GSI

Report of
Non-Destructive Crosshole Sonic Logging

DEMONSTRATION SHAFT
I-80 over MISSOURI RIVER
POTTAWATTAMIE COUNTY, IOWA

GSI PROJECT NO. 086041

April 24, 2008

Prepared By:

Geotechnical Services, Inc.

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Prepared For:

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GSI

April 24, 2008

Mr. Daniel Timmons, Vice President
Jensen Construction Company
P.O. Box 3345
Des Moines, Iowa 50316-0345

**RE: CROSSHOLE SONIC LOGGING TESTS
NONDESTRUCTIVE TESTING OF DEMONSTRATION SHAFT
NEW STEEL GIRDER BRIDGE ON I-80 OVER MISSOURI RIVER
POTTAWATTAMIE COUNTY, IOWA
GSI PROJECT NO. 086041**

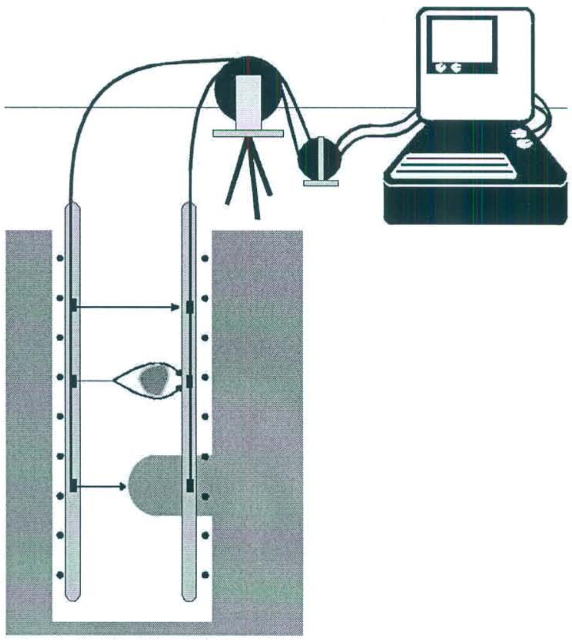
Dear Mr. Timmons:

Geotechnical Services, Inc. (GSI) is providing this report of nondestructive test results for the demonstration shaft at the above referenced bridge. We are providing these services in accordance with the Special Provisions for this project.

Crosshole Sonic Logging tests were performed on April 22, 2008 on the demonstration shaft located on the east bank of the Missouri River in Council Bluffs, Iowa. The demonstration shaft was constructed on April 19, 2008 using the direct rotary and pumped concrete placement method. Six (6) sonic testing access tubes were attached to the inside of the shaft reinforcing steel cage and extended above the shaft concrete. The demonstration shaft included an Osterberg Cell which was located near the bottom of the shaft and the CSL access tubes passed through the Osterberg Cell. The shaft diameter is 72 inches. Our scanned lengths varied between 100.9 and 101.3 feet. The access tubes consist of Schedule 40 steel pipe with an inside diameter of 2 inches.

Crosshole Sonic Logging (CSL) is a nondestructive test for determining the integrity of concrete in drilled shaft foundations and concrete slurry walls. The test requires that an ultrasonic pulse pass through the concrete between a source and receiver probe, both of which are pulled from the bottom to the top in water filled access tubes in the concrete. These access tubes are cast in the concrete at the time of concrete placement and filled with water to provide a good "connection" between the pulse and the concrete. The position of the probes with respect to the top of the shaft is recorded during the test with a calibrated measurement wheel for the probe cables.

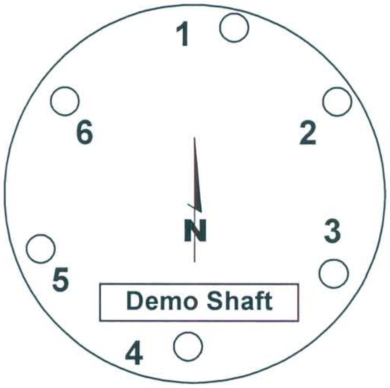
During the test, a high voltage ultrasonic pulse is generated for every 0.1 to 0.2 foot of probe travel as the cables are pulled. The receiver response and the depth are recorded for each interval and processed with a personal computer based logging system. Please refer to the Crosshole Sonic schematic below for the test setup.



CROSSHOLE SONIC LOGGING METHOD

The analysis of the concrete quality is based on the relationship between wave (pulse) travel times between the source and the receiver, and the receiver response energy. Wave velocities can be calculated from the wave travel times and the distance between tubes. Assuming that the access tubes are bonded to the concrete, longer wave travel times and corresponding slower velocities indicate poor quality concrete. If the signal is completely lost, a significant defect or void exists between the corresponding tubes tested.

The CSL tests for this project were conducted by the author using an Olson Instruments, Inc. CSL-1 system. This system utilizes 10 volt, 35 kilohertz transducers with a diameter of 1.25 inches. The steel access tubes were extended to the bottom of the reinforcing steel cage. The CSL method cannot locate enlargements in the shaft because of the test geometry; however, the test is effective in locating neck-downs and voids because the signal paths are interrupted.



Sketches of the access tube configuration with respect to direction are shown at the left. CSL tests are conducted around the perimeter of the shaft, i.e., tubes 1 to 2, tubes 2 to 3, tubes 3 to 4, tubes 4 to 5, tubes 5 to 6, and tubes 6 to 1 initially. Crosshole tests are then conducted between tubes 1 to 4, tubes 2 to 5, etc. In crosshole testing, the source probe and receiver probe are interchangeable between pairs of access tubes.

Plots of fifteen (15) Crosshole Sonic Logs performed for this drilled shaft are enclosed in Appendix A.

The sonic logs exhibited a decrease in energy and an increase in arrival time for the top 1 foot of the shaft. Examination of the individual records associated with the interval indicates that the decrease in velocity is on the order of 15 to 20 percent. This top one foot of the shaft is most likely laitance from concrete placement.

The sonic logs below 1 foot of the top of the shaft exhibit strong signal strength and relatively consistent wave arrival times. No increases in arrival times in excess of 10 percent were observed for the shaft below the top 12 inches of the shaft. Therefore, it is our opinion that the sonic logs indicate sound quality concrete below the top 1 foot of shaft.

Our services were performed in accordance with generally accepted nondestructive testing practices. If we can provide additional service, please contact us at 515-270-6542.

