Energy Research and Development Division
FINAL PROJECT REPORT

DRILLING AND TESTING OF AN EXPLORATORY WELL TRUCKHAVEN GEOTHERMAL AREA IMPERIAL COUNTY CALIFORNIA

APPENDICES

Prepared for: California Energy Commission
Prepared by: Layman Energy Associates, Inc.

MARCH 2008
CEC-500-2013-083-AP

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ACKNOWLEDGEMENTS

Layman Energy Associates, Inc. (LEA) wishes to express its sincere appreciation to Iceland America Energy, Inc. (IAE), with whose involvement this drilling and testing program could not have been completed. IAE's financial support, project management assistance and general perseverance were critical to success of the project. We also wish to express our thanks to the California Energy Commission for its financial support of the project under the GRDA program.

PREFACE

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Drilling and testing of an exploratory well, Truckhaven geothermal area, Imperial County California is the final report for the Geothermal Resources Development Account Program project (contract number GEO-04-007) conducted by Layman Energy Associates, Inc. The information from this project contributes to Energy Research and Development Division's Energy-Related Environmental Research Program.

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ABSTRACT

Iceland America Energy, Inc. drilled and tested an exploratory geothermal well at the Truckhaven area in northwest Imperial County, California. The project was partially funded by the Energy Commission's Geothermal Resources Development Account Program. The project goals were to obtain necessary permits; procure services and equipment; construct the wellpad; drill and test an exploratory well; and prove that a commercially productive resource was present. Well IAE Trk-1 was completed to a depth of 7,139 feet and the project team subsequently ran temperature, pressure and spinner logs and flow tested the well.

Flow testing indicated IAE Trk-1 was a marginally productive geothermal well. Equilibrated temperature logs indicated a maximum temperature of 350 degrees Fahrenheit at 7,000 feet. However, the temperature profiles lacked the extensive isothermal zones commonly associated with commercially productive geothermal resources. The well-produced about 660 gallons/minute (pre-flash) at low wellhead pressure during a 3.5 hour artesian test after well stimulation. The well produced a low-salinity, 260 degree Fahrenheit fluid derived from porous sand horizons below the 13 3/8 inch casing shoe to a depth of 4,500 feet. Formation productivity was relatively low, with a carbonate hardness value of about 10,000 millidarcy feet and a productivity index of 2.5 gallons/minute per pounds per square inch. Computer simulation of the well performance indicated a productive potential of about 1.5 megawatts, net of parasitic, if the well was equipped with a downhole pump. If it is not used as a producer, IAE Trk-1 could be converted to an excellent injector well by perforating high porosity sands currently behind the cemented 13 3/8-inch casing.

Keywords: geothermal, geothermal exploration, geothermal drilling, geothermal well testing, Imperial County, Truckhaven, Iceland America Energy, Inc., Layman Energy Associates, Inc.

Please use the following citation for this report:

Layman,, Erk. Layman Energy Associates, Inc. 2008. *Drilling and testing of an exploratory well, Truckhaven geothermal area, Imperial County California*. California Energy Commission. Publication number CEC-500-2013-083-AP.

APPENDIX A:
Geothermex Report on Flow Test Results

APPENDIX A

GEOTHERMEX REPORT ON FLOW TEST RESULTS

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MEMORANDUM

To: Erik B. Layman
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Date: 2 May 2008

cc: Steve Johnson
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From: Jim Lovekin

Subject: Truckhaven No. 1 Flow Testing, 4-9 March 2008

Summary

The Truckhaven No. 1 well at the IAE Truckhaven geothermal project was flow tested in early March 2008. The testing included two periods of artesian flow, before and after coiled tubing work to clean out the bottom portion of the well and induce additional flow by nitrogen lifting. Pressure-temperature-spinner (PTS) surveys were run before and during the flow testing, and pressure build-up data were recorded after both artesian flow periods to characterize the permeability of the formation. Samples of produced brine and steam were collected during the first artesian flow period to determine reservoir fluid chemistry.

The testing indicates that Truckhaven No. 1 has a productive potential equivalent to about 1.5 MW net, assuming use of a downhole pump. The combination of injection and coiled-tubing work appears to have improved the well's performance, increasing the Productivity Index (PI) from 1.9 to 2.5 gpm/psi. Artesian flow after the coiled-tubing work averaged about 660 gpm pre-flash, which could be increased to about 1,340 gpm by pumping. The maximum downhole temperature was approximately 350°F, measured at the bottom of the hole. Spinner data indicate that production was dominated by a cooler zone at 4,500 feet, both before and after the coiled tubing work. The flowing temperature of the brine at the top of the production interval (representing the mixture of all production zones) was about 260°F. Chemical analysis indicates a vapor pressure of 188.5 psia of non-condensible components in pre-flash brine at 260°F. This vapor pressure in part reflects relatively high levels of nitrogen, which could potentially decline under production with the recovery of drilling fluid lost to the formation. An alternative use for the Truckhaven No. 1 could be as an injection well, particularly by perforating the 13-3/8-inch casing in intervals of clean, high-porosity sandstone between 1,900 and 3,100 feet.

Test Description

Permitting limitations precluded flowing the Truckhaven No. 1 to the sump on the drilling pad. Therefore, the testing used twenty 500-barrel tanks to contain produced brine. Figure 1 is a schematic of the layout of the test facility. Flow from the well passed through a flow line to an

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elevated, atmospheric flash tank (AFT), which discharged post-flash brine to Tank No. 4 (the "regulating tank"). The tanks were close-topped with man-holes on top, and they were connected by a manifold with valves that allowed the independent filling and draining of each tank. The flow line to the AFT had three valves: a throttle valve to regulate flow; a shut-off valve to effect a tight seal for purposes of pressure-transient testing, and a working valve immediately downstream of the wellhead as a back-up for the other two valves.

The testing included the following elements:

4 March:	A static pressure and temperature (PT) survey.
5 March:	An artesian flow test that filled all twenty tanks.
6-8 March:	Re-injection of 18 tanks of water, leaving 2 tanks for coiled-tubing operations.
8 March (mid-day):	Water-jetting the bottom portion of the hole through coiled-tubing while simultaneously flowing the well back, filling 6 tanks.
8 March (evening):	Lifting the well with nitrogen through coiled tubing, filling 7 tanks.
9 March:	A second artesian flow period, filling the remaining 7 tanks.

Table 1 summarizes the timing and the volumes of fluid produced and injected during the testing. Tables 2, 3, and 4 present the field data recorded during the first artesian flow test, the coiled-tubing work, and the second artesian flow test, respectively. During each flow period, produced brine was discharged through the regulating tank to the manifold, and the other tanks connected to the manifold were filled sequentially by opening and closing their inlet valves. The water level in the regulating tank oscillated continuously, dropping when each new tank was opened to receive fluid from the manifold, and peaking as each tank reached capacity. This allowed the flow rate of the well to be calculated repeatedly, based on the time between peaks (typically 30 to 40 minutes) and the final liquid level of each tank. The calculation was complicated somewhat by tanks with leaky inlet valves: the changing water levels in these tanks have been accounted for as much as possible based on spot checks during the filling of other tanks. During the nitrogen lifting, the brine flow rate was so high that several tanks had to be opened to the manifold simultaneously to avoid overflowing the regulating tank. For this flow period (which lasted 99 minutes), only a single average flow rate could be calculated, because of oscillations in the liquid levels of multiple tanks.

Static PT Survey, 4 March 2008

This survey was conducted about 10 weeks after completion of the well in December 2007. Figure 2 shows a plot of the results. The well reached a maximum temperature of 350°F on bottom. The tag depth was 7,002 feet with respect to Kelly Bushing (KB), indicating about 137 feet of fill above the original total depth (TD) of 7,139. There was a positive wellhead pressure (WHP) of 234 psia (219 psig) at the time of the survey. The portion of the well below 4,500 feet KB showed several stair-step changes in temperature that appear to represent low-velocity convection of fluids in discrete cells within the wellbore. These convection cells persist over time, as evidenced by the fact that they show essentially the same pattern in the up-run as in the

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down-run. Overall, the interval of stair-stepping temperatures in the lower portion of the well has a gradient of about 3°F per 100 feet, with no evidence of a temperature reversal.

First Artesian Flow Test, 5 March 2008

During the first artesian flow test, all twenty of the Rain-for-Rent (RFR) tanks were filled sequentially over a period of 11.8 hours. The cumulative volume produced was 376,890 gallons, representing an average flow rate of 532 gpm of post-flash brine. Figure 3 shows the water levels measured in the regulating tank and the interpreted water levels in 4 tanks that had leaky inlet valves. Figure 4 shows the flow rates estimated from individual tank volumes. The rates decreased from more than 700 gpm to about 470 gpm over the course of the test. The well had a static artesian WHP of 219 psig before the start of flow. The flowing WHP was about 13 psig. Flow-line temperatures during the flow test were 235 – 240°F, as measured by the chemical sampling contractor (Thermochem) at the sample ports.

Figure 5 shows the flowing PTS survey performed during the first artesian flow test, in comparison to the static PT survey the day before. The temperatures below 4,500 feet KB are essentially identical, indicating that there is no contribution of flow from the lower zones to disturb the pattern of convection cells in a static wellbore. Flowing temperatures above 4,500 feet KB are controlled by fluids entering the wellbore at this point, with relatively minor contributions from cooler zones just below 3,000 feet KB, just below the shoe of the 13-3/8-inch casing. The difference in pressures between static and flowing conditions is about 286 psi. Figure 6 shows the spinner data from the PTS survey of 5 March 2008. It confirms the dominance of the zone at 4,500 feet KB, with minor entries just below 3,000 feet KB.

Figure 7 shows a Horner analysis of the pressure build-up measured at the conclusion of the first artesian flow test. The transmissivity (kh) of the formation is calculated to be 5,990 millidarcy-feet (md-ft), with a skin factor of -4.4. The negative skin factor suggests some contribution of flow from fractures, resulting in a larger effective radius for the well. Figure 8 shows an alternate fit to the pressure build-up data using a radial flow model. The results are very similar, with a kh value of 8,154 md-ft and negative skin factor.

Re-injection of 18 Tank Volumes, 6 – 8 March 2008

After the first artesian flow test, the pumping contractor (Halliburton) re-injected 18 tanks of water into Truckhaven No. 1. Figure 9 shows a plot of this pumping operation. Injection was initiated gradually, starting at 2 barrels per minute (BPM) and increasing in increments of 1 BPM every half hour up to 6 BPM. Thereafter, rates generally remained in the range of 4 to 6 BPM, with occasional peaks as high as 7 BPM. Injection pressures were generally in the range of 650 to 900 psig.

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Water-Jetting Through Coiled Tubing, 8 March 2008

In order to stimulate potential production from the deeper, hotter portion of Truckhaven No. 1, IAE used a coiled-tubing unit (CTU) to jet water near the bottom of the well, starting at the contact with granitic basement (6,685 feet KB) and pulling up through an interval of relatively clean sandstone to a depth of 5,300 feet. The intention was to flush out any drilling mud and cuttings that might be behind the slotted 9-5/8-inch liner. A total of 673 BBL of water (net of the volume of the coiled tubing itself) was pumped down the coiled tubing at a rate of about 4.2 BPM, while the coiled tubing was pulled up at a speed generally between 5 and 15 feet per minute. The Halliburton job report of this operation is included as Appendix A.

While water-jetting was under way, the well was flowed back to bring any flushed-out solids to the surface. Several samples from the flow line showed a trend from dark brown color to a light grey, suggesting decreasing quantities of drilling mud. However, all the samples showed abundant returns of fine sand, which appeared to represent sloughing of the formation wall. Figure 10 shows the water levels recorded during the water-jetting operation at the regulating tank and in one tank with a leaky inlet valve (No. 19). A total of 84,439 gallons was produced from the well during this operation, net of the volume of water injected. Figure 11 shows the flow rates estimated from individual tank volumes, as well as the average flow rate of formation water produced (521 GPM) after subtracting the volume of water injected. The shut-in WHP prior to the water-jetting was about 250 psig, somewhat higher than the initial artesian pressure, apparently due to pressuring up of the formation by the preceding injection period. The flowing WHP was essentially equivalent to that of the first artesian flow test (11-13 psig). The line temperature (as estimated by a laser sensor aimed at the exterior of the flow line) was in the range of 168 to 175°F, reflecting the cooling effect of the preceding injection. At the conclusion of water-jetting, the water in the regulating tank was pumped to Tank No. 9, to make room for the flow with nitrogen-lift.

Nitrogen-Lift Through Coiled Tubing, 8 March 2008

The nitrogen-lift operation began with the coiled tubing at 500 ft. The coiled tubing was run in the hole at speeds between 15 and 25 feet per minute. The nitrogen injection rate started at 1000 standard cubic feet per minute (SCFM) and was later decreased to 750 SCFM. The details are included in the Halliburton job log in Appendix A. The nitrogen effectively lightened the liquid column and resulted in a significant increase in flow rate. It was necessary to open several tanks to the manifold at once to avoid overflow at the regulating tank. Over the 99 minutes of nitrogen injection, a total of 101, 908 gallons was produced, reflecting an average flow rate of 1,029 GPM. This value may be somewhat high due to the entrainment of nitrogen bubbles that effectively increased the volume of water in the regulating tank.

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Second Artesian Flow Test, 9 March 2008

The second artesian flow test began just after midnight. Figure 12 shows the water levels measured at the regulating tank and at the tank with the leaky inlet valve (No. 19). Figure 13 shows flow rates estimated from individual tank volumes. The shut-in WHP of 257 psig (measured by the wireline tool in the lubricator) probably reflects the pressure of nitrogen accumulated at the top of the wellbore. There was a burst of nitrogen through the flow line when the well was opened up to flow. Flow rates during the second artesian flow test were roughly comparable to the first, at equivalent elapsed times (compare Figure 4). However, because the second test was shorter (just 3.37 hours), higher rates toward the start of flow represented a larger proportion of the readings taken, and the average flow rate of 632 GPM for the second artesian test was about 100 GPM higher than the average rate for the first artesian test.

Figure 14 compares the flowing PTS survey during the second artesian flow test with the previous flowing and static surveys. The temperature profile shows some cooling in the lower portion of the hole, down to the maximum depth of coiled tubing penetration (6,685 feet KB). The temperature stair-steps have been smoothed out by the fluid injected down coiled tubing, but the temperature of the zone at 4,500 feet KB appears to be essentially unchanged. The lack of isothermal profiles below 4,500 feet suggests that the flow contribution of the bottom part of the hole remains negligible. The zone just below 3,000 feet appears to be contributing significantly cooler fluid, possibly indicating that this zone took a disproportionate share of the 18 tanks of water injection after the first artesian flow test. The pressure drawdown for the second flowing PTS survey is slightly less than for the first, but again this probably just reflects a shorter period of flow.

Figure 15 shows the spinner results for the second flowing PTS survey. The spinner tool response was much more prone to showing zero readings than during the first survey, probably because of a greater amount of suspended solids in the well after the water-jetting operation. However, the runs at 100 ft/min down, 150 ft/min down, and 200 ft/min up all suggest that the zone at 4,500 feet KB continues to dominate fluid production.

Figure 16 presents a Horner analysis of the pressure build-up after the second artesian flow test. The kh value is 9,606 md-ft, somewhat higher than the value from the first build-up (compare Figure 7), and the skin factor is a bit more negative (-5.35) suggesting some degree of stimulation from the injection and the coiled tubing operation. Similarly, the radial flow analysis (Figure 17) yields a somewhat higher kh value (10,791 md-ft) and a skin value essentially the same as the one from the first artesian test (compare Figure 8). On balance, the pressure build-up analyses suggest that the injection and the coiled tubing work yielded some improvement in productivity.

Table 5 compares the two artesian flow tests in terms of their Productivity Indices (PI values), defined as the amount of flow at reservoir conditions per unit of pressure drawdown relative to initial reservoir pressures. The static PT survey of 4 March 2008 provides a reference point for initial pressures, with a reservoir pressure of 2,058 psia at the main production zone of 4,500 feet

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KB. The average flow rates for the two flow tests have been converted to pre-flash conditions based on their flowing temperatures at the top of the production zone. This comparison also suggests an improvement in productivity associated with the combination of injection and coiled tubing work: the PI value for the second test is 2.5 GPM/psi vs. 1.9 GPM/psi for the first.

Using the PI value from the second test, GeothermEx has performed a pump flow calculation to estimate the equivalent power capacity of the Truckhaven No. 1 well assuming installation of a downhole pump. Table 6 includes a summary of the input assumptions for this calculation. The production zone temperature is assumed to be 260°F, on the premise that the cooler conditions encountered during the second artesian flow test represent a temporary cooling due to injection. The gas partial pressure of non-condensible components has been estimated at 188.5 psia, based on geochemical modeling using the results of the Thermochem analyses from the first artesian flow test (included as Appendix B). It is possible that this gas partial pressure could decline, if the relatively high nitrogen levels in the sample analyses reflect residual effects of drilling fluid invasion. A lower gas partial pressure would make the well less susceptible to gas break-out under pumping conditions and could further improve the estimate of equivalent power capacity. GeothermEx has assumed that conventional pump technology (that is, line-shaft pumps) would be applied, implying a maximum practical pump-setting depth of 1,500 feet. Figure 18 shows the result of the pump flow calculation based on these assumptions. The curve for net power reflects both the power usage by the pump itself and an additional 20% parasitic loss for operation of a binary power plant and associated injection pumps. At the maximum assumed pump-setting depth of 1,500 feet, the Truckhaven No. 1 well would have an equivalent power capacity of 1.5 MW net.

The Truckhaven No. 1 well could also be useful as an injector, depending on how it fits into the overall development scheme at Truckhaven. Figure 19 (from IAE) shows a plot of sand abundance and sand porosity for the entire wellbore, based on Schlumberger logs. This plot shows that the interval from 1,900 to 3,100 feet has a relatively clean sandstone with high porosity. Perforating the 13-3/8-inch casing in this interval could potentially yield a suitable zone for injection. If this proved successful, other injectors could be targeted at the same shallow zone for relatively low cost.

