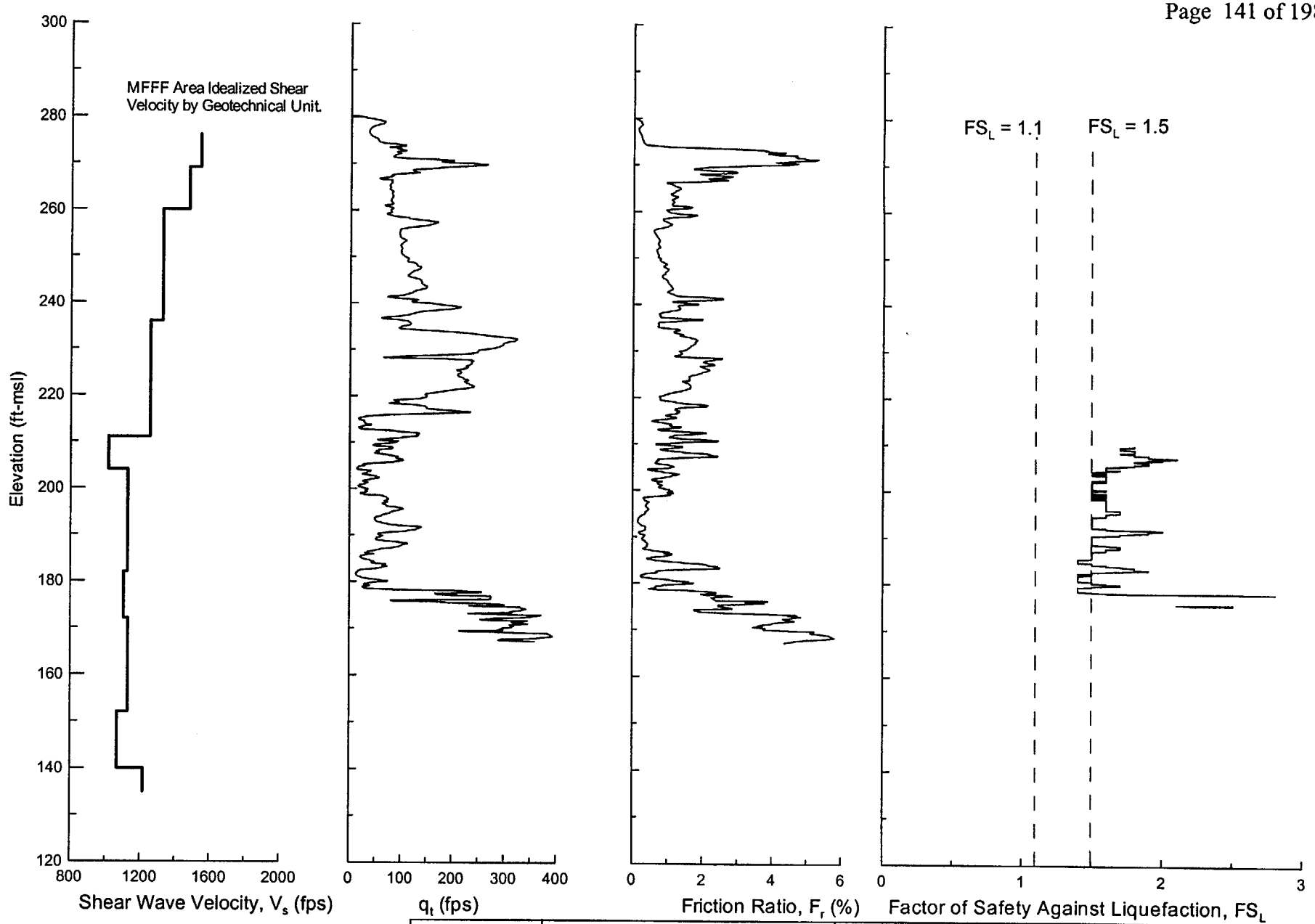
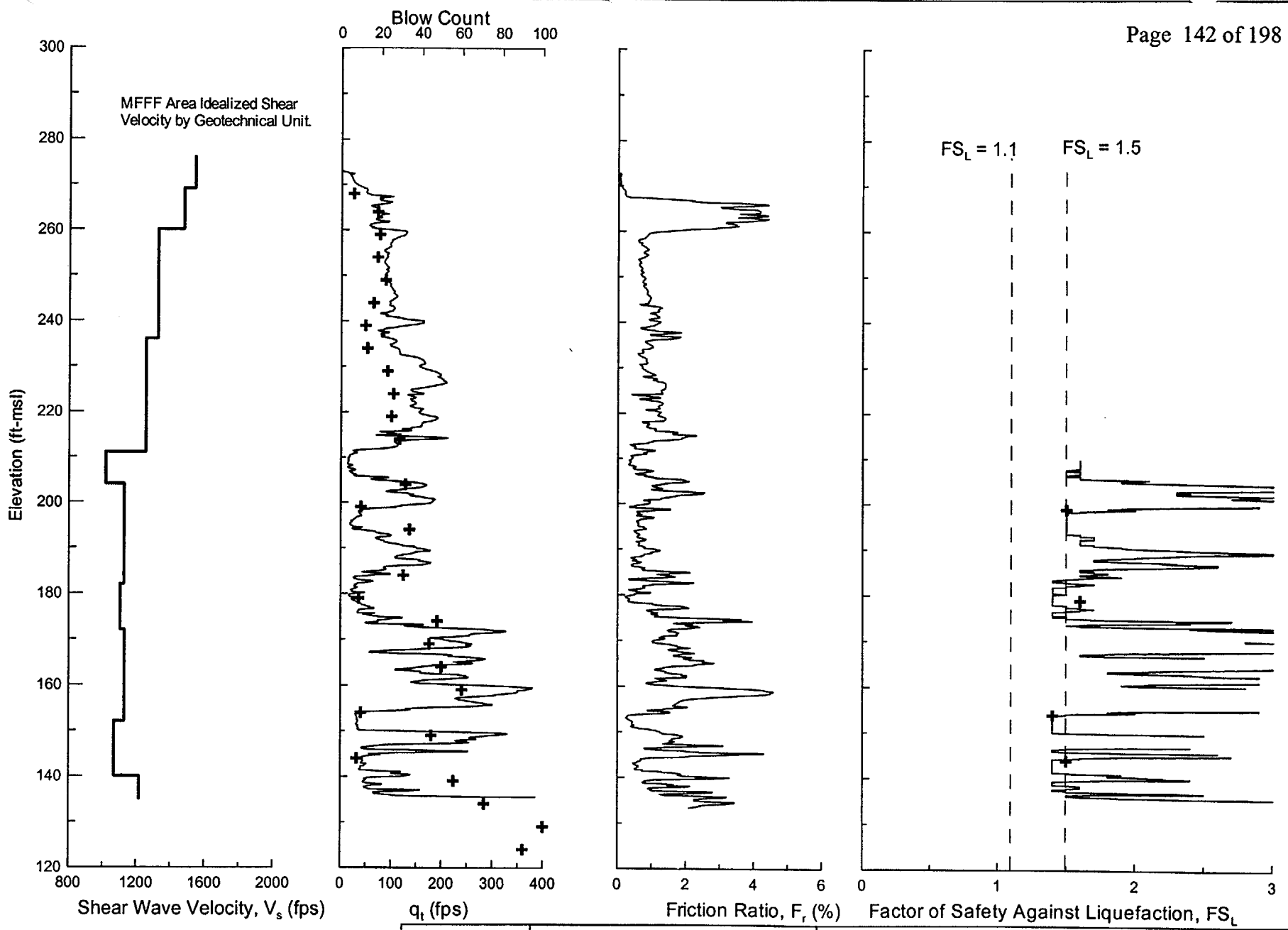


DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-7 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-1

Cpt7.grf w/CPT-7_Data.xls & global shear vel.xls by jjt [8/8/01]



Crosses indicate SPT values.

Cpt8.grf w/CPT-8_Data.xls, cpt-8.xls, global shear vel.xls & BH-1_SPT_Data by jit [8/8/01]

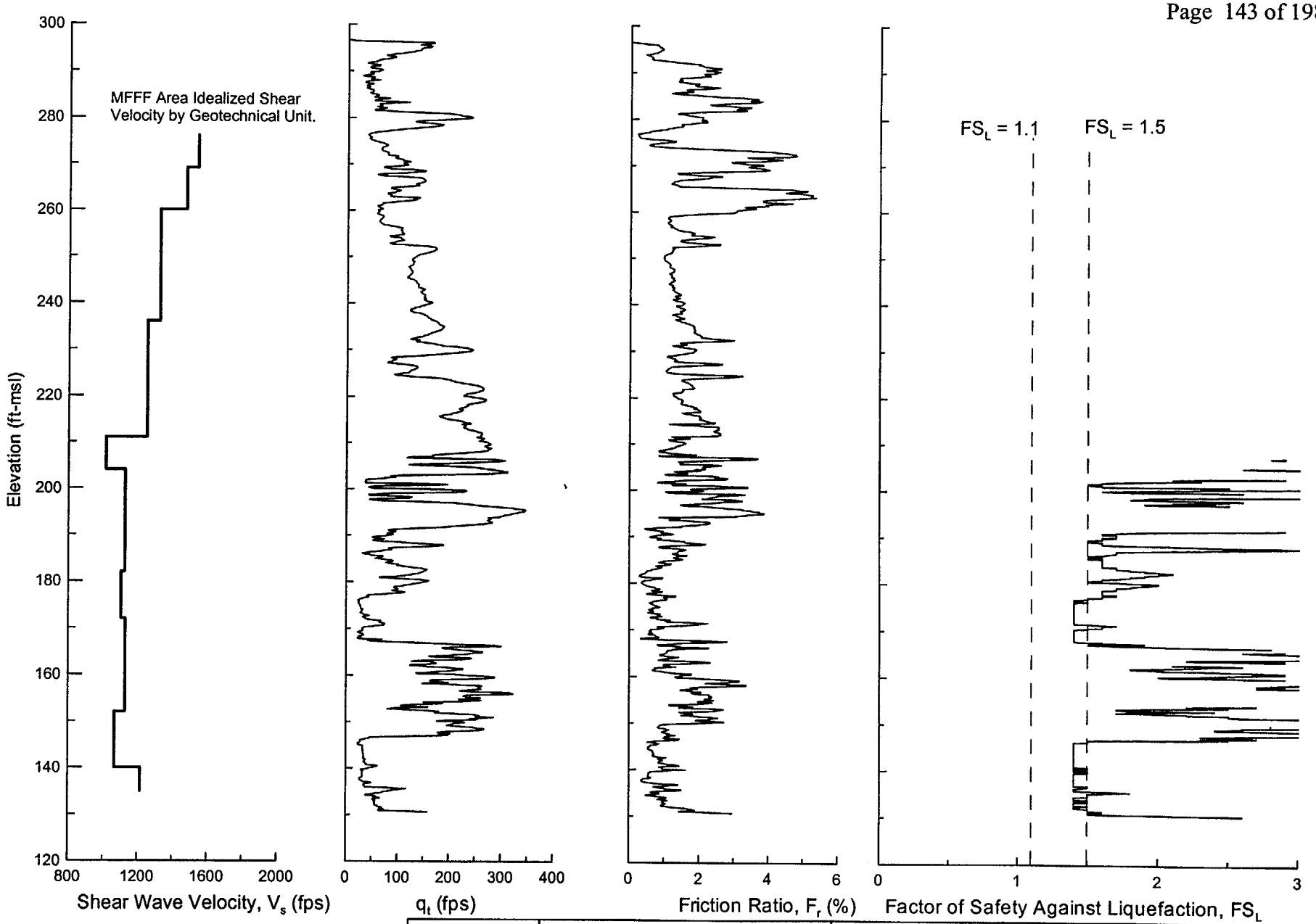
DUKE COGEMA STONE & WEBSTER

MOX Fuel Fabrication Facility
US Department of Energy CH

J.O. 08716

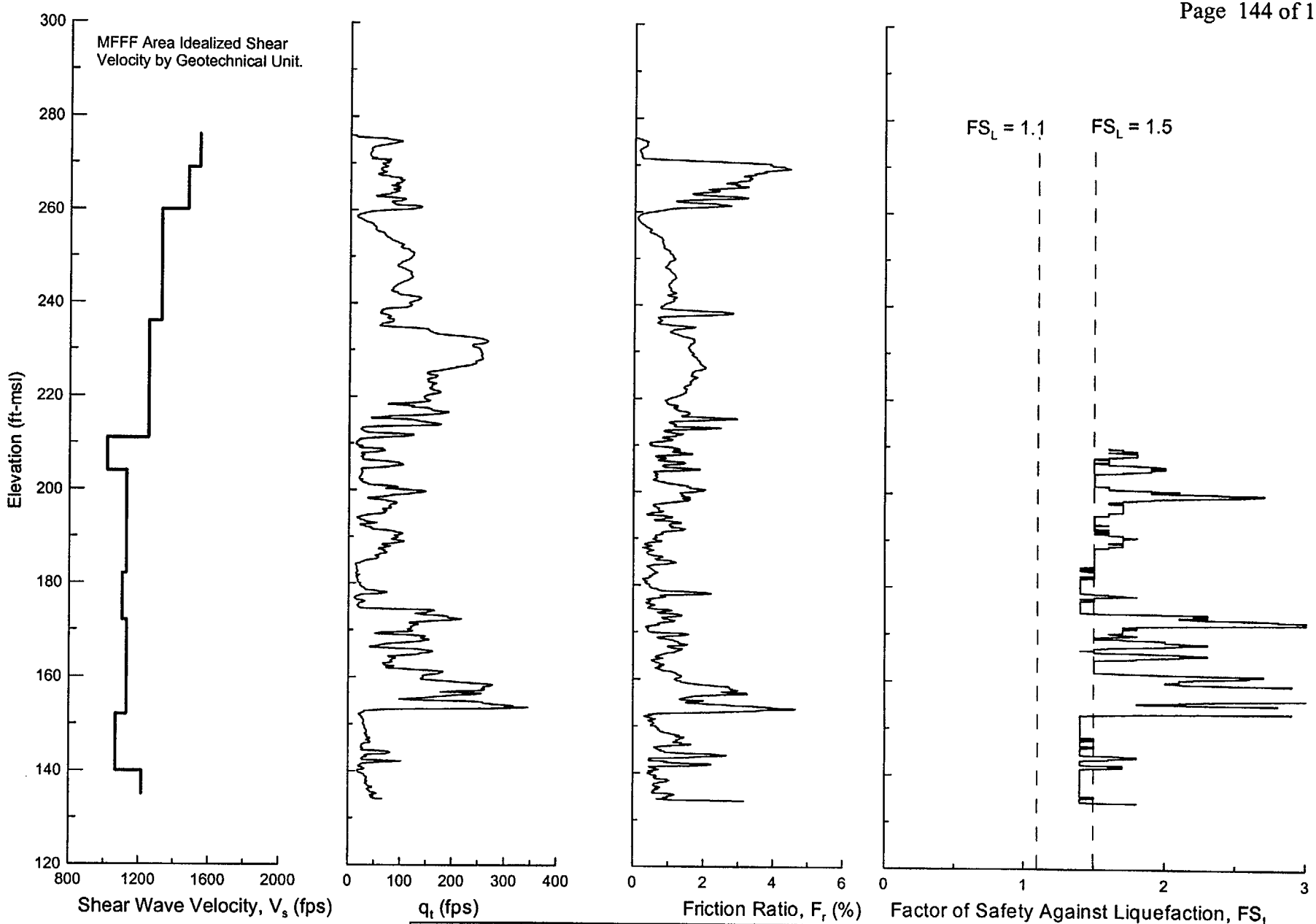
Factor of Safety Against Liquefaction
CPT-8 and BH-1
1886 Charleston 50th Percentile Motion
Idealized Shear Velocity Profile

Figure 8-2



DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-13 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-3

Cpt13.grf w/CPT-13_Data.xls & global shear vel.xls by jjt [8/8/01]



CPT14.grf w/CPT-14_Data.xls & global shear vel.xls by jjt [8/8/01]

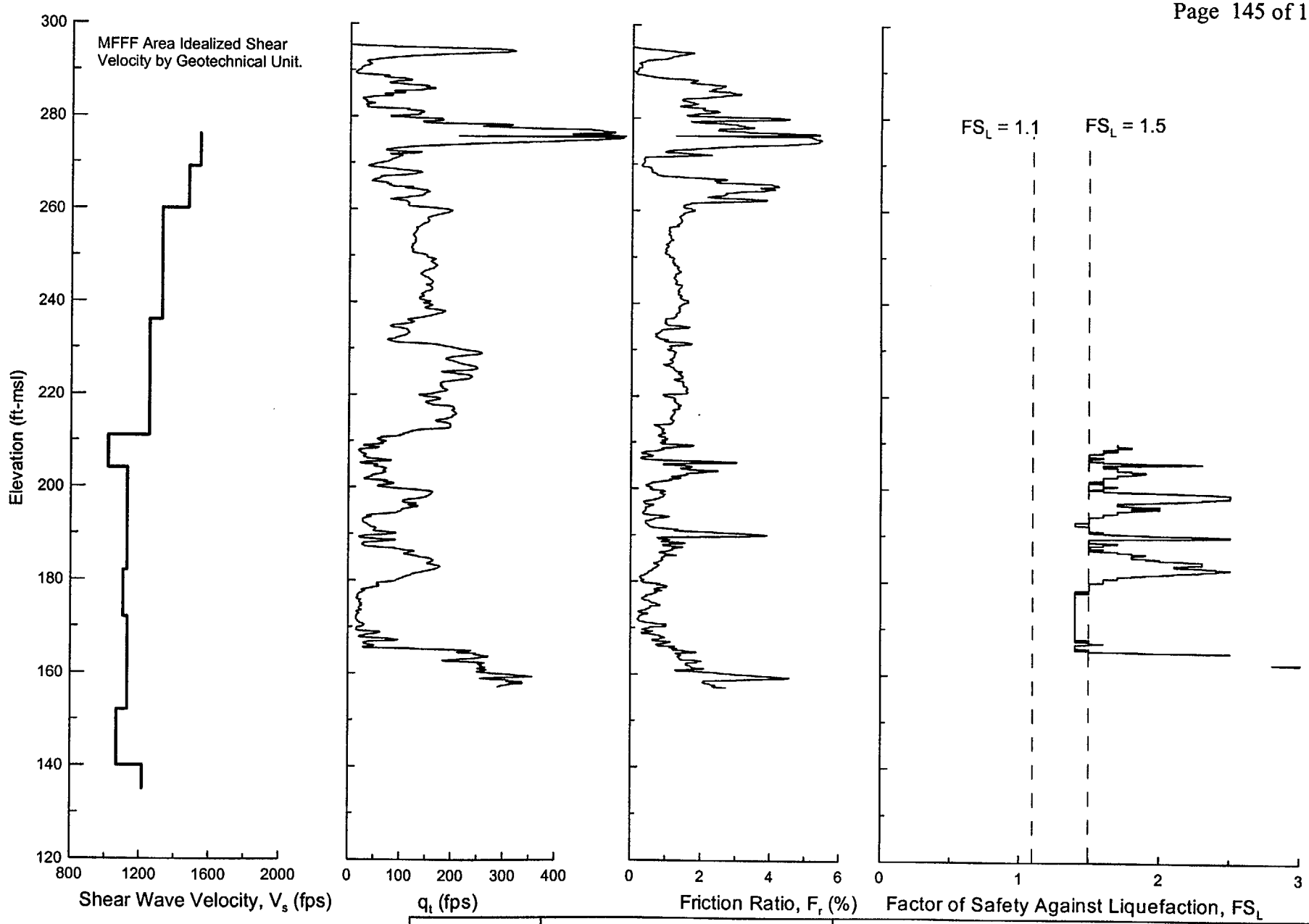
DUKE COGEMA STONE & WEBSTER

MOX Fuel Fabrication Facility
US Department of Energy CH

J.O. 08716

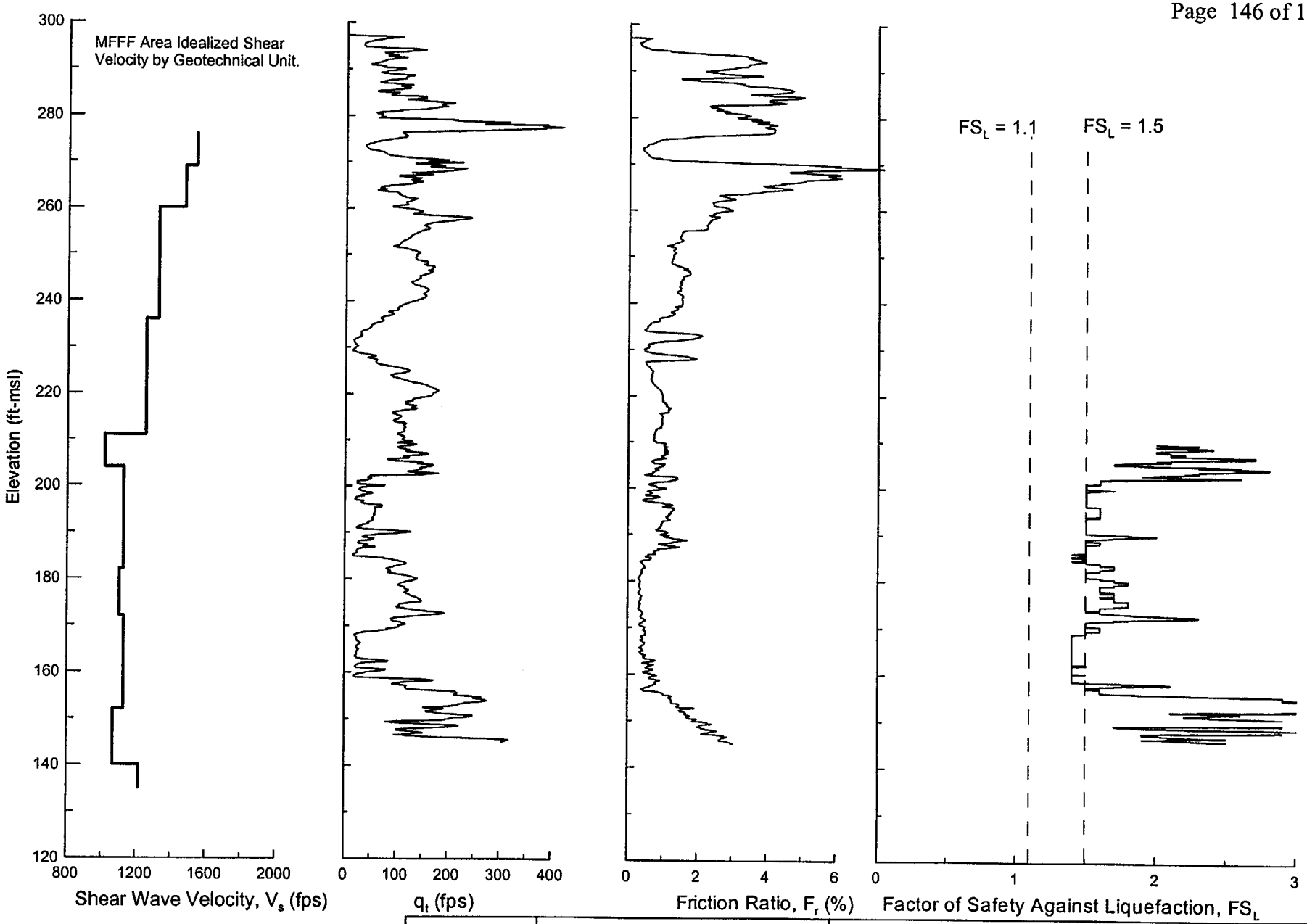
Factor of Safety Against Liquefaction
CPT-14
1886 Charleston 50th Percentile Motion
Idealized Shear Velocity Profile

Figure 8-4



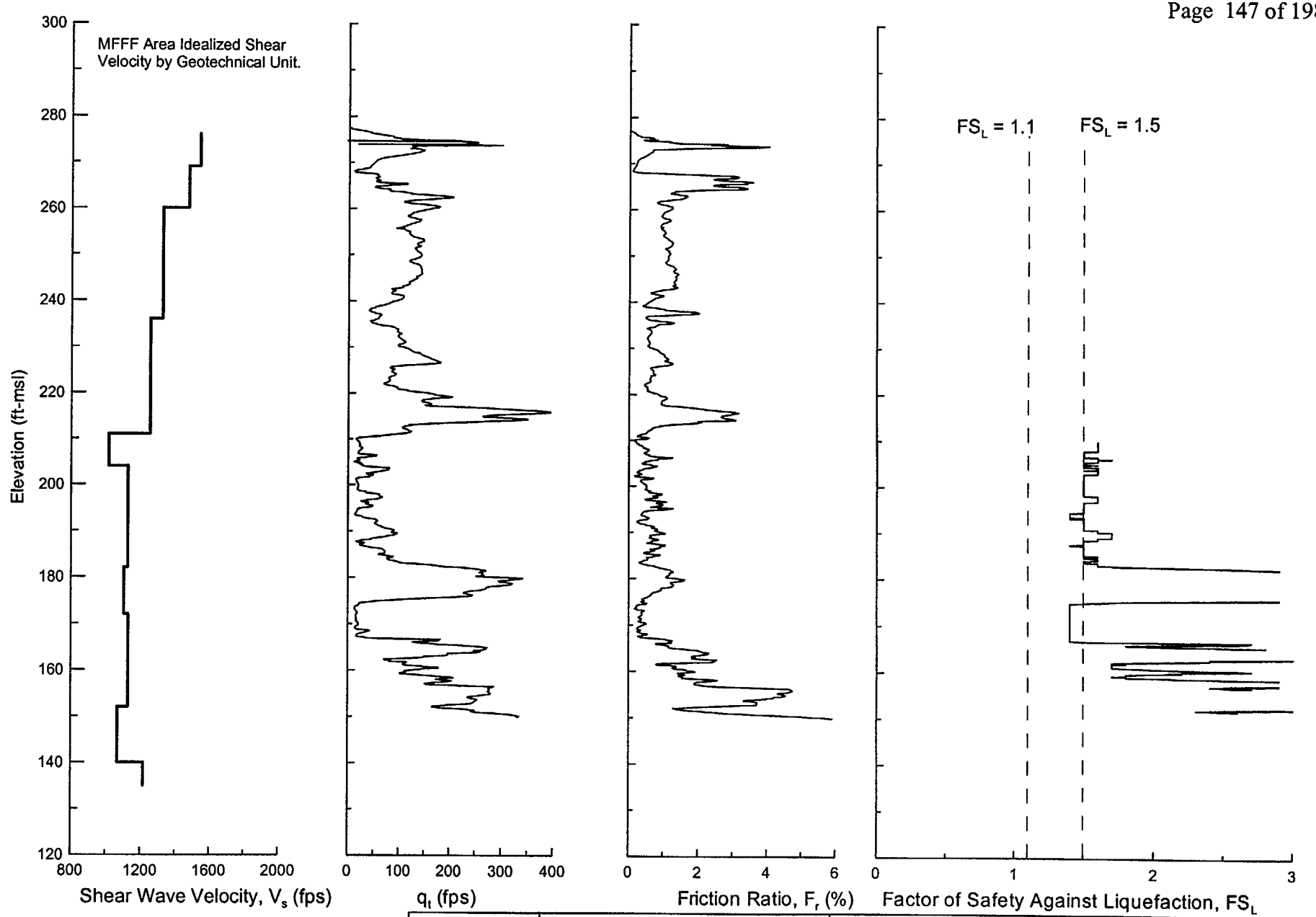
DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-21 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-5

CPT21.grf w/CPT-21_Data.xls & global shear vel.xls by jjt [8/8/01]

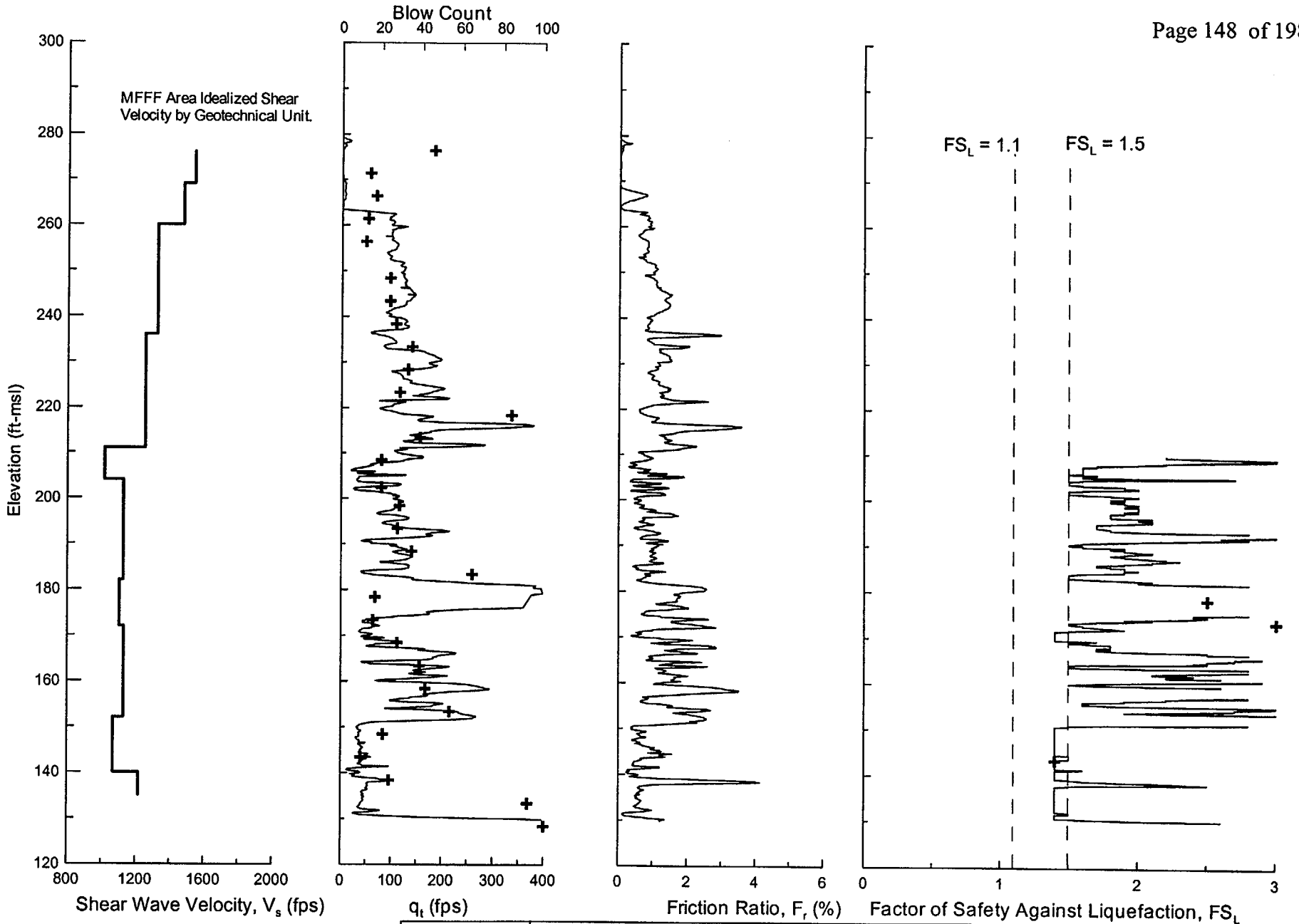


DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-22 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-6

CPT22.grf w/CPT-22_Data.xls, global shear vel.xls by fjw/jjt [8/8/01]



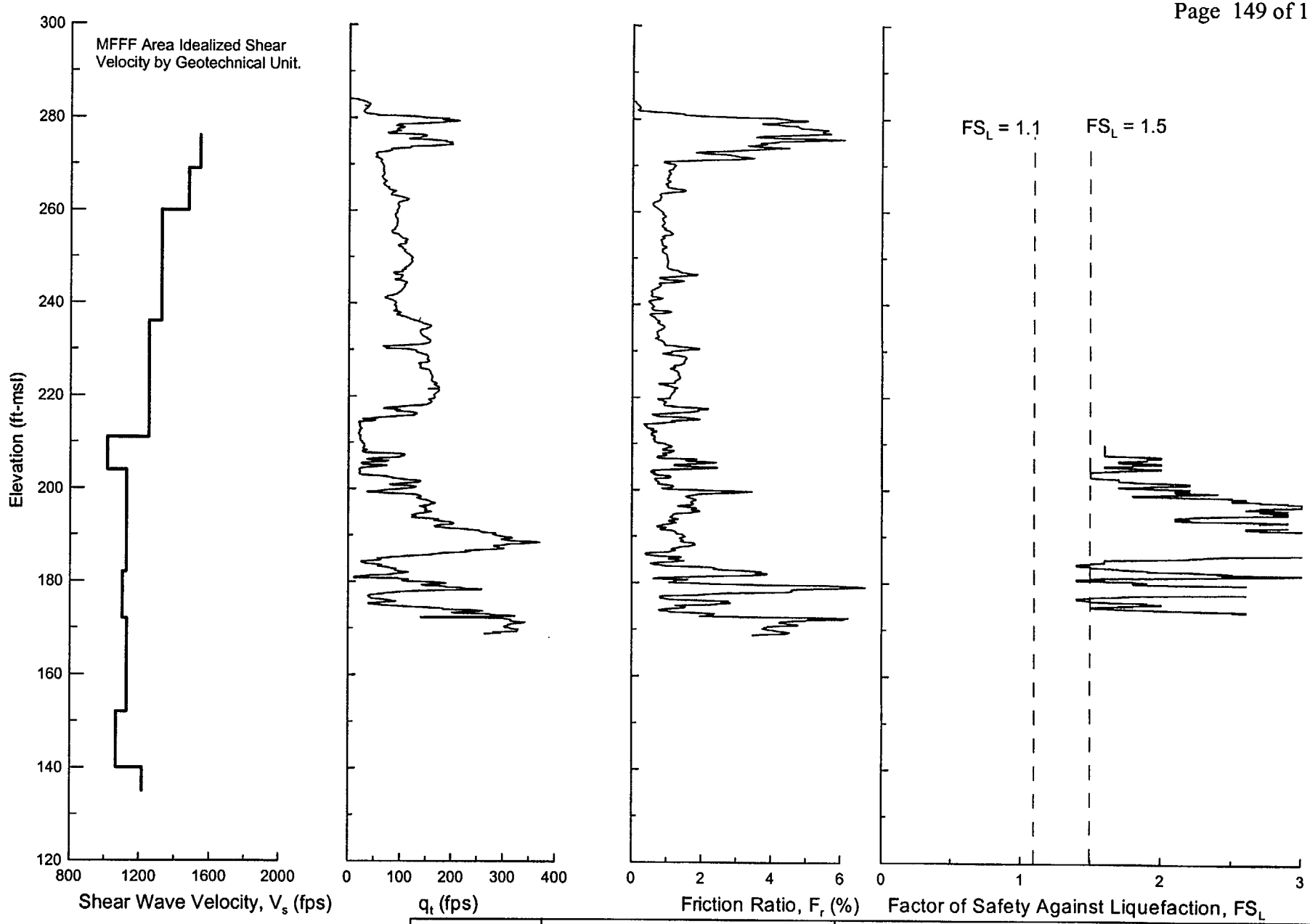
CPT27.grf w/CPT-27_Data.xls & global shear vel.xls by fjw [8/8/01]	DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-27 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-7



Crosses indicate SPT values.

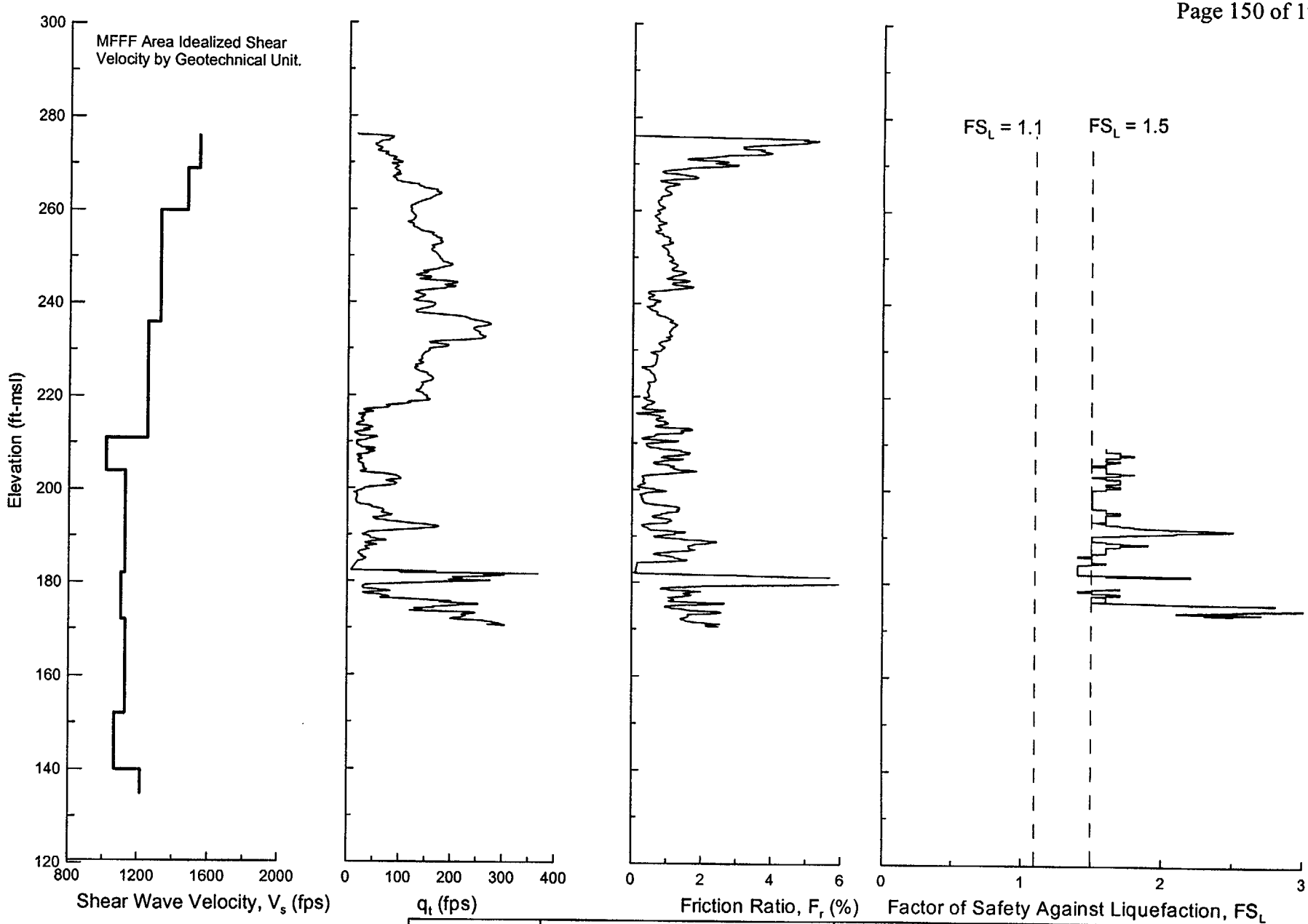
CPT28.grf w/CPT-28_Data.xls & global shear vel.xls,CPT-28.xls & BH-8_SPT_Data by jit [8/8/01]

DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-28 and BH-8 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-8



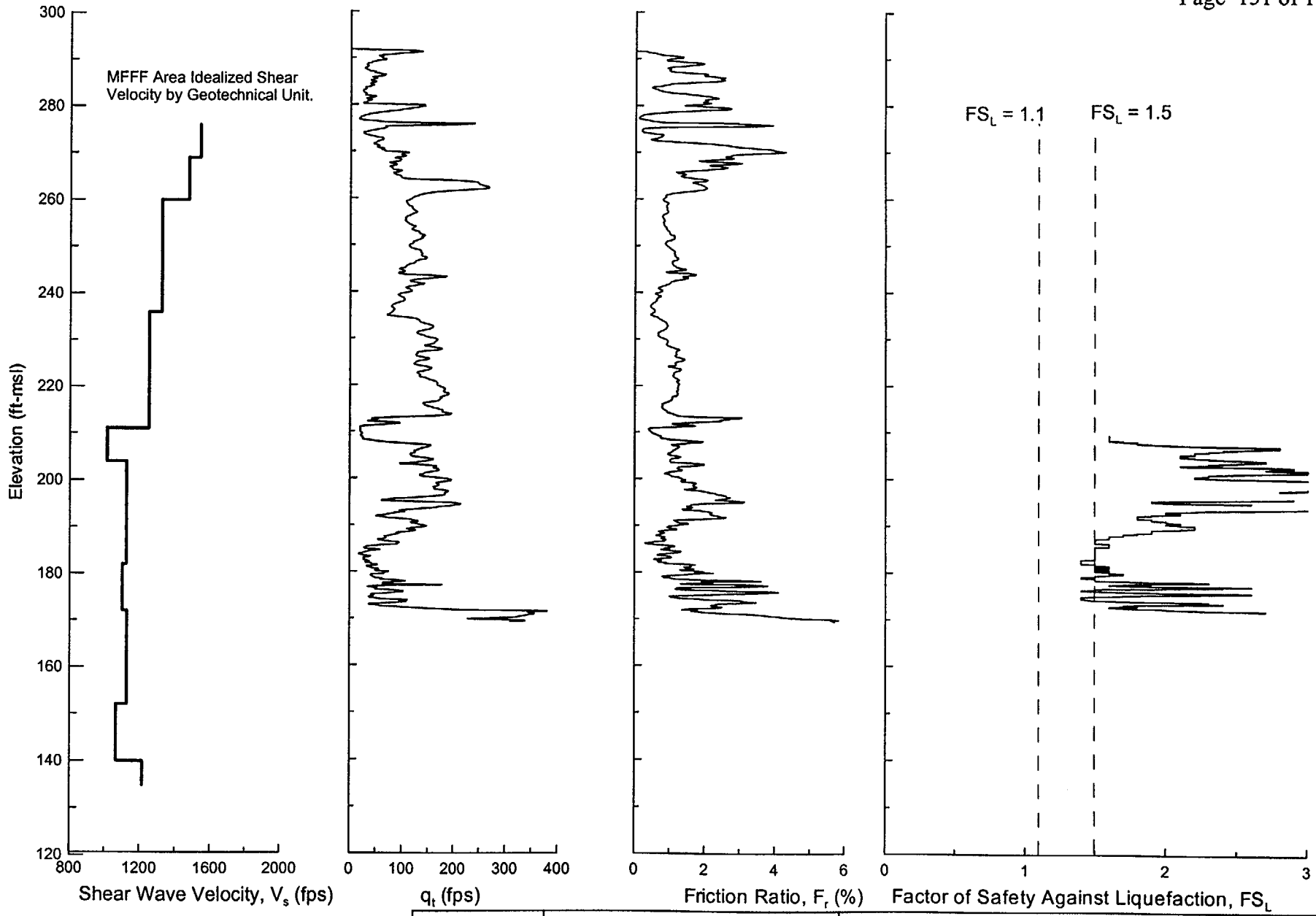
DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-47 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-9

CPT47.grf w/CPT-47_Data.xls & global shear vel.xls by fjw [8/8/01]



DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-48 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-10

CPT48.grf w/CPT-48_Data.xls & global shear vel.xls by fjw/jjt [8/8/01]



CPT49.grf w/CPT-49_Data.xls & global shear vel.xls by fjw [8/8/01]