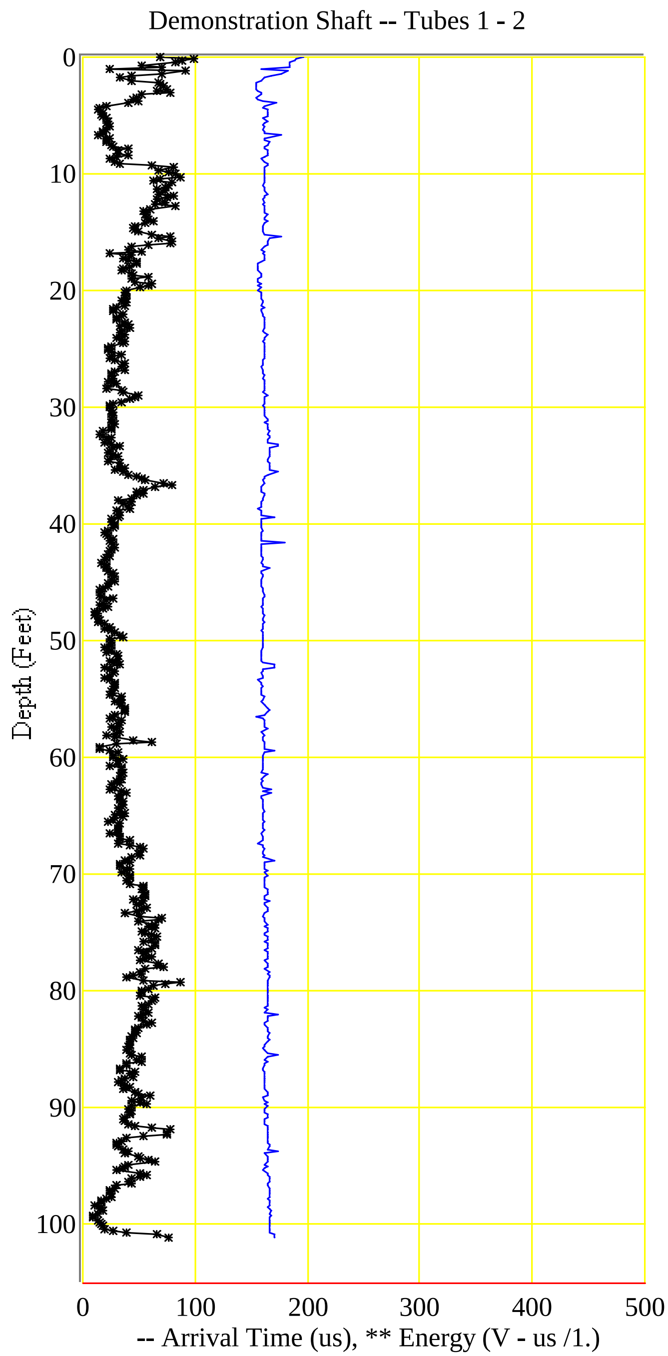
Respectfully,
Geotechnical Services, Inc.

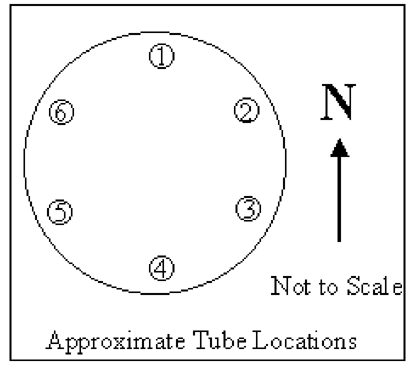
Shihai Zhang
Staff Engineer

Michael T. Lustig, P.E.
Principal Engineer

APPENDIX A

CROSSHOLE SONIC LOGS (DEMONSTRATION SHAFT)

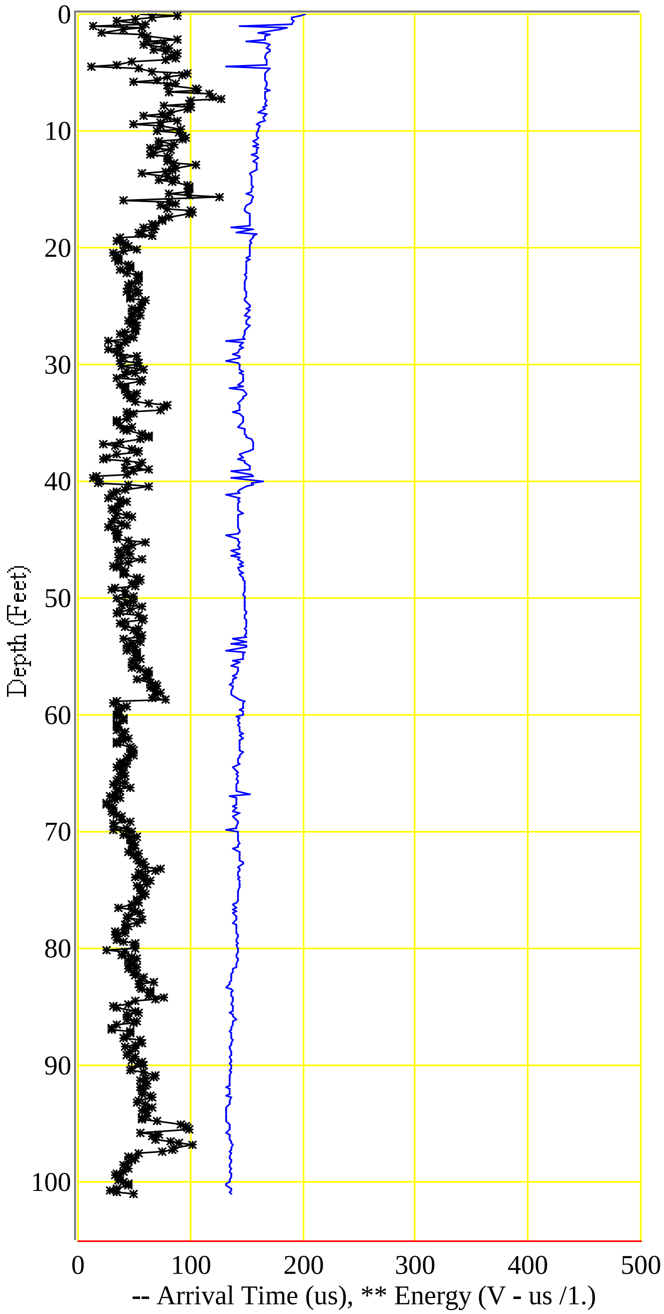


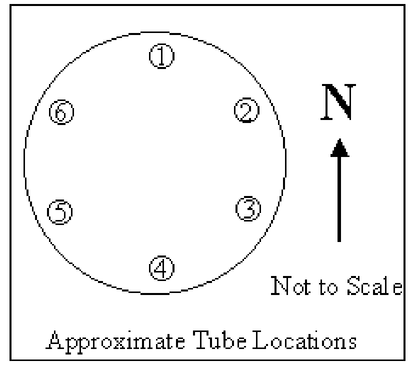


Tube Spacing :	25.00	inches
Signal Gain :	1	
Threshold :	2.00	
At Depth of	101.05	ft
Velocity	12200	ft/sec
First Arrival Time	170	us
Signal Energy	76.48	V-us