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TABLES

Table 1: Summary of Periods of Flow and Injection, IAE Truckhaven No. 1
5 - 9 March 2008

Activity	Start Time	End Time	Duration (hours)	Production or Injection (P or I)	Volume (gallons)	Average Rate (gallons / minute)	Comment
First artesian flow period	05-Mar-2008 09:40 AM	05-Mar-2008 09:28 PM	11.80	P	376,890	532	Filled 20 Rain-for-Rent (RFR) tanks, plus piping manifold
Injection of 18 RFR tanks	06-Mar-2008 08:25 PM	08-Mar-2008 05:38 AM	33.22	I	335,244	168	Pumped Tanks 3-20 into well, leaving Tanks 1 & 2 for water-jetting bottom of well
Flow well while water-jetting through coiled tubing							
- Several false starts to get pump working	08-Mar-2008 11:48 AM	08-Mar-2008 12:17 PM	0.48	P	11,251	388	Small amount of water injected down coiled tubing did not contribute to flow, just filled coiled tubing volume.
- Water jetting at approximately 4.2 BPM	08-Mar-2008 01:36 PM	08-Mar-2008 04:18 PM	2.70	P	84,439	521	Produced volume is net of 673 BBL of water injected into well through coiled tubing. Filled 6 RFR tanks (Nos. 3-8) with flow-back from well during water-jetting. After shut-in, transferred contents of Tank 4 to Tank 9.
Flow well while lifting with nitrogen through coiled tubing	08-Mar-2008 07:30 PM	08-Mar-2008 09:09 PM	1.65	P	101,908	1,029	Filled 7 RFR tanks (Nos. 1, 2, 4, and 10 - 13)
Second artesian flow period	09-Mar-2008 12:10 AM	09-Mar-2008 03:32 AM	3.37	P	127,680	632	Filled remaining 7 RFR tanks (Nos. 14 - 20)

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Table 2: First Artesian Flow Test, 5 March 2008, IAE Truckhaven No. 1

Time	Wellhead Pressure (psig)	Line Pressure (psig)	Line Temperature (deg F)[a]	Active Tank No.	Level in Regulating Tank (No.4) (inches from top of vent[b])	Level in Active Tank (inches from top of tank[c])	Activities & Comments
05-Mar-2008 07:30 AM	219						Measured WHP with 300-psig gauge on north wing valve on casing head.
05-Mar-2008 08:10 AM							Conducted safety meeting. Personnel on site:
							Erik Layman (EBL) - IAE
							Roberto Augustine - IAE
							James Lovekin - GeothermEx
							Mike Higgins - PMC supervisor
							Bernie Quines - PMC
							Nash Quines - PMC
							Russ Kunzman - Thermochem
							Ivan Katz - Thermochem
							Herman Cornejo - Primo Construction
							Russel _____ - Primo Construction
							Tom Bradley - Welaco
							Shawn McMurphy - Welaco
							Jim Lagle - Welaco
05-Mar-2008 09:29 AM	219						
05-Mar-2008 09:30 AM	220						Confirmed master valve fully open (after static PTS survey on 4 March).
05-Mar-2008 09:34 AM							Opened working valve.
05-Mar-2008 09:36 AM	219	218					Opened shut-off valve. Confirmed no leaks in flow line.
05-Mar-2008 09:40 AM				4			Opened throttle valve. START WELL FLOW.
05-Mar-2008 09:41 AM	14			4			Throttle valve fully open. Filling Tank 4 through top manhole.
05-Mar-2008 09:45 AM	13			4			
05-Mar-2008 09:55 AM				4	62		
05-Mar-2008 09:58 AM				4	52.5		
05-Mar-2008 10:00 AM				4	43		
05-Mar-2008 10:02 AM				4	37		
05-Mar-2008 10:04 AM				4	30		Open Tank 4 discharge valve to manifold. Open Tank 1 inlet valve.
05-Mar-2008 10:06 AM	10	8		1			Manifold filling (manifold volume = 2,449 gal). Tank 1 taking fluid from manifold.
05-Mar-2008 10:07 AM				1	37		
05-Mar-2008 10:15 AM	10	10		1	30		
05-Mar-2008 10:17 AM				1	30	63.5	
05-Mar-2008 10:22 AM				1	30		
05-Mar-2008 10:24 AM				1		47	Modest amount of steam from atmospheric flash tank (AFT).
05-Mar-2008 10:27 AM				1		43	
05-Mar-2008 10:28 AM				1	30		
05-Mar-2008 10:30 AM	11	11		1		38.5	
05-Mar-2008 10:32 AM				1		36	
05-Mar-2008 10:33 AM				1		34.5	
05-Mar-2008 10:35 AM			234.5	1		31.5	Line temperature measured by Thermochem at bottom sampling port on flow line.
05-Mar-2008 10:37 AM				1	19	29	
05-Mar-2008 10:38 AM				1		27.5	
05-Mar-2008 10:39 AM				1	16	25	

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Table 2: First Artesian Flow Test, 5 March 2008, IAE Truckhaven No. 1

Time	Wellhead Pressure (psig)	Line Pressure (psig)	Line Temperature (deg F)[a]	Active Tank No.	Level in Regulating Tank (No.4) (inches from top of vent[b])	Level in Active Tank (inches from top of tank[c])	Activities & Comments
05-Mar-2008 10:40 AM				1	24	20	Close Tank 1 inlet valve. Open Tank 2 inlet valve.
05-Mar-2008 10:44 AM				2	30		EBL notes say this reading on Tank 4 may be bad.
05-Mar-2008 10:45 AM	14	14		2			
05-Mar-2008 10:53 AM				2		55	
05-Mar-2008 10:55 AM	15	13		2			Line pressure oscillating ±1 psi. Modest amount of steam from AFT.
05-Mar-2008 11:00 AM	15	15		2	45		
05-Mar-2008 11:02 AM				2		37	
05-Mar-2008 11:05 AM				2		32	
05-Mar-2008 11:06 AM				2	33		Start using float on Tank 4 readings (EBL)
05-Mar-2008 11:07 AM				2	30	30	
05-Mar-2008 11:09 AM				2		26	
05-Mar-2008 11:10 AM				2	27		
05-Mar-2008 11:11 AM				2		24.5	
05-Mar-2008 11:13 AM				2		22	
05-Mar-2008 11:14 AM				2	22		
05-Mar-2008 11:15 AM	14	13	237	2		19	Close Tank 2 inlet valve. Open Tank 3 inlet valve.
05-Mar-2008 11:17 AM				3	31		
05-Mar-2008 11:18 AM	15	13.5		3			Line pressure oscillating ±0.5 psi.
05-Mar-2008 11:24 AM				3			Discovered Tank 5 is warm to touch - inlet valve is leaking. Tightened inlet valve.
05-Mar-2008 11:25 AM				3	40		
05-Mar-2008 11:27 AM				3			Measured 11 inches of water in Tank 5 (from bottom of tank - BOT)
05-Mar-2008 11:30 AM	13	13	240.4	3			
05-Mar-2008 11:37 AM				3		34	Found 3 other tanks with leaky inlet valves, warm to touch: #14, #17, & #19.
05-Mar-2008 11:38 AM				3	33		
05-Mar-2008 11:41 AM	13			3			Water in Tank 5 still at 11 inches (BOT) => inlet leak stopped at 11:24 AM.
05-Mar-2008 11:44 AM				3	23	23	
05-Mar-2008 11:45 AM	13	13		3			
05-Mar-2008 11:46 AM				3	19		
05-Mar-2008 11:47 AM				3		19	Close Tank 3 inlet valve. Open Tank 5 inlet valve.
05-Mar-2008 11:51 AM				5			Measured 32.5 inches of water in Tank 14 (BOT).
05-Mar-2008 11:54 AM				5	37		Measured 20 inches of water in Tank 17 (BOT).
05-Mar-2008 12:00 PM	13	13		5		42	
05-Mar-2008 12:04 PM				5			Measured 7.5 inches of water in Tank 19 (BOT).
05-Mar-2008 12:09 PM				5		27	
05-Mar-2008 12:11 PM				5	24		
05-Mar-2008 12:13 PM				5		22	
05-Mar-2008 12:14 PM				5	19		
05-Mar-2008 12:15 PM	13	13		5			
05-Mar-2008 12:16 PM				5		17	Close Tank 5 inlet valve. Open Tank 6 inlet valve.
05-Mar-2008 12:28 PM	14	13.5		6			Line pressure oscillating ±0.5 psi.
05-Mar-2008 12:30 PM	13	13		6			
05-Mar-2008 12:39 PM				6	34	31	

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Table 2: First Artesian Flow Test, 5 March 2008, IAE Truckhaven No. 1

Time	Wellhead Pressure (psig)	Line Pressure (psig)	Line Temperature (deg F)[a]	Active Tank No.	Level in Regulating Tank (No.4) (inches from top of vent[b])	Level in Active Tank (inches from top of tank[c])	Activities & Comments
05-Mar-2008 12:45 PM	13	12		6	25		
05-Mar-2008 12:48 PM				6	19		
05-Mar-2008 12:49 PM				6		16	Close Tank 6 inlet valve. Open Tank 7 inlet valve.
05-Mar-2008 12:52 PM				7	31		
05-Mar-2008 01:00 PM	12	12	238.5	7	42		
05-Mar-2008 01:05 PM				7			
05-Mar-2008 01:15 PM	12	12		7			
05-Mar-2008 01:18 PM				7	28		
05-Mar-2008 01:23 PM				7		19	Close Tank 7 inlet valve. Open Tank 8 inlet valve.
05-Mar-2008 01:28 PM				8			Tank 19 has 11 inches of water (BOT) => filled 3.5 inches since 12:04 PM.
05-Mar-2008 01:35 PM				8	39		
05-Mar-2008 01:40 PM				8			Tank 17 still at 20 in. of water (BOT) => leak stopped at 11:37 AM when discovered.
05-Mar-2008 01:44 PM				8			Tank 14 still at 32.5 in. of water (BOT) => leak stopped at 11:37 AM when discovered.
05-Mar-2008 01:45 PM				8	42		
05-Mar-2008 01:48 PM	14	13		8			Line pressure oscillating ±1 psi. Annulus on NE side of casinghead altermately takes slugs of water from puddle in cellar and squirts water back out in a spray up to 2 feet tall. Squirts on cycle of about 1 minute.
05-Mar-2008 01:55 PM				8	31	21	
05-Mar-2008 01:58 PM			238.1	8		17	Close Tank 8 inlet valve. Open Tank 9 inlet valve. Annulus between 20" and 13-3/8" alternately drains cellar fluid and jets it back out, apparently due to boiling in annulus adjacent to hot 13-3/8" casing.
05-Mar-2008 02:05 PM				9	30		
05-Mar-2008 02:25 PM				9	34		
05-Mar-2008 02:26 PM				9		30	
05-Mar-2008 02:30 PM				9		23.5	
05-Mar-2008 02:35 PM				9	23		
05-Mar-2008 02:37 PM				9		14	Close Tank 9 inlet valve. Open Tank 10 inlet valve.
05-Mar-2008 02:45 PM				10	34		
05-Mar-2008 02:57 PM	13	12.5		10			Line pressure oscillating ±0.5 psi.
05-Mar-2008 03:00 PM				10	44		
05-Mar-2008 03:11 PM				10		16	
05-Mar-2008 03:13 PM				10		13	Close Tank 10 inlet valve. Open Tank 11 inlet valve.
05-Mar-2008 03:20 PM				11	26		
05-Mar-2008 03:25 PM				11	34		
05-Mar-2008 03:30 PM				11	39		
05-Mar-2008 03:39 PM				11		33	13-3/8" casing has grown about 2". Thermochem taking chemical sample #1.
05-Mar-2008 03:43 PM				11	32		
05-Mar-2008 03:51 PM			237.3	11		14	Close Tank 11 inlet valve. Open Tank 12 inlet valve. Temperature at top sampling port = 240.1°F.
05-Mar-2008 03:55 PM				12	18		
05-Mar-2008 04:00 PM				12	26		

Table 2: First Artesian Flow Test, 5 March 2008, IAE Truckhaven No. 1

Time	Wellhead Pressure (psig)	Line Pressure (psig)	Line Temperature (deg F)[a]	Active Tank No.	Level in Regulating Tank (No.4) (inches from top of vent[b])	Level in Active Tank (inches from top of tank[c])	Activities & Comments
05-Mar-2008 04:15 PM				12	29		
05-Mar-2008 04:23 PM				12		23	
05-Mar-2008 04:30 PM				12	20		
05-Mar-2008 04:31 PM				12		12.5	Close Tank 12 inlet valve. Open Tank 13 inlet valve.
05-Mar-2008 04:37 PM	13			13			
05-Mar-2008 04:40 PM				13	27		
05-Mar-2008 04:44 PM				13			Tank 19 has 22 inches of water (BOT) => filled 11 inches since 1:28 PM. Confirmed Tanks 14 and 17 no longer leaking.
05-Mar-2008 04:45 PM				13	38		
05-Mar-2008 04:57 PM	13	12		13			
05-Mar-2008 05:00 PM				13	33	27	
05-Mar-2008 05:10 PM				13	24	12.5	Close Tank 13 inlet valve. Open Tank 14 inlet valve. Tank 14 already has 32.5 inches of water (BOT).
05-Mar-2008 05:15 PM				14	28		
05-Mar-2008 05:30 PM				14	31	25	
05-Mar-2008 05:37 PM				14		15.5	
05-Mar-2008 05:39 PM				14		12	Close Tank 14 inlet valve. Open Tank 15 inlet valve.
05-Mar-2008 05:40 PM				15	22		
05-Mar-2008 05:44 PM			236.5	15			
05-Mar-2008 05:56 PM				15	37		
05-Mar-2008 06:04 PM				15	34		
05-Mar-2008 06:07 PM				15		31.5	
05-Mar-2008 06:10 PM				15		27	
05-Mar-2008 06:12 PM				15	26		
05-Mar-2008 06:14 PM				15		21	Welaco tool back in lubricator after flowing temperature-pressure-spinner survey.
05-Mar-2008 06:23 PM				15		8	Close Tank 15 inlet valve. Open Tank 16 inlet valve.
05-Mar-2008 06:24 PM				16	16		
05-Mar-2008 06:34 PM				16			Tank 19 has 26.5 inches of water (BOT) => filled 4.5 inches since 4:44 PM.
05-Mar-2008 06:35 PM				16	26		
05-Mar-2008 06:41 PM				16	33		
05-Mar-2008 06:48 PM	13	12		16			Annulus between 20" and 13-3/8" casing is wisping steam. No liquid is making it into the annulus over the lip of the 20" casing now, so geysering has stopped.
05-Mar-2008 06:55 PM				16	21		
05-Mar-2008 06:57 PM				16		18	
05-Mar-2008 07:00 PM				16		14	Close Tank 16 inlet valve. Open Tank 17 inlet valve. Tank 17 already has 20 inches of water (BOT).
05-Mar-2008 07:02 PM				17	25		
05-Mar-2008 07:07 PM				17	36		
05-Mar-2008 07:22 PM				17	37		
05-Mar-2008 07:23 PM				17		28	
05-Mar-2008 07:29 PM				17	26		
05-Mar-2008 07:32 PM				17	21		

Table 2: First Artesian Flow Test, 5 March 2008, IAE Truckhaven No. 1

Time	Wellhead Pressure (psig)	Line Pressure (psig)	Line Temperature (deg F)[a]	Active Tank No.	Level in Regulating Tank (No.4) (inches from top of vent[b])	Level in Active Tank (inches from top of tank[c])	Activities & Comments
05-Mar-2008 07:33 PM				17		15	Close Tank 17 inlet valve. Open Tank 18 inlet valve.
05-Mar-2008 07:35 PM				18	31		
05-Mar-2008 07:38 PM	13	12		18			
05-Mar-2008 07:45 PM				18	45		
05-Mar-2008 07:47 PM				18			Tank 19 has 29 inches of water (BOT) => filled 2.5 inches since 6:34 PM.
05-Mar-2008 08:07 PM				18	30	24	Thermochem sampling Tank 4 (Regulating Tank).
05-Mar-2008 08:13 PM			235.8	18		16.5	Close Tank 18 inlet valve. Open Tank 19 inlet valve. Tank 19 already has more than 29 inches of water (BOT). Welaco TPS tool is back at 4,500 feet KB and monitoring downhole pressure.
05-Mar-2008 08:15 PM				19	27		
05-Mar-2008 08:19 PM				19	35		
05-Mar-2008 08:34 PM				19	33		
05-Mar-2008 08:36 PM				19		25.5	Thermochem taking chemical sample #2 from flow line.
05-Mar-2008 08:42 PM				19	22		
05-Mar-2008 08:44 PM				19	20		
05-Mar-2008 08:45 PM				19		14	Close Tank 19 inlet valve. Open Tank 20 inlet valve.
05-Mar-2008 08:49 PM				20			Wellhead annulus geysering again due to water from Thermochem sampling separator flowing into cellar and cresting the lip of the 20" casing.
05-Mar-2008 08:52 PM				20	32		
05-Mar-2008 09:03 PM				20	36		
05-Mar-2008 09:13 PM				20	28		
05-Mar-2008 09:20 PM				20			Welaco TPS tool readings at 4,500 feet KB: T = 278.7°F, P = 1,769 psia.
05-Mar-2008 09:21 PM				20	20		
05-Mar-2008 09:25 PM				20		16	
05-Mar-2008 09:28 PM	13			20	14	11.5	Shut in well at shut-off valve.
05-Mar-2008 09:40 PM							Shut working valve. END OF FIRST ARTESIAN FLOW TEST.

Notes: [a] Line temperatures measured by Thermochem at sampling ports. Readings are at bottom port, unless noted otherwise.
[b] Reference point for level readings in regulating tank (No. 4) is top of vent flange, 6 inches above top of interior of tank.
[c] Reference point for level readings in other tanks is top of interior of tank as measured at the manhole, equal to 117 inches above bottom of tank, as listed in table posted on side of tanks. Readings are referenced to top of tank (TOT) unless explicitly referenced to bottom of tank (BOT).