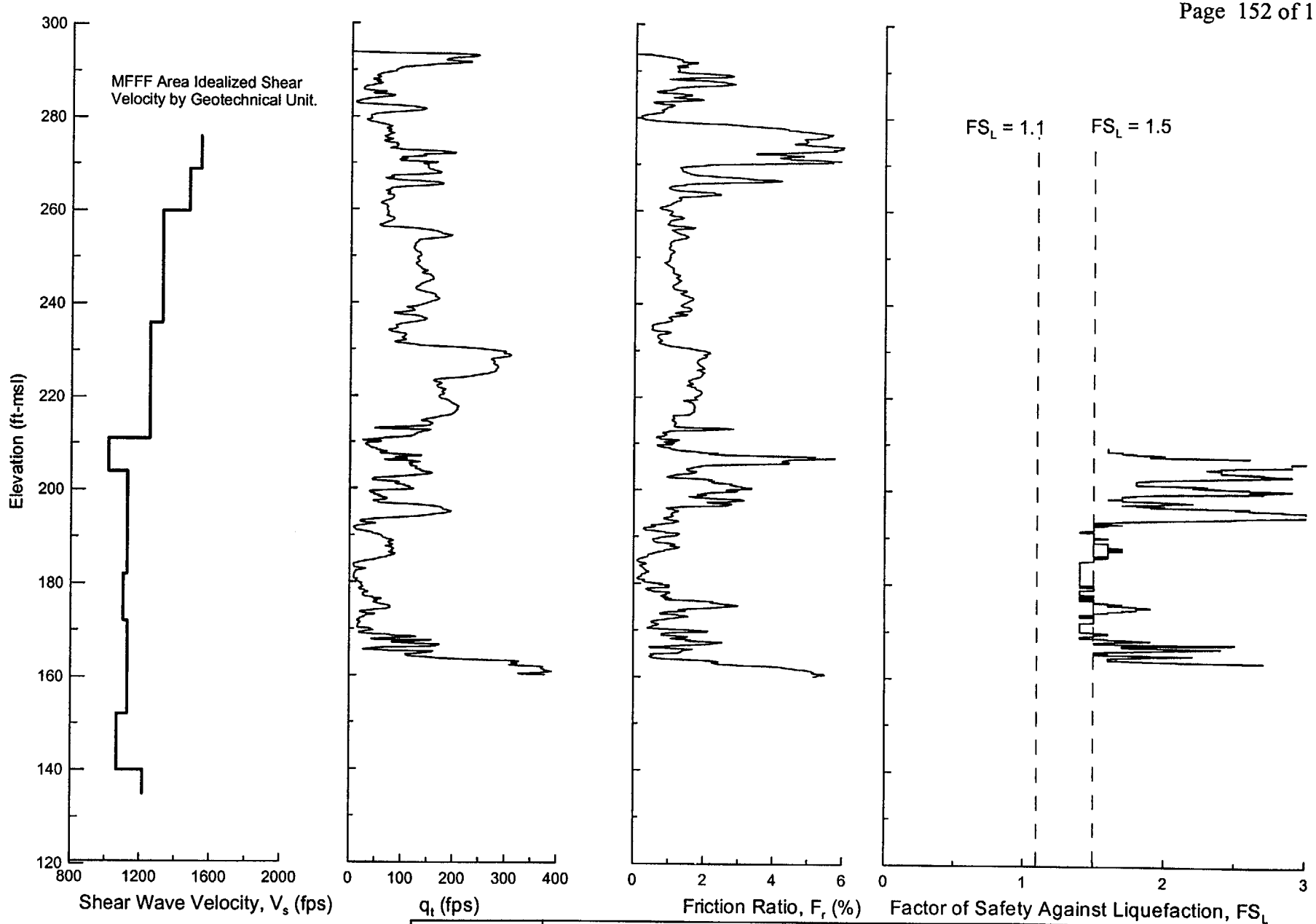
DUKE COGEMA STONE & WEBSTER

MOX Fuel Fabrication Facility
US Department of Energy CH

J.O. 08716

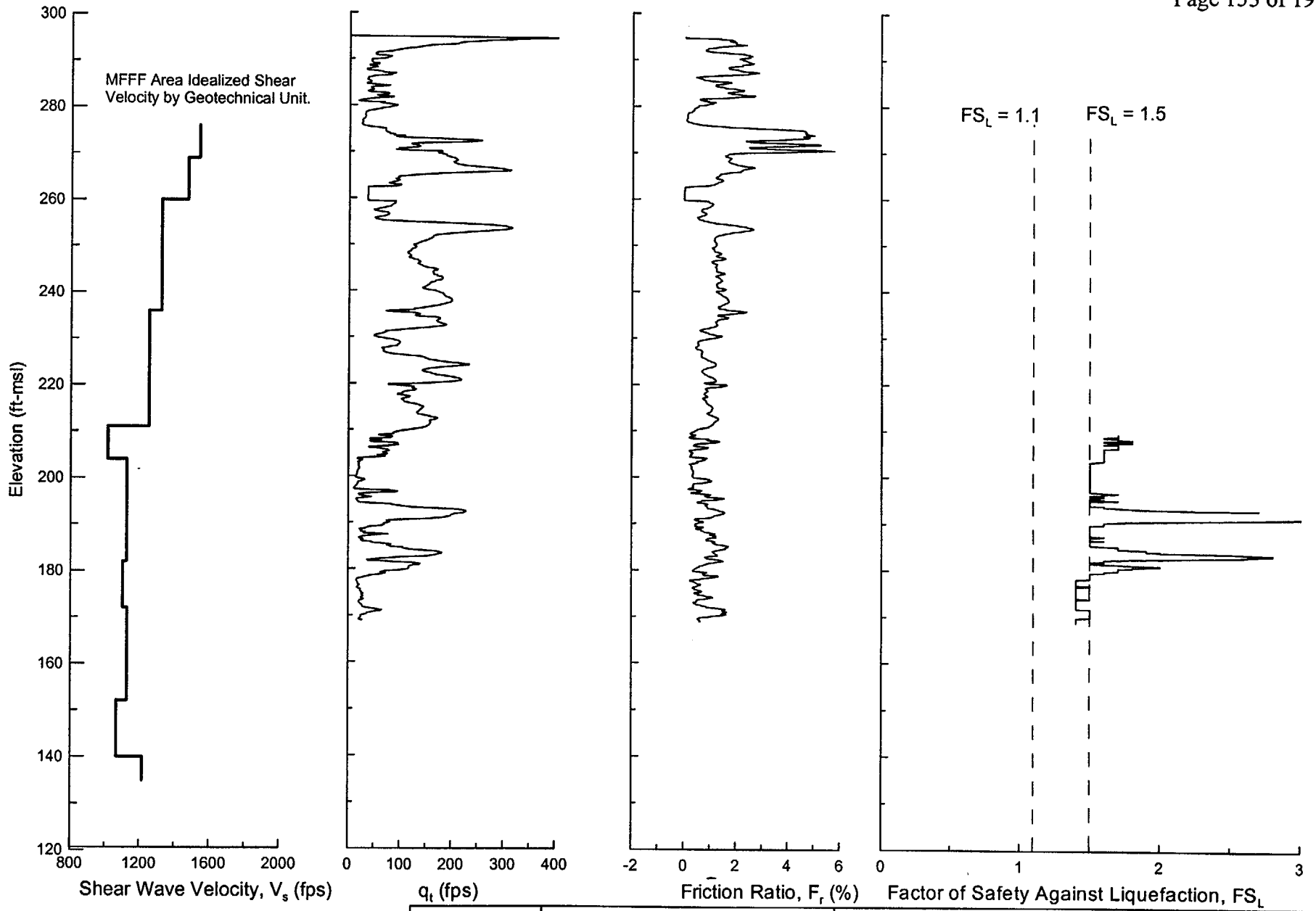
Factor of Safety Against Liquefaction
CPT-49
1886 Charleston 50th Percentile Motion
Idealized Shear Velocity Profile

Figure 8-11



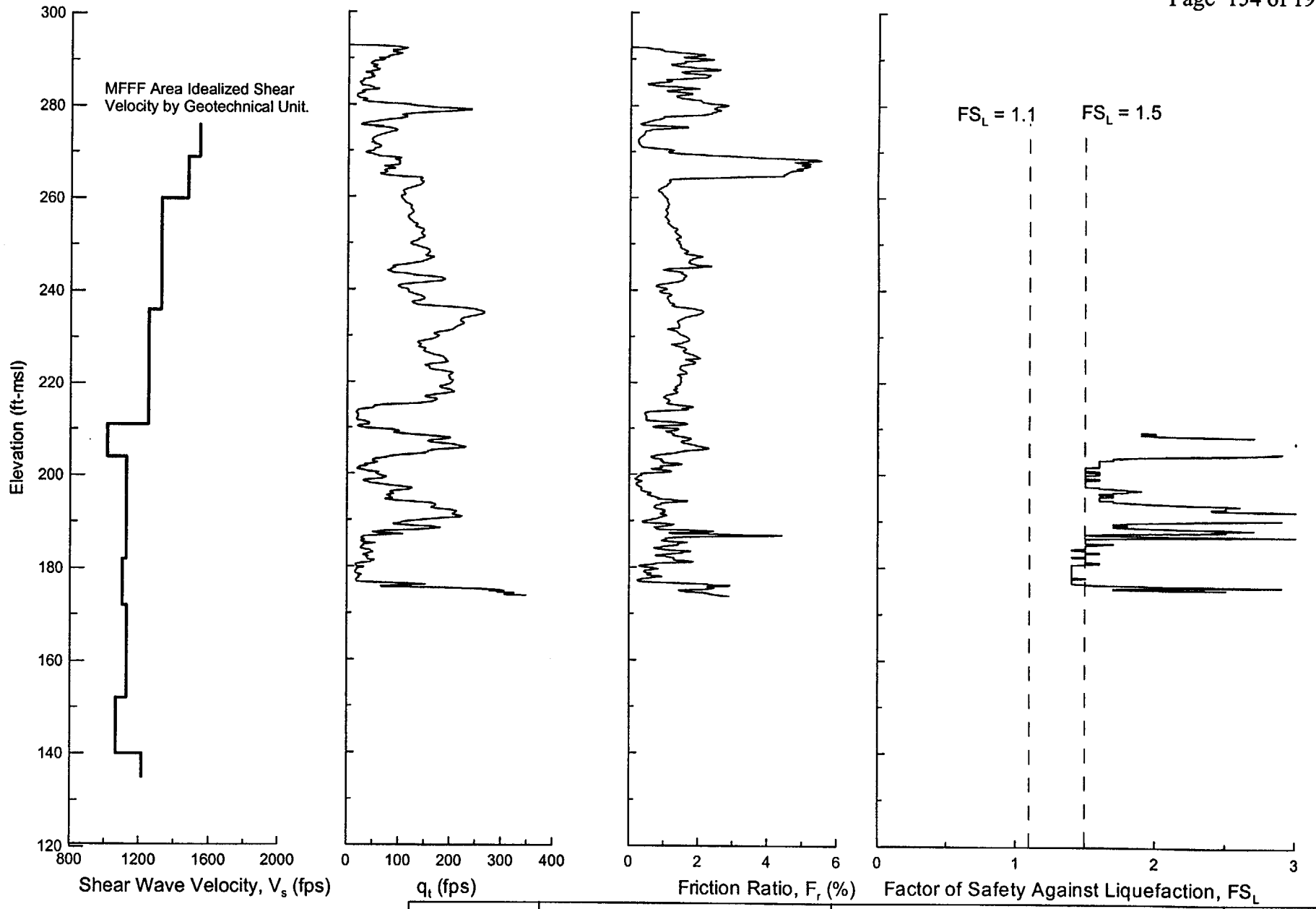
DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-50 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-12

CPT50.grf w/CPT-50_Data.xls & global shear vel.xls by fjw/jjt [8/8/01]



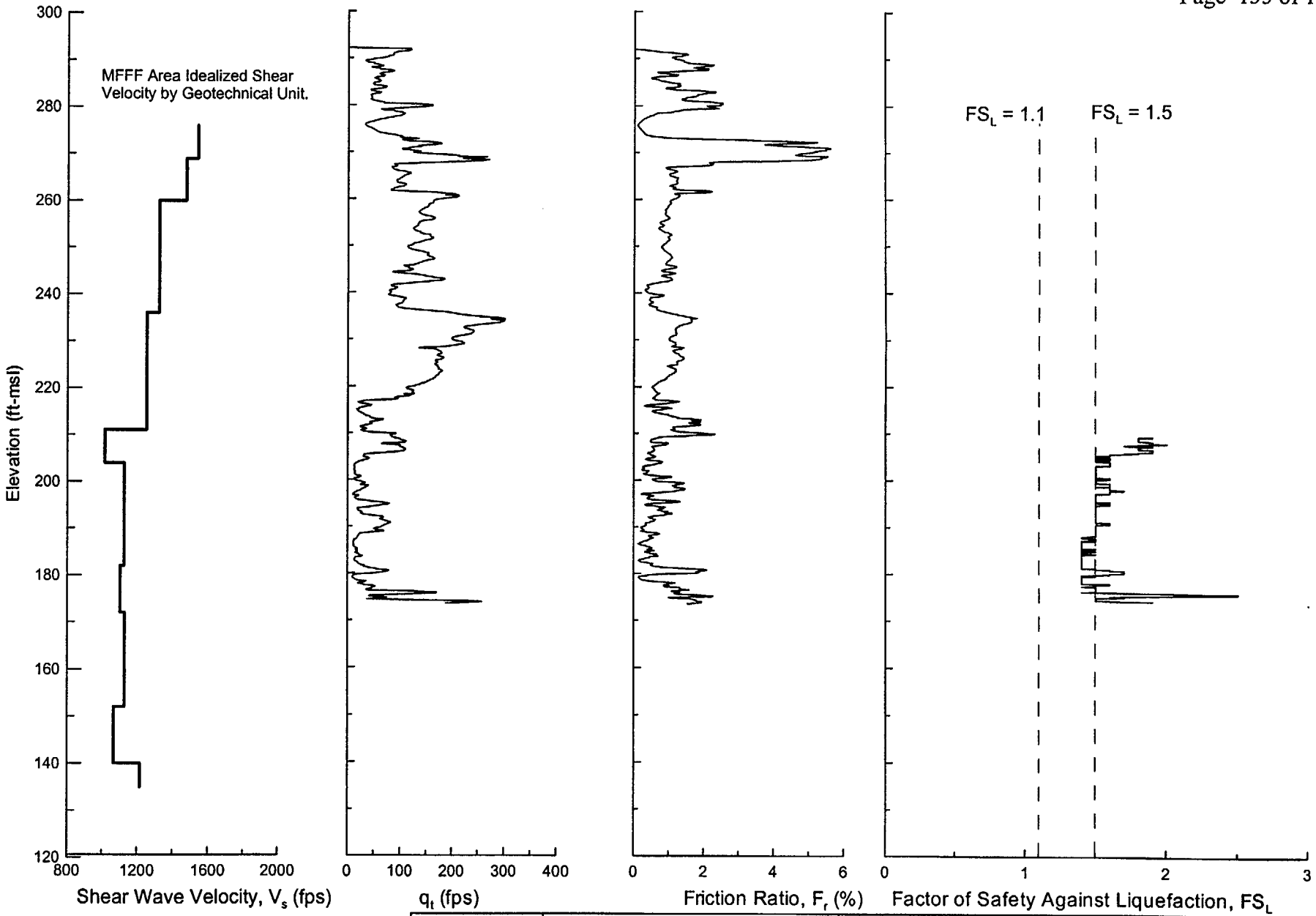
DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-51 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-13

CPT51.grf w/CPT-51_Data.xls & global shear vel.xls by fjw [8/8/01]



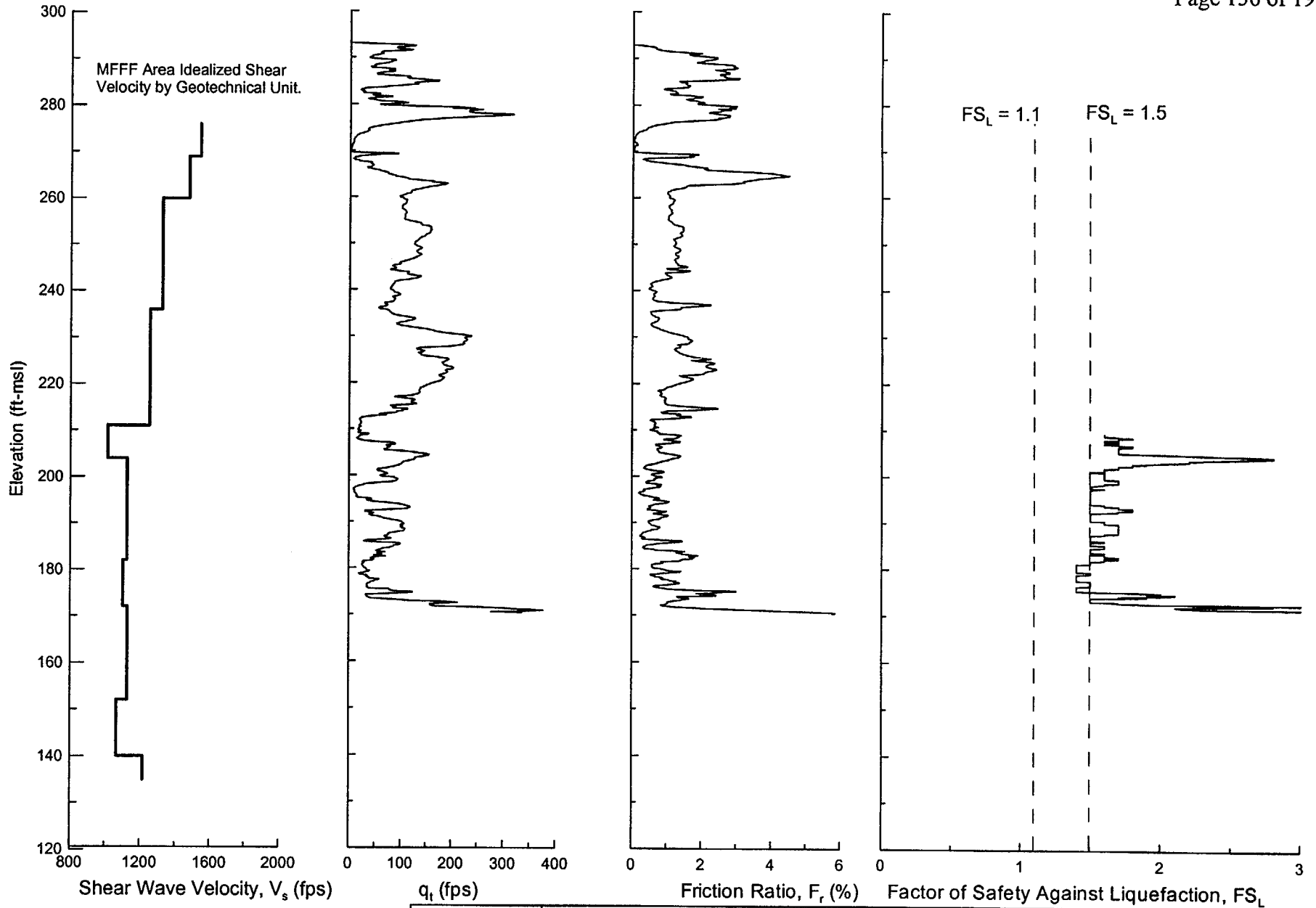
DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-52 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-14

CPT52.grf w/CPT-52_Data.xls & global shear vel.xls by fjw [8/8/01]



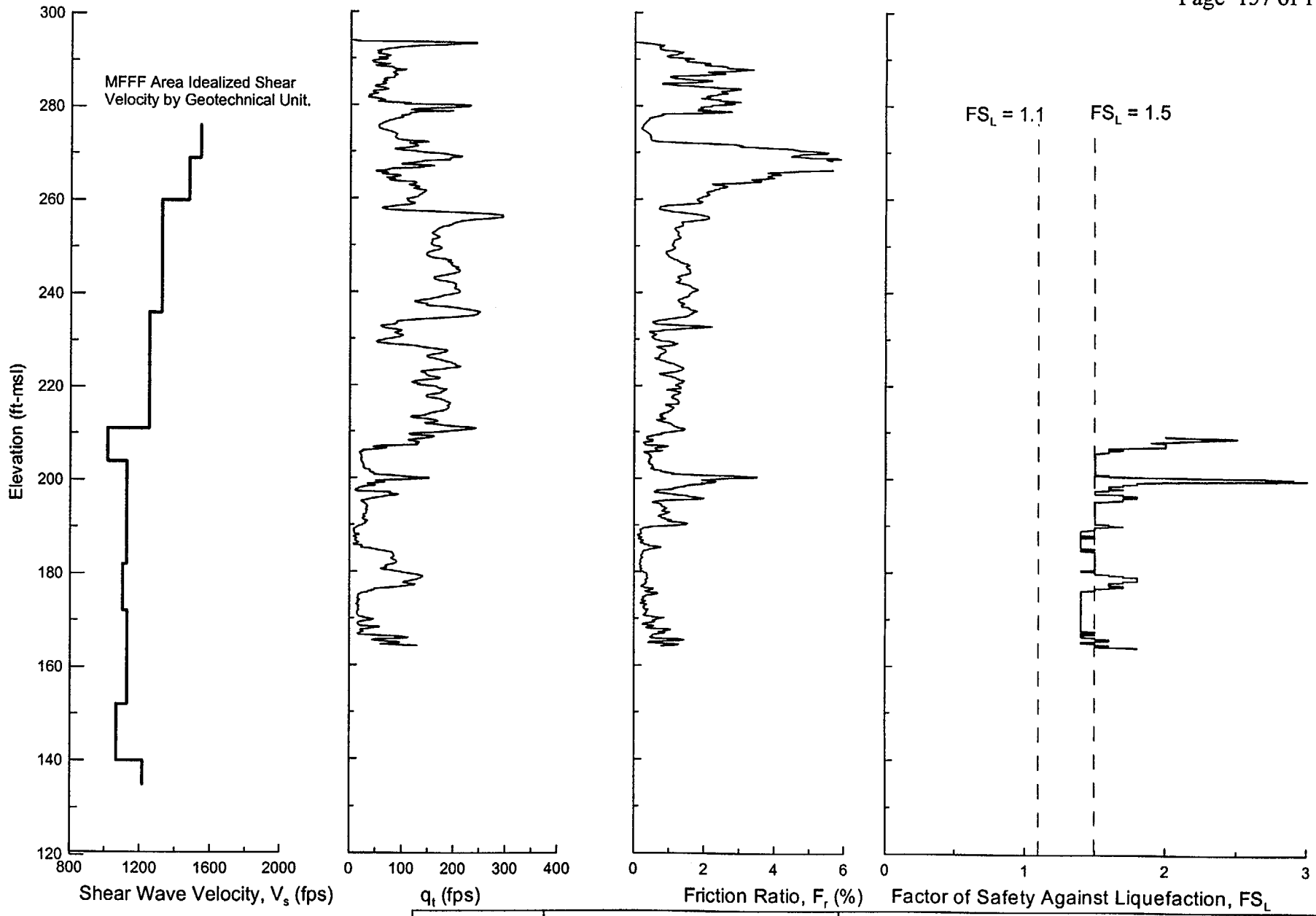
DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-53 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-15

CPT53.grf w/CPT-53_Data.xls & global shear vel.xls by fjw [8/8/01]



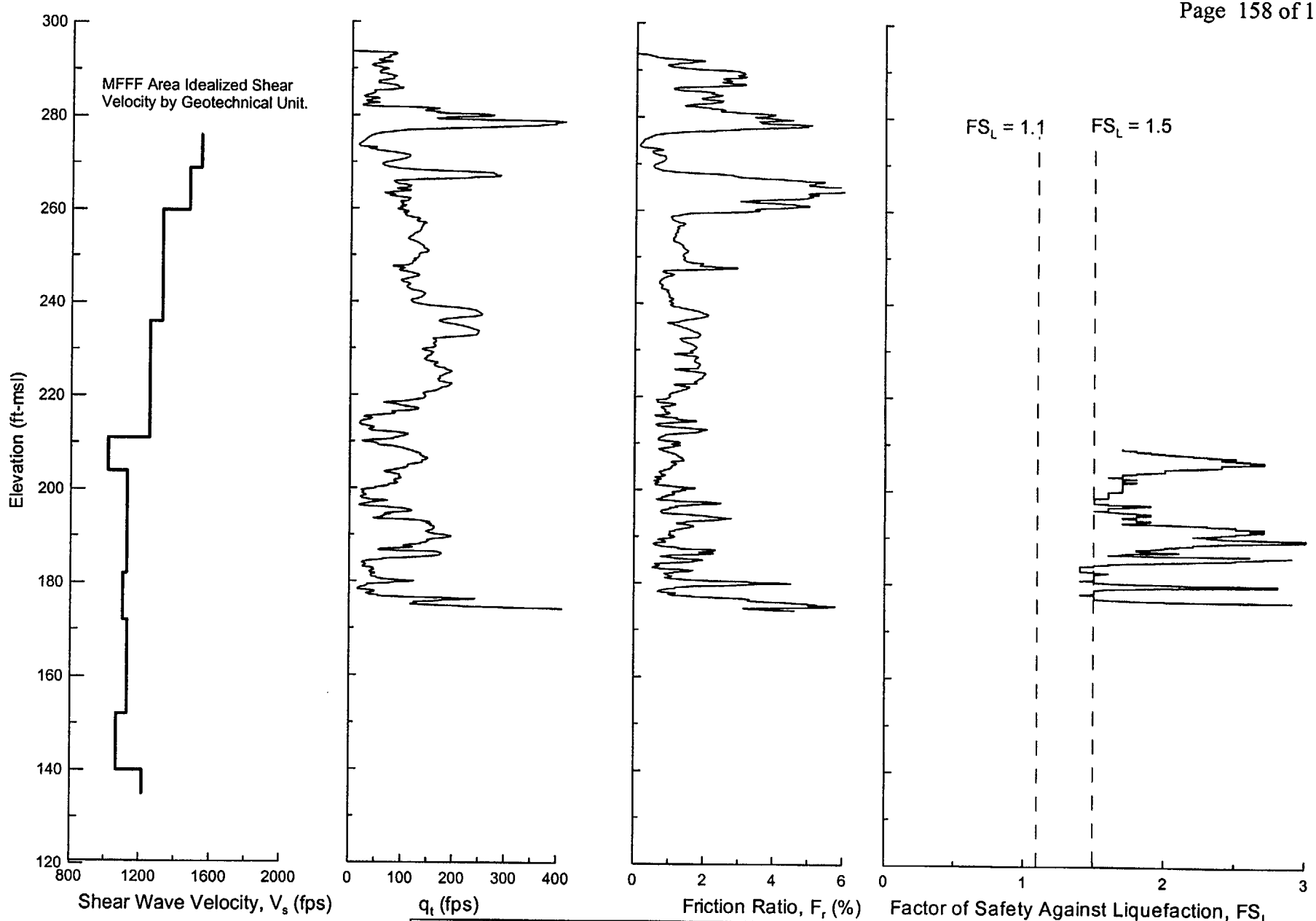
DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-54 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-16

CPT54.grf w/CPT-54_Data.xls & global shear vel.xls by fjw [8/8/01]



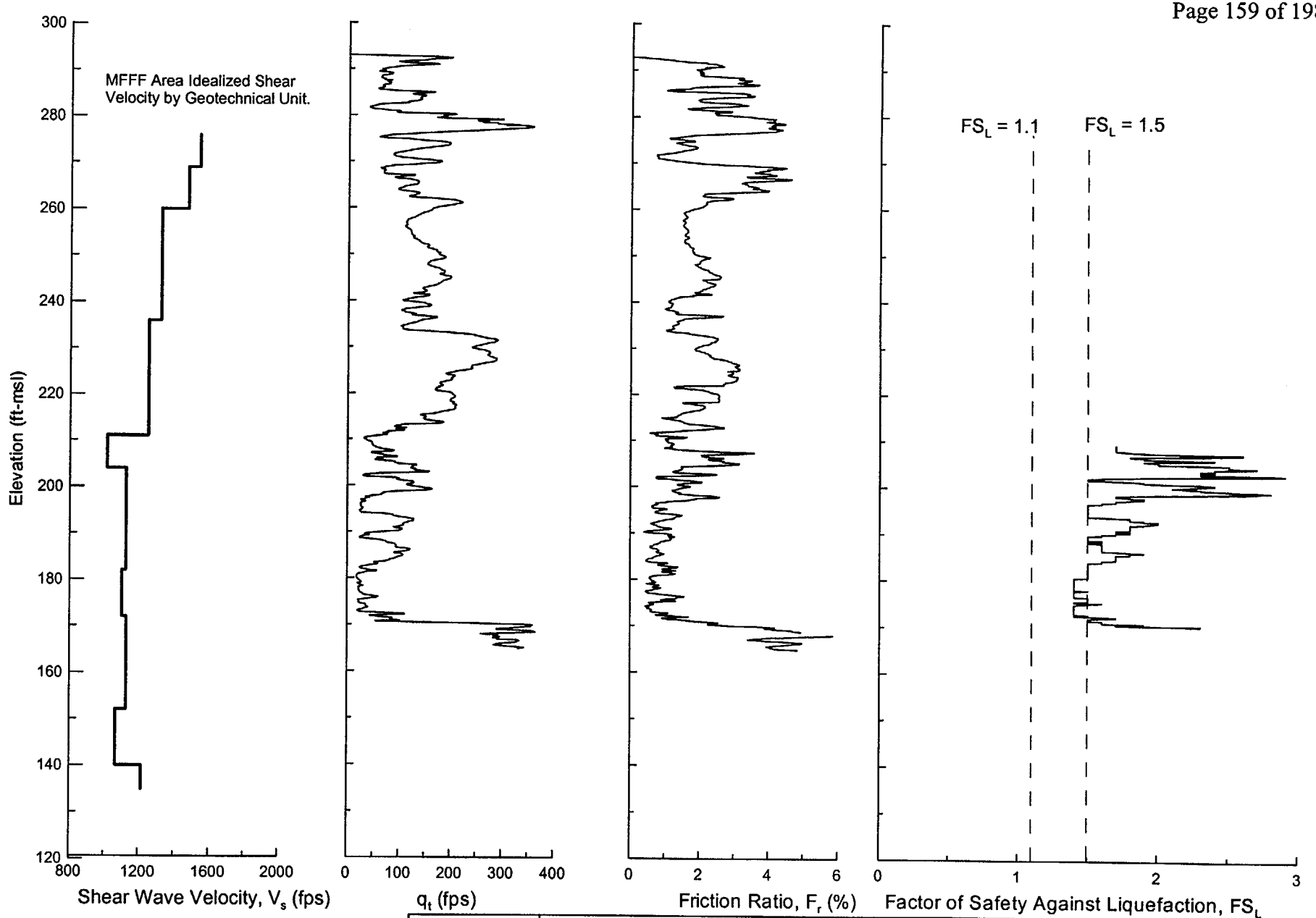
DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-55 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-17

CPT55.grf w/CPT-55_Data.xls & global shear vel.xls by fjw [8/8/01]



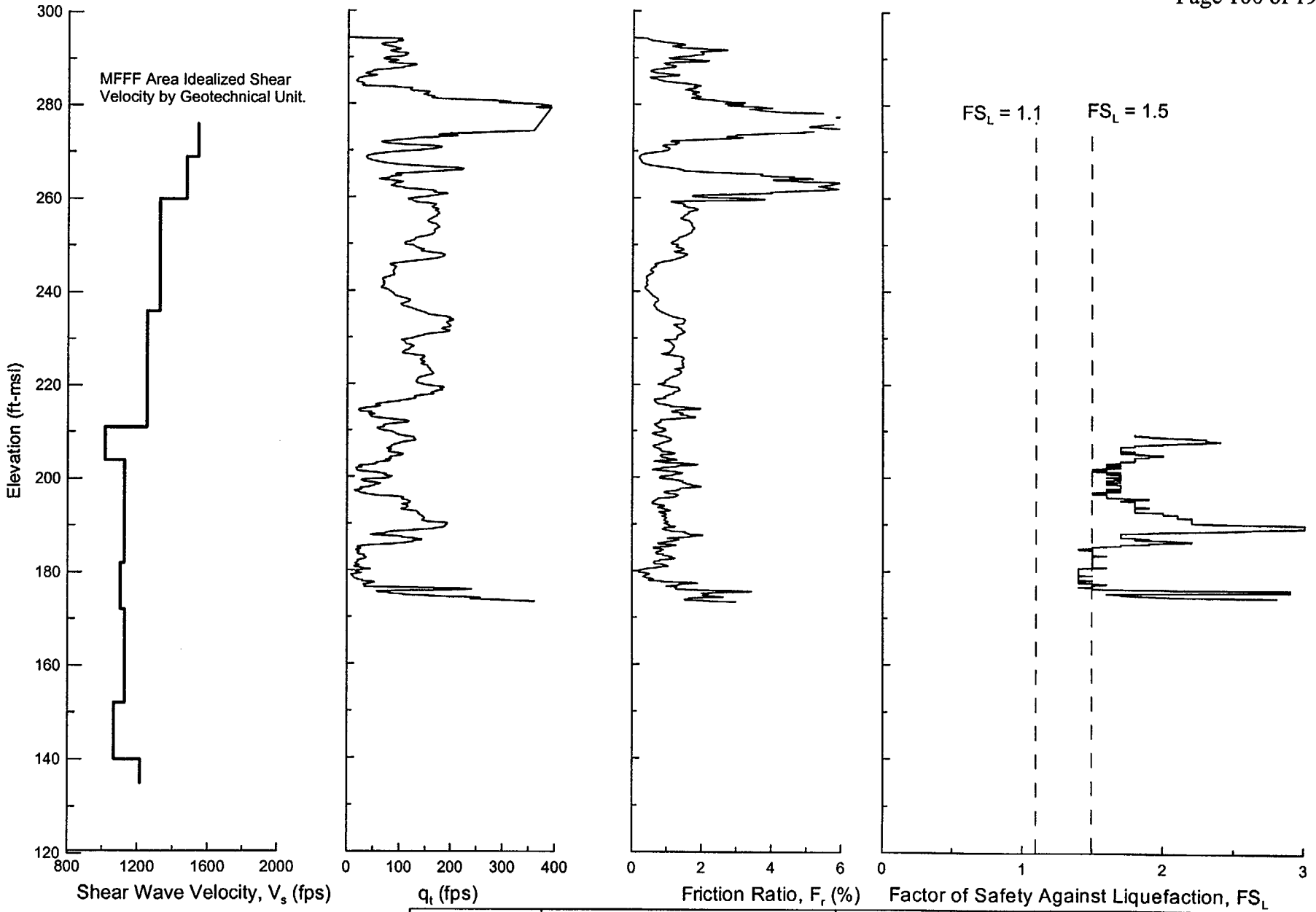
DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-56 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-18

CPT56.grf w/CPT-56_Data.xls & global shear vel.xls by jjt [8/8/01]



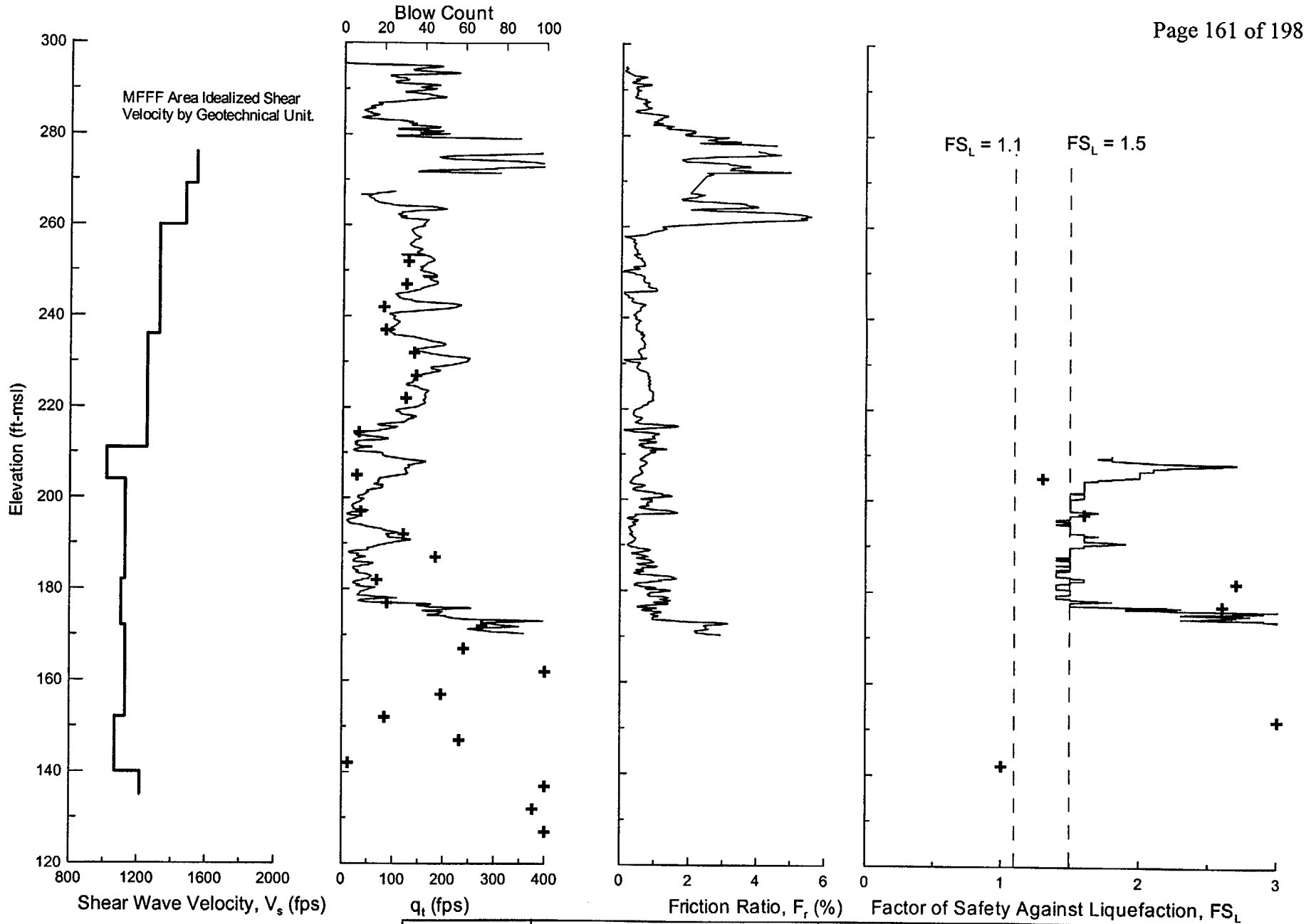
DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-57 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-19

CPT57.grf w/CPT-57_Data.xls & global shear vel.xls by jjt [8/8/01]



DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-58 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-20

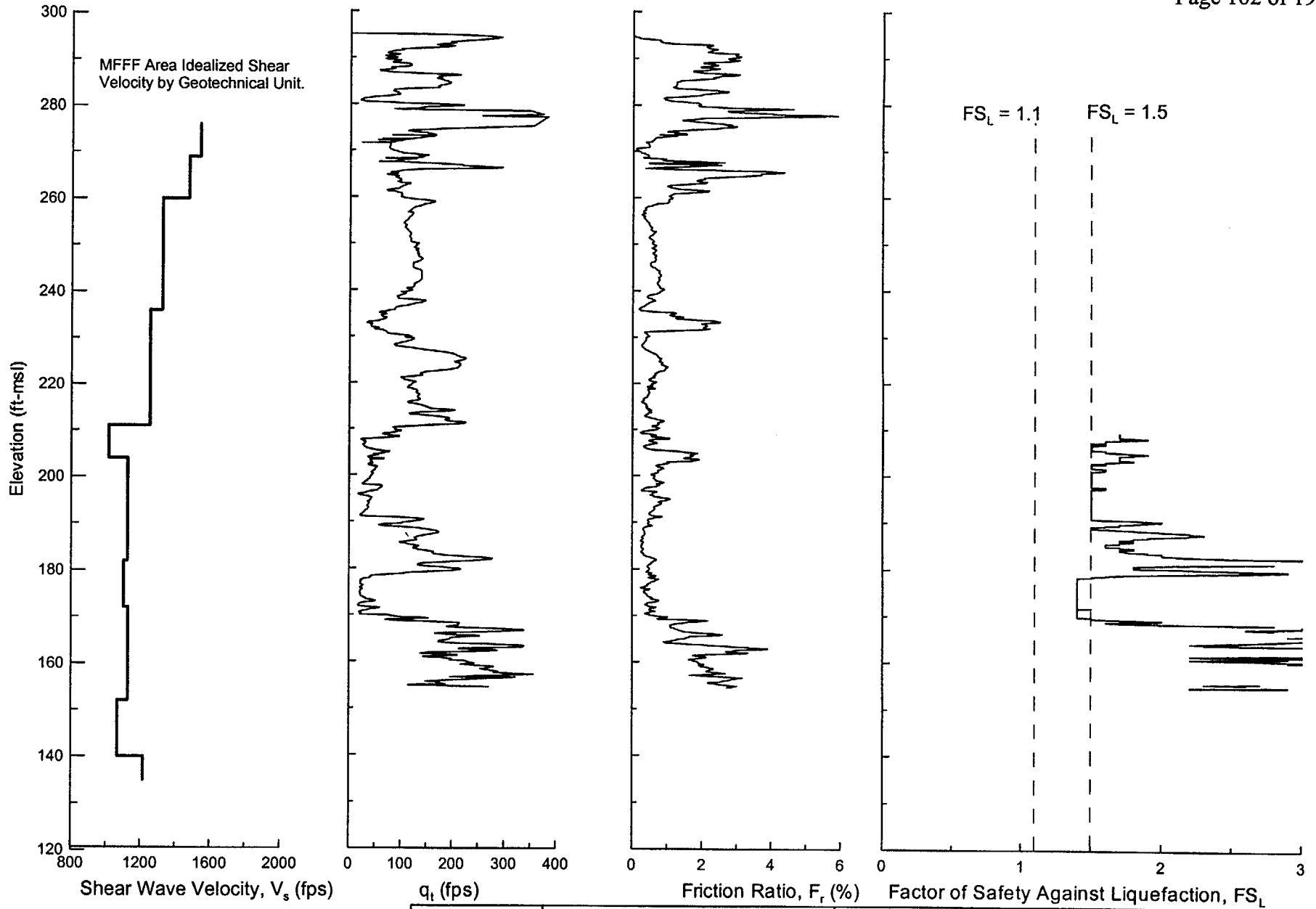
CPT58.grf w/CPT-58_Data.xls & global shear vel.xls by jjt [8/8/01]



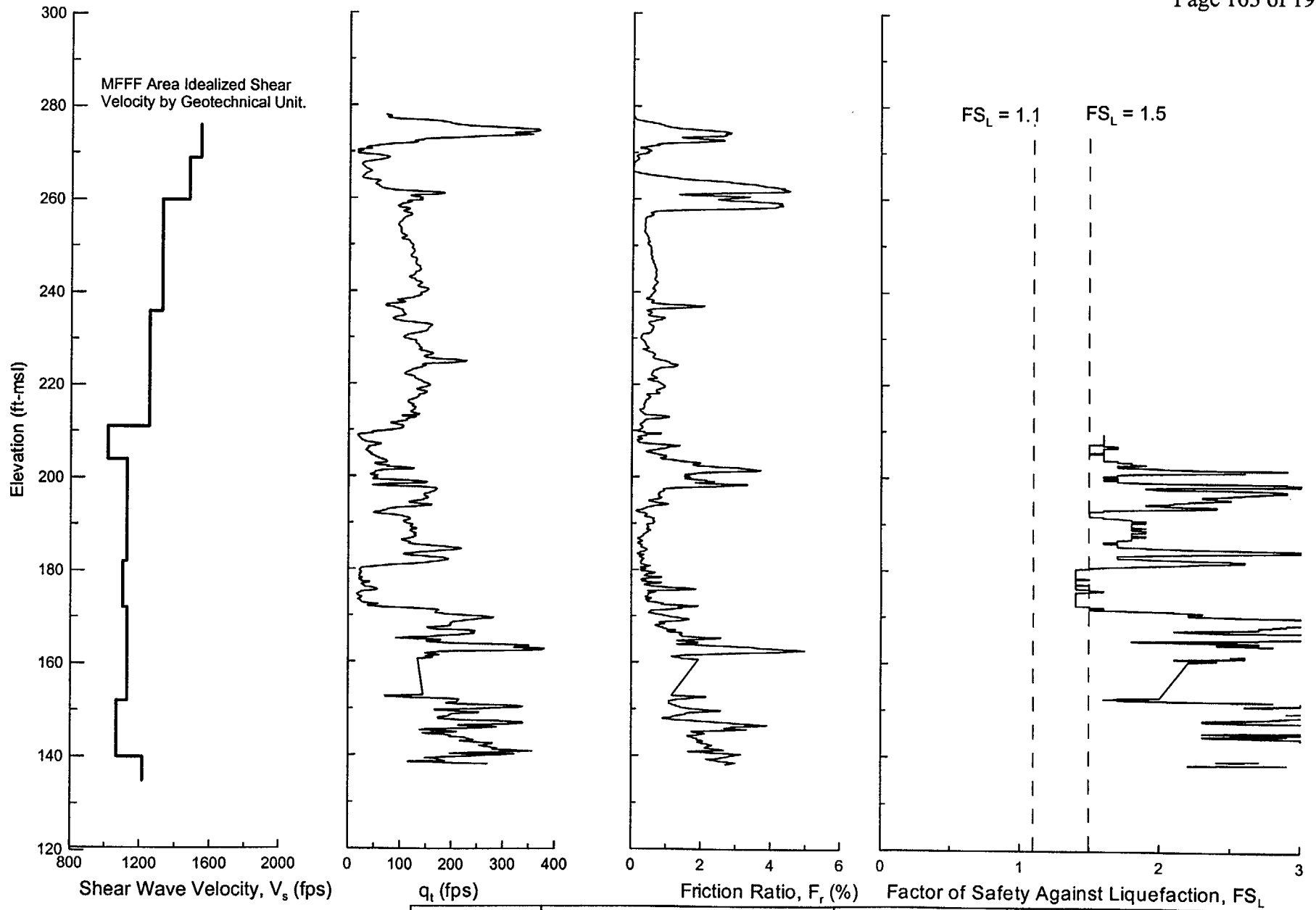
Crosses indicate SPT values.

DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-59 and BH-11 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-21

CPT59.grf w/CPT-59_Data.xls & global shear vel.xls & BH-11_SPT_Data.xls by jit [8/8/01]

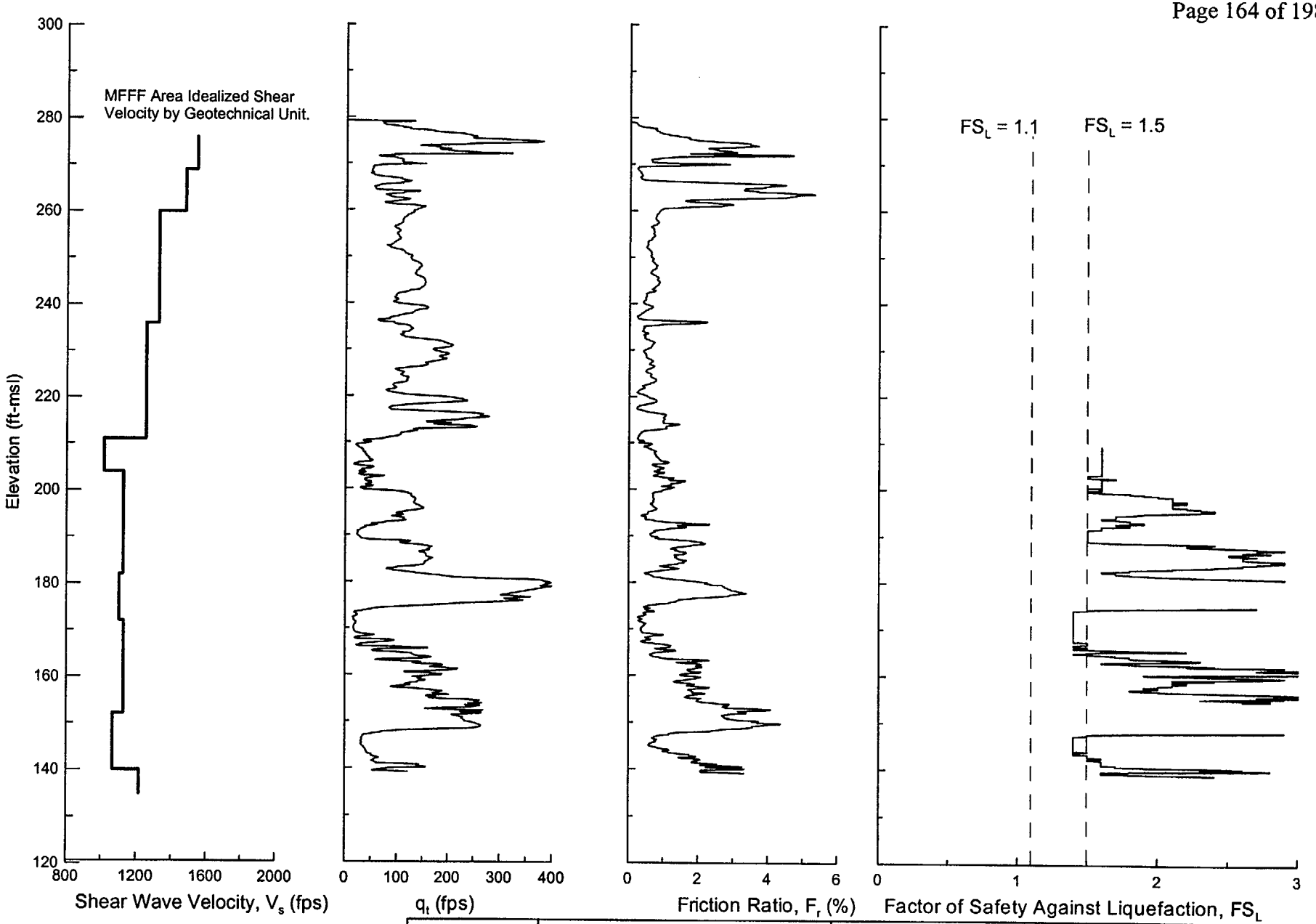


Cpt60.grf w/CPT-60_Data.xls & global shear vel.xls by jjt [8/8/01]	DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-60 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-22

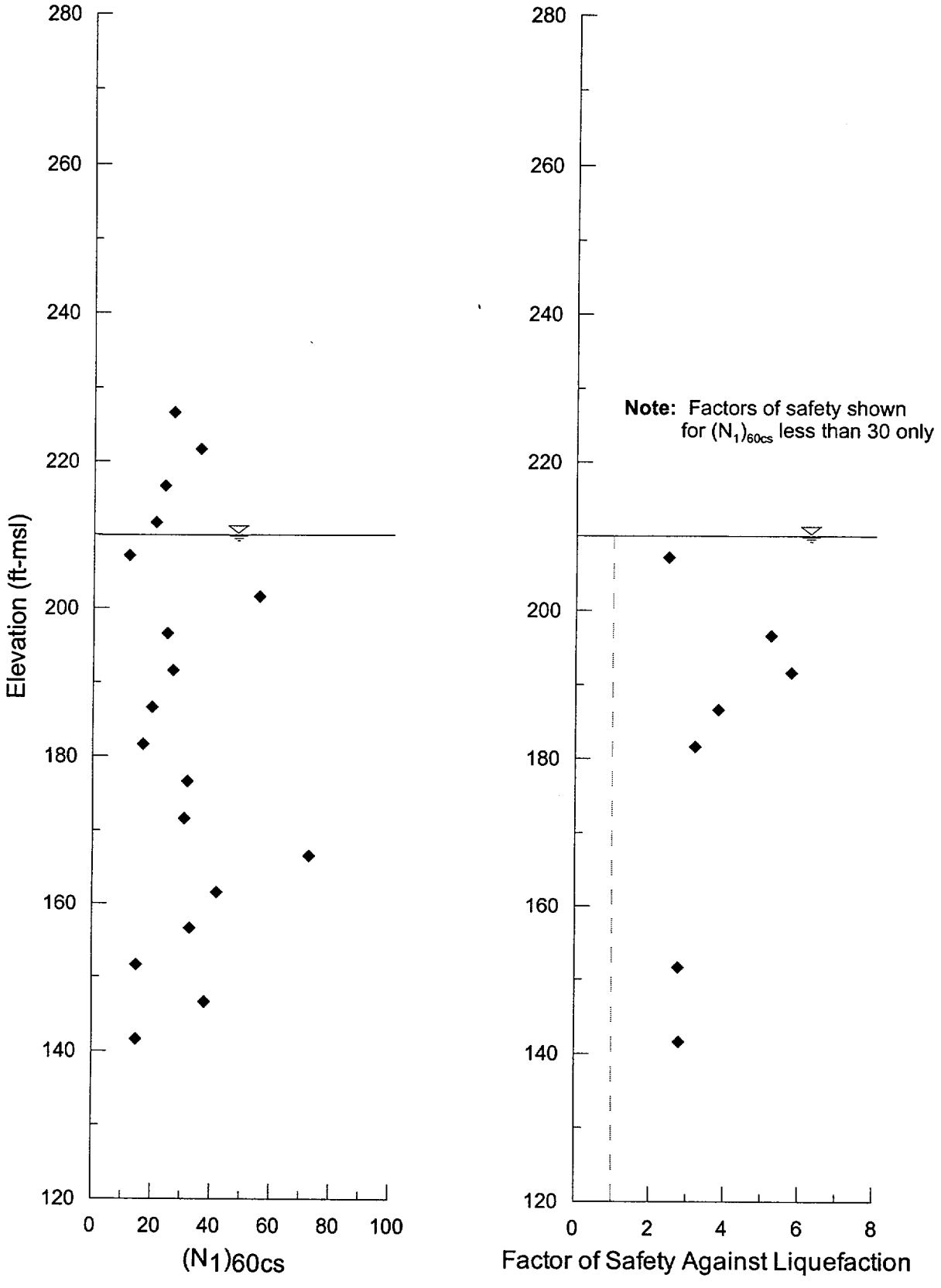


DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-63 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-23

Cpt63.grf w/CPT-63_Data.xls & global shear vel.xls by jjt [8/8/01]

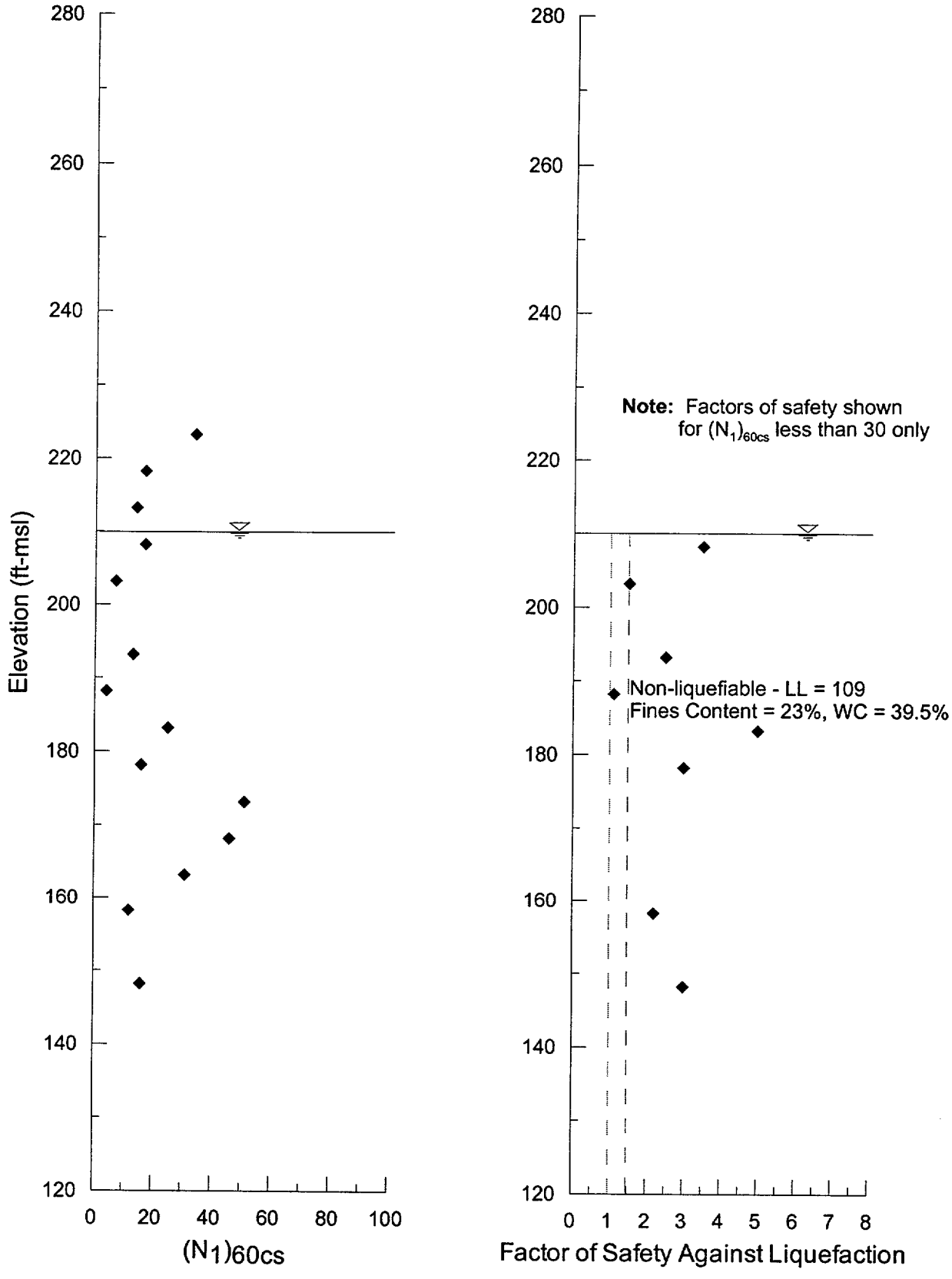


Cpt64.grf w/CPT-64_Data.xls & global shear vel.xls by jjt [8/8/01]	DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-64 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-24



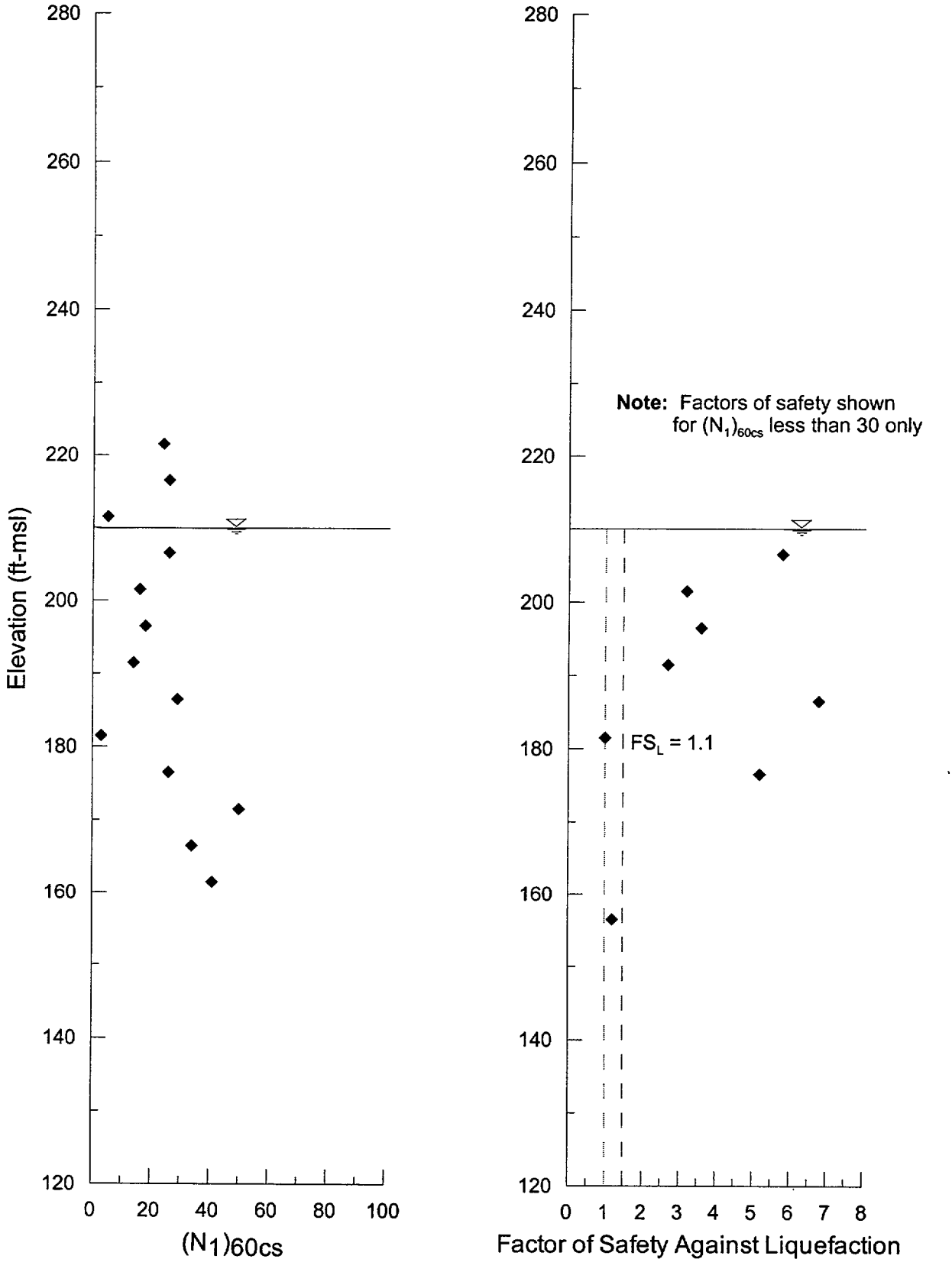
BH-4.GRF w/BH-4_SPT_Data.xls by fjw 8/6/01

DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **Duke Cogema Stone & Webster** J.O. 08716	Factor of Safety Against Liquefaction BH-4 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-25



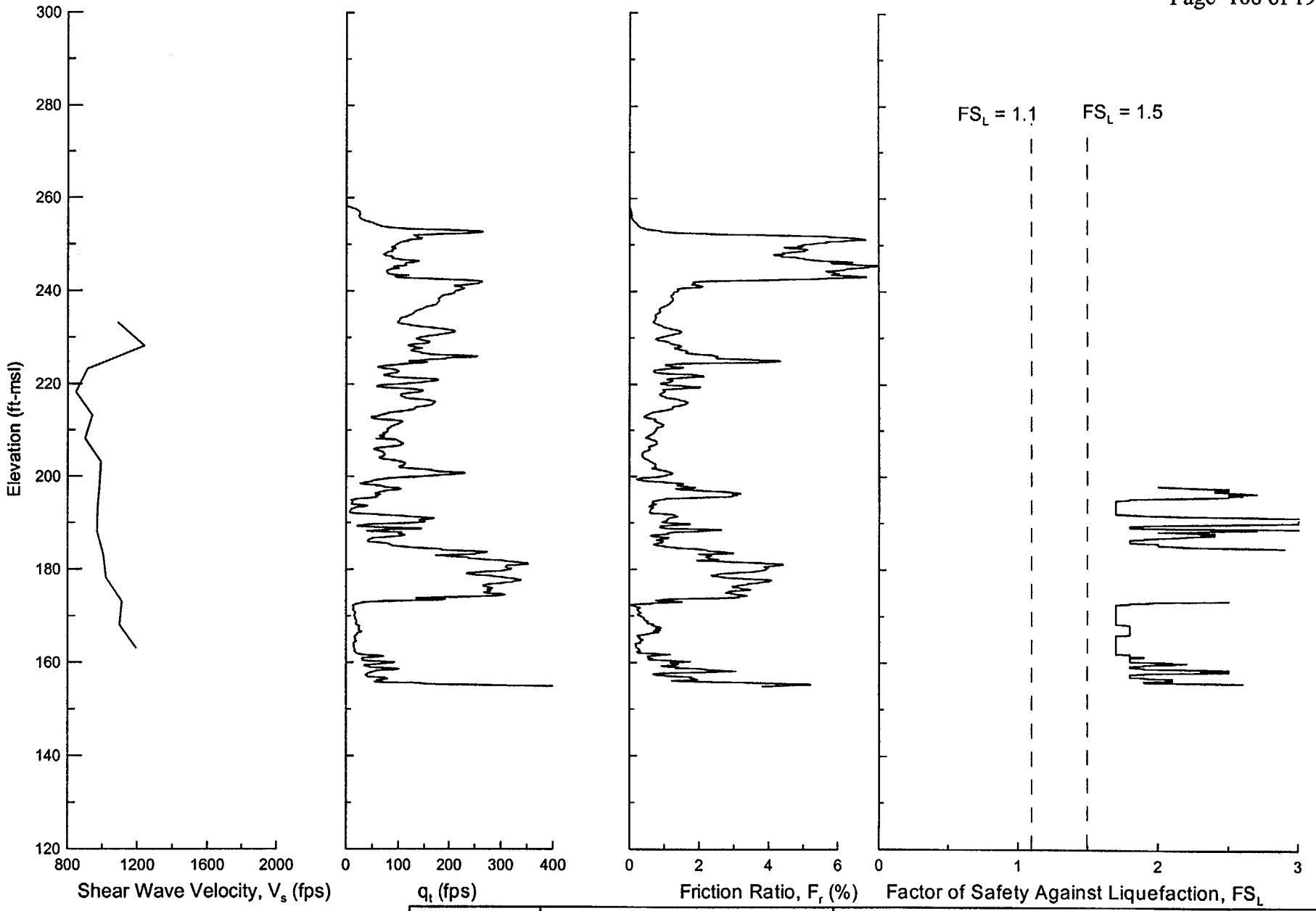
BH-12.GRF w/BH-12_SPT_Data.xls by ljw 8/8/01

DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **Duke Cogema Stone & Webster** J.O. 08716	Factor of Safety Against Liquefaction BH-12 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-26



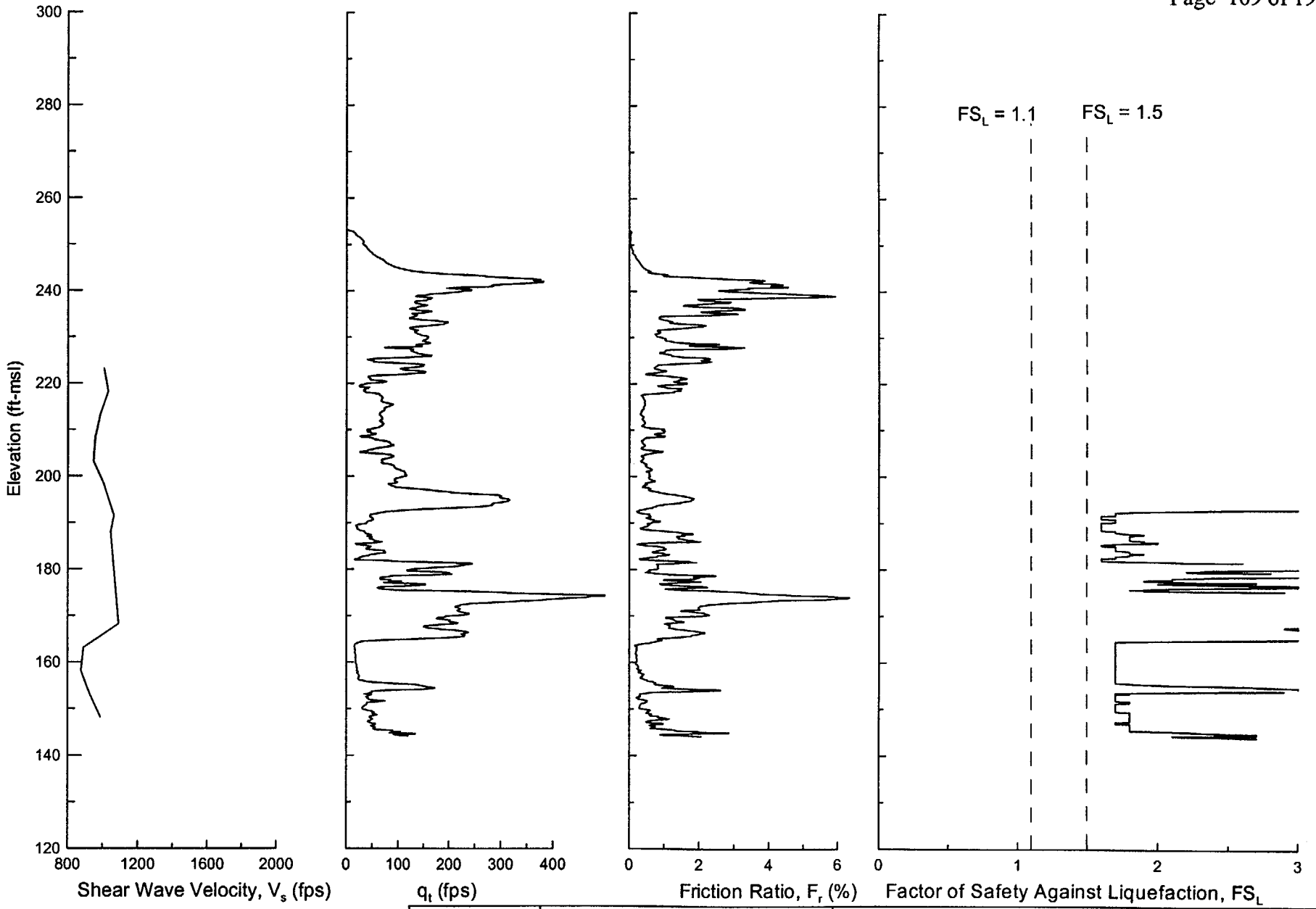
BH-13.GRF w/BH-13_SPT_Data.xls by fjw 8/8/01

DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **Duke Cogema Stone & Webster** J.O. 08716	Factor of Safety Against Liquefaction BH-13 1886 Charleston 50th Percentile Motion Idealized Shear Velocity Profile	Figure 8-27



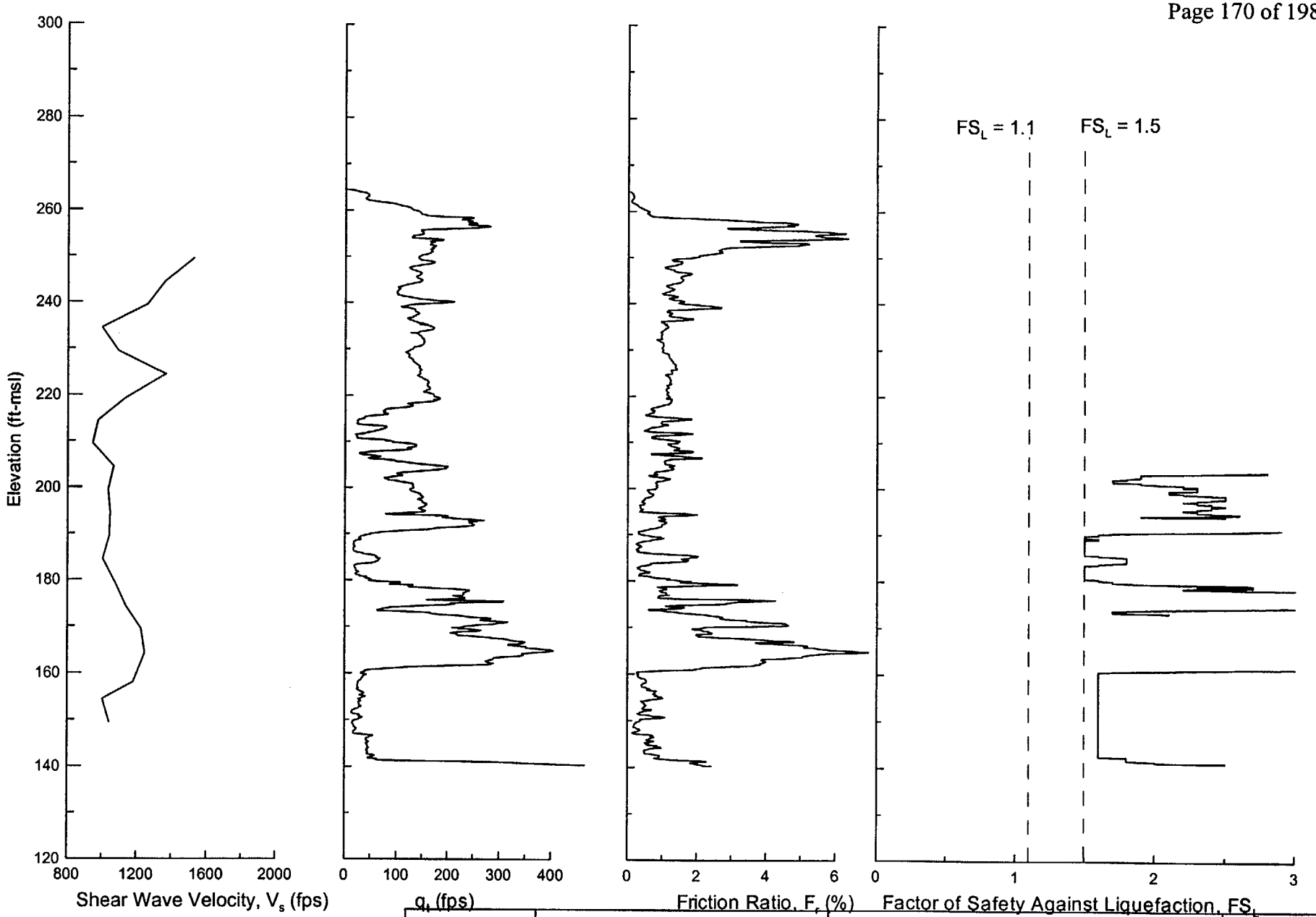
DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-1 PC3+ Individual S-CPT Profile	Figure 8-28

CPT-1-CP.grf w/CPT-1-P_Data.xls & Seismic Shear.xls by jjt 7/16/01



DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-3 PC3+ Individual S-CPT Profile	Figure 8-29

CPT-3-P.grf w/CPT-3-P_Data.xls & Seismic Shear.xls by jjt [7/16/01]



DUKE COGEMA STONE & WEBSTER

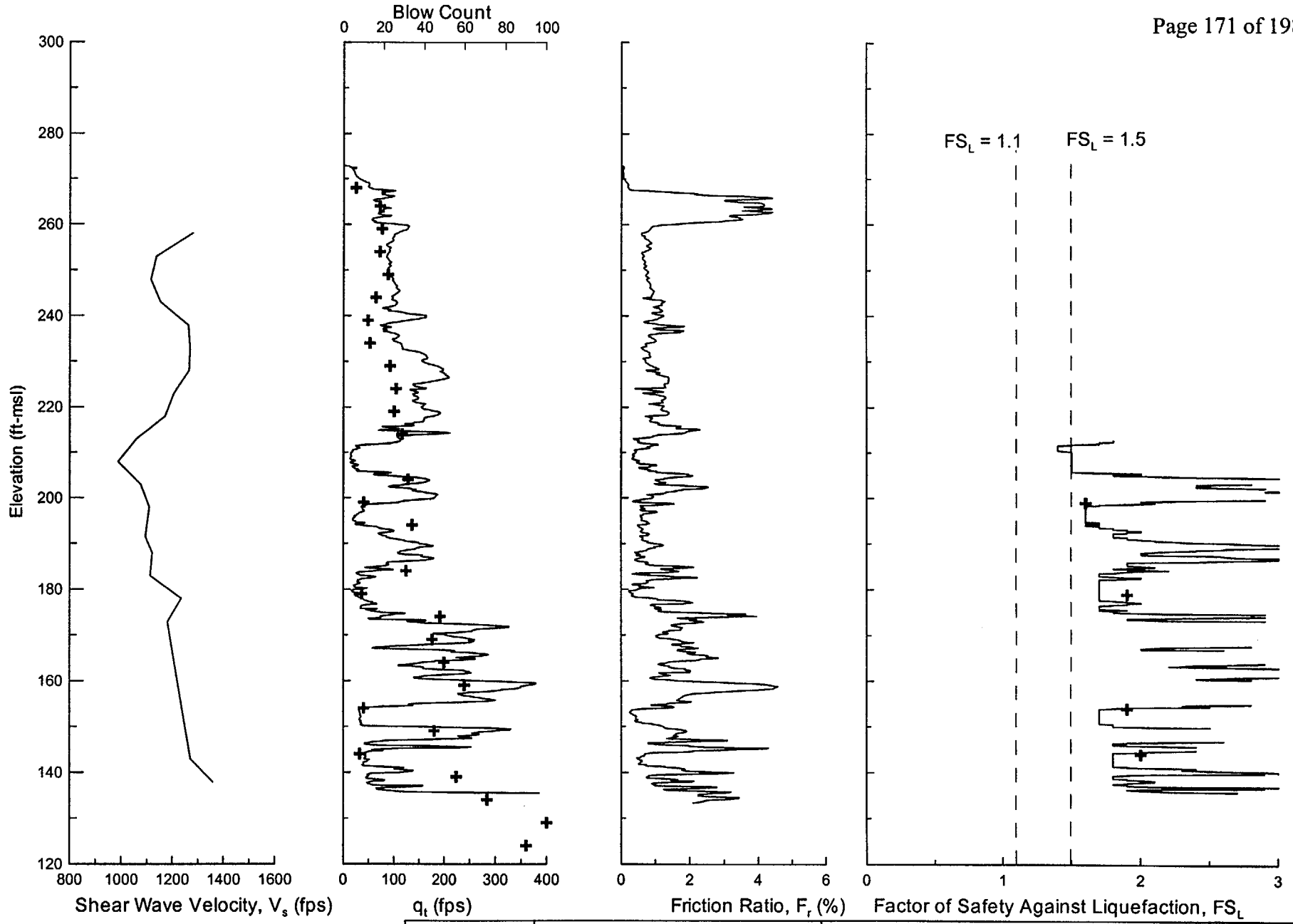
MOX Fuel Fabrication Facility
US Department of Energy CH

J.O. 08716

Factor of Safety Against Liquefaction
CPT-5
PC3+
Individual S-CPT Profile

Figure 8-30

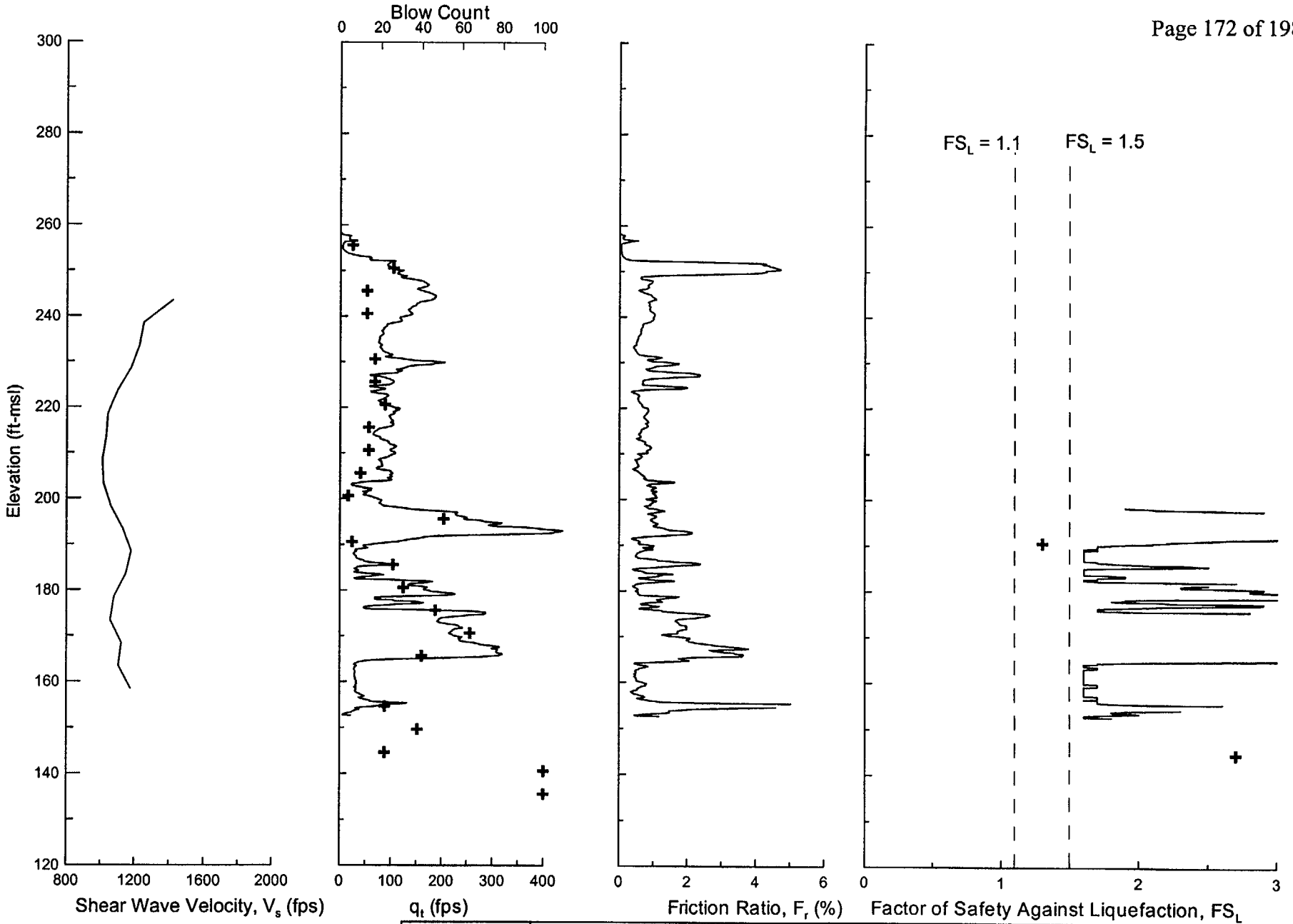
CPT-5-P.grf w/CPT-5-P Data.xls & Seismic Shear.xls by jit 7/16/01



Crosses indicate SPT values.

CPT-8-P.grf w/CPT-8-CP_Data.xls & Seismic Shear.xls by jjt [7/13/01]

DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-8 and BH-1 PC3+ Individual S-CPT Profile	Figure 8-31



Crosses indicate SPT values.

CPT-11-P.grf w/CPT-11-P_Data.xls & Seismic Shear.xls by jjt [7/13/01]

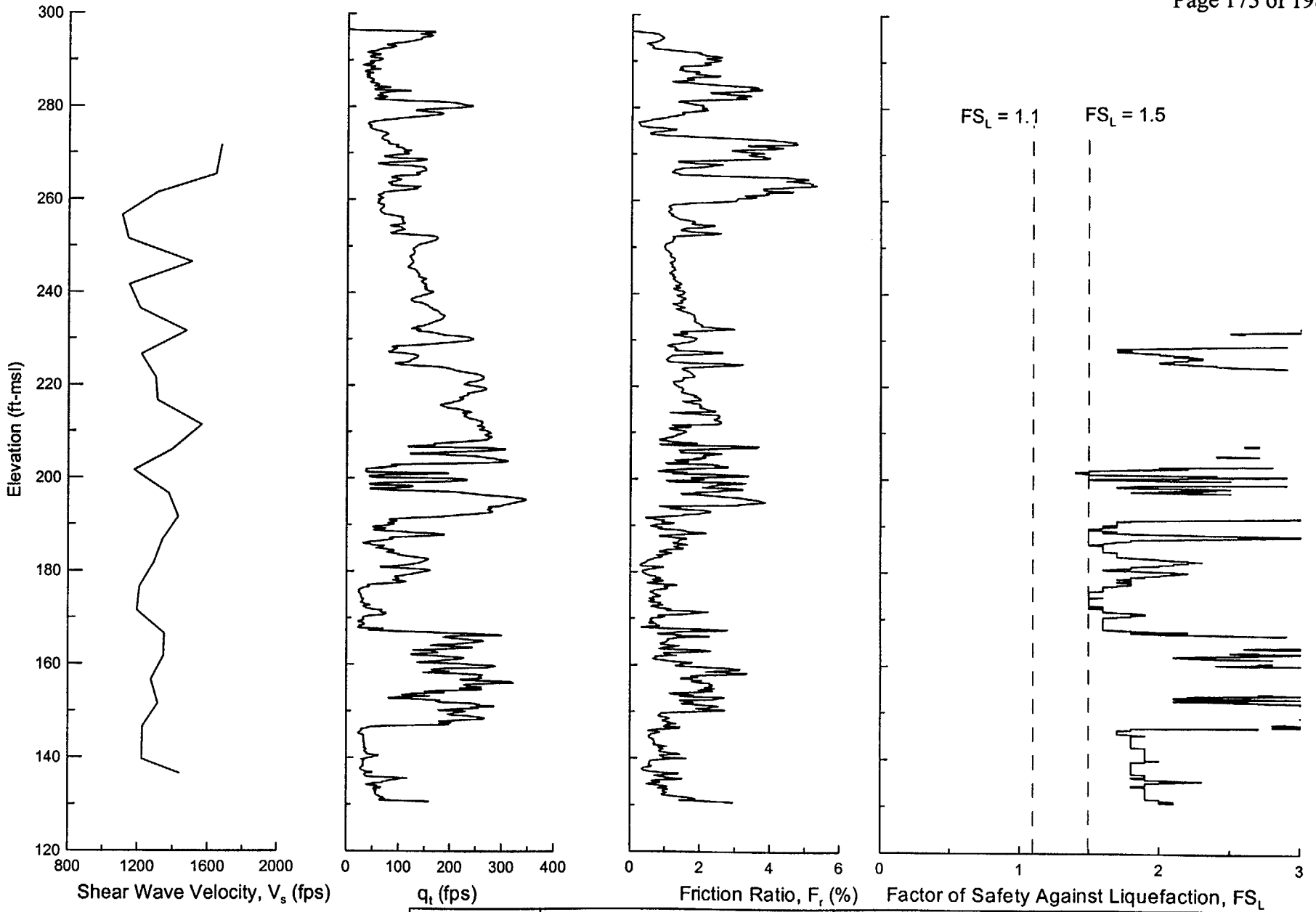
DUKE COGEMA STONE & WEBSTER

MOX Fuel Fabrication Facility
US Department of Energy CH

J.O. 08716

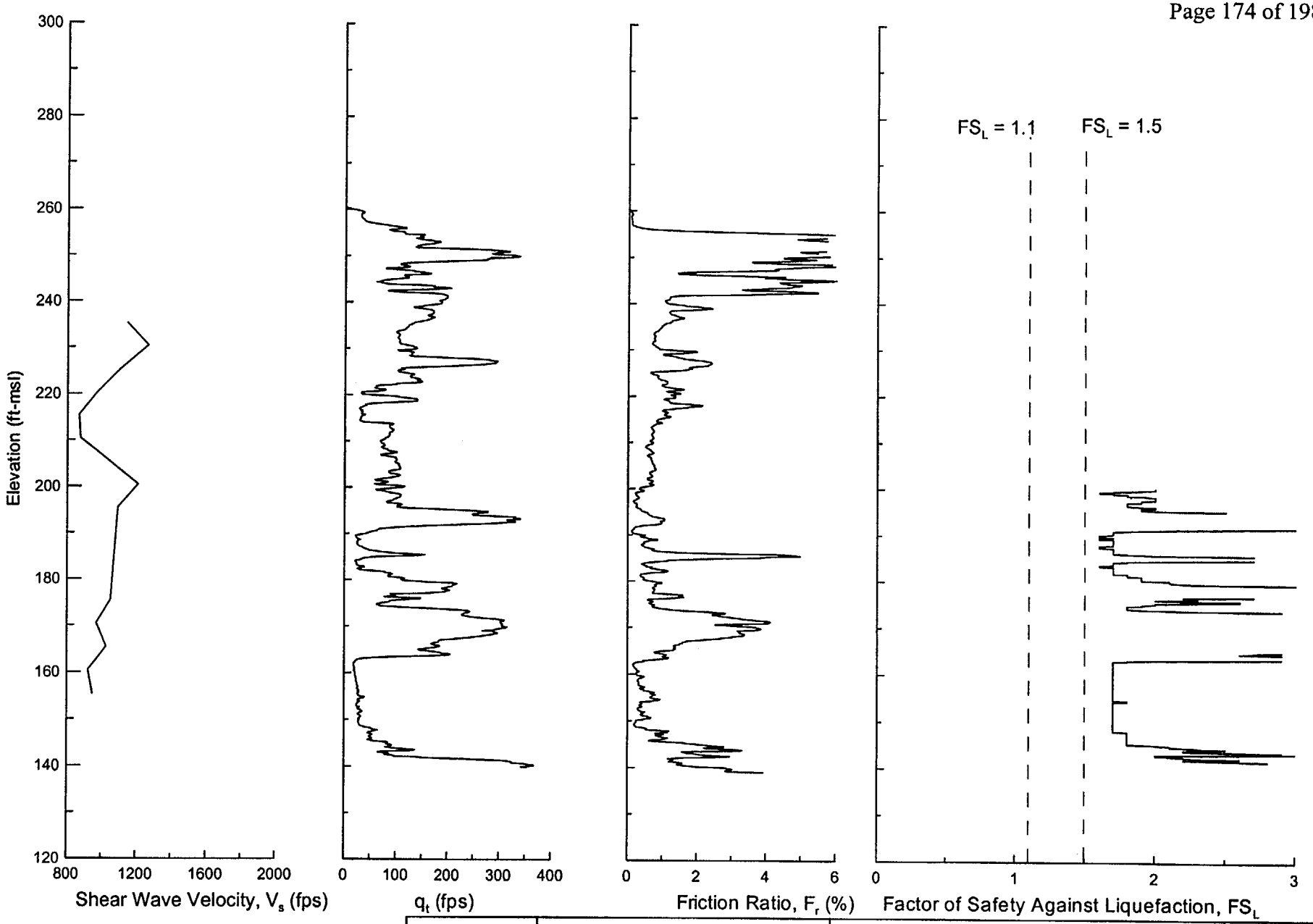
Factor of Safety Against Liquefaction
CPT-11 and BH-2
PC3+
Individual S-CPT Profile

Figure 8-32



DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-13 PC3+ Individual S-CPT Profile	Figure 8-33

CPT-13-P.grf w/CPT-13-P_Data.xls & Seismic Shear.xls by jjt [7/13/01]



DUKE COGEMA STONE & WEBSTER

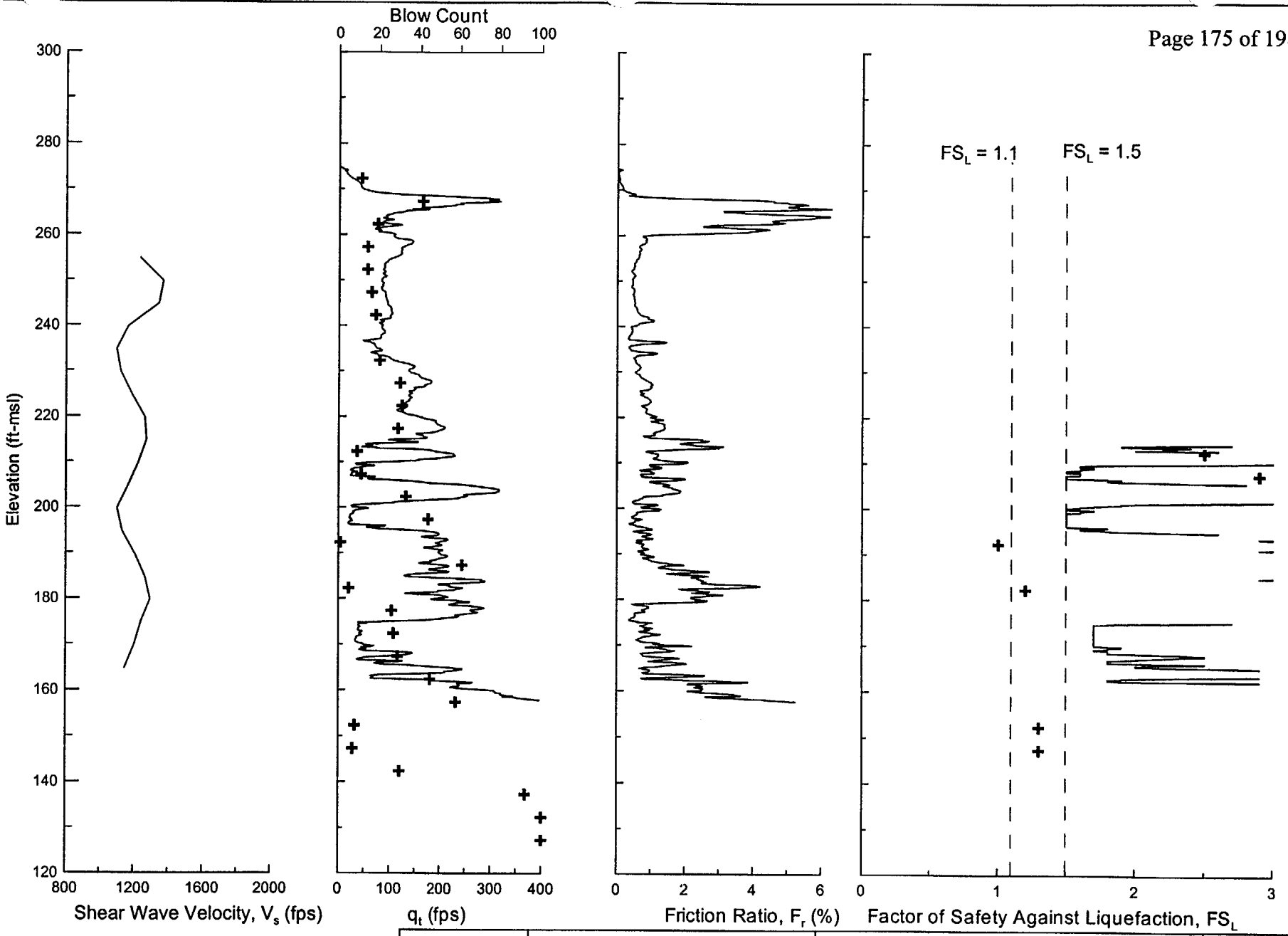
MOX Fuel Fabrication Facility
US Department of Energy CH

J.O. 08716

Factor of Safety Against Liquefaction
CPT-16
PC3+
Individual S-CPT Profile

Figure 8-34

CPT-16-P.grf w/CPT-16-P_Data.xls & Seismic Shear.xls by jjt [7/13/01]



Crosses indicate SPT values.

