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:	550
PROJECT NO.:	6468-07-1950	SERIAL NO.:	212393
DATE:	4/22/2008	HAMMER TYPE:	Automatic
WEATHER:	clear 70s - 80s windy	ROPE CONDITION:	N/A
INSPECTOR: HC 4/22/08	~~Steve Kiser~~ Jay Cereo	ROD SIZE:	AWJ
DRILLING COMPANY:	MACTEC	NO. OF SHEAVES:	N/A

BORING DATA			
BORING NUMBER:	B-710 DH OFFSET		
DEPTH DRILLED:	6, 8.5, 11.5, 13.5		
TIME DRIVEN:	9:30		
RIG OPERATOR:	J. Warren		
HAMMER OPERATOR:	C. Sloan		
PDA PAK SERIAL NO.:	3622L	3622L	3622L
INSTR. ROD AREA:	1.19		
ACCEL. SERIAL NOS.:	P5992 + K1050		
STRAIN SERIAL NOS.:	75 AW1+2 HC 4/22/08		

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)	SAMPLE DEPTH (feet)	SPT N-VALUE (bpf)	DEPTH cont. (feet)	SPT N-VALUE (bpf)
6.5-7.5	5-10-14	11.0									
9-10	5-5-3	14									
11.5-12.5	20-8-13	15									
14-15	3-8-34	19									

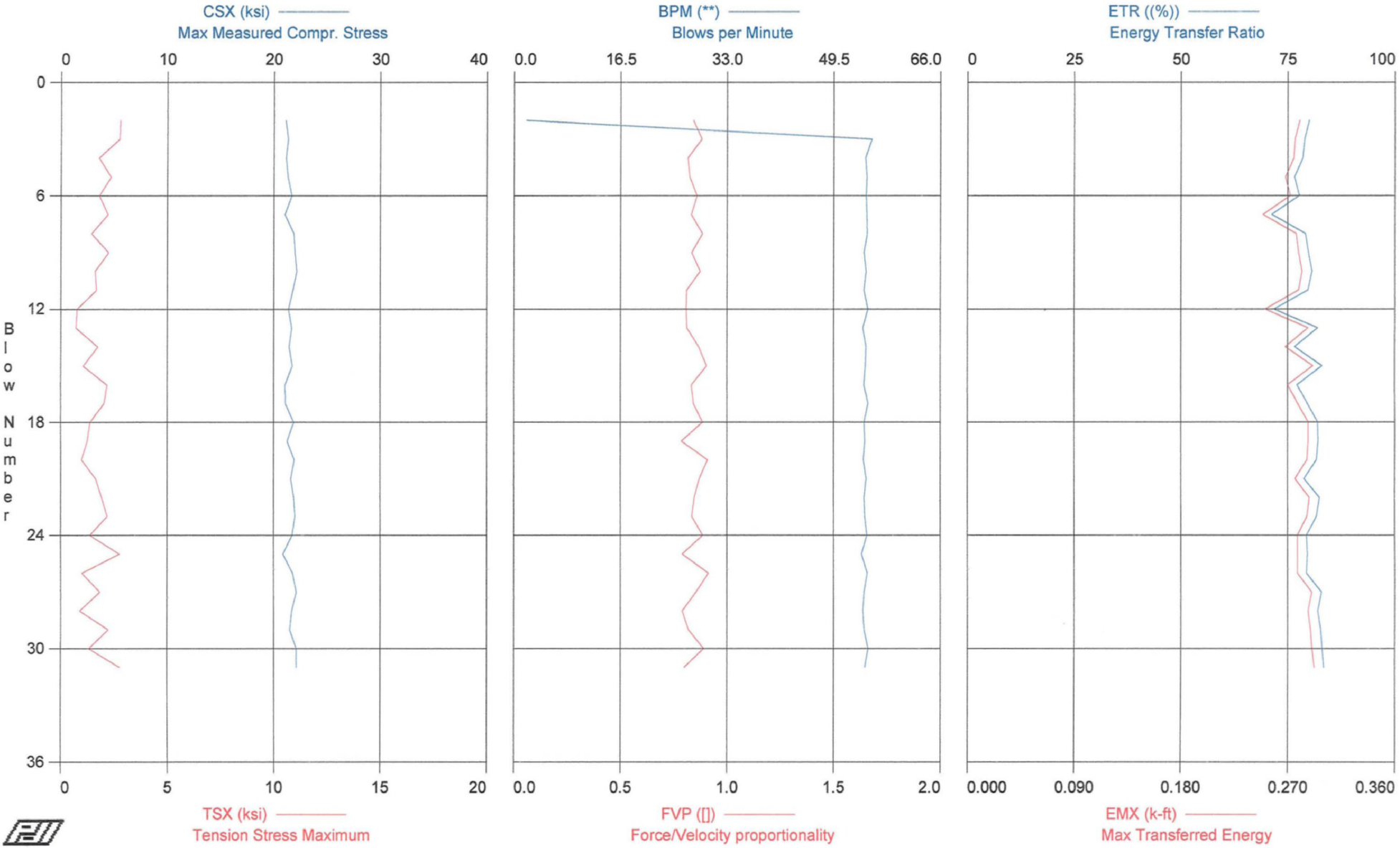
REMARKS:

MACTEC Engineering and Consulting, Inc. - Case Method Results

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

Test date: 22-Apr-2008

TURKEY POINT COL PROJECT - BORING B-710 (DH) R; 6' - 7.5' Sample



TURKEY POINT COL PROJECT - BORING B-710 (DH) R; 6' - 7.5' Sample

HAMMER ID 212393 (J.WARREN)

OP: HJC

Test date: 22-Apr-2008

AR: 1.19 in^2
LE: 11.00 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	21.1	2.8	25	16.3	1.9	0.84	0.171	80	0.280
3	0.00	21.3	2.8	25	14.7	55.4	0.88	0.168	79	0.276
4	0.00	21.1	1.8	25	14.4	54.4	0.82	0.167	78	0.275
5	0.00	21.3	2.4	25	14.4	54.6	0.82	0.171	77	0.268
6	0.00	21.7	1.8	26	15.2	54.5	0.86	0.172	78	0.272
7	0.00	21.0	2.2	25	14.2	54.6	0.83	0.165	71	0.249
8	0.00	21.9	1.4	26	14.6	54.7	0.89	0.176	79	0.277
9	0.00	22.0	2.3	26	14.6	54.2	0.83	0.179	80	0.279
10	0.00	22.2	1.6	26	14.3	54.5	0.87	0.172	81	0.282
11	0.00	21.8	1.7	26	13.8	54.2	0.81	0.171	80	0.279
12	0.00	21.4	0.8	25	13.8	54.8	0.81	0.160	72	0.251
13	0.00	21.7	0.7	26	15.2	54.0	0.81	0.172	82	0.287
14	0.00	21.4	1.7	26	14.7	54.5	0.87	0.162	77	0.268
15	0.00	21.8	1.1	26	14.3	54.4	0.90	0.167	83	0.291
16	0.00	21.1	2.2	25	14.0	54.2	0.83	0.163	77	0.270
17	0.00	21.1	2.0	25	14.1	54.8	0.84	0.163	80	0.278
18	0.00	21.9	1.4	26	13.8	54.2	0.88	0.168	82	0.287
19	0.00	21.2	1.2	25	14.8	54.3	0.79	0.173	82	0.287
20	0.00	21.9	1.0	26	13.6	54.1	0.91	0.166	82	0.286
21	0.00	21.6	1.6	26	14.0	54.5	0.87	0.163	79	0.276
22	0.00	21.9	1.9	26	14.5	54.2	0.85	0.173	82	0.288
23	0.00	22.0	2.2	26	14.8	54.3	0.83	0.174	82	0.286
24	0.00	21.7	1.4	26	13.8	54.6	0.89	0.165	79	0.278
25	0.00	20.9	2.8	25	14.3	53.8	0.79	0.158	80	0.278
26	0.00	21.8	1.0	26	13.4	54.7	0.91	0.163	79	0.278
27	0.00	22.1	1.8	26	14.5	54.2	0.86	0.172	83	0.290
28	0.00	21.7	0.9	26	14.1	54.0	0.79	0.168	82	0.287
29	0.00	21.5	2.2	26	14.4	54.2	0.82	0.173	83	0.289
30	0.00	22.1	1.3	26	13.9	54.8	0.89	0.174	83	0.290
31	0.00	22.1	2.8	26	15.6	54.3	0.80	0.179	83	0.292
	Average	21.6	1.8	26	14.4	52.7	0.85	0.169	80	0.279

Total number of blows analyzed: 30

Time Summary

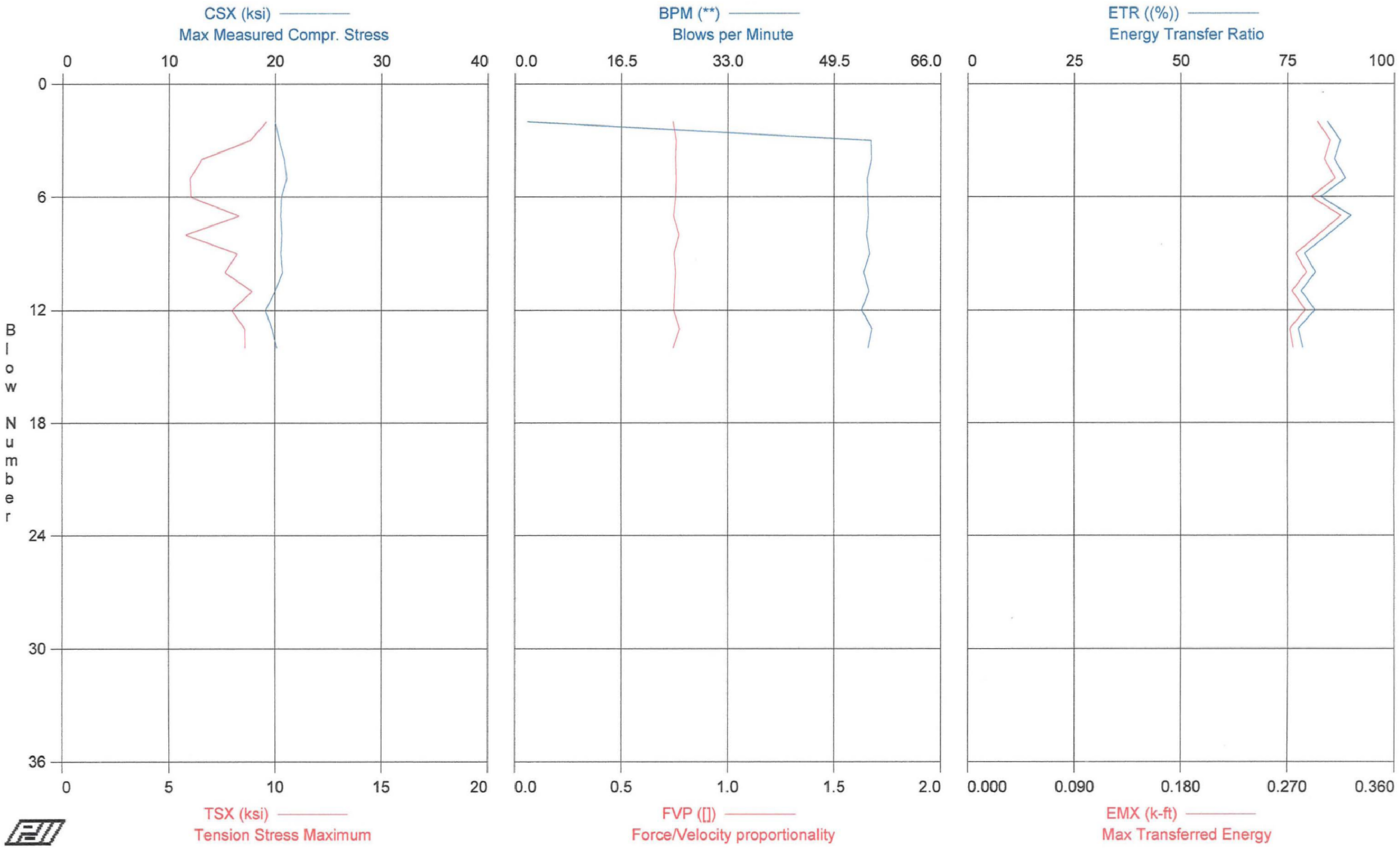
Drive 31 seconds 9:07:05 AM - 9:07:36 AM (4/22/2008) BN 2 - 31

