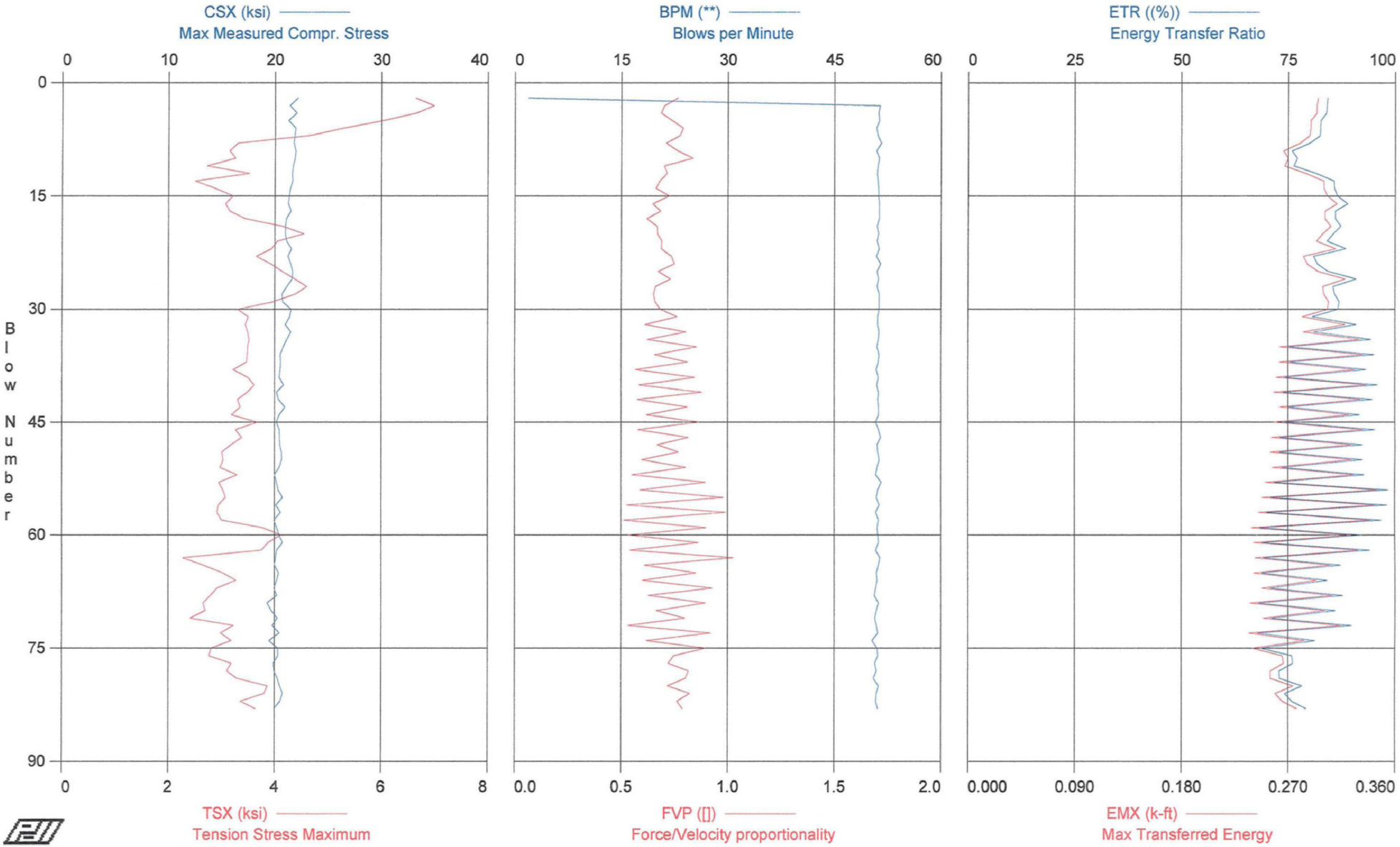
MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 28-May-2008

Test date: 25-Mar-2008

TURKEY POINT COL PROJECT - BORING B-615; 117.3'-118.8' Sample



TURKEY POINT COL PROJECT - BORING B-615; 117.3'-118.8' Sample
OP: HJC

HAMMER ID 331145 (BANKS)
Test date: 25-Mar-2008

AR: 1.19 in^2
LE: 121.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows per Minute

FVP: Force/Velocity proportionality
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	depth	CSX	TSX	FMX	VMX	BPM	FVP	EF2	ETR	EMX
	ft	ksi	ksi	kips	f/s	**	[]	k-ft	(%)	k-ft
2	0.00	22.1	6.6	26	14.2	1.9	0.77	0.279	84	0.295
3	0.00	21.4	7.0	25	14.4	51.4	0.70	0.272	84	0.294
4	0.00	22.0	6.7	26	14.1	51.2	0.69	0.273	84	0.294
5	0.00	21.3	6.0	25	14.1	51.3	0.74	0.273	83	0.289
6	0.00	21.9	5.3	26	13.9	50.9	0.79	0.274	82	0.289
7	0.00	21.8	4.6	26	13.8	51.1	0.77	0.272	82	0.288
8	0.00	21.8	3.3	26	13.1	51.6	0.71	0.268	80	0.280
9	0.00	21.9	3.1	26	12.4	50.9	0.76	0.265	76	0.266
10	0.00	21.9	3.3	26	12.6	51.3	0.84	0.270	77	0.270
11	0.00	21.7	2.7	26	12.8	51.1	0.70	0.265	76	0.267
12	0.00	21.6	3.5	26	14.4	51.0	0.72	0.271	82	0.285
13	0.00	21.7	2.5	26	15.6	51.1	0.68	0.270	86	0.300
14	0.00	21.4	2.9	26	15.3	51.2	0.66	0.269	86	0.300
15	0.00	21.3	3.2	25	15.5	51.2	0.72	0.262	87	0.303
16	0.00	21.3	3.1	25	16.0	51.3	0.65	0.269	89	0.311
17	0.00	21.5	3.2	26	15.5	51.3	0.68	0.266	86	0.301
18	0.00	21.1	3.4	25	15.4	51.3	0.62	0.265	86	0.301
19	0.00	21.0	4.1	25	16.2	51.0	0.67	0.267	87	0.306
20	0.00	21.0	4.5	25	15.3	51.2	0.67	0.266	86	0.299
21	0.00	21.1	4.0	25	14.8	51.0	0.69	0.265	84	0.294
22	0.00	21.5	3.9	26	15.4	51.3	0.69	0.268	88	0.310
23	0.00	21.2	3.7	25	13.1	50.9	0.74	0.266	81	0.283
24	0.00	21.5	3.9	26	12.5	51.5	0.75	0.269	82	0.286
25	0.00	21.7	4.1	26	14.3	51.0	0.67	0.269	84	0.295
26	0.00	21.6	4.4	26	15.6	51.2	0.73	0.275	91	0.318
27	0.00	21.1	4.6	25	15.2	51.0	0.66	0.271	85	0.299
28	0.00	20.7	4.4	25	15.1	51.3	0.65	0.266	86	0.300
29	0.00	20.7	4.0	25	15.2	51.3	0.66	0.270	87	0.304
30	0.00	21.5	3.3	26	15.5	51.3	0.68	0.269	87	0.303
31	0.00	21.4	3.5	25	13.7	51.1	0.76	0.266	81	0.282
32	0.00	21.0	3.5	25	16.5	51.1	0.61	0.267	91	0.318
33	0.00	21.5	3.5	26	13.1	51.3	0.80	0.270	81	0.283
34	0.00	21.1	3.5	25	17.1	51.2	0.62	0.268	94	0.330
35	0.00	20.8	3.5	25	11.6	51.0	0.85	0.262	75	0.263
36	0.00	20.5	3.5	24	17.0	51.3	0.66	0.267	95	0.333
37	0.00	20.6	3.5	24	11.7	51.2	0.81	0.269	75	0.263
38	0.00	20.5	3.2	24	17.0	50.9	0.57	0.262	93	0.326
39	0.00	20.4	3.5	24	11.5	51.2	0.85	0.268	74	0.260
40	0.00	20.8	3.6	25	17.5	51.0	0.58	0.268	96	0.336
41	0.00	20.2	3.5	24	11.1	51.2	0.88	0.266	74	0.258
42	0.00	20.3	3.3	24	17.2	51.1	0.57	0.264	95	0.331
43	0.00	21.0	3.3	25	11.1	51.2	0.81	0.268	75	0.263
44	0.00	20.4	3.2	24	16.6	51.2	0.62	0.263	92	0.321
45	0.00	20.2	3.7	24	11.0	50.8	0.87	0.267	74	0.258
46	0.00	20.4	3.3	24	17.2	51.2	0.58	0.264	95	0.333
47	0.00	20.5	3.4	24	11.3	51.5	0.81	0.263	73	0.256
48	0.00	20.5	3.2	24	16.3	51.0	0.67	0.263	92	0.323
49	0.00	20.6	3.0	25	11.7	51.1	0.77	0.260	73	0.255
50	0.00	20.7	3.0	25	16.7	51.3	0.60	0.261	92	0.323
51	0.00	20.4	3.0	24	10.2	51.0	0.80	0.263	74	0.257
52	0.00	20.0	3.3	24	17.3	50.8	0.55	0.255	93	0.325
53	0.00	20.2	3.0	24	10.4	51.6	0.90	0.260	72	0.251
54	0.00	20.3	3.0	24	18.0	51.1	0.59	0.263	98	0.345
55	0.00	20.7	3.1	25	9.8	50.9	0.98	0.262	71	0.248
56	0.00	20.1	2.9	24	17.8	51.3	0.53	0.262	98	0.343
57	0.00	20.6	2.9	24	9.5	50.8	0.99	0.264	70	0.245
58	0.00	20.0	3.0	24	17.8	51.2	0.51	0.264	97	0.339
59	0.00	20.2	3.8	24	9.2	51.0	0.90	0.258	68	0.239
60	0.00	20.4	4.1	24	16.8	51.1	0.53	0.258	92	0.323
61	0.00	20.7	3.9	25	10.0	51.2	0.86	0.263	69	0.241
62	0.00	20.2	3.8	24	17.4	50.8	0.54	0.266	94	0.329
63	0.00	20.1	2.3	24	9.0	51.4	1.03	0.262	69	0.242
64	0.00	20.0	2.7	24	15.5	51.2	0.61	0.262	87	0.305
65	0.00	20.4	3.0	24	9.6	50.9	0.85	0.261	69	0.241
66	0.00	20.2	3.3	24	14.9	51.0	0.60	0.257	84	0.294