Table 3: Water-Jetting and Nitrogen-Lift Through Coiled Tubing, 8 March 2008, IAE Truckhaven No. 1

Time	Wellhead Pressure (psig)	Line Pressure (psig)	Line Temperature (deg F)[a]	Active Tank No.	Level in Regulating Tank (No.4) (inches from top of vent[b])	Level in Active Tank (inches from top of tank[c])	Activities & Comments
08-Mar-2008 05:38 AM					0	0	Halliburton completed injecting 18 tank volumes (7,982 BBL) into well. Tank Nos. 1 & 2 are full, to provide water for coiled-tubing injection.
08-Mar-2008 08:00 AM	250						Halliburton coiled-tubing unit (CTU) rigging up. Repairing injection pump. Wellhead pressure (WHP) estimated from 3,000-psi gauge (300-psi gauge damaged during injection). WHP still pressured up from injection.
08-Mar-2008 09:30 AM							Halliburton CTU rigged up.
							Personnel on site:
							Erik Layman (EBL) - IAE
							James Lovekin - GeothermEx
							Bernie Quines - PMC
							Nash Quines - PMC
							Halliburton CTU crew
							Schlumberger nitrogen-unit crew
08-Mar-2008 09:35 AM							Opened master valve.
08-Mar-2008 09:38 AM							Started running in hole with coiled tubing.
08-Mar-2008 11:37 AM							Coiled tubing (CT) at 6,685 feet KB.
08-Mar-2008 11:44 AM	252	252					Opened working valve. WHP before pumping is estimated from line pressure and probably still reflects pressurizing by injection.
08-Mar-2008 11:47 AM							Opened shut-off valve. No leaks. Regulating tank (No. 4) has about 3 inches of water on bottom (estimated).
08-Mar-2008 11:48 AM				4	123		Opened throttle valve and started flow to Tank No. 4.
08-Mar-2008 11:51 AM				4	102		Closed throttle valve and stopped flow - Halliburton pump not ready. Water level in Tank No. 4 is 21 inches from bottom of tank (BOT).
08-Mar-2008 12:04 PM				4			Re-opened throttle valve. Water entering Tank No. 4 but no steam from AFT.
08-Mar-2008 12:06 PM				4	90		Water level in Tank No. 4 is 33 inches (BOT)
08-Mar-2008 12:07 PM	12	12		4			Flowing wellhead pressure estimated from line pressure.
08-Mar-2008 12:08 PM				4			Halliburton injecting 2 BPM into CT with bottom at 6,685 feet KB. Water is coming from Tank No. 1. Volume of CT is 29.23 BBL.
08-Mar-2008 12:09 PM				4			Halliburton stopped pumping to re-prime pump. CT still at 6,685 ft KB.
08-Mar-2008 12:10 PM				4	75		Water level in Tank No. 4 is 48 inches (BOT)
08-Mar-2008 12:14 PM				4			Halliburton has pumped 16 BBL- still filling CT. Still at 6,685 ft KB.
08-Mar-2008 12:15 PM				4	63		
08-Mar-2008 12:17 PM				4	58		Shut in well at throttle valve in order to pump down Tank 4. Level in Tank No. 4 is 65 inches (BOT) - over half full.
08-Mar-2008 12:20 PM		14					
08-Mar-2008 12:27 PM							CT now full of water (cumulative volume pumped 29.94 BBL). Shut down pump pending pumping water from Tank 4 to Tank 1 with vacuum truck.
08-Mar-2008 01:28 PM					101		Finished pumping down Tank 4. Water level 22 inches (BOT) = 85 BBL.
08-Mar-2008 01:32 PM		22		4			Start opening throttle valve, re-starting flow.
08-Mar-2008 01:35 PM				4			Halliburton pumping 3.5-3.6 BPM.
08-Mar-2008 01:36 PM				4	83		Pump rate dropped to 0 BPM. Shut well in again. Tank 4 has 40 " (BOT).
08-Mar-2008 01:39 PM				4			Opened well up again, Halliburton pumping 4.1 BPM. Start raising CT.

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Table 3: Water-Jetting and Nitrogen-Lift Through Coiled Tubing, 8 March 2008, IAE Truckhaven No. 1

Time	Wellhead Pressure (psig)	Line Pressure (psig)	Line Temperature (deg F)[a]	Active Tank No.	Level in Regulating Tank (No.4) (inches from top of vent[b])	Level in Active Tank (inches from top of tank[c])	Activities & Comments
08-Mar-2008 01:41 PM				4	74		
08-Mar-2008 01:43 PM				4	65		CT at 6,622 feet KB.
08-Mar-2008 01:47 PM				4	52		
08-Mar-2008 01:51 PM				4	37		
08-Mar-2008 01:54 PM				4	27		
08-Mar-2008 01:56 PM				4	21		Open discharge valve on Tank 4 and inlet valve on Tank 3. Filling manifold.
08-Mar-2008 01:58 PM				3	26		CT at 6,476 feet KB.
08-Mar-2008 02:01 PM				3	32		CT at 6456 feet KB. Increase speed of raising CT from 10 to 13 feet / minute.
08-Mar-2008 02:05 PM				3	34		
08-Mar-2008 02:07 PM				3			First sample of produced water at bottom tap on flow line: muddy and sandy.
08-Mar-2008 02:11 PM				3	30		
08-Mar-2008 02:16 PM				3	23		
08-Mar-2008 02:19 PM				3	16	17	
08-Mar-2008 02:20 PM				3		14	
08-Mar-2008 02:21 PM				3	9		
08-Mar-2008 02:22 PM				3	6	10	Close Tank 3 inlet valve. Open Tank 5 inlet valve. Tank 4 level estimated (full).
08-Mar-2008 02:24 PM				5	24		Coiled tubing at 6,133 feet KB. CT coming up at 13-14 feet / minute
08-Mar-2008 02:28 PM				5			Checked Tanks 6 - 20: not warm to touch => no leaky inlet valves. Later determined that inlet valve to Tank 19 was still leaking slowly.
08-Mar-2008 02:31 PM				5			Second sample of produced water at bottom tap on flow line: water is dark brown with abundant fine sand.
08-Mar-2008 02:32 PM				5	37		
08-Mar-2008 02:40 PM				5	29		
08-Mar-2008 02:41 PM				5		30	
08-Mar-2008 02:43 PM				5		26	
08-Mar-2008 02:44 PM				5		24.5	
08-Mar-2008 02:48 PM				5		15	
08-Mar-2008 02:49 PM				5	14		
08-Mar-2008 02:50 PM				5	12	10	Close Tank 5 inlet valve. Open Tank 6 inlet valve. Tank 4 level estimated.
08-Mar-2008 02:52 PM				6			CT at 5,785 feet KB. Decrease speed of raising CT from 12 to 9 feet / minute.
08-Mar-2008 02:55 PM				6			CT at 5,747 feet KB, coming up at 9 feet / minute.
08-Mar-2008 03:00 PM				6			Third sample of produced water at bottom tap on flow line: water is slightly less dark (?) but still has abundant fine sand.
08-Mar-2008 03:05 PM				6	33		
08-Mar-2008 03:08 PM				6		32	
08-Mar-2008 03:09 PM				6		30	
08-Mar-2008 03:12 PM				6	26	24	
08-Mar-2008 03:16 PM				6		16.5	
08-Mar-2008 03:17 PM				6	15		
08-Mar-2008 03:19 PM				6	13	9.5	Close Tank 6 inlet valve. Open Tank 7 inlet valve. Tank 4 level estimated.
08-Mar-2008 03:20 PM				7			CT at 5,546 feet KB, pumping at 4.2 BPM.
08-Mar-2008 03:22 PM				7			Fourth sample of produced water at bottom tap on flow line: water is grey and still very sandy.

Table 3: Water-Jetting and Nitrogen-Lift Through Coiled Tubing, 8 March 2008, IAE Truckhaven No. 1

Time	Wellhead Pressure (psig)	Line Pressure (psig)	Line Temperature (deg F)[a]	Active Tank No.	Level in Regulating Tank (No.4) (inches from top of vent[b])	Level in Active Tank (inches from top of tank[c])	Activities & Comments
08-Mar-2008 03:23 PM				7	28		
08-Mar-2008 03:30 PM			168	7			Line temperature measured with laser sensor at elbow of vertical riser to AFT.
08-Mar-2008 03:33 PM				7			Decrease speed of raising CT from 9 to 6 feet / minute.
08-Mar-2008 03:35 PM				7	33		
08-Mar-2008 03:45 PM				7		17	
08-Mar-2008 03:46 PM				7	21		
08-Mar-2008 03:48 PM				7			CT at 5,341 feet KB. Coming up at 5 feet / minute.
08-Mar-2008 03:49 PM				7	15	8.5	Close Tank 7 inlet valve. Open Tank 8 inlet valve. Tank 4 level estimated.
08-Mar-2008 03:51 PM				8	22		
08-Mar-2008 03:55 PM	11	11	175	8			Flowing wellhead pressure estimated from line pressure. 3000-psi gauge on wellhead reads 0 psig.
08-Mar-2008 03:57 PM				8			CT reached 5,300 feet KB. Started back in hole at 3 to 4 feet / minute.
08-Mar-2008 04:00 PM				8	35		Fifth sample of produced water at bottom tap on flow line: water is clearer but still very sandy.
08-Mar-2008 04:17 PM				8	12		
08-Mar-2008 04:18 PM				8	11	8	Stopped pumping down CT. Shut in well at throttle valve. Close Tank 8 inlet valve. Final levels in Tanks 4 and 8 are estimated. Cumulative volume pumped through CT = 702.27 BBL (including CT volume of 29.23 BBL). Begin raising CT to 500 feet KB in preparation for nitrogen lift.
08-Mar-2008 04:23 PM	12.5	12.5					Shut-in wellhead pressure estimated as equal to line pressure (working valve on flow line is still open). Begin transferring water from Tank 4 to Tank 9, so Tank 4 will be available for flow during nitrogen lift.
08-Mar-2008 05:29 PM							CT is at 500 feet KB. Still transferring water from Tank 4 to Tank 9.
08-Mar-2008 05:48 PM							Measured water level in Tank 1 (31 inches BOT) and Tank 2 (40 inches BOT).
08-Mar-2008 06:02 PM							Measured water level in Tank 9: 33 inches BOT (water has leaked in from manifold since 2:28 PM). PMC shift change: Bernie and Nash Quines leave, Chino Solarzano and Eric Hawk arrive. Mike Higgins (PMC) also on site.
08-Mar-2008 07:12 PM				4	102		Level in Tank 4 is 21 inches BOT. End water transfers from Tank 4 to Tank 9. Manifold between tanks remains full (estimated volume 2,449 gallons).
08-Mar-2008 07:15 PM				4			Hold safety meeting with personnel on site, including PMC, Halliburton, and Schlumberger crew.
08-Mar-2008 07:30 PM				4	102		Open throttle valve on flow line and re-start flow. Start injecting nitrogen through CT at 1,000 SCFM.
08-Mar-2008 07:34 PM				4			Nitrogen is displacing water from CT. Start running CT in hole at 5 feet / minute.
08-Mar-2008 07:35 PM				4			Increase rate of running CT in hole to 14 feet / minute.
08-Mar-2008 07:36 PM				4			CT at 539 feet KB. Rate of running in hole has increased to about 25 feet / minute.
08-Mar-2008 07:39 PM				4			Start of significant flow of nitrogen out of AFT and Tank 4 man-hole.
08-Mar-2008 07:40 PM				4	57		Water levels in Tank 4 exaggerated by presence of nitrogen bubbles.
08-Mar-2008 07:42 PM				4	32		
08-Mar-2008 07:43 PM				4	21		Tank 4 filling rapidly. Liquid level at man-hole is higher than at measuring point on vent flange due to nitrogen entrainment through pipe entering at man-hole.
08-Mar-2008 07:44 PM				4	19		Open Tank 4 discharge valve to manifold, open inlet valve to Tank 1.
08-Mar-2008 07:47 PM				1	17		Water level in Tank 4 still rising, even though Tank 1 is open to receive flow.

Table 3: Water-Jetting and Nitrogen-Lift Through Coiled Tubing, 8 March 2008, IAE Truckhaven No. 1

Time	Wellhead Pressure (psig)	Line Pressure (psig)	Line Temperature (deg F)[a]	Active Tank No.	Level in Regulating Tank (No.4) (inches from top of vent[b])	Level in Active Tank (inches from top of tank[c])	Activities & Comments
08-Mar-2008 07:50 PM				1	8	54	Tank 1 water level is at 63 inches (BOT) => rose 32 inches since opening inlet valve at 7:44 PM.
08-Mar-2008 07:51 PM				1	6		Tank 4 full and beginning to overflow at man-hole.
08-Mar-2008 07:52 PM				1 & 2			Opened inlet valve at Tank 2 (Tank 1 inlet valve still open).
08-Mar-2008 07:53 PM				1, 2 & 10			Opened inlet valve at Tank 10 (Tanks 1 & 2 still open)
08-Mar-2008 07:54 PM				1, 2 & 10	16		Water level subsiding at Tank 4. Flowing into Tanks 1, 2, and 10 simultaneously. Water level in Tank 1 is 42 inches (TOT).
08-Mar-2008 07:57 PM				1, 2 & 10	17		Water level in Tank 2 is 59 inches (TOT).
08-Mar-2008 07:59 PM				1, 2 & 10	24		Water level in Tank 1 is 49 inches (TOT) - subsiding as Tanks 2 and 10 rise.
08-Mar-2008 08:00 PM				1, 2 & 10	25		
08-Mar-2008 08:01 PM				1, 2 & 10			Water level in Tank 10 is 72 inches (TOT).
08-Mar-2008 08:04 PM				1, 2 & 10			Water level in Tank 1 is 44 inches (TOT) - coming back up.
08-Mar-2008 08:05 PM				1, 2 & 10	24.5		Tank 4 is rising again with 3 other tanks open.
08-Mar-2008 08:06 PM				1, 2 & 10	23		Water level in Tank 2 is 48 inches (TOT).
08-Mar-2008 08:08 PM				1, 2 & 10			Water level in Tank 1 is 39 inches (TOT).
08-Mar-2008 08:10 PM				1, 2 & 10	21		Water level in Tank 2 is 38 inches (TOT).
08-Mar-2008 08:12 PM				1, 2 & 10	18		Water level in Tank 10 is 35 inches (TOT).
08-Mar-2008 08:13 PM				1, 2, 10 & 1	17		Opened inlet valve to Tank 11 (Tanks 1, 2, and 10 still open).
08-Mar-2008 08:15 PM				1, 2, 10 & 1	16		Tank 1 is at 31 inches (TOT), Tank 2 is at 34.5 inches (TOT)
08-Mar-2008 08:17 PM				1, 2, 10 & 1	14		Tank 4 still rising with 4 other tanks open.
08-Mar-2008 08:18 PM				1, 2, 10-12			Opened inlet valve to Tank 12 (Tanks 1, 2, 10 & 11 still open).
08-Mar-2008 08:19 PM				1, 2, 10-12	14		Water level in Tank 1 is 29 inches (TOT).
08-Mar-2008 08:20 PM				1, 2, 10-12	9		
08-Mar-2008 08:21 PM				1, 2, 10-12			Water level in Tank 2 is 27 inches (TOT).
08-Mar-2008 08:22 PM				1, 2, 10-12	10		
08-Mar-2008 08:23 PM				1, 2, 10-12			Water level in Tank 10 is 39 inches (TOT).
08-Mar-2008 08:24 PM				1, 2, 10-12			Decrease nitrogen rate from 1,000 to 750 SCFM. CT at 1,644 feet KB. Slowed rate of running in hole from 25 to 15 feet / minute.
08-Mar-2008 08:25 PM				1, 2, 10-12	14		Water level in Tank 11 is 68 inches (TOT).
08-Mar-2008 08:26 PM				1, 2, 10-12			Water level in Tank 1 is 28 inches (TOT).
08-Mar-2008 08:27 PM				1, 2, 10-12	16		Water level in Tank 12 is 84 inches (TOT).
08-Mar-2008 08:28 PM				1, 2, 10-12			Water level in Tank 2 is 27 inches (TOT).
08-Mar-2008 08:30 PM				1, 2, 10-12			Water level in Tank 10 is 39 inches (TOT).
08-Mar-2008 08:31 PM				1, 2, 10-12			Water level in Tank 11 is 57 inches (TOT).
08-Mar-2008 08:32 PM				1, 2, 10-12	15		Water level in Tank 12 is 65 inches (TOT).
08-Mar-2008 08:33 PM				1, 2, 10-12			Water level in Tank 1 is 28 inches (TOT).
08-Mar-2008 08:34 PM				1, 2, 10-12			Water level in Tank 2 is 26 inches (TOT).
08-Mar-2008 08:35 PM				1, 2, 10-12	15		Tank 4 holding steady with 5 other tanks open.
08-Mar-2008 08:36 PM				1, 2, 10-12			Water level in Tank 10 is 34 inches (TOT).
08-Mar-2008 08:37 PM				1, 2, 10-12			CT at 1,719 Feet KB. Running inat 16-17 feet / minute.
08-Mar-2008 08:38 PM				1, 2, 10-12	15		
08-Mar-2008 08:39 PM				1, 2, 10-12			Water level in Tank 11 is 39 inches (TOT).
08-Mar-2008 08:40 PM				1, 2, 10-12	15		Water level in Tank 12 is 46 inches (TOT).

2008 GeothermEx, Inc.

Table 3: Water-Jetting and Nitrogen-Lift Through Coiled Tubing, 8 March 2008, IAE Truckhaven No. 1

Time	Wellhead Pressure (psig)	Line Pressure (psig)	Line Temperature (deg F)[a]	Active Tank No.	Level in Regulating Tank (No.4) (inches from top of vent[b])	Level in Active Tank (inches from top of tank[c])	Activities & Comments
08-Mar-2008 08:41 PM				1, 2, 10-12			Water level in Tank 2 is 26 inches (TOT).
08-Mar-2008 08:44 PM				1, 2, 10-12			Water level in Tank 1 is 23 inches (TOT).
08-Mar-2008 08:45 PM				1, 2, 10-13	8		Opened inlet valve to Tank 13 (Tanks 1, 2, 10, 11, and 12 still open).
08-Mar-2008 08:51 PM				1, 2, 10-13	6		Overflowing at Tank 4 man-hole. Shut off nitrogen. CT at 1,961 feet KB. Level in Tank 4 estimated (full).
08-Mar-2008 08:54 PM				1, 2, 10-13	15		
08-Mar-2008 08:55 PM				1, 2, 10-13	19		Released Schlumberger nitrogen unit.
08-Mar-2008 08:59 PM				1, 2, 10-13	29		Water level in Tank 1 = 21 inches (TOT); in Tank 10 = 28 inches (TOT).
08-Mar-2008 09:00 PM				1, 2, 10-13			Water level in Tank 2 = 22 inches (TOT); in Tank 11 = 32 inches (TOT).
08-Mar-2008 09:01 PM				1, 2, 10-13			Water level in Tank 12 = 32 inches (TOT); in Tank 13 = 35 inches (TOT).
08-Mar-2008 09:05 PM				1, 2, 10-13	29		Water level in Tank 1 = 25 inches (TOT); in Tank 2 = 25 inches (TOT).
08-Mar-2008 09:06 PM				1, 2, 10-13			Water level in Tank 10 = 28 inches (TOT).
08-Mar-2008 09:07 PM				1, 2, 10-13			Water level in Tank 11 = 27 inches (TOT); in Tank 22 = 29 inches (TOT).
08-Mar-2008 09:08 PM				1, 2, 10-13			Water level in Tank 13 = 27 inches (TOT).
08-Mar-2008 09:09 PM				1, 2, 10-13			Shut in well at throttle valve. Ending tank levels as follows (from top of tank):
							Tank 1: 27 inches
							Tank 2: 25 inches
							Tank 4: 25 inches
							Tank 10: 23 inches
							Tank 11: 23 inches
							Tank 12: 25 inches
							Tank 13: 24 inches
09-Mar-2008 12:03 AM							Water level in Tank 19 = 42 inches (BOT).