MACTEC Engineering and Consulting, Inc. - Case Method Results

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

Test date: 22-Apr-2008

TURKEY POINT COL PROJECT - BORING B-710 (DH) R; 8.5' - 10' Sample



TURKEY POINT COL PROJECT - BORING B-710 (DH) R; 8.5' - 10' Sample
OP: HJC

HAMMER ID 212393 (J.WARREN)
Test date: 22-Apr-2008

AR: 1.19 in^2
LE: 14.00 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 ft	CSX ksi	TSX ksi	FMX kips	VMX f/s	BPM **	FVP []	EF2 k-ft	ETR (%)	EMX k-ft
2	0.00	20.0	9.6	24	16.7	1.9	0.74	0.178	84	0.295
3	0.00	20.4	8.8	24	16.8	55.2	0.76	0.171	87	0.306
4	0.00	20.8	6.5	25	15.3	55.3	0.75	0.178	86	0.301
5	0.00	21.1	6.0	25	15.6	54.6	0.76	0.183	89	0.310
6	0.00	20.6	6.0	24	15.2	54.7	0.76	0.176	83	0.290
7	0.00	20.5	8.3	24	15.3	54.8	0.75	0.183	90	0.315
8	0.00	20.6	5.8	25	15.0	54.5	0.77	0.181	85	0.296
9	0.00	20.6	8.2	24	15.4	55.0	0.75	0.179	79	0.277
10	0.00	20.7	7.6	25	15.4	54.1	0.76	0.179	82	0.286
11	0.00	20.0	8.9	24	15.4	54.9	0.75	0.175	78	0.274
12	0.00	19.1	8.0	23	14.7	53.8	0.75	0.169	81	0.285
13	0.00	19.7	8.6	23	15.6	55.4	0.78	0.170	78	0.272
14	0.00	20.2	8.6	24	15.3	54.8	0.74	0.178	79	0.275
	Average	20.3	7.8	24	15.5	50.7	0.75	0.177	83	0.291

Total number of blows analyzed: 13

Time Summary

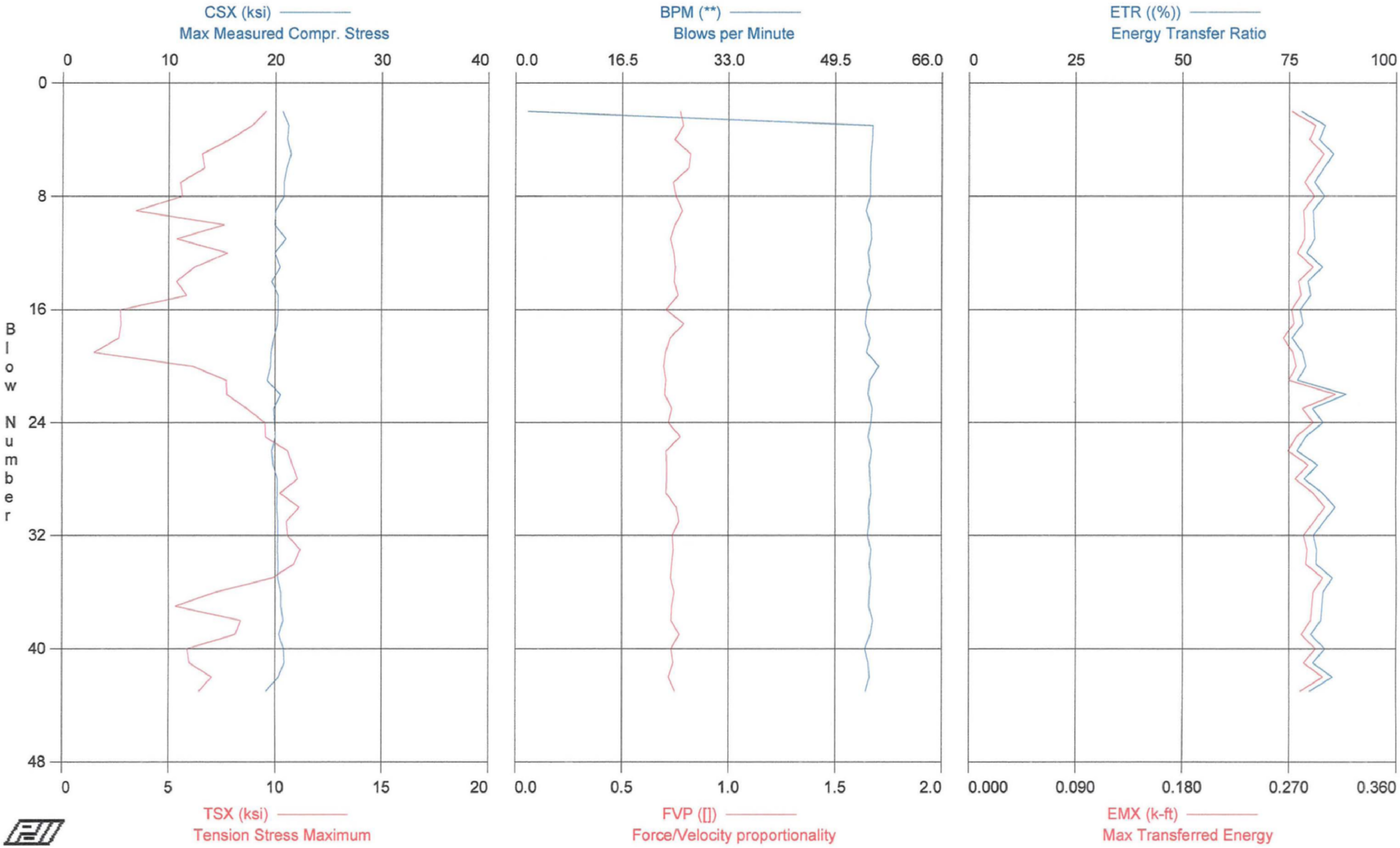
Drive 13 seconds 9:15:49 AM - 9:16:02 AM (4/22/2008) BN 2 - 14

MACTEC Engineering and Consulting, Inc. - Case Method Results

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

Test date: 22-Apr-2008

TURKEY POINT COL PROJECT - BORING B-710 (DH) R; 11' - 12.5' Sample



TURKEY POINT COL PROJECT - BORING B-710 (DH) R; 11' - 12.5' Sample
OP: HJC

HAMMER ID 212393 (J.WARREN)
Test date: 22-Apr-2008

AR: 1.19 in^2
LE: 15.00 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	9.5	25	14.9	1.9	0.77	0.180	78	0.272
3	0.00	21.2	8.9	25	15.0	55.3	0.79	0.186	83	0.292
4	0.00	21.1	7.8	25	14.3	55.2	0.75	0.182	82	0.287
5	0.00	21.5	6.6	26	14.6	55.0	0.82	0.186	85	0.299
6	0.00	21.1	6.7	25	14.5	54.9	0.81	0.179	83	0.291
7	0.00	20.8	5.5	25	14.4	54.9	0.74	0.174	81	0.283
8	0.00	20.8	5.6	25	14.8	54.9	0.75	0.181	83	0.291
9	0.00	20.0	3.5	24	14.3	54.3	0.78	0.172	81	0.282
10	0.00	19.9	7.6	24	14.9	55.0	0.75	0.174	81	0.283
11	0.00	21.0	5.4	25	14.2	55.1	0.73	0.177	81	0.283
12	0.00	20.0	7.8	24	14.6	54.6	0.74	0.170	79	0.277
13	0.00	20.5	6.2	24	15.1	54.9	0.75	0.181	83	0.290
14	0.00	19.7	5.4	23	14.9	54.5	0.75	0.167	79	0.278
15	0.00	20.3	5.8	24	14.9	55.0	0.76	0.171	80	0.280
16	0.00	20.3	2.7	24	14.6	54.4	0.71	0.169	78	0.272
17	0.00	20.2	2.8	24	14.3	54.2	0.79	0.170	78	0.274
18	0.00	19.9	2.7	24	15.0	54.9	0.73	0.166	76	0.265
19	0.00	19.6	1.5	23	14.5	54.4	0.71	0.164	78	0.273
20	0.00	19.6	6.2	23	15.2	56.3	0.70	0.169	79	0.276
21	0.00	19.3	7.7	23	15.3	54.9	0.71	0.168	77	0.270
22	0.00	20.5	7.7	24	16.4	54.6	0.70	0.183	88	0.309
23	0.00	19.9	8.7	24	15.1	55.2	0.73	0.175	80	0.281
24	0.00	19.9	9.5	24	14.6	55.0	0.72	0.174	83	0.290
25	0.00	20.0	9.5	24	14.4	54.6	0.77	0.174	79	0.276
26	0.00	19.7	10.6	23	14.7	55.1	0.71	0.168	77	0.269
27	0.00	19.8	10.8	24	15.7	54.8	0.71	0.177	82	0.286
28	0.00	20.2	11.1	24	15.9	54.9	0.71	0.181	78	0.275
29	0.00	20.2	10.2	24	16.0	55.0	0.71	0.179	83	0.290
30	0.00	20.2	11.1	24	15.0	54.7	0.76	0.180	86	0.300
31	0.00	20.2	10.5	24	14.7	54.8	0.77	0.182	83	0.291
32	0.00	20.2	10.6	24	14.6	54.5	0.74	0.179	81	0.282
33	0.00	20.2	11.2	24	15.2	55.0	0.74	0.180	81	0.285
34	0.00	20.3	10.9	24	15.5	54.8	0.73	0.179	81	0.284
35	0.00	20.2	9.9	24	15.6	55.0	0.73	0.181	85	0.298
36	0.00	20.6	7.2	24	15.0	54.8	0.75	0.183	83	0.290
37	0.00	20.5	5.3	24	15.7	54.7	0.73	0.181	83	0.289
38	0.00	20.7	8.4	25	15.9	55.3	0.73	0.184	82	0.288
39	0.00	20.3	8.1	24	14.8	54.9	0.77	0.175	80	0.280
40	0.00	20.8	5.9	25	15.8	54.1	0.73	0.184	83	0.292
41	0.00	20.9	6.0	25	14.6	54.6	0.74	0.182	80	0.282
42	0.00	20.3	7.0	24	15.8	54.8	0.72	0.182	85	0.298
43	0.00	19.1	6.4	23	14.4	54.2	0.75	0.171	80	0.279
	Average	20.3	7.4	24	15.0	53.6	0.74	0.177	81	0.284