TURKEY POINT COL PROJECT - BORING B-615; 117.3'-118.8' Sample

HAMMER ID 331145 (BANKS)

OP: HJC

Test date: 25-Mar-2008

BL#	depth	CSX	TSX	FMX	VMX	BPM	FVP	EF2	ETR	EMX
	ft	ksi	ksi	kips	f/s	**	[]	k-ft	(%)	k-ft
67	0.00	19.9	2.9	24	9.4	50.8	0.93	0.264	71	0.248
68	0.00	20.2	2.8	24	15.3	50.6	0.63	0.262	88	0.307
69	0.00	19.3	2.7	23	8.9	51.2	0.89	0.256	68	0.238
70	0.00	19.7	2.7	23	13.7	50.9	0.67	0.260	86	0.301
71	0.00	20.3	2.4	24	10.5	50.7	0.80	0.263	71	0.249
72	0.00	19.8	3.2	24	16.9	50.9	0.53	0.260	90	0.314
73	0.00	20.4	3.0	24	9.4	51.1	0.92	0.262	68	0.237
74	0.00	19.5	3.2	23	12.6	50.3	0.62	0.257	81	0.284
75	0.00	20.3	2.8	24	9.3	51.0	0.90	0.260	69	0.240
76	0.00	20.3	2.8	24	11.6	51.1	0.75	0.261	76	0.265
77	0.00	19.9	3.2	24	10.9	50.7	0.72	0.265	76	0.266
78	0.00	19.9	3.1	24	9.4	50.9	0.82	0.265	73	0.255
79	0.00	20.3	3.3	24	10.3	50.5	0.80	0.262	73	0.255
80	0.00	20.5	3.9	24	11.9	51.2	0.72	0.264	78	0.274
81	0.00	20.7	3.8	25	10.5	50.9	0.82	0.264	74	0.259
82	0.00	20.5	3.4	24	11.2	50.8	0.76	0.262	76	0.265
83	0.00	19.9	3.6	24	11.0	51.1	0.79	0.261	79	0.277
	Average	20.8	3.5	25	13.6	50.5	0.73	0.265	82	0.287

Total number of blows analyzed: 82

Time Summary

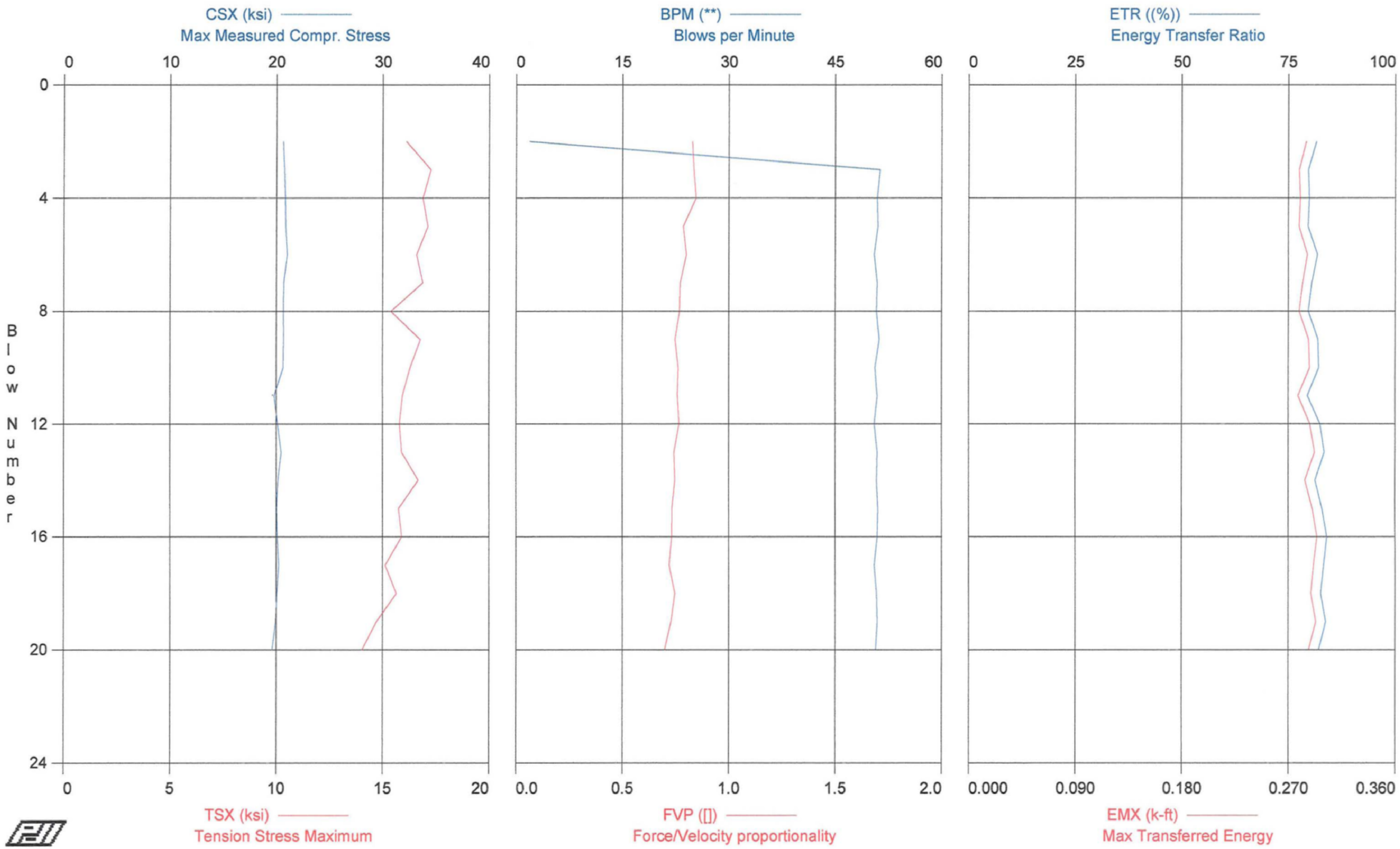
Drive 1 minute 35 seconds 4:31:21 PM - 4:32:56 PM (3/25/2008) BN 2 - 83

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 28-May-2008

Test date: 26-Mar-2008

TURKEY POINT COL PROJECT - BORING B-615; 127' - 128.5' Sample



TURKEY POINT COL PROJECT - BORING B-615; 127' - 128.5' Sample

HAMMER ID 331145 (BANKS)

OP: HJC

Test date: 26-Mar-2008

AR: 1.19 in^2
LE: 134.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows per Minute

FVP: Force/Velocity proportionality
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	depth	CSX	TSX	FMX	VMX	BPM	FVP	EF2	ETR	EMX
	ft	ksi	ksi	kips	f/s	**	[]	k-ft	(%)	k-ft
2	0.00	20.6	16.1	25	13.9	1.9	0.83	0.260	82	0.285
3	0.00	20.7	17.3	25	13.5	51.3	0.84	0.253	80	0.279
4	0.00	20.8	16.9	25	13.8	50.9	0.85	0.252	80	0.280
5	0.00	20.9	17.1	25	14.9	51.0	0.79	0.255	80	0.279
6	0.00	21.0	16.6	25	14.7	50.5	0.30	0.258	82	0.286
7	0.00	20.7	16.9	25	15.0	50.9	0.77	0.256	80	0.282
8	0.00	20.7	15.4	25	15.0	50.8	0.77	0.252	80	0.279
9	0.00	20.7	16.8	25	15.5	51.2	0.75	0.255	82	0.287
10	0.00	20.7	16.3	25	15.1	50.6	0.76	0.258	82	0.288
11	0.00	19.8	15.9	24	14.5	50.9	0.76	0.252	79	0.278
12	0.00	20.1	15.8	24	14.8	50.5	0.77	0.256	82	0.288
13	0.00	20.5	15.9	24	15.4	50.9	0.74	0.260	83	0.292
14	0.00	20.2	16.7	24	15.1	50.8	0.75	0.255	81	0.284
15	0.00	20.0	15.7	24	15.3	51.0	0.73	0.257	83	0.290
16	0.00	20.1	15.9	24	15.4	50.9	0.73	0.258	84	0.294
17	0.00	20.2	15.1	24	15.7	50.5	0.72	0.257	83	0.291
18	0.00	20.0	15.7	24	15.0	50.8	0.75	0.256	83	0.289
19	0.00	19.9	14.7	24	15.3	50.9	0.73	0.255	84	0.293
20	0.00	19.6	14.0	23	15.7	50.7	0.70	0.252	82	0.287
	Average	20.4	16.0	24	14.9	48.3	0.76	0.256	82	0.286