Notes: [a] Line temperatures measured with Halliburton's laser sensor aimed at exterior of flow line.
[b] Reference point for level readings in regulating tank (No. 4) is top of vent flange, 6 inches above top of interior of tank.
[c] Reference point for level readings in other tanks is top of interior of tank as measured at the manhole, equal to 117 inches above bottom of tank, as listed in table posted on side of tanks. Readings are referenced to top of tank (TOT) unless explicitly referenced to bottom of tank (BOT).

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Table 4: Second Artesian Flow Test, 9 March 2008, IAE Truckhaven No. 1

Time	Wellhead Pressure (psig)	Line Pressure (psig)	Line Temperature (deg F)[a]	Active Tank No.	Level in Regulating Tank (No.4) (inches from top of vent[b])	Level in Active Tank (inches from top of tank[c])	Activities & Comments
08-Mar-2008 09:09 PM							Shut in well at throttle valve after nitrogen lift through coiled tubing.
							Personnel on site:
							Erik Layman (EBL) - IAE
							James Lovekin - GeothermEx
							Chino Solarzano - PMC
							Erik Hawk - PMC
							Tom Bradley - Welaco
							Shawn McMurphy - Welaco
							Jim Lagle - Welaco
							Halliburton coiled-tubing crew (rigging down)
							Schlumberger nitrogen-unit crew (rigging down)
09-Mar-2008 12:03 AM				4	37		Tanks available to fill are Nos. 14-20. These are empty with inlet valves shut, except No. 19 has 42" measured from bottom of tank (BOT) (inlet valve leaking slowly).
09-Mar-2008 12:04 AM		254		4			Master valve and throttle valve are closed. Line pressure is trapped between these.
09-Mar-2008 12:05 AM	257.3			4			Begin opening master valve. Wellhead pressure at ground level (GL) is based on Welaco pressure tool reading of 268 psia at crown valve (10 feet above GL), adjusted for 10-foot elevation difference and atmospheric pressure of 14.7 psi. Manual gauge on wellhead wing valve (0-3,000 psig) reads about 200 psig.
09-Mar-2008 12:10 AM				4			Open thottle valve. Well gives initial burst of nitrogen and starts flowing to Tank 4.
09-Mar-2008 12:11 AM		212		4			Nitrogen still coming out of manhole at Tank 4.
09-Mar-2008 12:12 AM				4	34		
09-Mar-2008 12:14 AM				4	27		
09-Mar-2008 12:16 AM				4	18		Open Tank 4 discharge valve to manifold and open Tank 14 inlet valve.
09-Mar-2008 12:17 AM	10			14			Start in hole with Welaco tools for flowing pressure-temperature-spinner (PTS) survey. Flowing wellhead pressure from PTS logging tool at ground level.
09-Mar-2008 12:18 AM				14	20		
09-Mar-2008 12:20 AM				14	25		
09-Mar-2008 12:24 AM				14	30		
09-Mar-2008 12:24 AM				14		50	
09-Mar-2008 12:29 AM				14	31		
09-Mar-2008 12:33 AM				14		30	
09-Mar-2008 12:35 AM				14	27		
09-Mar-2008 12:38 AM				14	22	26	
09-Mar-2008 12:40 AM				14	18		
09-Mar-2008 12:42 AM				14	16	15	Close Tank 14 inlet valve. Open Tank 15 inlet valve.
09-Mar-2008 12:49 AM				15	24		
09-Mar-2008 12:56 AM				15	21		
09-Mar-2008 12:57 AM				15		52	
09-Mar-2008 12:59 AM				15		39	
09-Mar-2008 01:02 AM				15	20	30	
09-Mar-2008 01:06 AM				15	15	26	
09-Mar-2008 01:07 AM				15		23	

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Table 4: Second Artesian Flow Test, 9 March 2008, IAE Truckhaven No. 1

Time	Wellhead Pressure (psig)	Line Pressure (psig)	Line Temperature (deg F)[a]	Active Tank No.	Level in Regulating Tank (No.4) (inches from top of vent[b])	Level in Active Tank (inches from top of tank[c])	Activities & Comments
09-Mar-2008 01:08 AM				15	12		
09-Mar-2008 01:09 AM				15		20	
09-Mar-2008 01:10 AM				15	9	16	Close Tank 15 inlet valve. Open Tank 16 inlet valve. Slight overflow at Tank 4 man-hole.
09-Mar-2008 01:17 AM				16	19		
09-Mar-2008 01:24 AM				16		52	
09-Mar-2008 01:25 AM				16	22		
09-Mar-2008 01:29 AM				16		38	
09-Mar-2008 01:31 AM				16	20		
09-Mar-2008 01:33 AM				16		29	
09-Mar-2008 01:34 AM				16		24	Reading at Tank 16 uncertain.
09-Mar-2008 01:35 AM				16	15	21	
09-Mar-2008 01:39 AM				16	10	14.5	Close Tank 16 inlet valve. Open Tank 17 inlet valve. Tank 4 level estimated.
09-Mar-2008 01:45 AM				17	32		
09-Mar-2008 01:53 AM				17	36		
09-Mar-2008 01:54 AM				17		38	
09-Mar-2008 01:59 AM				17		32	
09-Mar-2008 02:01 AM				17		27.5	
09-Mar-2008 02:02 AM				17	29		
09-Mar-2008 02:04 AM				17		22	
09-Mar-2008 02:06 AM				17	20		
09-Mar-2008 02:07 AM				17		18	
09-Mar-2008 02:10 AM				17	14		
09-Mar-2008 02:11 AM				17	12.5	8.5	Close Tank 17 inlet valve. Open Tank 18 inlet valve. Tank 4 level estimated.
09-Mar-2008 02:19 AM				18	36		
09-Mar-2008 02:20 AM				18		58	
09-Mar-2008 02:25 AM				18		41	
09-Mar-2008 02:27 AM				18			Tank 19 has 48" of water (BOT) => 6" water leaked in since 12:03 am.
09-Mar-2008 02:28 AM				18	37		
09-Mar-2008 02:31 AM				18		34	
09-Mar-2008 02:35 AM				18		27	
09-Mar-2008 02:38 AM				18	26	20	
09-Mar-2008 02:41 AM				18	22	17.5	Close Tank 18 inlet valve. Open Tank 19 inlet valve. Tank 4 level estimated. Tank 19 starts with apx 48.5" of water (BOT) = 68.5" TOT
09-Mar-2008 02:47 AM				19		44	
09-Mar-2008 02:48 AM				19	29		
09-Mar-2008 02:50 AM				19		36	
09-Mar-2008 02:52 AM				19		32	
09-Mar-2008 02:55 AM				19	25	27	
09-Mar-2008 02:58 AM				19		20.5	
09-Mar-2008 02:59 AM				19	20		
09-Mar-2008 03:01 AM				19	17.5	15.5	Close Tank 19 inlet valve. Open Tank 20 inlet valve. Tank 4 level estimated.
09-Mar-2008 03:05 AM				20	25		
09-Mar-2008 03:15 AM				20		54	

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Table 4: Second Artesian Flow Test, 9 March 2008, IAE Truckhaven No. 1

Time	Wellhead Pressure (psig)	Line Pressure (psig)	Line Temperature (deg F)[a]	Active Tank No.	Level in Regulating Tank (No.4) (inches from top of vent[b])	Level in Active Tank (inches from top of tank[c])	Activities & Comments
09-Mar-2008 03:16 AM				20	31		
09-Mar-2008 03:20 AM				20		47	Hung Welaco PTS tool at 4,500 feet KB.
09-Mar-2008 03:21 AM				20	29		
09-Mar-2008 03:23 AM				20		38	
09-Mar-2008 03:27 AM				20	22	31	
09-Mar-2008 03:30 AM				20		26	
09-Mar-2008 03:32 AM				20	12	22	Shut in well at shut-off valve.

Notes: [a] Line temperatures measured by Thermochem at sampling ports. None recorded during flow test of 9 Mar 08 (Thermochem not on site).
[b] Reference point for level readings in regulating tank (No. 4) is top of vent flange, 6 inches above top of interior of tank.
[c] Reference point for level readings in other tanks is top of interior of tank as measured at the manhole, equal to 117 inches above bottom of tank, as listed in table posted on side of tanks. Readings are referenced to top of tank (TOT) unless explicitly referenced to bottom of tank (BOT).

Table 5: Comparison of Productivity Indices from First and Second Artesian Flow Tests, IAE Truckhaven No. 1

Test	Average Flow Rate Post-Flash (GPM)	Temperature At Top of Production Interval (°F)	Enthalpy Based on Production Temperature (BTU/lbm)	Steam Fraction at Atmos-pheric Pressure (%)	Average Flow Rate Pre-Flash (GPM)	Pressure at 4,500 ft KB at End of Flow (psia)	Pressure Drawdown Compared to Static Survey of 4 Mar 08	Productivity Index (GPM/psi)
First Artesian Flow Test, 5 March 2008	532	260	229	5	560	1769	289	1.9
Second Artesian Flow Test, 9 March 2008	632	250	219	4	658	1792	266	2.5

Table 6: Pump Calculation Assumptions for IAE Truckhaven No. 1
Assuming Productivity Index of 2.5 GPM / PSI

Input Parameters		
Productivity Index (PI):	2.5	gpm/psi
Static pressure at production level:	2,058	psia
Depth to production level:	4,472	feet
Density of produced water:	58.53	lb/ft^3
Vapor pressure at temperature of produced water:	35.4	psia
Gas partial pressure*:	188.5	psia
Pump suction pressure:	77	psia
Pressure safety margin:	10	psi
Relative roughness:	0.0006	feet
Casing internal diameter (ID):	12.5	inches
Viscosity of produced water:	0.22	cp
Pump discharge pressure:	35.4	psia
Pump efficiency:	0.76	
Motor efficiency:	0.88	
Parasitic load factor for plant and injection pumps:	0.20	
Temperature of produced water:	260	°F
Rejection temperature:	60	°F
Average specific heat of water between T and T_0:	1.02	BTU/lb/°F
Utilization factor:	0.37	

*Based on Thermochem analysis for production temperature of 260°F.

2008 GeothermEx, Inc.

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E-MAIL: mw@geothermex.com

FIGURES

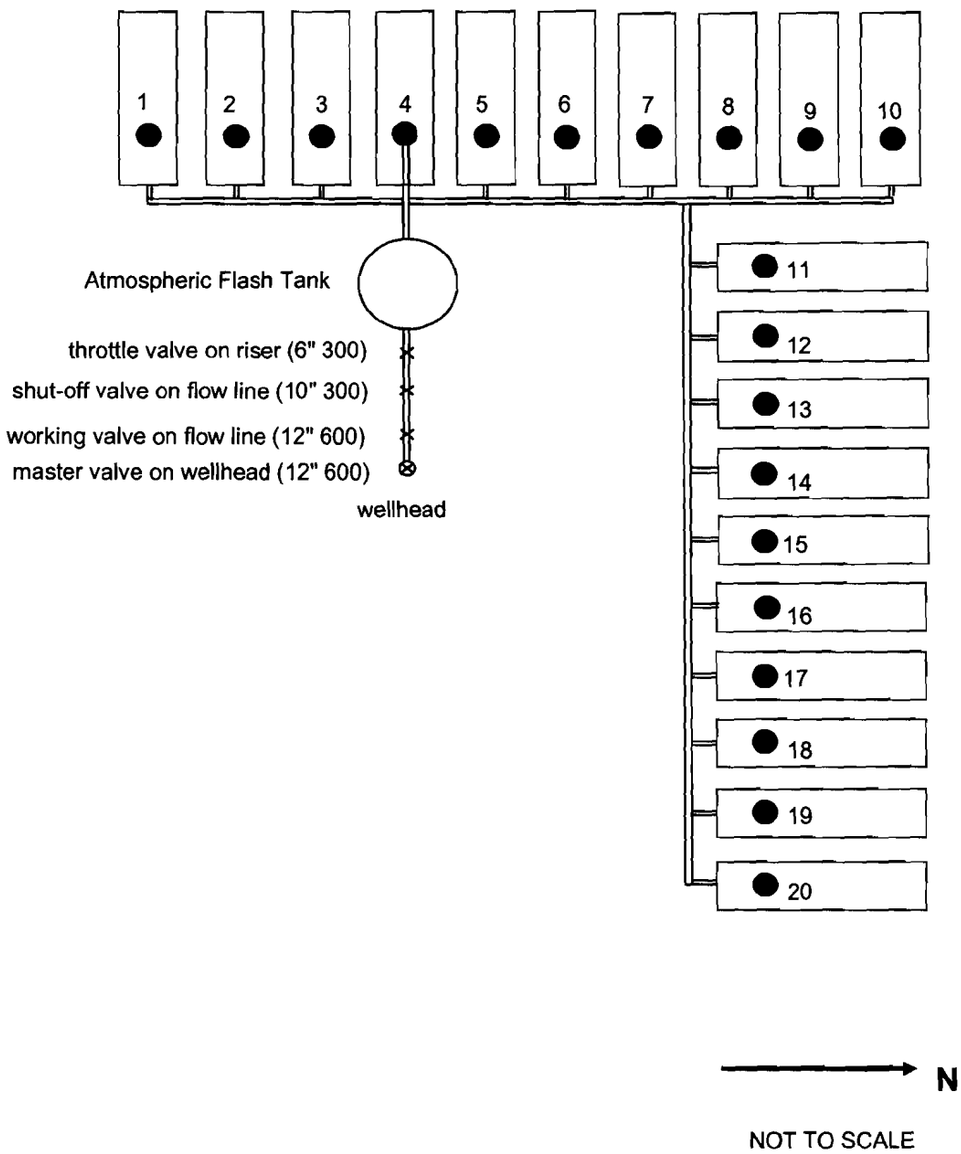

Figure 1: Well Test Lay-out for IAE Truckhaven No. 1, March 5-9, 2008

Figure 2:
Static Pressure-Temperature Survey, 4 Mar 2008
IAE Truckhaven No. 1

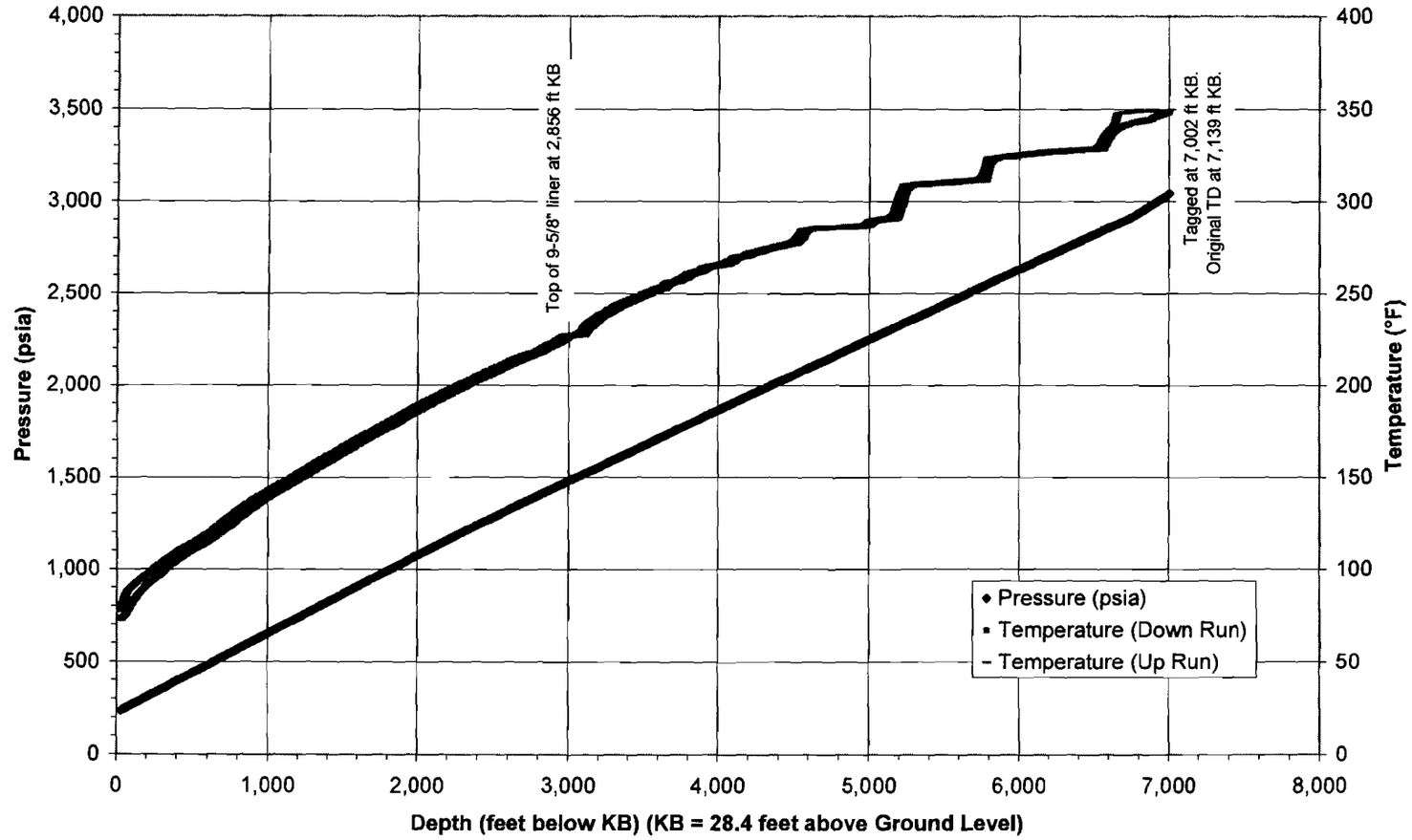

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Figure 3: Water Levels in Regulating Tank and in Tanks with Leaky Inlet Valves
IAE Truckhaven No. 1, First Artesian Flow Test,
5 March 2008