CPT-19-P.grf w/CPT-19-P_Data.xls & Seismic Shear.xls by jjt [7/13/01]

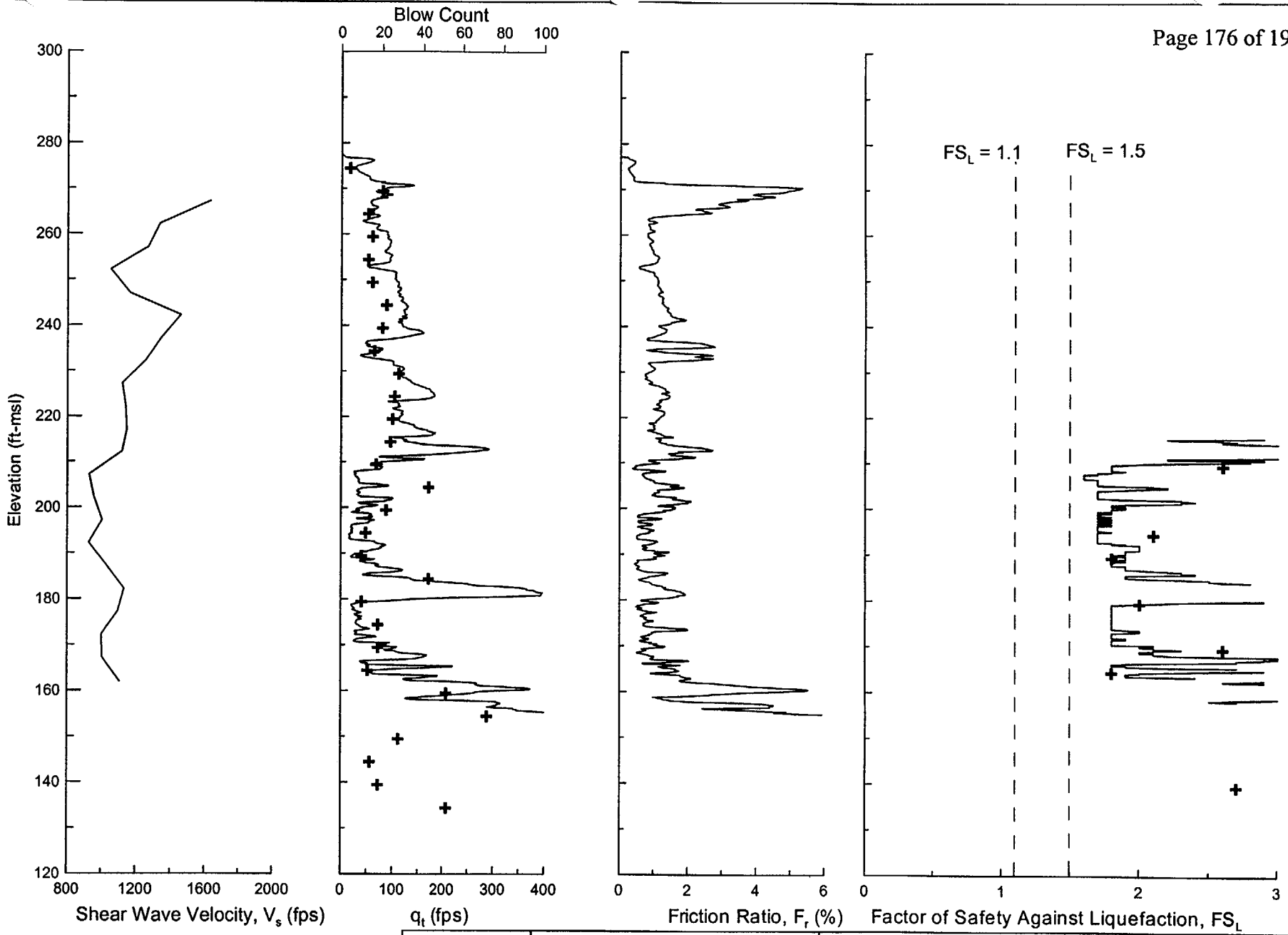
DUKE COGEMA STONE & WEBSTER

MOX Fuel Fabrication Facility
US Department of Energy CH

J.O. 08716

Factor of Safety Against Liquefaction
CPT-19 and BH-5
PC3+
Individual S-CPT Profile

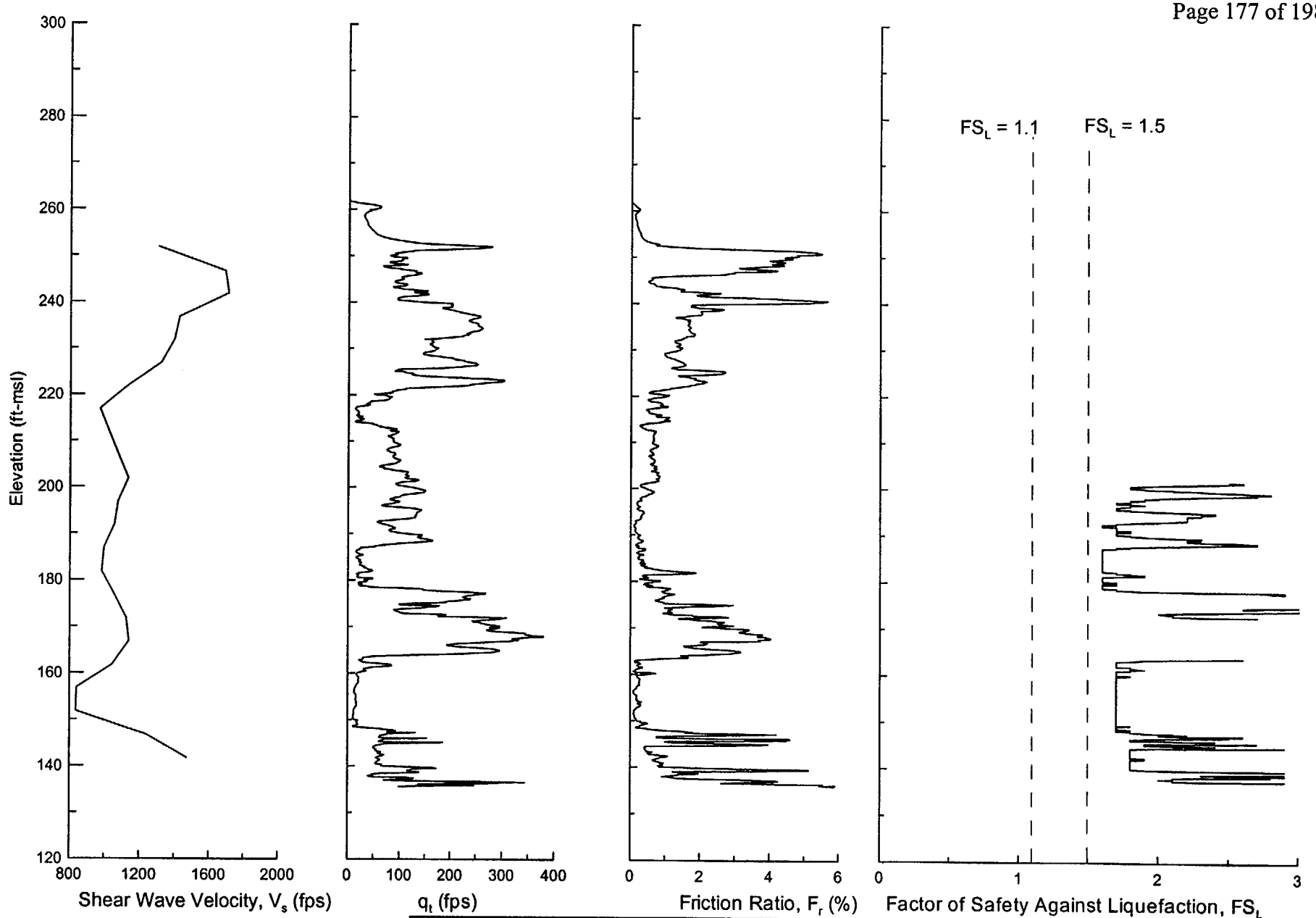
Figure 8-35



Crosses indicate SPT values.

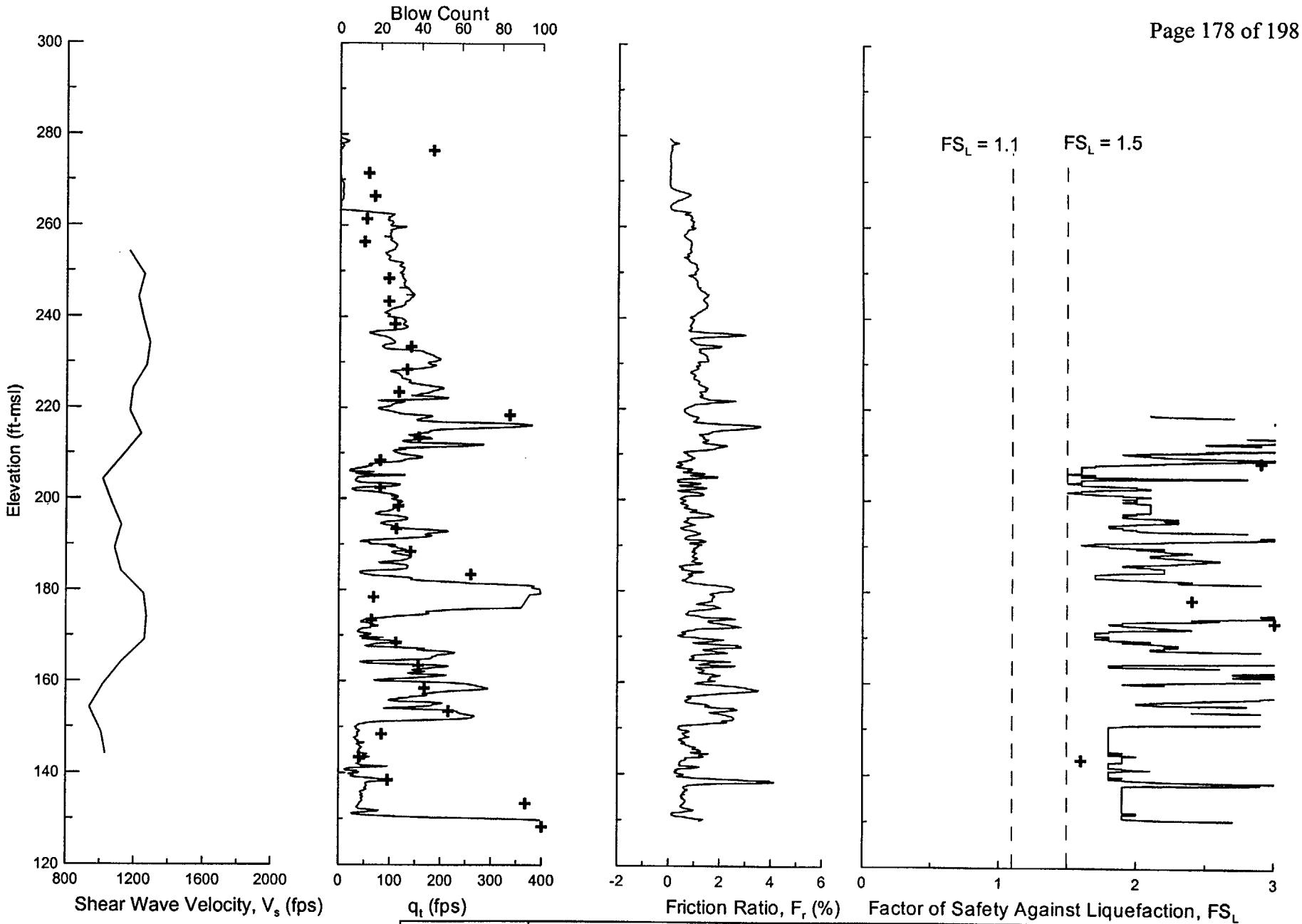
CPT-23-P.grf w/CPT-23-P_Data.xls & Seismic Shear.xls by jjt [7/17/01]

DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH**	Factor of Safety Against Liquefaction CPT-23 and BH-7 PC3+ Individual S-CPT Profile	Figure 8-36
	J.O. 08716		



DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-26 PC3+ Individual S-CPT Profile	Figure 8-37

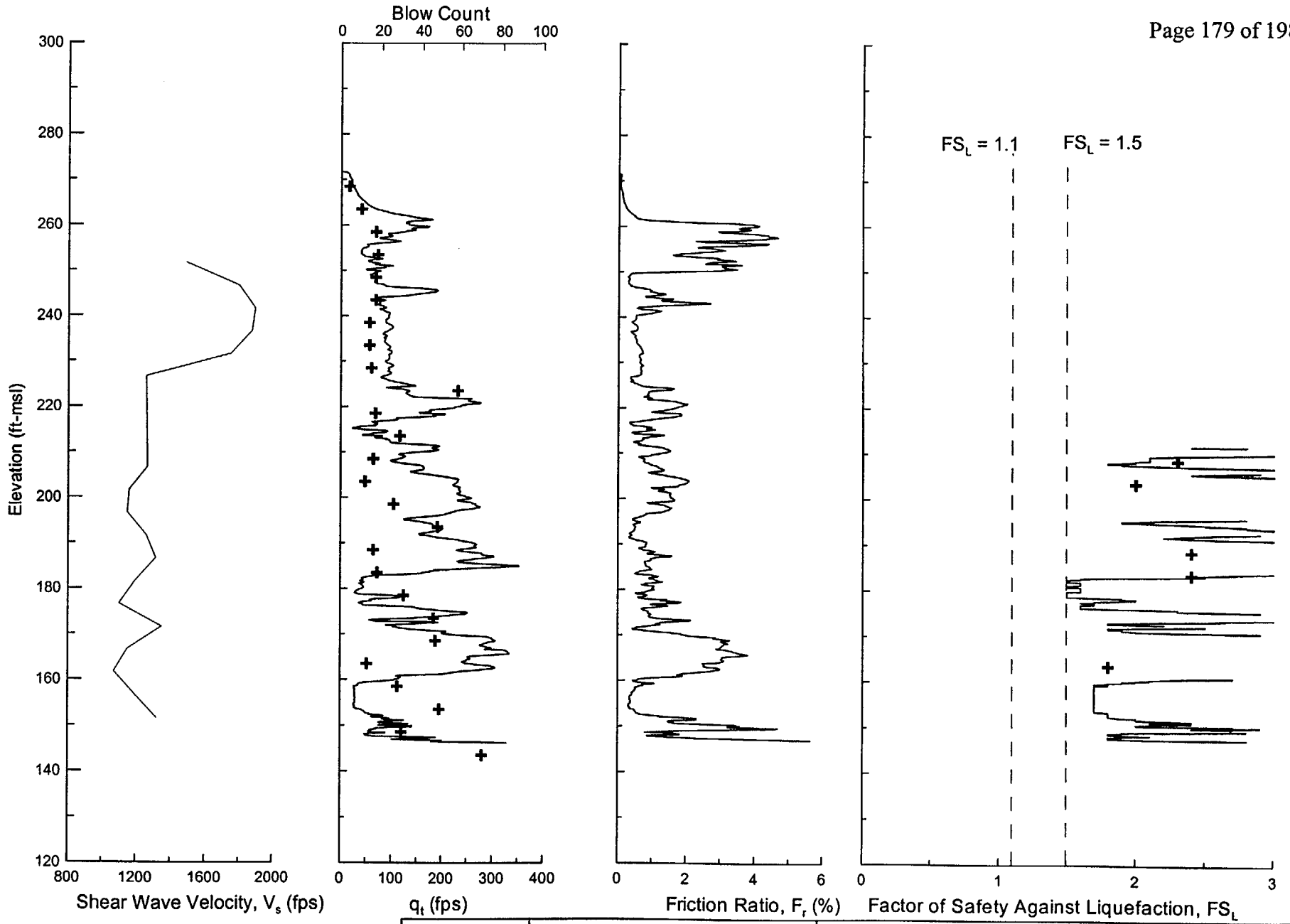
CPT-26-P.grf w/CPT-26-P_Data.xls & Seismic Shear.xls by jjt [7/16/01]



Crosses indicate SPT values.

CPT-28-P.grf w/CPT-28-P_Data.xls & Seismic Shear.xls by jjt [7/16/01]

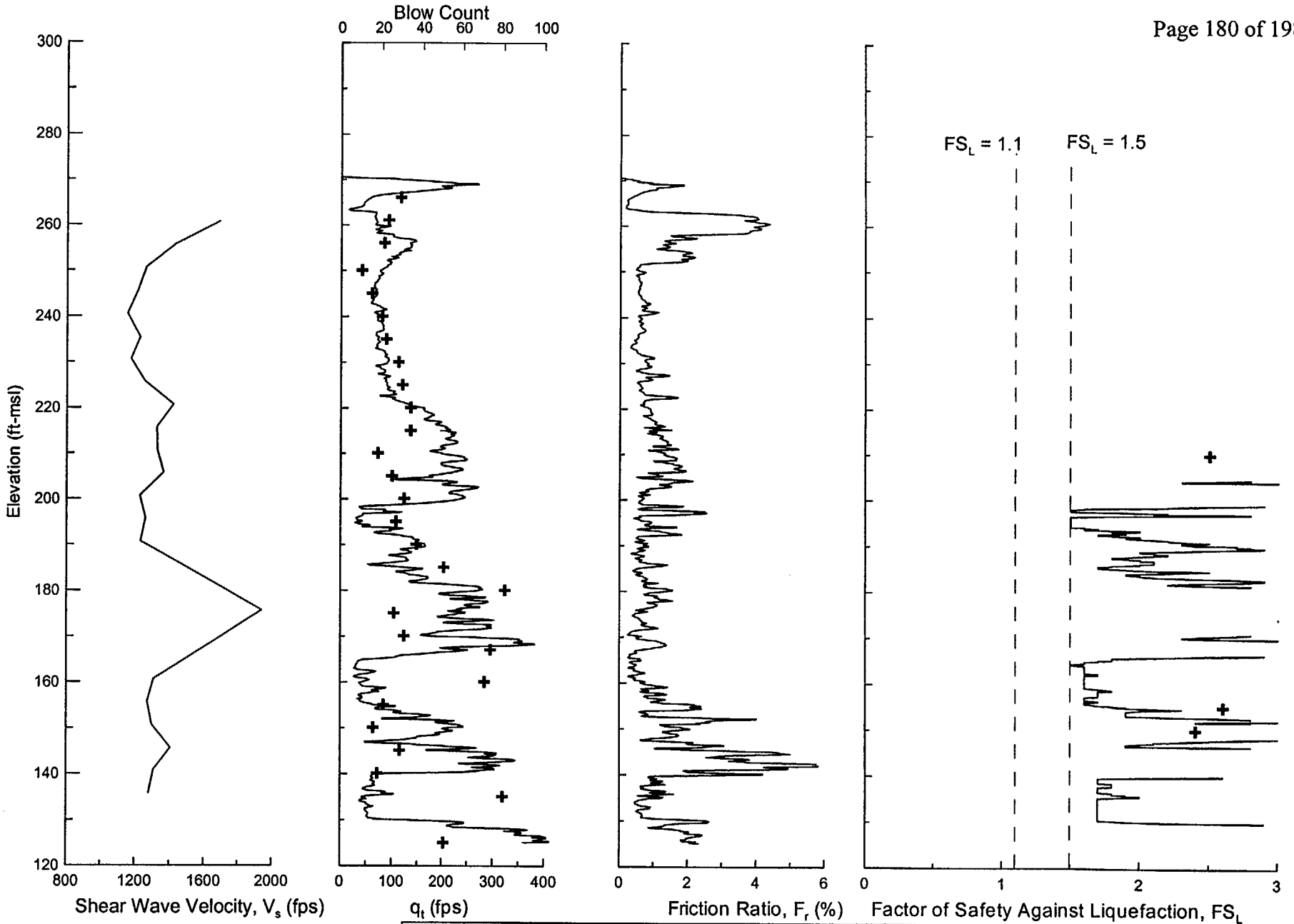
DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH**	Factor of Safety Against Liquefaction CPT-28 and BH-8 PC3+ Individual S-CPT Profile	Figure 8-38
	J.O. 08716		



Crosses indicate SPT values.

CPT-31-P.grf w/CPT-31-P_Data.xls & Seismic Shear.xls by jjt [7/17/01]

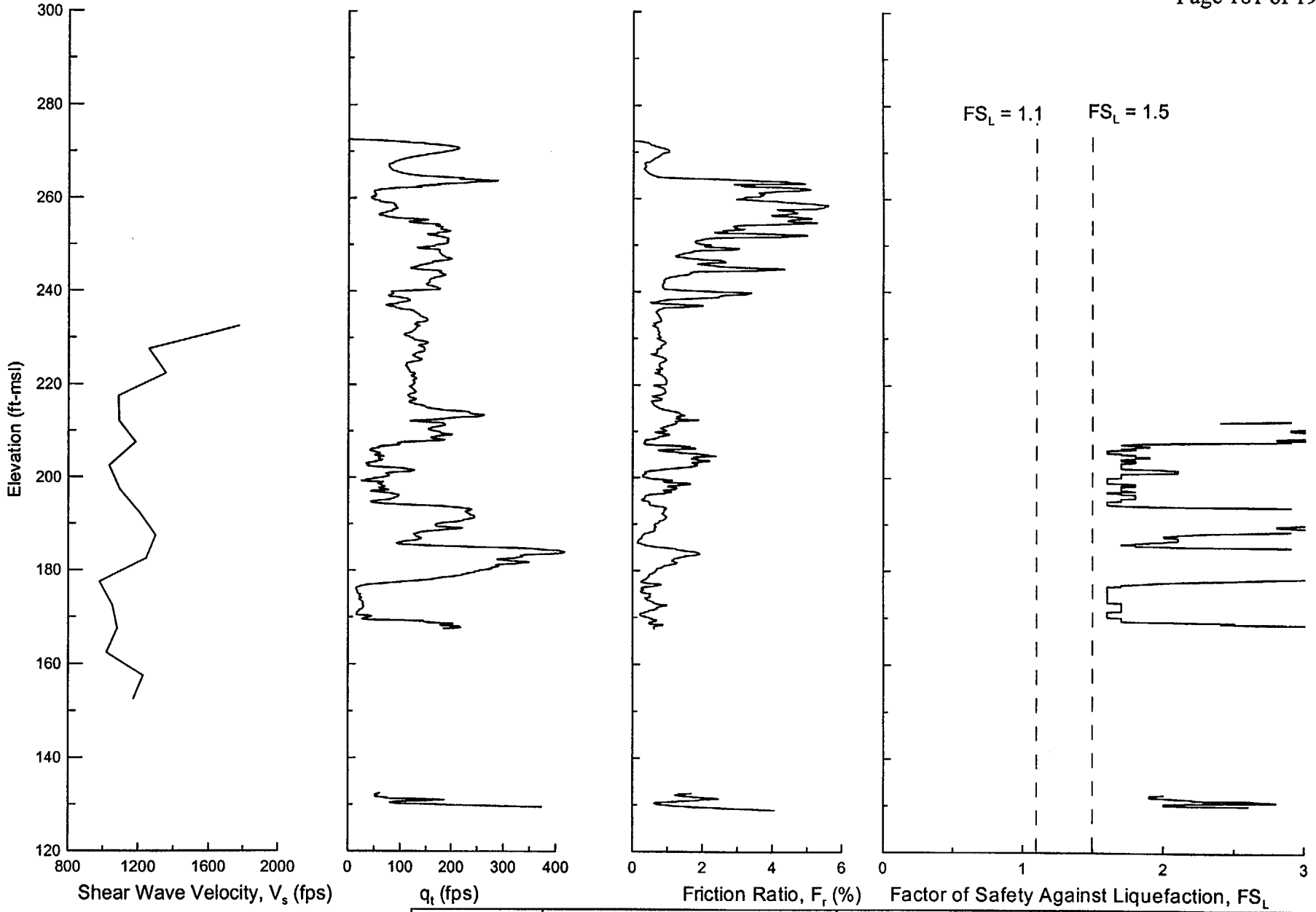
DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH**	Factor of Safety Against Liquefaction CPT-31and BH-9 PC3+ Individual S-CPT Profile	Figure 8-39
	J.O. 08716		



Crosses indicate SPT values.

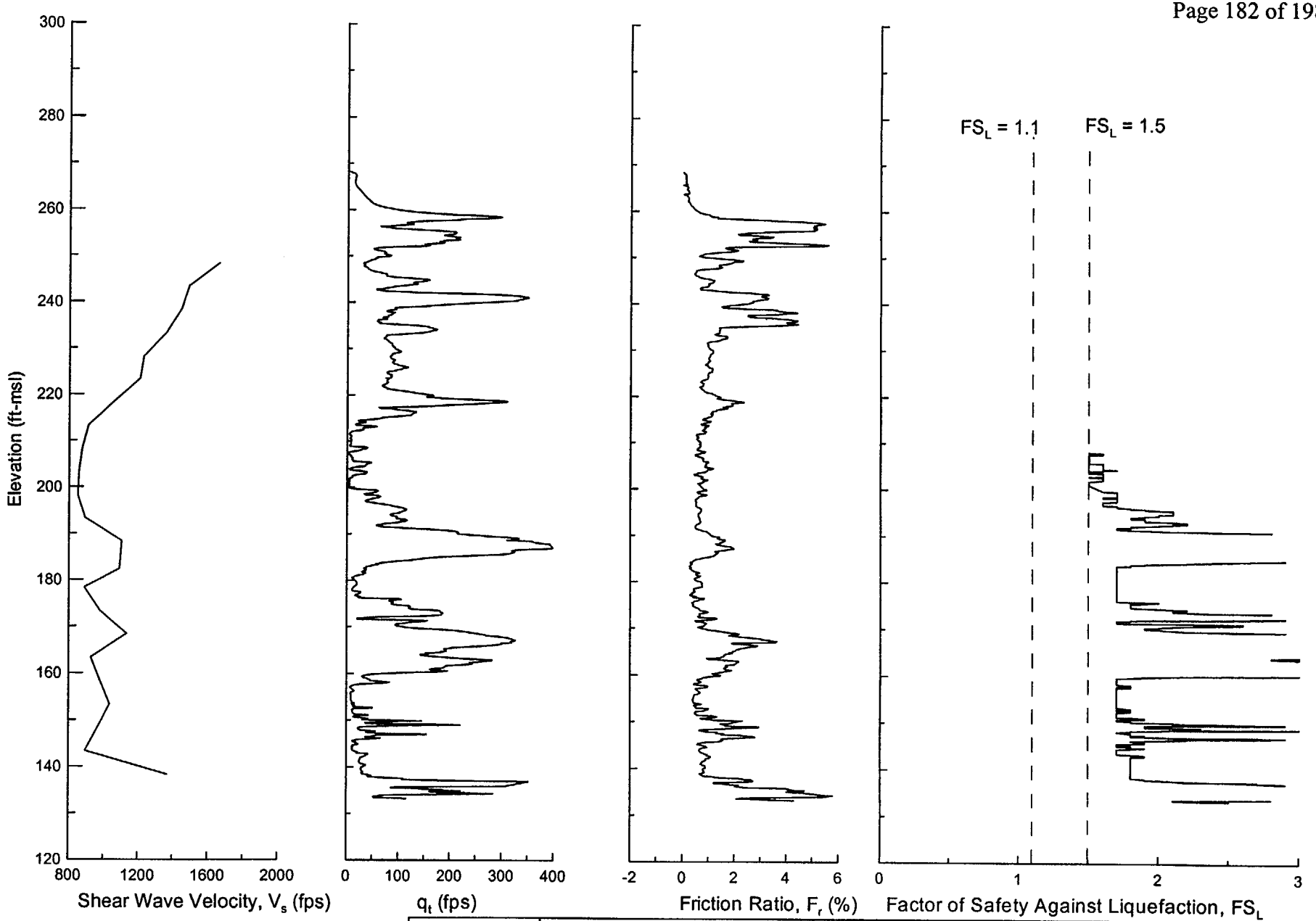
CPT-34-P.grf w/CPT-34-P_Data.xls & Seismic Shear.xls by jjt [7/17/01]

DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH**	Factor of Safety Against Liquefaction CPT-34 and BH-10 PC3+ Individual S-CPT Profile	Figure 8-40
	J.O. 08716		



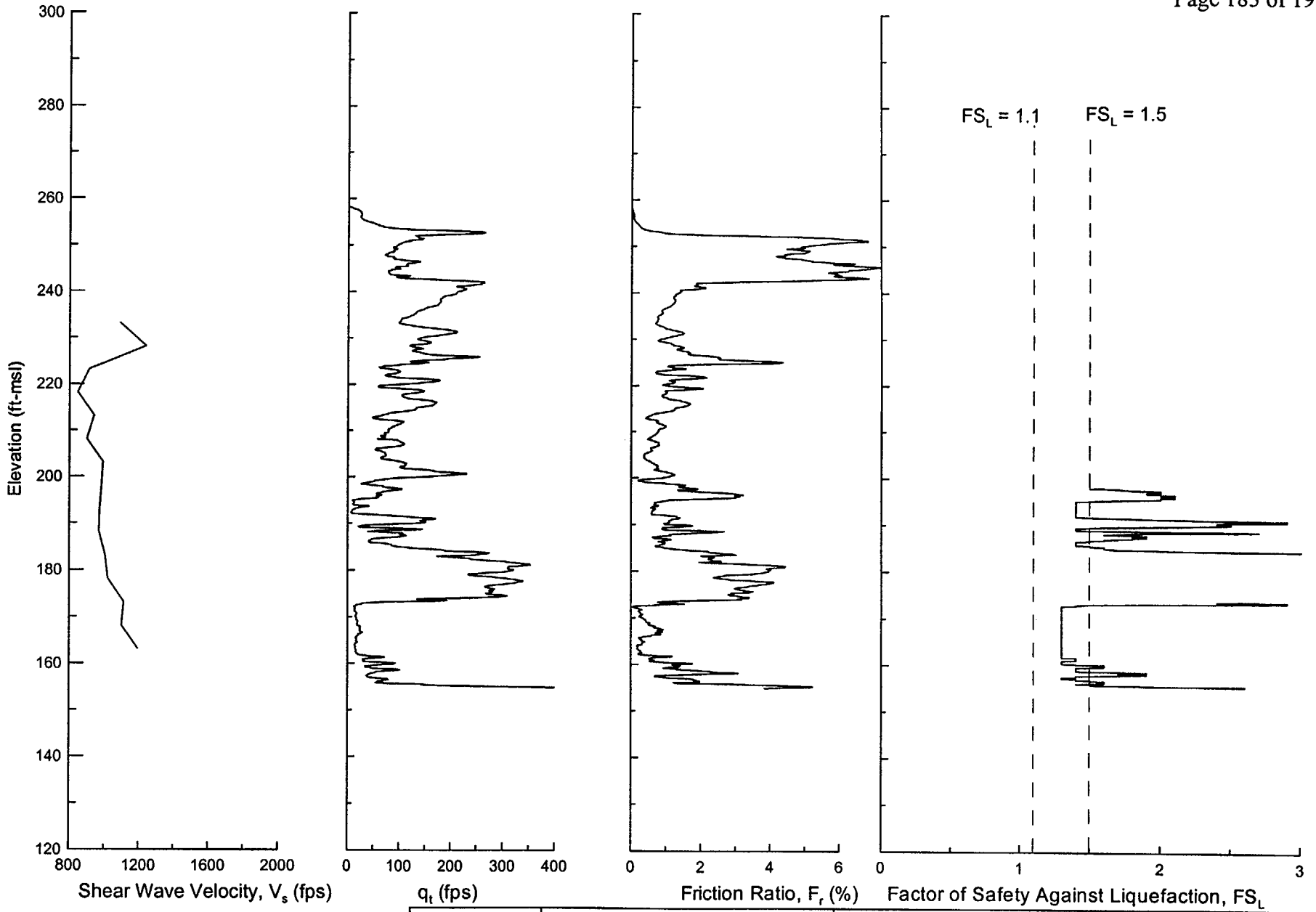
DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-35 PC3+ Individual S-CPT Profile	Figure 8-41

CPT-35-P.grf w/CPT-35-P_Data.xls & Seismic Shear.xls by jjt [7/16/01]



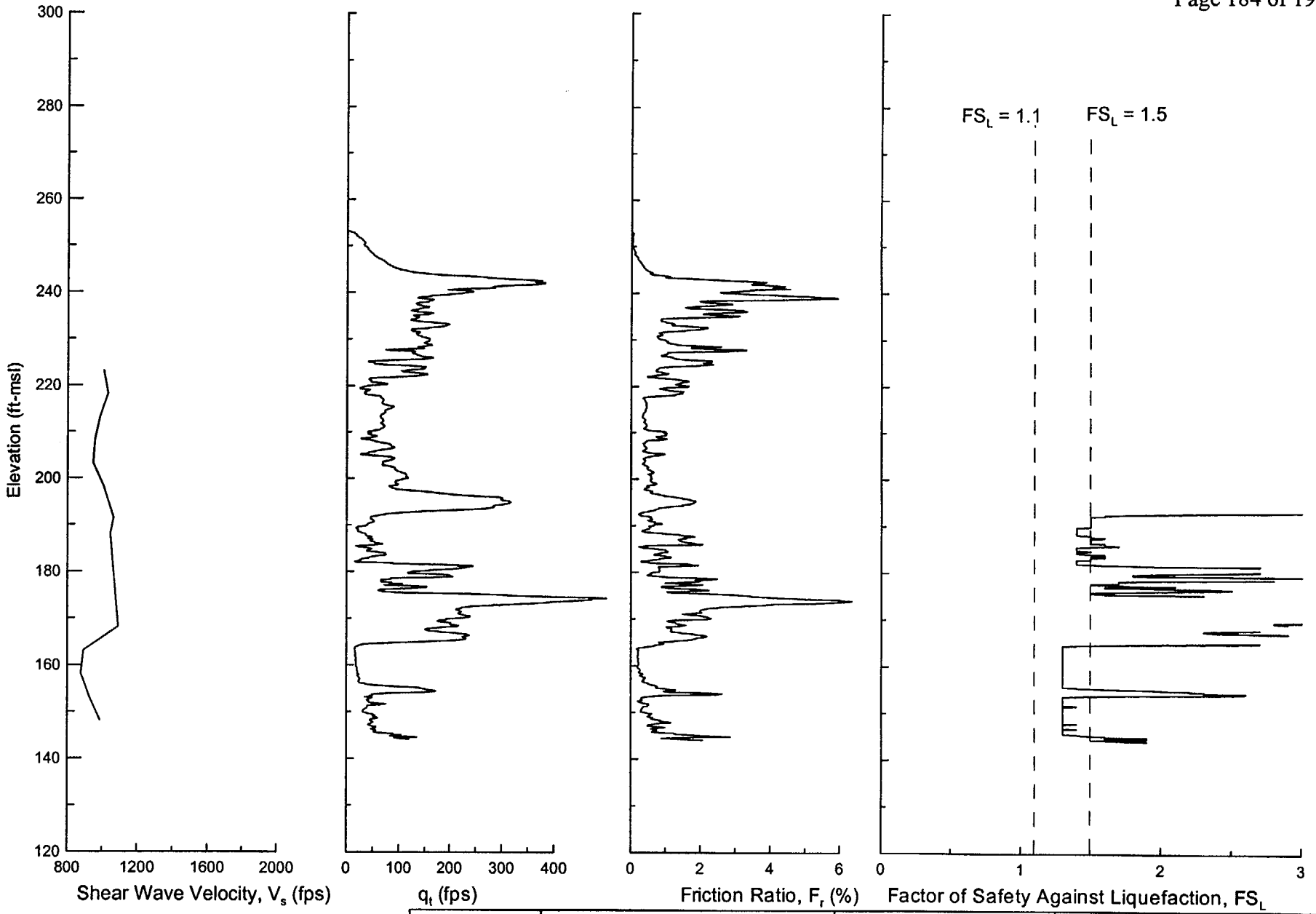
DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-37 PC3+ Individual S-CPT Profile	Figure 8-42

CPT-37-P.grf w/CPT-37-P_Data.xls & Seismic Shear.xls by jjt [7/16/01]



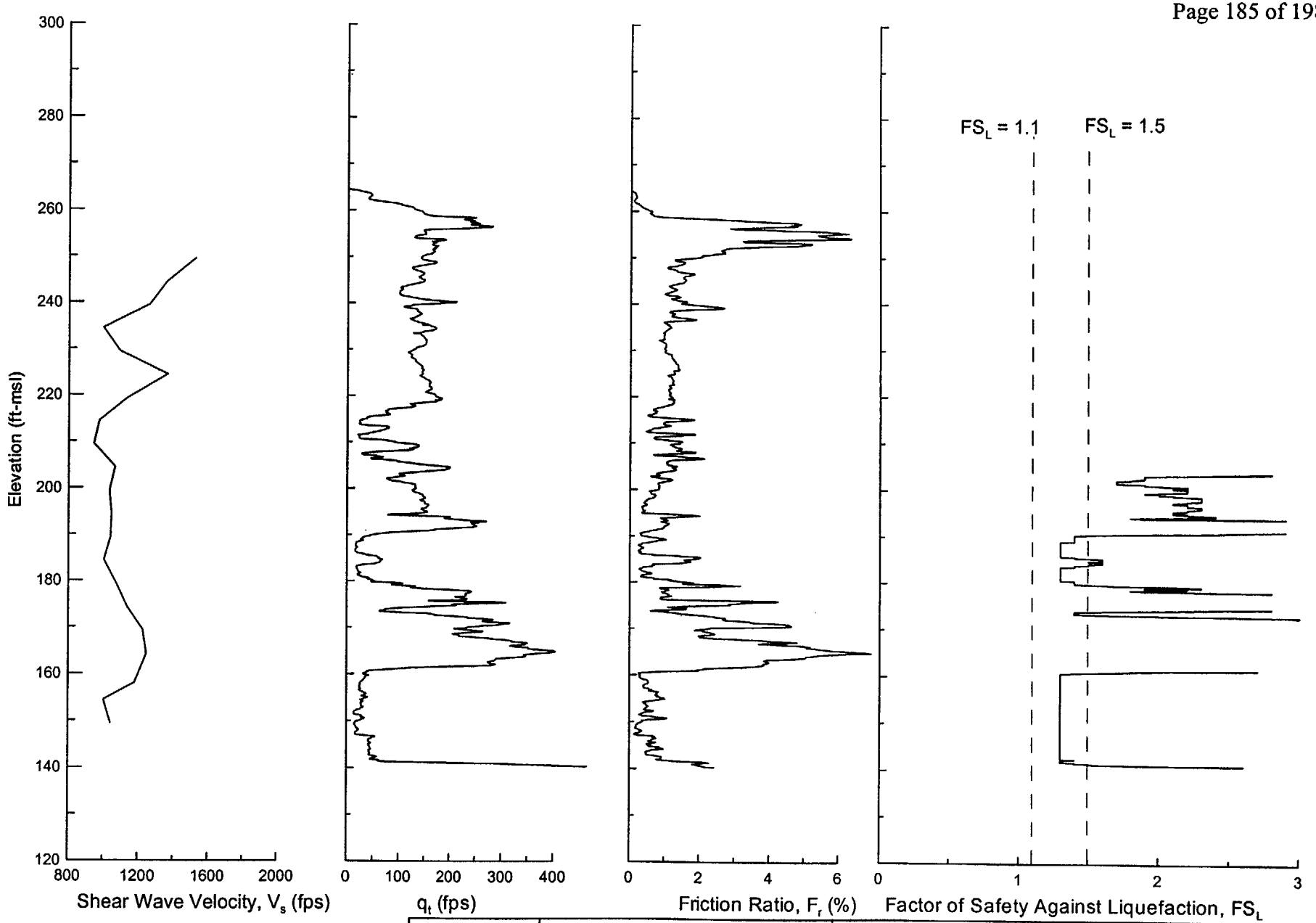
DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-1 1886 Charleston 50th Percentile Individual S-CPT Profile	Figure 8-43

CPT-1-C.grf w/CPT-1-C_Data.xls & Seismic Shear.xls by fjw /8/8/01



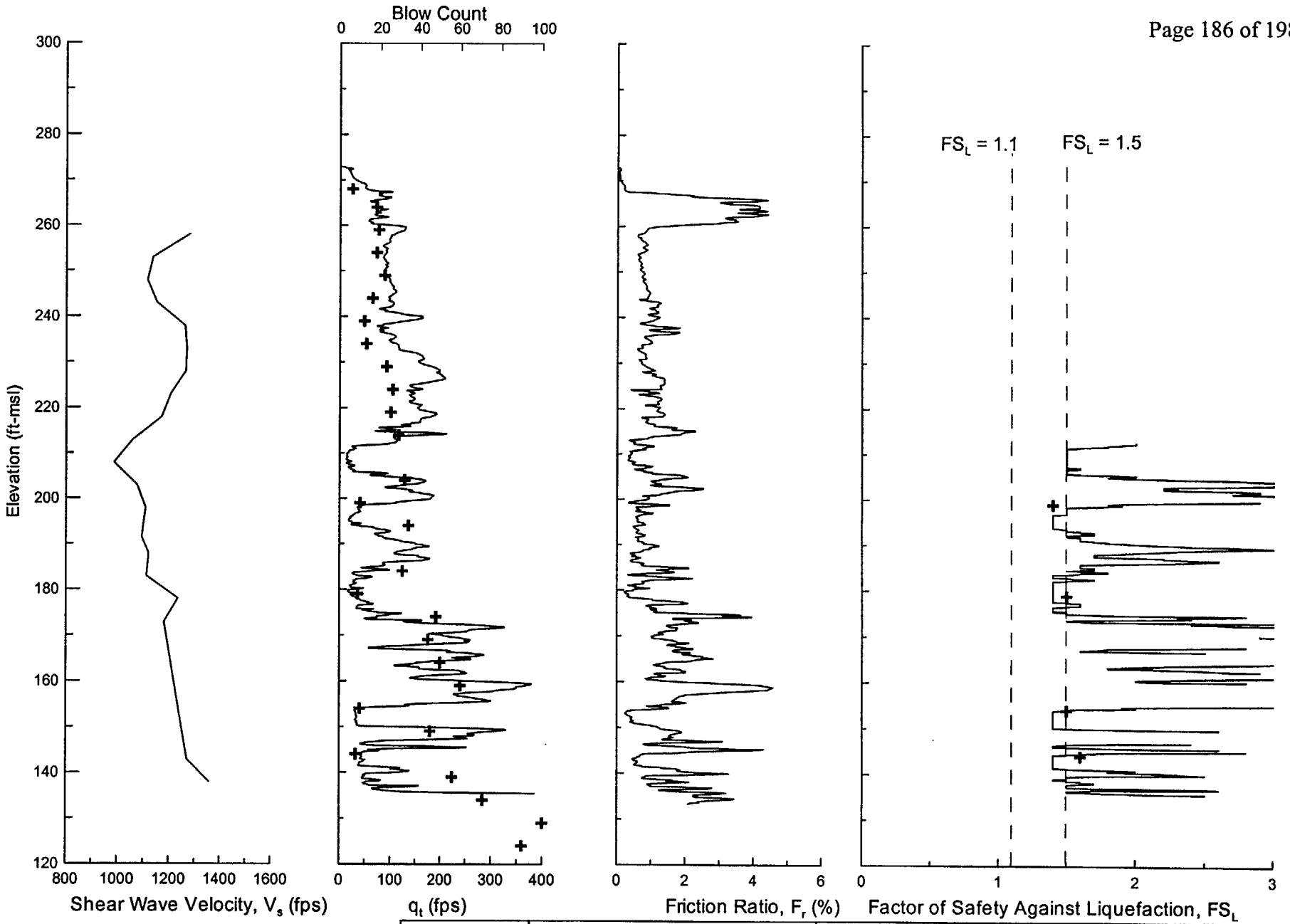
DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-3 1886 Charleston 50th Percentile Individual S-CPT Profile	Figure 8-44

CPT-3-C.grf w/CPT-3-C_Data.xls & Seismic Shear.xls by fjw 8/8/01



DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-5 1886 Charleston 50th Percentile Individual S-CPT Profile	Figure 8-45

CPT-5-C.grf w/CPT-5-C_Data.xls & Seismic Shear.xls by fjw /8/8/01



Crosses indicate SPT values.