Total number of blows analyzed: 19

Time Summary

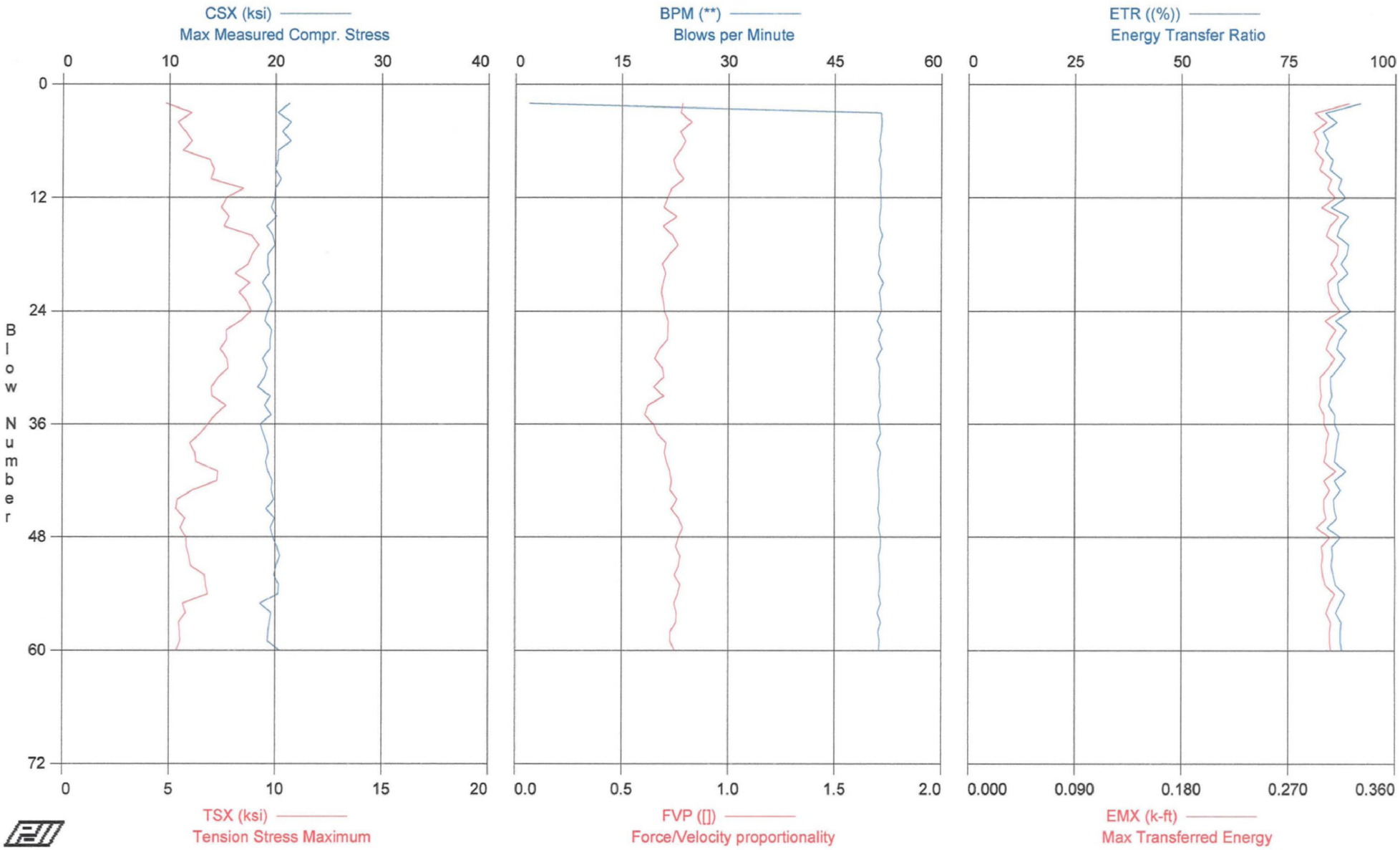
Drive 21 seconds 8:14:34 AM - 8:14:55 AM (3/26/2008) BN 2 - 20

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 28-May-2008

Test date: 26-Mar-2008

TURKEY POINT COL PROJECT - BORING B-615 139.1' - 140.6' Sample



TURKEY POINT COL PROJECT - BORING B-615 139.1' - 140.6' Sample
OP: HJC

HAMMER ID 331145 (BANKS)
Test date: 26-Mar-2008

AR: 1.19 in^2
LE: 144.00 ft
WS: 16,807.9 f/s

SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows per Minute

FVP: Force/Velocity proportionality
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	depth	CSX	TSX	FMX	VMX	BPM	FVP	EF2	ETR	EMX
	ft	ksi	ksi	kips	f/s	**	[]	k-ft	(%)	k-ft
2	0.00	21.3	4.8	25	15.2	1.9	0.79	0.288	92	0.321
3	0.00	20.2	6.0	24	14.6	51.5	0.78	0.270	84	0.292
4	0.00	21.5	5.4	26	14.5	51.6	0.83	0.280	86	0.302
5	0.00	20.6	5.7	25	14.9	51.5	0.77	0.269	83	0.291
6	0.00	21.4	6.1	25	14.9	51.3	0.80	0.275	84	0.295
7	0.00	20.2	5.6	24	14.6	51.5	0.77	0.272	84	0.292
8	0.00	20.2	6.9	24	14.1	51.2	0.74	0.277	85	0.299
9	0.00	20.0	7.1	24	14.8	51.5	0.76	0.277	85	0.296
10	0.00	20.5	7.0	24	14.5	51.5	0.79	0.281	87	0.306
11	0.00	20.0	8.5	24	15.3	51.4	0.73	0.279	87	0.303
12	0.00	19.9	7.7	24	14.6	51.5	0.72	0.283	88	0.309
13	0.00	19.6	7.4	23	15.1	51.5	0.70	0.272	85	0.298
14	0.00	20.1	7.8	24	14.9	51.3	0.76	0.280	89	0.312
15	0.00	19.2	7.6	23	15.1	51.3	0.69	0.276	87	0.305
16	0.00	19.7	8.9	23	14.9	51.7	0.74	0.275	86	0.302
17	0.00	20.0	9.2	24	14.6	51.3	0.76	0.283	89	0.312
18	0.00	19.3	8.9	23	14.9	51.2	0.72	0.276	89	0.311
19	0.00	19.3	8.7	23	15.5	51.5	0.69	0.276	87	0.306
20	0.00	19.4	8.1	23	15.4	51.1	0.71	0.275	89	0.311
21	0.00	18.8	8.8	22	15.1	51.8	0.69	0.272	86	0.303
22	0.00	19.4	8.3	23	15.8	51.3	0.69	0.271	87	0.304
23	0.00	19.7	8.7	23	15.8	51.5	0.70	0.277	88	0.307
24	0.00	19.3	8.9	23	15.5	51.6	0.70	0.277	90	0.314
25	0.00	19.0	8.4	23	14.8	51.0	0.72	0.272	86	0.301
26	0.00	19.7	7.7	23	15.3	51.7	0.72	0.277	89	0.310
27	0.00	19.5	7.7	23	15.3	51.2	0.72	0.274	87	0.305
28	0.00	19.5	7.4	23	16.1	51.7	0.68	0.272	86	0.302
29	0.00	18.8	7.7	22	16.1	50.9	0.66	0.271	88	0.309
30	0.00	19.3	7.8	23	15.6	51.4	0.69	0.272	87	0.304
31	0.00	19.0	7.3	23	15.3	51.3	0.70	0.262	85	0.297
32	0.00	18.4	7.0	22	15.8	51.4	0.65	0.267	85	0.297
33	0.00	19.5	7.0	23	15.6	51.3	0.70	0.269	85	0.298
34	0.00	19.0	7.7	23	15.7	51.5	0.62	0.264	84	0.296
35	0.00	19.6	7.2	23	15.4	51.1	0.61	0.266	86	0.300
36	0.00	18.6	6.8	22	16.1	51.3	0.65	0.262	86	0.300
37	0.00	18.9	6.5	22	15.8	51.5	0.67	0.263	87	0.304
38	0.00	19.2	6.0	23	15.2	50.9	0.71	0.262	86	0.302
39	0.00	19.4	6.2	23	15.5	51.5	0.70	0.259	86	0.302
40	0.00	19.1	6.3	23	15.1	51.3	0.71	0.262	86	0.300
41	0.00	19.3	7.3	23	14.9	51.1	0.73	0.263	88	0.310
42	0.00	19.7	7.3	23	15.0	51.2	0.73	0.265	86	0.300
43	0.00	19.6	6.1	23	15.0	51.3	0.73	0.267	87	0.305
44	0.00	19.9	5.4	24	14.7	51.3	0.76	0.264	86	0.300
45	0.00	19.1	5.3	23	14.6	51.1	0.73	0.259	86	0.300
46	0.00	19.9	5.8	24	14.5	51.4	0.77	0.262	86	0.302
47	0.00	19.5	5.5	23	13.9	51.2	0.79	0.255	84	0.294
48	0.00	19.8	5.8	24	14.4	51.5	0.77	0.263	87	0.305
49	0.00	20.2	5.8	24	15.0	51.5	0.75	0.259	85	0.298
50	0.00	20.4	5.9	24	14.8	51.2	0.78	0.260	85	0.299
51	0.00	20.1	6.0	24	14.6	51.3	0.77	0.257	85	0.298
52	0.00	19.9	6.7	24	14.1	51.4	0.75	0.260	85	0.299
53	0.00	20.3	6.7	24	14.7	51.4	0.78	0.261	86	0.301
54	0.00	20.3	6.8	24	14.8	51.2	0.76	0.262	88	0.309
55	0.00	18.6	5.7	22	13.9	51.5	0.75	0.254	87	0.305
56	0.00	19.6	5.8	23	14.5	51.0	0.76	0.257	86	0.302
57	0.00	19.5	5.5	23	14.5	51.5	0.76	0.254	87	0.306
58	0.00	19.4	5.5	23	14.8	51.1	0.73	0.259	87	0.305
59	0.00	19.3	5.5	23	14.8	51.3	0.73	0.263	87	0.305
60	0.00	20.4	5.3	24	15.3	51.2	0.75	0.261	88	0.306
	Average	19.7	6.9	23	15.0	50.5	0.73	0.268	87	0.303

Total number of blows analyzed: 59

Time Summary

Drive 1 minute 8 seconds 9:08:24 AM - 9:09:32 AM (3/26/2008) BN 2 - 60

MACTEC

engineering and constructing a better tomorrow

June 30, 2008

Memorandum to File
From: Steve Kiser
Reviewed By: Tom McDaniel

Subject: **Report of SPT Energy – MACTEC Charlotte CME 75 Truck Hammer Serial No. MEC-09 Automatic Hammer**
WORK INSTRUCTION TUR-055
Turkey Point COL Project
Dade County, Florida
MACTEC Project No. 6468-07-1950

Jay Cerceo, of MACTEC Engineering and Consulting, Inc. (MACTEC), performed energy measurements on the drill rig at the subject site per the referenced Work Instructions. This memorandum summarizes the field testing activities and presents the results of the energy measurements.

SPT Energy Field Measurements

SPT energy measurements were made on April 5 and 6, 2008, during drilling of Borings B-710 (DH) at the referenced site. The testing was performed by Jay Cerceo from approximately 4:25 PM on April 5 to 1:35 PM on April 6 under partly cloudy skies and a temperature of in the 80s in degrees Fahrenheit. The boring was drilled with personnel and equipment from MACTEC Charlotte. The drilling equipment consisted of a CME 75 model truck-mounted drill rig with an SPT automatic hammer. The drilling tools consisted of NW-J-sized drilling rods and a 2-foot long split tube sampler. Mud rotary drilling techniques were used to advance the borings below the depth at which groundwater was encountered at the time of energy testing. The drill rig operator during sampling was Mr. Jimmy Warren. Energy measurements were recorded during sampling at the depth intervals shown in Table 1.