Total number of blows analyzed: 42

Time Summary

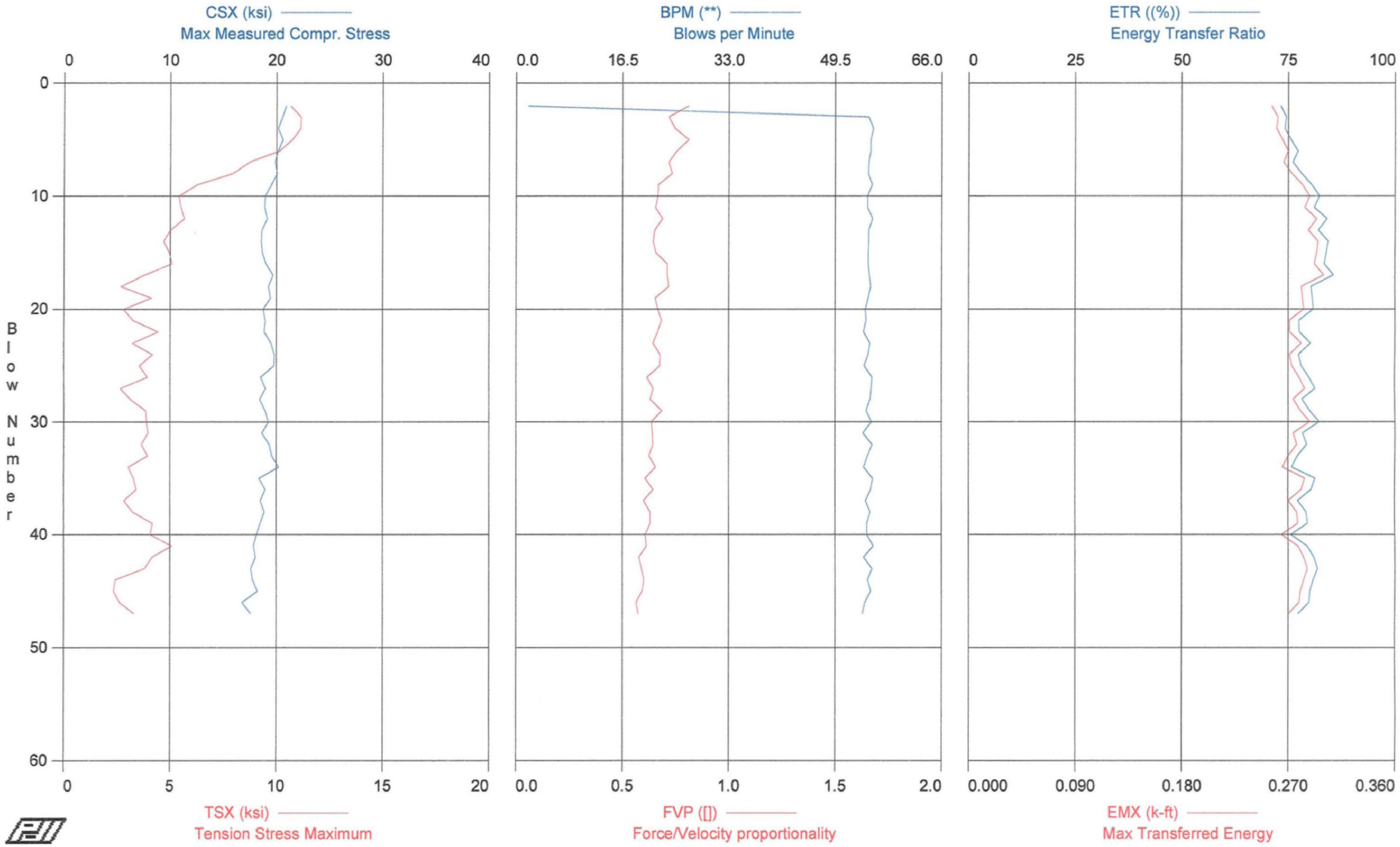
Drive 44 seconds 9:26:37 AM - 9:27:21 AM (4/22/2008) BN 2 - 43

MACTEC Engineering and Consulting, Inc. - Case Method Results

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

Test date: 22-Apr-2008

TURKEY POINT COL PROJECT - BORING B-710 (DH) R; 13.5' - 15' Sample



TURKEY POINT COL PROJECT - BORING B-710 (DH) R; 13.5' - 15' Sample
OP: HJC

HAMMER ID 212393 (J.WARREN)
Test date: 22-Apr-2008

AR: 1.19 in^2
LE: 19.00 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	20.9	10.7	25	14.6	1.9	0.81	0.193	73	0.256
3	0.00	20.5	11.1	24	15.4	54.7	0.72	0.187	75	0.261
4	0.00	20.1	11.1	24	15.0	55.4	0.75	0.184	74	0.260
5	0.00	20.6	10.8	24	14.3	55.0	0.81	0.181	76	0.265
6	0.00	20.1	10.1	24	14.9	55.0	0.76	0.184	77	0.270
7	0.00	19.9	8.7	24	15.2	54.7	0.72	0.182	76	0.266
8	0.00	20.1	7.9	24	15.3	54.6	0.73	0.192	78	0.273
9	0.00	19.5	6.3	23	16.0	55.2	0.67	0.179	80	0.282
10	0.00	18.9	5.4	23	15.6	54.5	0.67	0.179	82	0.288
11	0.00	18.9	5.5	22	15.9	54.5	0.66	0.180	81	0.284
12	0.00	19.1	5.7	23	15.7	55.3	0.69	0.184	84	0.294
13	0.00	18.6	5.0	22	16.1	54.7	0.65	0.177	82	0.287
14	0.00	18.6	4.7	22	16.1	54.7	0.64	0.181	84	0.295
15	0.00	18.7	5.0	22	15.9	54.6	0.66	0.183	84	0.294
16	0.00	19.0	5.1	23	14.9	54.6	0.71	0.181	83	0.292
17	0.00	19.7	3.8	23	15.0	54.8	0.71	0.185	86	0.300
18	0.00	19.2	2.7	23	15.1	55.0	0.72	0.178	80	0.281
19	0.00	19.5	4.1	23	16.1	54.6	0.65	0.185	81	0.282
20	0.00	18.8	2.8	22	15.8	54.2	0.67	0.180	81	0.283
21	0.00	19.0	3.2	23	15.3	54.3	0.68	0.179	77	0.271
22	0.00	18.9	4.4	22	15.7	53.9	0.67	0.179	78	0.271
23	0.00	19.5	3.2	23	16.0	54.9	0.64	0.183	80	0.281
24	0.00	19.8	4.2	24	15.4	54.6	0.68	0.179	77	0.271
25	0.00	19.8	3.6	24	15.2	54.0	0.68	0.182	78	0.273
26	0.00	18.5	3.9	22	16.7	55.2	0.62	0.180	80	0.279
27	0.00	19.0	2.7	23	15.9	55.1	0.65	0.182	81	0.284
28	0.00	18.4	3.1	22	16.2	54.9	0.63	0.175	78	0.274
29	0.00	18.9	3.9	23	15.2	54.3	0.69	0.180	80	0.280
30	0.00	19.3	3.9	23	16.5	55.1	0.64	0.181	82	0.288
31	0.00	18.6	4.0	22	15.7	53.8	0.64	0.183	78	0.274
32	0.00	19.4	3.7	23	16.1	55.2	0.64	0.185	79	0.277
33	0.00	19.6	3.9	23	16.3	54.5	0.63	0.176	77	0.270
34	0.00	20.2	3.0	24	15.3	53.9	0.66	0.174	76	0.265
35	0.00	18.4	3.3	22	16.5	55.3	0.61	0.179	81	0.284
36	0.00	19.0	3.4	23	15.7	55.0	0.64	0.183	80	0.281
37	0.00	18.5	2.8	22	16.6	54.2	0.60	0.178	77	0.270
38	0.00	18.9	3.2	22	15.5	54.9	0.63	0.178	79	0.277
39	0.00	18.5	4.2	22	16.5	54.4	0.63	0.175	79	0.278
40	0.00	18.1	4.1	22	15.3	54.4	0.61	0.170	76	0.264
41	0.00	17.9	5.1	21	16.5	55.4	0.61	0.172	79	0.278
42	0.00	18.0	4.2	21	16.5	53.9	0.58	0.177	81	0.283
43	0.00	17.6	3.8	21	16.5	55.2	0.59	0.176	82	0.286
44	0.00	17.8	2.4	21	15.7	54.5	0.60	0.167	81	0.283
45	0.00	18.2	2.3	22	15.6	55.0	0.59	0.171	80	0.280
46	0.00	16.8	2.6	20	16.6	54.1	0.57	0.169	80	0.279
47	0.00	17.6	3.3	21	16.4	53.7	0.58	0.173	77	0.270
	Average	19.0	4.8	23	15.7	53.5	0.66	0.180	79	0.278

Total number of blows analyzed: 46

Time Summary

Drive 49 seconds 9:42:44 AM - 9:43:33 AM (4/22/2008) BN 2 - 47

MACTEC

engineering and constructing a better tomorrow

August 15, 2008

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

Subject: **Report of SPT Energy – MACTEC Raleigh CME 45C Hammer Serial No. MEC-12 Automatic Hammer WORK INSTRUCTION TUR-055**
Turkey Point COL Project
Dade County, Florida
MACTEC Project No. 6468-07-1950

Steve Kiser and 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 March 10 and April 4, 2008, during drilling of Borings B-602 and B-734, respectively, at the referenced site. The testing was performed from 10:00 to 10:30 AM under cloudy skies and a temperature of about 70 in degrees Fahrenheit on March 10. The testing was performed from 10:35 AM to 12:55 PM under partly cloudy skies and a temperature of about 80 in degrees Fahrenheit on April 4. The boring was drilled with personnel and equipment from MACTEC. The drilling equipment consisted of a CME 45C track-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. Donnie Rhodes. 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. P5953 and P5992 on March 10; K1050 and P5992 on April 4) 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.