CPT-8-C.grf w/CPT-8-C_Data.xls & Seismic Shear.xls by fjw /8/8/01

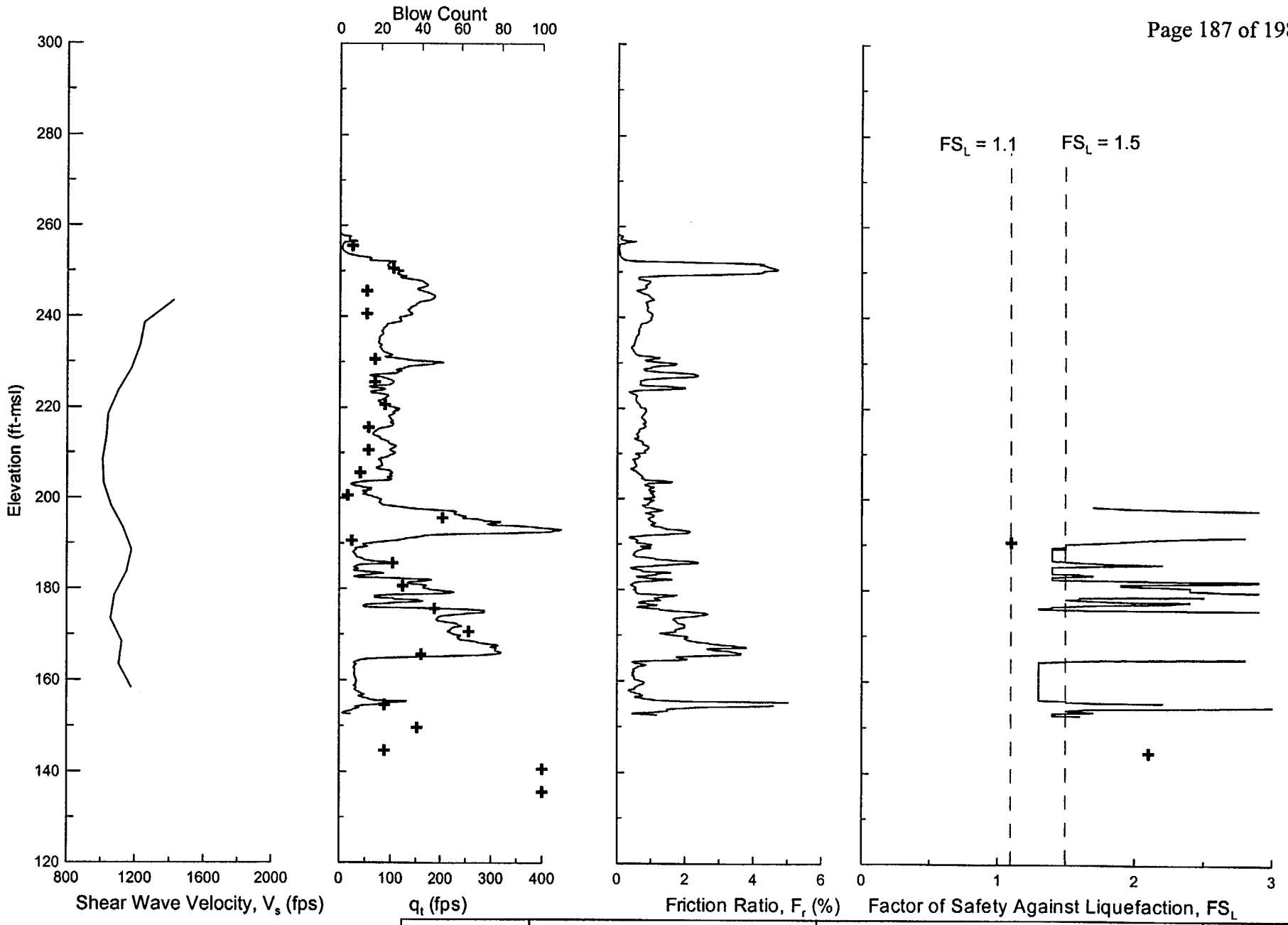
DUKE COGEMA STONE & WEBSTER

MOX Fuel Fabrication Facility
US Department of Energy CH

J.O. 08716

Factor of Safety Against Liquefaction
CPT-8 and BH-1
1886 Charleston 50th Percentile
Individual S-CPT Profile

Figure 8-46



Crosses indicate SPT values.

CPT-11-C.grf w/CPT-11-C_Data.xls & Seismic Shear.xls by fjw /8/8/01

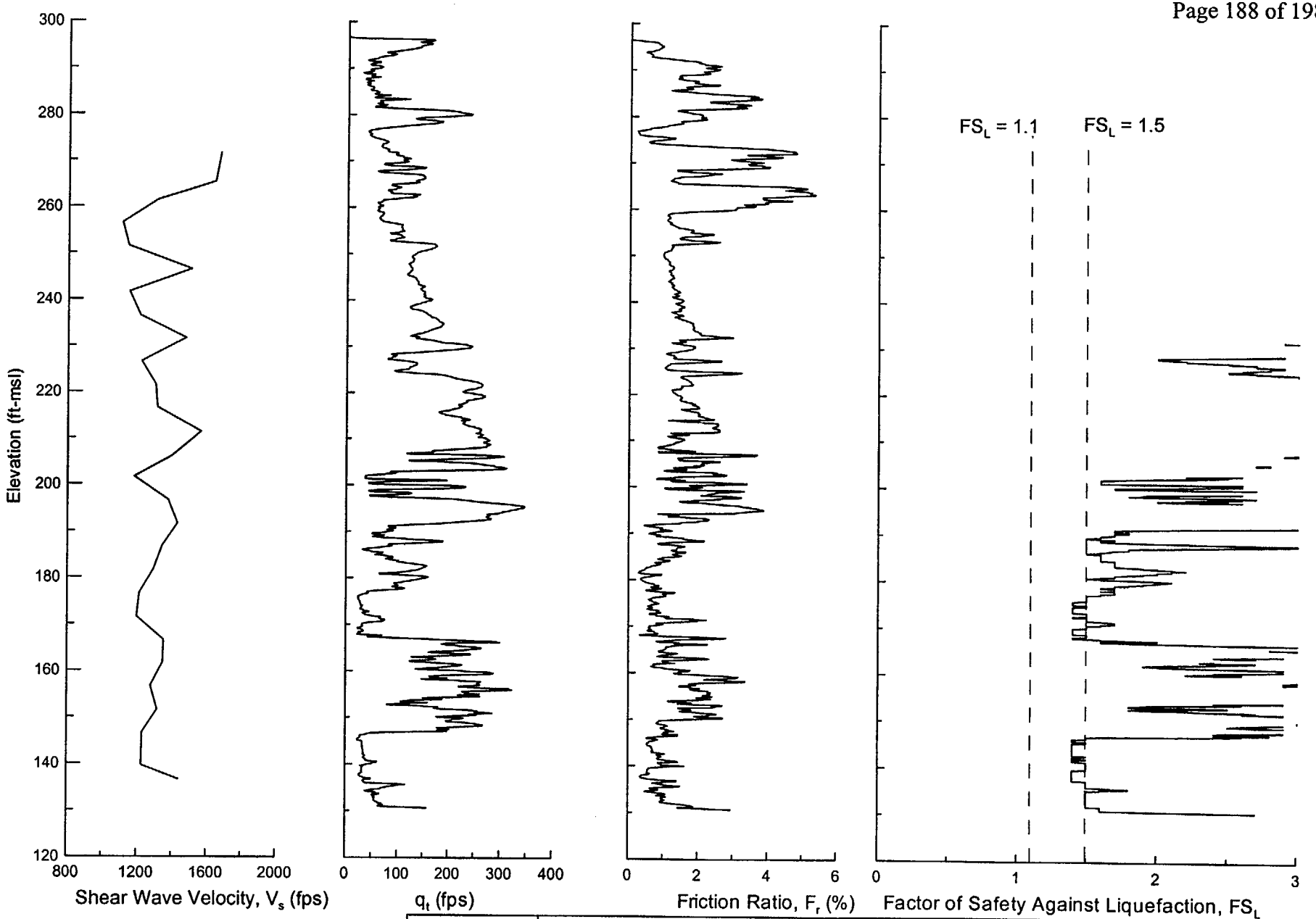
DUKE COGEMA STONE & WEBSTER

MOX Fuel Fabrication Facility
US Department of Energy CH

J.O. 08716

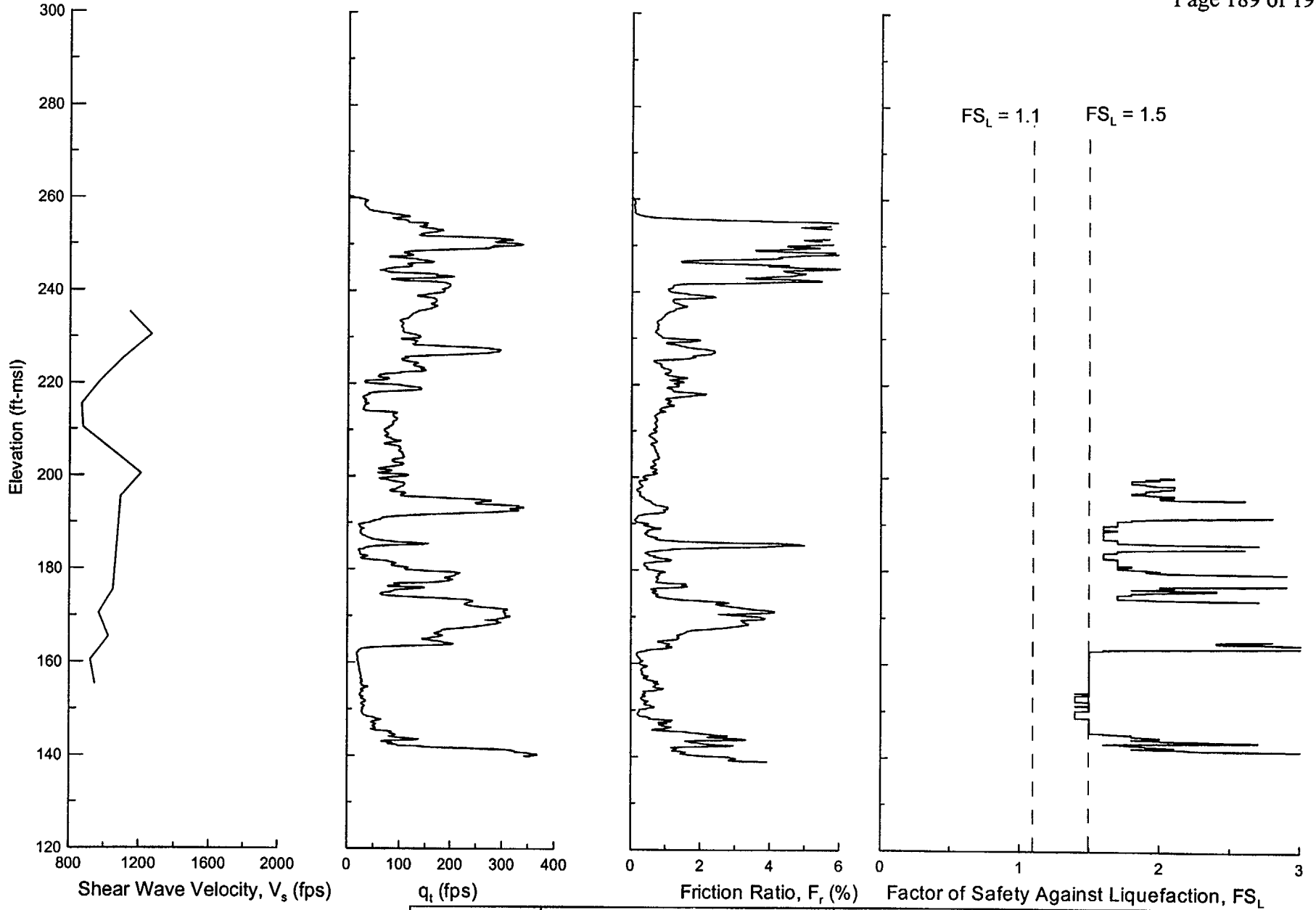
Factor of Safety Against Liquefaction
CPT-11and BH-2
1886 Charleston 50th Percentile
Individual S-CPT Profile

Figure 8-47



DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-13 1886 Charleston 50th Percentile Individual S-CPT Profile	Figure 8-48

CPT-13-C.grf w/CPT-13-C_Data.xls & Seismic Shear.xls by fjw /8/8/01



CPT-16-C.grf w/CPT-16-C_Data.xls & Seismic Shear.xls by fjw /8/8/01

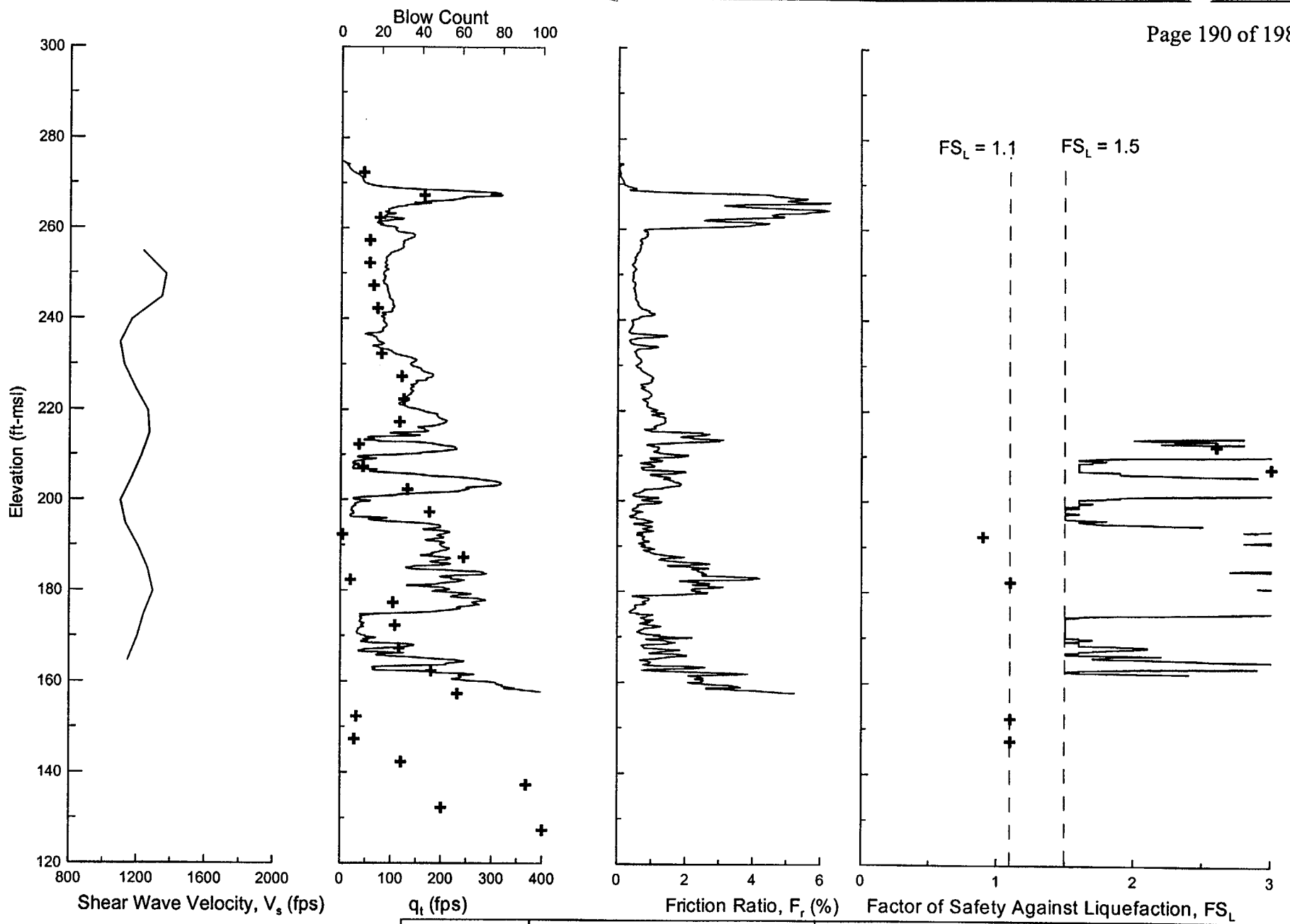
DUKE COGEMA STONE & WEBSTER

MOX Fuel Fabrication Facility
US Department of Energy CH

J.O. 08716

Factor of Safety Against Liquefaction
CPT-16
1886 Charleston 50th Percentile
Individual S-CPT Profile

Figure 8-49



Crosses indicate SPT values.

CPT-19-C.grf w/CPT-19-C_Data.xls & Seismic Shear.xls by fjw /8/8/01

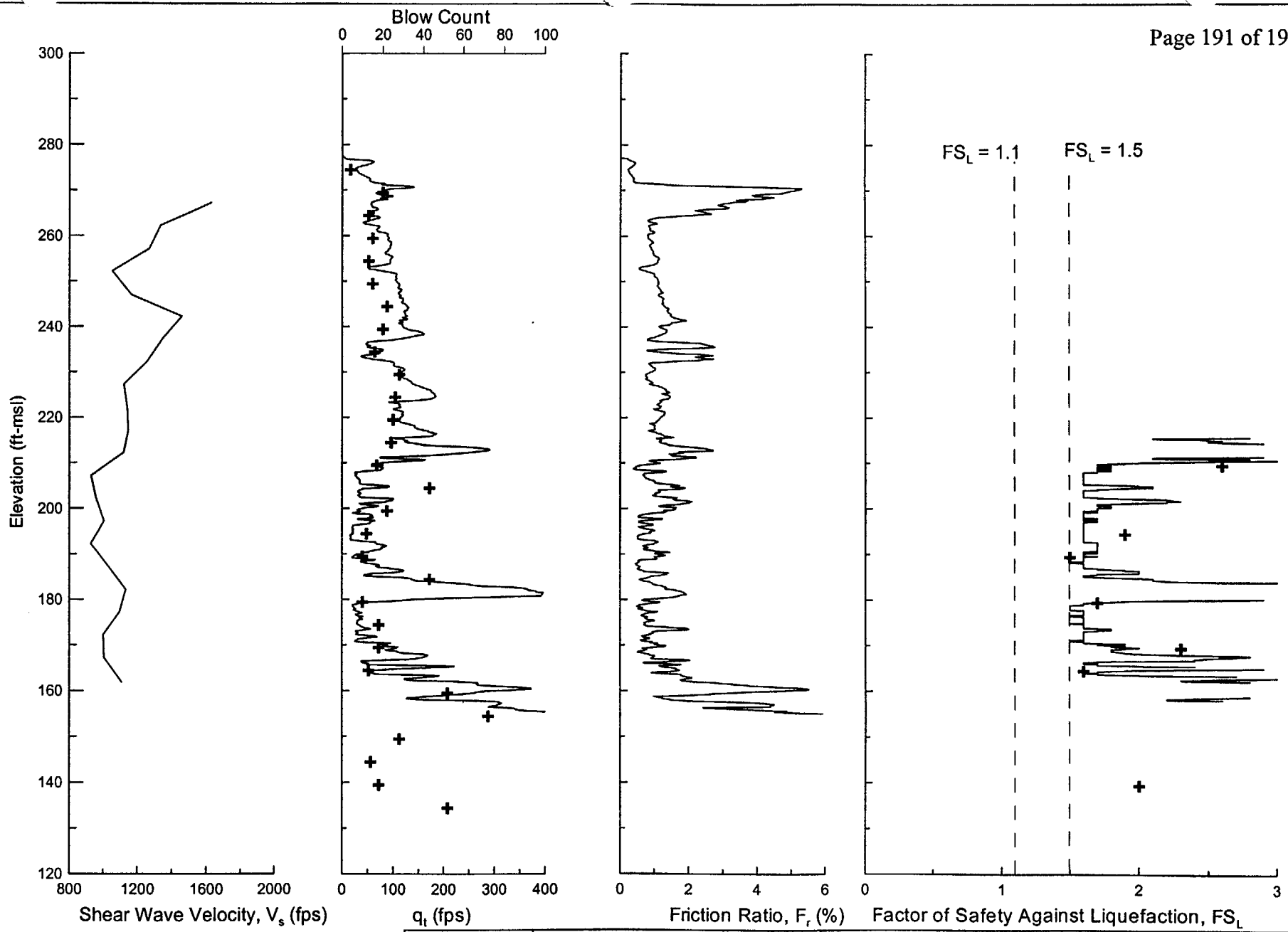
DUKE COGEMA STONE & WEBSTER

MOX Fuel Fabrication Facility
US Department of Energy CH

J.O. 08716

Factor of Safety Against Liquefaction
CPT-19 and BH-5
1886 Charleston 50th Percentile
Individual S-CPT Profile

Figure 8-50



Crosses indicate SPT values.

CPT-23-C.grf w/CPT-23-C_Data.xls & Seismic Shear.xls by fjw /8/8/01

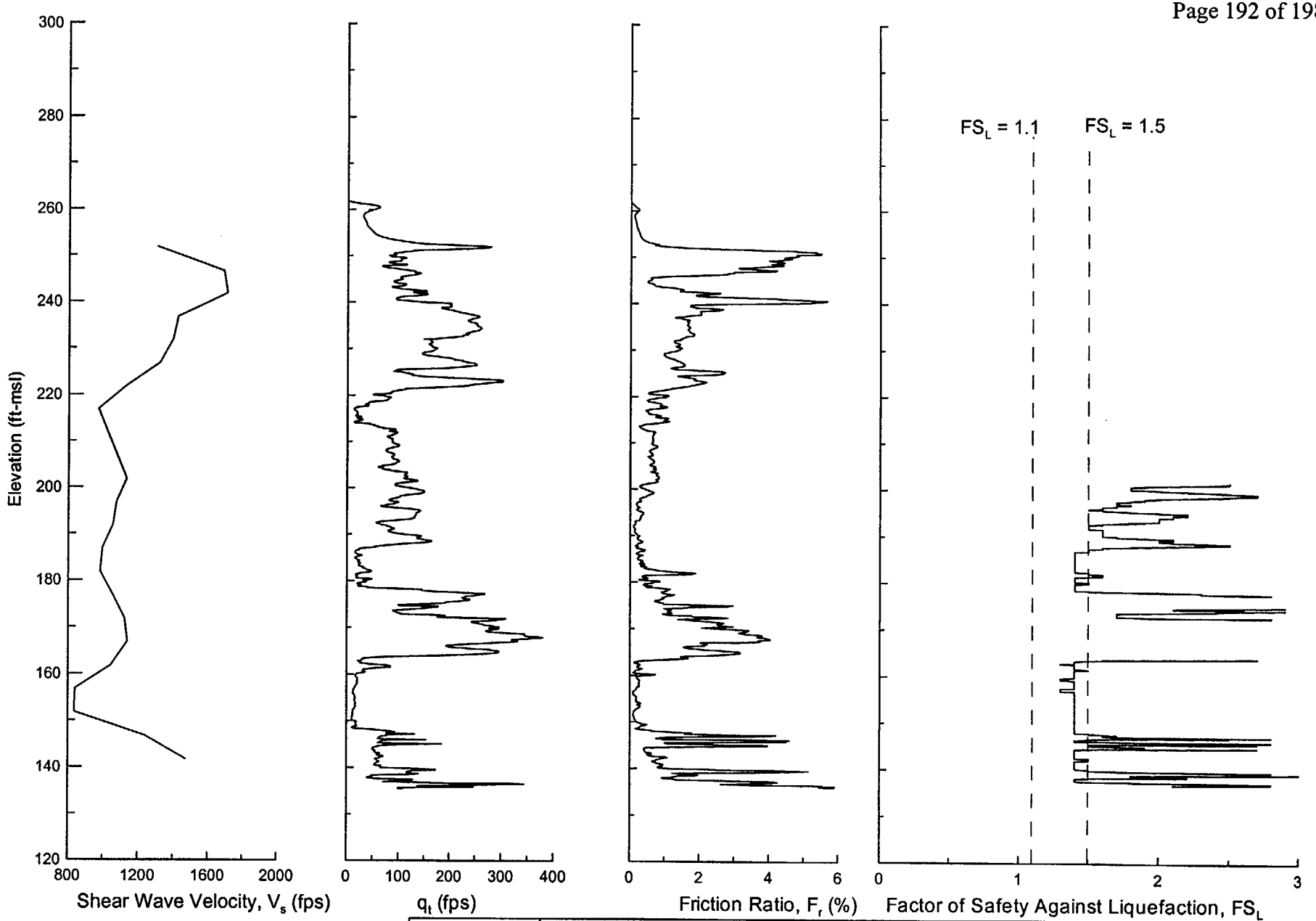
DUKE COGEMA STONE & WEBSTER

MOX Fuel Fabrication Facility
US Department of Energy CH

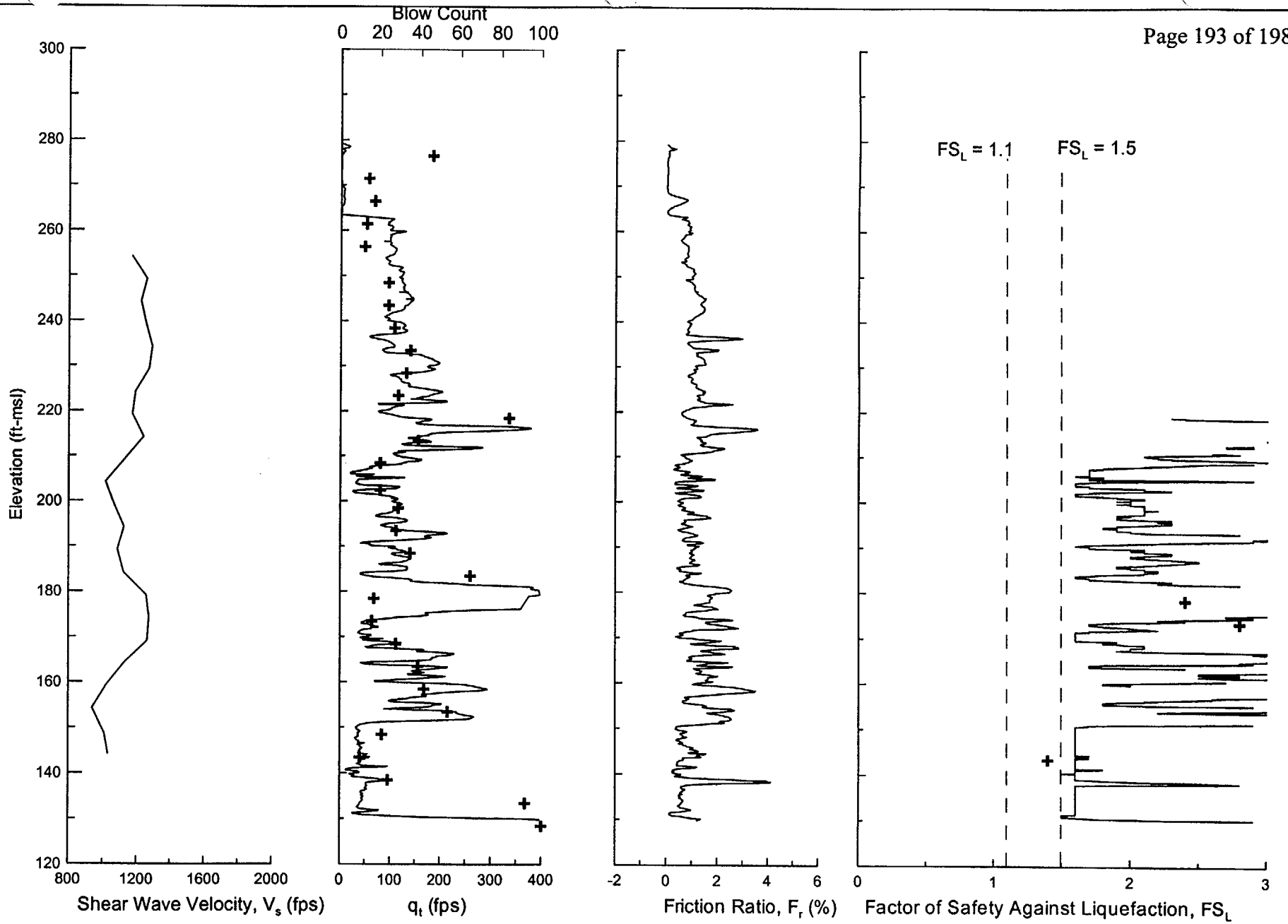
J.O. 08716

Factor of Safety Against Liquefaction
CPT-23 and BH-7
1886 Charleston 50th Percentile
Individual S-CPT Profile

Figure 8-51



CPT-26-C.grf w/CPT-26-C_Data.xls & Seismic Shear.xls by fjw /8/8/01	DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-26 1886 Charleston 50th Percentile Individual S-CPT Profile	Figure 8-52



Crosses indicate SPT values.

CPT-28-C.grf w/CPT-28-C_Data.xls & Seismic Shear.xls by fjw /8/8/01

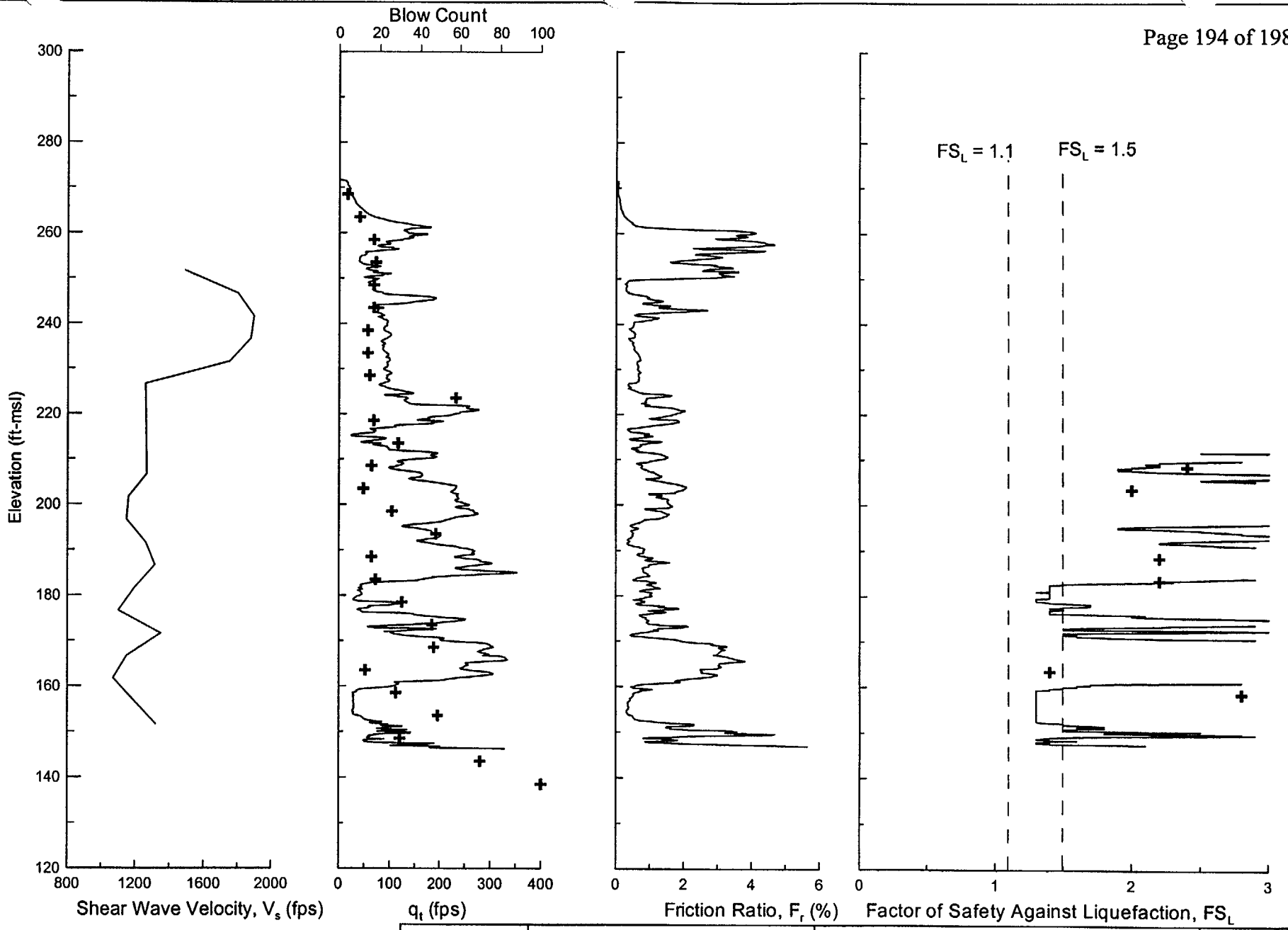
DUKE COGEMA STONE & WEBSTER

MOX Fuel Fabrication Facility
US Department of Energy CH

J.O. 08716

Factor of Safety Against Liquefaction
CPT-28 and BH-8
1886 Charleston 50th Percentile
Individual S-CPT Profile

Figure 8-53



Crosses indicate SPT values.

CPT-31-C.grf w/CPT-31-C_Data.xls & Seismic Shear.xls by fjw /8/8/01

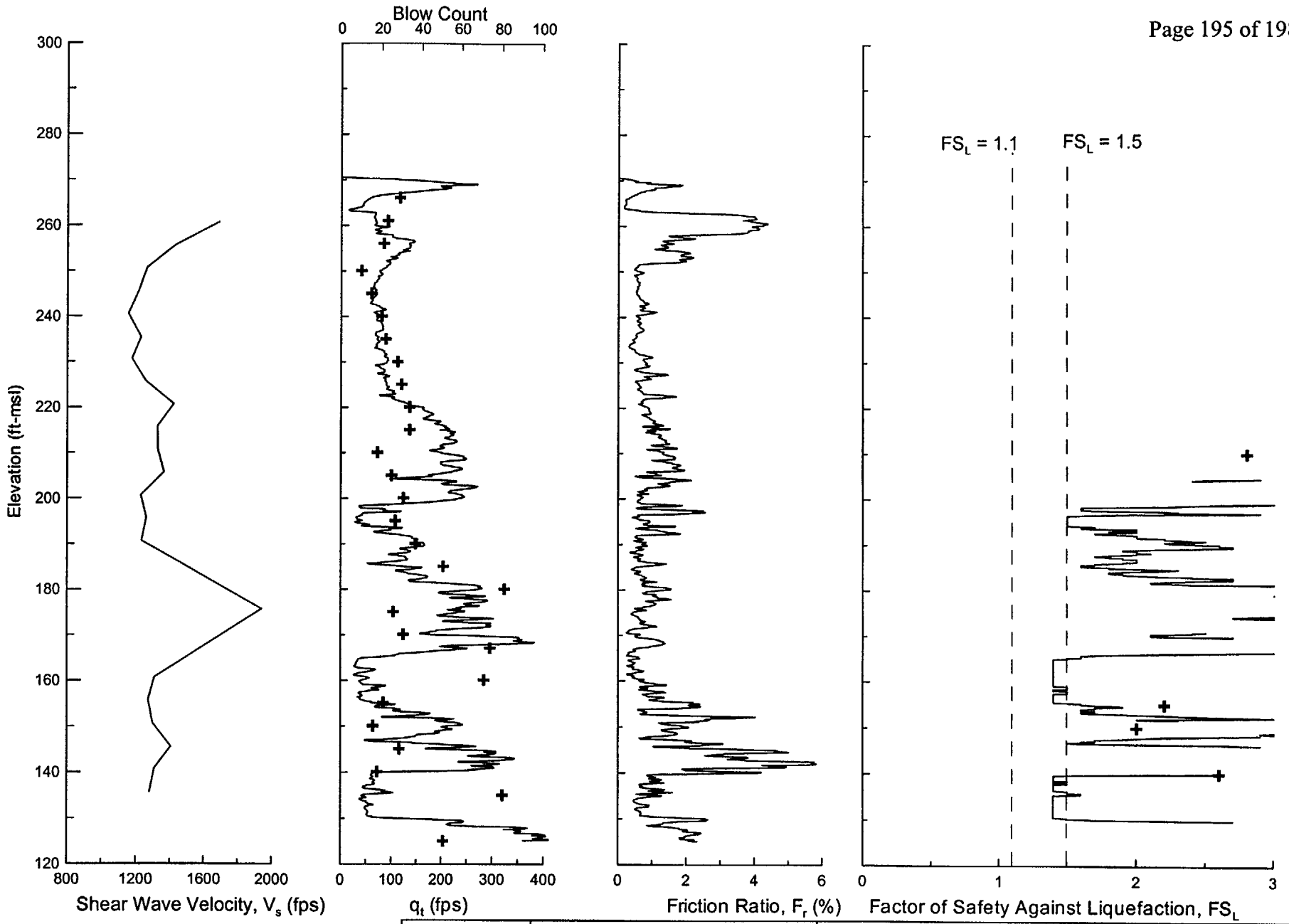
DUKE COGEMA STONE & WEBSTER

MOX Fuel Fabrication Facility
US Department of Energy CH

J.O. 08716

Factor of Safety Against Liquefaction
CPT-31 and BH-9
1886 Charleston 50th Percentile
Individual S-CPT Profile

Figure 8-54



Crosses indicate SPT values.