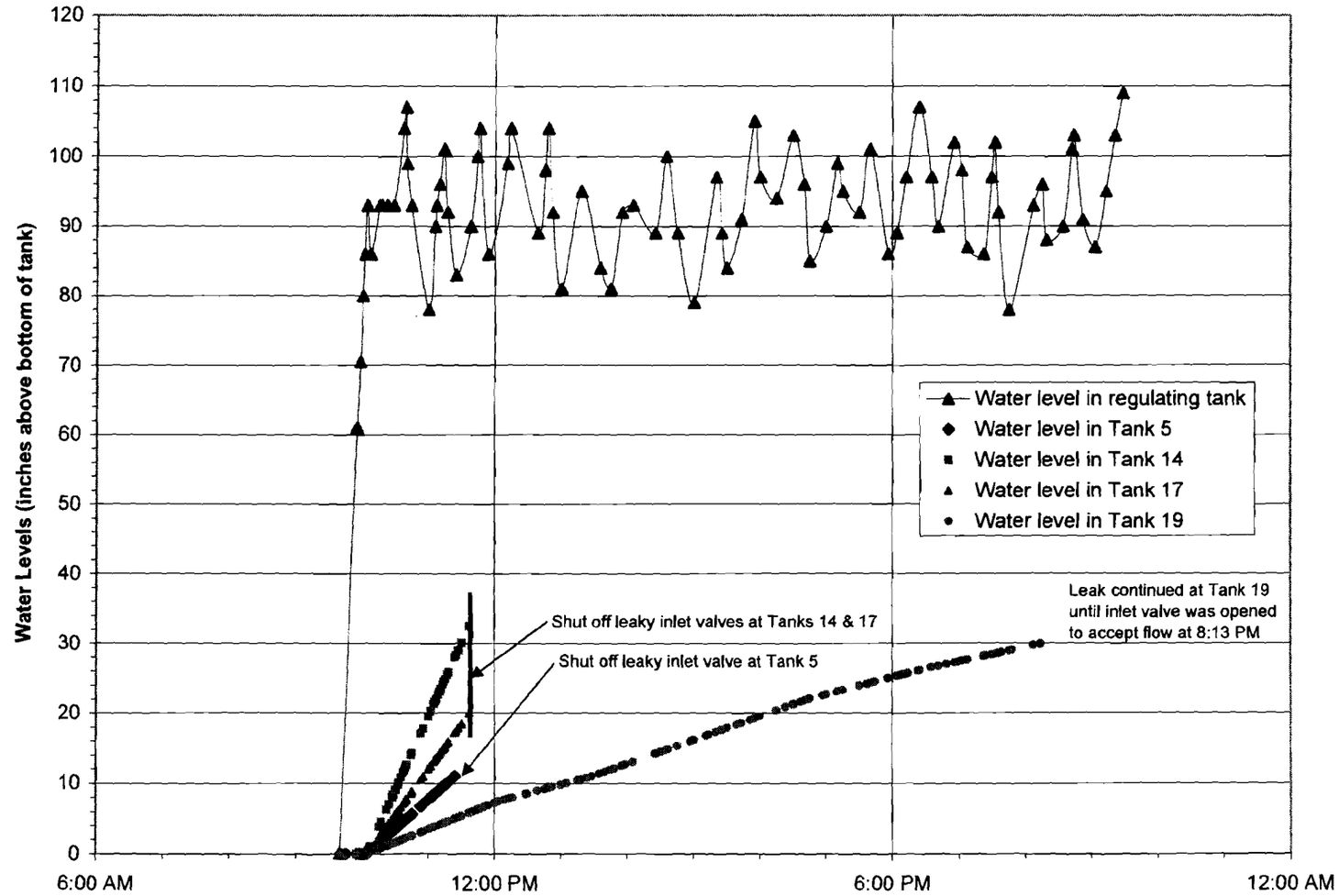

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Figure 4: Flow Rate, Line Temperature, and Wellhead Pressure
IAE Truckhaven No. 1, First Artesian Flow Test,
5 March 2008

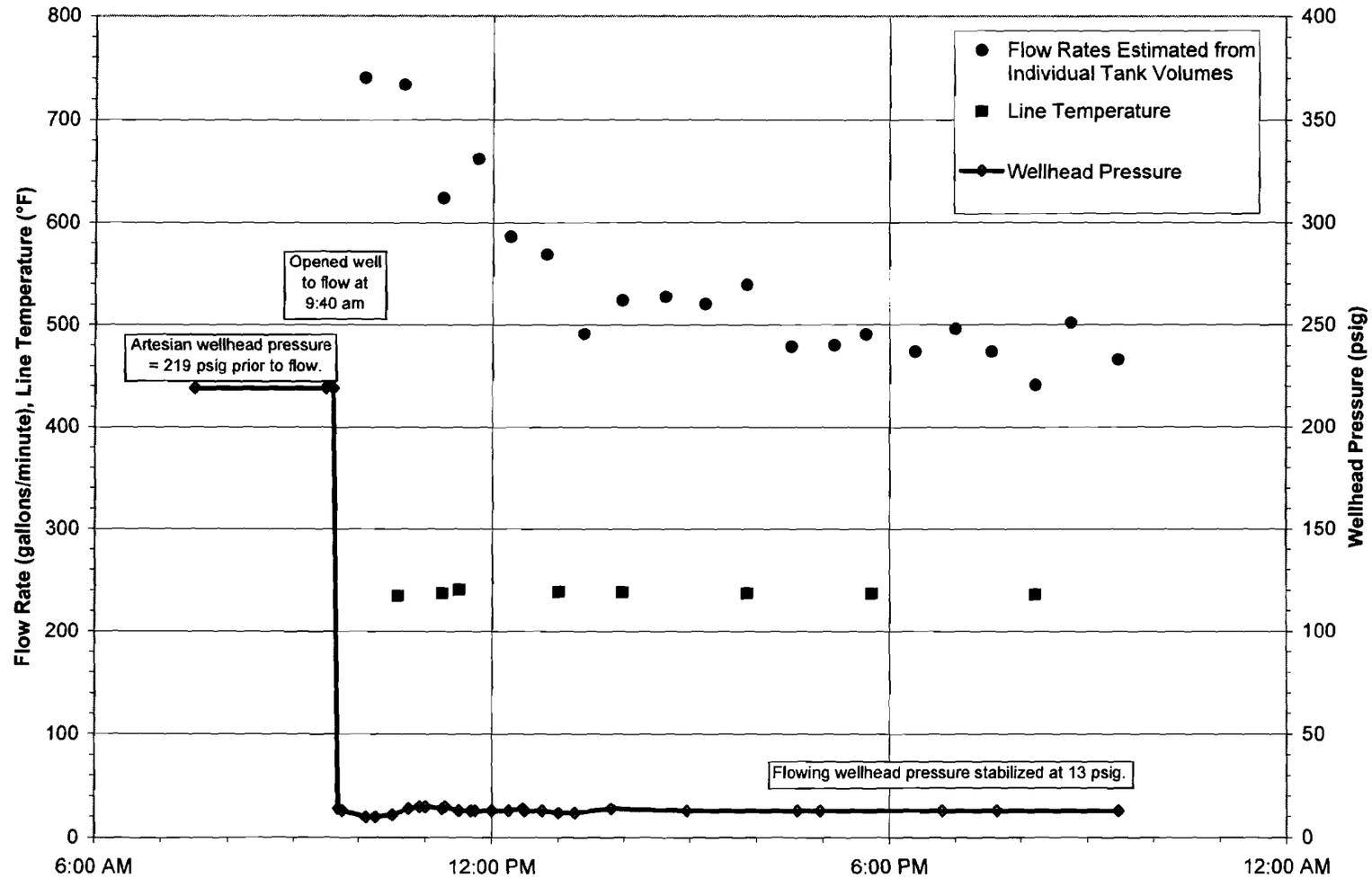

Fig 3 & 4.xls

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Figure 5:
Comparison of Static and Flowing Surveys, 4 - 5 March 2008
IAE Truckhaven No. 1

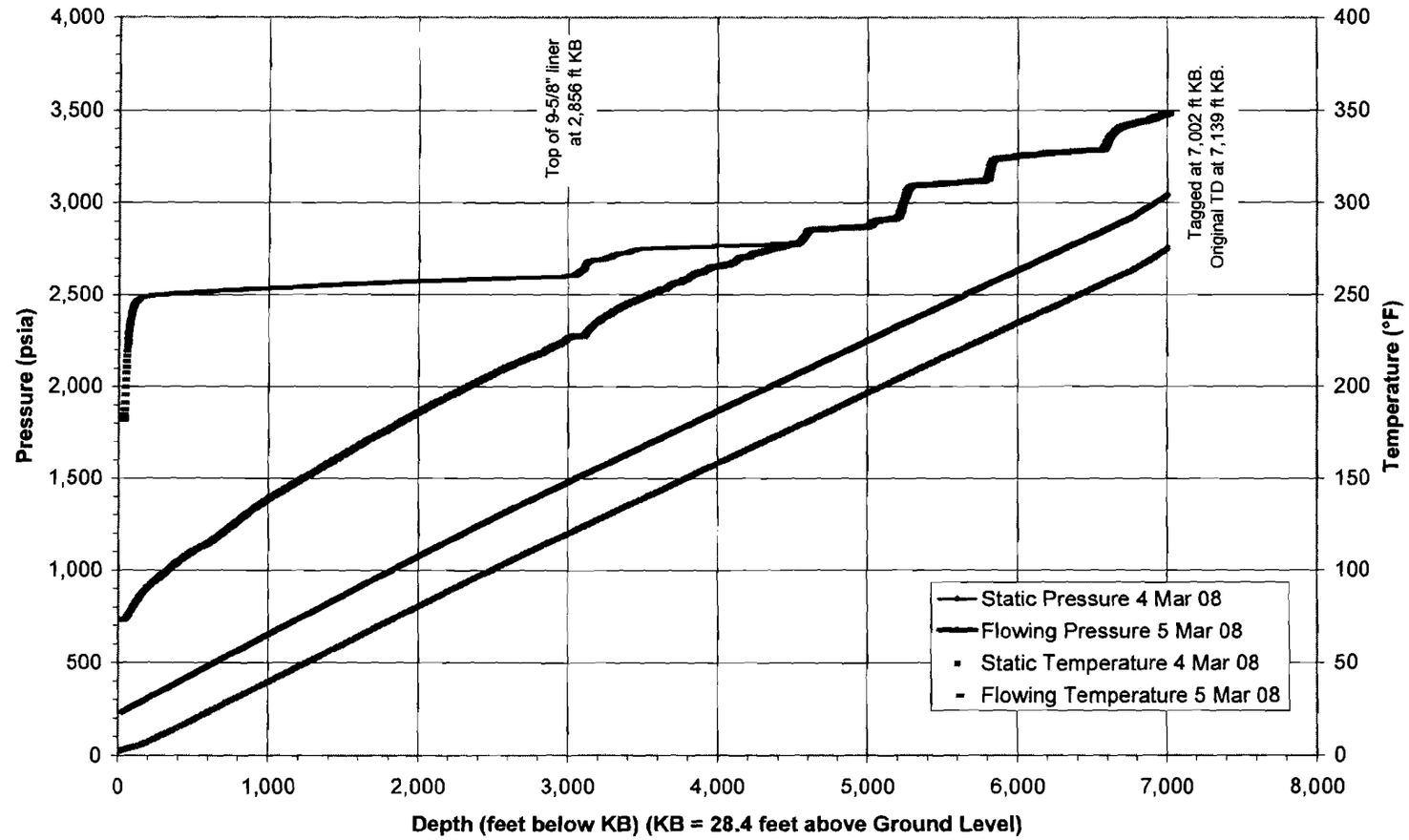

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Figure 6:
Pressure-Temperature-Spinner Survey, 5 March 2008
IAE Truckhaven No. 1

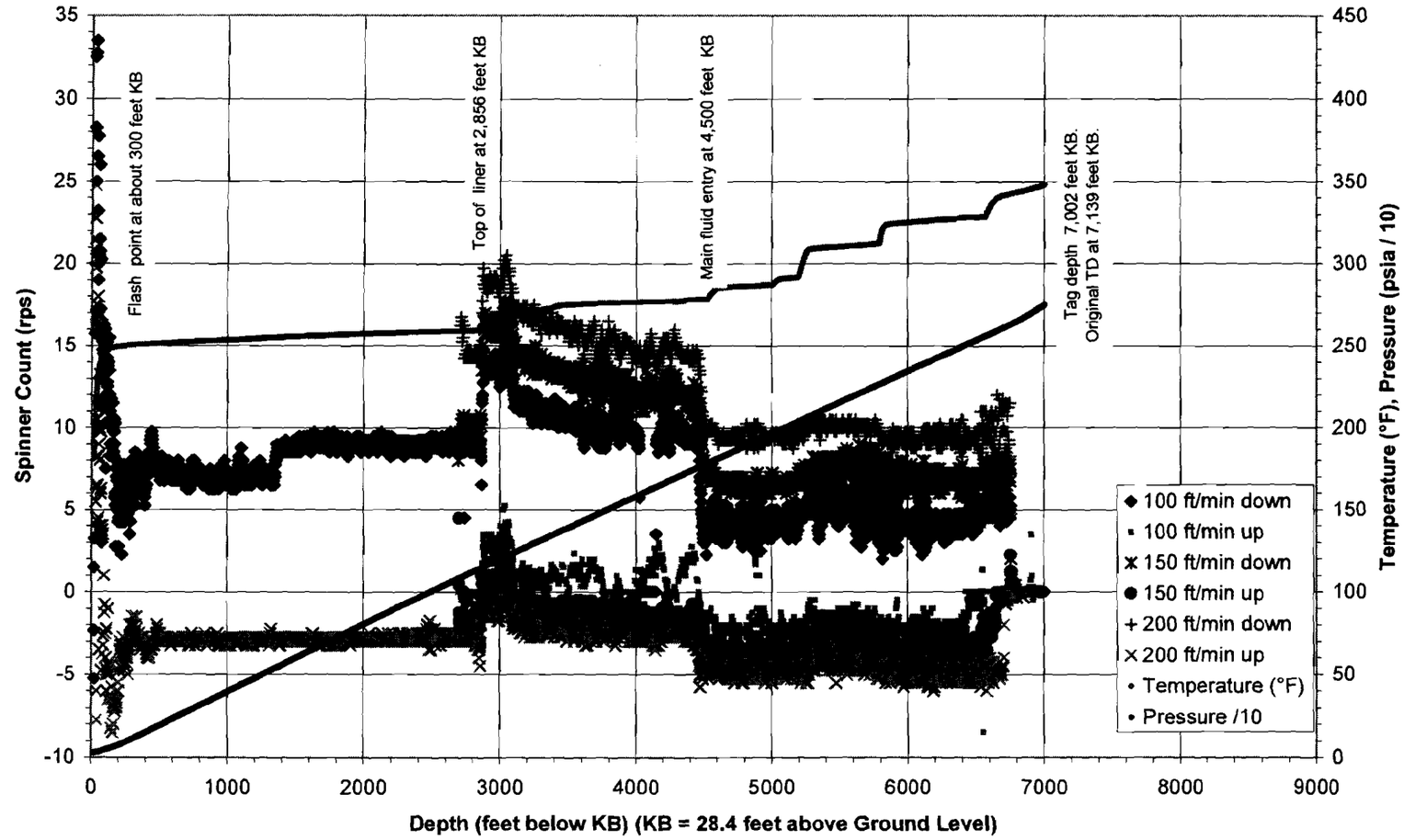

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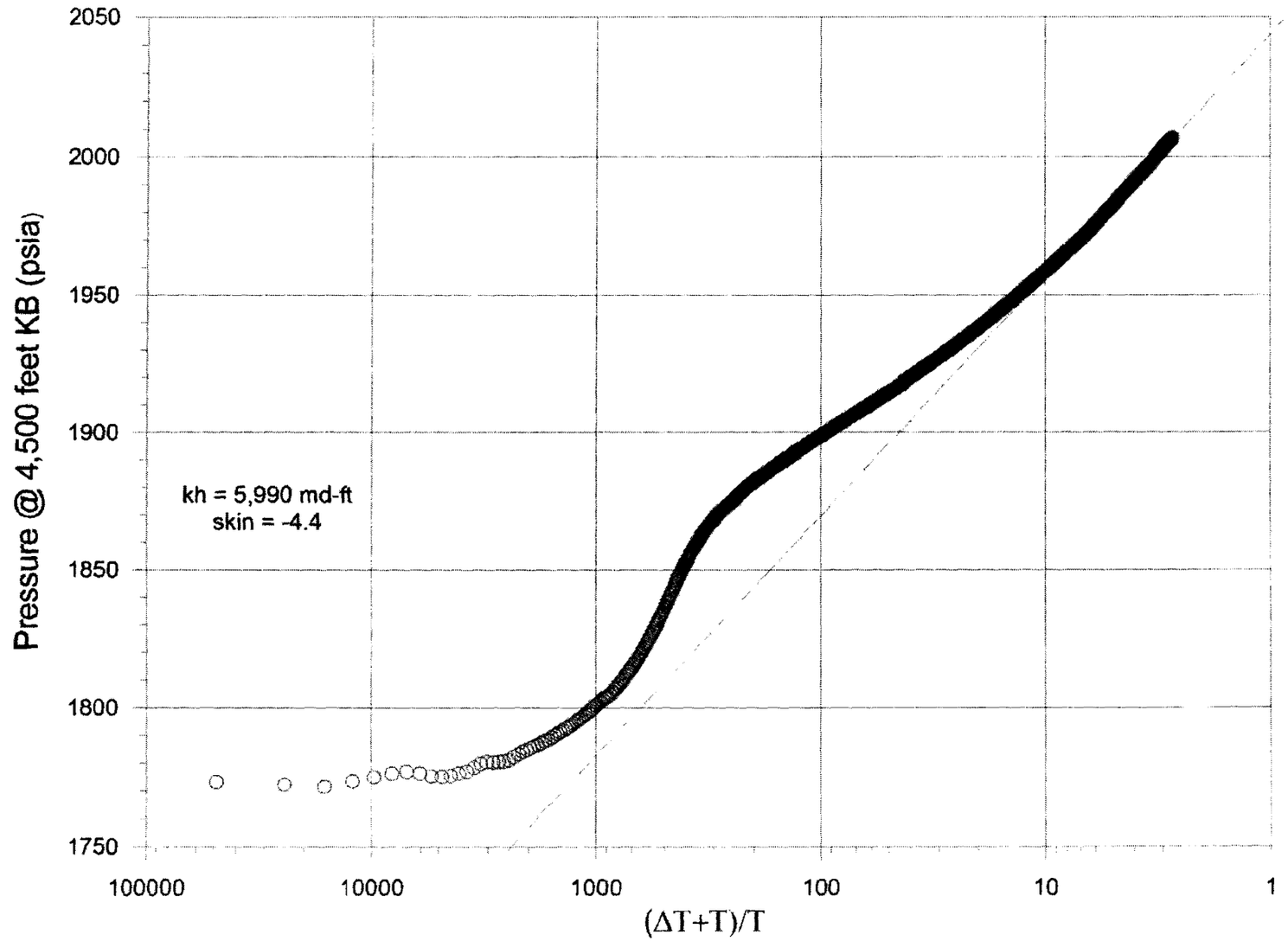
Figure 7: Horner Analysis of First Artesian Flow Test, 5 March 2008
IAE Truckhaven No. 1



2008, GeothermEx Inc.