Figure 1

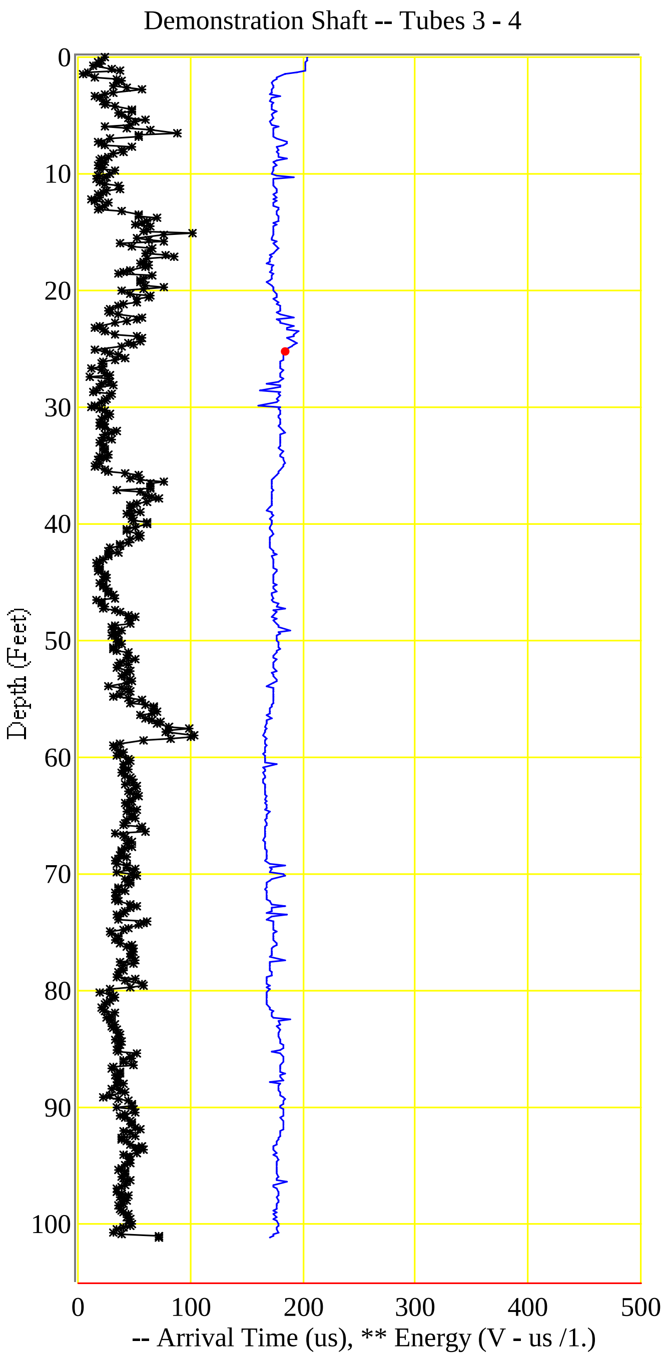
Demonstration Shaft -- Tubes 2 - 3

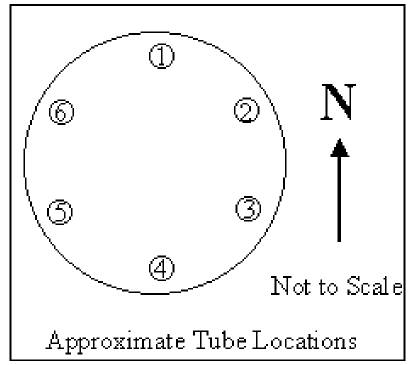




Tube Spacing :	25.00	inches
Signal Gain :	1	
Threshold :	1.50	
At Depth of	101.01	ft
Velocity	15300	ft/sec
First Arrival Time	136	us
Signal Energy	49.63	V-us

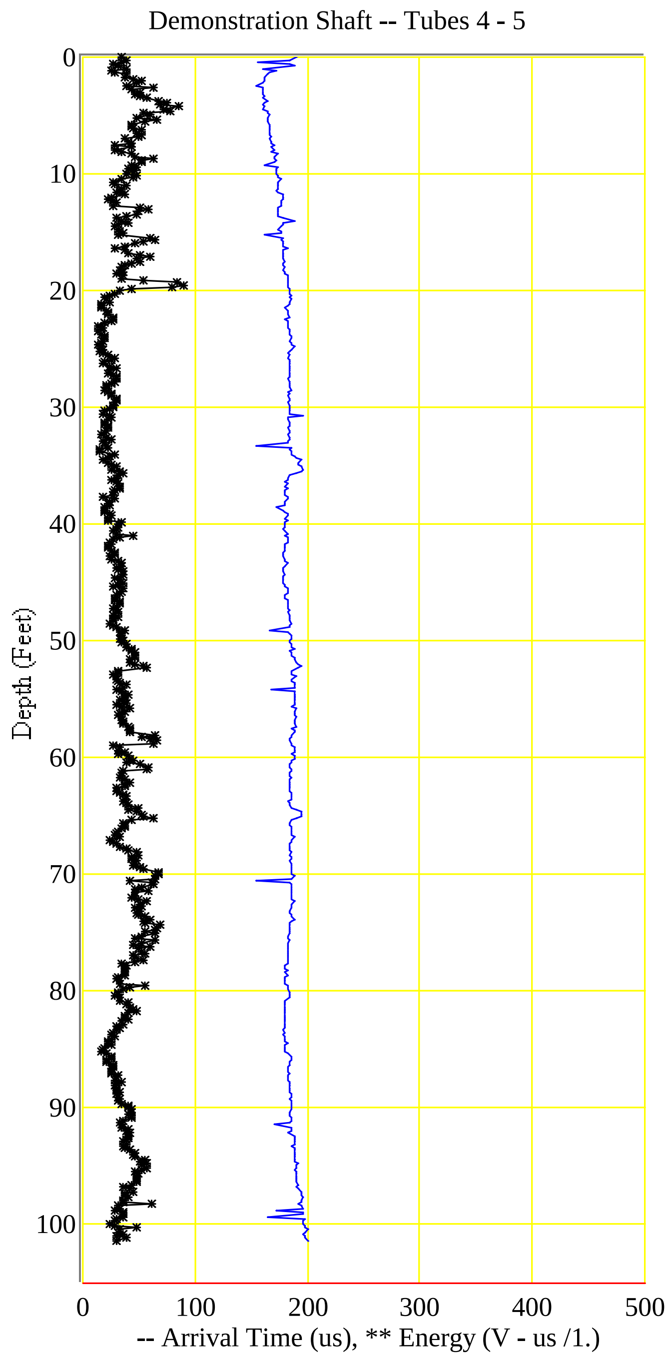
Figure 2

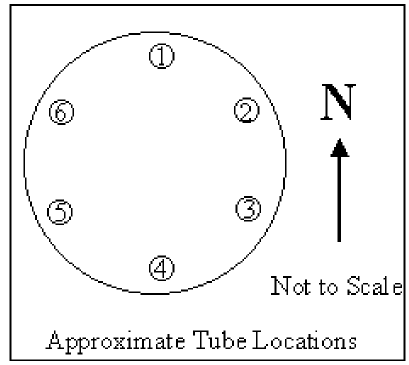




Tube Spacing :	25.50	inches
Signal Gain :	1	
Threshold :	1.50	
At Depth of	101.15	ft
Velocity	12500	ft/sec
First Arrival Time	170	us
Signal Energy	72.06	V-us

