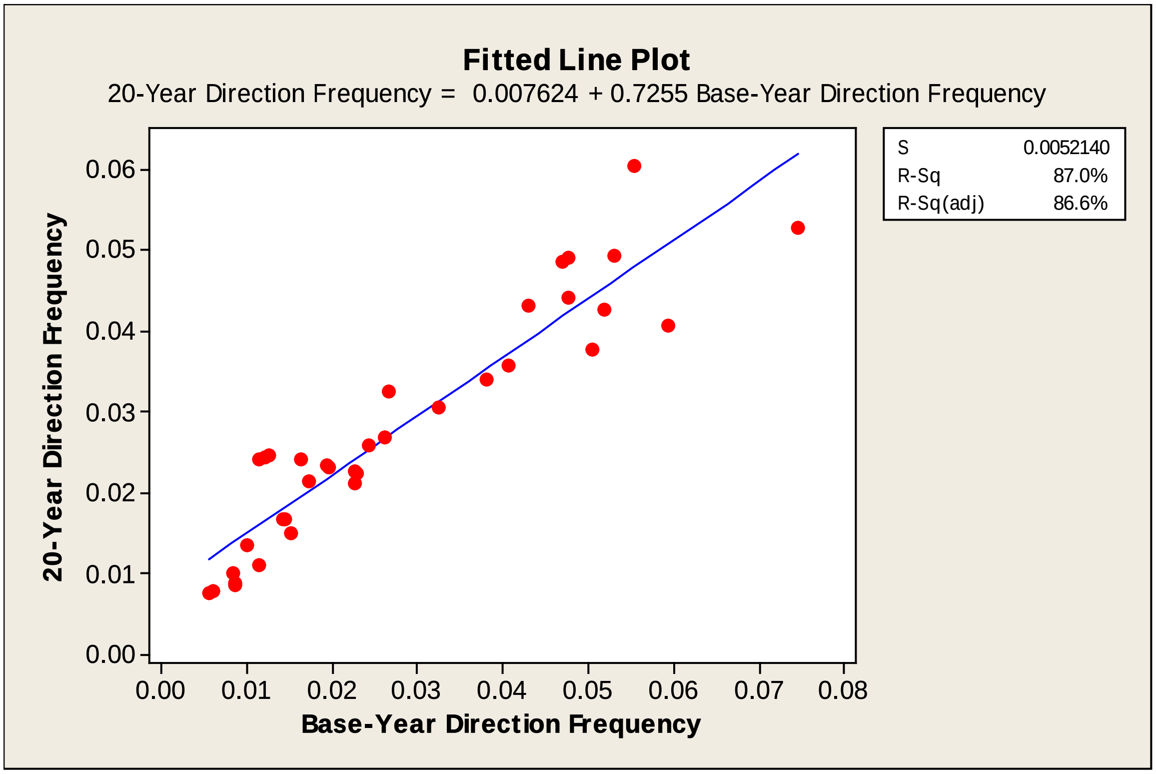
15-Year Direction Frequency = - 0.00065 + 1.02 Base-Year Direction Frequency

S = 0.00366230 R^2 = 95.7% R^2 (adj.) = 95.6%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	0.010098	0.010098	752.87	0.000
Residual Error	34	0.000456	0.000013		
Total	35	0.010554			

Figure 8 Revised – Buckskin Regression Analysis



From MINITAB: The regression equation is:

20-Year Direction Frequency = 0.00762 + 0.726 Base-Year Direction Frequency

S = 0.00521403 R^2 = 87.0% R^2 (adj.) = 86.6%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	0.0062003	0.0062003	228.07	0.000
Residual Error	34	0.0009243	0.0000272		
Total	35	0.0071247			