20 Pages Total

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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 278 foot-pounds to 314 foot-pounds. These average energy transfers correspond to energy transfer ratios (ETR) of 79% to 90% 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 291.3 foot-pounds, with an average ETR of 83.2%.

Attachments: Page 4 Table 1 - Summary of SPT Energy Measurements – 1 Page
Page 5 Work Instruction – DCN TUR-055 – 1 Page
Pages 6 – 7 Record of SPT Energy Measurement – 2 Pages
Pages 8 – 20 PDIPLOT Output – 13 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-12 (CME 45C)	MACTEC Raleigh	Donnie Rhodes	B-602	AW-J	3/10/2008	9.9 - 11.4	3 - 4 - 8	16	307	87.7%
						12.3 - 13.8	9 - 10 - 13	33	278	79.4%
						14.8 - 16.2	13 - 17 - 50/0.4'	86	280	80.0%
			B-734		4/4/2008	116.6 - 118.1	9 - 9 - 8	25	314	89.7%
						123.5 - 125.0	11 - 5 - 5	22	310	88.6%
						128.5 - 130.0	7 - 8 - 11	26	298	85.1%
								Average for Rig:	**291.3**	**83.2%**

[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: SLV	Date: 8-15-08	Checked By:	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

MACTEC

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RECORD OF SPT ENERGY MEASUREMENT

GENERAL INFORMATION		DRILL RIG DATA	
PROJECT:	Turkey Point COL Project	MAKE:	CME
LOCATION:	Florida City, Florida	MODEL:	45C
PROJECT NO.:	6468-07-1950	SERIAL NO.:	269354
DATE:	4/4/2008	HAMMER TYPE:	Automatic
WEATHER:	Partly Cloudy, Low 80's	ROPE CONDITION:	N/A
INSPECTOR: HC 4/4/08 ~~Steve Kicer~~ J. Cerezo		ROD SIZE:	AWJ
DRILLING COMPANY:	MACTEC	NO. OF SHEAVES:	N/A

BORING DATA			
BORING NUMBER:	B-734		
DEPTH DRILLED:	116.6', 123.5',		
TIME DRIVEN:	11:30am, 1:20pm,		
RIG OPERATOR:	HC 4/4/08 ~~F. Cox~~ D. Rhodes		
HAMMER OPERATOR:	HC ~~R. Hall~~ R. Price		
PDA PAK SERIAL NO.:	4/4/08 3622L	3622L	3622L
INSTR. ROD AREA:	1.19		
ACCEL. SERIAL NOS.:	K1050 + P5992		
STRAIN SERIAL NOS.:	75AW/1 + 75AW/2 HC 4/4/08		

SAMPLE DEPTH (feet)	SPT N-VALUE (bpf)	~~DEPTH cont.~~ LE (feet)	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)
117-118	9-9-8	119									
124-125	11-5-5	129									
129-130	7-8-11	134									

REMARKS: From 129'-130', while switching hammer off pda recorded hammer bounce resulting in ETR = 12%

MACTEC

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RECORD OF SPT ENERGY MEASUREMENT

GENERAL INFORMATION		DRILL RIG DATA	
PROJECT:	Turkey Point COL Project	MAKE:	CME 45
LOCATION:	Florida City, Florida	MODEL:	45 TRACK
PROJECT NO.:	6468-07-1950	SERIAL NO.:	269354
DATE:	3-10-08	HAMMER TYPE:	Automatic
WEATHER:	CLOUDY 70°	ROPE CONDITION:	N/A
INSPECTOR:	Steve Kiser	ROD SIZE:	AW-J
DRILLING COMPANY:	MACTEC RALEIGH	NO. OF SHEAVES:	N/A

BORING DATA			
BORING NUMBER:	B-602		
DEPTH DRILLED:	150' PLANNED		
TIME DRIVEN:	VARIOUS - SEE DATA		
RIG OPERATOR:	DONNIE RHODES		
HAMMER OPERATOR:	N.R.		
PDA PAK SERIAL NO.:	3-10-08 3622L	3622L	3622L
INSTR. ROD AREA:	~~75 A~~ SK 1.19 in²		
ACCEL. SERIAL NOS.:	P5953 P5992		
STRAIN SERIAL NOS.:	75 AW #1 /2		

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)	SAMPLE DEPTH (feet)	SPT N-VALUE (bpf)	DEPTH cont. (feet)	SPT N-VALUE (bpf)
10'-11.5'	3-4-8										
12.5'-14'	9-10-13										
	~~13-17~~ SK	3-10-08									
15'-16.5'	13-17-	50/0.4'									

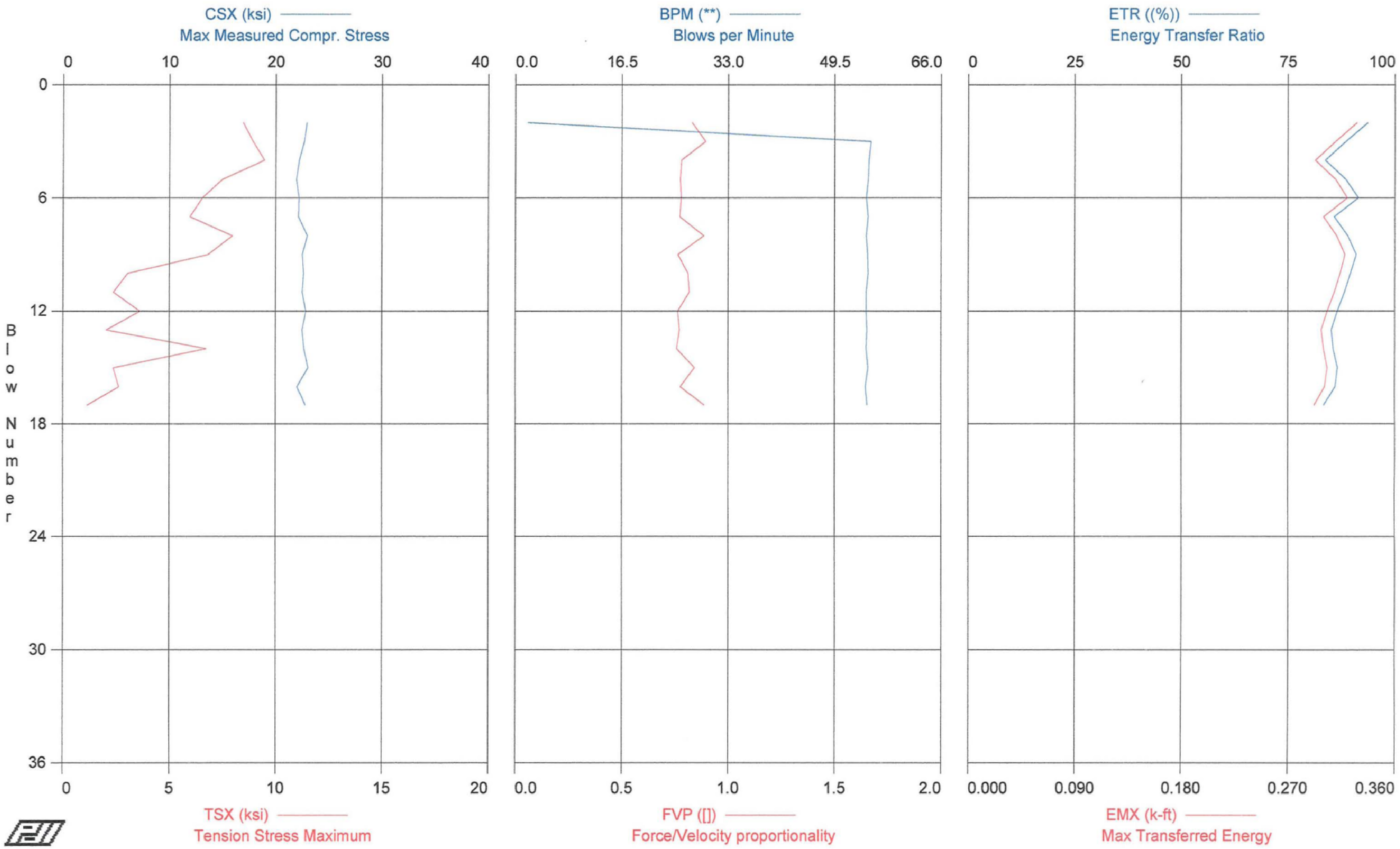
REMARKS:

MACTEC Engineering and Consulting, Inc. - Case Method Results

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

Test date: 10-Mar-2008

TURKEY POINT COL PROJECT - BORING B-602; 9.9' - 11.4' Sample



TURKEY POINT COL PROJECT - BORING B-602; 9.9' - 11.4' Sample
OP: SEK

HAMMER ID 269354 (RHODES)
Test date: 10-Mar-2008

AR: 1.19 in^2
LE: 16.00 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 ft	CSX ksi	TSX ksi	FMX kips	VMX f/s	BPM **	FVP []	EF2 k-ft	ETR (%)	EMX k-ft
2	0.00	22.9	8.5	27	14.8	1.9	0.83	0.203	94	0.328
3	0.00	22.7	8.9	27	14.4	55.1	0.89	0.206	88	0.310
4	0.00	22.2	9.5	26	15.2	54.8	0.78	0.197	84	0.293
5	0.00	21.9	7.5	26	14.5	54.7	0.78	0.195	89	0.310
6	0.00	22.2	6.5	26	15.6	54.4	0.78	0.198	91	0.320
7	0.00	22.1	6.0	26	15.4	54.7	0.77	0.178	86	0.300
8	0.00	23.0	8.0	27	14.4	54.4	0.89	0.182	89	0.311
9	0.00	22.5	6.8	27	14.1	54.6	0.76	0.178	91	0.318
10	0.00	22.6	3.0	27	15.6	54.7	0.81	0.176	90	0.314
11	0.00	22.5	2.4	27	15.3	54.4	0.82	0.169	88	0.309
12	0.00	22.9	3.6	27	14.2	54.4	0.76	0.180	87	0.303
13	0.00	22.5	2.0	27	13.5	54.5	0.77	0.177	85	0.298
14	0.00	22.7	6.7	27	15.1	54.4	0.76	0.183	86	0.300
15	0.00	23.1	2.4	27	15.4	54.7	0.84	0.184	87	0.303
16	0.00	22.0	2.6	26	15.9	54.3	0.78	0.175	86	0.301
17	0.00	22.8	1.1	27	14.4	54.5	0.89	0.176	83	0.292
	Average	22.5	5.3	27	14.9	51.3	0.81	0.185	88	0.307