Figure 8: Radial Flow Analysis of First Artesian Flow Test, 5 March 2008
IAE Truckhaven No. 1

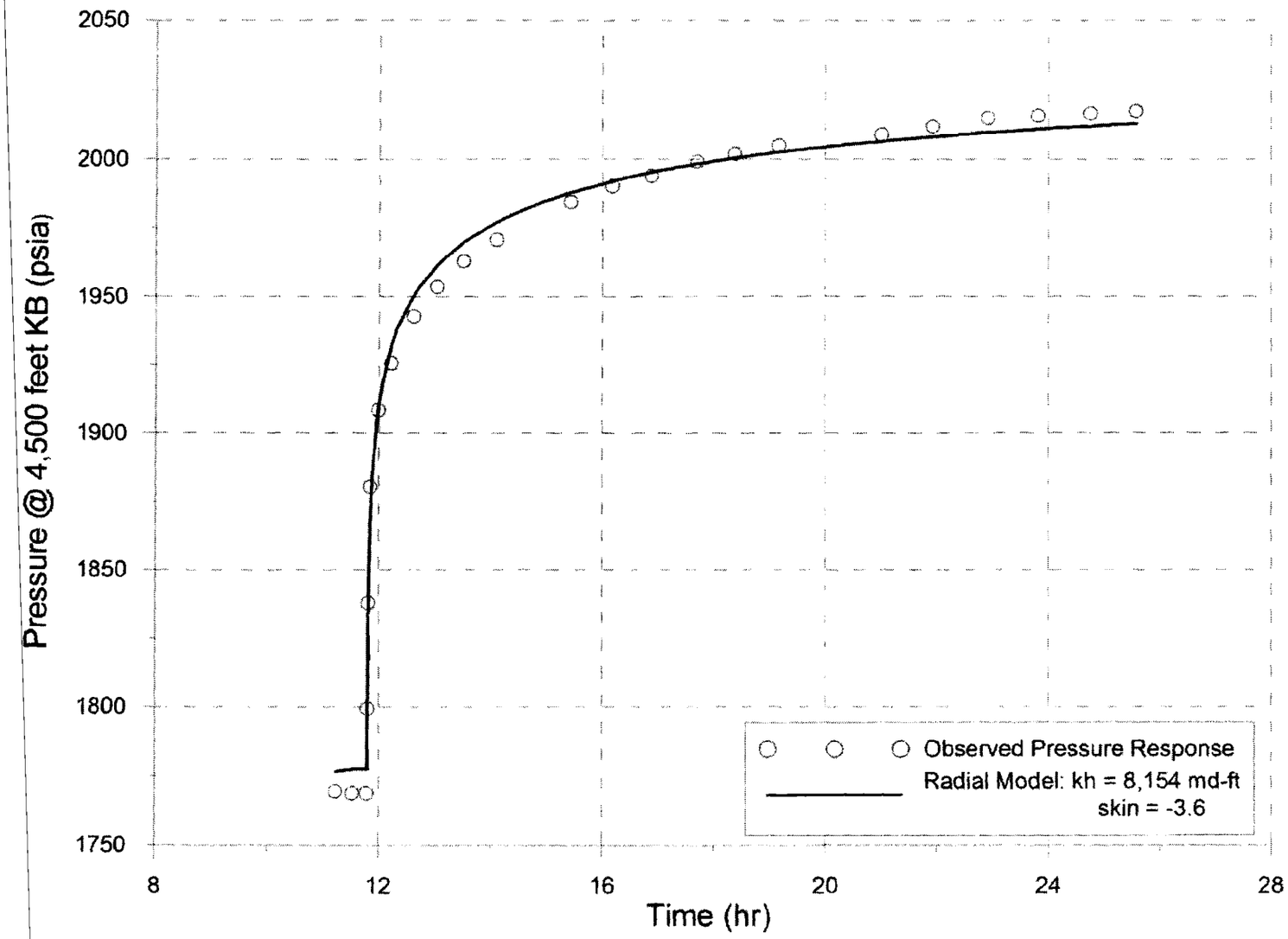


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Figure 9: IAE Truckhaven No. 1 Injection
6-8 March 2008

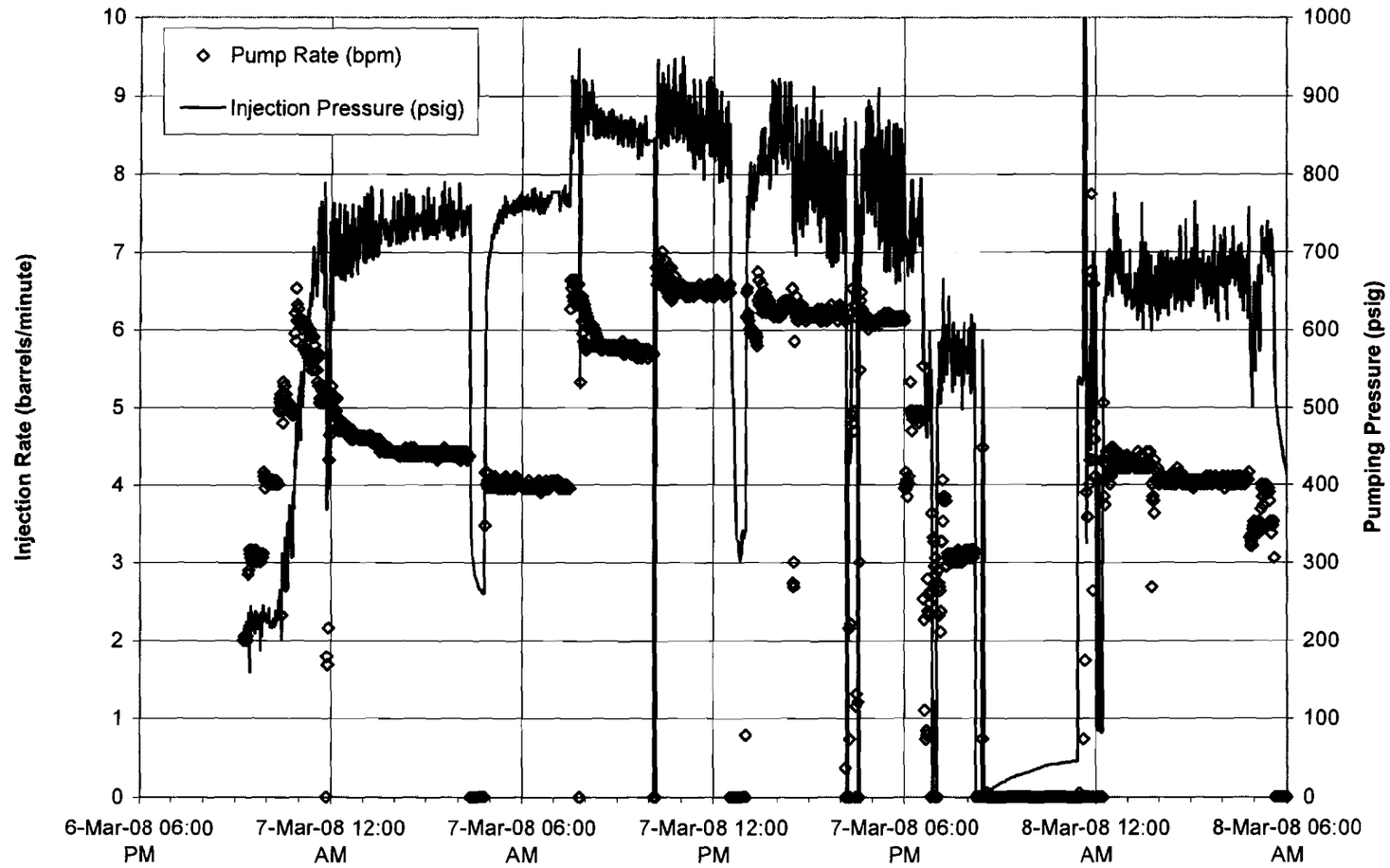

Fig 9.xls

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Figure 10:
Water Levels in Regulating Tank and in Tank with Leaky Inlet Valve (No. 19)
IAE Truckhaven No. 1, Coiled-Tubing Flow Test, 8 March 2008

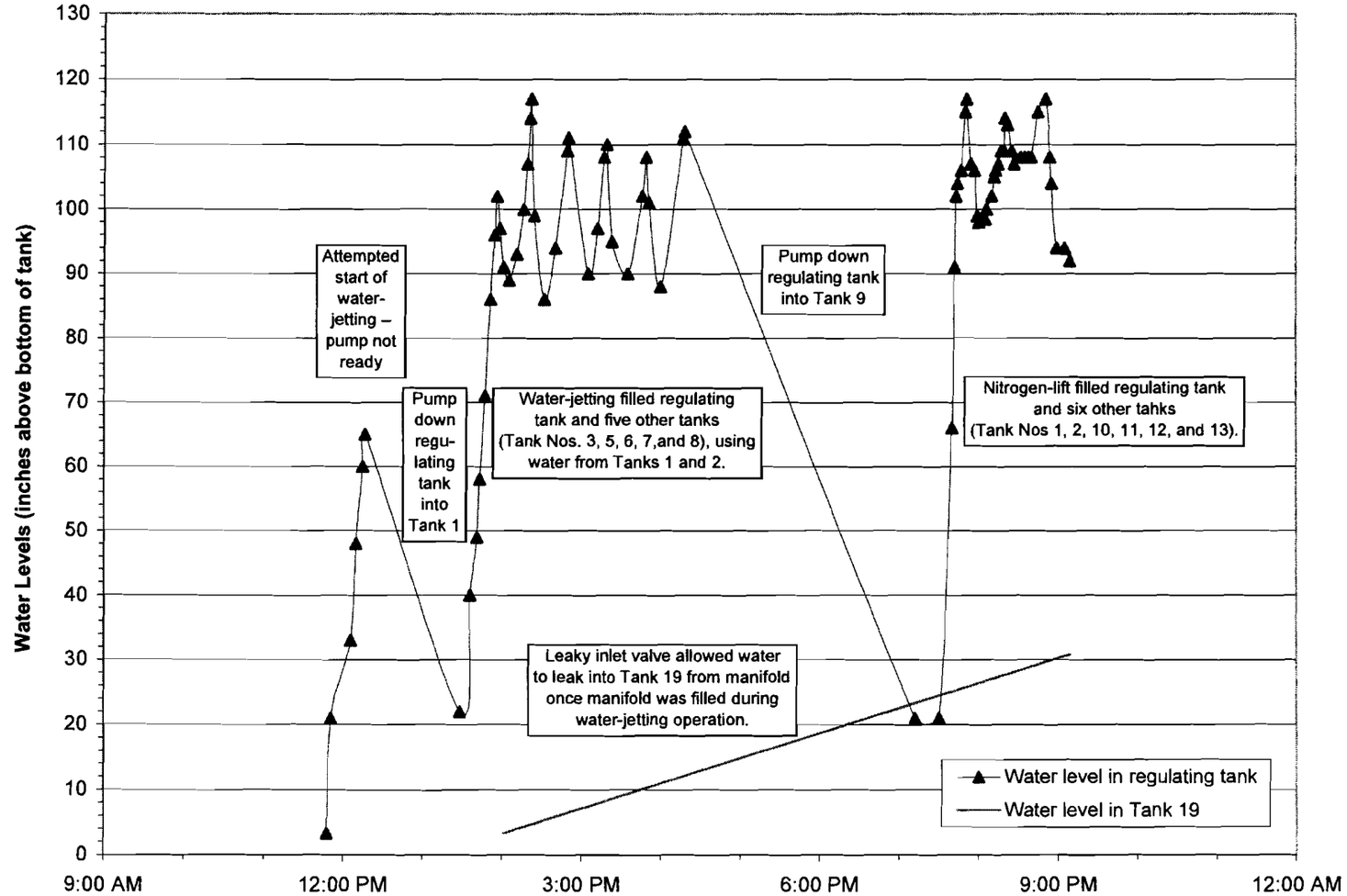

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Figure 11:
Flow Rate, Line Temperature, and Wellhead Pressure
IAE Truckhaven No. 1, Coiled-Tubing Operations, 8 March 2008

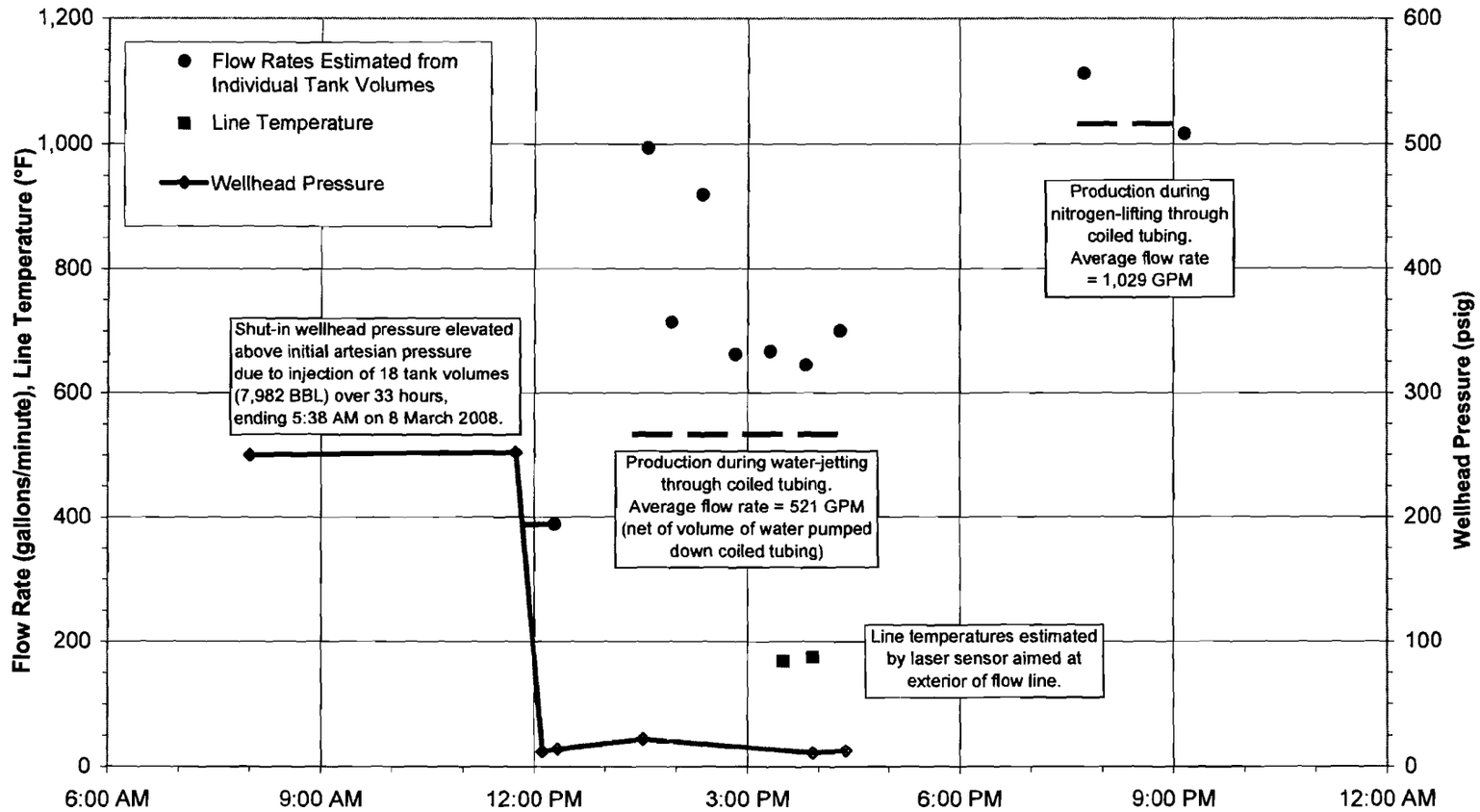

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Figure 12:
Water Levels in Regulating Tank and in Tank with Leaky Inlet Valve (No. 19)
IAE Truckhaven No. 1, Second Artesian Flow Test, 9 March 2008

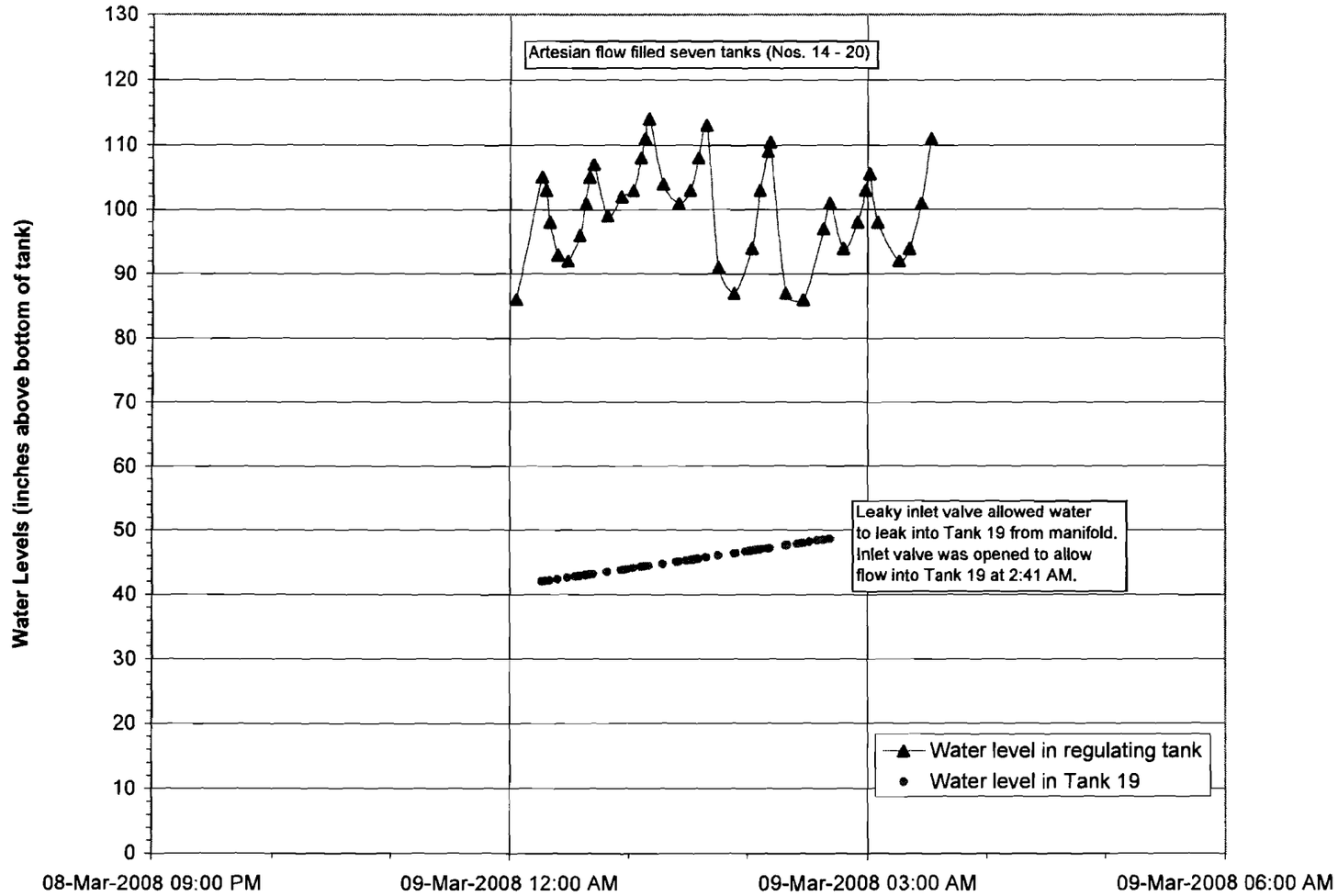

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Figure 14:
Comparison of Static and Flowing Surveys, 4 - 9 March 2008
IAE Truckhaven No. 1