Figure 11 Revised – Antelope 1990-2009 95% Confidence Interval

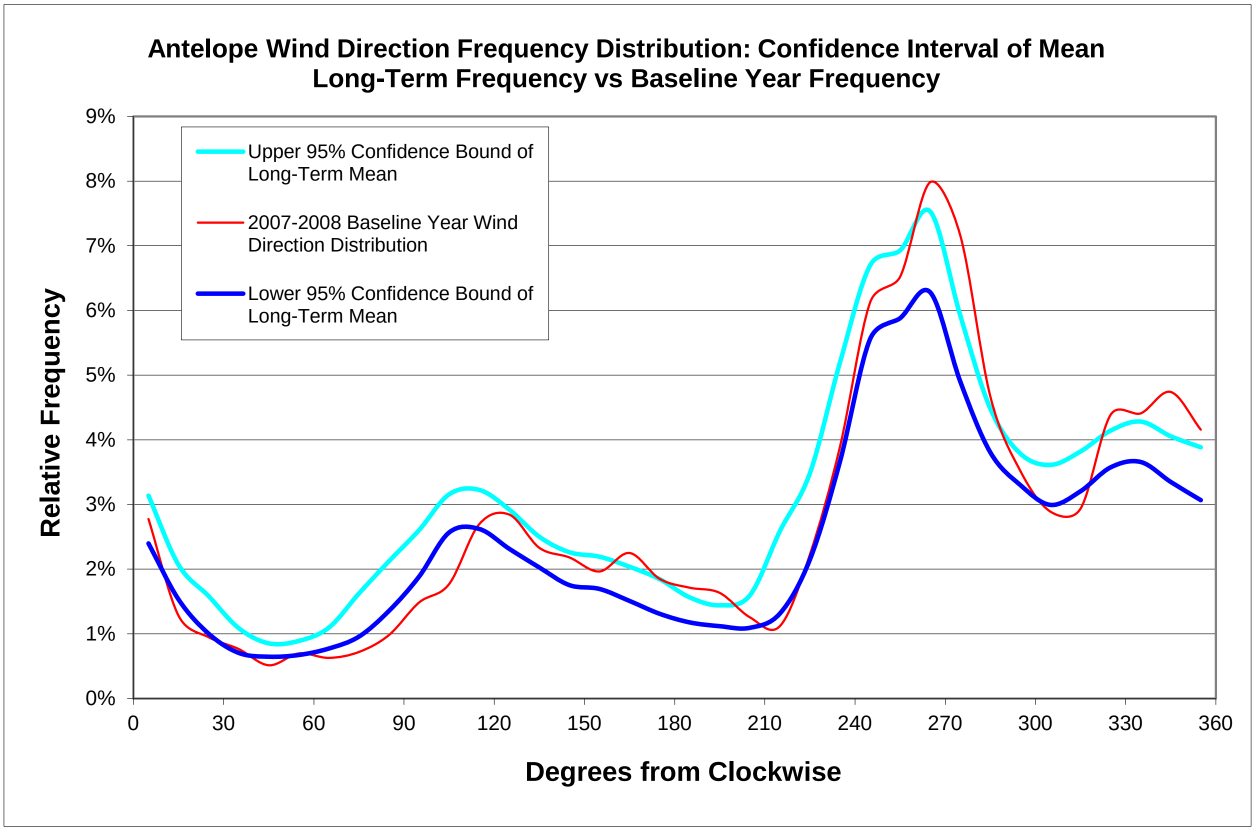


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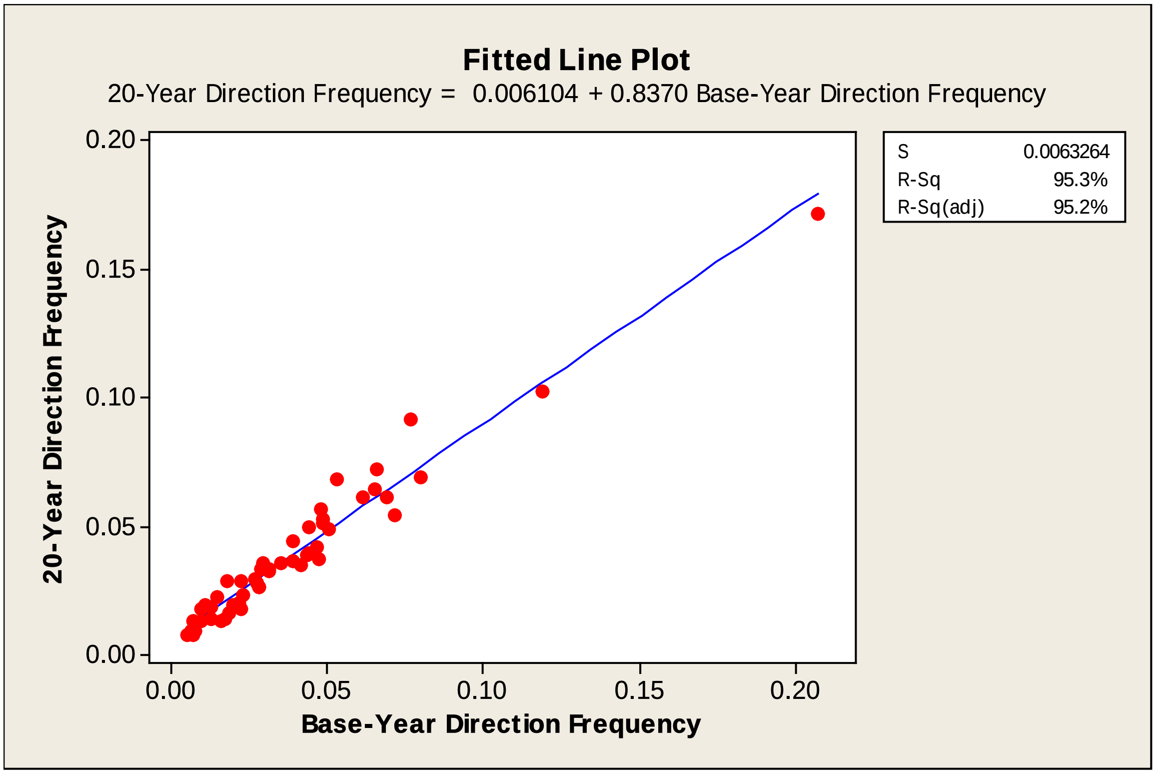
Figure 12 Revised – Antelope Regression Analysis