CPT-34-C.grf w/CPT-34-C_Data.xls & Seismic Shear.xls by jjt [7/17/01]

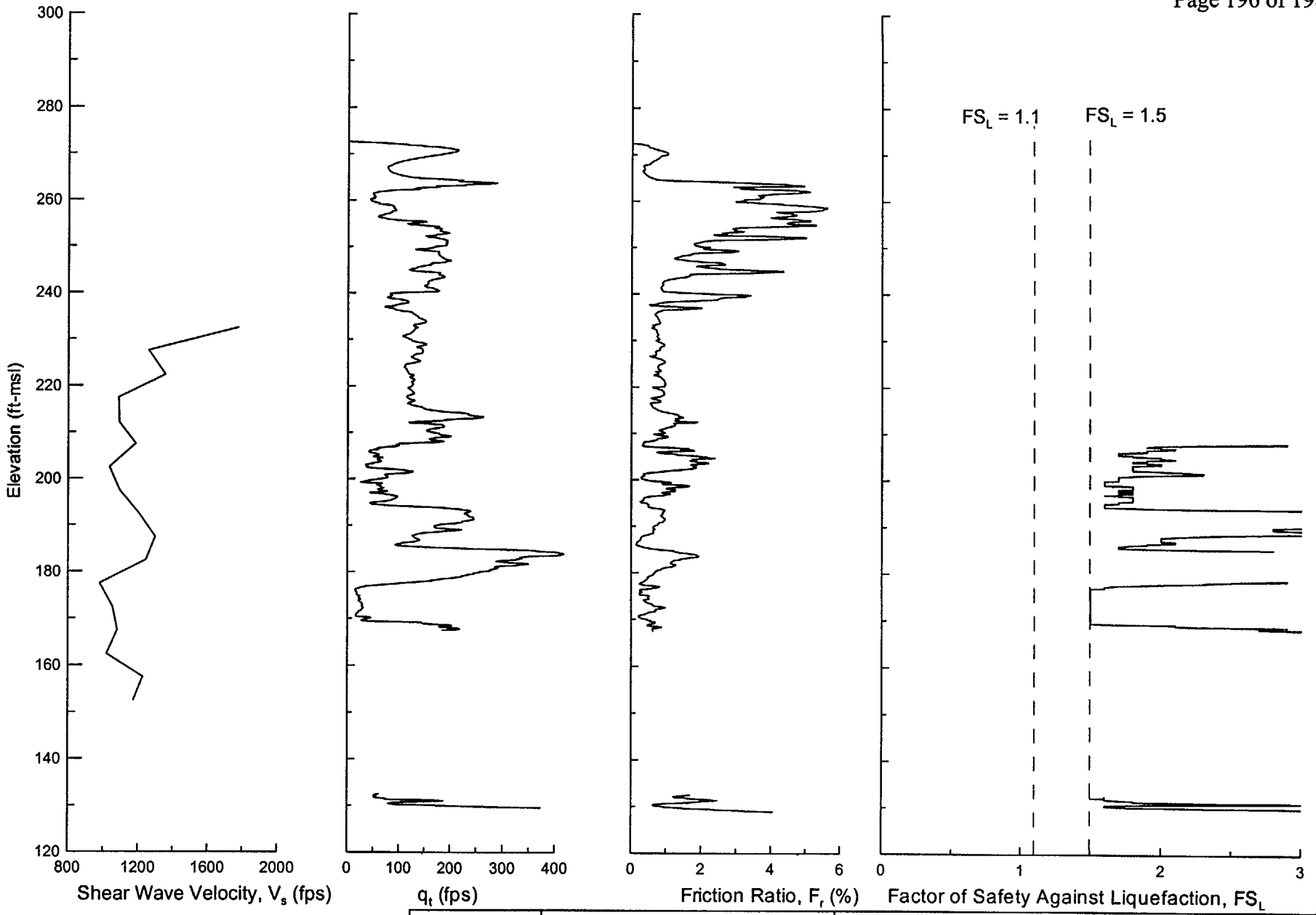
DUKE COGEMA STONE & WEBSTER

MOX Fuel Fabrication Facility
US Department of Energy CH

J.O. 08716

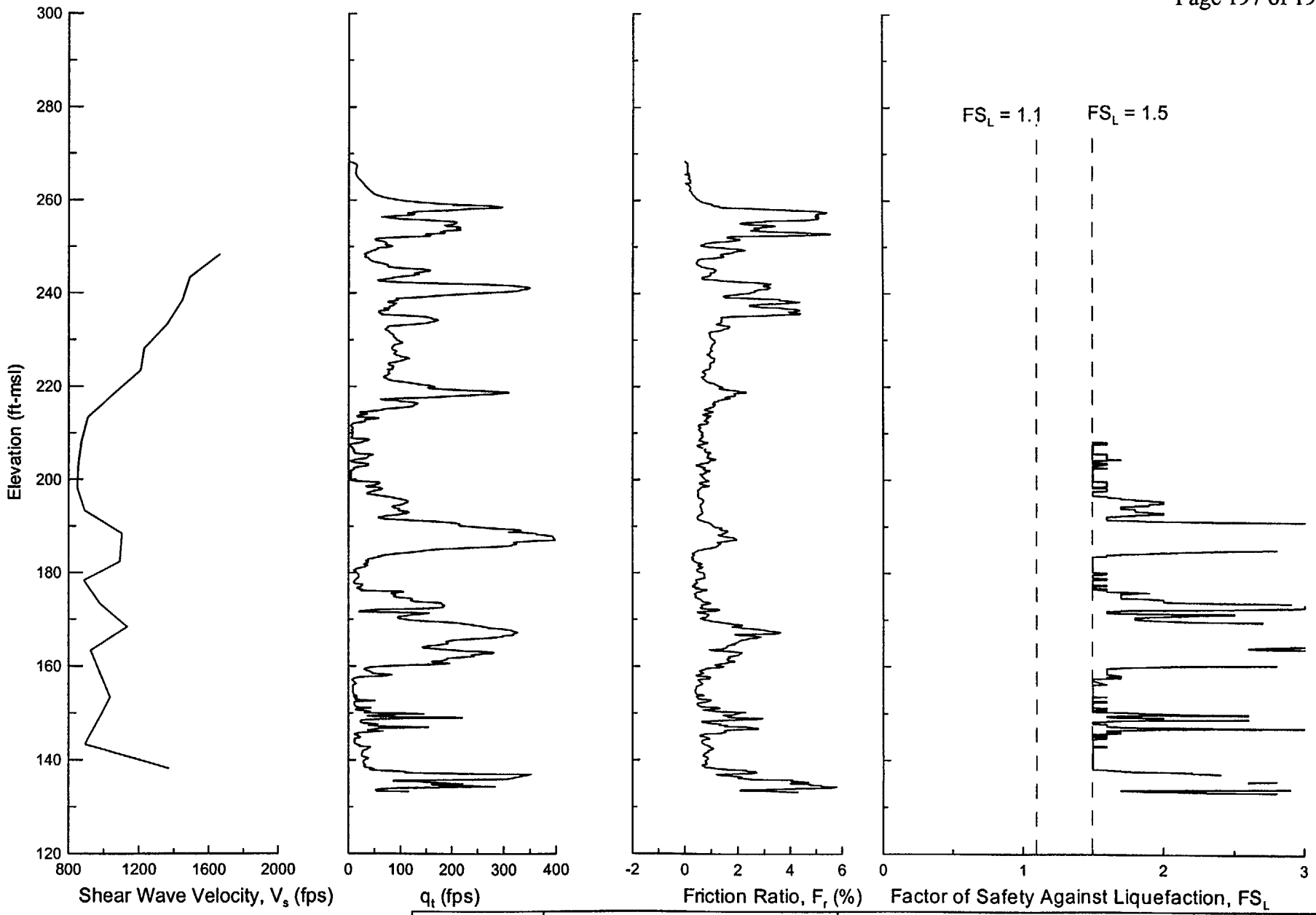
Factor of Safety Against Liquefaction
CPT-34 and BH-10
1886 Charleston 50th Percentile
Individual S-CPT Profile

Figure 8-55



DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-35 1886 Charleston 50th Percentile Individual S-CPT Profile	Figure 8-56

CPT-35-C.grf w/CPT-35-C_Data.xls & Seismic Shear.xls by fjw /8/8/01



DUKE COGEMA STONE & WEBSTER	MOX Fuel Fabrication Facility **US Department of Energy CH** J.O. 08716	Factor of Safety Against Liquefaction CPT-37 1886 Charleston 50th Percentile Individual S-CPT Profile	Figure 8-57

CPT-37-C.grf w/CPT-37-C_Data.xls & Seismic Shear.xls by fjw /8/8/01

E54400
N80900

E55900
N80900

PLANT

SCPT-1
(0.9)

CPT-2

SCPT-3
(1.3)

CPT-44

CPT-45

SCPT-5
(1.4)

CPT-46

CPT-48
(1.0)

CPT-47
(0.8)

CPT-4

CPT-6
(0.5)

CPT-7
(1.1)

BH-13
(1.8)

BH-1
(0.4)

CPT-9

CPT-10

BH-2

BH-12
(0.1)

CPT-50
(0.3)

SCPT-8
(1.3)

SCPT-11
(0.8)

CPT-12

CPT-49
(0.9)

MOX FUEL FABRICATION BUILDING

CPT-53
(1.1)

CPT-51
(1.3)

CPT-14
(1.3)

CPT-15

BH-3

SCPT-16
(0.8)

CPT-17

CPT-52
(1.0)

CPT-55
(1.4)

SCPT-13
(1.3)

C1

C2

CPT-43

CPT-20

CPT-39

CPT-54
(1.2)

CPT-56
(0.9)

CPT-57
(1.1)

CPT-18

BH-5
(1.9)

BH-6

AQUEUOS POLISHING AREA SUBLEVEL

BH-4
(0.0)

CPT-42

CPT-59(1.2)

SCPT-19
(0.9)

CPT-58
(1.2)

C3

CPT-21
(1.4)

CPT-60
(1.4)

CPT-22
(1.6)

BH-11
(1.6)

G1U

(1.1)

CPT-24

CPT-25

SCPT-26
(1.4)

SCPT-23

BH-7 (0.3)

CPT-61

CPT-62

CPT-63
(1.1)

EMERGENCY DIESEL GEN. BLDG.

B4

CPT-64

(1.0)

SCPT-28
(0.9)

(0.2)

CPT-32

H1

CPT-27
(0.9)

CPT-29

CPT-30

BH-9

SCPT-31
(0.8)

BH-8
(0.0)

CPT-40

B9

CPT-36

CPT-38

SCPT-35
(1.4)

SCPT-37
(0.6)

CPT-33

SCPT-34
(1.0)

BH-10
(0.0)

E54400
N79700

E55900
N79700

LEGEND:

(0.6) Estimated Post-Earthquake Settlement (inches) From 1886 Charleston based motion (used highest values from Tables 8-2 and 8-3)

CPT-XX — CONE PENETROMETER LOCATION (2000)

SCPT-XX — (SCPT is a Seismic CPT)

BH-XX — BOREHOLE LOCATION (2000)

SOFT ZONE LOCATION

MOX SITE BOUNDARY

ARCHEOLOGICAL BOUNDARY (APPROXIMATE)

EXISTING ROAD

TOPOGRAPHY (2000)

OVERHEAD ELECTRICAL LINE

UNDERGROUND ELECTRICAL LINE

ABOVE GROUND COMM./SIGNAL LINES

MFFF SITE GEOTECHNICAL REPORT
DCS01-WRS-DS-NTE-G-0005-B
POST-EARTHQUAKE SETTLEMENT
ESTIMATE AT DEPTH
FIGURE 8-58
(1886 CHARLESTON EARTHQUAKE)

DUKE COGEMA STONE & WEBSTER

MOX Fuel Fabrication Facility
DOE Savannah River Site, Aiken, SC
Project Number 08716

planlestdp.dgn Final Geot. Report

QUALITY LEVEL QL-1A (IROFS) Total Pages 92

ATTACHMENT NUMBER 1

EXPLORATION BORING PROGRAM AND LOG OF BORINGS

ATTACHMENT NO. 1
EXPLORATION BORING PROGRAM AND LOG OF BORINGS

1. DRILLING PROGRAM

1.1 Soil Drilling

During June and July of 2000, 13 soil borings were completed at the MFFF site as part of the geotechnical exploration program. All drilling was performed in accordance with DCS document number DCS01-WRS-DS-SPE-G-00002 – Specification for Geotechnical Borings and Sampling. The borings were advanced with a CME-75 truck-mounted drill rig utilizing the rotary-wash method. Drill bits with side discharge, or in the case of tricone bits, bottom deflectors, were required for reaming and advancing the borings. Ten borings were six inches in diameter, and three were eight inches in diameter. The larger diameter borings were cased with six-inch-diameter PVC plastic pipe to allow for seismic downhole testing at a later date. The locations of the borings were surveyed and staked in the field prior to drilling. The selection of boring locations was primarily based on: 1) the proposed structure locations; 2) access restrictions, i.e., brush and trees, steep terrain, archeological restrictions; 3) availability of existing data; and 4) locations of CPT soundings (for borings used to correlate CPT data).

1.2 Standard Penetration Testing (SPT)

SPT testing was performed at maximum intervals of five feet in all borings, with the exception that no sampling was conducted in the berm fill in borings BH-4, BH-11, BH-12 and BH-13. In cases where continuous SPT was performed, the hole was reamed out over the 18-inch sample interval prior to making the next drive. All SPT was performed in accordance with the ASTM Test Method D 1586-99. The split-spoon sampler was equipped with a check valve and bleeder located at the top of the sampler to prevent drilling fluid from entering the sampler from the drill rod. An automatic drive hammer was used to drive the SPT sampler in accordance with ASTM Test Method D 1586 -99. The SPT N-value was determined by adding the number of blows required to drive the spoon sampler the last 12 inches of the standard 18-inch drive.

1.3 Thin-walled Tube Sampling

Thin-walled (Shelby tube) samples were collected in clayey soils where possible, in accordance with ASTM Test Method D 1587-94. Sampling was performed using three-inch-diameter, 30-inch-long thin-walled tubes. All sample tubes were in new condition and made of hardened extruded steel with a smooth coating of Teflon™ or an approved equal. Thin-walled samples were mainly collected in clayey zones within the Tobacco Road Formation (TR3/4) and the Lower Dry Branch Formation (DB4/5). The sample procedure consisted of advancing the tube 24 inches into the material to be sampled, or until 750 psi of hydraulic pressure was reached. The tube was then allowed to "rest" for five minutes before rotating the drill string 90 degrees to shear the bottom of the sample off of the surrounding soil. Upon retrieval from the hole, any space in the ends of the sample tube was filled with melted paraffin wax. The ends of the tube

were then capped and labeled, and the tube was placed upright in a tube box as prescribed by ASTM Procedure 4220-95.

2. Radiological Monitoring

Radiological monitoring was performed at the drill site on each day that soil drilling and sampling was performed. At each drill location, Savannah River Site (SRS) Health Physics obtained samples of drill cuttings and fluids and a sample from each SPT jar sample and Shelby tube sample for radiological analysis and screening. SRS Health Physics cleared all samples of any radiological contamination prior to any sample being removed from the SRS site. No radiological contamination was identified in any of drilling fluids and cuttings or samples tested during the Exploration Boring Program.

3. SAMPLE PREPARATION, HANDLING AND STORAGE

In general, all samples were prepared and handled in accordance with DCS document number DCS01-WRS-DS-SPE-G-00002 – Specification for Geotechnical Borings and Sampling. SPT samples were typically collected from the top and bottom six inches of the sample spoon. If a material change occurred within the sample, additional samples were collected. Care was taken to exclude drill cuttings from the representative samples taken from the SPT split spoon sampler. SPT samples were placed in eight-ounce glass jars with tightly sealing lids. Both the jar and lid were labeled with the boring number, sample number, sample depth, date and job number.

Thin-walled samples were trimmed, measured and sealed with paraffin wax at the drill site. Plastic caps were placed over the ends of the tube, taped and labeled, and the tubes placed vertically in four-tube wooden boxes for transport and storage.

Samples were not removed from the SRS site until released by SRS Health Physics. A locked temporary sample storage area was established in DCS's field office in Aiken, near the SRS site. The storage area was maintained at a temperature of approximately 72 degrees Fahrenheit. Access to samples was limited to the DCS Lead and Field Engineers. The samples were stored at this location until released to the soils testing laboratory.

All samples were turned over to LAWGibb laboratory personnel for transport and storage at LAW's Atlanta, Georgia laboratory testing facility following the procedures outlined in DCS document number DCS01-WRS-DS-SPE-G-00003 – Specification for Laboratory Testing of Soil.

4. BORING LOGS

Field boring logs were prepared in the field by an experienced Field Geotechnical Engineer as the exploration borings were advanced and sampled. Initial field classification of the soils was made by the Field Geotechnical Engineer and recorded on the field boring logs. Changes in drilling characteristics and fluid losses were identified and recorded on the logs. Sampling

depths, blow counts, push pressure for thin walled samples, sample recovery etc. were recorded on the field boring logs.

After completion of the laboratory testing program, the field boring logs were edited and soil descriptions were refined to correspond to USCS definitions. Laboratory testing and classification results were also added to create the final boring log. The completed final of Log of Boring for borings BH-1 through BH-13 are included as part of Attachment No. 1.

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-1

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:		Date Started:	7/13/00
Northing:	80,405.4	Date Completed:	7/14/00
Easting:	55,341.0	Drill Method:	6" mud rotary
Surface Elevation:	272.0	Logged By:	JJT
Datum:	MSL	Reviewed By:	FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
0	272														
2	270	TR1 - To El. 268'													
4	268	TR1A - El. 268' to 260' Yellow-tan poorly graded SAND, some silt, fine- to medium-grained, loose, moist.	SP		SS	1	2 2 4 — 6	33							
6	266														
8	264	Mottled reddish-brown/tan CLAY, some fine-grained sand, medium dense, moist.	CL		SS	2	5 7 11 — 18	83					39	23	16
10	262														
12	260	TR2A - El. 260'- 238'													
14	258	Mottled reddish-brown/tan silty SAND, trace clay, fine- to medium-grained, interbedded thin clayey stringers, medium dense, moist.	SM		SS	3	5 9 10 — 19	94							
16	256														
18	254	Mottled reddish-brown/tan and white clayey SAND, trace clay, fine- to medium-grained, medium dense, moist. Visible layering.	SC		SS	4	6 8 10 — 18	72					38	21	17
20	252														
22	250														
24	248	Similar to above material.	SM		SS	5	9 10 12 — 22								

Completion Depth: 149.5

Drilling Rig: CME-75

Weather: Sunny, high 90's F

Remarks: Hole grouted immediately upon completion. Ave. grout density = 13.3 lb/gal.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 15:58

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-1

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80.405.4
Easting: 55.341.0
Surface Elevation: 272.0
Datum: MSL

Date Started: 7/13/00
Date Completed: 7/14/00
Drill Method: 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
26	246														
28	244	Yellow-tan to reddish-brown clayey SAND, fine- to medium-grained, moist, medium dense.	SC												
		Layered brown-orange, tan, pink, red poorly graded SAND, fine- to coarse-grained, medium dense, moist.	SP		SS	6	5 7 9 = 16	56							
30	242														
32	240														
34	238	Yellow-orange clayey SAND, fine- to medium-grained, with thinly laminated clay layers, medium dense, moist. TR2B - El. 238' - 211'	SC		SS	7A	3 6 6 = 12	56	22.5		81.9	18.1	44	23	21
36	236				ST	7B	750/1	0							
38	234														
		Yellow-orange poorly graded SAND, trace silt, fine- to medium-grained, medium dense, moist.	SP		SS	8	5 6 7 = 13	44					NV	NP	NP
40	232														
42	230														
44	228	Reddish-brown/purple poorly graded SAND, trace silt, fine- to medium-grained, medium dense, moist.	SP		SS	9	7 11 12 = 23	44							
46	226														
48	224														
		Yellow-orange poorly graded SAND, some silt, trace clay, fine- to medium-grained, medium dense, moist.	SP		SS	10	9 13 13 = 26								
50	222														

Completion Depth: 149.5
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Hole grouted immediately upon completion. Ave. grout density = 13.3 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 15:58

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-1

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80.405.4
Easting: 55.341.0
Surface Elevation: 272.0
Datum: MSL

Date Started: 7/13/00
Date Completed: 7/14/00
Drill Method: 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
50	222														
52	220														
54	218	Reddish-brown poorly graded SAND, trace silt, trace fine gravel, fine- to coarse-grained, medium dense, moist, with occasional thin laminae of white fat clay.	SP		SS	11	7 12 13	25	50						
56	216														
58	214	similar to above, becomes yellow-orange.	SP		SS	12A	9 17 12	29	50						
60	212	Becomes reddish-brown.													
		TR3/4 - El. 211' - 206'													
62	210	Brown clayey SAND, with silt, fine- to medium-grained, medium dense, moist.	SC		ST	12B	150/12 250/6 450/3		104	19.6 22.5 27.0		81.4 75.5	18.6 24.5	43	20	23
64	208														
66	206	DB1/3 - El. 206' - 184'													
68	204	Top 1" layered purple, white and tan silty CLAY to clayey SILT, very stiff, moist.	CL ML		SS	13	13 17 15	32	61						
		Layered reddish-brown, tan and white silty SAND, dense, moist.	SM												
70	202														
72	200														
74	198	Tan silty SAND, trace clay, fine- to medium-grained, loose to medium dense, moist.	SM		SS	14	3 4 6	10		28.5		86.2	13.8		

Completion Depth: 149.5
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Hole grouted immediately upon completion. Ave. grout density = 13.3 lb/gal.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 15:58

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-1

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80.405.4
Easting: 55.341.0
Surface Elevation: 272.0
Datum: MSL

Date Started: 7/13/00
Date Completed: 7/14/00
Drill Method: 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
76	196														
78	194	Gray-tan poorly graded SAND, some silt, fine- to medium-grained, dense, wet.	SP		SS	15	14 17 17 — 34	94							
80	192														
82	190														
84	188	Disturbed material, cuttings/caved material.			SS	16		0							
86	186														
88	184	DB4/5 - El. 184' - 174' Greenish-gray clayey SAND, fine- to medium-grained, dense, moist. Interbedded with thin layers of greenish-gray silt.	SC SM		SS	17A	9 14 17 — 31	100	36.1		65.7	34.3			
90	182														
92	180	Tan-brown silty SAND, trace clay, fine- to coarse-grained, trace fine-grained gravel, dense, wet.	SM		ST	17B	250/15 450/9	100	51.5	1.2	82.4	16.4	86	52	34
94	178	Gray-green clayey SAND, fine-grained, loose, moist.	SC		SS	18	WH 2 7 — 9	100	34.0		73.6	26.4	42	22	20
96	176														
98	174	ST1 - El. 174' - 154' Light brownish-orange poorly graded SAND, trace silt, fine- to coarse-grained, dense, wet.	SP		SS	19	17 24 24 — 48								
100	172														

Completion Depth: 149.5
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Hole grouted immediately upon completion. Ave. grout density = 13.3 lb/gal.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 15:58

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-1

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,405.4
Easting: 55,341.0
Surface Elevation: 272.0
Datum: MSL

Date Started: 7/13/00
Date Completed: 7/14/00
Drill Method: 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
100	172														
102	170														
104	168	Yellow-orange poorly graded SAND with silt, fine-grained, dense, wet with very thin clay and lignite laminae.	SP		SS	20	16 21 23	44	50						
106	166														
108	164	Layered yellow-orange, tan, pink poorly graded SAND, trace silt, dense to very dense, wet.	SP		SS	21	16 19 31	50	56						
110	162														
112	160														
114	158	Light brown/yellow-orange poorly graded SAND, trace silt, fine- to medium-grained, very dense, wet.	SP		SS	22	18 27 33	60	56						
116	156														
118	154	ST2 - El. 154' - 140' Reddish-tan clayey SAND, trace shell fragments, very fine-grained, loose to medium dense, wet.	SC		SS	23A	WH 4 6	10	100	33.0	78.4	21.6	53	27	26
120	152				ST	23B	WR/3 50/3 350/6		0						
122	150														
124	148	Yellow-orange poorly graded SAND, some silt, fine-grained, dense, wet.	SP		SS	24	14 25 20	45	61						

Completion Depth: 149.5
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Hole grouted immediately upon completion. Ave. grout density = 13.3 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 15:58

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-1

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,405.4
Easting: 55,341.0
Surface Elevation: 272.0
Datum: MSL

Date Started: 7/13/00
Date Completed: 7/14/00
Drill Method: 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
126	146														
128	144	Tan silty SAND, fine-grained, trace medium-grained, loose, wet.	SM		SS	25	WR 1 7 8	100	32.8		56.5	43.5	35	28	7
130	142														
132	140	GC - El. 140' - 137'													
134	138	Yellow-brown poorly graded to silty SAND, trace clay, fine- to medium-grained, very dense, wet.	SP SM		SS	26	9 16 40 56	100							
136	136														
		CG - El. 137'													
138	134	Yellow-brown poorly graded quartz SAND, trace silt, fine- to coarse-grained, very dense, wet.	SP		SS	27	28 38 33 71	44							
140	132														
142	130														
144	128	Similar to above.	SP		SS	28	32/6" 10/0" >100	0							
146	126														
148	124	Dark gray poorly graded SAND, trace silt, fine- to medium-grained, very dense, moist.	SP		SS	29	21 38 52 90								
150	122	Completed boring at 149.5.													

Completion Depth: 149.5
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Hole grouted immediately upon completion. Ave. grout density = 13.3 lb/gal.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 15:58

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-1

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site
Job Number: 08716

Boring Location:
Northing: 80,405.4
Easting: 55,341.0
Surface Elevation: 272.0
Datum: MSL

Date Started: 7/13/00
Date Completed: 7/14/00
Drill Method: 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
150	122	Completed boring at 149.5'.														
152	120															
154	118															
156	116															
158	114															
160	112															
162	110															
164	108															
166	106															
168	104															
170	102															
172	100															
174	98															

Completion Depth: 149.5
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Hole grouted immediately upon completion. Ave. grout density = 13.3 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 15:58

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-2

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,406.7
Easting: 55,625.3
Surface Elevation: 258.6
Datum: MSL

Date Started: 7/1/00
Date Completed: 7/7/00
Drill Method: 8" auger to 25'/ 8" mud rotary
Logged By: JJT/JKM
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
0	258	TR1A - To El. 249'													
2	256														
4	254	Yellow-orange poorly graded SAND, trace silt, fine- to medium-grained, loose, dry to slightly moist.	SP		SS	1	1 2 4	6	78	6.9					
6	252														
8	250	Red-orange poorly graded SAND, trace silt, fine-grained, medium dense, slightly moist.	SP		SS	2	10 12 14	26	100						
10	248	TR2A - El. 249' - 226'													
12	246														
14	244	Yellow-orange poorly graded SAND, with silt, fine- to medium-grained, medium dense, slightly moist.	SP SM		SS	3	6 7 6	13	89	6.9	0.3	90.6	9.1		
16	242														
18	240	Similar to above.	SP SM		SS	4	6 7 6	13	0						
20	238														
22	236														
24	234														

Completion Depth: 138
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Hole cased to 137.35' with 6" dia. PVC pipe capped at bottom. Annulus between hole and casing grouted to top of hole.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 15:59

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-2

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80.406.7
Easting: 55.625.3
Surface Elevation: 258.6
Datum: MSL

Date Started: 7/1/00
Date Completed: 7/7/00
Drill Method: 8" auger to 25'/ 8" mud rotary
Logged By: JJT/JKM
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
26	232				ST	5B									
28	230	Yellow-orange poorly graded SAND. with silt, fine- to medium-grained, medium dense, slightly moist.	SP SM		SS	5A	7 7 10	17	83		2.5	82.5	11			
30	228														
32	226	TR2B - El. 226' - 204'													
34	224	Yellow poorly graded SAND, with silt, fine- to medium-grained, medium dense, slightly moist.	SP SM		SS	6	6 7 10	17	94	67.0		89.9	11.1		
36	222														
38	220	Yellow-orange poorly graded SAND, some silt, fine- to medium-grained, medium dense, moist.	SP SM		SS	7	7 10 12	22	78						
40	218														
42	216														
44	214	Yellow-orange silty SAND, fine-grained, medium- to coarse-grained, medium dense, moist.	SM		SS	8	5 6 8	14	56			87.5	12.5		
46	212														
48	210	Yellow-orange poorly graded SAND, some silt, fine- to medium-grained, medium dense.	SP SM		SS	9	4 5 9	14	67						
50															

Completion Depth: 138
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Hole cased to 137.35' with 6" dia. PVC pipe capped at bottom. Annulus between hole and casing grouted to top of hole.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 15:59

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-2

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 80,406.7

Easting: 55,625.3

Surface Elevation: 258.6

Datum: MSL

Date Started: 7/1/00

Date Completed: 7/7/00

Drill Method: 8" auger to 25'/ 8" mud rotary

Logged By: JJT/JKM

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
50	208														
52	206														
54	204	Yellow-orange silty SAND, fine- to medium-grained, loose to medium dense, moist.	SM		SS	10	4 5 5	10	100						
		TR3/4 - El. 204' - 202'													
56	202	DB1/3 - El. 202' - 190'			ST	11	200/12 150/12 500/3		63						
58	200	Yellow-orange poorly graded SAND, with silt, fine- to medium-grained, trace coarse grained, very loose to loose, moist.	SP		SS	12	1 2 2	4	78	24.3		92	8		
60	198														
62	196														
64	194	Light yellow-brown to yellow-orange poorly graded SAND, trace silt, fine- to medium-grained, very dense, moist.	SP		SS	13	13 23 28	51	100						
66	192														
68	190	Yellow-orange silty SAND, trace clay, fine- to medium-grained, grades with thin seams (<1" silt and clay), loose, wet.	SM		SS	14	0 2 4	6	111	35.7		84.2	15.8	32	25	7
		DB4/5 - El. 190' - 181'														
70	188						250/12 540/12				2.0	81.3	16.7			
72	186	Tan brown clayey SAND, fine- to medium-grained, trace coarse-grained, wet.	SC		ST	15			115	35.3		81.5	18.5	89	31	58
74	184	Light brown-brown silty SAND, fine- to medium-grained, trace coarse-grained, medium dense, wet.	SM		SS	16	7 10 16	26	100			79.3 73.0	20.7 27.0			

Completion Depth: 138

Drilling Rig: CME-75

Weather: Sunny, high 90's F

Remarks: Hole cased to 137.35' with 6" dia. PVC pipe capped at bottom. Annulus between hole and casing grouted to top of hole.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 15:59

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-2

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80.406.7
Easting: 55.625.3
Surface Elevation: 258.6
Datum: MSL

Date Started: 7/1/00
Date Completed: 7/7/00
Drill Method: 8" auger to 25'/ 8" mud rotary
Logged By: JJT/JKM
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
76	182	ST1 - El. 181' - 164'													
78	180	Yellow-brown to brown-orange silty SAND, fine-grained, dense, moist.	SM		SS	17	8 14 17	31	83						
80	178														
82	176														
84	174	Yellow-brown to brown-orange poorly graded SAND, with silt, fine-grained, dense, moist.	SP SM		SS	18	8 22 25	47	111		94.0	6.0			
86	172														
88	170	Grades less silt.	SP		SS	19	19 29 35	64	89						
90	168														
92	166														
94	164	Yellow-brown to orange-brown poorly graded SAND, with silt, fine-grained, dense, moist. ST2 - El. 164' - 152.5'	SP SM		SS	20	17 20 20	40	81		93.2	6.8			
96	162	Tan clayey SAND, with silt, fine grained, trace medium- to coarse-grained, wet.	SC		ST	21	200/18 500/6		115	34.9	77.8 77.1	22.2 22.9	59	29	30
98	160														
100															

Completion Depth: 138
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Hole cased to 137.35' with 6" dia. PVC pipe capped at bottom. Annulus between hole and casing grouted to top of hole.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 15:59

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-2

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,406.7
Easting: 55,625.3
Surface Elevation: 258.6
Datum: MSL

Date Started: 7/1/00
Date Completed: 7/7/00
Drill Method: 8" auger to 25'/ 8" mud rotary
Logged By: JJT/JKM
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
100	158	Harder drilling at 100'.													
102	156	Grades harder drilling at 102'.													
104	154	Yellow-brown clayey SAND, with silt, fine-grained, trace medium-grained, medium dense, damp.	SC SM		SS	22	7 10 12 — 22	133	31.4		58.2	41.8	49	24	25
106	152	Harder drilling with chatter 105.5'-107'. GC - El. 152.5' - 143'													
108	150														
110	148	Mottled yellow-brown to green-grey silty CLAY, with fine sand, hard, moist.	CL		SS	23	5 10 28 — 38	150							
112	146														
114	144	Mottled yellow-brown to green-grey silty CLAY, with sandier layers containing larger quartz grains, very stiff, moist.	CL		SS	24	8 10 12 — 22	133							
116	142	CG - El. 143'													
118	140	Light brown to yellow-orange well graded SAND, with silt, trace fine-grained gravel, fine- to coarse-grained, very dense, moist.	SW SM		SS	25	45 50/5 — >100			1.5	90.7	7.8			
120	138														
122	136														
124	134	Dark grey poorly graded SAND, fine- to coarse-grained, very dense, moist.	SP		SS	26	34 50/5.5 — >100								

Completion Depth: 138
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Hole cased to 137.35' with 6" dia. PVC pipe capped at bottom. Annulus between hole and casing grouted to top of hole.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 15:59

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-2

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 80,406.7

Easting: 55,625.3

Surface Elevation: 258.6

Datum: MSL

Date Started: 7/1/00

Date Completed: 7/7/00

Drill Method: 8" auger to 25'/ 8" mud rotary

Logged By: JJT/JKM

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
126	132	Dark grey poorly graded SAND, fine- to coarse-grained, very dense, moist.	SP												
128	130														
130	128														
132	126														
134	124														
136	122														
138	120	Completed boring at 138'.													
140	118														
142	116														
144	114														
146	112														
148	110														
150															

Completion Depth: 138

Drilling Rig: CME-75

Weather: Sunny, high 90's F

Remarks: Hole cased to 137.35' with 6" dia. PVC pipe capped at bottom. Annulus between hole and casing grouted to top of hole.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 15:59

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-3

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80.277.5
Easting: 55.528.8
Surface Elevation: 265.9
Datum: MSL

Date Started: 6/24/00
Date Completed: 6/27/00
Drill Method: 8" auger to 25'/ 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
0														
2	264	TR1A - To El. 252'												
4	262	Tan-brown poorly graded SAND, fine- to medium-grained, medium dense, slightly moist.	SP		SS	1	4 4 7	11	100					
6	260													
8	258	Reddish-brown silty SAND, trace clay, fine- to medium-grained, dense, damp. Very thin white clay/silt laminae throughout.	SM		SS	2	10 14 17	31	100	12.8				
10	256													
12	254													
14	252	TR2A - El. 252' - 244' Reddish-brown silty SAND, some clay, fine- to medium-grained, dense, damp. Very thin white clay/silt laminae throughout.	SM		SS	3	15 13 17	30	100		79.6	20.4		
16	250													
18	248	Similar to above.	SM		SS	4	11 15 15	30	100					
20	246													
22	244	TR2B - El. 244' - 218'												
24	242	Reddish-brown silty SAND, fine- to medium-grained, medium dense, damp.	SP		SS	5	8 10 14	24	100		77.1	22.9		

Completion Depth: 137.5
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Hole grouted immediately upon completion. Ave. grout density = 13.5 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 15:59

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-3

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80.277.5
Easting: 55.528.8
Surface Elevation: 265.9
Datum: MSL

Date Started: 6/24/00
Date Completed: 6/27/00
Drill Method: 8" auger to 25'/ 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
26	240														
28	238	Orange-brown poorly graded SAND, trace silt, fine- to medium-grained, medium dense, damp.	SP		SS	6A	6 8 12	20	40						
30	236				ST	6B	100/18		75						
32	234														
34	232	Grading fine-grained.	SP		SS	7	6 10 11	21							
36	230	Grading coarser.													
38	228														
40	226	Similar to above, grading fine-grained.	SP		SS	8	7 12 14	26	40						
42	224														
44	222	Yellow-orange poorly graded SAND, with silt, fine- to medium-grained, medium dense, moist.	SP SM		SS	9	11 12 12	24	40	93.8	6.2				
46	220														
48	218	TR3/4 - El. 218' - 211'													
50	216	Yellow-orange clayey SAND, fine- to medium-grained, loose, moist. Grading more clay with depth.	SC		ST	10A	150/24 375/6		125	66.3	10.3	89.7	175	82	93

Completion Depth: 137.5
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Hole grouted immediately upon completion. Ave. grout density = 13.5 lb/gal.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 15:59

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-3

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80.277.5
Easting: 55.528.8
Surface Elevation: 265.9
Datum: MSL

Date Started: 6/24/00
Date Completed: 6/27/00
Drill Method: 8" auger to 25'/ 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
50		Tan CLAY, highly plastic, trace fine sand, wet.	CH		SS	10B	4 4 4	40	44.1 66.3	12 10.3	88 89.7	148 175	47 82	101 93
52	214	Tan SILT, highly plastic, trace fine sand, wet.	MH											
54	212	Yellow-orange clayey SAND to poorly graded SAND with clay, medium dense, fine- to medium-grained, moist. Thinly bedded with black carbonaceous layers. DB1/3 - El. 211' - 182'	SC/ SP SC		SS	11	5 6 7	60	34.9 24.7	70.8 89.8	29.2 10.2	59 84	29 24	30 60
56	210													
58	208	Yellow-orange mottled black and white, silty SAND, trace clay, fine-to medium-grained, loose, wet.	SM		SS	12	WH WH 9	60		79.8	20.2			
60	206													
62	204													
64	202	Yellow-orange poorly graded SAND, with silt, trace clay, fine- to medium-grained, medium dense, wet.	SP SM		SS	13	10 10 11	60		91.9	8.1			
66	200													
68	198	Yellow-orange with mottled black poorly graded SAND, with clay, fine-grained, medium dense, wet.	SP SC		SS	14	3 4 10	100	25.7	92.1	7.9	39	25	14
70	196													
72	194													
74	192	Similar to above.	SP SC		SS	15A	4 5 7	12						

Completion Depth: 137.5
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Hole grouted immediately upon completion. Ave. grout density = 13.5 lb/gal.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 15:59

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-3

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site
Job Number: 08716

Boring Location:
Northing: 80,277.5
Easting: 55,528.8
Surface Elevation: 265.9
Datum: MSL

Date Started: 6/24/00
Date Completed: 6/27/00
Drill Method: 8" auger to 25'/ 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
76	190	Tan poorly graded SAND, with clay, fine- to coarse-grained, medium dense, moist.	SP SC		ST	15B	>1500		75	24.4	90.9	9.1	101	26	75
78	188														
80	186														
82	184	Yellow-tan poorly graded SAND, trace silt, trace clay, fine- to medium-grained, dense, saturated.	SP		SS	16	23 25 15	40	30		95.3	4.7			
84	182	DB4/5 - El. 182' - 176'													
86	180	Mottled light brown black and white interbedded SANDS, SILTS and CLAYS, fine-grained, loose, soft. Bedding planes clearly visible. Carbonaceous.	SC		SS	17A	WH 2 5	7		37.9	72.1	27.9	59	24	35
88	178		SC		ST	17B	400/12 750/12			49.8 29.3	61.2 79.4	38.8 20.6	98 43	36 31	62 12
90	176	ST1 - El. 176' - 157' Brown silty SAND, with clay, fine- to medium-grained.	SM												
92	174														
94	172														
96	170														
98	168	Yellow-orange poorly graded SAND, fine- to medium-grained, dense, saturated. Interbedded with thin (1-2mm) white clay laminae.	SP		SS	18	18 21 20	41	30						
100	166														

Completion Depth: 137.5
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Hole grouted immediately upon completion. Ave. grout density = 13.5 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 15:59

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-3

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 80.277.5

Easting: 55,528.8

Surface Elevation: 265.9

Datum: MSL

Date Started: 6/24/00

Date Completed: 6/27/00

Drill Method: 8" auger to 25'/ 6" mud rotary

Logged By: JJT

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
100														
102	164	Yellow-orange silty SAND, fine-grained, dense, wet.	SM		SS	19	17 21 24	45	45					
104	162													
106	160	Similar to above, very dense, very moist.	SM		SS	20	21 27 27	54	100					
108	158	ST2 - El. 157' - 147'												
110	156													
112	154	Yellow-orange silty SAND, fine-grained, loose, moist. Shell fragments visible throughout.	SM		SS	21	WH WH 5	5	100	33.5	80.8	19.2	44	28	16
114	152				ST		300/24 500/6		0					
116	150	Yellow-orange clayey SAND, trace limestone fragments, fine-grained, dense, moist.	SC		SS	22	22 18 18	36	65					
118	148	GC - El. 147' - 142'												
120	146													
122	144	Yellow-orange SILT, with fine-grained sand, trace clay, very dense, moist.	ML		SS	23	28 38 39	77	30					
124	142	CG - El. 142'												

Completion Depth: 137.5

Drilling Rig: CME-75

Weather: Sunny, high 90's F

Remarks: Hole grouted immediately upon completion. Ave. grout density = 13.5 lb/gal.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 15:59

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-3

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 80,277.5

Easting: 55,528.8

Surface Elevation: 265.9

Datum: MSL

Date Started: 6/24/00

Date Completed: 6/27/00

Drill Method: 8" auger to 25'/ 6" mud rotary

Logged By: JJT

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
126	140													
128	138	Very hard drilling with softer layers between 126 and 128.5 feet.			SS	24	23 50 50	100	0					
130	136													
132	134	Yellow-orange poorly graded SAND, some silt, trace clay, fine- to coarse-grained, very dense, saturated.	SP		SS	25	28 53 54	107						
134	132													
136	130	Light-brown poorly graded SAND, some silt, fine- to medium-grained, very dense, wet.	SP		SS	26	29 48 54	102						
138	128	Completed boring at 137.5'.												
140	126													
142	124													
144	122													
146	120													
148	118													
150	116													

Completion Depth: 137.5

Drilling Rig: CME-75

Weather: Sunny, high 90's F

Remarks: Hole grouted immediately upon completion. Ave. grout density = 13.5 lb/gal.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 15:59

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-4

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,182.6
Easting: 55,230.1
Surface Elevation: 297.1
Datum: MSL

Date Started: 6/13/00
Date Completed: 6/15/00
Drill Method: 8" auger to 40'/ 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
0	296	Reddish-brown silty SAND, fine- to medium-grained, dry to moist. No sampling in the first 25'.	SM											
2	294	Fill to El. 267'												
4	292													
6	290													
8	288													
10	286													
12	284													
14	282													
16	280													
18	278													
20	276													
22	274													
24														

Completion Depth: 181
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Head pressure grouting through drill rods. Average grout density was 13.2 lb/gallon. Observed good flow of mud.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-4

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 80,182.6

Easting: 55,230.1

Surface Elevation: 297.1

Datum: MSL

Date Started: 6/13/00

Date Completed: 6/15/00

Drill Method: 8" auger to 40'/ 6" mud rotary

Logged By: JJT

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
26	272	Reddish-brown silty SAND, fine- to medium-grained, dry to moist.	SM											
28	270													
	268	Reddish-brown clayey SAND, fine-grained, damp (FILL).	SC		SS	1	9 11 13 (24)	90						
30		TR1 - El. 267' - 264'												
	266	Brown clayey SAND, with roots, damp. (original ground)	SC											
32														
34	264	TR1A - El. 264' - 252'												
		Mottled pink-orange silty SAND, fine-grained, medium dense, dry to damp. Interbedded with thinly laminated light grey-purple clay.	SM		SS	2	7 8 10 (18)	70						
36	262													
38	260													
	258				ST	3	400/24	100						
40														
42	256	Reddish brown and tan silty SAND, fine- to medium-grained, medium dense, damp. Clay stringers throughout.	SM		SS	4	2 4 8 (12)	40	9.5	78.4	21.6			
44	254													
	252	TR2A - El. 252' - 230'												
46		Yellow-tan mottled with pink and white silty SAND, fine- to medium-grained, medium dense, moist. Interspersed clay nodules.	SM		SS	5	12 12 12 (24)	90	22	81.4	18.6			
48	250													
	248													
50														

Completion Depth: 181

Drilling Rig: CME-75

Weather: Sunny, high 90's F

Remarks: Head pressure grouting through drill rods. Average grout density was 13.2 lb/gallon. Observed good flow of mud.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-4

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 80,182.6

Easting: 55,230.1

Surface Elevation: 297.1

Datum: MSL

Date Started: 6/13/00

Date Completed: 6/15/00

Drill Method: 8" auger to 40'/ 6" mud rotary

Logged By: JJT

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
50	246	Yellow-tan silty SAND, fine-grained, medium dense, moist, thin white clay laminae throughout.	SM		SS	6	12 13 16	29	50					
52	244													
54	242													
56	240	Similar to above, reddish-brown mottled with tan, grading fine- to medium-grained, dense.	SM		SS	7	18 19 23	42		17.7	86.0	14.0		
58	238													
60	236	Yellow-tan to pink silty SAND, fine- to medium-grained, dense, moist.	SM		SS	8	14 19 25	44	50					
62	234													
64	232													
66	230	Yellow-tan silty/clayey SAND, fine- to medium-grained, dense, moist. TR2B - El 230' - 207'	SC SM		SS	9	14 17 20	37	80					
68	228													
70	226	Yellow-tan poorly graded SAND, with silt, fine- to medium-grained, dense, moist.	SP SM		SS	10	18 21 20	41	45		93.8	6.2		
72	224													
74														

Completion Depth: 181

Drilling Rig: CME-75

Weather: Sunny, high 90's F

Remarks: Head pressure grouting through drill rods. Average grout density was 13.2 lb/gallon. Observed good flow of mud.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-4

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,182.6
Easting: 55,230.1
Surface Elevation: 297.1
Datum: MSL