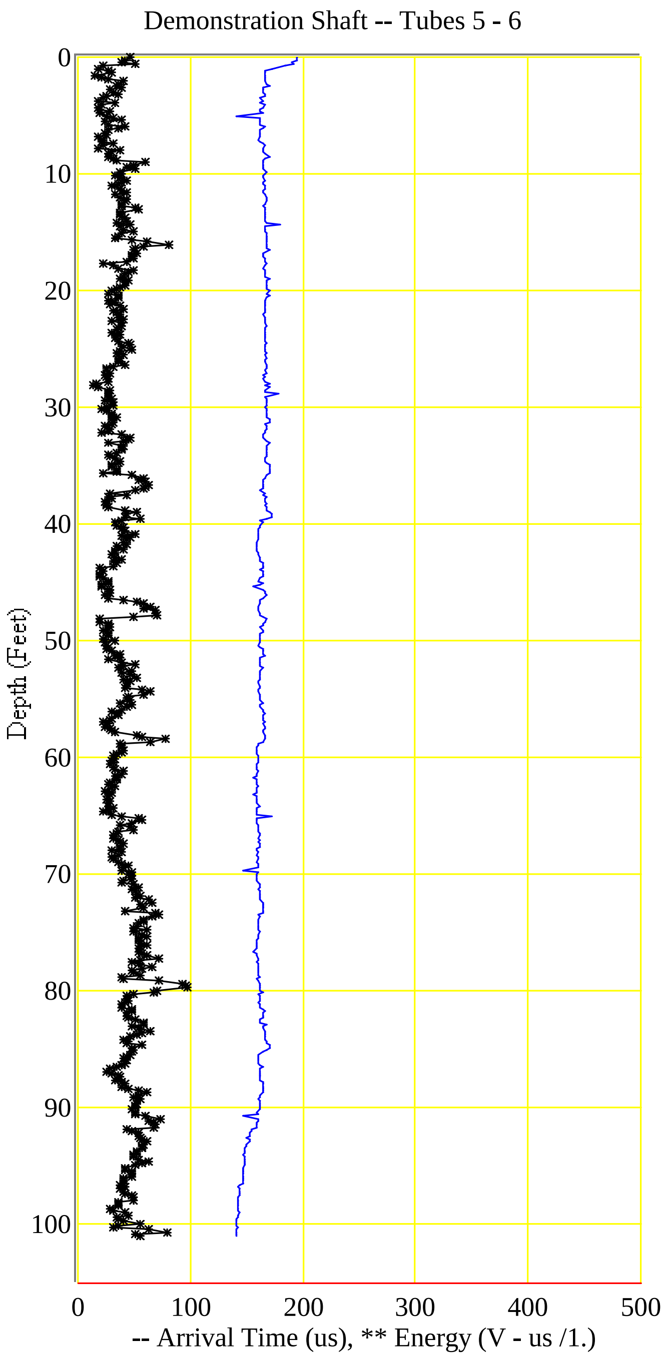
Figure 3

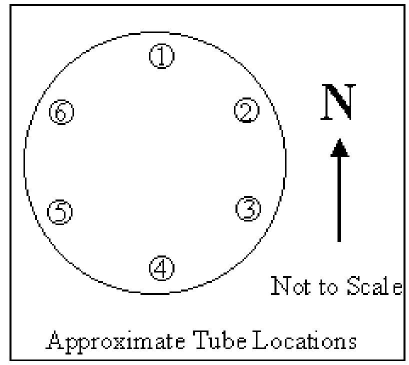




Tube Spacing :	23.00	inches
Signal Gain :	1	
Threshold :	1.50	
At Depth of	101.33	ft
Velocity	9500	ft/sec
First Arrival Time	200	us
Signal Energy	30.24	V-us

Figure 4

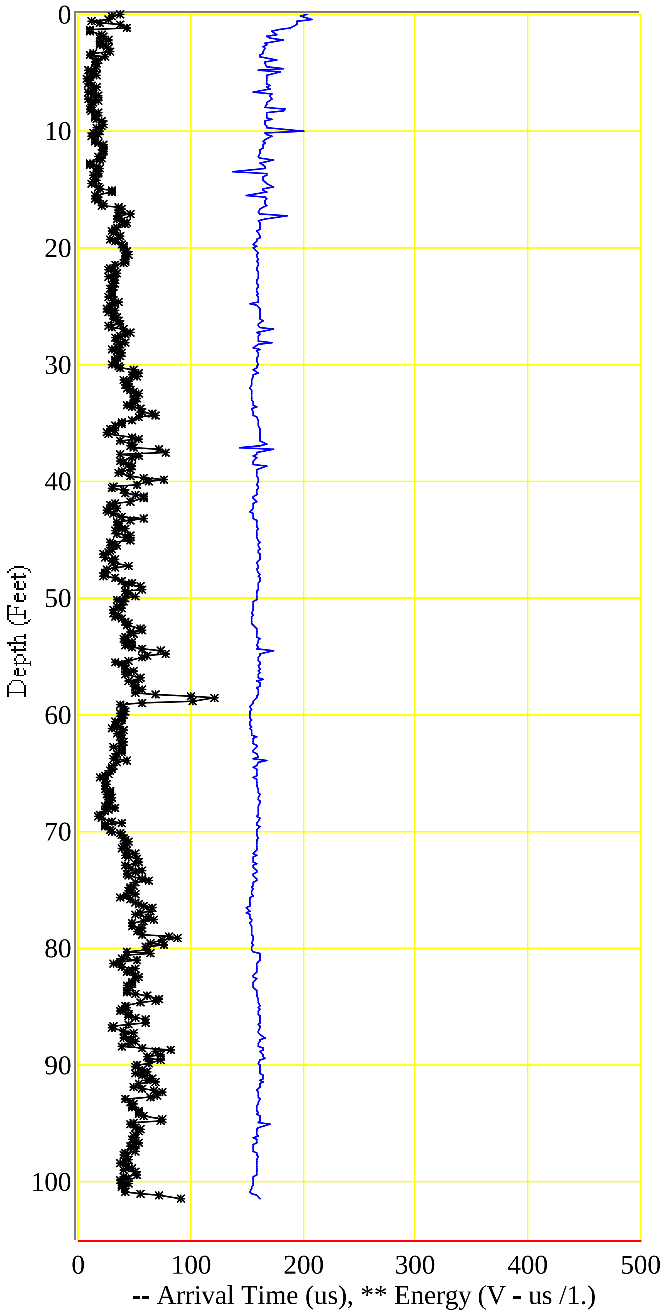


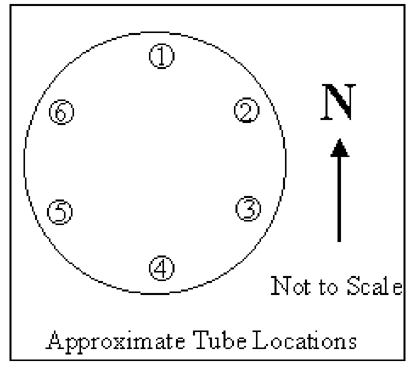


Tube Spacing :	25.50	inches
Signal Gain :	1	
Threshold :	1.50	
At Depth of	100.98	ft
Velocity	15100	ft/sec
First Arrival Time	140	us
Signal Energy	55.32	V-us

Figure 5

Demonstration Shaft -- Tubes 6 - 1

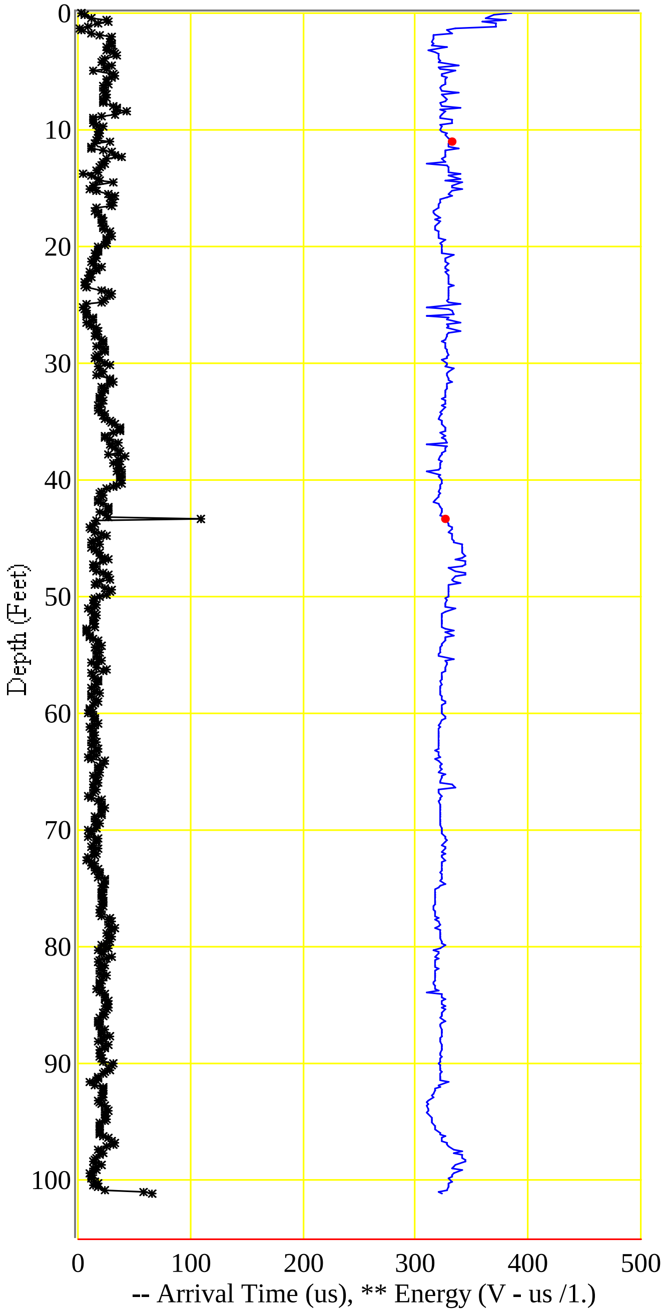


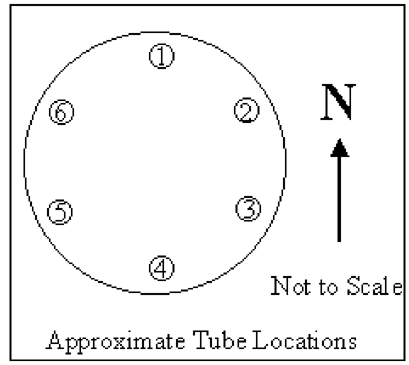


Tube Spacing :	25.00	inches
Signal Gain :	1	
Threshold :	1.50	
At Depth of	101.31	ft
Velocity	6100	ft/sec
First Arrival Time	162	us
Signal Energy	91.20	V-us