From MINITAB: The regression equation is:

20-Year Direction Frequency = 0.00610 + 0.837 Base-Year Direction Frequency

S = 0.00632643 R^2 = 95.3% R^2 (adj.) = 95.2%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	0.039455	0.039455	985.80	0.000
Residual Error	49	0.001961	0.000040		
Total	50	0.041417			

Figure 13 Revised – Gillette 1999-2011 95% Confidence Interval

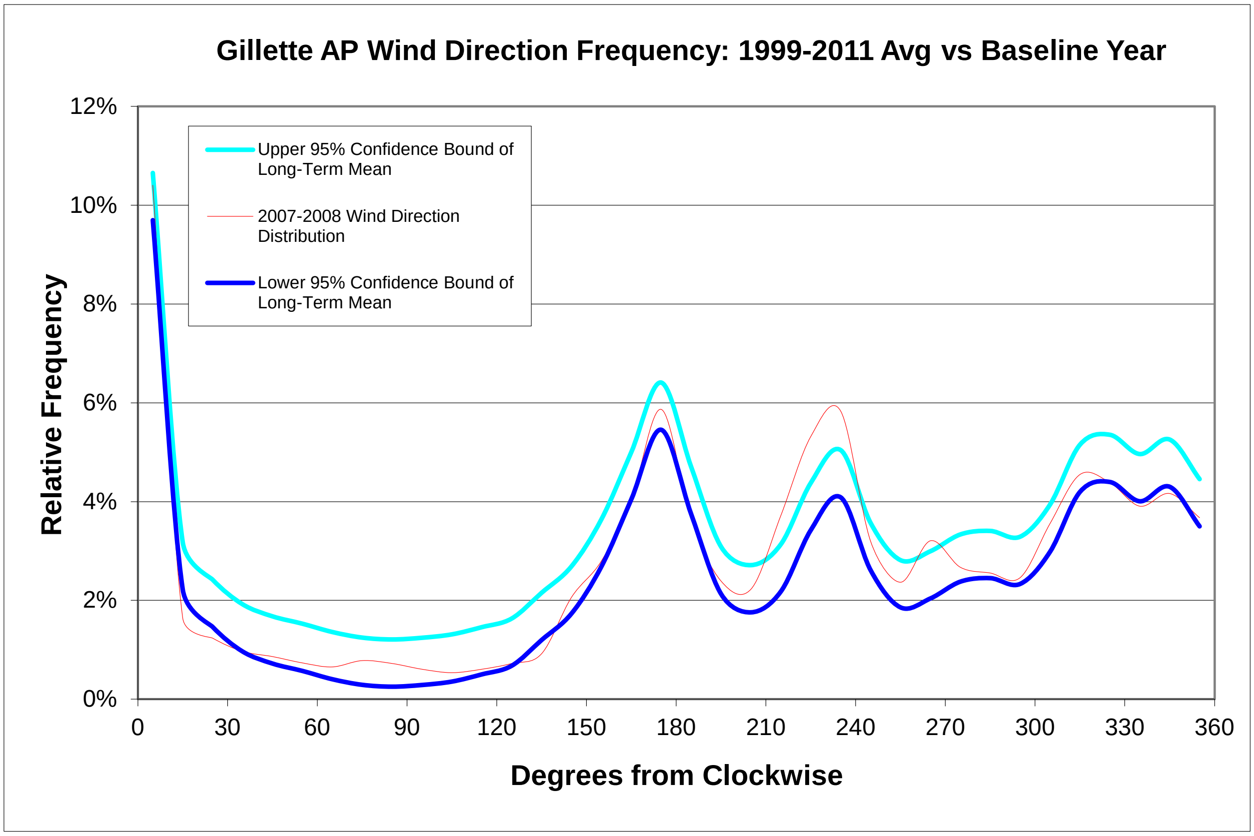