Date Started: 6/13/00
Date Completed: 6/15/00
Drill Method: 8" auger to 40'/ 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
75	222														
76	221	Yellow-tan poorly graded SAND, trace silt, trace clay, fine- to medium-grained, very dense, moist.	SP		SS	11	21 25 27	52	40						
78	219														
80	217	Yellow-tan poorly graded SAND, with silt, trace clay, fine- to medium-grained, dense, moist to wet.	SP SM		SS	12	16 17 18	35	40		89.9	10.1			
82	215														
84	213														
86	211	Similar to above, with pink medium plastic clay stringers, wet.	SP SM		SS	13	17 15 17	32	33						
88	209														
90	207	TR3/4 - El. 207' - 195'													
	206	Brown clayey SAND, fine- to medium-grained, medium dense, moist.	SC		SS	14	3 4 11	15		26.3	78.6	21.4	94	36	58
92	205	Brown-orange poorly graded SAND, trace clay, fine- to coarse-grained, medium dense, moist.	SP												
94	203														
96	201	Grey-green sandy SILT, dense, moist with thin lenses of orange fine-grained sand and lignite <1mm thick.	MH		SS	15	15 21 26	47		67	43.3	56.7	80	62	18
98	199														
100	197														

Completion Depth: 181
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Head pressure grouting through drill rods. Average grout density was 13.2 lb/gallon. Observed good flow of mud.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-4

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,182.6
Easting: 55,230.1
Surface Elevation: 297.1
Datum: MSL

Date Started: 6/13/00
Date Completed: 6/15/00
Drill Method: 8" auger to 40'/ 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press /Int. psi/in	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
100	196	Grey silty SAND, trace clay, fine-grained, medium dense, very moist. Layering visible. Becoming tan. DB1/3 - El. 195' - 168'	SM		SS	16	9 12 15	27	100						
102	194														
104	192														
106	190	Orange-brown silty SAND, medium-grained, dense, very moist to saturated.	SM		SS	17	17 16 16	32	70						
108	188														
110	186	Yellow-tan poorly graded SAND, with silt, fine- to medium-grained, dense, wet.	SP SM		SS	18	14 17 17	34	75		91.2	8.8			
112	184														
114	182														
116	180	Yellow-orange poorly graded SAND, some clay, fine- to medium-grained, medium dense, saturated.	SP		SS	19	11 14 15	29	95						
118	178														
120	176	Mottled orange/tan/black clayey SAND, fine- to medium-grained, medium dense, moist.	SC		SS	20	12 14 15	29	100	34.4	60.0	40.0	74	22	52
122	174														
124															

Completion Depth: 181
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Head pressure grouting through drill rods. Average grout density was 13.2 lb/gallon. Observed good flow of mud.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-4

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,182.6
Easting: 55,230.1
Surface Elevation: 297.1
Datum: MSL

Date Started: 6/13/00
Date Completed: 6/15/00
Drill Method: 8" auger to 40'/ 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
126	172	Yellow-tan poorly graded SAND, with silt, fine- to medium-grained, very dense, wet. Brown interbedded silt layers.	SP		SS	21	28 25 27	52	100					
128	170													
130	168	DB4/5 - El. 168' - 162'												
132	166	Yellow-tan interbedded silty SAND, fine- to medium-grained, very dense, very moist. Interbedded with white clay laminae 1-3mm thick.	SM		SS	22	17 20 80	100	100					
134	164													
136	162	ST1 - El. 162' - 152'												
138	160	Orange-yellow poorly graded SAND, with silt, very fine- to fine-grained, dense to very dense, moist. Interbedded with thin clay laminae and lignite.	SP SM		SS	23	25 27 23	50	75					
140	158													
142	156	Grey-brown silty SAND, fine- to coarse-grained, dense to very dense, wet.	SM											
144	154	Orange-yellow poorly graded SAND, some silt, trace clay, fine-grained, very dense.	SP		SS	24	19 23 36	59	75					
146	152	ST2 - El. 152' - 142'												
148	150	Orange-brown silty SAND, very fine-grained, medium dense, moist. White clay stringers throughout.	SM		SS	25	13 13 14	27	75					
150	148													

Completion Depth: 181
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Head pressure grouting through drill rods. Average grout density was 13.2 lb/gallon. Observed good flow of mud.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-4

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,182.6
Easting: 55,230.1
Surface Elevation: 297.1
Datum: MSL

Date Started: 6/13/00
Date Completed: 6/15/00
Drill Method: 8" auger to 40'/ 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
150	146	Orange-yellow silty SAND, trace clay, fine-grained, very dense, moist. Widely spaced thin clay laminae.	SM		SS	26	25 25 30 55	100						
152	144													
154	142	GC - El. 142' - 139'												
156	140	Yellow/yellow-orange clayey SILT, some fine- to medium-grained SAND, medium dense, moist.	ML		SS	27	2 13 14 27							
158	138	Yellow-brown clayey SAND, fine- to medium-grained, medium dense, moist.	SC											
160	136	CG - El. 139'												
162	134	Orange-brown poorly graded SAND, with silt, fine- to coarse-grained, very dense, moist. Thin clay stringers throughout.	SP SM		SS	28	25 100/8 >100			88.4	11.6			
164	132													
166	130	Yellow-orange poorly graded SAND, trace silt, fine- to coarse-grained, very dense, moist.	SP		SS	29	32 40 50/5 >100							
168	128													
170	126	Dark grey to black silty SAND, fine- to coarse-grained, very dense, damp.	SM		SS	30	24 40 50/5 >100							
172	124													
174														

Completion Depth: 181
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Head pressure grouting through drill rods. Average grout density was 13.2 lb/gallon. Observed good flow of mud.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-4

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,182.6
Easting: 55,230.1
Surface Elevation: 297.1
Datum: MSL

Date Started: 6/13/00
Date Completed: 6/15/00
Drill Method: 8" auger to 40'/ 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
176	122	Tan poorly graded SAND, trace silt, very dense, wet.	SP		SS	31	50/5 >100							
178	120													
180	118													
182	116	Tan silty SAND, fine-grained, very dense, wet.	SM		SS	32	33 40 50/4 >100							
		Completed boring at 182'.												
184	114													
186	112													
188	110													
190	108													
192	106													
194	104													
196	102													
198	100													
200	98													

Completion Depth: 181
Drilling Rig: CME-75
Weather: Sunny, high 90's F

Remarks: Head pressure grouting through drill rods. Average grout density was 13.2 lb/gallon. Observed good flow of mud.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-5

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,183.5
Easting: 55,460.2
Surface Elevation: 275.3
Datum: MSL

Date Started: 7/8/00
Date Completed: 7/10/00
Drill Method: 8" mud rotary
Logged By: JKM
Reviewed By: FJW/JJT

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
0	274	TR1 to El. 266'													
2	272	Light-orange/brown poorly graded SAND, with silt, fine-grained, medium dense, dry.	SP SM		SS	1	1 4 7	11	78						
4	270														
6	268														
8	266	Red-orange silty CLAY, with fine-grained sand, dense, wet. TR1A - El. 266' - 259'	CL		SS	2	9 14 27	41	89						
10	264														
12	262	Mottled red-orange to yellow-orange silty SAND, fine- to medium-grained, medium dense, damp. Grades with calcite stringers.	SM		SS	3	5 9 10	19	78	13.6		76.2	23.8		
14	260	TR2A - El. 259' - 235'													
16	258														
18	256	Similar to above, grades with more sand, stiff.	SM		SS	4	4 5 9	14	78						
20	254														
22	252	Red-brown and tan clayey SAND, fine- to medium-grained, medium dense, damp, with more calcite stringers.	SC		SS	5	4 5 9	14	67	15.4		80.4	19.6	37	20	17
24															

Completion Depth: 158
Drilling Rig: CME-75
Weather: Sunny, low 90's F

Remarks: Hole cased with 6" PVC casing from ground surface to 153'. Annulus between casing and wall of boring grouted with lean cement grount (~13.5 lb/gal).

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-5

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,183.5
Easting: 55,460.2
Surface Elevation: 275.3
Datum: MSL

Date Started: 7/8/00
Date Completed: 7/10/00
Drill Method: 8" mud rotary
Logged By: JKM
Reviewed By: FJW/JJT

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
26	250															
28	248															
30	246	Similar to above, grades with more white stringers and more fine sand, very stiff.	SC		SS	6A	4 7 9	16	83							
32	244	Yellow-tan silty SAND, fine- to coarse-grained, medium dense.	SM		ST	6B	100/12 200/6 300/3		0							
34	242	Tan brown silty SAND, fine- to medium-grained, trace coarse-grained, medium dense. With white stringers at 33.5'.	SM		SS	7	4 8 10	18	72			79.7	20.3			
36	240															
38	238															
40	236	Yellowish-tan silty SAND, with clay, fine- to coarse-grained, trace fine-grained gravel, medium dense, moist. TR2B - El. 235' - 213'	SM		ST	8	250/12 600/12 1000/2		108	21.8	0.4	78.3	21.3	112	48	64
42	234															
44	232	Red-brown poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, medium dense, moist.	SP SM		SS	9	6 9 11	20	61			94.3	5.7			
46	230															
48	228															
50	226	Red-brown poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, dense, moist.	SP SM		SS	10	9 15 15	30	72			92.9	7.1			

Completion Depth: 158
Drilling Rig: CME-75
Weather: Sunny, low 90's F

Remarks: Hole cased with 6" PVC casing from ground surface to 153'. Annulus between casing and wall of boring grouted with lean cement grount (~13.5 lb/gal).

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-5

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,183.5
Easting: 55,460.2
Surface Elevation: 275.3
Datum: MSL

Date Started: 7/8/00
Date Completed: 7/10/00
Drill Method: 8" mud rotary
Logged By: JKM
Reviewed By: FJW/JJT

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
50																
	224															
52																
	222	Mottled red-brown to yellow-brown poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, dense, moist.	SP SM		SS	11	10 15 16	31	67							
54																
	220															
56																
	218															
58		Similar to above, medium dense to dense.	SP SM		SS	12	10 14 15	29	78			92.5	7.5			
	216															
60																
	214															
62		TR3/4 - El. 213' - 203'														
	212															
64		Mottled yellow-orange to red-orange sandy CLAY, stiff, wet, with thin sand lenses.	CH		SS	13	5 4 5	9	100	41.4		33.3	66.7	92	28	64
	210															
66		Red-brown sandy CLAY, soft, wet.	CH		ST	14	250/12 300/6 400/6		100	46.0		31.6	68.4	78	25	53
	208															
68																
	206	Light yellow-brown sandy CLAY, with silt, trace medium-grained, stiff, wet. Grades with black organic streaks and fine sand.	CH		SS	15	2 5 6	11	128	42.5		49.0	51.0			
70																
	204															
72		DB1/3 - El. 203' - 183'														
	202															
74		Light yellow-brown poorly graded SAND, with silt, fine- to medium-grained, dense, moist.	SP SM		SS	16	11 17 16	33				91.2	8.8			

Completion Depth: 158
Drilling Rig: CME-75
Weather: Sunny, low 90's F

Remarks: Hole cased with 6" PVC casing from ground surface to 153'. Annulus between casing and wall of boring grouted with lean cement grount (~13.5 lb/gal).

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-5

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80.183.5
Easting: 55.460.2
Surface Elevation: 275.3
Datum: MSL

Date Started: 7/8/00
Date Completed: 7/10/00
Drill Method: 8" mud rotary
Logged By: JKM
Reviewed By: FJW/JJT

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
76	200	Attempted shelby tube sample at 75'. Pushed 6" at 1,000 psi, no recovery.													
78	198	Light brown poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, dense, moist.	SP SM		SS	17	17 17 27	44	94						
80	196														
82	194														
84	192	Similar to above, loose. Becoming medium dense at 84.5'-85'.	SP SM		SS	18	WH WH 1	1	133	29.5		91.4	8.6		
86	190														
88	188	Light-brown poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, very dense, moist.	SP SM		SS	19	16 26 35	61	89			95.0	5.0		
90	186	Harder drilling at 90'.													
92	184	DB4/5 - El. 183' - 173'													
94	182	Yellow-brown clayey SAND, fine- to medium-grained, loose, wet, with shell fragments.	SC		SS	20	WH 2 3	5	144	31.2		83.7	16.3	60	27	33
96	180														
98	178	Grading more clayey, medium dense.	SC		SS	21	5 10 16	26	122						
100	176														

Completion Depth: 158
Drilling Rig: CME-75
Weather: Sunny, low 90's F

Remarks: Hole cased with 6" PVC casing from ground surface to 153'. Annulus between casing and wall of boring grouted with lean cement grount (~13.5 lb/gal).

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-5

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,183.5
Easting: 55,460.2
Surface Elevation: 275.3
Datum: MSL

Date Started: 7/8/00
Date Completed: 7/10/00
Drill Method: 8" mud rotary
Logged By: JKM
Reviewed By: FJW/JJT

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
100															
	174	Yellow-brown tan clayey SAND, fine- to medium-grained, medium dense, wet.	SC		ST	22	250/12 400/8 500/4	100	32.5 47.1		82.1 75.9	17.9 24.1	67 67	32 32	35 35
102		ST1 - El. 173' - 154'													
	172	Similar to above, medium dense.													
104		Yellow-brown silty SAND, fine- to coarse-grained, medium dense, moist.	SM		SS	23	3 8 19	27	111						
	170														
106															
	168														
108		Mottled yellow-orange/yellow-brown poorly graded SAND, with silt, fine-grained, medium dense to dense. Grading to fine silty SAND, last 6" grading with hard brittle clay lenses.	SP SM		SS	24	3 10 19	29	122		89.4	10.6			
	166														
110															
	164														
112															
	162	Similar to above, dense, with thin silt lenses througout.	SP SM		SS	25	19 21 24	45	106						
114															
	160														
116															
	158														
118		Similar to above, very dense.	SP SM		SS	26	23 28 30	58	94						
	156														
120															
	154	ST2 - El. 154' - 143'													
122															
	152														
124		Mottled yellow-brown to yellow-orange clayey SAND, fine-grained, loose, wet. Numerous white stringers (calcite) and shell fragments.	SC		SS	27	WH 1 7	8	133	34.6	75.0	25.0	61	30	31

Completion Depth: 158
Drilling Rig: CME-75
Weather: Sunny, low 90's F

Remarks: Hole cased with 6" PVC casing from ground surface to 153'. Annulus between casing and wall of boring grouted with lean cement grount (~13.5 lb/gal).

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-5

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,183.5
Easting: 55,460.2
Surface Elevation: 275.3
Datum: MSL

Date Started: 7/8/00
Date Completed: 7/10/00
Drill Method: 8" mud rotary
Logged By: JKM
Reviewed By: FJW/JJT

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
126	150														
128	148	Similar to above, loose. Grades with less white stringers and shells.	SC		SS	28	WH WH 7	144							
130	146														
132	144	Tan sandy CLAY, highly plastic, medium stiff, wet.	CH		ST	29	WR/12 50/8 250/8	100	39.3		42.0	58.0	61	25	36
134	142	GC - El. 143' - 139'													
136	140	Mottled brown and yellow-brown clayey SAND, fine-grained, dense.	SC		SS	30	7 14 16	122	32.0		65.0	35.0			
138	138	CG - El. 139'													
140	136	Yellow-brown poorly graded SAND, with silt, fine- to coarse-grained, very dense.	SP SM		SS	31	22 42 50	92	94						
142	134														
144	132	Similar to above, very dense.	SP		SS	32	50/5	>100	39						
146	130														
148	128														
150	126	Light brown poorly graded SAND, some silt, fine- to medium-grained, very dense.	SP		SS	33	25/1	>100	28						

Completion Depth: 158
Drilling Rig: CME-75
Weather: Sunny, low 90's F

Remarks: Hole cased with 6" PVC casing from ground surface to 153'. Annulus between casing and wall of boring grouted with lean cement grount (~13.5 lb/gal).

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-5

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,183.5
Easting: 55,460.2
Surface Elevation: 275.3
Datum: MSL

Date Started: 7/8/00
Date Completed: 7/10/00
Drill Method: 8" mud rotary
Logged By: JKM
Reviewed By: FJW/JJT

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
150	124	Hard drilling 150'-151.5'.													
152	122														
154	120														
156	118	Harder drilling 156.5'-158.0'.													
158	116	Completed boring at 158'.													
160	114														
162	112														
164	110														
166	108														
168	106														
170	104														
172	102														
174															

Completion Depth: 158
Drilling Rig: CME-75
Weather: Sunny, low 90's F

Remarks: Hole cased with 6" PVC casing from ground surface to 153'. Annulus between casing and wall of boring grouted with lean cement grount (~13.5 lb/gal).

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-6

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 80,210.0

Easting: 55,692.9

Surface Elevation: 259.4

Datum: MSL

Date Started: 6/20/00

Date Completed: 6/22/00

Drill Method: 8" auger to 25'/ 6" mud rotary

Logged By: JJT

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
0	258	TR1A to El. 246'														
2	256	Yellow-orange poorly graded SAND, fine-grained, very loose, slightly moist.	SP		SS	1	2 1 2	3	75							
4	254															
6	252															
8	250	Mottled red and tan SILT, some fine-grained sand, medium dense, moist. Interbedded with thin clay and sand layers.	ML		SS	2	9 13 14	27								
10	248															
12	246	TR2A - El. 246' - 242'														
14	244	Mottled red and tan silty SAND, fine- to medium-grained, dense, moist.	SM		SS	3	9 17 17	34		13.5		67.9	32.1			
16	242	TR2B - El. 242' - 204'														
18	240	Red-orange silty SAND, trace clay, fine- to medium-grained, trace coarse-grained, medium dense, moist.	SM		SS	4	6 9 19	28		13.6		68.9	31.1			
20	238															
22	236															
24																

Completion Depth: 131

Drilling Rig: CME-75

Weather: Sunny, mid 90's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-6

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site
Job Number: 08716

Boring Location:
Northing: 80,210.0
Easting: 55,692.9
Surface Elevation: 259.4
Datum: MSL

Date Started: 6/20/00
Date Completed: 6/22/00
Drill Method: 8" auger to 25'/ 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
26	234	Light brown poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, medium dense, moist.	SP SM		SS	5	11 11 12 / 23	35							
28	232														
30	230														
32	228	Yellow-tan poorly graded SAND, with silt, fine- to medium-grained, medium dense, moist.	SP SM		SS	6	8 10 12 / 22	50			92.2	7.8			
34	226														
36	224														
38	222														
40	220														
42	218														
44	216	Mottled tan and gray silty SAND, fine- to medium-grained, moist.	SM		ST	7A	600/23	96							
46	214	Tan silty SAND, trace clay, fine- to medium-grained, trace coarse-grained, medium dense, moist. Black clayey stringers throughout.	SM		SS	7B	8 7 7 / 14	75			87.1	12.9			
48	212														
50	210														

Completion Depth: 131
Drilling Rig: CME-75
Weather: Sunny, mid 90's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-6

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,210.0
Easting: 55,692.9
Surface Elevation: 259.4
Datum: MSL

Date Started: 6/20/00
Date Completed: 6/22/00
Drill Method: 8" auger to 25'/ 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
50															
52	208	Yellow-tan silty SAND, fine- to medium-grained, medium dense, moist. Interspersed with clay nodules.	SM		SS	8	7 7 8 15	80							
54	206														
56	204	TR3/4 - El. 204' - 199'													
58	202	Mottled black yellow-tan clayey SAND, with silt, fine- to medium-grained, trace coarse-grained, loose to medium dense, wet. Black carbonaceous nodules throughout.	SC		SS	9	3 3 7 10	100	36.3		71.1	28.9			
60	200														
62	198	DB1/3 - El. 199' - 185' Yellow-tan poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, medium dense, moist. White clay stringers throughout.	SP SM		SS	10	8 8 10 18	100			90.1	9.9			
64	196														
66	194														
68	192	Yellow-tan interbedded silty SAND and poorly graded SAND, fine- to coarse-grained, medium dense, wet.	SP SM		SS	11	13 13 16 29	75							
70	190														
72	188	Yellow-tan poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, medium dense, saturated.	SP SM		SS	12	17 14 15 29	40			93.9	6.1			
74	186	DB4/5 - El. 185' - 179'													

Completion Depth: 131
Drilling Rig: CME-75
Weather: Sunny, mid 90's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-6

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 80,210.0

Easting: 55,692.9

Surface Elevation: 259.4

Datum: MSL

Date Started: 6/20/00

Date Completed: 6/22/00

Drill Method: 8" auger to 25'/ 6" mud rotary

Logged By: JJT

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
76	184	Olive-tan silty SAND, trace gravel, fine- to medium-grained, trace coarse-grained, loose, wet with black carbonaceous stringers.	SM		SS	13A	2 3 2	5	100	37.6	0.2	75.2	24.6	36	27	9
78	182	Tan-brown clayey SAND, fine-grained, trace medium- to coarse-grained, wet.	SC		ST	13B	900/18		100	37.0 33.2		75.6 74.2	24.4 25.8	58 58	26 26	32 32
80	180	ST1 - El. 179' - 165'														
82	178	Yellow-tan poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, dense, saturated.	SP SM		SS	14	16 17 14	31	40			92.9	7.1			
84	176															
86	174	Similar to above, grading fine-grained, more dense.	SP SM		SS	15	18 20 20	40	40							
88	172															
90	170															
92	168	Yellow-tan poorly graded SAND, with silt, very fine-grained, dense, saturated. Interbedded with silty SAND, very fine-grained.	SP SM		SS	16	9 17 19	36	45							
94	166	ST2 - El. 165' - 149'														
96	164	Yellow-tan silty SAND, trace clay, fine-grained, trace medium-grained, loose, wet, with shell fragments.	SP SM		SS	17A	0 0 9	9	100	35.2		74.5	25.5			
98	162															
100	160	Tan poorly graded SAND, with clay, fine- to medium-grained, wet.	SP SC		ST	17B	250/24		100	18.9		72.7 88.8	27.3 11.2	51	23	28

Completion Depth: 131

Drilling Rig: CME-75

Weather: Sunny, mid 90's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-6

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 80,210.0

Easting: 55,692.9

Surface Elevation: 259.4

Datum: MSL

Date Started: 6/20/00

Date Completed: 6/22/00

Drill Method: 8" auger to 25'/ 6" mud rotary

Logged By: JJT

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
100	158	Yellow-tan clayey SAND, fine-grained, trace medium-grained, very loose, wet.	SC		SS	18A	WR WR WR	100	39.7		66.6	33.4	49	25	24
102	156	Tan clayey SAND, fine-grained, trace medium-grained, wet.	SC		ST	18B	300/24		38.2		51.4	48.6	57	22	35
104	154														
106	152	Yellow-brown sandy CLAY, fine- to medium-grained, hard, wet.	CH		SS	19	6 10 25	35	100	34.6		33.4	66.6	58	30	28
108	150	Very hard seam at 108.5' (possibly limestone).													
110	148	GC - El. 149' - 144'													
112	146	Grading from brown, rust, black and grey-green mottled to yellow-tan silty SAND, with clay, fine-grained, trace medium-grained, medium dense, wet.	SM		SS	20	10 10 17	27	100	32		61.4	38.6			
114	144	Possible limestone seam at 115.5'. CG - El. 144'													
116	142	Yellow-tan clayey SAND, fine- to coarse-grained, very dense, wet. Light tan-grey poorly graded SAND, fine- to medium-grained, very dense, saturated.	SC SP		SS	21	26 44 42/4	>100	50						
118	140														
120	138														
122	136	Light yellow-tan poorly graded SAND, fine-grained, very dense, saturated. Grading light orange-brown SAND, with silt.	SP SM		SS	22	41 34/4 10/0	>100	50						
124															

Completion Depth: 131

Drilling Rig: CME-75

Weather: Sunny, mid 90's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-6

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 80,210.0

Easting: 55,692.9

Surface Elevation: 259.4

Datum: MSL

Date Started: 6/20/00

Date Completed: 6/22/00

Drill Method: 8" auger to 25'/ 6" mud rotary

Logged By: JJT

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
126	134	Yellow-tan grading brown and grey poorly graded SAND, fine- to medium-grained, very dense, wet.	SP		SS	23	42 47 50/4	>100							
128	132														
130	130														
132	128	Completed boring at 131'.													
134	126														
136	124														
138	122														
140	120														
142	118														
144	116														
146	114														
148	112														
150	110														

Completion Depth: 131

Drilling Rig: CME-75

Weather: Sunny, mid 90's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:03

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-7

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,082.9
Easting: 55.414.4
Surface Elevation: 277.4
Datum: MSL

Date Started: 7/11/00
Date Completed: 7/12/00
Drill Method: 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
0	276	TR1 to El. 272'														
2	274	Pinkish-tan poorly graded SAND, some silt, fine-grained, loose, moist.	SP		SS	1	1 2 2	4	56							
4	272	TR1A - El. 272' - 263'														
6	270															
8	268	Mottled red and tan sandy CLAY/SILT, fine-grained, very stiff, slightly moist.	CL ML		SS	2	10 10 10	20	100							
10	266															
12	264	Reddish brown silty SAND, with silt, fine- to medium-grained, medium dense, damp.	SM		SS	3	3 6 7	13	67	20.3		59.1	40.9			
14	262	TR2A - El. 263' - 235'														
16	260															
18	258	Yellow-orange silty SAND, fine-grained, medium dense, moist. Thin white clay/silt laminae throughout.	SM		SS	4	5 7 8	15	72							
20	256															
22	254	Yellow-orange silty SAND, fine- to medium-grained, trace coarse-grained, medium dense, damp.	SM		SS	5	5 6 7	13	72			81.2	18.8			
24																

Completion Depth: 153
Drilling Rig: CME-75
Weather: Sunny, low 80's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-7

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,082.9
Easting: 55,414.4
Surface Elevation: 277.4
Datum: MSL

Date Started: 7/11/00
Date Completed: 7/12/00
Drill Method: 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
26	252														
28	250														
		Similar to above, with more white clayey laminae.	SM		SS	6A	5 7 8	15	78						
30	248														
		Tan clayey SAND, some silt, fine- to coarse-grained, gravel, moist.	SC		ST	6B	250/4 750/2	71	20.1	7.7	78.2	14.1	31	20	11
32	246														
		Yellow-orange silty SAND, fine- to medium-grained, medium dense, moist.	SM		SS	7	7 9 13	22	72						
34	244														
36	242														
38	240														
		Red-brown tan silty SAND, fine- to medium-grained, trace coarse-grained, medium dense, moist. Thin clayey laminae throughout.	SM		SS	8A	7 10 10	20			83.2	16.8			
40	238														
		Tan clayey SAND, some silt, fine- to coarse-grained with fine-grained gravel, moist.	SC		ST	8B	250/6 450/2 800/7	63	26.2	8.0	74.7	17.3	36	19	17
42	236	TR2B - El. 235' - 207'													
		Yellow-orange mottled with rust clayey SAND, fine- to medium-grained, medium dense, moist. Thin white clay/silt laminae throughout.	SC		SS	9	6 7 9	16	83		74.4	25.6			
44	234														
46	232														
48	230														
		Brown poorly graded SAND, with silt, fine- to medium-grained trace coarse-grained, medium dense, moist.	SP SM		SS	10	8 13 15	28			93.2	6.8			
50	228														

Completion Depth: 153
Drilling Rig: CME-75
Weather: Sunny, low 80's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-7

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,082.9
Easting: 55,414.4
Surface Elevation: 277.4
Datum: MSL

Date Started: 7/11/00
Date Completed: 7/12/00
Drill Method: 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
50	226														
52	224	Tan with lavender hue poorly graded SAND, with silt, trace clay, fine- to medium-grained, trace coarse-grained, medium dense, saturated.	SP SM		SS	11	7 12 14 / 26	72			93.0	7.0			
54	222														
56	220	Yellow-orange poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, medium dense, moist.	SP SM		SS	12	8 12 13 / 25	72			91.6	8.4			
58	218														
60	216	Yellow-orange poorly graded SAND, with silt, fine- to coarse-grained, trace fine-grained gravel, medium dense, saturated.	SP SM		SS	13	8 13 11 / 24	72							
62	214														
64	212	Yellow-orange silty SAND, trace clay, fine-grained, medium dense, saturated.	SM		SS	14A	4 8 9 / 17	67							
66	210														
68	208	TR3/4 - El. 207' - 191'													
70	206	Tan silty SAND, fine- to coarse-grained, saturated.	SM		ST	14B	350/6 750/3 1000/3	54	45.9		54.4	45.6	109	68	41
72	204	Yellow-orange interbedded poorly graded SAND and silty SAND, fine- to coarse-grained, dense, moist.	SP SM		SS	15	9 18 25 / 43	100							
74															

Completion Depth: 153
Drilling Rig: CME-75
Weather: Sunny, low 80's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-7

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,082.9
Easting: 55,414.4
Surface Elevation: 277.4
Datum: MSL

Date Started: 7/11/00
Date Completed: 7/12/00
Drill Method: 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
76	202														
78	200	Tan silty SAND, fine- to medium-grained, medium dense, moist.	SM		SS	16A	5 10 12	22			82.5	17.5			
80	198	Grading to greenish-grey poorly graded SAND, with thin silt laminae, fine- to medium-grained, medium dense, moist.	SP SM												
82	196				ST	16B	250/7 500/13 800/4	0							
84	194	Greyish-tan mottled with black clayey SAND, trace silt, fine- to medium-grained, trace coarse-grained, medium dense, wet.	SC		SS	17	2 4 8	12	89	32.5	83.3	16.7	62	28	34
86	192	DB1/3 - El. 191' - 179.5'													
88	190	Yellow-orange SAND, with silt, fine- to medium-grained, loose to medium dense, wet.	SP SM		SS	18	3 4 6	10	100	33.0	89.3	10.7			
90	188														
92	186	Tan poorly graded SAND, with silt, fine- to coarse-grained, dense, saturated.	SP SM		SS	19	3 14 29	43	83		93.6	6.4			
94	184														
96	182														
98	180	DB4/5 - El. 179.5' - 169'													
100	178	Alternating layers yellow-orange silty/clayey SAND, fine- to medium-grained, loose to medium dense, wet. Thinly laminated silt layers visible.	SC SM		SS	20A	6 5 5	10	72						

Completion Depth: 153
Drilling Rig: CME-75
Weather: Sunny, low 80's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-7

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,082.9
Easting: 55,414.4
Surface Elevation: 277.4
Datum: MSL

Date Started: 7/11/00
Date Completed: 7/12/00
Drill Method: 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
100															
	176	Tan sandy SILT, with clay, wet.	MH		ST	20B	50/9 100/6 400/9	100	54.5		30.9	69.1	93	43	50
102															
	174	Brownish-tan clayey SAND, with silt, fine- to medium-grained, medium dense, wet. Grading less fine-grained with depth. Very thin white/black layers visible. Carbonaceous particles also visible.	SC		SS	21	WH 7 11	18	128	30.1		71.9	28.1	74	31	43
104															
	172														
106															
	170														
108		As above.	SC												
	168	ST1 - El. 169' - 146' Light brown-orange poorly graded SAND, with silt, fine- to medium-grained, medium dense, moist.	SP SM		SS	22	4 8 10	18	100						
110															
	166														
112															
	164	Brown-tan mottled rust/black poorly graded SAND, with silt, trace clay, fine- to medium-grained, medium dense, wet. Small carbonaceous particles visible.	SP SM		SS	23	4 5 8	13	111	35.3		88.1	11.9			
114															
	162														
116															
	160														
118		Brown-tan poorly graded SAND, very fine-grained, very dense, moist.	SP		SS	24	22 28 24	52	100						
	158														
120															
	156														
122															
	154	Brown-tan silty SAND, fine-grained, very dense, moist.	SM		SS	25	18 34 38	72	78		87.4	12.6			
124															

Completion Depth: 153
Drilling Rig: CME-75
Weather: Sunny, low 80's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-7

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80.082.9
Easting: 55,414.4
Surface Elevation: 277.4
Datum: MSL

Date Started: 7/11/00
Date Completed: 7/12/00
Drill Method: 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
126	152															
128	150															
130	148	Rust-brown clayey SAND, trace silt, fine-grained, trace medium-grained, medium dense, moist. Grey-green thin silt laminae throughout (<0.5mm).	SC		SS	26	9 13 15	28	83			75.0	25.0			
132	146	ST2 - El. 146' - 139'														
134	144	Yellow-brown silty SAND, fine-grained, trace medium-grained, medium dense, moist. Grey-green thin silt laminae throughout.	SM		SS	27	WH 5 9	14	133	32.6		62.6	37.4			
136	142															
138	140	GC - El. 139' - 135' Yellow-orange SILT, with fine-grained sand, medium dense, moist. Grading rust-light brown, clayey, trace fine sand, dense, moist.	ML		SS	28	WH 1 17	18	133							
140	138															
142	136	CG - El. 135'														
144	134	Yellowish-orange silty SAND, trace clay, fine- to coarse-grained, dense to very dense, saturated. Grading coarser with depth.	SM		SS	29	18 24 28	52	89							
146	132															
148	130															
150	128	Similar to above, very dense.	SM		SS	30	24/1	>100	0							

Completion Depth: 153
Drilling Rig: CME-75
Weather: Sunny, low 80's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-7

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 80,082.9

Easting: 55,414.4

Surface Elevation: 277.4

Datum: MSL

Date Started: 7/11/00

Date Completed: 7/12/00

Drill Method: 6" mud rotary

Logged By: JJT

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
150	126	As above.	SM		SS	31	18/1 >100								
152	124	Black fine-grained clayey SAND observed in recirculated drill mud at 153'. Completed boring at 153'.													
154	122														
156	120														
158	118														
160	116														
162	114														
164	112														
166	110														
168	108														
170	106														
172	104														
174															

Completion Depth: 153

Drilling Rig: CME-75

Weather: Sunny, low 80's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-8

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 79.995.3

Easting: 55.335.1

Surface Elevation: 279.4

Datum: MSL

Date Started: 6/6/00

Date Completed: 6/9/00

Drill Method: 8" auger to 25'/ 6" mud rotary

Logged By: JJT/FJW

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
0	278	TR1A to El. 263'													
2															
4	276	Reddish-brown silty SAND, fine- to medium-grained, dense, moist.	SM		SS	1	12 19 27	46	100						
6	274														
8	272														
10	270	Yellow-tan grading to reddish brown mottled yellow clayey SAND, fine- to medium-grained, medium dense, moist.	SC		SS	2	3 5 9	14	100						
12	268														
14	266	Red-brown silty SAND, fine-grained, trace medium-grained, medium dense, moist.	SM		SS	3	3 8 9	17	100	14.9	59.9	40.1			
16	264	TR2A - El. 263' - 237'													
18	262	Red-brown SILT, trace sand, trace clay, medium dense, moist.	ML												
20	260	Red-tan poorly graded SAND, with silt, fine- to medium-grained, medium dense, moist.	SP SM		SS	4	4 6 7	13	100						
22	258														
24	256	Tan silty SAND, fine- to medium-grained, medium dense, moist.	SM		SS	5	5 5 7	12	100		85.8	14.2			

Completion Depth: 152.5

Drilling Rig: CME-75

Weather: Sunny, mid 80's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-8

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 79.995.3
Easting: 55.335.1
Surface Elevation: 279.4
Datum: MSL

Date Started: 6/6/00
Date Completed: 6/9/00
Drill Method: 8" auger to 25'/ 6" mud rotary
Logged By: JJT/FJW
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
26	254														
28	252														
30	250														
32	248	Yellow-tan mottled red-brown silty SAND, trace clay, fine- medium-grained, medium dense, moist.	SM		SS	6	9 11 13	24	100						
34	246														
36	244														
38	242	Mottled yellow/white/brown silty SAND, fine- to medium-grained, medium dense, moist.	SM		SS	7	10 11 13	24	100		80.9	19.1			
40	240														
42	238	Yellow-tan silty SAND, trace clay, fine- to medium-grained, medium dense, moist. TR2B - El. 237' - 206'	SM		SS	8	9 11 16	27	50						
44	236														
46	234														
48	232	Mottled yellow/red-grey/tan poorly graded SAND, with silt, fine- to medium-grained, dense, moist.	SP SM		SS	9	13 16 19	35	40	19.0	90.1	9.9			
50	230														

Completion Depth: 152.5
Drilling Rig: CME-75
Weather: Sunny, mid 80's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-8

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 79,995.3
Easting: 55,335.1
Surface Elevation: 279.4
Datum: MSL

Date Started: 6/6/00
Date Completed: 6/9/00
Drill Method: 8" auger to 25'/ 6" mud rotary
Logged By: JJT/FJW
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
50															
52	228	Red-brown mottled red-yellow/tan silty SAND, with clay, fine- to medium-grained, dense, moist.	SM		SS	10	13 15 18	33	40						
54	226														
56	224	Yellow-tan silty SAND, some clay, medium dense to dense, moist.	SM		SS	11	11 14 15	29	35						
58	222														
60	220	Yellow-tan to red-brown poorly graded SAND, with silt, fine- to medium-grained, very dense, moist. Grades silter with depth.	SP SM		SS	12	19 37 47	84	40		93.7	6.3			
62	218														
64	216	Yellow-tan poorly graded SAND, with silt, fine- to medium-grained, dense, moist.	SP SM		SS	13	15 19 20	39	60						
66	214														
68	212	Yellow-orange silty SAND, trace clay, fine- to coarse-grained, medium dense, moist.	SM		SS	14	9 8 12	20	100						
70	210														
72	208	TR3/4 - El. 206' - 202'													
74	206														

Completion Depth: 152.5
Drilling Rig: CME-75
Weather: Sunny, mid 80's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-8

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 79,995.3

Easting: 55,335.1

Surface Elevation: 279.4

Datum: MSL

Date Started: 6/6/00

Date Completed: 6/9/00

Drill Method: 8" auger to 25'/ 6" mud rotary

Logged By: JJT/FJW

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
76	204	Yellow-orange CLAY, some silt, medium stiff, moist.	CL												
78	202	DB1/3 - El. 202' - 173.5' Grades to yellow-orange silty SAND, fine- to medium-grained, some clay, medium dense, moist.	SM		SS	15	8 8 12	20	100						
80	200														
82	198	Yellow-orange silty SAND, fine- to medium-grained, medium dense to dense, moist. Thin black carbonaceous layers throughout.	SM		SS	16	12 14 15	29	80	31.5	85.0	15.0			
84	196														
86	194	Yellow-orange mottled white poorly graded SAND, with silt, medium dense, moist.	SP SM		SS	17	21 15 13	28	70						
88	192														
90	190														
92	188	Yellow-orange mottled silty SAND, trace clay, fine- to medium-grained, dense, wet.	SM		SS	18	15 16 19	35	100	35.1	87.2	12.8			
94	186														
96	184														
98	182	Yellow-tan mottled black well graded SAND, with silt, fine- to coarse-grained, very dense, wet.	SW		SS	19	14 26 39	65	75						
100	180	Yellow-orange poorly graded SAND, with silt, very dense, wet, with clay stringers.	SP												

Completion Depth: 152.5

Drilling Rig: CME-75

Weather: Sunny, mid 80's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-8

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 79,995.3
Easting: 55,335.1
Surface Elevation: 279.4
Datum: MSL

Date Started: 6/6/00
Date Completed: 6/9/00
Drill Method: 8" auger to 25'/ 6" mud rotary
Logged By: JJT/FJW
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
100	178	Yellow-orange silty SAND, fine- to medium-grained, trace coarse-grained, medium dense, wet.	SM		SS	20	7 8 9	17	100		86.9	13.1			
102	176														
104	174														
106	172	DB4/5 - El. 173.5' - 168' Mottled yellow/tan clayey SAND, with silt, fine- to medium-grained, medium dense, wet.	SC		SS	21	6 7 9	16	100	37.3	61.0	39.0	102	32	70
108	170														
110	168	ST1 - El. 168' - 151' Dark orange silty SAND, fine-grained, medium dense, moist. Grading less silt.	SM		SS	22	11 11 17	28	75						
112	166														
114	164														
116	162	Dark orange poorly graded SAND, with silt, fine-grained, dense, moist to wet.	SP SM		SS	23	14 15 24	39	100						
118	160														
120	158														
122	156	Tan poorly graded SAND, with silt, fine-grained, trace medium-grained, dense, wet. Clay stringers in top 6" of sample.	SP SM		SS	24	20 22 20	42	60	26.3	88.7	11.3			
124															

Completion Depth: 152.5
Drilling Rig: CME-75
Weather: Sunny, mid 80's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-8

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site
Job Number: 08716

Boring Location:
Northing: 79.995.3
Easting: 55.335.1
Surface Elevation: 279.4
Datum: MSL

Date Started: 6/6/00
Date Completed: 6/9/00
Drill Method: 8" auger to 25'/ 6" mud rotary
Logged By: JJT/FJW
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
126	154	As above, grade moist to wet with depth, very dense.	SP SM		SS	25	27 26 28	54	100						
128	152	ST2 - El. 151' - 138'													
130	150														
132	148	Orange silty SAND, fine-grained, trace medium-grained, medium dense, moist, with shell fragments.	SM		SS	26	9 10 11	21	100		75.8	24.2			
134	146														
136	144	Orange mottled black silty SAND, with clay, fine-grained, trace medium-grained, loose, moist.	SC		SS	27	WR WR 10		100	35.4	58.6	41.4	56	26	30
138	142	Hard drilling 138'-140'.													
140	140														
142	138	GC - El. 138' - 133.5' Light grey/white clayey SILT, interbedded with thin layers of orange mottled poorly graded SAND, fine- to medium-grained, medium dense, moist. Thin layer of green CLAY, with silt and fine- to coarse-grained sand at bottom of sample, very stiff.	ML		SS	28	10 9 15	24	100						
144	136														
146	134	CG - El. 133.5' Yellow-orange well graded SAND, fine- to coarse-grained, very dense, wet.	SW		SS	29	42 49 43	92	85						
148	132														
150	130														

Completion Depth: 152.5
Drilling Rig: CME-75
Weather: Sunny, mid 80's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-8

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 79,995.3

Easting: 55,335.1

Surface Elevation: 279.4

Datum: MSL

Date Started: 6/6/00

Date Completed: 6/9/00

Drill Method: 8" auger to 25'/ 6" mud rotary

Logged By: JJT/FJW

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
150	128	Harder drilling.													
152		Yellow-orange poorly graded SAND, medium- to coarse-grained, very dense, wet.	SP		SS	30	75 25/1	>100							
	126	Completed boring at 152.5'.													
154	124														
156	122														
158	120														
160	118														
162	116														
164	114														
166	112														
168	110														
170	108														
172	106														
174															

Completion Depth: 152.5

Drilling Rig: CME-75

Weather: Sunny, mid 80's F

Remarks: Hole grouted immediately upon completion.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-9

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 79,981.9
Easting: 55,614.7
Surface Elevation: 271.5
Datum: MSL

Date Started: 6/9/00
Date Completed: 6/12/00
Drill Method: 8" auger to 25'/6" mud rotary to 136'
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
0	270	TR1 to El. 262'														
2		Tan poorly graded SAND, trace silt, fine-grained, loose, dry.	SP		SS	1	2 2 2	4	100							
4	268															
6	266															
8	264	Similar to above, pinkish-tan medium dense.	SP		SS	2	3 4 6	10	70							
10	262	TR1A - El. 262' - 250'														
12	260															
14	258	Reddish-brown silty SAND, fine- to medium-grained, trace coarse-grained, medium dense, moist.	SM		SS	3	5 7 10	17	100	15.2		68.4	31.6			
16	256															
18	254	Similar to above.	SM		SS	4	4 8 10	18	100							
20	252															
22	250	TR2A - El. 250' - 241'														
24	248	Reddish-brown silty SAND, fine- to medium-grained, trace coarse-grained, medium dense, damp.	SM		SS	5	7 6 11	17	50	8.0		81.9	18.1			

Completion Depth: 136
Drilling Rig: CME-75
Weather: Sunny, low 90's F

Remarks: Hole grouted, average fluid density 14 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-9

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 79,981.9
Easting: 55,614.7
Surface Elevation: 271.5
Datum: MSL

Date Started: 6/9/00
Date Completed: 6/12/00
Drill Method: 8" auger to 25'/6" mud rotary to 136'
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
26	246															
28	244	Same as above.	SM		SS	6	7 7 10	17	100							
30	242	TR2B - El. 241' - 216'														
32	240															
34	238	Tan poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, medium dense, damp.	SP SM		SS	7	6 6 8	14	50	5.1		94.2	5.8			
36	236															
38	234	Yellow-tan silty SAND, fine-grained, medium dense, damp.	SM		SS	8	6 7 7	14	95							
40	232															
42	230															
44	228	Grading less silt, medium-grained.	SM		SS	9	5 7 8	15	90							
46	226															
48	224															
50	222	Yellow-tan poorly graded SAND, with silt, fine-grained, very dense, damp.	SP SM		SS	10	18 25 33	58	50							