Figure 6

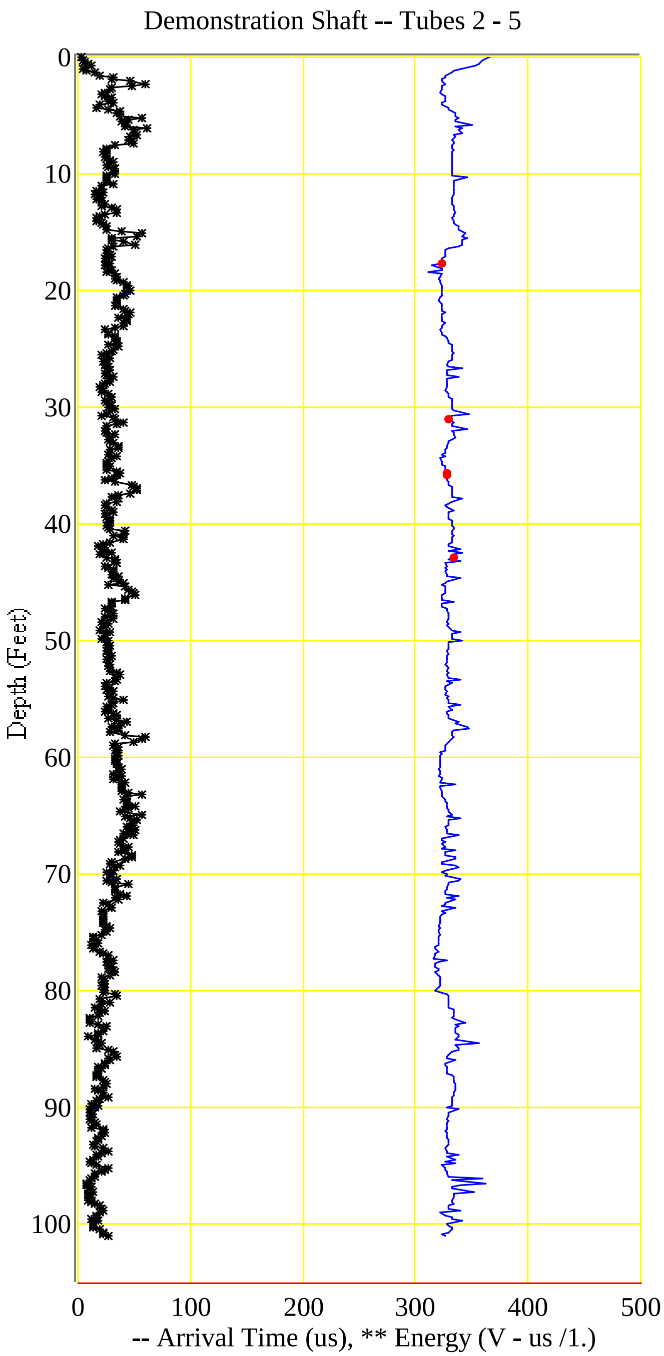
Demonstration Shaft -- Tubes 1 - 4

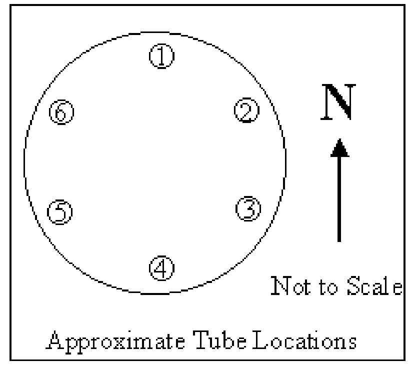




Tube Spacing :	48.50	inches
Signal Gain :	1	
Threshold :	1.50	
At Depth of	101.13	ft
Velocity	12400	ft/sec
First Arrival Time	324	us
Signal Energy	65.23	V-us

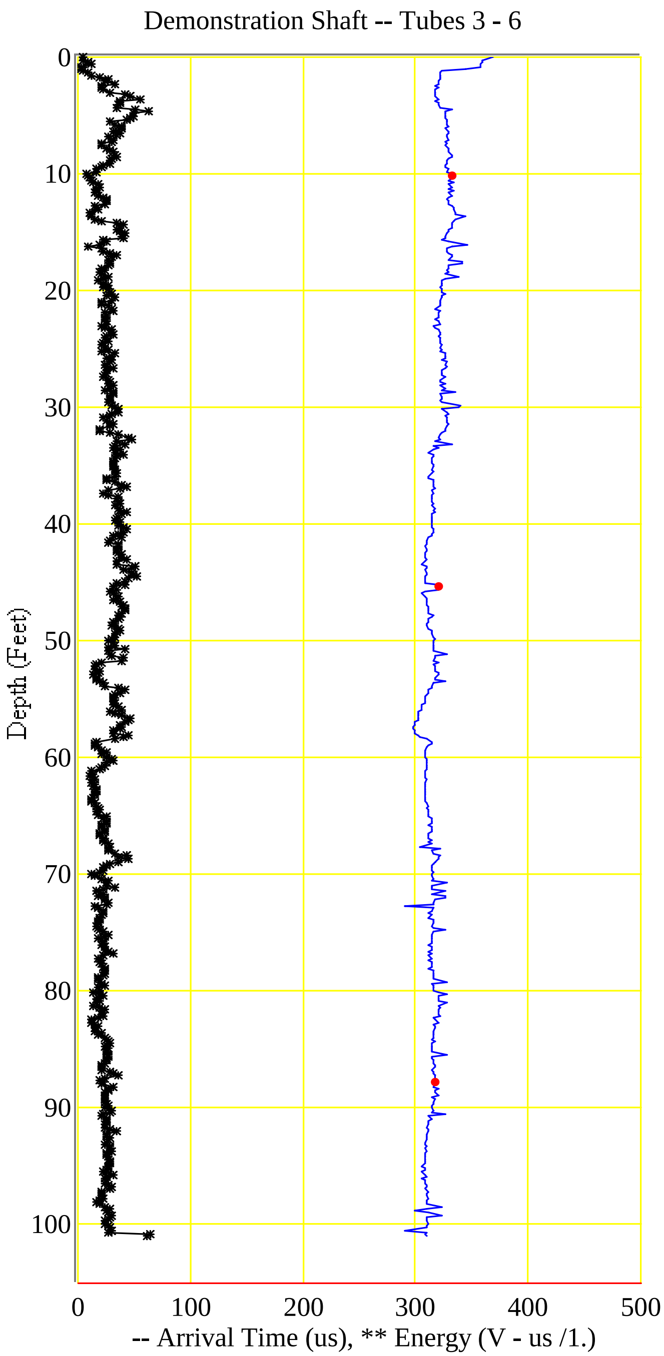
Figure 7

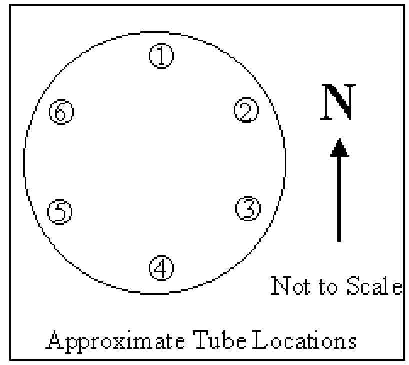




Tube Spacing :	50.00	inches
Signal Gain :	1	
Threshold :	1.50	
At Depth of	100.98	ft
Velocity	12700	ft/sec
First Arrival Time	326	us
Signal Energy	27.46	V-us