The energy measurements were performed with a Pile Driving Analyzer (PDA) model PAX (Serial No. 3622L), and calibrated accelerometers (Serial Nos. K1050 and P5992) and strain gages (Serial Nos. NW #146/1 and NW#146/2). A steel drill rod, 2 feet long and instrumented with dedicated strain gages, was inserted at the top of the drill rod string immediately below the SPT hammer. The inserted rod was also instrumented with two piezoresistive accelerometers that were bolted to the outside of the rod. The instrumented rod insert had a cross-sectional area of approximately 1.49 square inches and an outside diameter of approximately 2.625 inches at the gage location. The drill rods included in the drill rod string were hollow rods in 5 to 10 foot long sections, with an outside and inside diameter of approximately 2.625 and 2.25 inches, respectively. The recommended operation rate of the hammer is not known. Due to the closed hammer system, the hammer lubrication condition and anvil dimensions could not be observed.

Calibration Records

The calibration records for all the above are filed in DCN TUR054.

13 Pages Total

MACTEC Engineering and Consulting, Inc.
2801 Yorkmont Road, Suite 100 • Charlotte, NC 28208 • Phone: 704.357.8600 • Fax: 704.357.8638
www.mactec.com

Calculations for EFV

The work was done in general accordance with ASTM D 4633-05. The strain and acceleration signals were converted to force and velocity by the PDA, and the data was interpreted by the PDA according to the Case Method equation. The maximum energy transmitted to the drill rod string (as measured at the location of the strain gages and accelerometers) was calculated by the PDA using the EFV method equation, as shown below:

$$EFV = \int F(t) * V(t) * dt$$

Where: EFV = Transferred energy (EFV equation), or Energy of FV
F(t) = Calculated force at time t
V(t) = Calculated velocity at time t

The EFV method of energy calculation is recommended in ASTM Standard D4633-05. The EFV equation, integrated over the complete wave event, measures the total energy content of the event using both force and velocity measurements. The EFV values associated with each blow analyzed are tabulated in the attached PDIPLOT tables and are also shown graphically in the PDIPLOT charts.

Calculations for ETR

The ratio of the measured transferred energy (EFV) to the theoretical potential energy of the SPT system (140 lb weight with the specified 30 inch fall) is the ETR. The ETR values (as percent of the theoretical value) are shown in Table 1.

Comparison of ETR to Typical Energy Transfer Ratio Range

Based on a research report published by the Florida Department of Transportation (FDOT) (Report WPI No. 0510859, 1999), the average ETR measured for automatic hammers is 79.6%. The standard deviation was 7.9%; therefore, the range of ETRs within one standard deviation of the average was reported to be 71.7% to 87.5%. This range of ETRs was also consistent with other research that was cited in the FDOT research paper; however, maximum and minimum ETR values of up to 98% and 56%, respectively, were reported in the literature. The ETR values shown in Table 1 are generally within the range of typical values for automatic hammers as reported in the literature.

Discussion

Based on the field testing results, observations from the SPT energy measurements are summarized below:

- The data obtained by the PDA are consistent between individual hammer blows and between the sample depths tested. In general, the first and last one (and sometimes two) hammer blow records recorded by the PDA produced poor quality data (which is relatively common) and, as such, the record(s) was(were) not used in the data reduction.

- The average energy transferred from the hammer to the drill rods for each individual depth interval using the EFV method ranged from 270 foot-pounds to 295 foot-pounds. These average energy transfers correspond to energy transfer ratios (ETR) of 77% to 84% of the theoretical energy (350 foot-pounds) of the SPT hammer.

- The average at each depth interval was calculated as the transferred energy for each analyzed blow of the depth intervals divided by the total number of hammer blows analyzed. The overall average energy transfer of the SPT system (for all the depth intervals tested) was 289.7 foot-pounds, with an average ETR of 82.8%.

Attachments: Page 4 Table 1 - Summary of SPT Energy Measurements – 1 Page
Page 5 Work Instruction – DCN TUR-055 – 1 Page
Pages 6 Record of SPT Energy Measurement – 1 Page
Pages 7 – 13 PDIPLOT Output – 7 Pages

Work Instruction No. 9
Turkey Point COL Project
MACTEC Engineering and Consulting, Inc.
MACTEC Project 6468-07-1950

Issued To: Steve Kiser and Jay Cerceo **Rev. No.** 1

Issued By: Tom McDaniel **Date:** 3-24-08

Valid From: 3-24-08 **To:** 4-30-08

Task Description: Perform SPT Energy Measurements

Applicable Technical Procedures or Plans, or other reference: Geotechnical Work Plan (current revision; available at Site Office), Bechtel Specification 25409-102-3PS-CY00-00001, Rev. 000 or later revision, section 4.3, ASTM D 4633-05 (copy attached.).

Specific Instructions (note attachments where necessary): Perform energy measurements for each drill rig on site in accordance with ASTM D-4633-05. Consult with Site Coordinator as to schedule for rigs that may be planned for use that are not yet present. Hammer weights have been checked by site personnel, and records will be available on site. All rigs are using automatic hammer systems. Confirm that automatic hammer system is being operated within manufacturer's recommendations or in a typical operating fashion as observed from watching one or two SPT measurements prior to measuring energy. Be sure to check each drill rig using all hammer/rod combinations that it will be using. Depths for measurements should be coordinated with the Site Coordinator, and can be directed by Becthel in accordance with the specification. Site profile consists of very soft soils to about 5 feet followed by high-N-value soft rock to about 20 feet where coring begins. Sands are present below about 100 to 125 feet. Energy measurements should be made in the deeper sand zone as often as can be done, consistent with the drilling depths at the time of the measurements. See Site Coordinator for current boring logs of holes drilled and use these to plan most effective field measurement program.

Submit copies of calibration records for equipment to Project Principal for review prior to beginning work on site.

Special Instructions (note attachments where necessary): Confirm with Site Manager that approval of equipment calibration records has been received prior to beginning field testing. If unexpected conditions are encountered that affect measurements, contact Site Coordinator, Project Principal (Tom McDaniel) or Sr. Project Principal (Al Tice) immediately.

Report Format: Standard report in accordance with ASTM D 4633 requirements.

Specific Quality Assurance Procedures Applicable: QAP 20-1; QAP 25-1; QAP for Reporting Nuclear-Related Defects, or Noncompliances, per Federal Regulation 10CFR21 and Section 306 of the Energy Reorganization Act of 1974. Current revisions apply.

Hold Points or Witness Points: None

Records: All records generated shall be considered QA Records.

Reviewed and Approved by: (Note: Only one signature is required for issuance)

Project Manager: _____ Date: _____

Project Principal Engineer: _____ Date: 3/24/08

Site Manager/Coordinator: _____ Date: _____

Pages: 1 plus attachment **DCN:** TUR-055

Attachments: ASTM D 4633-05

TABLE 1
SUMMARY OF SPT ENERGY MEASUREMENTS (ASTM D4633-05)
Turkey Point COL Project
Dade County, Florida
MACTEC Project No. 6468-07-1950

Hammer Serial No.	Rig Owner	Rig Operator	Boring No. Tested	Rod Size	Date Tested	Sample Depth (feet)	SPT Blow Count (blows per six inches)	No. of Blows Analyzed	Average Measured Energy (Average EFV) (ft-lbs)[a]	Energy Transfer Ratio (%)[b] (Average ETR)
MEC-09 (CME 75 Truck)	MACTEC Charlotte	Jimmy Warren	B-710 (DH)	NW-J	4/5/2008	121.3 - 122.8	7 - 6 - 7	23	270	77.1%
					4/6/2008	128.4 - 129.9	10 - 15 - 17	-	-	-
						138.4 - 139.9	8 - 11 - 20	41	295	84.3%
						148.4 - 149.9	23 - 35 - 44	100	292	83.4%
								Average for Rig:	**289.7**	**82.8%**

[a]Measured Energy is energy based on the EFV method, as outlined in ASTM D4633-05, for each blow recorded by the PDA. In some cases, the initial and final one to two blows produced poor quality data, and were not used to calculate the Average Measured Energy.

EFV = EMX * 1000 lbs/kip, where EMX equals the maximum transferred energy measured by the PDA (see attached PDA data).

[b]Energy Transfer Ratio is the Measured Energy divided by the theoretical SPT energy of 350 foot-pounds (140 pound hammer falling 2.5 feet).

The average ETR values may differ slightly and insignificantly from those in the PDIPLOT tables due to roundoff.

Data from depth of 128.4 to 129.9 was not used in analysis due to improper mounting of equipment on to drill rod.

Prepared By: [illegible]	Date: 5-30-08	Checked By: WBC	Date: 6-4-08

MACTEC

2801 YORKMONT ROAD, SUITE 100 □ CHARLOTTE, NC 28208
Telephone: (704) 357-8600 / Facsimile: (704) 357-8638

RECORD OF SPT ENERGY MEASUREMENT

GENERAL INFORMATION		DRILL RIG DATA	
PROJECT:	Turkey Point COL Project	MAKE:	CME
LOCATION:	Florida City, Florida	MODEL:	75 Truck
PROJECT NO.:	6468-07-1950	SERIAL NO.:	211797
DATE:	4/5/2008	HAMMER TYPE:	Automatic
WEATHER:	partly cloudy 80s humid	ROPE CONDITION:	N/A
INSPECTOR: HC	Steve Kiser Jay Cisco	ROD SIZE:	NWJ
DRILLING COMPANY 4/5/08	MACTEC	NO. OF SHEAVES:	N/A

BORING DATA			
BORING NUMBER:	B-710 DH		
DEPTH DRILLED:	121.3		
TIME DRIVEN:	5:30 pm		
RIG OPERATOR:	J. Warren		
HAMMER OPERATOR:	C. Sloan		
PDA PAK SERIAL NO.:	3622L	3622L	3622L
INSTR. ROD AREA:	1.49		
ACCEL. SERIAL NOS.:	K1050 + P5992		
STRAIN SERIAL NOS.:	NW146-1 NW146-2		