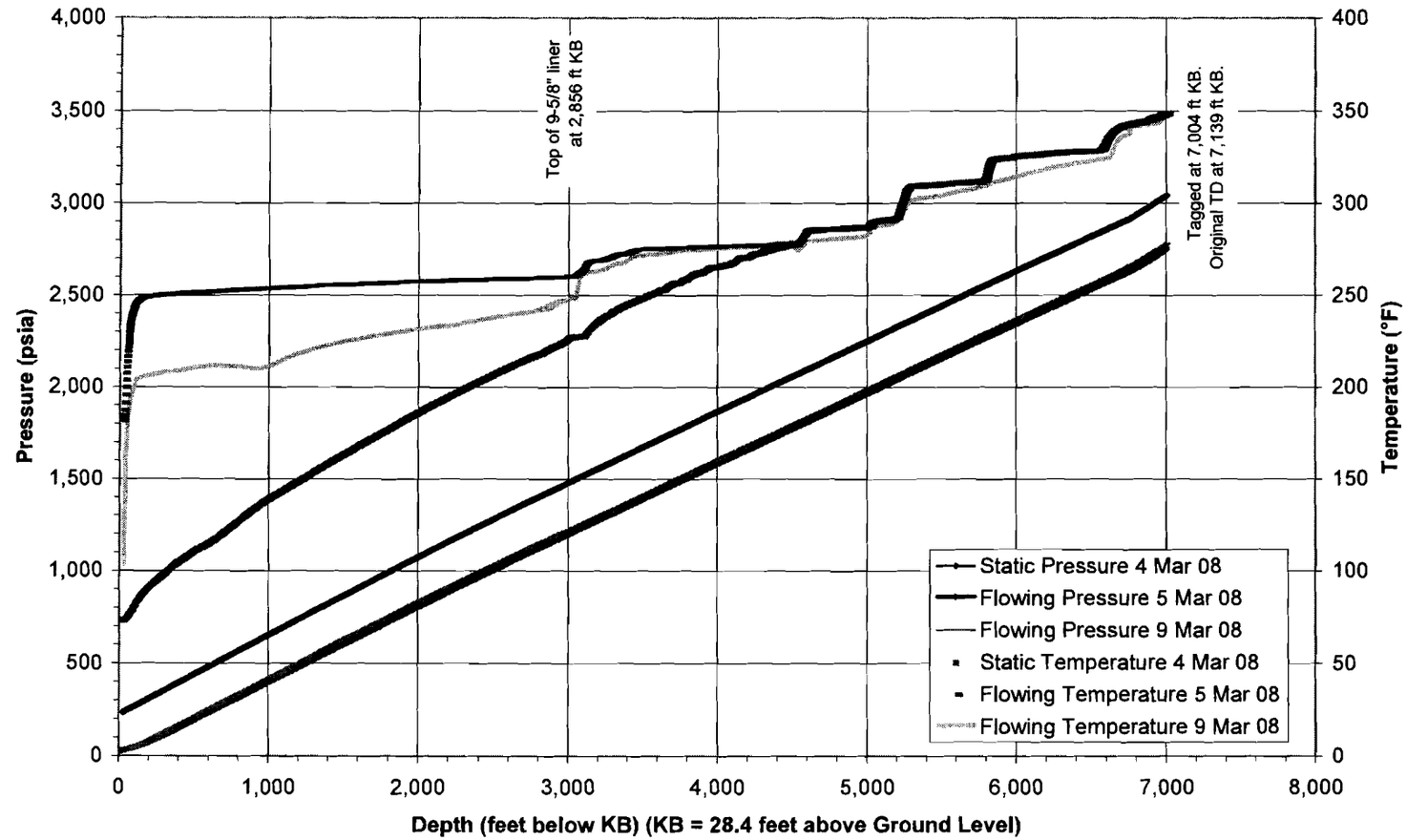

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Figure 13:
Flow Rate and Wellhead Pressure
IAE Truckhaven No. 1, Second Artesian Flow Test, 9 March 2008

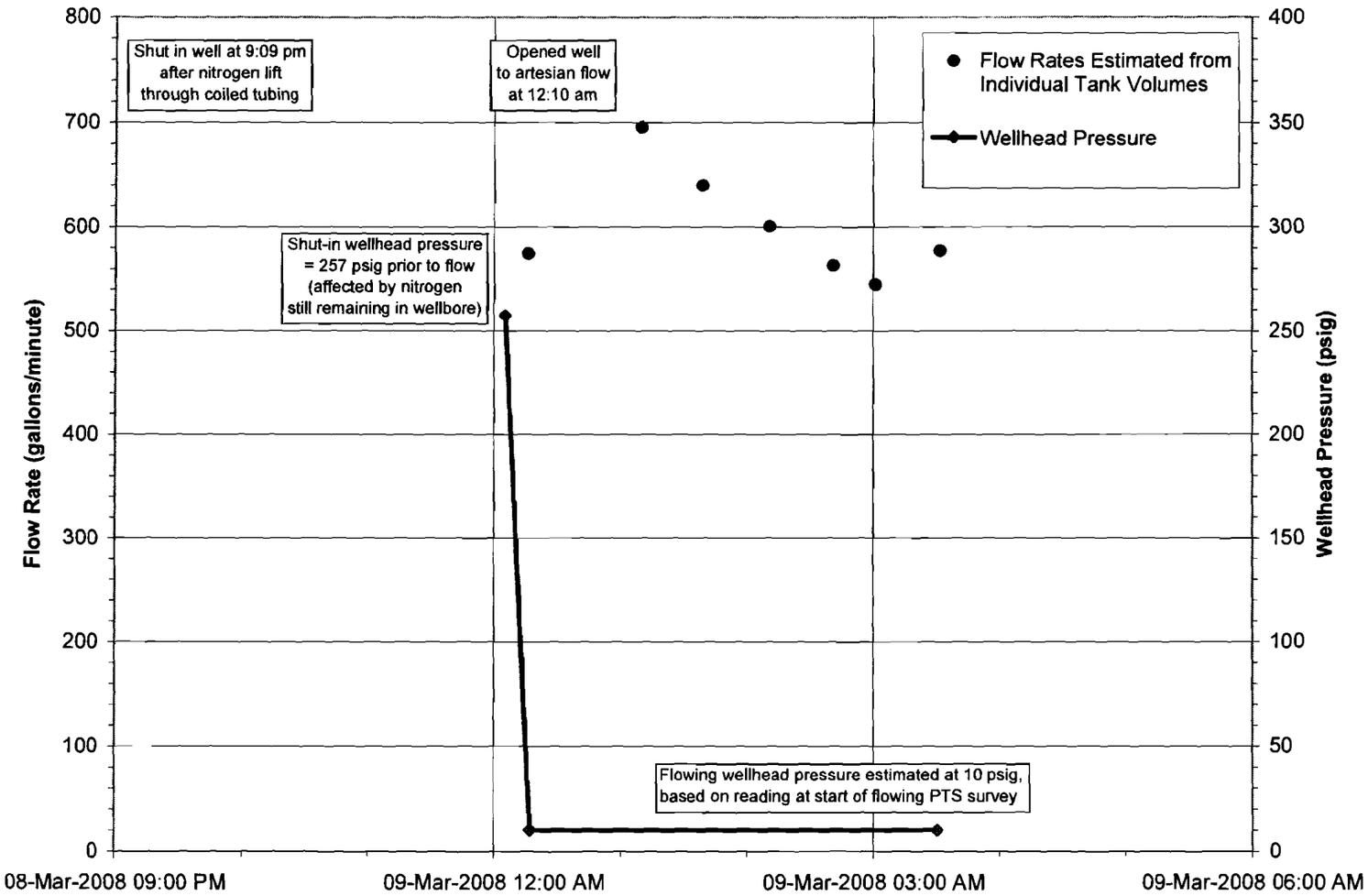

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Figure 14:
Comparison of Static and Flowing Surveys, 4 - 9 March 2008
IAE Truckhaven No. 1

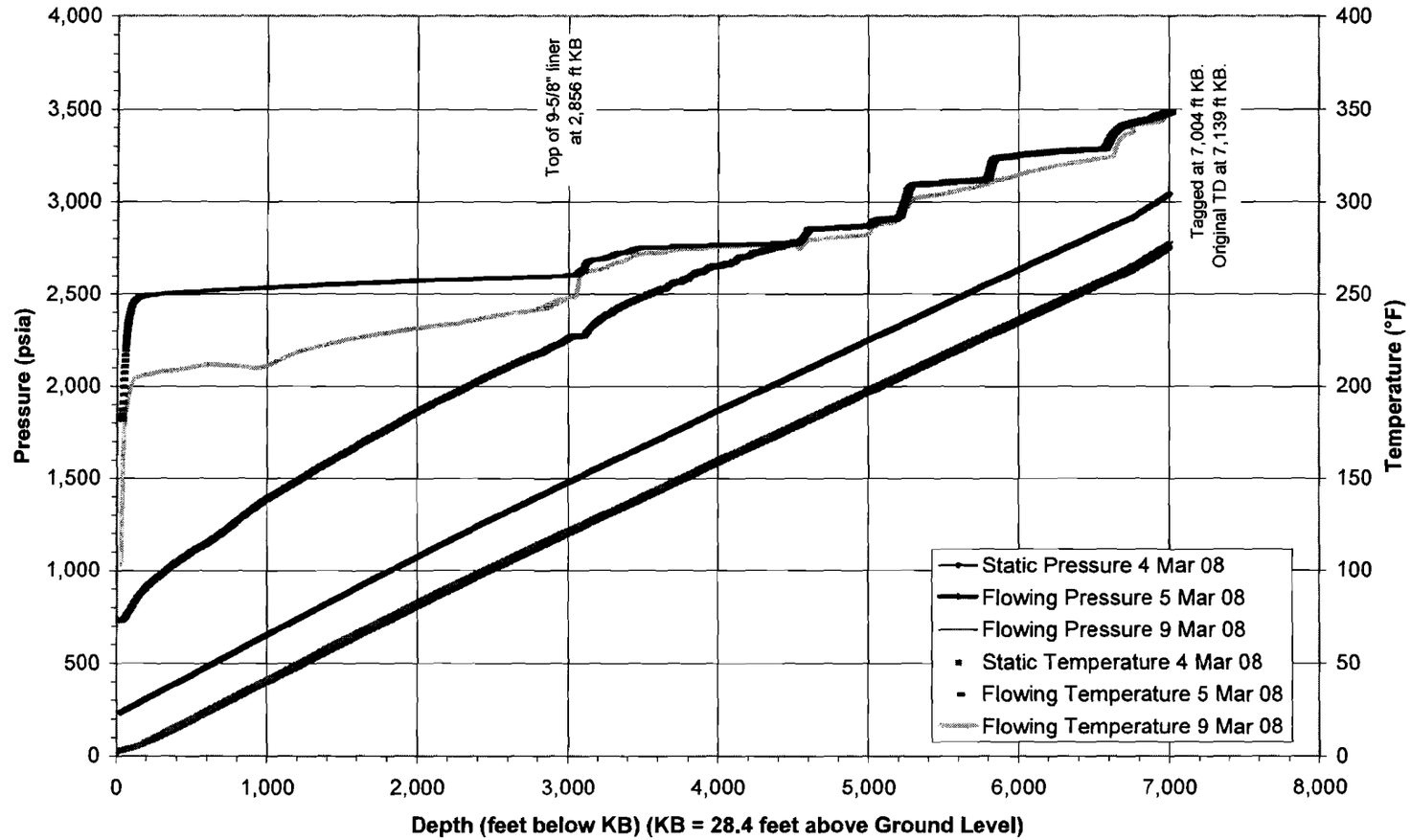

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Figure 15:
Pressure-Temperature-Spinner Survey, 9 March 2008
IAE Truckhaven No. 1

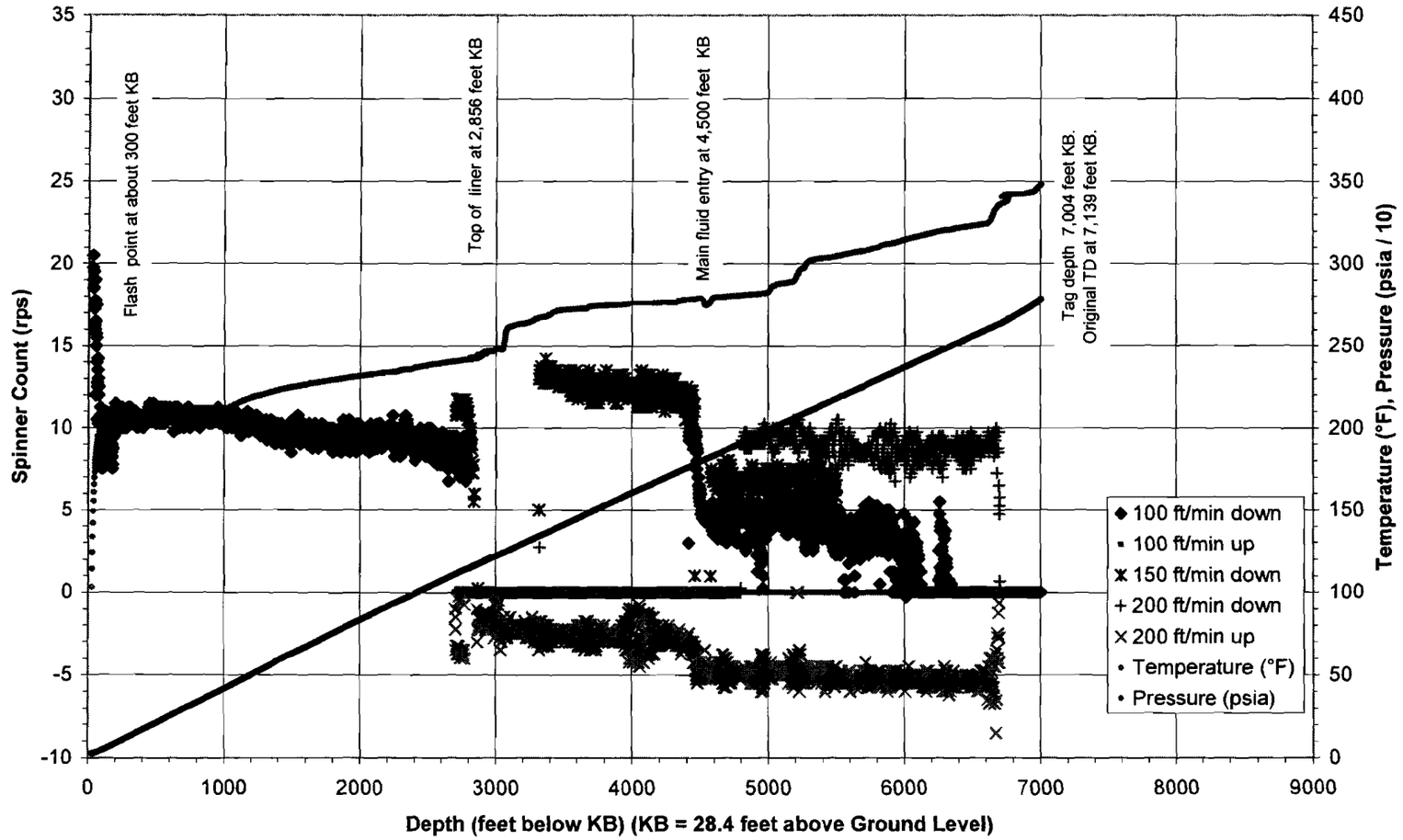

Fig 15.xls

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Figure 16: Horner Analysis of Second Artesian Flow Test, 9 March 2008
IAE Truckhaven No. 1

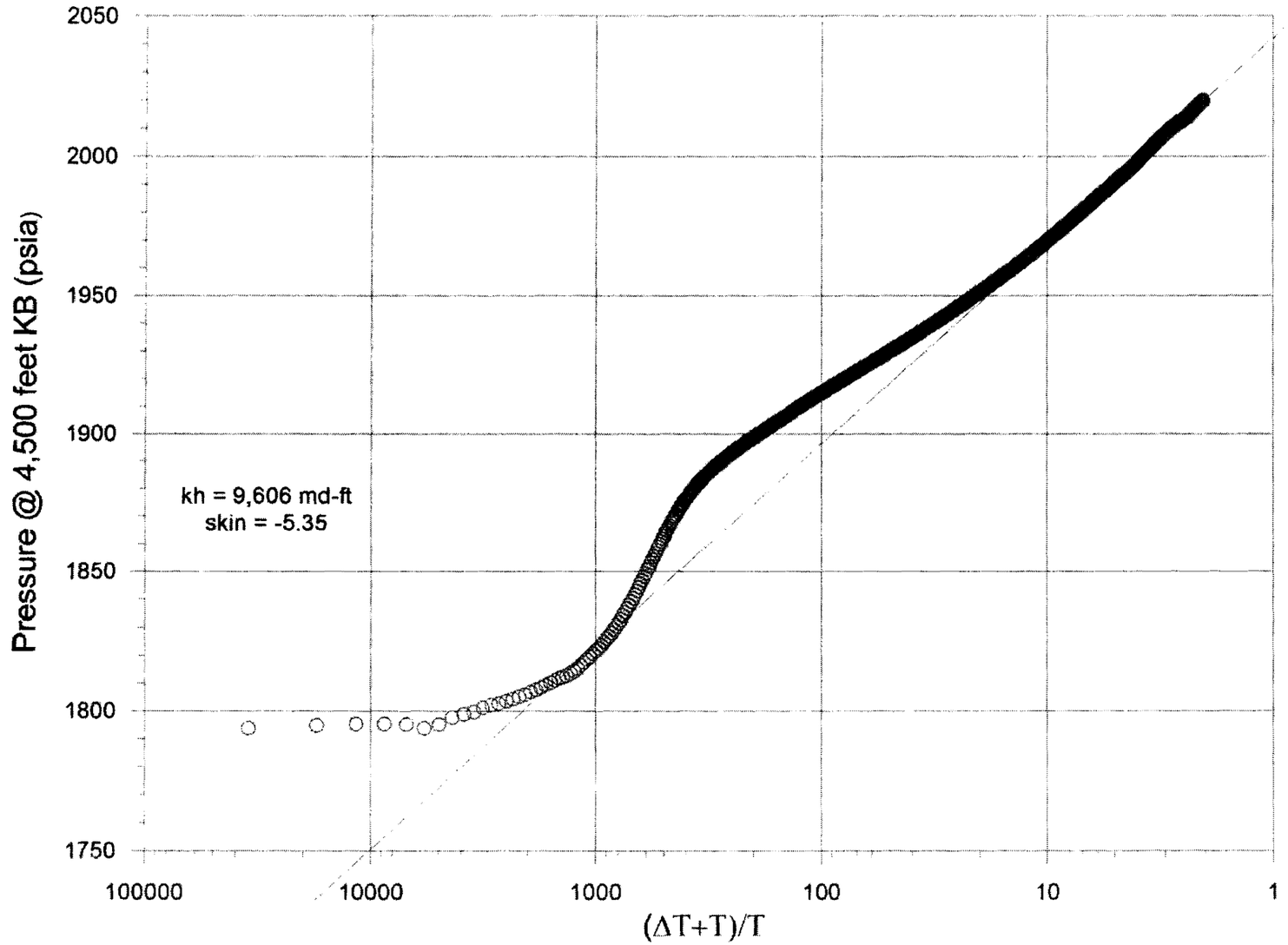

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Figure 17: Radial Flow Analysis of Second Artesian Flow Test, 9 March 2008
IAE Truckhaven No. 1