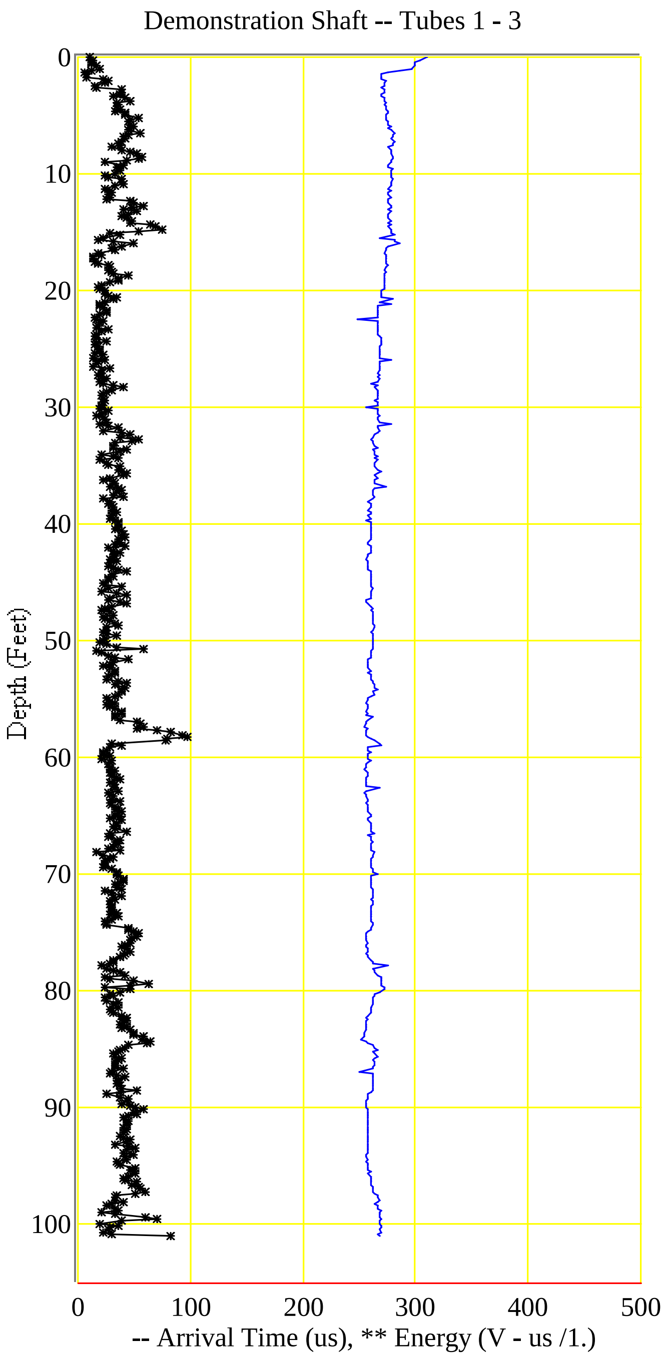
Figure 8

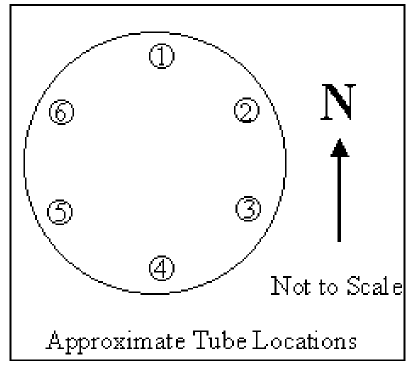




Tube Spacing :	50.00	inches
Signal Gain :	1	
Threshold :	1.50	
At Depth of	101.00	ft
Velocity	13400	ft/sec
First Arrival Time	310	us
Signal Energy	61.74	V-us

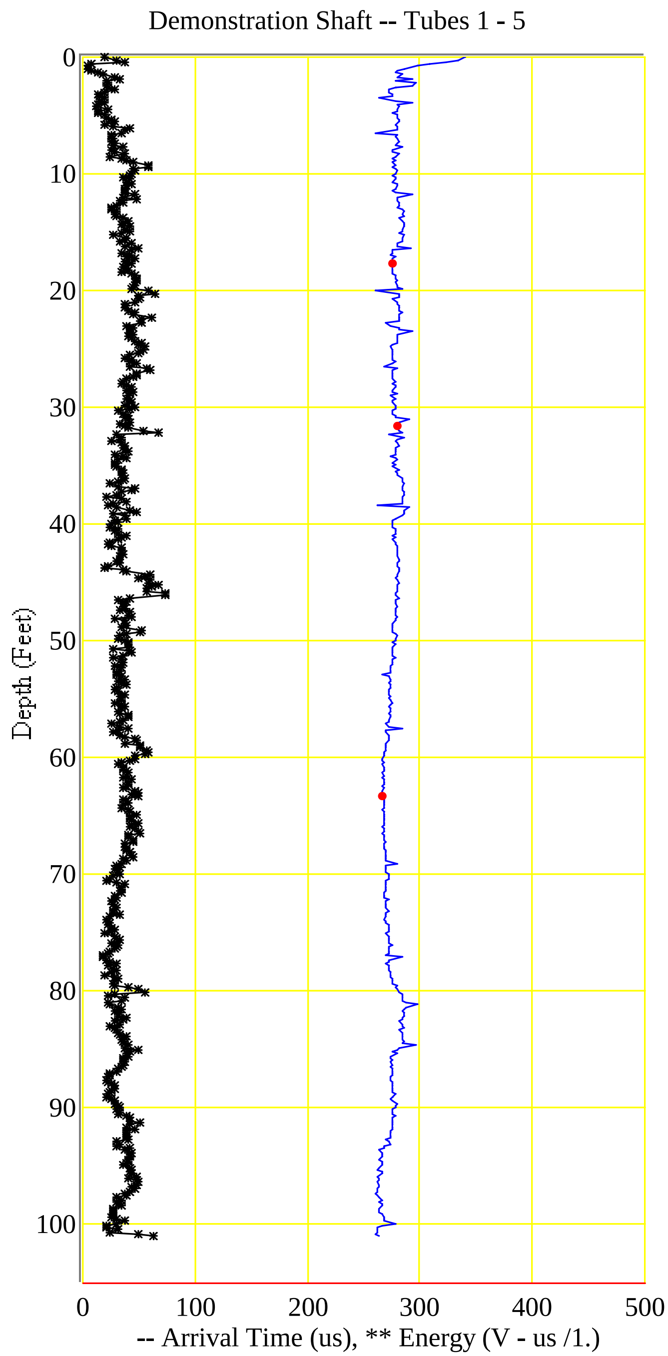
Figure 9

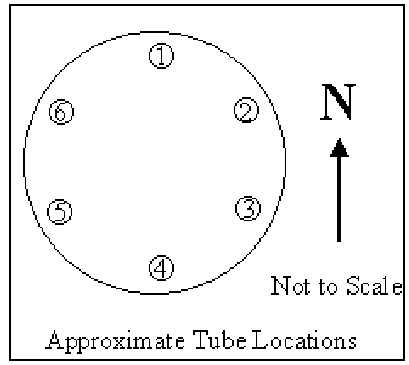




Tube Spacing :	42.00	inches
Signal Gain :	1	
Threshold :	1.50	
At Depth of	100.96	ft
Velocity	13200	ft/sec
First Arrival Time	268	us
Signal Energy	82.30	V-us

