



BECHTEL PROJECT NO.: 25409		MACTEC PROJECT NO.: 6468-07-1950		COUNTY: Miami-Dade		GEOLOGIST: J. Liles							
SITE DESCRIPTION: Turkey Point COL		DRILL MACHINE: CME-550 (Miller)		DRILLER: R. White/ J. Dugger/ C. White		GROUND WATER (ft)							
BORING NO.: B-814		DRILL METHOD: Mud Rotary/ Core		SAMPLE METHODS: SPT/Core		0 HR. NA							
GROUND ELEV.: 9.0 ft (NAVD88)		NORTHING: 399,139 US ft (NAD83/90)		EASTING: 877,405 US ft (NAD83/90)		24 HR. NA							
TOTAL DEPTH: 153.2 ft		BORING DIAMETER: 4" to 98.0", 3" to 153.2'		CASING DEPTH: 4" to 98.0'		HAMMER (ID): 140 lb. Auto (M06)							
DATE STARTED: 5/15/08		COMPLETED: 5/18/08		CORE SIZE: HQ3		BITS USED: 2 7/8" Roller Cone							
ELEV. (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	SOIL AND ROCK DESCRIPTION	
		0.5ft	0.5ft	0.5ft	0	20	40	60	80				100
-140.6					Continued from previous page								
-142.7	151.7	4	4	5						814-20		151.7ft: loose	
												-144.2	Boring Terminated at Elevation -144.2 ft
													153.2

TURKEY POINT COL BORE TURKEY POINT GPJ TURKEY POINT COL.GDT \$:30/08



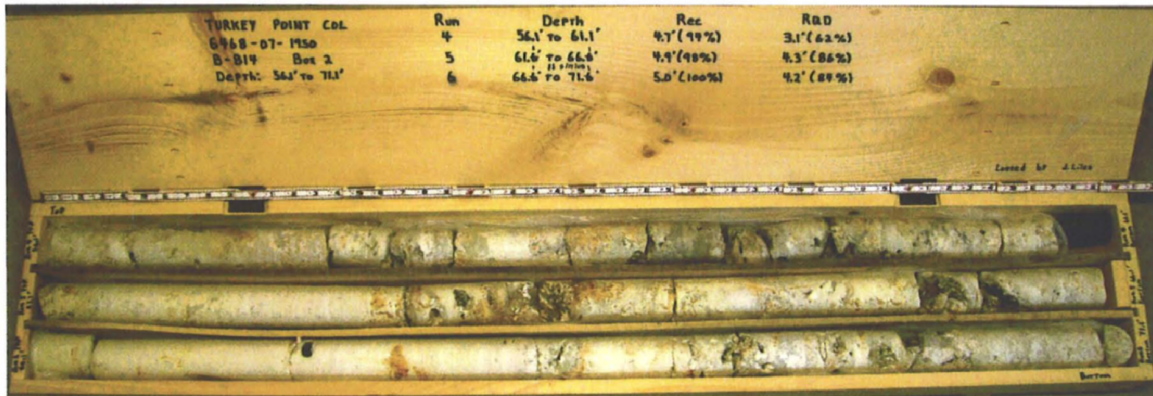
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BORING NO.: B-814		DRILL METHOD: Mud Rotary/ Core		SAMPLE METHODS: SPT/Core		0 HR. NA	
GROUND ELEV.: 9.0 ft (NAVD88)		NORTHING: 399,139 US ft (NAD83/90)		EASTING: 877,405 US ft (NAD83/90)		24 HR. NA	
TOTAL DEPTH: 153.2 ft		CASING DEPTH: 4" to 98.0'				HAMMER (ID): 140 lb. Auto (M06)	
DATE STARTED: 5/15/08		COMPLETED: 5/18/08		CORE SIZE: HQ3		CORE BARREL TYPE: Triple Tube Wireline (Split inner liners)	