Total number of blows analyzed: 16

Time Summary

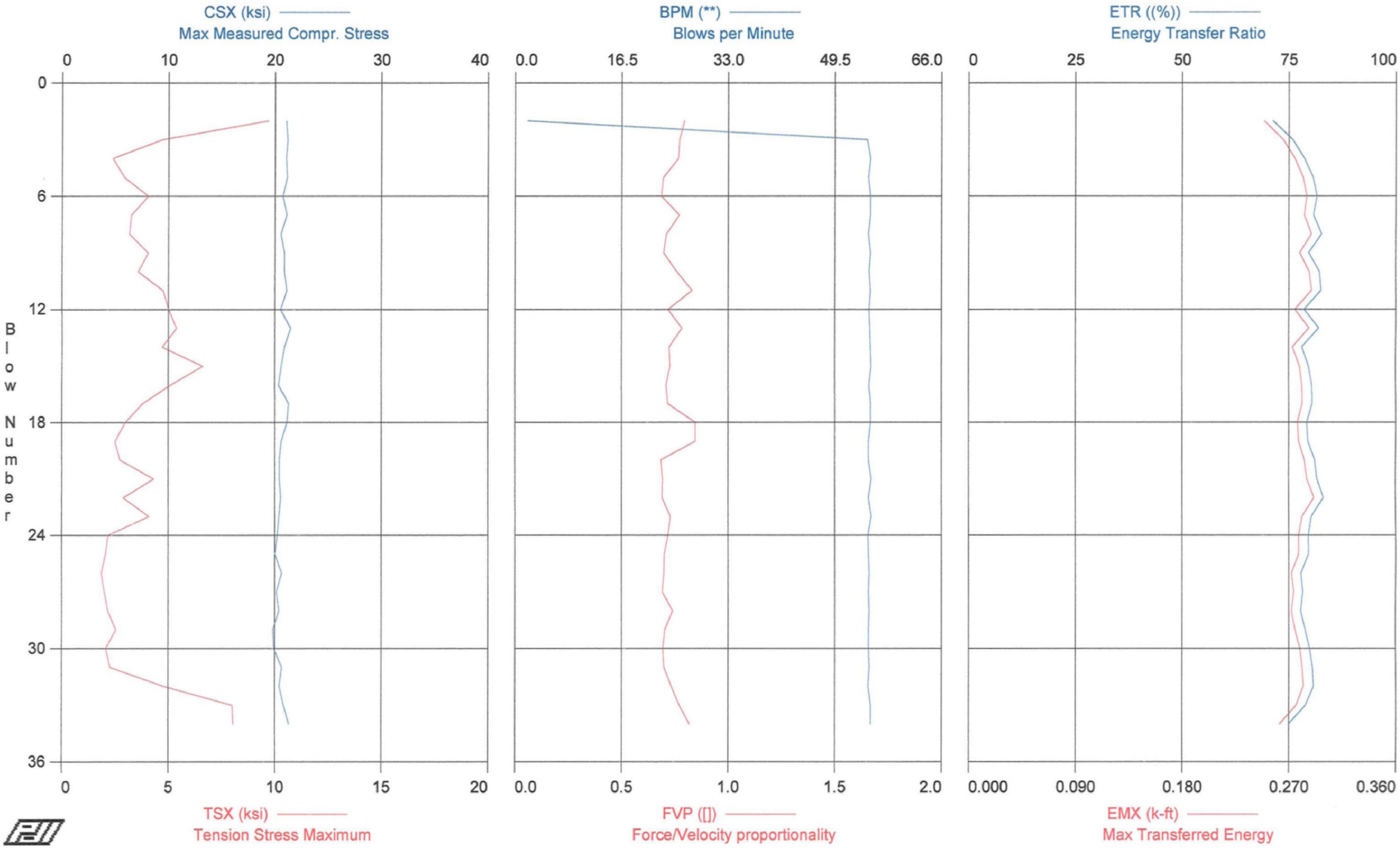
Drive 16 seconds 10:02:29 AM - 10:02:45 AM (3/10/2008) BN 2 - 17

MACTEC Engineering and Consulting, Inc. - Case Method Results

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

Test date: 10-Mar-2008

TURKEY POINT COL PROJECT - BORING B-602; 12.3' - 13.8' Sample



TURKEY POINT COL PROJECT - BORING B-602; 12.3' - 13.8' Sample
OP: SEK

HAMMER ID 269354 (RHODES)
Test date: 10-Mar-2008

AR: 1.19 in^2
LE: 20.00 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	21.1	9.7	25	14.8	1.9	0.79	0.191	71	0.249
3	0.00	21.2	4.7	25	15.3	54.5	0.77	0.194	76	0.265
4	0.00	21.1	2.4	25	15.4	55.0	0.77	0.192	79	0.275
5	0.00	21.2	2.9	25	15.6	54.7	0.70	0.192	81	0.282
6	0.00	20.7	4.1	25	15.8	55.0	0.69	0.190	82	0.285
7	0.00	21.1	3.3	25	15.3	55.0	0.77	0.193	81	0.283
8	0.00	20.6	3.2	24	16.3	54.7	0.71	0.192	83	0.289
9	0.00	20.9	4.1	25	15.1	55.0	0.70	0.190	80	0.279
10	0.00	20.9	3.6	25	15.5	54.8	0.76	0.195	82	0.287
11	0.00	21.1	4.8	25	14.3	55.0	0.83	0.196	82	0.289
12	0.00	20.6	5.0	24	16.0	54.8	0.72	0.194	79	0.275
13	0.00	21.5	5.4	26	15.4	54.9	0.78	0.200	82	0.287
14	0.00	20.9	4.7	25	15.0	55.0	0.72	0.195	78	0.273
15	0.00	20.6	6.6	25	15.9	55.1	0.73	0.196	80	0.279
16	0.00	20.4	5.1	24	15.7	54.8	0.71	0.198	80	0.281
17	0.00	21.3	3.8	25	14.6	55.0	0.72	0.197	80	0.281
18	0.00	21.1	3.0	25	14.0	55.0	0.85	0.196	79	0.277
19	0.00	20.6	2.5	25	13.6	54.7	0.85	0.195	79	0.278
20	0.00	20.4	2.7	24	15.7	54.7	0.68	0.191	81	0.283
21	0.00	20.4	4.3	24	15.9	55.1	0.69	0.188	82	0.285
22	0.00	20.5	2.9	24	16.0	54.7	0.69	0.190	83	0.291
23	0.00	20.4	4.1	24	15.7	55.1	0.73	0.187	80	0.281
24	0.00	20.2	2.2	24	15.8	54.6	0.72	0.187	80	0.278
25	0.00	20.0	2.0	24	15.8	54.7	0.70	0.186	80	0.278
26	0.00	20.6	1.9	25	13.9	54.8	0.70	0.188	78	0.272
27	0.00	20.1	2.0	24	14.6	54.7	0.69	0.184	78	0.274
28	0.00	20.4	2.2	24	15.4	54.8	0.74	0.189	78	0.272
29	0.00	19.8	2.5	24	15.6	54.7	0.70	0.188	79	0.275
30	0.00	19.9	2.1	24	14.7	54.7	0.69	0.184	80	0.279
31	0.00	20.6	2.3	25	15.3	54.8	0.70	0.190	80	0.281
32	0.00	20.4	4.8	24	15.6	54.6	0.73	0.190	81	0.282
33	0.00	20.8	8.0	25	15.2	55.0	0.77	0.190	79	0.276
34	0.00	21.3	8.0	25	14.7	55.0	0.82	0.193	75	0.262
	Average	20.7	4.0	25	15.3	53.2	0.74	0.192	80	0.278

Total number of blows analyzed: 33

Time Summary

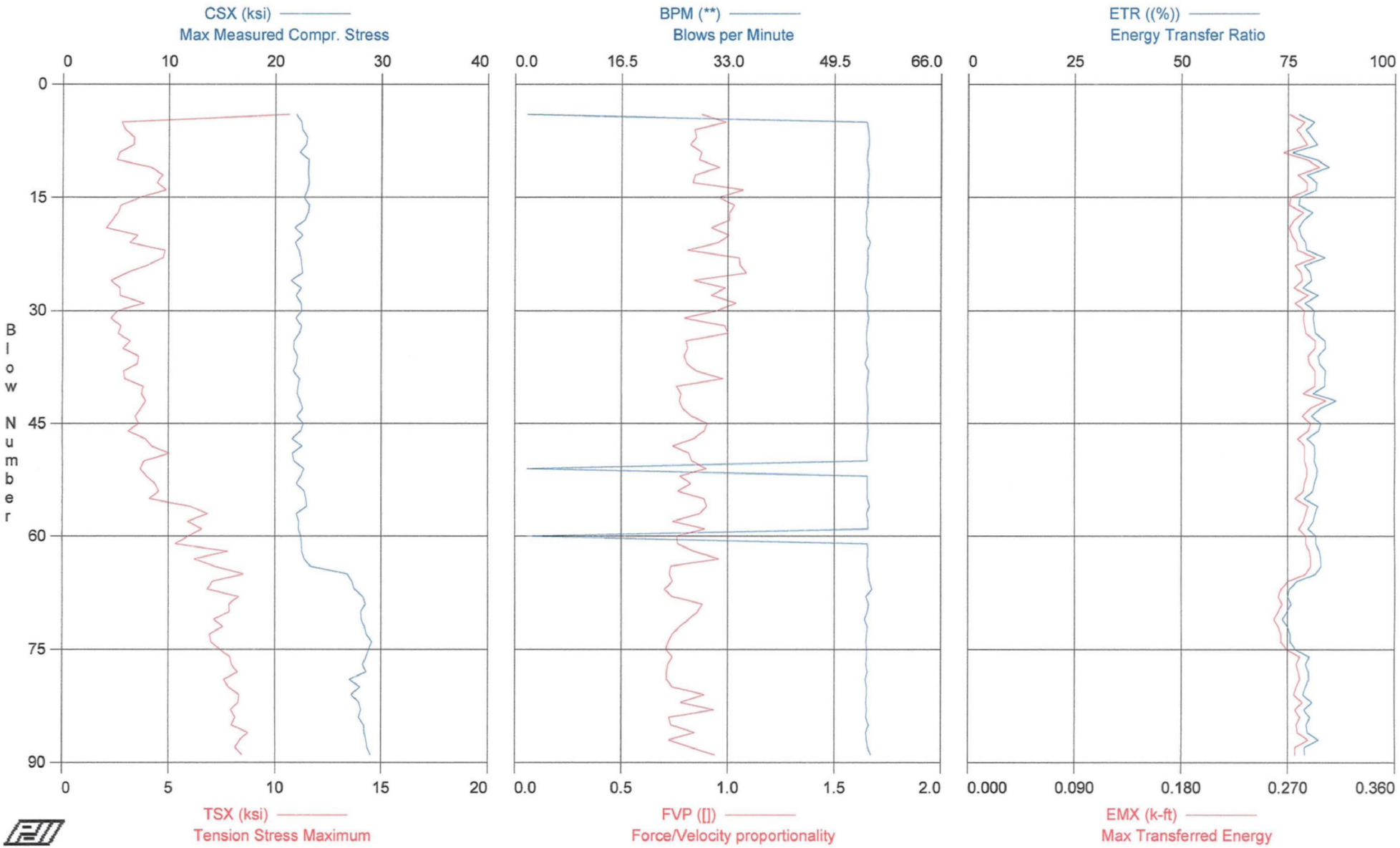
Drive 35 seconds 10:15:53 AM - 10:16:28 AM (3/10/2008) BN 2 - 34