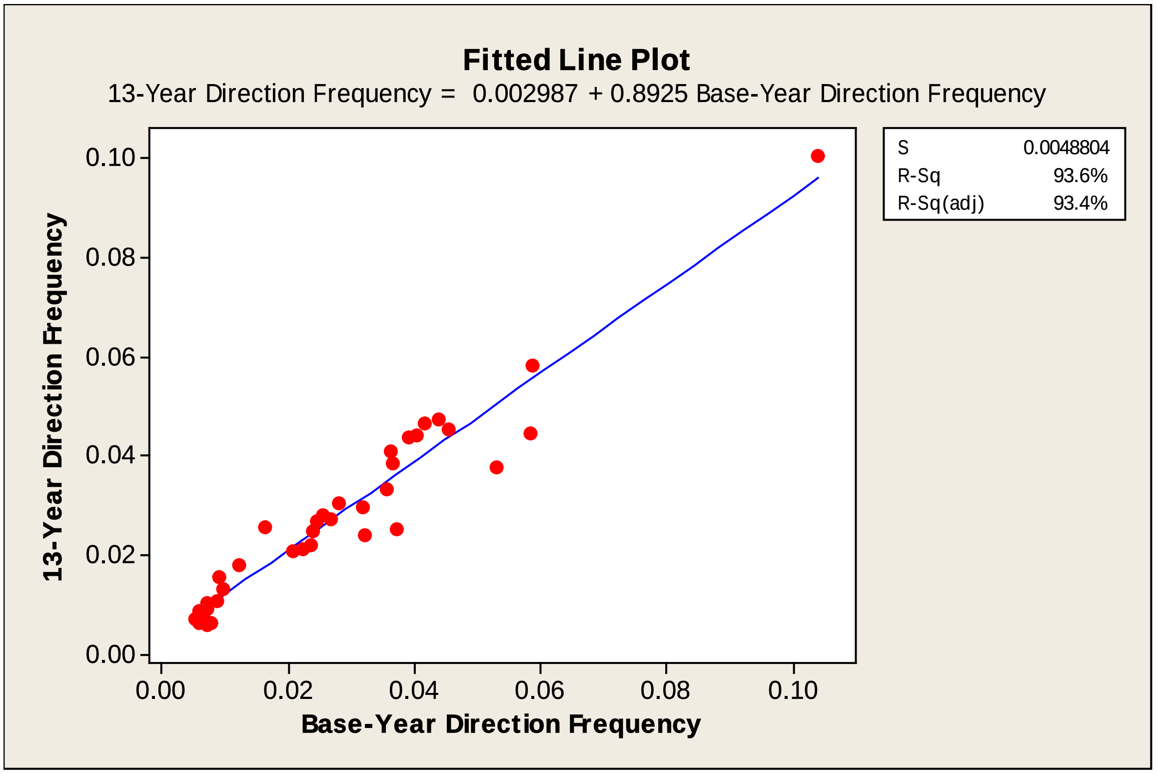


Figure 14 Revised – Gillette Regression Analysis



From MINITAB: The regression equation is:

13-Year Direction Frequency = 0.00299 + 0.892 Base-Year Direction Frequency

S = 0.00488041 R^2 = 93.6% R^2 (adj.) = 93.4%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	0.011813	0.011813	495.94	0.000
Residual Error	34	0.000810	0.000024		
Total	35	0.012622			