	SAMPLE DEPTH (feet)	SPT N-VALUE (bpf)	~~DEPTH~~ LE cont. (feet) HC 4/5/08	SPT N-VALUE (bpf)	SAMPLE DEPTH (feet)	SPT N-VALUE (bpf)	DEPTH cont. (feet)	SPT N-VALUE (bpf)	SAMPLE DEPTH (feet)	SPT N-VALUE (bpf)	DEPTH cont. (feet)	SPT N-VALUE (bpf)
4/5/08	121.3-123.8	7-6-7	129									
4/6/08, 9:00am	128.5-130.0	10-15-17	134									
4/6/08 12:15pm	138.5-140	8-11-20	144									
4/6/08 1:37pm	148.5-150.0	23-33-44	154									

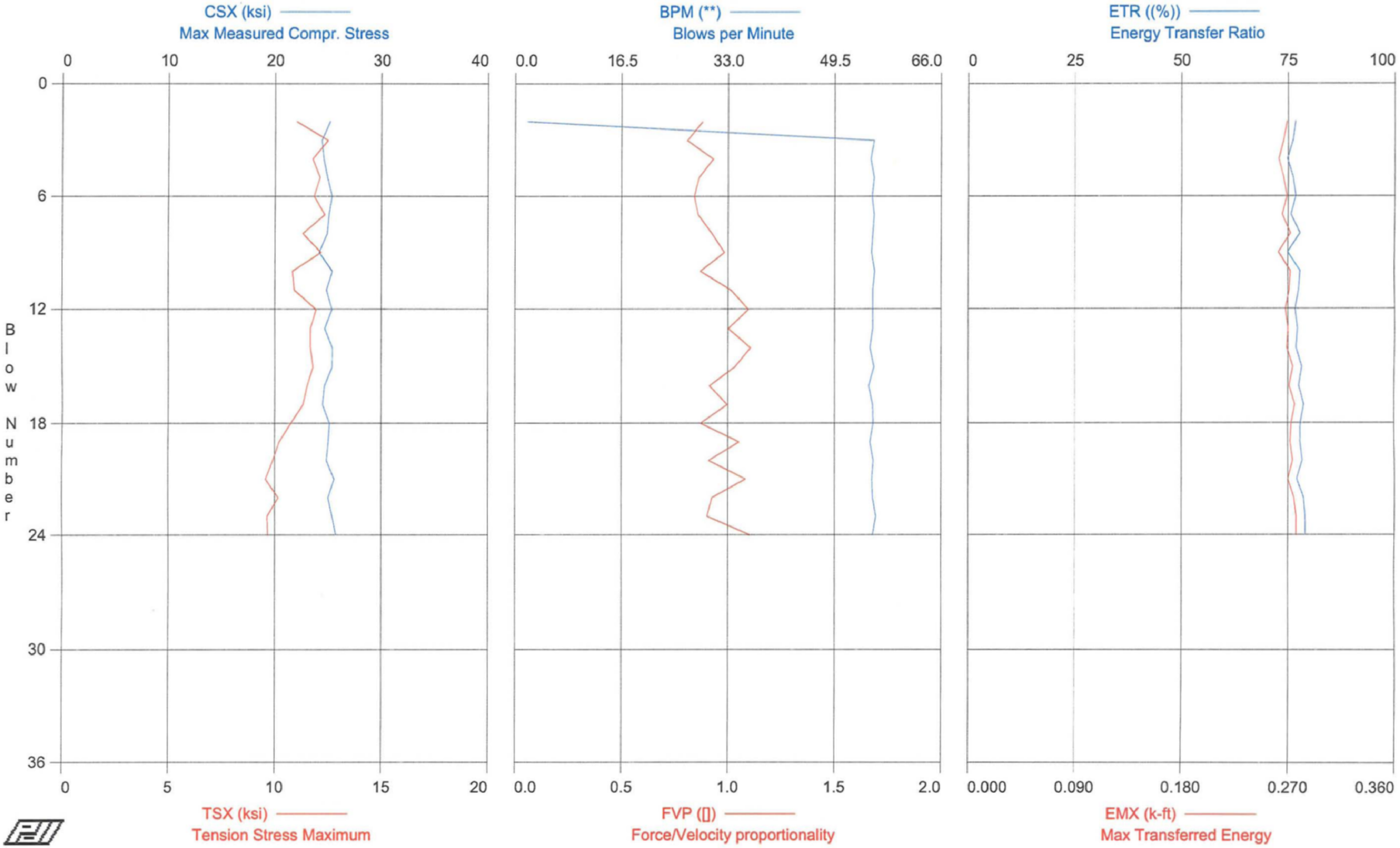
REMARKS:

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 30-May-2008

Test date: 5-Apr-2008

TURKEY POINT COL PROJECT - BORING B-710 (DH); 121.3' - 122.8' Sample



TURKEY POINT COL PROJECT - BORING B-710 (DH); 121.3' - 122.8' Sample

HAMMER ID 311797 (J.WARREN

OP: HJC

Test date: 5-Apr-2008

AR: 1.49 in^2

SP: 0.492 k/ft3

LE: 129.00 ft

EM: 30,000 ksi

WS: 16,807.9 f/s

JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows per Minute

FVP: Force/Velocity proportionality
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	depth ft	CSX ksi	TSX ksi	FMX kips	VMX f/s	BPM **	FVP []	EF2 k-ft	ETR (%)	EMX k-ft
2	0.00	25.1	11.0	37	12.2	1.9	0.88	0.295	77	0.269
3	0.00	24.4	12.5	36	11.7	55.6	0.81	0.290	76	0.266
4	0.00	24.6	11.8	37	11.7	55.1	0.93	0.288	75	0.262
5	0.00	24.9	12.1	37	11.6	55.6	0.86	0.290	76	0.266
6	0.00	25.3	11.8	38	11.6	55.3	0.84	0.293	77	0.269
7	0.00	25.1	12.3	37	11.6	55.6	0.86	0.288	76	0.265
8	0.00	24.9	11.3	37	11.9	55.4	0.92	0.295	78	0.272
9	0.00	24.1	12.2	36	11.8	55.2	0.98	0.290	75	0.262
10	0.00	25.4	10.8	38	11.9	55.7	0.87	0.297	78	0.272
11	0.00	24.8	10.9	37	11.9	55.4	1.01	0.295	77	0.271
12	0.00	25.3	11.9	38	11.6	55.4	1.10	0.294	77	0.268
13	0.00	24.7	11.7	37	12.2	55.4	1.00	0.294	77	0.270
14	0.00	25.4	11.7	38	11.8	55.0	1.11	0.293	77	0.269
15	0.00	25.4	11.8	38	12.1	55.6	1.03	0.297	78	0.274
16	0.00	24.7	11.5	37	12.1	54.8	0.91	0.289	78	0.271
17	0.00	24.5	11.3	36	12.1	55.4	1.00	0.290	79	0.276
18	0.00	25.1	10.8	37	11.9	55.5	0.87	0.295	78	0.273
19	0.00	25.0	10.2	37	11.8	55.0	1.05	0.292	78	0.272
20	0.00	24.9	9.9	37	12.0	55.5	0.91	0.292	78	0.274
21	0.00	25.6	9.6	38	11.9	55.3	1.08	0.291	77	0.270
22	0.00	25.0	10.2	37	12.1	55.4	0.93	0.293	79	0.275
23	0.00	25.4	9.7	38	12.0	55.9	0.90	0.295	79	0.277
24	0.00	25.7	9.7	38	12.0	55.4	1.11	0.298	79	0.277
	Average	25.0	11.2	37	11.9	53.1	0.96	0.293	77	0.270

Total number of blows analyzed: 23

Time Summary

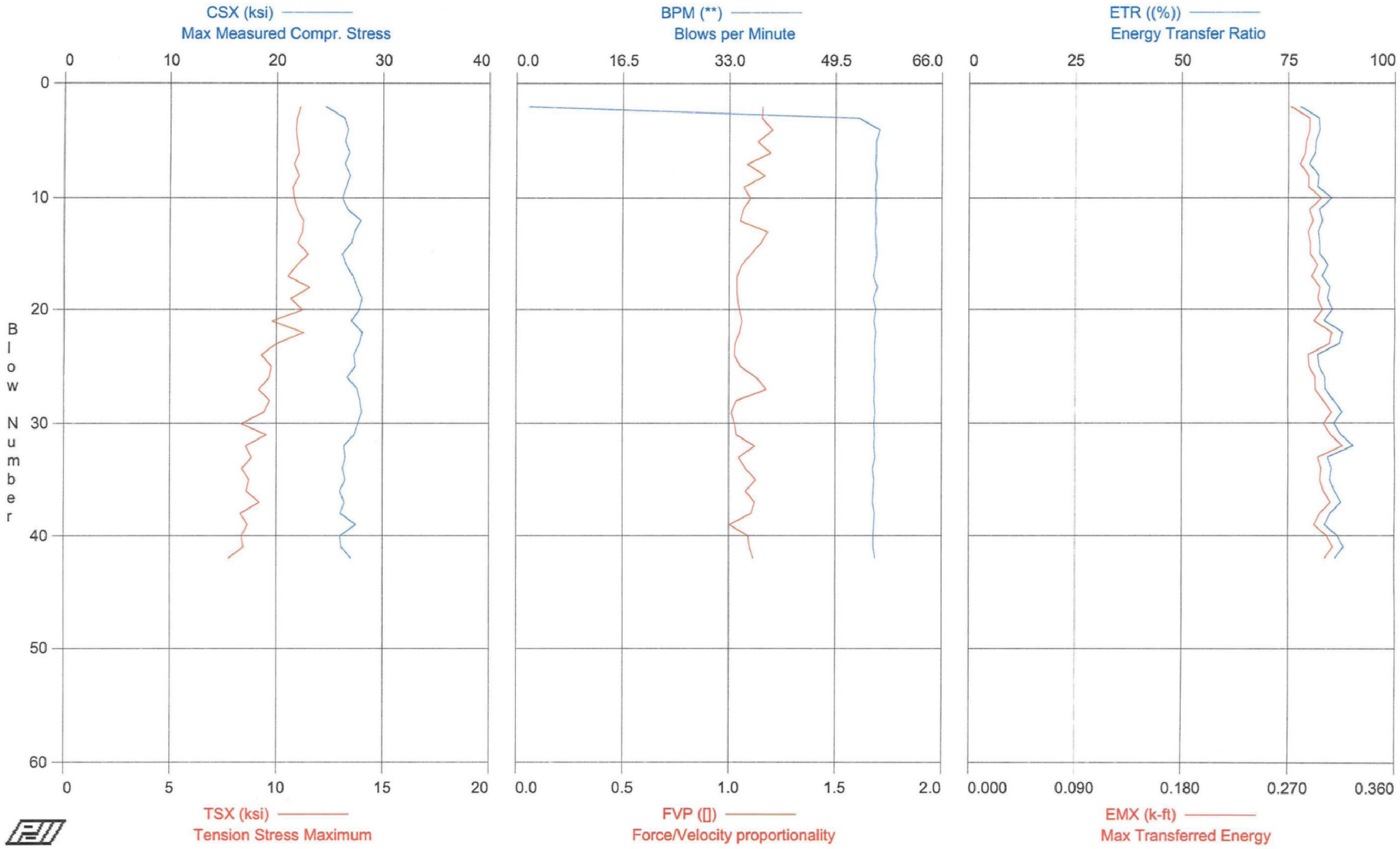
Drive 23 seconds 4:26:00 PM - 4:26:23 PM (4/5/2008) BN 2 - 24