MACTEC Engineering and Consulting, Inc. - Case Method Results

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

Test date: 10-Mar-2008

TURKEY POINT COL PROJECT - BORING B-602; 14.8' - 16.2' Sample



TURKEY POINT COL PROJECT - BORING B-602; 14.8' - 16.2' Sample
OP: SEK

HAMMER ID 269354 (RHODES)
Test date: 10-Mar-2008

AR: 1.19 in^2
LE: 22.00 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 ft	CSX ksi	TSX ksi	FMX kips	VMX f/s	BPM **	FVP []	EF2 k-ft	ETR (%)	EMX k-ft
4	0.00	22.0	10.7	26	13.1	1.9	0.88	0.218	78	0.271
5	0.00	22.4	2.8	27	12.8	54.5	0.99	0.218	81	0.284
6	0.00	22.5	2.9	27	13.1	54.7	0.84	0.218	79	0.277
7	0.00	23.0	3.4	27	12.5	54.8	0.85	0.222	81	0.282
8	0.00	22.9	3.3	27	12.7	54.8	0.82	0.220	82	0.286
9	0.00	22.3	2.7	27	14.2	54.6	0.88	0.220	76	0.266
10	0.00	23.1	2.5	28	13.2	54.5	0.86	0.225	82	0.286
11	0.00	23.1	4.2	28	13.6	54.7	0.96	0.223	84	0.296
12	0.00	23.1	4.7	28	12.7	54.8	0.85	0.222	79	0.278
13	0.00	23.2	4.4	28	12.1	54.7	0.84	0.225	82	0.286
14	0.00	23.1	4.8	27	12.1	54.6	1.07	0.222	82	0.286
15	0.00	22.7	3.7	27	13.2	54.7	0.96	0.222	78	0.272
16	0.00	23.2	2.7	28	12.6	54.6	1.03	0.222	77	0.271
17	0.00	23.1	2.6	28	12.9	54.4	1.01	0.221	81	0.283
18	0.00	22.8	2.3	27	12.6	54.5	1.01	0.218	79	0.275
19	0.00	21.9	2.1	26	13.1	54.4	0.92	0.222	78	0.271
20	0.00	22.6	3.5	27	12.6	54.5	1.00	0.217	78	0.273
21	0.00	21.9	3.2	26	12.9	55.0	0.96	0.214	79	0.277
22	0.00	22.2	4.8	26	12.3	54.6	0.81	0.218	79	0.278
23	0.00	22.4	4.7	27	12.0	54.7	1.05	0.216	84	0.293
24	0.00	22.5	4.0	27	11.9	54.6	1.06	0.214	79	0.276
25	0.00	22.6	3.0	27	11.6	54.6	1.09	0.218	80	0.281
26	0.00	21.5	2.3	26	13.8	54.4	0.84	0.217	80	0.282
27	0.00	22.5	2.7	27	12.7	54.3	0.99	0.220	78	0.275
28	0.00	22.0	2.7	26	13.4	54.6	0.92	0.219	82	0.287
29	0.00	22.4	3.8	27	12.1	54.6	1.04	0.218	79	0.276
30	0.00	22.5	2.6	27	13.3	54.6	0.95	0.220	81	0.284
31	0.00	22.0	2.3	26	13.7	54.8	0.80	0.216	81	0.283
32	0.00	22.5	2.8	27	12.8	54.6	0.99	0.215	81	0.284
33	0.00	22.3	2.6	27	12.4	54.5	1.00	0.217	81	0.285
34	0.00	21.8	3.2	26	13.7	54.5	0.80	0.213	84	0.293
35	0.00	21.8	2.8	26	14.0	54.6	0.81	0.215	84	0.293
36	0.00	22.2	3.6	26	13.2	54.7	0.80	0.218	82	0.287
37	0.00	22.0	3.5	26	14.0	54.3	0.81	0.216	82	0.288
38	0.00	21.7	2.9	26	14.3	54.8	0.85	0.215	84	0.293
39	0.00	22.3	2.9	27	12.9	54.7	0.98	0.219	84	0.293
40	0.00	22.2	3.8	26	13.1	54.5	0.76	0.214	84	0.293
41	0.00	22.1	3.7	26	13.6	54.6	0.78	0.216	81	0.283
42	0.00	22.3	3.9	27	13.6	54.6	0.77	0.217	86	0.302
43	0.00	22.6	3.7	27	13.5	54.7	0.79	0.215	83	0.289
44	0.00	22.1	3.4	26	13.8	54.6	0.83	0.216	80	0.282
45	0.00	22.7	3.6	27	14.1	54.6	0.90	0.216	83	0.289
46	0.00	22.4	3.1	27	14.2	54.7	0.89	0.213	82	0.287
47	0.00	21.6	3.9	26	14.5	54.6	0.84	0.212	79	0.278
48	0.00	22.5	4.2	27	13.0	54.5	0.74	0.460	81	0.284
49	0.00	21.6	5.0	26	14.7	54.5	0.82	0.470	81	0.284
50	0.00	21.8	3.9	26	14.6	54.6	0.83	0.422	81	0.284
51	0.00	22.7	3.7	27	14.2	1.9	0.90	0.427	82	0.286
52	0.00	22.4	4.0	27	14.6	54.6	0.78	0.214	82	0.286
53	0.00	22.0	4.4	26	14.9	54.6	0.83	0.218	81	0.284
54	0.00	22.7	4.5	27	14.3	54.6	0.77	0.217	81	0.283
55	0.00	22.9	4.1	27	14.3	54.6	0.89	0.220	79	0.276
56	0.00	23.0	6.0	27	14.3	54.9	0.90	0.481	82	0.287
57	0.00	22.0	6.8	26	14.2	54.5	0.87	0.489	81	0.285
58	0.00	22.3	5.9	26	13.7	54.7	0.74	0.502	81	0.283
59	0.00	22.2	6.6	26	14.0	54.7	0.89	0.488	80	0.279
60	0.00	22.4	5.9	27	14.4	1.9	0.76	0.486	82	0.285
61	0.00	22.5	5.3	27	14.6	54.6	0.76	0.520	82	0.285
62	0.00	22.5	7.8	27	15.0	54.7	0.84	0.530	82	0.288
63	0.00	22.8	6.2	27	13.3	54.6	0.96	0.555	83	0.289
64	0.00	23.3	7.2	28	14.9	54.6	0.73	0.580	83	0.289
65	0.00	26.8	8.5	32	15.3	54.8	0.73	0.666	81	0.285
66	0.00	27.2	7.1	32	15.0	54.9	0.74	0.770	77	0.270
67	0.00	27.5	6.8	33	13.9	55.3	0.70	0.779	75	0.264
68	0.00	28.3	8.3	34	14.3	54.4	0.74	0.808	75	0.262

TURKEY POINT COL PROJECT - BORING B-602; 14.8' - 16.2' Sample

HAMMER ID 269354 (RHODES)

OP: SEK

Test date: 10-Mar-2008

BL#	depth	CSX	TSX	FMX	VMX	BPM	FVP	EF2	ETR	EMX
	ft	ksi	ksi	kips	f/s	**	[]	k-ft	(%)	k-ft
69	0.00	28.5	7.8	34	13.8	54.8	0.88	0.818	76	0.265
70	0.00	28.1	7.9	33	14.0	54.6	0.86	0.801	75	0.262
71	0.00	28.1	7.1	33	14.2	54.2	0.82	0.809	74	0.258
72	0.00	28.4	7.6	34	14.5	54.6	0.77	0.809	75	0.262
73	0.00	28.6	6.9	34	14.1	54.5	0.74	0.821	76	0.264
74	0.00	29.1	7.0	35	13.4	54.4	0.72	0.833	76	0.264
75	0.00	28.8	7.4	34	13.6	54.5	0.71	0.824	77	0.269
76	0.00	28.6	7.9	34	15.3	54.5	0.74	0.824	80	0.280
77	0.00	28.3	8.0	34	15.1	54.4	0.72	0.814	79	0.277
78	0.00	28.6	8.2	34	13.7	54.6	0.71	0.809	80	0.279
79	0.00	27.0	7.6	32	13.2	54.3	0.71	0.787	80	0.280
80	0.00	28.0	7.8	33	14.6	54.5	0.74	0.812	79	0.277
81	0.00	27.2	8.3	32	14.0	54.5	0.89	0.794	78	0.275
82	0.00	27.9	8.3	33	15.3	54.4	0.78	0.800	81	0.282
83	0.00	28.1	7.9	33	13.5	54.5	0.93	0.817	79	0.276
84	0.00	27.9	8.1	33	15.8	54.4	0.72	0.812	80	0.280
85	0.00	28.4	7.9	34	15.3	54.8	0.73	0.807	79	0.277
86	0.00	28.4	8.7	34	14.8	54.4	0.84	0.826	80	0.278
87	0.00	28.6	8.3	34	13.3	54.5	0.72	0.833	82	0.287
88	0.00	28.7	8.1	34	14.9	54.7	0.83	0.840	79	0.276
89	0.00	29.0	8.5	34	13.2	55.1	0.94	0.831	79	0.276
	Average	24.1	5.1	29	13.7	52.8	0.85	0.430	80	0.280