ELEV. (ft)	DEPTH (ft)	RUN (ft)	DRILL RATE (Min/ft)	RUN		SAMP. NO.	STRATA		LOG	DESCRIPTION AND REMARKS
				REC (ft) %	RQD (ft) %		REC (ft) %	RQD (ft) %		
										Begin Coring @ 43.1 ft
-34.1	43.1	3.0	1:53 1:05 0:48	(3.0) 100%	(2.2) 73%	RUN-1	(17.6) 98%	(13.2) 73%		LIMESTONE, boundstone, pale yellow (2.5Y8/2), hard, wet, some coarse grained sand, strong HCl (Upper Fort Thompson Formation) <i>(continued)</i>
-37.1	46.1									43.1ft: medium hard to moderately hard, friable to moderately indurated, trace vugs
		5.0	1:07 1:07 1:09 1:17 1:18	(4.9) 98%	(3.5) 70%	RUN-2				
-42.1	51.1									51.5ft: moderately hard to hard, moderately indurated to indurated
		5.0	1:24 1:26 1:11 0:54 1:13	(5.0) 100%	(4.4) 88%	RUN-3				
-47.1	56.1									56.1ft: few vugs, recrystallized calcite
		5.0	1:28 1:21 1:07 1:47 1:32	(4.7) 94%	(3.1) 62%	RUN-4				
-52.1	61.1									61.1
		5.0	1:51 2:00 2:10 2:08 1:28	(4.9) 98%	(4.3) 86%	RUN-5	(19.3) 58%	(10.7) 32%		LIMESTONE, boundstone, white (2.5Y8/1), hard, indurated, trace vugs, recrystallized calcite, strong HCl reaction (Lower Fort Thompson Formation)
-57.1	66.1									
		5.0	2:24 1:42 1:24 1:12 1:04	(5.0) 100%	(4.2) 84%	RUN-6				
-62.1	71.1									71.1ft: few fine grained sand, few vugs
		5.0	0:51 1:02 0:51 2:21 1:54	(4.0) 80%	(1.3) 26%	RUN-7				
-67.1	76.1									76.1ft: moderately hard to hard, moderately indurated to indurated, trace vugs
		5.0	1:50 0:24 0:06 0:32 1:37	(2.5) 50%	(0.9) 18%	RUN-8				77.0 to 99.0ft: interbedded sand layers
-72.1	81.1									81.0ft: hard, indurated, some sand
		5.0	0:53 0:50 0:23 0:22 0:05 N=0	(0.9) 18%	(0.0) 0%	RUN-9				
-77.1	86.1					814-73				86.1ft: Switch sampling method to SPT
		3.5	WOR/0.5 0:11 0:27 1:02	(1.0) 29%	(0.0) 0%	RUN-10				86.1ft: interbedded sand, very loose, fine grained sand, wet, strong HCl reaction
-78.6	87.6									87.6ft: Switch sampling method to coring
		5.0	0:02 0:09 0:06 0:15 1:25	(1.0) 20%	(0.0) 0%	RUN-11				87.6 to 88.1ft: rod drop
-82.1	91.1									88.1ft: moderately hard, moderately indurated
-87.1	96.1									96.1
										Coring Terminated at Elevation -87.1

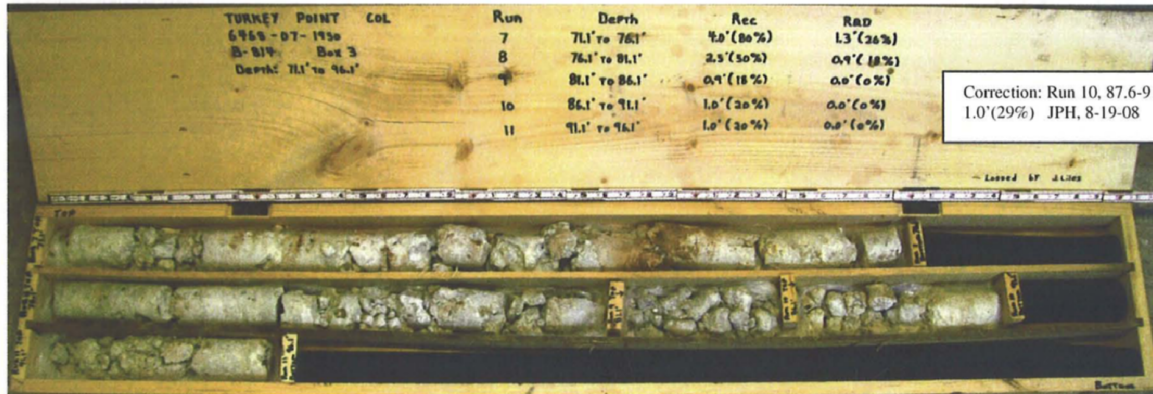
TURKEY POINT COL CORE TURKEY POINT.GPJ TURKEY POINT COL.GDT 5:30:08