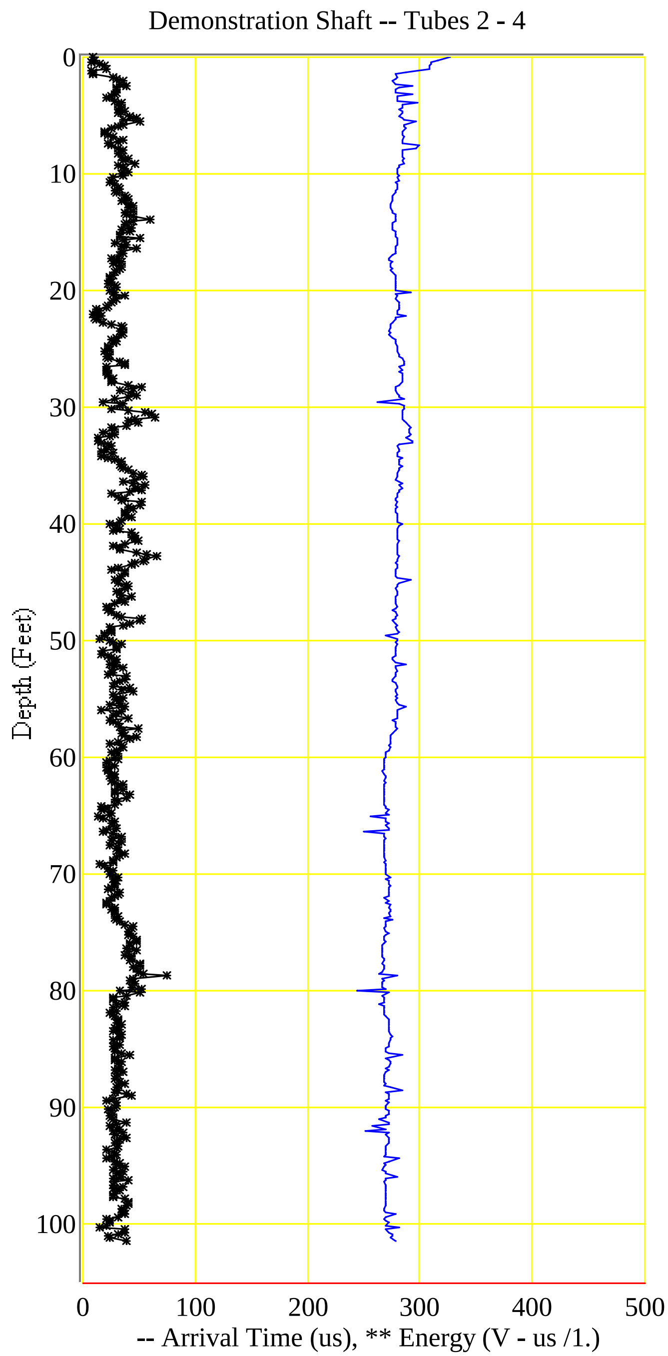
Figure 10

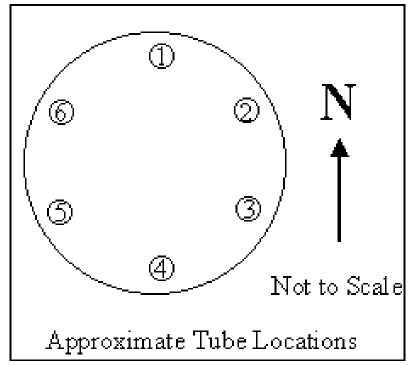




Tube Spacing :	43.00	inches
Signal Gain :	1	
Threshold :	1.50	
At Depth of	100.96	ft
Velocity	13700	ft/sec
First Arrival Time	264	us
Signal Energy	62.77	V-us

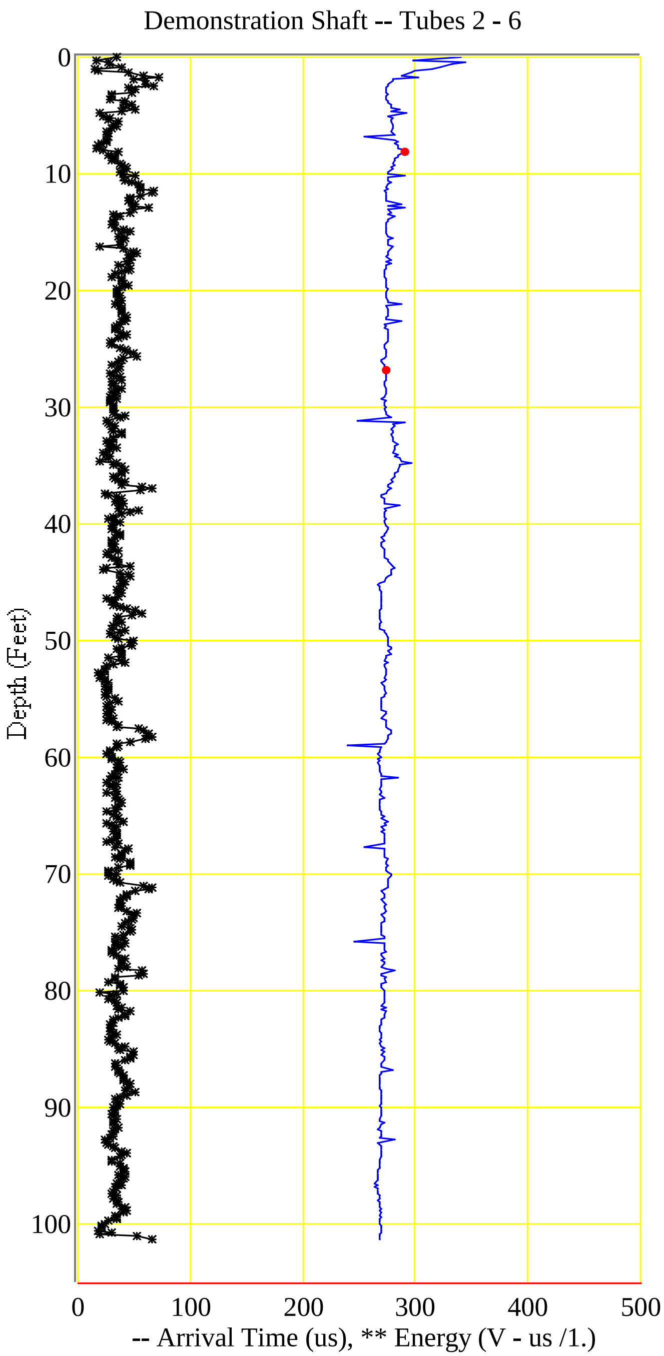
Figure 11

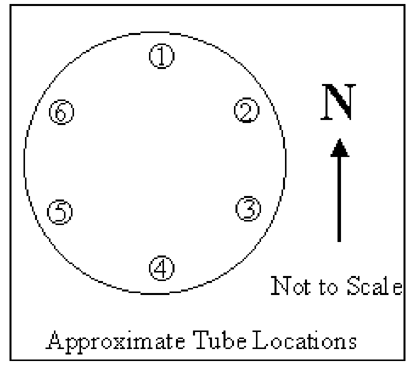




Tube Spacing :	43.00	inches
Signal Gain :	1	
Threshold :	1.50	
At Depth of	101.33	ft
Velocity	12800	ft/sec
First Arrival Time	278	us
Signal Energy	38.38	V-us