Total number of blows analyzed: 86

Time Summary

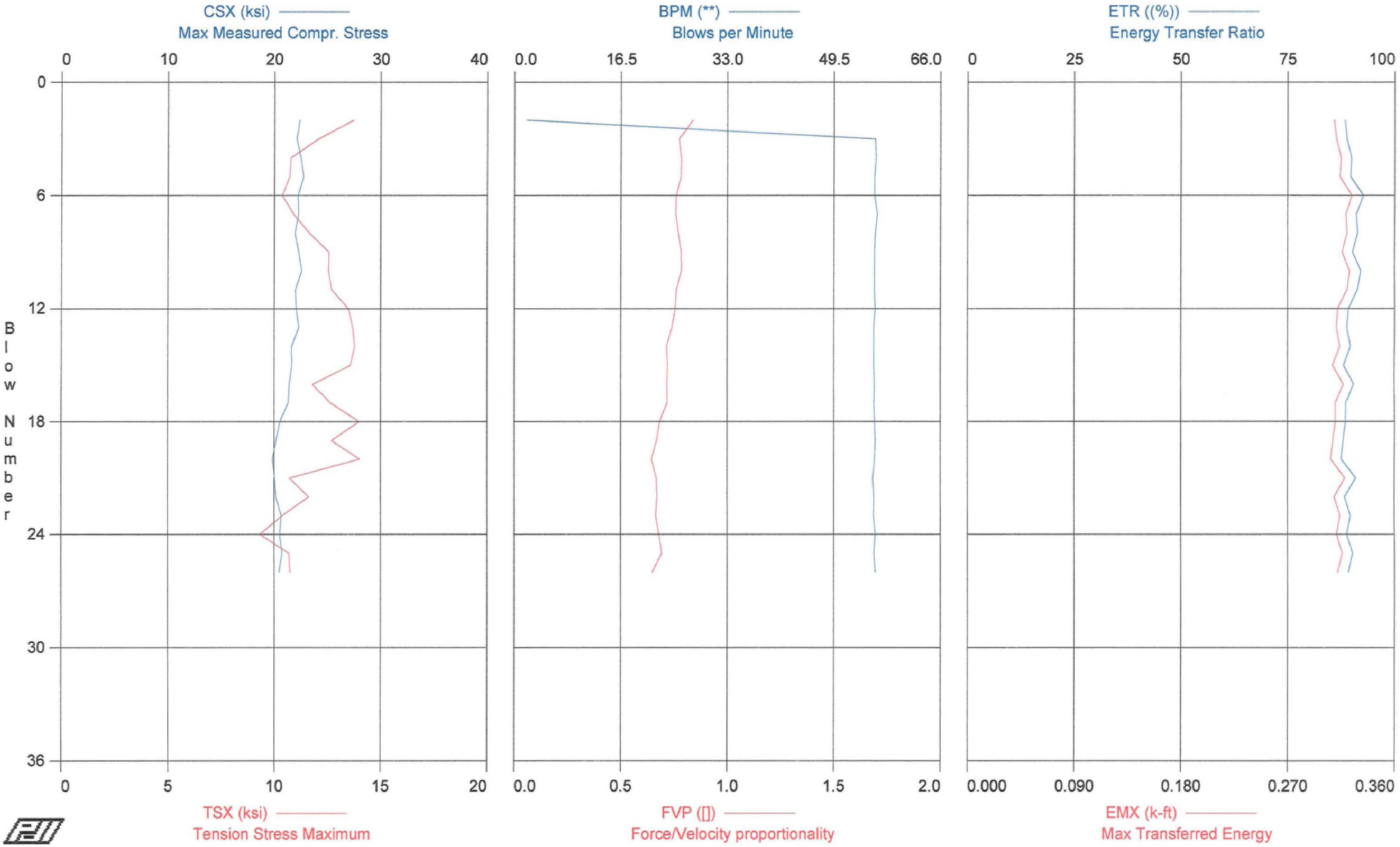
Drive 1 minute 35 seconds 10:28:56 AM - 10:30:31 AM (3/10/2008) BN 4 - 89

MACTEC Engineering and Consulting, Inc. - Case Method Results

PDIPLOT Ver. 2008.1 - Printed: 4-Jun-2008

Test date: 4-Apr-2008

TURKEY POINT COL PROJECT - BORING B-734; 116.6' - 118.1' Sample



MACTEC

engineering and constructing a better tomorrow

August 15, 2008

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

Subject: **Report of SPT Energy – MACTEC Raleigh CME 550**
Hammer Serial No. 893 Automatic Hammer
WORK INSTRUCTION TUR-055
Turkey Point COL Project
Dade County, Florida
MACTEC Project No. 6468-07-1950

Steve Kiser and 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 March 10 and April 5, 2008, during drilling of Borings B-808 and B-737, respectively, at the referenced site. The testing was performed from 12:30 to 2:25 PM under cloudy skies and a temperature of about 70 in degrees Fahrenheit on March 10. The testing was performed from 8:50 AM to 1:35 PM under partly cloudy skies and temperatures in the mid-80s in degrees Fahrenheit on April 5. The boring was drilled with personnel and equipment from MACTEC Raleigh. The drilling equipment consisted of a CME 550 ATV-model drill rig with an SPT automatic hammer mounted to a marsh buggy. 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. David White and Mr. Floyd Cox. 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.

25 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 296 foot-pounds to 323 foot-pounds. These average energy transfers correspond to energy transfer ratios (ETR) of 85% to 92% 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 308.1 foot-pounds, with an average ETR of 88.0%.

Attachments: Page 4 Table 1 - Summary of SPT Energy Measurements – 1 Page
Page 5 Work Instruction – DCN TUR-055 – 1 Page
Pages 6 – 7 Record of SPT Energy Measurement – 2 Pages
Pages 8 – 25 PDIPLOT Output – 18 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)
893 (CME 550 Marsh Buggy)	MACTEC Raleigh	David White	B-808	AW-J	3/10/2008	12.0 - 13.5	7 - 9 - 15	32	303	86.6%
						15.0 - 16.5	19 - 21 - 50/0.5'	107	302	86.3%
						19.6 - 21.1	6 - 6 - 5	17	296	84.6%
						24.1 - 25.6	50 / 0.1'	50	296	84.6%
		Floyd Cox	B-737		4/5/2008	96.8 - 98.3	34 - 13 - 27	74	319	91.1%
						111.8 - 113.3	6 - 3 - 6	15	323	92.3%
						121.8 - 123.3	5 - 5 - 11	21	317	90.6%
						131.8 - 133.3	5 - 5 - 9	19	329	94.0%
								Average for Rig:	**308.1**	**88.0%**

[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:	Date: 8-15-08	Checked By:	Date: 8/19/08

TURKEY POINT COL PROJECT - BORING B-734; 116.6' - 118.1' Sample

HAMMER ID 269354 (RHODES)

OP: HJC

Test date: 4-Apr-2008

AR: 1.19 in^2
LE: 119.00 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	22.4	13.7	27	14.9	1.9	0.84	0.285	88	0.309
3	0.00	22.1	12.1	26	16.0	55.9	0.77	0.283	89	0.311
4	0.00	22.5	10.8	27	16.1	56.0	0.78	0.283	90	0.315
5	0.00	22.8	10.7	27	16.3	55.8	0.78	0.284	90	0.314
6	0.00	22.2	10.4	26	16.4	55.8	0.76	0.284	93	0.324
7	0.00	22.3	10.9	26	16.4	56.2	0.76	0.282	91	0.319
8	0.00	22.0	11.7	26	15.7	55.9	0.77	0.280	91	0.320
9	0.00	22.3	12.6	27	15.9	55.8	0.78	0.281	90	0.316
10	0.00	22.6	12.5	27	16.1	55.8	0.79	0.280	92	0.322
11	0.00	22.0	12.7	26	16.2	55.8	0.76	0.281	91	0.320
12	0.00	22.1	13.5	26	16.3	55.9	0.76	0.279	89	0.312
13	0.00	22.3	13.7	27	16.9	55.7	0.74	0.278	89	0.311
14	0.00	21.6	13.8	26	16.9	55.7	0.72	0.277	90	0.314
15	0.00	21.7	13.6	26	16.8	55.7	0.72	0.275	88	0.308
16	0.00	21.4	11.8	26	16.8	55.8	0.72	0.273	91	0.317
17	0.00	21.3	12.6	25	16.6	55.7	0.72	0.273	89	0.310
18	0.00	20.5	14.0	24	16.9	55.8	0.68	0.270	88	0.310
19	0.00	20.1	12.7	24	16.6	55.9	0.67	0.268	88	0.308
20	0.00	19.8	14.0	24	16.8	55.8	0.64	0.266	88	0.306
21	0.00	20.0	10.7	24	16.6	55.5	0.67	0.271	91	0.318
22	0.00	20.1	11.6	24	16.6	55.7	0.67	0.267	88	0.309
23	0.00	20.7	10.4	25	17.4	55.6	0.66	0.271	90	0.314
24	0.00	20.5	9.3	24	17.0	55.9	0.68	0.270	89	0.311
25	0.00	20.7	10.7	25	16.4	55.7	0.69	0.273	90	0.316
26	0.00	20.4	10.7	24	17.7	55.9	0.65	0.270	89	0.312
	Average	21.5	12.0	26	16.5	53.6	0.73	0.276	90	0.314

Total number of blows analyzed: 25

Time Summary

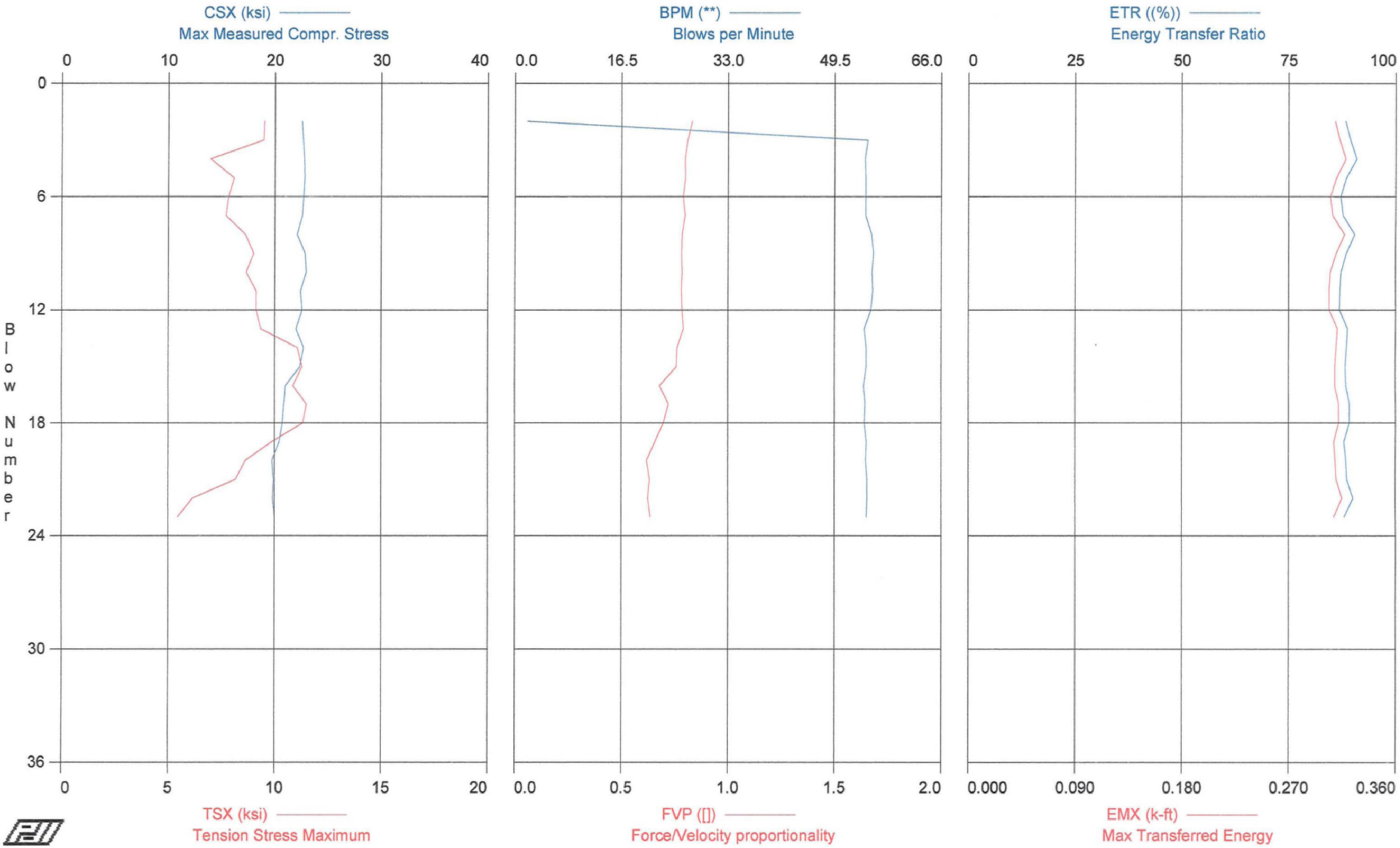
Drive 26 seconds 10:39:45 AM - 10:40:11 AM (4/4/2008) BN 2 - 26