B-814 - Box 1



B-814 - Box 2



B-814 - Box 3

# **Back Hoe Test Pit Logs**





GEOTECHNICAL BORING LOG

Prepared By SPZ Date 5-30-08

Checked By JM Date 5-30-08

SHEET 1 OF 1

BECHTEL PROJECT NO.: 25409			MACTEC PROJECT NO.: 6468-07-1950			COUNTY: Miami-Dade			GEOLOGIST: S. Woodham			
SITE DESCRIPTION: Turkey Point COL			DRILL MACHINE: Deere 310G			DRILLER: Dan Rhodes			GROUND WATER (ft)			
BORING NO.: TP-601			DRILL METHOD: Backhoe			SAMPLE METHODS: Bulk			0 HR. 0.5			
GROUND ELEV.: -1.4 ft (NAVD88)			NORTHING: 397,106 US ft (NAD83/90)			EASTING: 876,036 US ft (NAD83/90)			24 HR. NA			
TOTAL DEPTH: 5.2 ft			BORING DIAMETER: NA			CASING DEPTH: NA			HAMMER (ID): NA			
DATE STARTED: 5/1/08			COMPLETED: 5/1/08			CORE SIZE: NA			BITS USED: Backhoe bucket with steel rock teeth			
ELEV. (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG	SOIL AND ROCK DESCRIPTION
		0.5ft	0.5ft	0.5ft	0	20	40	60	80			
-1.4												Ground Surface
												MUCK, some to mostly organics, clayey, organics increase with depth Not Sampled
-4.6	3.2									TP-601-1		LIMESTONE, boundstone, white (10YR8/1), very soft to moderately hard, friable to moderately indurated, wet, oolitic, strong HCL reaction (Miami Formation) Samples Collected: Ten (10) 5-gallon buckets (TP-601-1, Buckets 1 to 10)
												Boring Terminated at Elevation -6.6 ft

TURKEY POINT COL BORE TURKEY POINT.GPJ TURKEY POINT COL.GDT 5/30/08



GEOTECHNICAL BORING LOG

Prepared By *[Signature]* Date 5-30-08

Checked By *[Signature]* Date 5-30-08

SHEET 1 OF 1

BECHTEL PROJECT NO.: 25409		MACTEC PROJECT NO.: 6468-07-1950		COUNTY: Miami-Dade		GEOLOGIST: S. Woodham							
SITE DESCRIPTION: Turkey Point COL		DRILL MACHINE: Deere 310G		DRILLER: Dan Rhodes		GROUND WATER (ft)							
BORING NO.: TP-701		DRILL METHOD: Backhoe		SAMPLE METHODS: Bulk		0 HR.	0.0						
GROUND ELEV.: -1.4 ft (NAVD88)		NORTHING: 396,988 US ft (NAD83/90)		EASTING: 875,509 US ft (NAD83/90)		24 HR.	NA						
TOTAL DEPTH: 5.0 ft		BORING DIAMETER: NA		CASING DEPTH: NA		HAMMER (ID): NA							
DATE STARTED: 5/1/08		COMPLETED: 5/1/08		CORE SIZE: NA		BITS USED: Backhoe bucket with steel rock teeth							
ELEV. (ft)	DEPTH (ft)	BLOW COUNT			BLOWS PER FOOT					SAMP. NO.	LOG MOI	SOIL AND ROCK DESCRIPTION	
		0.5ft	0.5ft	0.5ft	0	20	40	60	80				100
-1.4													Ground Surface
-1.4	0.0												MUCK, some to mostly organics, clayey, organics increase with depth Samples Collected: Two (2) 5-gallon buckets (TP-701-2, bucket 12; TP-701-3, bucket 11)
-2.9	1.5												SEE LEGEND FOR ROCK HARDNESS CRITERIA BASED ON SPT DATA
-4.4	3.0												
													LIMESTONE, boundstone, white (10YR8/1), very soft to moderately hard, friable to moderately indurated, wet, oolitic, some coarse sand, strong HCl reaction (Miami Formation) Samples Collected: Ten (10) 5-gallon buckets (TP-701-1, buckets 1 to 10)
													Boring Terminated at Elevation -6.4 ft