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 30-May-2008

Test date: 6-Apr-2008

TURKEY POINT COL PROJECT - BORING B-710 (DH); 138.4 - 139.9 Sample



TURKEY POINT COL PROJECT - BORING B-710 (DH); 138.4 - 139.9 Sample
OP: HJC
AR: 1.49 in^2
LE: 144.00 ft
WS: 16,807.9 f/s

HAMMER ID 311797 (J.WARREN)
Test date: 6-Apr-2008
SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows per Minute

FVP: Force/Velocity proportionality
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	depth	CSX	TSX	FMX	VMX	BPM	FVP	EF2	ETR	EMX
	ft	ksi	ksi	kips	f/s	**	[]	k-ft	(%)	k-ft
2	0.00	24.6	11.1	37	11.9	1.9	1.16	0.296	78	0.272
3	0.00	26.3	10.9	39	12.8	53.1	1.15	0.312	82	0.288
4	0.00	26.7	10.9	40	12.5	56.3	1.20	0.311	82	0.288
5	0.00	26.4	11.0	39	13.1	55.8	1.13	0.312	81	0.285
6	0.00	26.8	11.0	40	12.6	55.8	1.19	0.309	81	0.284
7	0.00	26.4	10.8	39	12.7	55.7	1.09	0.310	80	0.280
8	0.00	26.9	11.0	40	12.9	55.9	1.17	0.312	82	0.287
9	0.00	26.5	10.7	40	12.7	55.7	1.07	0.310	82	0.287
10	0.00	26.2	10.8	39	13.3	55.8	1.10	0.318	85	0.298
11	0.00	26.7	11.0	40	12.8	55.7	1.07	0.312	82	0.288
12	0.00	27.9	11.3	42	13.4	55.8	1.05	0.320	83	0.291
13	0.00	27.3	11.2	41	13.0	55.7	1.18	0.315	82	0.287
14	0.00	27.1	11.0	40	13.2	55.8	1.15	0.312	82	0.289
15	0.00	26.2	11.5	39	13.3	55.9	1.10	0.315	82	0.289
16	0.00	26.5	11.0	40	13.6	55.7	1.06	0.317	84	0.295
17	0.00	27.2	10.5	40	13.0	55.4	1.04	0.316	83	0.290
18	0.00	27.6	11.6	41	13.4	56.0	1.04	0.320	85	0.297
19	0.00	28.0	10.7	42	13.3	55.4	1.04	0.318	84	0.295
20	0.00	27.8	11.2	41	13.4	55.8	1.05	0.319	85	0.299
21	0.00	27.0	9.8	40	13.0	55.5	1.06	0.311	83	0.292
22	0.00	28.1	11.3	42	13.5	55.8	1.05	0.317	88	0.307
23	0.00	27.8	10.0	41	13.0	55.6	1.03	0.321	87	0.305
24	0.00	27.3	9.3	41	13.0	55.6	1.03	0.306	82	0.287
25	0.00	27.4	9.8	41	13.2	55.7	1.05	0.310	82	0.288
26	0.00	26.7	9.7	40	13.2	55.5	1.13	0.310	84	0.293
27	0.00	27.6	9.2	41	13.2	55.6	1.18	0.315	84	0.293
28	0.00	27.8	9.7	41	13.3	55.5	1.04	0.314	86	0.300
29	0.00	28.0	9.4	42	13.4	55.7	1.01	0.314	88	0.307
30	0.00	27.7	8.3	41	13.5	55.5	1.03	0.317	86	0.300
31	0.00	27.3	9.5	41	13.3	55.6	1.04	0.316	87	0.306
32	0.00	26.3	8.6	39	13.2	55.5	1.12	0.315	90	0.316
33	0.00	26.5	8.8	39	12.8	55.7	1.05	0.311	84	0.295
34	0.00	26.2	8.4	39	13.3	55.3	1.08	0.313	85	0.298
35	0.00	26.5	8.7	39	13.1	55.5	1.13	0.312	85	0.297
36	0.00	26.0	8.6	39	13.3	55.4	1.08	0.310	86	0.300
37	0.00	26.4	9.2	39	13.1	55.3	1.12	0.313	87	0.306
38	0.00	26.0	8.3	39	13.2	55.6	1.11	0.310	85	0.297
39	0.00	27.5	8.6	41	13.2	55.5	1.00	0.306	84	0.292
40	0.00	26.0	8.4	39	13.3	55.4	1.09	0.314	87	0.303
41	0.00	26.1	8.4	39	13.3	55.4	1.10	0.314	88	0.308
42	0.00	27.0	7.8	40	13.6	55.7	1.11	0.321	86	0.301
	Average	26.9	10.0	40	13.1	54.3	1.09	0.313	84	0.295

Total number of blows analyzed: 41

Time Summary

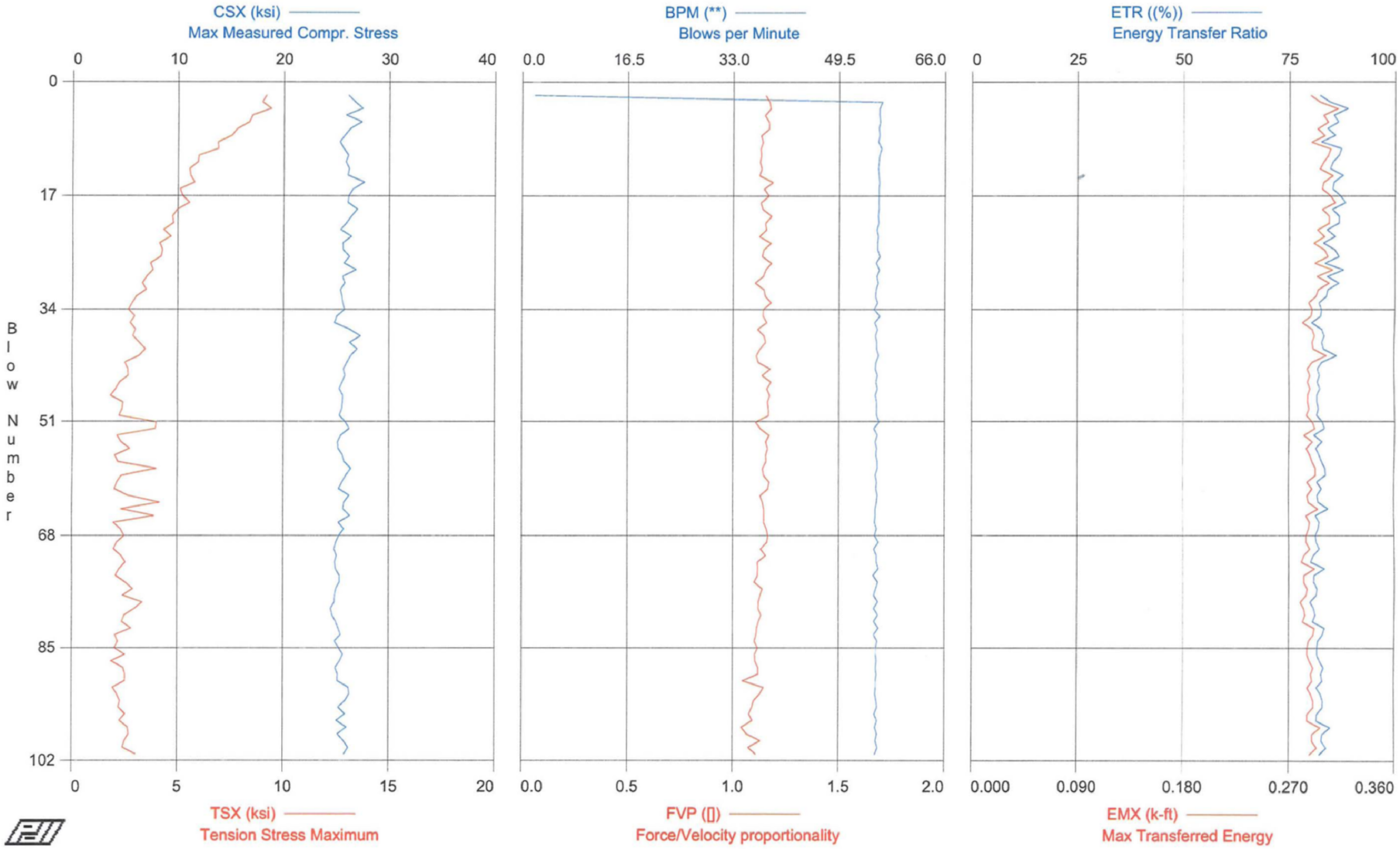
Drive 43 seconds 12:09:26 PM - 12:10:09 PM (4/6/2008) BN 2 - 42

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 30-May-2008

Test date: 6-Apr-2008

TURKEY POINT COL PROJECT - BORING B-710 (DH); 148.4' - 149.9' Sample



TURKEY POINT COL PROJECT - BORING B-710 (DH); 148.4' - 149.9' Sample
OP: HJC
AR: 1.49 in^2
LE: 154.00 ft
WS: 16,807.9 f/s

HAMMER ID 311797 (J.WARREN)
Test date: 6-Apr-2008
SP: 0.492 k/ft3
EM: 30,000 ksi
JC: 0.70