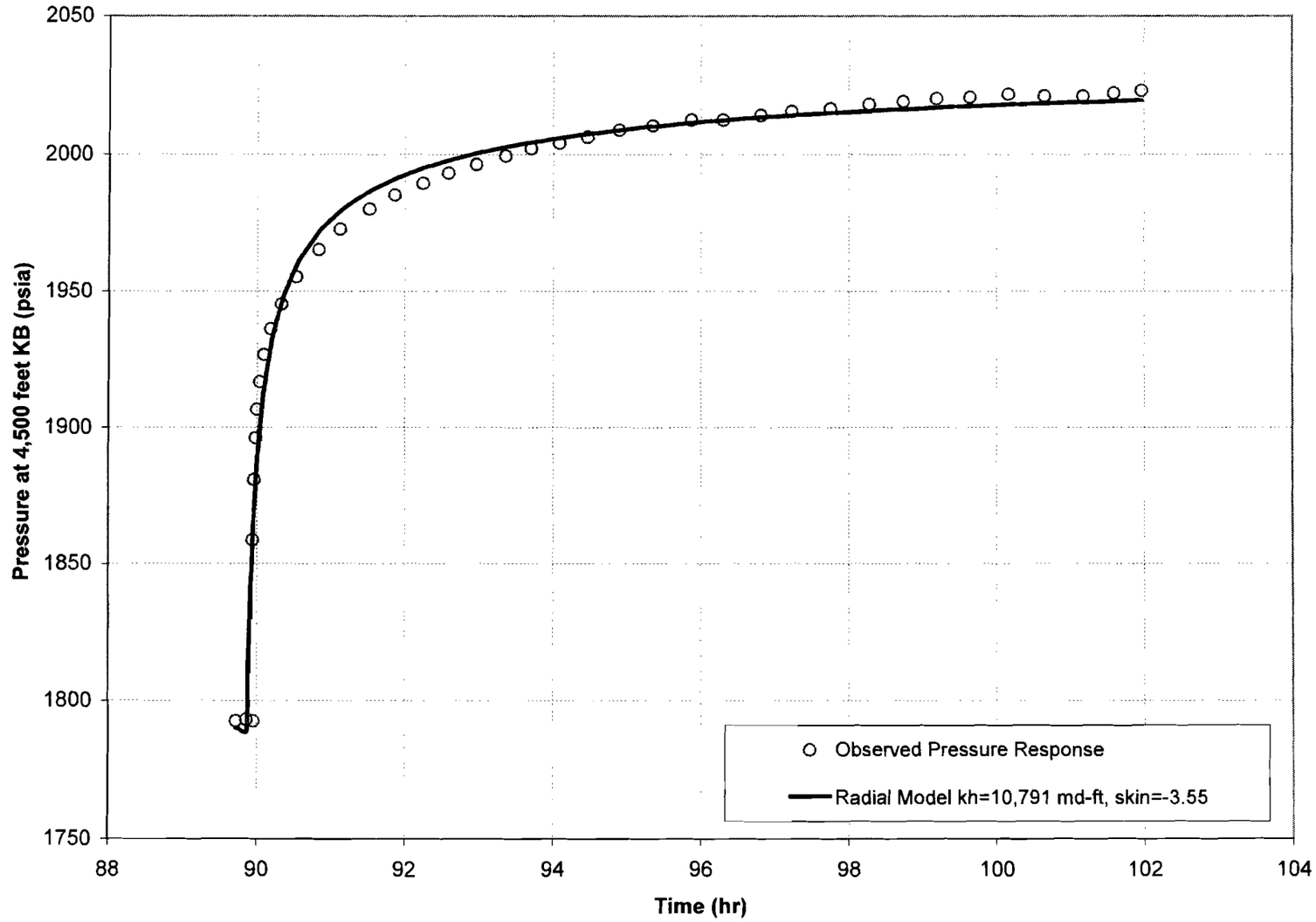

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Figure 18: Power capacity vs. pump-setting depth for IAE Truckhaven No. 1

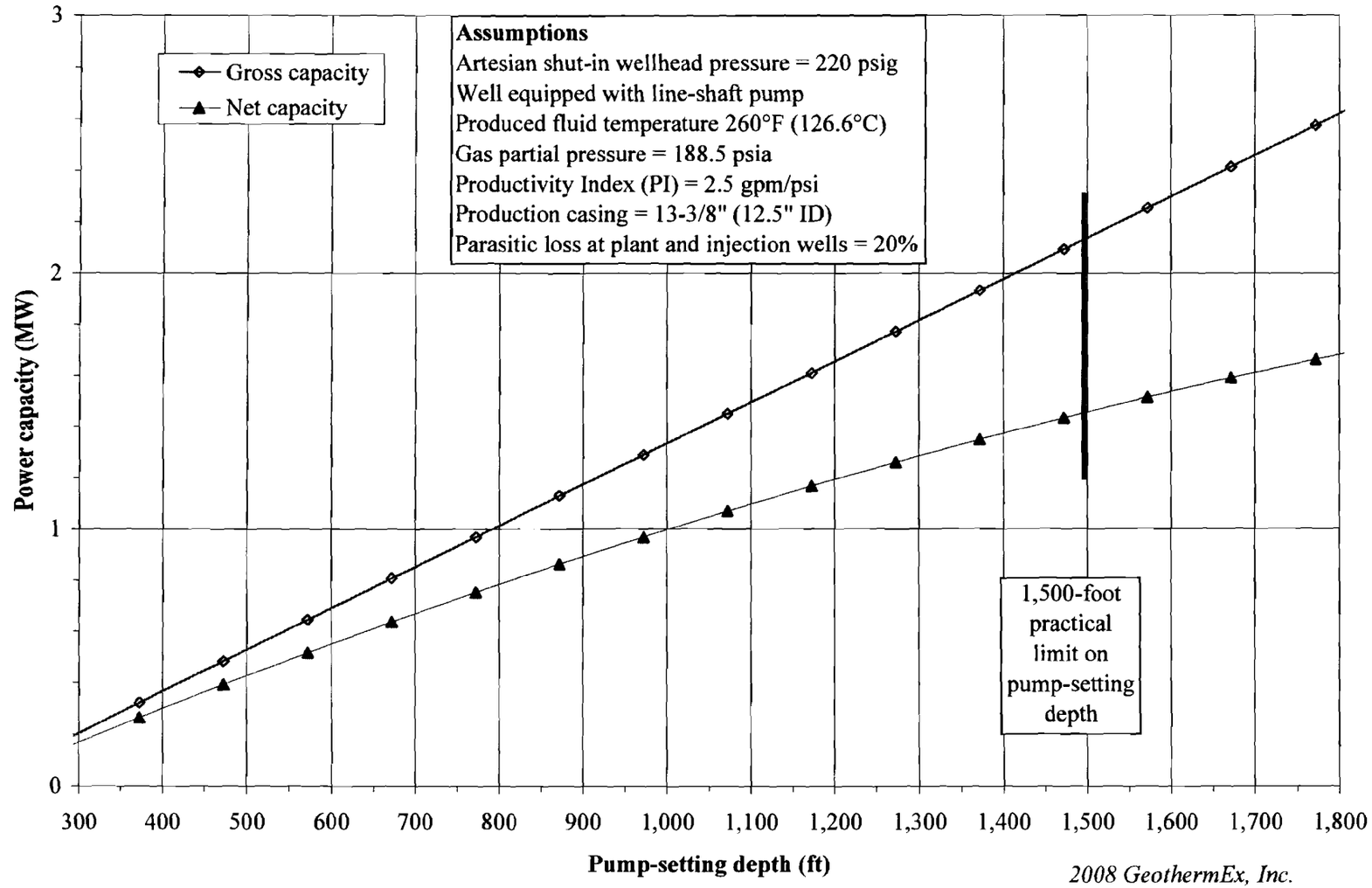

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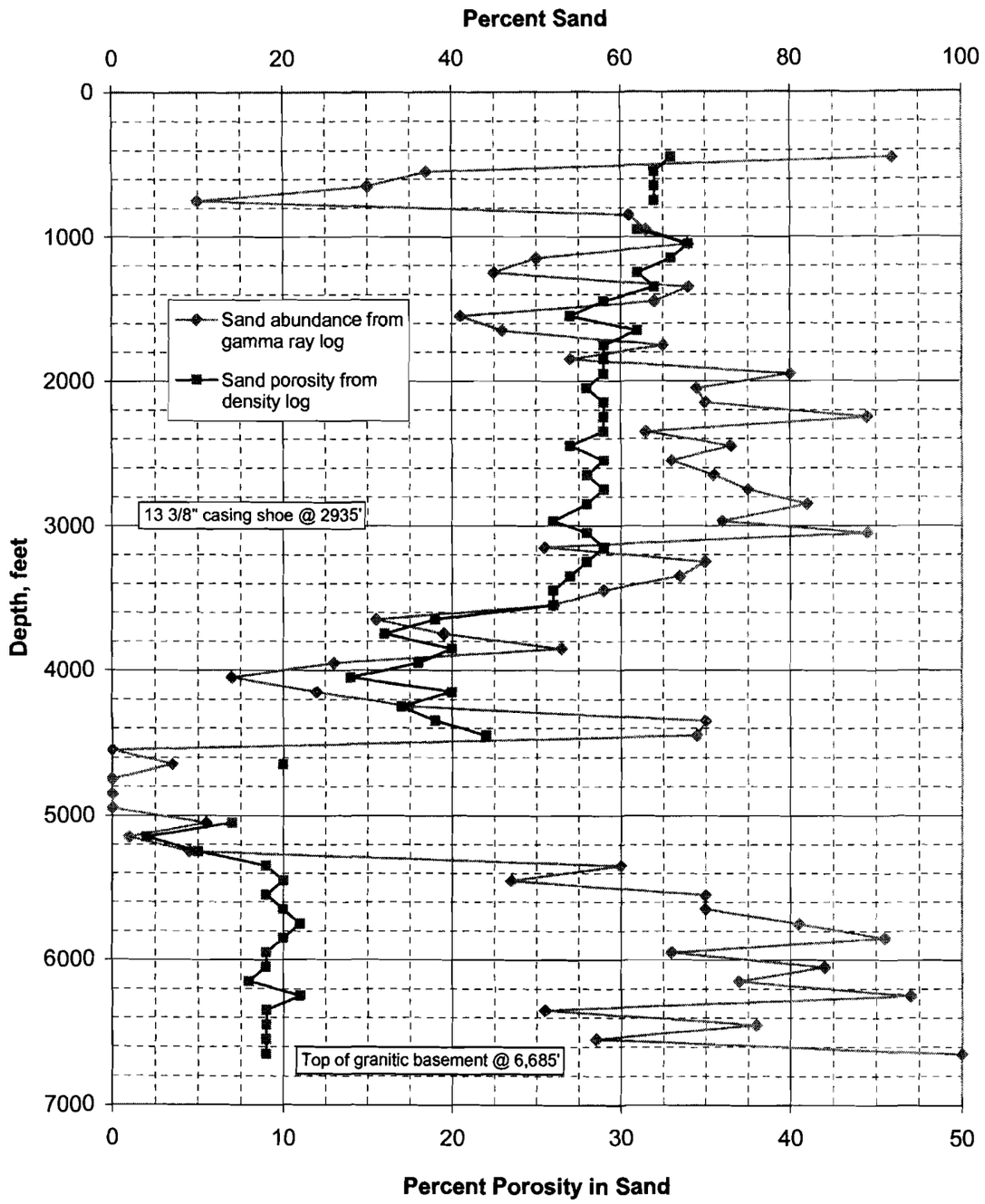
Figure 19: Truckhaven-1 Well Sand Abundance and Sand Porosity from Schlumberger Logs (100 ft. averages)



APPENDIX B:
Thermochem Analysis of Brine and Steam

APPENDIX B

THERMOCHEM ANALYSIS OF BRINE AND STEAM

THERMOCHEM

13295 (1-4) April 22, 2008

Iceland America Energy

Report of Analysis

Lab Number: 13295 - 1

Descriptor: Truckhaven #1 3-05-08 15:50

Bottom Port Upstream Shut-Off Valve
Separator Pressure = 9.7 - 11.4 psig
Separator Temperature = 237.3°F

Analyte	mg/kg
Sodium	1290
Potassium	71.3
Calcium	15.3
Magnesium	2.28
Lithium	1.77
Strontium	1.82
Zinc	0.044
Barium	0.294
Iron	0.842
Boron	22.6
Silica	119
Aluminum	<0.811
Antimony	<0.0040
Arsenic	0.328
Cadmium	<0.0041
Chromium	0.012
Cobalt	<0.0041
Copper	0.0047
Lead	<0.0041
Manganese	0.017
Mercury	<0.0026
Molybdenum	0.018
Nickel	0.0076
Silver	<0.0041
Vanadium	<0.0041
Chloride	1320
Fluoride	1.16

Laboratory & Consulting Services 3414 Regional Parkway , Suite A Santa Rosa, CA 95403 (707) 575-1310

IAETrk1ThChemBrine1 25Apr08

THERMOCHEM

13295 (1-4) April 22, 2008

Iceland America Energy

Report of Analysis

Lab Number: 13295 - 1

Descriptor: Truckhaven #1 3-05-08 15:50

Bottom Port Upstream Shut-Off Valve
Separator Pressure = 9.7 - 11.4 psig
Separator Temperature = 237.3°F

Analyte	mg/kg
Sulfate	182
Carbonate Alkalinity (as CO3=)	<2.00
Bicarbonate Alkalinity (as HCO3-)	1350
Ammonia	4.56
Hydrogen Sulfide	0.850
Total Phosphate	<3.00
Conductivity, umhos/cm	6180
TDS (Calculated)	4370
pH (units)	7.88
Field pH (units)	7.64

IAETk1ThChemBrine2 25Apr08

Laboratory & Consulting Services 3414 Regional Parkway , Suite A Santa Rosa, CA 95403 (707) 575-1310

THERMOCHEM

13295 (1-4) April 22, 2008

Iceland America Energy

Report of Analysis

Lab Number: 13295 - 4

Descriptor: Truckhaven #1 3-05-08 20:15

Bottom Port Upstream Shut-Off Valve
Separator Pressure = 10.3 psig
Separator Temperature = 235.8°F

Analyte	mg/kg
Sodium	1390
Potassium	65.7
Calcium	8.43
Magnesium	1.74
Lithium	1.78
Strontium	1.52
Barium	0.266
Iron	0.185
Boron	22.3
Silica	138
Arsenic	0.427
Manganese	0.0052
Chloride	1360
Fluoride	1.02
Sulfate	172
Carbonate Alkalinity (as CO3=)	<2.00
Bicarbonate Alkalinity (as HCO3-)	1350
Ammonia	4.24
Hydrogen Sulfide	0.630
Conductivity, umhos/cm	6210
TDS (Calculated)	4510
pH (units)	7.96
Field pH (units)	7.73

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THERMOCHEM

13293 (1-4) April 22, 2008

Descriptor: Truckhaven #1 3-05-08 15:50
Top Port Upstream Shut-Off Valve

Lab Number: 13293-2

Sample Gas/Steam Ratio (ft^3/lb):	1.0638
Sample Gas/Steam Ratio (moles /10^6 moles H_2O):	60123
Sample Gas/Steam Ratio (ppm by Weight):	114437
Percent Air[1] in Sample:	0.046
STP mls of Air[1] in Sample:	1.59
Total Weight of Condensate (grams):	52
Initial Headspace Pressure (psia @ STP):	19.04

Gas	Dry Gas % by Volume	Moles per 10^6 Moles Water	Parts per Million by Weight
Water Vapor	N/A	N/A	8.86E+05
Carbon Dioxide	7.92E+01	4.76E+04	1.03E+05
Hydrogen Sulfide	1.13E-02	6.82E+00	1.14E+01
Ammonia	1.29E-01	7.74E+01	6.48E+01
Argon	3.65E-02	2.19E+01	4.31E+01
Nitrogen	4.46E+00	2.68E+03	3.69E+03
Methane	1.61E+01	9.66E+03	7.62E+03
Hydrogen	1.34E-01	8.05E+01	7.97E+00

1. Air content based on Oxygen determination

THERMOCHEM

13293 (1-4) April 22, 2008

Descriptor: Truckhaven #1 3-05-08 20:15
Top Port Upstream Shut-Off Valve

Lab Number: 13293-4

Sample Gas/Steam Ratio (ft^3/lb):	1.0155
Sample Gas/Steam Ratio (moles /10^6 moles H_2O):	57054
Sample Gas/Steam Ratio (ppm by Weight):	109166
Percent Air[1] in Sample:	0.067
STP mls of Air[1] in Sample:	1.83
Total Weight of Condensate (grams):	43
Initial Headspace Pressure (psia @ STP):	18.81

Gas	Dry Gas % by Volume	Moles per 10^6 Moles Water	Parts per Million by Weight
Water Vapor	N/A	N/A	8.91E+05
Carbon Dioxide	7.90E+01	4.51E+04	9.81E+04
Hydrogen Sulfide	1.38E-02	7.89E+00	1.33E+01
Ammonia	1.26E-01	7.22E+01	6.08E+01
Argon	3.59E-02	2.05E+01	4.05E+01
Nitrogen	4.47E+00	2.55E+03	3.54E+03
Methane	1.63E+01	9.28E+03	7.36E+03
Hydrogen	6.34E-02	3.62E+01	3.61E+00

1. Air content based on Oxygen determination

IAETk1ThChemNCG5 25Apr08

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