TURKEY POINT COL BORE TURKEY POINT.GPJ TURKEY POINT COL.GDT 5:30.08

# **SPT Energy Measurement Reports**



engineering and constructing a better tomorrow

August 15, 2008

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

Subject: **Report of SPT Energy – MACTEC Raleigh CME 55LC  
Hammer Serial No. MEC-02 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 March 25, 2008, during drilling of Borings B-615 at the referenced site. The testing was performed by Jay Cerceo from approximately 4:30 PM on March 25 to 9:10 AM on March 26 under clear skies and a temperature of about 70 degrees Fahrenheit. The boring was drilled with personnel and equipment from MACTEC. The drilling equipment consisted of a CME 55LC 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. Robert Banks. 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.

13 Pages Total



### 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 PDILOT tables and are also shown graphically in the PDILOT 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 286 foot-pounds to 303 foot-pounds. These average energy transfers correspond to energy transfer ratios (ETR) of 82% to 87% 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 292.8 foot-pounds, with an average ETR of 83.7%.

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 PDILOT Output – 7 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) <sup>a</sup>	Energy Transfer Ratio (%) <sup>b</sup> (Average ETR)
MEC-02 (CME 55LC)	MACTEC Raleigh	Robert Banks	B-615	AW-J	3/25/2008	117.3 - 118.8	27 - 22 - 31	82	287	82.0%
						127.0 - 128.5	4 - 8 - 8	19	286	81.7%
						139.1 - 140.6	27 - 24 - 16	59	303	86.6%
<b>Average for Rig:</b>								<b>292.8</b>	<b>83.7%</b>	

<sup>a</sup>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).

<sup>b</sup>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 PDILOT tables due to roundoff.

Prepared By: <i>[Signature]</i>	Date: 8-15-08	Checked By: <i>[Signature]</i>	Date: 8/19/08
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**Work Instruction No. 9**  
 Turkey Point COL Project  
 MACTEC Engineering and Consulting, Inc.  
 MACTEC Project 6468-07-1950

<b>Issued To:</b> Steve Kiser and Jay Cerceo	<b>Rev. No.</b> 1
<b>Issued By:</b> Tom McDaniel	<b>Date:</b> 3-24-08
<b>Valid From:</b> 3-24-08	<b>To:</b> 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.

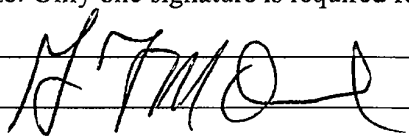
**Special Instructions** (note attachments where necessary): Confirm with Site Manager that approval of equipment calibration records has been received prior to beginning field testing. If unexpected conditions are encountered that affect measurements, contact Site Coordinator, Project Principal (Tom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

<b>Reviewed and Approved by:</b> (Note: Only one signature is required for issuance)	
Project Manager: _____	Date: _____
Project Principal Engineer: 	Date: 3/24/08
Site Manager/Coordinator: _____	Date: _____
<b>Pages:</b> 1 plus attachment	<b>DCN:</b> TUR-055
<b>Attachments:</b> ASTM D 4633-05	