MACTEC Engineering and Consulting, Inc. - Case Method Results

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

Test date: 4-Apr-2008

TURKEY POINT COL PROJECT - BORING B-734; 123.5' - 125' Sample



TURKEY POINT COL PROJECT - BORING B-734; 123.5' - 125' Sample

HAMMER ID 269354 (RHODES)

OP: HJC

Test date: 4-Apr-2008

AR: 1.19 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	CSX	TSX	FMX	VMX	BPM	FVP	EF2	ETR	EMX
	ft	ksi	ksi	kips	f/s	**	[]	k-ft	(%)	k-ft
2	0.00	22.6	9.5	27	15.2	1.9	0.83	0.283	88	0.309
3	0.00	22.7	9.5	27	15.8	54.6	0.81	0.281	89	0.313
4	0.00	22.8	7.0	27	16.0	54.2	0.80	0.284	91	0.318
5	0.00	22.8	8.1	27	16.0	54.3	0.80	0.283	88	0.310
6	0.00	22.7	7.8	27	16.1	54.3	0.79	0.281	87	0.305
7	0.00	22.6	7.7	27	15.8	54.3	0.80	0.283	88	0.307
8	0.00	22.1	8.6	26	15.9	55.2	0.78	0.284	90	0.317
9	0.00	22.9	9.0	27	16.4	55.5	0.78	0.283	88	0.310
10	0.00	23.0	8.7	27	16.3	55.3	0.78	0.286	87	0.305
11	0.00	22.4	9.1	27	16.0	55.4	0.78	0.283	87	0.304
12	0.00	22.6	9.1	27	16.1	55.1	0.79	0.283	87	0.304
13	0.00	22.0	9.3	26	15.6	54.1	0.79	0.284	89	0.311
14	0.00	22.7	11.1	27	16.7	54.4	0.76	0.283	89	0.310
15	0.00	22.4	11.3	27	16.6	54.4	0.76	0.281	88	0.309
16	0.00	21.0	10.9	25	17.3	54.0	0.68	0.277	88	0.309
17	0.00	20.8	11.5	25	16.2	54.2	0.72	0.278	89	0.312
18	0.00	20.7	11.3	25	16.7	54.1	0.70	0.294	89	0.312
19	0.00	20.4	9.9	24	17.5	54.4	0.66	0.275	88	0.308
20	0.00	19.8	8.6	24	17.9	54.3	0.62	0.270	88	0.309
21	0.00	19.9	8.2	24	17.4	54.5	0.63	0.270	89	0.310
22	0.00	19.8	6.2	24	17.6	54.5	0.62	0.272	90	0.315
23	0.00	20.0	5.4	24	17.2	54.4	0.64	0.269	88	0.308
	Average	21.8	9.0	26	16.5	52.2	0.74	0.280	89	0.310

Total number of blows analyzed: 22

Time Summary

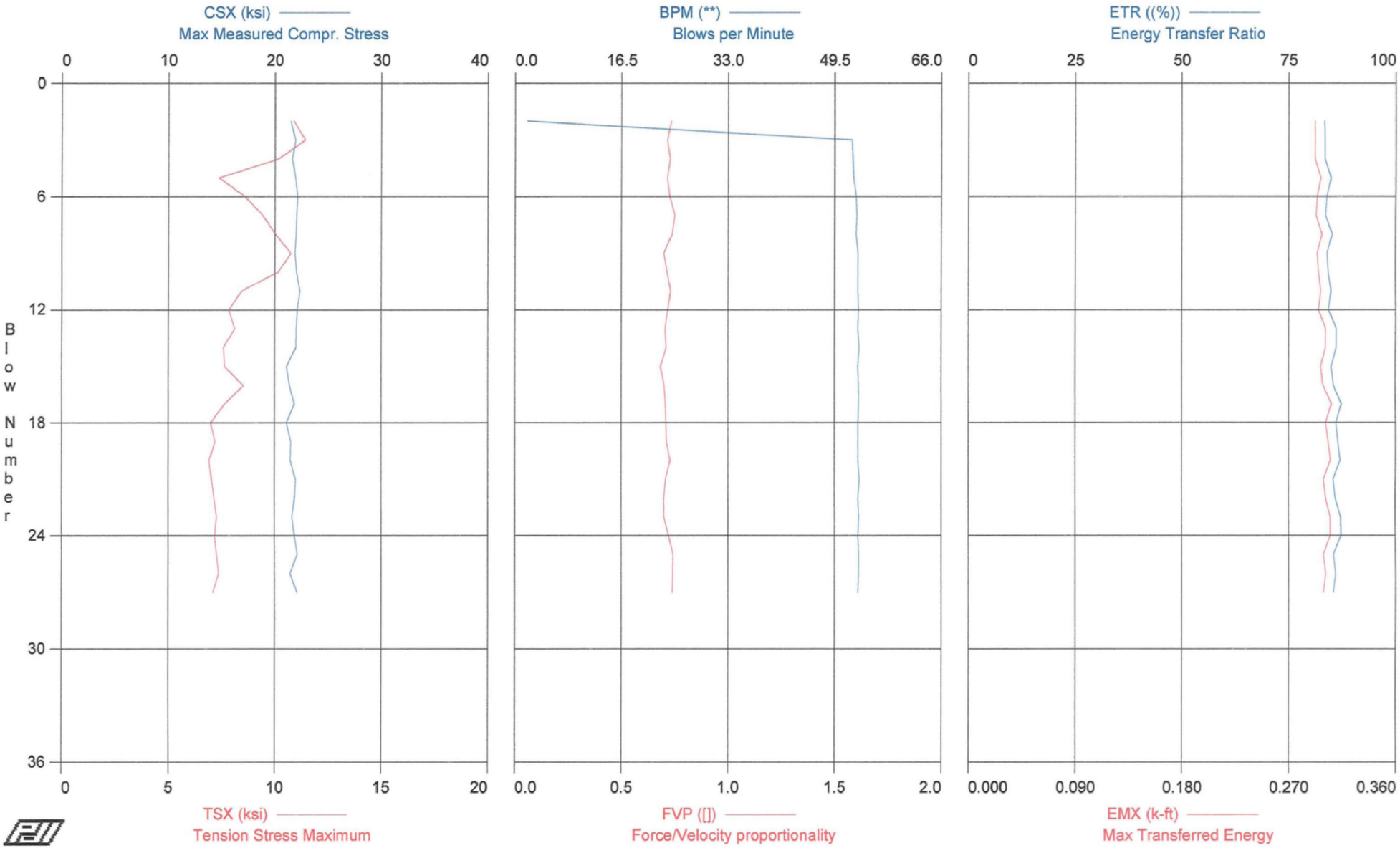
Drive 23 seconds 12:21:08 PM - 12:21:31 PM (4/4/2008) BN 2 - 23

MACTEC Engineering and Consulting, Inc. - Case Method Results

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

Test date: 4-Apr-2008

TURKEY POINT COL PROJECT - BORING B-734; 128.5' - 130' Sample



TURKEY POINT COL PROJECT - BORING B-734; 128.5' - 130' Sample
OP: HJC

HAMMER ID 269354 (RHODES)
Test date: 4-Apr-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 ft	CSX ksi	TSX ksi	FMX kips	VMX f/s	BPM **	FVP []	EF2 k-ft	ETR (%)	EMX k-ft
2	0.00	21.5	10.9	26	15.9	1.9	0.73	0.274	83	0.292
3	0.00	21.9	11.4	26	17.3	52.2	0.72	0.268	83	0.292
4	0.00	21.6	10.2	26	16.6	52.3	0.73	0.269	83	0.292
5	0.00	21.9	7.4	26	17.2	52.4	0.72	0.270	85	0.297
6	0.00	22.2	8.6	26	17.1	52.8	0.73	0.270	84	0.294
7	0.00	22.0	9.4	26	16.4	52.9	0.75	0.271	84	0.293
8	0.00	22.0	10.0	26	16.8	52.8	0.74	0.269	85	0.298
9	0.00	21.9	10.8	26	17.5	53.1	0.70	0.269	84	0.294
10	0.00	22.0	10.2	26	17.2	53.1	0.71	0.271	84	0.295
11	0.00	22.4	8.5	27	17.2	53.1	0.73	0.271	85	0.297
12	0.00	22.1	7.8	26	17.3	53.2	0.72	0.270	84	0.295
13	0.00	22.0	8.1	26	17.6	53.1	0.71	0.271	86	0.301
14	0.00	22.0	7.6	26	17.3	53.3	0.71	0.272	86	0.301
15	0.00	21.1	7.6	25	17.3	53.1	0.68	0.268	85	0.297
16	0.00	21.4	8.5	25	17.3	53.2	0.70	0.268	85	0.299
17	0.00	21.8	7.6	26	17.3	53.2	0.71	0.271	87	0.306
18	0.00	21.1	7.0	25	16.6	53.1	0.71	0.267	86	0.301
19	0.00	21.5	7.2	26	17.0	53.1	0.71	0.270	86	0.303
20	0.00	21.5	6.9	26	16.5	53.1	0.73	0.272	87	0.305
21	0.00	21.9	7.0	26	17.4	53.3	0.71	0.271	85	0.299
22	0.00	21.9	7.1	26	17.5	53.1	0.70	0.268	86	0.301
23	0.00	21.6	7.3	26	17.4	53.2	0.70	0.268	87	0.305
24	0.00	21.8	7.2	26	17.0	53.1	0.72	0.270	87	0.305
25	0.00	22.1	7.3	26	16.7	53.2	0.74	0.273	85	0.299
26	0.00	21.5	7.4	26	16.3	53.2	0.74	0.274	86	0.301
27	0.00	22.1	7.1	26	16.9	53.1	0.74	0.268	85	0.299
	Average	21.8	8.3	26	17.0	51.0	0.72	0.270	85	0.298

Total number of blows analyzed: 26

Time Summary

Drive 29 seconds 12:55:10 PM - 12:55:39 PM (4/4/2008) BN 2 - 27

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