CSX: Max Measured Compr. Stress
TSX: Tension Stress Maximum
FMX: Maximum Force
VMX: Maximum Velocity
BPM: Blows per Minute

FVP: Force/Velocity proportionality
EF2: Energy of F^2
ETR: Energy Transfer Ratio
EMX: Max Transferred Energy

BL#	depth	CSX	TSX	FMX	VMX	BPM	FVP	EF2	ETR	EMX
	ft	ksi	ksi	kips	f/s	**	[]	k-ft	(%)	k-ft
2	0.00	26.1	9.2	39	12.7	1.9	1.15	0.313	82	0.288
3	0.00	26.7	9.0	40	12.8	56.2	1.17	0.319	85	0.296
4	0.00	27.4	9.4	41	13.1	55.8	1.18	0.321	89	0.311
5	0.00	25.9	8.5	39	12.6	55.8	1.15	0.317	86	0.299
6	0.00	27.4	8.4	41	13.1	55.9	1.17	0.320	87	0.303
7	0.00	26.3	7.8	39	12.6	55.7	1.17	0.313	84	0.294
8	0.00	25.8	7.5	38	12.7	55.8	1.13	0.315	86	0.300
9	0.00	25.3	6.9	38	12.4	55.6	1.14	0.312	83	0.289
10	0.00	25.6	6.9	38	12.8	56.1	1.13	0.309	87	0.305
11	0.00	26.1	6.0	39	12.9	55.8	1.13	0.316	87	0.303
12	0.00	25.9	5.9	39	12.9	55.7	1.13	0.313	85	0.299
13	0.00	26.2	5.5	39	13.0	55.6	1.13	0.309	85	0.296
14	0.00	26.1	5.6	39	12.5	55.7	1.12	0.316	88	0.307
15	0.00	27.6	5.8	41	13.1	55.8	1.19	0.311	86	0.299
16	0.00	26.6	5.1	40	13.0	55.7	1.15	0.315	85	0.298
17	0.00	26.2	5.2	39	12.5	55.7	1.17	0.318	87	0.305
18	0.00	26.1	5.5	39	12.9	55.7	1.13	0.323	88	0.309
19	0.00	27.0	5.0	40	13.3	55.7	1.14	0.312	85	0.298
20	0.00	26.4	4.7	39	12.5	55.6	1.18	0.317	87	0.304
21	0.00	25.9	4.8	39	12.6	55.7	1.15	0.319	87	0.304
22	0.00	25.4	4.3	38	12.3	55.4	1.16	0.314	84	0.294
23	0.00	26.4	4.7	39	13.1	55.6	1.12	0.319	86	0.300
24	0.00	25.6	4.1	38	12.2	55.5	1.18	0.309	83	0.291
25	0.00	25.6	4.3	38	12.2	55.5	1.14	0.316	86	0.300
26	0.00	26.2	4.2	39	12.9	55.9	1.14	0.315	87	0.303
27	0.00	25.7	3.7	38	12.2	55.3	1.18	0.309	83	0.292
28	0.00	26.9	3.8	40	13.1	55.8	1.15	0.311	88	0.307
29	0.00	25.6	3.5	38	12.5	55.4	1.14	0.314	84	0.294
30	0.00	25.8	3.3	38	13.1	55.6	1.10	0.313	87	0.304
31	0.00	25.4	3.5	38	12.4	55.3	1.15	0.310	84	0.295
32	0.00	25.5	3.0	38	12.4	55.2	1.15	0.305	84	0.293
33	0.00	25.6	2.8	38	12.2	55.5	1.18	0.308	82	0.287
34	0.00	25.8	2.7	38	12.6	55.0	1.14	0.306	83	0.290
35	0.00	25.1	2.9	37	12.2	55.9	1.14	0.310	83	0.289
36	0.00	24.8	2.7	37	12.0	55.1	1.16	0.306	80	0.282
37	0.00	26.3	3.0	39	13.2	55.5	1.12	0.305	83	0.290
38	0.00	27.3	2.9	41	13.3	55.2	1.15	0.312	83	0.292
39	0.00	26.3	3.2	39	12.7	55.4	1.15	0.311	83	0.290
40	0.00	27.0	3.5	40	13.4	55.4	1.13	0.307	83	0.291
41	0.00	26.4	3.2	39	13.3	55.7	1.11	0.317	86	0.302
42	0.00	26.0	2.5	39	12.5	55.3	1.12	0.308	83	0.290
43	0.00	25.7	2.7	38	12.2	55.2	1.18	0.310	82	0.286
44	0.00	25.8	2.7	38	12.2	55.5	1.14	0.307	82	0.288
45	0.00	25.6	2.3	38	12.2	55.3	1.18	0.310	82	0.286
46	0.00	25.3	2.1	38	12.3	55.5	1.16	0.307	82	0.288
47	0.00	25.6	1.8	38	12.2	55.2	1.17	0.309	82	0.286
48	0.00	25.6	2.4	38	12.3	55.4	1.16	0.310	82	0.286
49	0.00	25.5	2.4	38	12.3	55.4	1.17	0.305	82	0.287
50	0.00	25.3	2.2	38	12.1	55.4	1.17	0.310	82	0.285
51	0.00	25.9	4.0	39	13.0	55.8	1.11	0.315	83	0.290
52	0.00	26.2	3.9	39	13.1	55.0	1.13	0.306	83	0.292
53	0.00	25.5	2.1	38	12.2	55.5	1.17	0.307	81	0.283
54	0.00	25.1	2.3	37	12.2	55.2	1.16	0.310	83	0.290
55	0.00	25.2	2.7	38	12.2	55.4	1.16	0.305	81	0.285
56	0.00	25.6	2.0	38	12.4	55.3	1.16	0.311	82	0.288
57	0.00	25.8	2.2	38	12.5	55.5	1.16	0.310	83	0.290
58	0.00	26.4	4.0	39	13.0	55.5	1.14	0.309	84	0.293
59	0.00	25.9	2.3	39	12.6	55.2	1.15	0.317	84	0.293
60	0.00	25.6	2.1	38	12.3	55.4	1.17	0.308	82	0.286
61	0.00	25.2	2.0	38	12.2	55.3	1.17	0.311	83	0.290
62	0.00	26.2	2.7	39	13.0	55.5	1.13	0.305	82	0.286
63	0.00	25.8	4.1	38	12.7	55.4	1.14	0.305	82	0.287
64	0.00	25.7	2.3	38	12.6	55.2	1.15	0.315	84	0.295
65	0.00	26.3	3.9	39	12.9	55.2	1.15	0.305	81	0.285
66	0.00	25.2	2.0	38	12.3	55.1	1.15	0.309	82	0.288

TURKEY POINT COL PROJECT - BORING B-710 (DH): 148.4' - 149.9' Sample

HAMMER ID 311797 (J.WARREN)

OP: HJC

Test date: 6-Apr-2008

BL#	depth	CSX	TSX	FMX	VMX	BPM	FVP	EF2	ETR	EMX
	ft	ksi	ksi	kips	f/s	**	[]	k-ft	(%)	k-ft
67	0.00	25.7	2.3	38	12.4	55.4	1.16	0.311	82	0.287
68	0.00	25.3	2.5	38	12.1	55.1	1.17	0.309	81	0.285
69	0.00	25.0	2.1	37	12.1	55.7	1.16	0.306	82	0.285
70	0.00	24.8	2.0	37	12.2	55.0	1.13	0.310	82	0.288
71	0.00	25.0	2.3	37	12.1	55.4	1.16	0.306	81	0.283
72	0.00	24.9	2.5	37	12.4	55.4	1.12	0.304	80	0.281
73	0.00	25.0	2.3	37	12.6	55.7	1.12	0.309	83	0.292
74	0.00	25.3	2.1	38	12.6	54.9	1.12	0.306	81	0.283
75	0.00	25.3	2.5	38	12.9	55.6	1.10	0.304	81	0.283
76	0.00	25.0	2.9	37	12.3	55.3	1.14	0.304	82	0.286
77	0.00	24.9	2.4	37	12.3	55.0	1.13	0.306	82	0.285
78	0.00	24.9	3.3	37	12.4	55.6	1.12	0.301	80	0.280
79	0.00	24.5	3.0	37	12.2	55.0	1.12	0.304	81	0.283
80	0.00	24.7	2.5	37	12.2	55.6	1.13	0.307	81	0.284
81	0.00	25.0	2.4	37	12.4	55.0	1.12	0.307	81	0.282
82	0.00	25.2	2.8	38	12.8	55.7	1.11	0.307	83	0.292
83	0.00	25.4	2.1	38	12.8	55.0	1.11	0.307	83	0.291
84	0.00	24.9	2.2	37	12.7	55.5	1.10	0.305	82	0.287
85	0.00	25.3	2.0	38	12.7	55.3	1.12	0.304	82	0.286
86	0.00	25.7	2.5	38	12.9	55.3	1.11	0.307	82	0.286
87	0.00	25.4	1.9	38	12.8	55.4	1.11	0.305	82	0.288
88	0.00	25.0	2.5	37	12.5	55.3	1.12	0.306	83	0.291
89	0.00	25.2	2.5	37	12.6	55.4	1.12	0.305	83	0.289
90	0.00	25.1	2.5	37	13.4	55.3	1.05	0.308	83	0.290
91	0.00	26.2	2.0	39	12.8	55.3	1.15	0.305	82	0.286
92	0.00	26.3	2.1	39	13.0	55.2	1.13	0.310	83	0.289
93	0.00	25.9	2.3	39	12.7	55.4	1.10	0.310	83	0.291
94	0.00	25.2	2.2	38	13.0	55.5	1.09	0.309	83	0.291
95	0.00	25.9	2.5	39	12.8	55.1	1.08	0.310	82	0.286
96	0.00	25.1	2.3	37	12.8	55.5	1.09	0.305	82	0.286
97	0.00	26.0	2.7	39	14.0	55.2	1.04	0.306	85	0.297
98	0.00	25.2	2.7	37	13.2	55.5	1.07	0.308	83	0.290
99	0.00	25.7	2.5	38	12.8	55.3	1.13	0.309	83	0.290
100	0.00	26.2	2.4	39	12.9	55.6	1.08	0.310	84	0.294
101	0.00	25.8	3.0	38	13.0	55.2	1.11	0.308	82	0.288
	Average	25.7	3.5	38	12.6	54.9	1.14	0.310	83	0.292

Total number of blows analyzed: 100

Time Summary

Drive 1 minute 47 seconds 1:31:22 PM - 1:33:09 PM (4/6/2008) BN 2 - 101

MACTEC

engineering and constructing a better tomorrow

August 15, 2008

Memorandum to File
From: Steve Kiser SK 8-15-08
Reviewed By: Tom McDaniel TMM 8/19/08

Subject: **Report of SPT Energy – MACTEC Charlotte CME 550 ATV Hammer Serial No. MEC-04 Automatic Hammer WORK INSTRUCTION TUR-055**
Turkey Point COL Project
Dade County, Florida
MACTEC Project No. 6468-07-1950

Jay Cerceo, of MACTEC Engineering and Consulting, Inc. (MACTEC), performed energy measurements on the drill rig at the subject site per the referenced Work Instructions. This memorandum summarizes the field testing activities and presents the results of the energy measurements.