Figure 15 Revised – Comparative Site Signatures

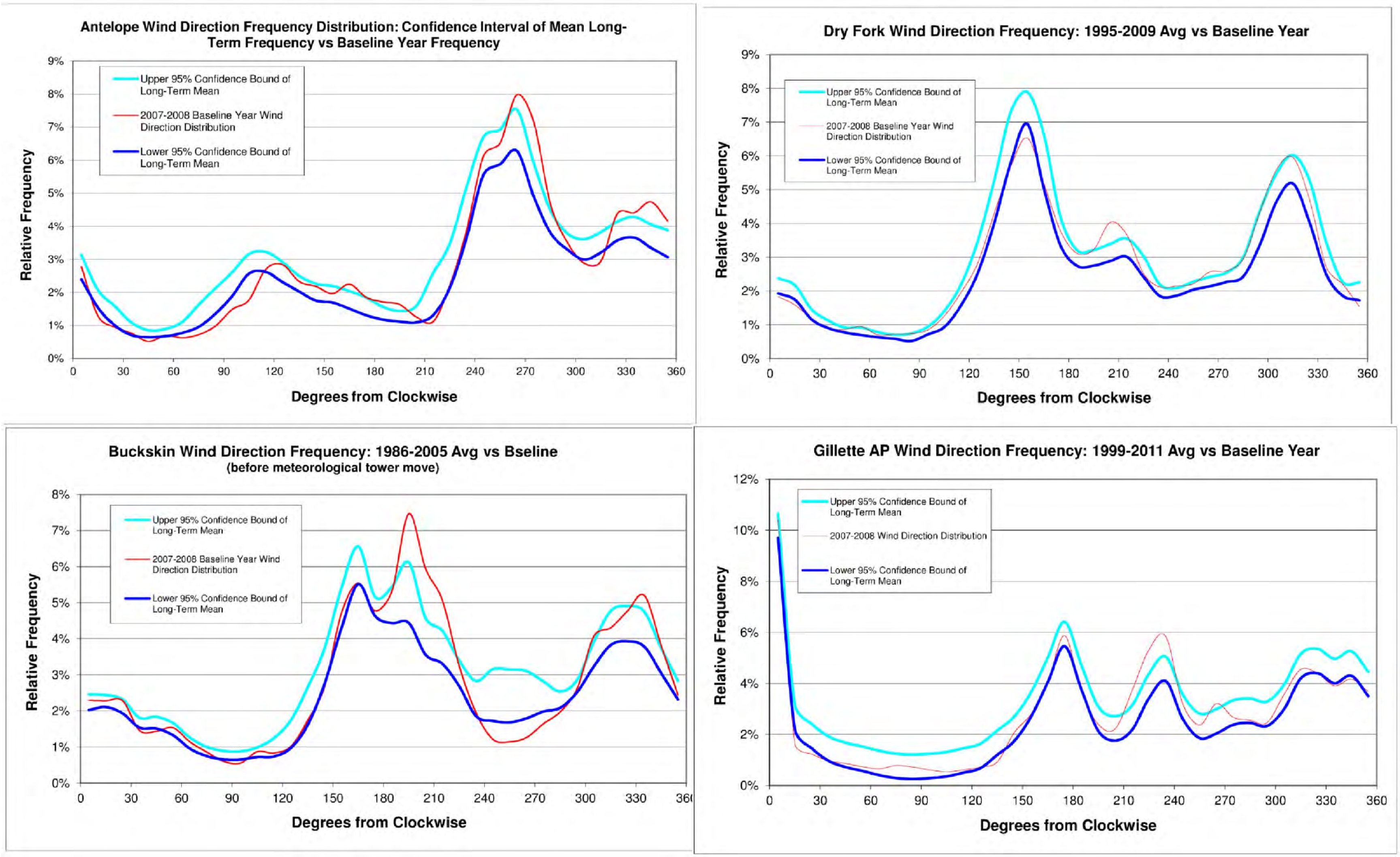


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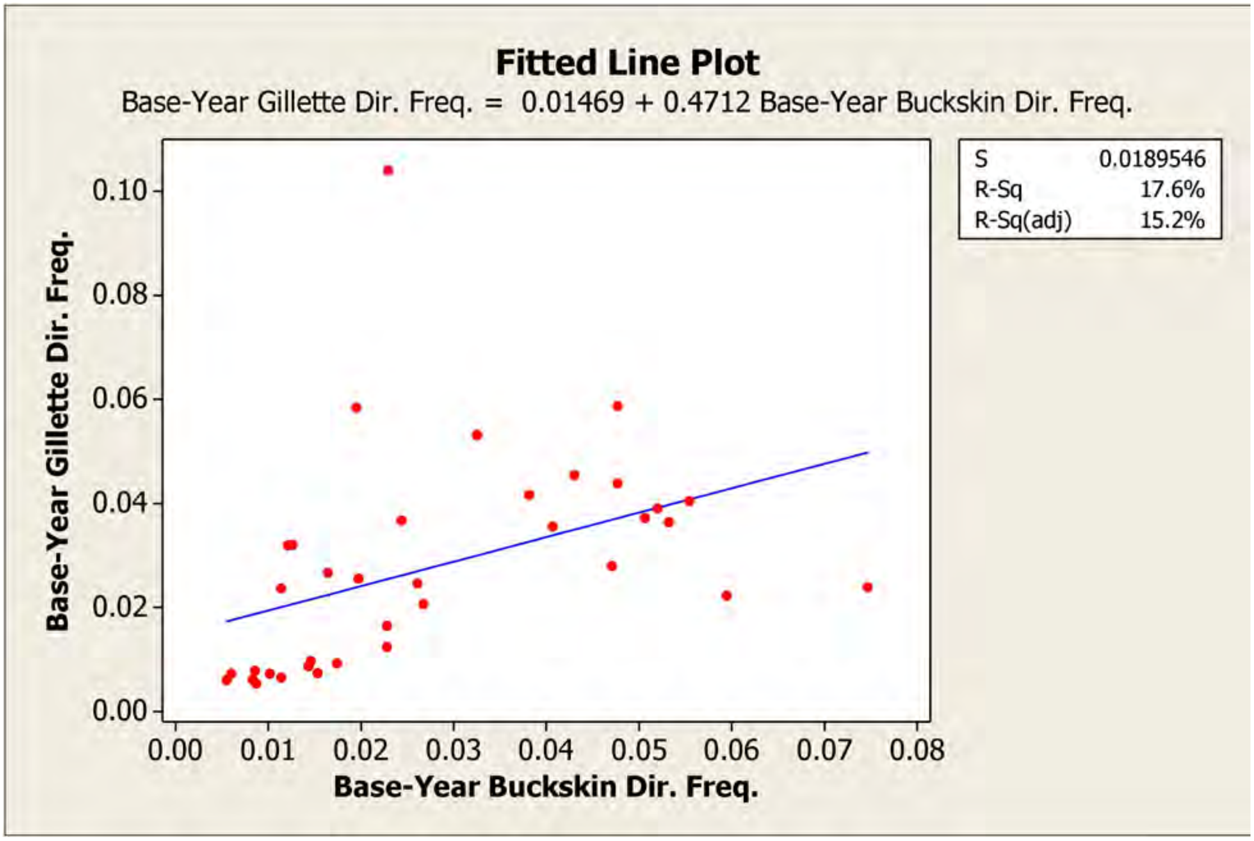
Figure 16 – Baseline-Year Wind Direction Frequency Correlation: Gillette vs. Buckskin



From MINITAB: The regression equation is:

Base-Year Gillette Dir. Freq. = 0.01469 + 0.4712 Base-Year Buckskin Dir. Freq.

S = 0.0189546 R^2 = 17.6% R^2 (adj.) = 15.2%

Analysis of Variance

Source	DF	SS	MS	F	P
Regression	1	0.0026156	0.0026156	7.28	0.011
Error	34	0.0122154	0.0003593		
Total	35	0.0148310			

APPENDIX 2.5-F

Dewey-Burdock Meteorological Station Operation and Maintenance

POWERTECH (USA) INC.

South Dakota State University

SDSU

College of Agriculture and Biological Science
and College of Engineering

Agricultural and Biosystems
Engineering Department
Box 2120, SDSU
Brookings, SD 57007-1496

April 6, 2011

Richard Blubaugh
VP-EH & S Resources Resources
Powertech (USA) Inc.

To Whom It May Concern:

The automated weather station at Dewey-Burdock was installed at the request of Powertech to monitor atmospheric conditions in the vicinity as required by the NRC. The automated station is part of the South Dakota Automated Weather Station Network (AWDN), one of 40 stations currently running across the state.

The station was completely new and fully functioning when installed in 2007. Our data technician completed two visits after installation to assure station was working according to needs. Data from the stations have a visual QA/QC to compare data to nearby stations. Because of the remote nature of the station and remoteness of the location for basic access to the station and because of the distance from our home data center in eastern South Dakota (Brookings) we only make annual visits to stations for annual maintenance. Addition trips occur as needed during other times of the year.

We therefore utilize comparisons of data to nearby stations with the ongoing data collection to determine the data quality. We found no issues that required special visits during the time in question.

Sincerely,

D. D. Todey

Dr. Dennis Todey
South Dakota State Climatologist