Figure 12

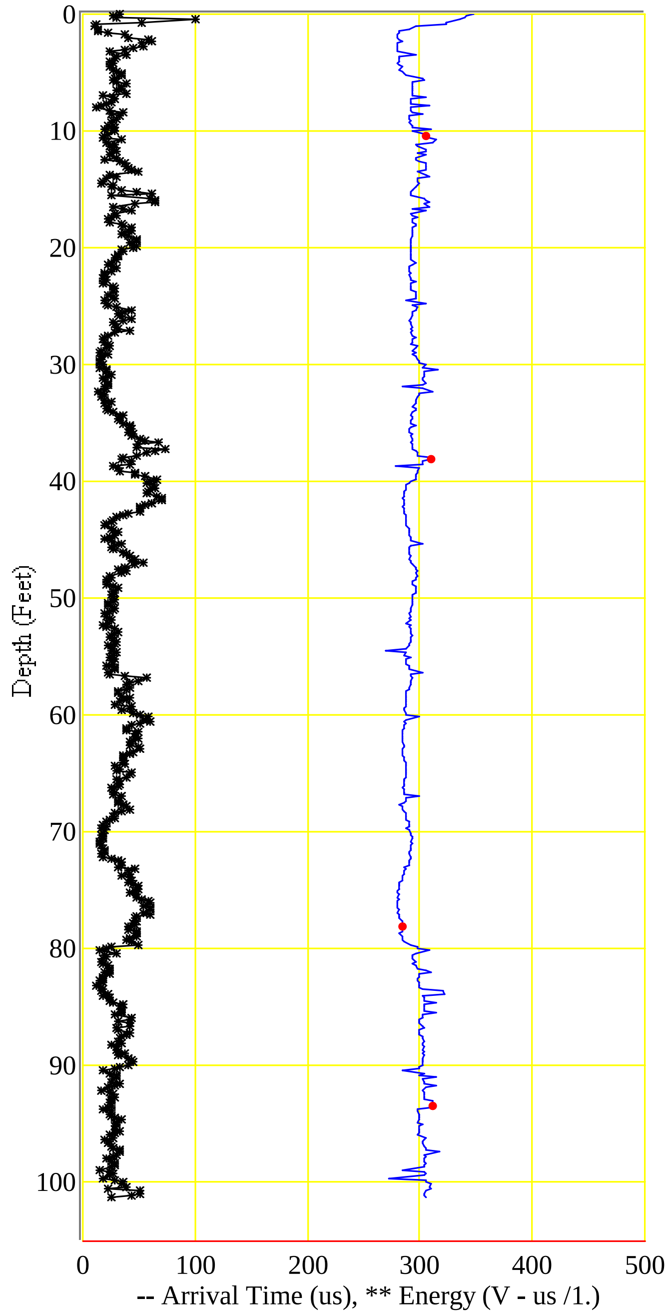


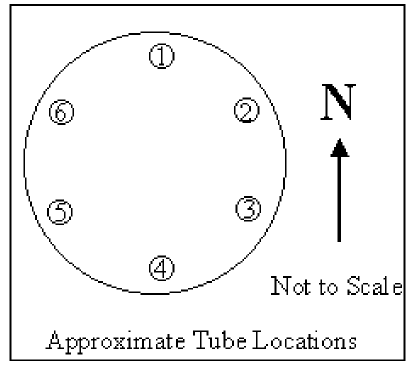


Tube Spacing :	43.00	inches
Signal Gain :	1	
Threshold :	1.50	
At Depth of	101.18	ft
Velocity	3700	ft/sec
First Arrival Time	268	us
Signal Energy	64.67	V-us

Figure 13

DT35 -- Tubes 3 - 5

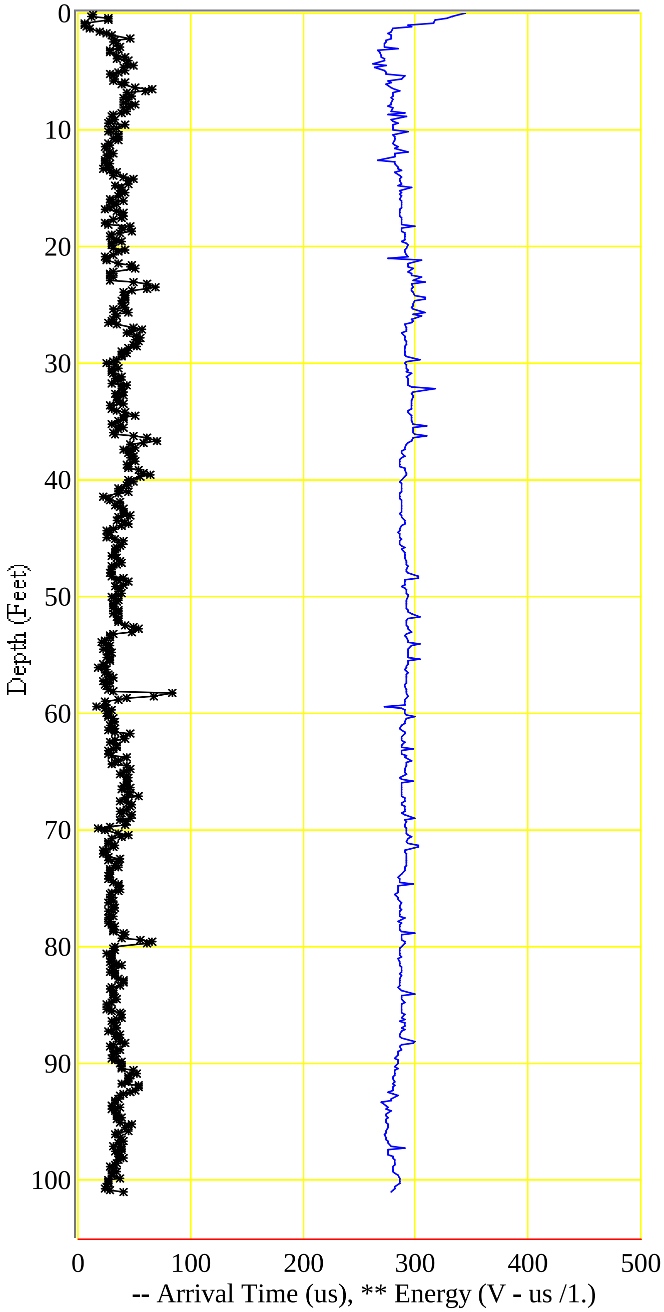


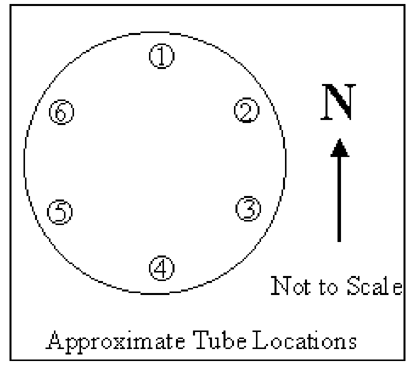


Tube Spacing :	43.00	inches
Signal Gain :	1	
Threshold :	1.50	
At Depth of	101.25	ft
Velocity	3200	ft/sec
First Arrival Time	306	us
Signal Energy	24.90	V-us

Figure 14

Demonstration Shaft -- Tubes 4 - 6





Tube Spacing :	42.00	inches
Signal Gain :	1	
Threshold :	2.00	
At Depth of	101.01	ft
Velocity	3500	ft/sec
First Arrival Time	278	us
Signal Energy	39.71	V-us

Figure 15