SPT Energy Field Measurements

SPT energy measurements were made on April 22, 2008, during drilling of Borings B-710 (DH) R at the referenced site. The testing was performed by Jay Cerceo from approximately 9:05 to 9:45 AM under clear skies and a temperature in the 70s and 80s in degrees Fahrenheit. The boring was drilled with personnel and equipment from MACTEC Charlotte. The drilling equipment consisted of a CME 550 ATV-model drill rig with an SPT automatic hammer. The drilling tools consisted of AW-J-sized drilling rods and a 2-foot long split tube sampler. Mud rotary drilling techniques were used to advance the borings below the depth at which groundwater was encountered at the time of energy testing. The drill rig operator during sampling was Mr. Jimmy Warren. Energy measurements were recorded during sampling at the depth intervals shown in Table 1.

The energy measurements were performed with a Pile Driving Analyzer (PDA) model PAX (Serial No. 3622L), and calibrated accelerometers (Serial Nos. K1050 and P5992) and strain gages (Serial Nos. AW #75/1 and AW#75/2). A steel drill rod, 2 feet long and instrumented with dedicated strain gages, was inserted at the top of the drill rod string immediately below the SPT hammer. The inserted rod was also instrumented with two piezoresistive accelerometers that were bolted to the outside of the rod. The instrumented rod insert had a cross-sectional area of approximately 1.19 square inches and an outside diameter of approximately 1.75 inches at the gage location. The drill rods included in the drill rod string were hollow rods in 5 to 10 foot long sections, with an outside and inside diameter of approximately 1.75 and 1.375 inches, respectively. The recommended operation rate of the hammer is not known. Due to the closed hammer system, the hammer lubrication condition and anvil dimensions could not be observed.

Calibration Records

The calibration records for all the above are filed in DCN TUR054.

14 Pages Total

MACTEC Engineering and Consulting, Inc.
3301 Atlantic Avenue • Raleigh, NC 27604 • Phone: 919.876.0416 • Fax: 919.831.8136 www.mactec.com

Calculations for EFV

The work was done in general accordance with ASTM D 4633-05. The strain and acceleration signals were converted to force and velocity by the PDA, and the data was interpreted by the PDA according to the Case Method equation. The maximum energy transmitted to the drill rod string (as measured at the location of the strain gages and accelerometers) was calculated by the PDA using the EFV method equation, as shown below:

$$EFV = \int F(t) * V(t) * dt$$

Where: EFV = Transferred energy (EFV equation), or Energy of FV
F(t) = Calculated force at time t
V(t) = Calculated velocity at time t

The EFV method of energy calculation is recommended in ASTM Standard D4633-05. The EFV equation, integrated over the complete wave event, measures the total energy content of the event using both force and velocity measurements. The EFV values associated with each blow analyzed are tabulated in the attached PDIPLOT tables and are also shown graphically in the PDIPLOT charts.

Calculations for ETR

The ratio of the measured transferred energy (EFV) to the theoretical potential energy of the SPT system (140 lb weight with the specified 30 inch fall) is the ETR. The ETR values (as percent of the theoretical value) are shown in Table 1.

Comparison of ETR to Typical Energy Transfer Ratio Range

Based on a research report published by the Florida Department of Transportation (FDOT) (Report WPI No. 0510859, 1999), the average ETR measured for automatic hammers is 79.6%. The standard deviation was 7.9%; therefore, the range of ETRs within one standard deviation of the average was reported to be 71.7% to 87.5%. This range of ETRs was also consistent with other research that was cited in the FDOT research paper; however, maximum and minimum ETR values of up to 98% and 56%, respectively, were reported in the literature. The ETR values shown in Table 1 are generally within the range of typical values for automatic hammers as reported in the literature.

Discussion

Based on the field testing results, observations from the SPT energy measurements are summarized below:

- The data obtained by the PDA are consistent between individual hammer blows and between the sample depths tested. In general, the first and last one (and sometimes two) hammer blow records recorded by the PDA produced poor quality data (which is relatively common) and, as such, the record(s) was(were) not used in the data reduction.

- The average energy transferred from the hammer to the drill rods for each individual depth interval using the EFV method ranged from 279 foot-pounds to 291 foot-pounds. These average energy transfers correspond to energy transfer ratios (ETR) of 80% to 83% of the theoretical energy (350 foot-pounds) of the SPT hammer.

- The average at each depth interval was calculated as the transferred energy for each analyzed blow of the depth intervals divided by the total number of hammer blows analyzed. The overall average energy transfer of the SPT system (for all the depth intervals tested) was 281.4 foot-pounds, with an average ETR of 80.4%.

Attachments: Page 4 Table 1 - Summary of SPT Energy Measurements – 1 Page
Page 5 Work Instruction – DCN TUR-055 – 1 Page
Pages 6 Record of SPT Energy Measurement -- 1 Page
Pages 7 – 14 PDIPLOT Output – 8 Pages

TABLE 1
SUMMARY OF SPT ENERGY MEASUREMENTS (ASTM D4633-05)
Turkey Point COL Project
Dade County, Florida
MACTEC Project No. 6468-07-1950

Hammer Serial No.	Rig Owner	Rig Operator	Boring No. Tested	Rod Size	Date Tested	Sample Depth (feet)	SPT Blow Count (blows per six inches)	No. of Blows Analyzed	Average Measured Energy (Average EFV) (ft-lbs)[a]	Energy Transfer Ratio (%)[b] (Average ETR)
MEC-04 (CME 550 ATV)	MACTEC Charlotte	Jimmy Warren	B-710 (DH) R	AW-J	4/22/2008	6.0 - 7.5	5 - 10 - 14	30	279	79.7%
						8.5 - 10.0	5 - 5 - 3	13	291	83.1%
						11.0 - 12.5	20 - 8 - 13	42	284	81.1%
						13.5 - 15.0	3 - 8 - 34	46	278	79.4%
								Average for Rig:	**281.4**	**80.4%**

[a]Measured Energy is energy based on the EFV method, as outlined in ASTM D4633-05, for each blow recorded by the PDA. In some cases, the initial and final one to two blows produced poor quality data, and were not used to calculate the Average Measured Energy.

EFV = EMX * 1000 lbs/kip, where EMX equals the maximum transferred energy measured by the PDA (see attached PDA data).

[b]Energy Transfer Ratio is the Measured Energy divided by the theoretical SPT energy of 350 foot-pounds (140 pound hammer falling 2.5 feet).

The average ETR values may differ slightly and insignificantly from those in the PDIPLOT tables due to roundoff.

Prepared By: SLW	Date: 8-15-08	Checked By: [signature]	Date: 8/19/08

Work Instruction No. 9
Turkey Point COL Project
MACTEC Engineering and Consulting, Inc.
MACTEC Project 6468-07-1950

Issued To: Steve Kiser and Jay Cerceo **Rev. No.** 1

Issued By: Tom McDaniel **Date:** 3-24-08

Valid From: 3-24-08 **To:** 4-30-08

Task Description: Perform SPT Energy Measurements

Applicable Technical Procedures or Plans, or other reference: Geotechnical Work Plan (current revision; available at Site Office), Bechtel Specification 25409-102-3PS-CY00-00001, Rev. 000 or later revision, section 4.3, ASTM D 4633-05 (copy attached.).

Specific Instructions (note attachments where necessary): Perform energy measurements for each drill rig on site in accordance with ASTM D-4633-05. Consult with Site Coordinator as to schedule for rigs that may be planned for use that are not yet present. Hammer weights have been checked by site personnel, and records will be available on site. All rigs are using automatic hammer systems. Confirm that automatic hammer system is being operated within manufacturer's recommendations or in a typical operating fashion as observed from watching one or two SPT measurements prior to measuring energy. Be sure to check each drill rig using all hammer/rod combinations that it will be using. Depths for measurements should be coordinated with the Site Coordinator, and can be directed by Bechtel in accordance with the specification. Site profile consists of very soft soils to about 5 feet followed by high-N-value soft rock to about 20 feet where coring begins. Sands are present below about 100 to 125 feet. Energy measurements should be made in the deeper sand zone as often as can be done, consistent with the drilling depths at the time of the measurements. See Site Coordinator for current boring logs of holes drilled and use these to plan most effective field measurement program.

Submit copies of calibration records for equipment to Project Principal for review prior to beginning work on site.

Special Instructions (note attachments where necessary): Confirm with Site Manager that approval of equipment calibration records has been received prior to beginning field testing. If unexpected conditions are encountered that affect measurements, contact Site Coordinator, Project Principal (Tom McDaniel) or Sr. Project Principal (Al Tice) immediately.

Report Format: Standard report in accordance with ASTM D 4633 requirements.

Specific Quality Assurance Procedures Applicable: QAP 20-1; QAP 25-1; QAP for Reporting Nuclear-Related Defects, or Noncompliances, per Federal Regulation 10CFR21 and Section 306 of the Energy Reorganization Act of 1974. Current revisions apply.

Hold Points or Witness Points: None

Records: All records generated shall be considered QA Records.

Reviewed and Approved by: (Note: Only one signature is required for issuance)

Project Manager: _____ Date: _____

Project Principal Engineer: _____ Date: 3/24/08

Site Manager/Coordinator: _____ Date: _____

Pages: 1 plus attachment **DCN:** TUR-055

Attachments: ASTM D 4633-05