Completion Depth: 136
Drilling Rig: CME-75
Weather: Sunny, low 90's F

Remarks: Hole grouted, average fluid density 14 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-9

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 79,981.9

Easting: 55,614.7

Surface Elevation: 271.5

Datum: MSL

Date Started: 6/9/00

Date Completed: 6/12/00

Drill Method: 8" auger to 25'/6" mud rotary to 136'

Logged By: JJT

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
50																
52	220															
54	218															
56	216	TR3/4 - El. 216' - 212' Yellow-brown clayey SAND, fine- to medium-grained, medium dense, moist.	SC													
58	214	Yellow-tan sandy CLAY, very stiff, moist.	CH		SS	11	3 7 10	17	100							
60	212	DB1/3 - El. 212' - 183'														
62	210	Yellow-orange poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, medium dense, moist.	SP SM		SS	12	16 15 14	29	75			94.5	5.5			
64	208															
66	206	Yellow-orange poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, medium dense, wet.	SP SM		SS	13	8 6 10	16	80	24.3		89.4	10.6			
68	204															
70	202															
72	200	Yellow-orange silty SAND, trace clay, fine-grained, trace medium-grained, medium dense, moist. Very thin laminae of carbonaceous material throughout.	SM		SS	14	4 4 8	12	90	29.2		82.3	17.7	52	30	22
74	198															

Completion Depth: 136

Drilling Rig: CME-75

Weather: Sunny, low 90's F

Remarks: Hole grouted, average fluid density 14 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-9

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 79,981.9
Easting: 55,614.7
Surface Elevation: 271.5
Datum: MSL

Date Started: 6/9/00
Date Completed: 6/12/00
Drill Method: 8" auger to 25'/6" mud rotary to 136'
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
76	196	Yellow-orange poorly graded SAND, some silt, fine- to medium-grained, medium dense, saturated.	SP SM		SS	15	12 12 14	26	90							
78	194															
80	192															
82	190	Yellow-orange mottled black and white silty SAND, fine- to coarse-grained, dense, wet. Interbedded with thin silty clay layers.	SM		SS	16	18 23 25	48	30							
84	188															
86	186	Orange-brown silty SAND, fine- to medium-grained, trace coarse-grained, medium dense, wet.	SM		SS	17	10 8 8	16	80			86.6	13.4			
88	184	DB4/5 - El. 183' - 176'														
90	182															
92	180	Yellow-orange mottled tan and black clayey SAND, fine-grained, medium dense, moist.	SC		SS	18	8 7 11	18	100							
94	178															
96	176	ST1 - El. 176' - 161'														
98	174	Yellow-orange poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, dense, moist.	SP SM		SS	19	17 15 16	31	75			92.5	7.5			
100	172															

Completion Depth: 136
Drilling Rig: CME-75
Weather: Sunny, low 90's F

Remarks: Hole grouted, average fluid density 14 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-9

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 79,981.9
Easting: 55,614.7
Surface Elevation: 271.5
Datum: MSL

Date Started: 6/9/00
Date Completed: 6/12/00
Drill Method: 8" auger to 25'/6" mud rotary to 136'
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
100	170															
102		Similar to above, grading siltier, fine-grained, dense.	SP SM		SS	20	20 22 24	46	40							
104	168															
106	166															
		Greyish-orange poorly graded SAND, medium- to coarse-grained, dense, saturated.	SP		SS	21	23 22 25	47	50							
108	164	Grading orange with silt, fine-grained, with shells.														
110	162															
		ST2 - El. 161' - 154'														
112	160	Tan silty SAND, fine- to coarse-grained, medium dense, wet. Grading orange-yellow mottled with black, fine-grained.	SM		SS	22	4 6 7	13	60							
114	158															
116	156															
		Orange silty/clayey SAND, fine-grained, medium dense, moist. Interbedded mottled yellow/white clays.	SC SM		SS	23	7 12 16	28	100							
118	154	GC - El. 154' - 148'														
120	152															
122	150	Yellowish-orange sandy SILT, dense, moist. 1" limestone layer in sample.	ML		SS	24	16 19 30	49	90		4.5	42.4	53.1			
124	148	CG - El. 148'														

Completion Depth: 136
Drilling Rig: CME-75
Weather: Sunny, low 90's F

Remarks: Hole grouted, average fluid density 14 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-9

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 79,981.9
Easting: 55.614.7
Surface Elevation: 271.5
Datum: MSL

Date Started: 6/9/00
Date Completed: 6/12/00
Drill Method: 8" auger to 25'/6" mud rotary to 136'
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6"	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
126	146	Reddish-brown clayey SAND, fine- to medium-grained, trace coarse-grained, trace fine-grained gravel, medium dense to dense, moist. Grey-green thin interbeds of silt/clay throughout.	SC		SS	25	12 14 16	30			0.2	61.1	38.7	50	23	27
128	144															
130	142															
132	140	Tan mottled grey-green and dark grey silty SAND, fine- to coarse-grained, loose to medium dense, moist (slough). Yellowish-orange/grey silty SAND, fine- to medium-grained, very dense, saturated.	SP SM		SS	26	WR 20 50	70	100							
134	138															
136	136	Grey-orange poorly graded SAND, trace silt, medium- to coarse-grained, very dense, moist.	SP		SS	27	100/6	>100	30							
138	134	Completed boring at 137.5'.														
140	132															
142	130															
144	128															
146	126															
148	124															
150	122															

Completion Depth: 136
Drilling Rig: CME-75
Weather: Sunny, low 90's F

Remarks: Hole grouted, average fluid density 14 lb/gal.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 16:06

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-10

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site
Job Number: 08716

Boring Location:
Northing: 79,809.5
Easting: 55,315.8
Surface Elevation: 273.1
Datum: MSL

Date Started: 6/27/00
Date Completed: 6/30/00
Drill Method: 8" Auger to 24'/8" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
0	272	TR1 to El. 263'													
2	270														
4	268														
6	266														
8	264	Reddish-brown silty SAND, trace clay, fine- to medium-grained, medium dense, moist.	SM		SS	1A	9 12 17	29	75						
10	262	TR1A - El. 263' - 251'			SS ST	1B	750/20		83						
12	260	Similar to above.	SM		SS	2	9 10 13	23	75	14.4		75.6	24.4		
14	258														
16	256														
18	254	Similar to above, but grades to yellow-orange at 19'.	SM		SS	3	8 10 11	21	100						
20	252														
22	250	TR2A - El. 251' - 222'													
24		Similar to above, less silty, moist.	SM		SS	4	4 5 5	10	75						

Completion Depth: 153
Drilling Rig: CME-75
Weather: Sunny/rainy, 70 F

Remarks: 6" PVC casing installed entire depth of boring. Annulus between casing and boring wall grouted with 13.4 lb/gal cement grout.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-10

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 79,809.5
Easting: 55,315.8

Surface Elevation: 273.1

Datum: MSL

Date Started: 6/27/00
Date Completed: 6/30/00
Drill Method: 8" Auger to 24'/8" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
26	248															
	246															
28		Yellow-orange silty SAND, fine- to medium-grained, trace coarse-grained, medium dense, moist.	SM		SS	5	4 7 8	15	50	18.5		80.7	16.3			
	244															
30																
	242															
32																
	240															
34		Yellow-orange to orange-brown poorly graded SAND, with silt, fine- to medium-grained, medium dense, very moist.	SP SM		SS	6A	7 9 11	20	40							
	238															
36					ST	6B	250/20 400/4		100							
	236															
38		Yellow-orange, layered red and yellow-orange poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, medium dense, moist.	SP SM		SS	7	5 9 13	22	40			90.9	9.1			
	234															
40																
	232															
42																
	230															
44		Reddish-brown to lavender-brown silty SAND, fine- to medium-grained, medium dense, moist.	SM		SS	8	8 13 15	28	56							
	228															
46																
	226															
48																
	224	Reddish-brown silty SAND, fine-grained, trace medium-grained, medium dense to dense, moist. White very thin layers of clay (>0.5mm).	SM		SS	9	9 13 17	30	56			87.3	12.7			
50																

Completion Depth: 153
Drilling Rig: CME-75
Weather: Sunny/rainy, 70 F

Remarks: 6" PVC casing installed entire depth of boring. Annulus between casing and boring wall grouted with 13.4 lb/gal cement grout.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-10

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 79,809.5
Easting: 55,315.8
Surface Elevation: 273.1
Datum: MSL

Date Started: 6/27/00
Date Completed: 6/30/00
Drill Method: 8" Auger to 24'/8" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
50															
	222	TR2B - El. 222' - 199'													
52															
	220														
54		Reddish-brown poorly graded SAND, with silt, trace fine-gravel, fine- to medium-grained, trace coarse-grained, dense, moist.	SP SM		SS	10	11 16 18	34	44	23.0	1.1	91.4	7.5			
	218														
56															
	216														
58															
	214	Yellow-orange poorly graded SAND, with silt, trace fine-grained gravel, fine- to coarse-grained, dense, moist.	SP SM		SS	11	12 17 17	34	61						
60															
	212														
62															
	210														
64		Reddish-brown with black interbedded silty SAND, silty CLAY and SILT, medium dense, very stiff, moist.	SM		SS	12	6 9 9	18	39						
	208														
66															
	206														
68															
	204	Brownish-red silty SAND, trace clay, fine- to medium-grained, trace coarse-grained, medium dense, moist.	SM		SS	13	7 12 13	25	50			86.9	13.1		
70															
	202														
72															
	200	Orange-tan to reddish-brown poorly graded SAND, with silt, fine- to medium-grained, dense, wet. Layering visible.	SP SM		SS	14A	17 15 16	31	56			92.7	7.3		
74		TR3/4 - El. 199' - 196'					200/8 450/3								

Completion Depth: 153
Drilling Rig: CME-75
Weather: Sunny/rainy, 70 F

Remarks: 6" PVC casing installed entire depth of boring. Annulus between casing and boring wall grouted with 13.4 lb/gal cement grout.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-10

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 79,809.5
Easting: 55,315.8
Surface Elevation: 273.1
Datum: MSL

Date Started: 6/27/00
Date Completed: 6/30/00
Drill Method: 8" Auger to 24'/8" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
76	198	Reddish-brown poorly graded SAND and silty SAND, fine- to coarse-grained, medium dense, moist.	SP SM		ST	14B	650/12		100							
78	196	DB1/3 El. 196' - 157'														
80	194	Layered yellow-orange, reddish brown poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, medium dense, moist to wet.	SP SM		SS	15	8 9 18	27	56			94.0	6.0			
82	192															
84	190	Whitish-pink poorly graded SAND, with silt, fine-grained, dense, wet. Layering visible.	SP SM		SS	16	12 18 19	37	89							
86	188															
88	186	White, black, yellow-orange well graded SAND, with silt, fine- to medium-grained, trace coarse-grained, very dense, moist. Layering visible.	SW SM		SS	17	19 25 26	51	56	16.3		93.6	6.4			
90	184															
92	182	Brown, yellow, white, black interbedded silty and clayey SAND, fine- to medium-grained, very dense, wet.	SC SM		SS	18	21 39 42	81	83							
94	180															
96	178	Pinkish tan mottled with black (carbonaceous material) interbedded clayey SILT/clayey SAND, fine- to medium-grained, medium dense, moist to wet.	SC		SS	19	9 11 15	26	117	28.5		62.0	38.0	83	23	60
98	176															
100	174															

Completion Depth: 153
Drilling Rig: CME-75
Weather: Sunny/rainy, 70 F

Remarks: 6" PVC casing installed entire depth of boring. Annulus between casing and boring wall grouted with 13.4 lb/gal cement grout.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-10

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 79,809.5
Easting: 55,315.8
Surface Elevation: 273.1
Datum: MSL

Date Started: 6/27/00
Date Completed: 6/30/00
Drill Method: 8" Auger to 24'/8" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
100	172														
102	170														
104	168	Yellow-orange poorly graded SAND, trace clay, very fine- to fine-grained, dense, saturated.	SP		SS	20	11 17 14	31	94						
106	166	Yellow-orange mottled black silty SAND, fine- grained, trace medium-grained, very dense, wet.	SM		SS	21A	17 34 40	74	78	23.2		85.1	14.9		
108	164	Reddish-brown poorly graded SAND, fine- to medium-grained, dense, wet. Becoming yellow-tan at 109'.	SP		ST	21B	500/12 1250/8		92						
110	162														
112	160	Yellow-orange mottled black/white poorly graded SAND, very fine- to fine-grained, very dense, wet.	SP		SS	22	17 30 41	71	56						
114	158														
116	156	DB4/5 - El. 157' - 148'													
118	154	Tan-brown sandy SILT, medium dense, moist. Interbedded grey-green silt, light brown silty sand and black lignite stringers. Shell fragments.	ML		SS	23	5 9 12	21	133						
120	152														
122	150														
124		Tan silty SAND, fine-grained, trace medium-grained, medium dense, wet.	SM		SS	24	4 7 9	16		32.8		82.4	17.6	43	28	15

Completion Depth: 153
Drilling Rig: CME-75
Weather: Sunny/rainy, 70 F

Remarks: 6" PVC casing installed entire depth of boring. Annulus between casing and boring wall grouted with 13.4 lb/gal cement grout.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-10

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 79,809.5
Easting: 55,315.8
Surface Elevation: 273.1
Datum: MSL

Date Started: 6/27/00
Date Completed: 6/30/00
Drill Method: 8" Auger to 24'/8" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
126	148	ST1 - El. 148' - 142'														
128	146															
130	144	Similar to above, grading with clay, medium dense to dense.	SM		SS	25	11 13 16	29	89							
132	142	ST2 - El. 142' - 138.5'														
134	140	Similar to above.	SM		SS	26A	7 7 11	18	128							
136	138	GC - El. 138.5' - 135'														
		Brown silty SAND, fine- to medium-grained, saturated.	SC SM		ST	26B	400/12 750/6		75	72.4 18		53.3 84.6	46.7 15.4	69 45	24 22	45 23
138	136	CG - El. 135'														
140	134	Yellow-orange poorly graded SAND, trace silt, trace fine-grained gravel, fine- to coarse-grained, very dense, saturated.	SP SM		SS	27	27 38 42	80	61							
142	132															
144	130	Yellow-brown poorly graded SAND, trace silt, trace clay, very dense, moist.	SP		SS	28	43 50/5	>100	67							
146	128															
148	126															
150	124	Gray-black poorly graded SAND, with silt, fine- to medium-grained, medium dense, wet.	SM		SS	29	11 14 37	51	51	22.6	0.1	93.5	6.4			

Completion Depth: 153
Drilling Rig: CME-75
Weather: Sunny/rainy, 70 F

Remarks: 6" PVC casing installed entire depth of boring. Annulus between casing and boring wall grouted with 13.4 lb/gal cement grout.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-10

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 79.809.5

Easting: 55.315.8

Surface Elevation: 273.1

Datum: MSL

Date Started: 6/27/00

Date Completed: 6/30/00

Drill Method: 8" Auger to 24'/8" mud rotary

Logged By: JJT

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
150	122														
152	120	Completed boring at 153'.													
154	118														
156	116														
158	114														
160	112														
162	110														
164	108														
166	106														
168	104														
170	102														
172	100														
174															

Completion Depth: 153

Drilling Rig: CME-75

Weather: Sunny/rainy, 70 F

Remarks: 6" PVC casing installed entire depth of boring. Annulus between casing and boring wall grouted with 13.4 lb/gal cement grout.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-11

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 80,154.0

Easting: 54,970.0

Surface Elevation: 295

Datum: MSL

Date Started: 7/17/00

Date Completed: 7/19/00

Drill Method: 8" mud rotary

Logged By: JJT

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
0	294	Fill to El. 275'													
2	292														
4	290														
6	288														
8	286														
10	284														
12	282														
14	280														
16	278														
18	276														
20	274	TR1 - El. 275' - 267' Assumed original ground.													
22	272														
24	270														

Completion Depth: 169.5

Drilling Rig: CME-75

Weather: Sunny, mid 90's F

Remarks: Hole grouted immediately upon completion. Average fluid weight 13.7 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-11

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 80,154.0

Easting: 54,970.0

Surface Elevation: 295

Datum: MSL

Date Started: 7/17/00

Date Completed: 7/19/00

Drill Method: 8" mud rotary

Logged By: JJT

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
26	270														
28	268	TR1A - El. 267' - 258'													
30	266														
32	264														
34	262														
36	260														
38	258	TR2A - El. 258' - 236'													
40	256														
42	254														
44	252	Yellow-tan silty SAND, trace clay, fine- to medium-grained, dense, moist. Thin green-grey thin silt/clay laminae (<0.5mm) throughout.	SM		SS	1	10 14 18	32	72	11.3	85.1	14.9			
46	250														
48	248														
50	246	Similar to above.	SM		SS	2	10 14 17	31	61						

Completion Depth: 169.5

Drilling Rig: CME-75

Weather: Sunny, mid 90's F

Remarks: Hole grouted immediately upon completion. Average fluid weight 13.7 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-11

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80.154.0
Easting: 54.970.0
Surface Elevation: 295
Datum: MSL

Date Started: 7/17/00
Date Completed: 7/19/00
Drill Method: 8" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
50	244														
52	242														
54	240	Red-light brown poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, medium dense, moist.	SP SM		SS	3	8 10 10	20	44	16.2		93.7	6.3			
56	238														
58	236	Red-brown silty SAND, trace clay, fine- to medium-grained, medium dense, wet. TR2B - El. 236' - 220.6'	SM		SS	4	8 9 12	21	56						
60	234														
62	232														
64	230	Yellow-orange well graded SAND, with silt, trace clay, fine- to medium-grained, dense, moist. Clayey stringers.	SW SM		SS	5	7 14 21	35	61	13.5		93.1	6.9			
66	228														
68	226	Yellow-orange poorly graded SAND, with silt, fine- to coarse-grained, dense, very moist.	SP SM		SS	6	12 17 19	36	50						
70	224														
72	222														
74	220	Yellow-orange poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, dense, moist. TR3/4 - El. 220.6' - 210'	SP SM		SS	7A	10 14 17 150/1	31		20.2		90.4	9.6			

Completion Depth: 169.5
Drilling Rig: CME-75
Weather: Sunny, mid 90's F

Remarks: Hole grouted immediately upon completion. Average fluid weight 13.7 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-11

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,154.0
Easting: 54,970.0
Surface Elevation: 295
Datum: MSL

Date Started: 7/17/00
Date Completed: 7/19/00
Drill Method: 8" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
76	220	Light brown clayey SAND, fine- to coarse-grained, wet.	SC		ST	7B	300/2 700/5			26.8	3.6	81.8	14.6	59	23	36
78	218															
80	216															
82	214	Yellow-orange clayey SAND, trace silt, medium- to coarse-grained, loose, saturated.	SC		SS	8A	2 3 5	8	50							
84	212	Light brown clayey SAND, fine- to medium-grained.	SC		ST	8B	100/10.5 150/12.5 400/1.5			28.9	1.2	71.6	27.2	54	20	34
										27.7		66.9	33.1	118	38	80
86	210	DB1/3 - El. 210' - 185'														
88	208															
90	206															
92	204	Yellow-orange silty SAND, trace fine-grained gravel, fine- to coarse-grained, loose, saturated.	SP SM		SS	9A	2 4 3	7	111		4.5	83.4	12.1			
94	202	Attempted shelby tube sample, no recovery.			ST	9B	750/12		0							
96	200															
98	198															
100	196	Yellow-orange clayey SAND, trace silt, trace fine-grained gravel, fine- to medium-grained, trace coarse-grained, loose to medium dense, wet.	SC		SS	10	1 2 7	9		37.6		72.6	27.4	86	34	52

Completion Depth: 169.5
Drilling Rig: CME-75
Weather: Sunny, mid 90's F

Remarks: Hole grouted immediately upon completion. Average fluid weight 13.7 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-11

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,154.0
Easting: 54,970.0
Surface Elevation: 295
Datum: MSL

Date Started: 7/17/00
Date Completed: 7/19/00
Drill Method: 8" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
100	194														
102	192														
104	190	Poorly graded SAND, with clay, trace silt, fine- to medium-grained, dense, wet. Clayey stringers throughout.	SP SC		SS	11	7 13 17	30	44						
106	188														
108	186	Light brown-orange, yellow-tan, black innerbedded silty/clayey SAND, SILT and CLAY, trace carbonaceous material, dense/hard, moist.	SM		SS	12	11 23 23	46	100						
110	184	DB4/5 - El. 185' - 178'													
112	182														
114	180	Greenish-brown mottled light grey silty SAND, trace clay, fine- to medium-grained, medium dense, wet.	SM		SS	13	7 9 8	17	111	27.8		77.1	22.9		
116	178	ST1 - El. 178' - 154'													
118	176	Orange, yellow-orange, yellow-tan poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, medium dense, wet.	SP SM		SS	14	6 5 17	22	100	30.8	1.5	88.9	9.6		
120	174														
122	172														
124	170	Yellow-orange poorly graded SAND, with silt, fine-grained, trace medium- to coarse-grained, very dense, saturated. Thin clay laminae and carbonaceous particles visible.	SP SM		SS	15	23 23 46	69	78	22.3		94.5	5.5		

Completion Depth: 169.5
Drilling Rig: CME-75
Weather: Sunny, mid 90's F

Remarks: Hole grouted immediately upon completion. Average fluid weight 13.7 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-11

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,154.0
Easting: 54,970.0
Surface Elevation: 295
Datum: MSL

Date Started: 7/17/00
Date Completed: 7/19/00
Drill Method: 8" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
126	170														
128	168														
130	166	Similar to above.	SP SM		SS	16	26 30 30	60	50						
132	164														
134	162	Similar to above grading with carbonaceous material, fine- to medium-grained, saturated.	SP SM		SS	17	26 50/5	>100	61	24.1		93.9	6.1		
136	160														
138	158														
140	156	Similar to above with grading with silt nodules, dense. Light brown, black, tan clay laminae observed.	SP SM		SS	18	20 25 24	49	56						
142	154	ST2 - El. 154' - 142'													
144	152	Yellow-orange clayey SAND, fine-grained, trace medium-grained, medium dense, wet. Trace shell fragments.	SC		SS	19	6 10 11	21	111	31.7		77.6	22.4	51	27	24
146	150														
148	148														
148	146	Yellow-orange silty SAND, very fine-grained, very dense, moist.	SM		SS	20	29 31 27	58	61						
150															

Completion Depth: 169.5
Drilling Rig: CME-75
Weather: Sunny, mid 90's F

Remarks: Hole grouted immediately upon completion. Average fluid weight 13.7 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-11

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,154.0
Easting: 54,970.0
Surface Elevation: 295
Datum: MSL

Date Started: 7/17/00
Date Completed: 7/19/00
Drill Method: 8" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
150	144	GC - El. 142' - 138'														
152	142	Yellow-orange sandy SILT, loose, wet. Light green and light brown-orange clay laminae throughout, soft, moist.	ML		SS	21A	WH WH 100/21	3	133	32.7		34.9	65.1	39	28	11
154	140	Tan fat CLAY with fine-grained sand, wet.	CH		ST	21B	500/3		100	36.6		23.7	76.3	83	27	56
156	138	CG - EL. 138'														
158	136	Yellow-orange poorly graded SAND, trace clay, fine- to coarse-grained, very dense, moist.	SP		SS	22	22 30/5	>100	100							
160	134															
162	132	Yellow-orange poorly graded SAND, trace silt, medium- to coarse-grained, very dense, saturated.	SP		SS	23	28 44 50	94	94							
164	130															
166	128															
168	126				SS	24	10/.1	>100	0							
170	124	Completed boring at 169.5'.														
172	122															
174	120															

Completion Depth: 169.5
Drilling Rig: CME-75
Weather: Sunny, mid 90's F

Remarks: Hole grouted immediately upon completion. Average fluid weight 13.7 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-12

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80.389.1
Easting: 55.050.6
Surface Elevation: 291.2
Datum: MSL

Date Started: 7/15/00
Date Completed: 7/17/00
Drill Method: 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
0	290	Fill to El. 282'													
2	288														
4	286														
6	284														
8	282	TR1 - El. 282' - 267' Approximate original ground.													
10	280														
12	278														
14	276														
16	274														
18	272														
20	270														
22	268														
24		TR1A - El. 267' - 258'													

Completion Depth: 154
Drilling Rig: CME-75
Weather: Sunny, low 90's F

Remarks: Hole grouted immediately upon completion. Ave fluid weight is 13.4 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-12

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site
Job Number: 08716

Boring Location:
Northing: 80.389.1
Easting: 55.050.6
Surface Elevation: 291.2
Datum: MSL

Date Started: 7/15/00
Date Completed: 7/17/00
Drill Method: 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
26	266														
28	264														
30	262														
32	260														
34	258	TR2A - El. 258' - 234'													
36	256														
38	254														
40	252														
42	250														
44	248	Yellow-orange silty SAND, trace clay, fine- to medium-grained, medium dense, moist. Thin white clay/silt laminae throughout.	SM		SS	1	7 10 11	21	83						
46	246														
48	244														
50	242	Light brown-orange interbedded silty/clayey SAND, fine- to medium-grained, medium dense, moist. Lavender and light brown-red clay seams (3-4mm).	SC SM		SS	2	6 9 11	20	67	17.6	81.3	18.7			

Completion Depth: 154
Drilling Rig: CME-75
Weather: Sunny, low 90's F

Remarks: Hole grouted immediately upon completion. Ave fluid weight is 13.4 lb/gal.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-12

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,389.1
Easting: 55,050.6
Surface Elevation: 291.2
Datum: MSL

Date Started: 7/15/00
Date Completed: 7/17/00
Drill Method: 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
50	240														
52	238	Red clayey SAND, fine- to medium-grained, trace coarse-grained, medium dense, moist. Thin clay laminae throughout.	SC		SS	3	9 7 17	24	67	18.0		80.8	19.2		
54	236														
56	234	TR2B - El. 234' - 213'													
58	232	Dark yellow-orange poorly graded SAND, with silt, dense, wet. Bottom 4" yellow-orange/red interbedded.	SP SM		SS	4	11 16 20	36	50						
60	230														
62	228	Red to yellow-orange silty SAND, fine- to medium-grained, trace coarse-grained, dense, moist.	SM		SS	5	11 17 21	38	67	19.9		87.5	12.5		
64	226														
66	224														
68	222	Similar to above, grades less silt, trace fine-grained gravel.	SP SM		SS	6	15 22 24	46	61						
70	220														
72	218														
74		Reddish-brown poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, dense, wet.	SP SM		SS	7	7 12 14	26		19.2	0.3	89.9	9.8		

Completion Depth: 154
Drilling Rig: CME-75
Weather: Sunny, low 90's F

Remarks: Hole grouted immediately upon completion. Ave fluid weight is 13.4 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-12

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,389.1
Easting: 55,050.6
Surface Elevation: 291.2
Datum: MSL

Date Started: 7/15/00
Date Completed: 7/17/00
Drill Method: 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
76	216														
	214														
78		TR3/4 - El. 213' - 209'													
	212	Red-brown mottled greenish-grey silty/clayey SAND, fine- to coarse-grained, medium dense, moist. Thin layering visible.	SC SM		SS	8	6 7 10	17	67						
80															
	210														
82		DB1/3 - El. 209' - 189'													
	208														
84		Brown poorly graded SAND, with silt, fine- to medium-grained, medium dense, moist.	SC SM		SS	9	11 10 17	27	56	23.2	90.0	10.0			
	206														
86															
	204														
88															
	202	Yellow-orange silty SAND, fine-grained, trace medium-grained, loose, moist.	SM		SS	10A	6 4 5	9	111	36.4	77.6	22.4			
90															
	200	Brown silty SAND, trace clay, fine-grained, trace medium- to coarse-grained.	SM		ST	10B	150/2.5 250/2.5 500/8.5		71	30.3	85.2	14.8	41	29	12
92															
	198														
94															
	196														
96															
	194														
98															
	192	Yellow-orange poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, medium dense, moist.	SP SM		SS	11	8 11 12	23	100	23.1	94.1	5.9			
100															

Completion Depth: 154
Drilling Rig: CME-75
Weather: Sunny, low 90's F

Remarks: Hole grouted immediately upon completion. Ave fluid weight is 13.4 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-12

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,389.1
Easting: 55,050.6
Surface Elevation: 291.2
Datum: MSL

Date Started: 7/15/00
Date Completed: 7/17/00
Drill Method: 6" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
100	190														
102		DB4/5 - El. 189' - 176'													
	188														
104		Green-grey silty SAND, with clay, trace carbonaceous material, fine- to medium-grained, loose, wet.	SM		SS	12A	5 2 4 6	128	39.5		76.7	23.3	109	67	42
	186														
106		Light yellow-tan clayey SAND, fine- to medium-grained, loose to medium dense, wet.	SC		ST	12B	50/19 250/4 500/1	117	36.9		81.4	18.6	59	28	31
	184														
108		Grey-green silty SAND, with clay, fine- to medium-grained, trace coarse-grained, dense, wet.	SM		SS	13	15 14 18 32	94	31.0		79.0	21.0	62	35	27
	182														
110															
	180														
112															
	178														
114		Interbedded light greyish-green mottled with white/black flecks sandy CLAY, sand is fine- to medium-grained, stiff, wet. Horizontal layering visible.	CH		SS	14	3 5 9 14	133	45.3		47.2	52.8	79	26	53
	176	ST1 - El. 176' - 159'													
116															
	174														
118		Light brown-orange poorly graded SAND, with silt, fine- to medium-grained, very dense, wet.	SP SM		SS	15	22 30 37 67	78							
	172														
120															
	170														
122															
	168														
124		Similar to above, grading fine-grained.	SP SM		SS	16	23 34 50 84	78	22.6		93.4	6.6			

Completion Depth: 154
Drilling Rig: CME-75
Weather: Sunny, low 90's F

Remarks: Hole grouted immediately upon completion. Ave fluid weight is 13.4 lb/gal.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-12

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 80.389.1

Easting: 55.050.6

Surface Elevation: 291.2

Datum: MSL

Date Started: 7/15/00

Date Completed: 7/17/00

Drill Method: 6" mud rotary

Logged By: JJT

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
126	166														
	164														
128		Light brown-orange poorly graded SAND, trace silt, dense, very moist to wet.	SP		SS	17	20 25 28	53	33						
130	162														
	160														
132		ST2 - El. 159' - 143'													
	158														
134		Light orange-brown poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, medium dense, wet. Interbedded with thin clayey layers.	SP SM		SS	18	7 12 8	20	111	25.3	90.6	9.4			
	156														
136															
	154														
138		GC - El. 143' - 140' Yellow-orange clayey SAND, fine-grained, trace medium- to coarse-grained, wet.	SC		ST	19	100/20 450/4		113	31.4	82.0	18.0	44	26	18
	152														
140															
	150														
142															
	148														
144		Yellow-orange sandy CLAY, with silt, fine-grained, trace medium-grained, very stiff, moist. Sandy zone of 1"-2" at 143.2' is saturated.	CH		SS	20	7 8 8	16	83	34.8	40.4	59.6	57	27	30
	146														
146															
	144														
148															
	142	Olive-grey silty SAND, with clay, fine-grained, trace medium- to coarse-grained, medium dense, moist. Grading siltier.	SM		SS	21	7 10 12	22	117	27.5	66.1	33.9			
150															

Completion Depth: 154

Drilling Rig: CME-75

Weather: Sunny, low 90's F

Remarks: Hole grouted immediately upon completion. Ave fluid weight is 13.4 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-12

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 80,389.1

Easting: 55,050.6

Surface Elevation: 291.2

Datum: MSL

Date Started: 7/15/00

Date Completed: 7/17/00

Drill Method: 6" mud rotary

Logged By: JJT

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
150	140	CG - El. 140'													
152	138														
154	136	Light yellow-orange poorly graded SAND, trace silt, trace fine-grained gravel, fine- to coarse-grained, very dense, saturated. completed boring at 154'.	SP		SS	22	43 55/5	>100	56						
156	134														
158	132														
160	130														
162	128														
164	126														
166	124														
168	122														
170	120														
172	118														
174															

Completion Depth: 154

Drilling Rig: CME-75

Weather: Sunny, low 90's F

Remarks: Hole grouted immediately upon completion. Ave fluid weight is 13.4 lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:08

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-13

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80.422.5
Easting: 54.905.3
Surface Elevation: 279.5
Datum: MSL

Date Started: 7/20/00
Date Completed: 7/21/00
Drill Method: 8" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
0	278	No samples collected in upper 13'.													
2		TR1 to El. 270'													
4	276														
6	274														
8	272														
10	270	TR1A - El. 270' - 262'													
12	268														
14	266	Yellow-orange, pink, orange, lavender-grey SILT, trace clay, medium dense, damp.	ML		SS	1	2 5 7	12	67						
16	264														
18	262	TR2A - El. 262' - 238'													
		Yellow-orange silty SAND, fine- to medium-grained, medium dense, damp. Thin white clayey laminae (1-3mm) throughout, more with depth. Horizontal layering visible.	SM		SS	2	5 8 11	19	83	14.8	82.8	17.2			
20	260														
22	258														
24	256	Similar to above.	SM		SS	3	7 11 12	23	100						

Completion Depth: 154.5
Drilling Rig: CME-75
Weather: Sunny, high 80's F

Remarks: Hole grouted immediately upon completion. Average fluid density 13.4lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:09

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-13

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 80.422.5

Easting: 54.905.3

Surface Elevation: 279.5

Datum: MSL

Date Started: 7/20/00

Date Completed: 7/21/00

Drill Method: 8" mud rotary

Logged By: JJT

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
26	254														
28	252	As above, fine- to medium-grained, trace coarse-grained, moist.	SM		SS	4	7 11 12 — 23	89	13.1		83.1	16.9			
30	250														
32	248														
34	246	As above.	SM		SS	5A	5 9 11 — 20	78							
36	244				ST	5B	100/1.5 350/1.5 600/6	54							
38	242														
40	240	As above, grading less silt, moist.	SM		SS	6	7 11 13 — 24	72	14.8		85.2	14.8			
42	238	TR2B - El. 238' - 214'													
44	236	As above, with thin white laminae, dense, moist.	SM		SS	7	10 17 18 — 35	56							
46	234														
48	232														
50	230	Red-brown poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, dense, moist.	SP SM		SS	8	15 22 25 — 47	61	12.9		94.0	6.0			

Completion Depth: 154.5

Drilling Rig: CME-75

Weather: Sunny, high 80's F

Remarks: Hole grouted immediately upon completion. Average fluid density 13.4lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:09

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-13

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,422.5
Easting: 54,905.3
Surface Elevation: 279.5
Datum: MSL

Date Started: 7/20/00
Date Completed: 7/21/00
Drill Method: 8" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
50															
	228														
52															
	226	As above.	SP SM		SS	9	10 16 21 / 37	50							
54															
	224														
56															
	222														
58		As above, reddish-brown, trace fine-grained gravel.	SP SM		SS	10	10 14 19 / 33	56	14.9	0.6	92.5	6.9			
	220														
60															
	218														
62															
	216	Pinkish and yellow-orange silty SAND, fine- to coarse-grained, medium dense, moist.	SP SM		SS	11	8 10 15 / 25	56							
64															
	214	TR3/4 - El. 214' - 207'													
66															
	212														
68															
	210	Interbedded purple-grey, yellow-orange, light brown, pink and black clayey SAND, trace silt, fine- to medium-grained, trace coarse-grained, loose, wet.	SC		SS	12A	3 2 3 / 5	133	28.7		74.4	25.6			
70															
	208	Tan clayey SAND, with silt, fine- to medium-grained, trace coarse-grained, wet.	SC		ST	12B	100/4 275/6 600/8	63	20.2		74.3	25.7	39	23	16
72															
		DB1/3 - El. 207' - 183'													
	206														
74		Reddish-brown silty SAND, fine-grained, medium dense, moist.	SM		SS	13	8 10 14 / 24	67							

Completion Depth: 154.5
Drilling Rig: CME-75
Weather: Sunny, high 80's F

Remarks: Hole grouted immediately upon completion. Average fluid density 13.4lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:09

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-13

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,422.5
Easting: 54,905.3
Surface Elevation: 279.5
Datum: MSL

Date Started: 7/20/00
Date Completed: 7/21/00
Drill Method: 8" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
76	204															
78	202															
80	200	Yellow-orange silty SAND, fine- to medium-grained, trace coarse-grained, medium dense, wet. Tan fine-grained sand at bottom of sample.	SM		SS	14	5 9 13	22		26.7		86.2	13.8			
82	198															
84	196	Greenish-tan silty SAND, with clay, fine- to medium-grained, trace coarse-grained, medium dense, moist.	SM		SS	15A	4 5 9	14		42.8		60.9	39.1	94	52	42
86	194	Tan poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, wet.	SP SM		ST	15B	100/5 150/7 450/5.5		100	21.8		90.6	9.4	52	31	21
88	192															
90	190	Yellow-orange mottled black silty SAND, trace clay, fine- to coarse-grained, medium dense, moist.	SM		SS	16	4 7 10	17	100							
92	188															
94	186	Greenish-grey mottled light brown orange and black silty SAND, fine- to medium-grained, trace coarse-grained dense, wet.	SM		SS	17	8 13 21	34	117	34.4		79.2	20.8			
96	184	DB4/5 - El. 183' - 177'														
98	182															
100	180	Hard white layer (calcite?) at 98.4'. Light greenish-grey speckled black motteled yellow-orange SILT, trace fine-grained sand, loose, wet to moist.	ML		SS	18A	3 2 2	4	100							

Completion Depth: 154.5
Drilling Rig: CME-75
Weather: Sunny, high 80's F

Remarks: Hole grouted immediately upon completion. Average fluid density 13.4lb/gal.

LOG OF BORING LETTER SIZE COMB2A-1.GPJ STNWB_CO.GDT 5/3/01 16:09

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-13

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,422.5
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Surface Elevation: 279.5
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Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in	N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
100		Yellow-brown clayey SAND, fine- to medium-grained, trace fine-grained gravel, moist.	SC		ST	18B	100/15 200/2 800/2		79	28.0	3.7	79.4	16.9	50	27	23
102	178	ST1 - El. 177' - 158'														
104	176	Yellow-orange to milky-white/clear interbedded poorly graded SAND and silty SAND, fine- to coarse-grained, dense, wet. Grey-green 1" silt layer between sand layers.	SP SM		SS	19	10 13 26	39								
106	174															
108	172	Tan-grey poorly graded SAND, with silt, fine-grained, trace coarse-grained, very dense, saturated. Becomes orange-yellow.	SP SM		SS	20	31 41 42	83		23.2		93.7	6.3			
110	170															
112	168															
114	166	Orange-yellow poorly graded SAND, with silt, fine-grained, very dense, saturated.	SP SM		SS	21	23 28 31	59								
116	164															
118	162	Dark yellow-orange poorly graded SAND, with silt, fine-grained, very dense, saturated.	SP SM		SS	22	23 34 38	72	78							
120	160															
122	158	ST2 - El. 158' - 147'														
124	156	Dark yellow-orange/light brown-orange clayey SAND, fine-grained, trace medium-grained, loose, wet. Trace spiral shell fragments.	SC		SS	23A	WH 1 6	7		35.5		75.5	24.5	55	26	29

Completion Depth: 154.5
Drilling Rig: CME-75
Weather: Sunny, high 80's F

Remarks: Hole grouted immediately upon completion. Average fluid density 13.4lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:09

DUKE COGEMA
STONE & WEBSTER

LOG OF BORING BH-13

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:
Northing: 80,422.5
Easting: 54,905.3
Surface Elevation: 279.5
Datum: MSL

Date Started: 7/20/00
Date Completed: 7/21/00
Drill Method: 8" mud rotary
Logged By: JJT
Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
126	154	Yellow-tan clayey SAND, fine-grained, wet.	SC		ST	23B			35.5		75.0	25.0	62	26	36
128	152	As above, but with thin greenish silt/clay laminae, medium dense.	SC		SS	24	WR 6 5	11	133						
130	150														
132	148	GC - El. 147' - 140'													
134	146	Brown sandy CLAY, with silt, fine- to medium-grained, trace coarse-grained, very stiff, wet.	CH		SS	25	6 8 10	18	133	27.1		42.3	57.7	52	23	29
136	144														
138	142	Light brown-orange silty SAND, trace clay, trace fine-grained gravel, fine- to coarse-grained, dense, moist.	SM		SS	26	6 10 25	35	133						
140	140	CG - El. 140'													
142	138														
144	136	Yellow-orange poorly graded SAND, with silt, fine- to medium-grained, very dense, wet to saturated.	SP SM		SS	27	31 34 50	84	72						
146	134														
148	132														
150	130	Yellow-orange to dark orange poorly graded SAND, with silt, with clayey stringers, fine- to coarse-grained, very dense, wet to saturated.	SP SM		SS	28	42 50/3	>100	56						

Completion Depth: 154.5
Drilling Rig: CME-75
Weather: Sunny, high 80's F

Remarks: Hole grouted immediately upon completion. Average fluid density 13.4lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:09

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STONE & WEBSTER

LOG OF BORING BH-13

Project Name: MOX Fuel Fabrication Facility

Location: DOE Savannah River Site

Job Number: 08716

Boring Location:

Northing: 80,422.5

Easting: 54,905.3

Surface Elevation: 279.5

Datum: MSL

Date Started: 7/20/00

Date Completed: 7/21/00

Drill Method: 8" mud rotary

Logged By: JJT

Reviewed By: FJW/JKM

Depth (ft)	Elevation (ft)	MATERIAL DESCRIPTION	USCS Classification	Graphic Log	Sample Type	Sample/Run No.	Blows/6" Press./Int. psi/in N Value (uncorrected)	Recovery (%)	Water Content (%)	% Gravel	% Sand	% Passing No. 200 Sieve	Liquid Limit	Plastic Limit	Plasticity Index
150	128														
152	126	Black silty poorly graded SAND, with silt, fine- to medium-grained, trace coarse-grained, very dense, wet.	SP SM		SS	29	9 22 31 53	133	25.9		92.1	7.9			
154	124	Completed boring at 154.5'.													
156	122														
158	120														
160	118														
162	116														
164	114														
166	112														
168	110														
170	108														
172	106														
174															

Completion Depth: 154.5

Drilling Rig: CME-75

Weather: Sunny, high 80's F

Remarks: Hole grouted immediately upon completion. Average fluid density 13.4lb/gal.

LOG OF BORING LETTER SIZE COMB2A~1.GPJ STNWB_CO.GDT 5/3/01 16:09

QUALITY LEVEL QL-1A (IROFS)

Total Pages 483

ATTACHMENT NUMBER 2

CONE PENETRATION TESTING FINAL REPORT

QUALITY LEVEL QL-1, IROFS

Total Pages 483

ATTACHMENT NUMBER 2

CONE PENETRATION TESTING FINAL REPORT

CONE PENETRATION TESTING
AT THE MIXED OXIDE
FUEL FABRICATION FACILITY (MFFF)
SAVANNAH RIVER SITE
AIKEN, SOUTH CAROLINA

Final Report

Copy 2

Prepared for:

Duke Cogema Stone & Webster, LLC
400 South Tryon Street
Charlotte, NC 28202

Prepared by:

Applied Research Associates, Inc.
New England Division
415 Waterman Road
South Royalton, Vermont 05068

ARA Report No. 0198

October 17, 2000

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LIST OF ILLUSTRATIONS

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SECTION 1
CONE PENETROMETER TESTING AT THE MIXED OXIDE FUEL FABRICATION FACILITY

INTRODUCTION

Applied Research Associates, Inc. (ARA) under contract to Duke, Cogema, Stone & Webster, LLC, conducted Electric Cone Penetration Tests with seismic soundings (S-CPT) at the Mixed Oxide Fuel Fabrication Facility (MFFF), Savannah River Site, South Carolina. This report documents ARA's site investigation efforts, test techniques, and analysis of the data for fieldwork conducted May 31 through July 24, 2000. Presented in this report is the field testing methods, data analysis techniques, and a brief discussion of the results.

TEST LOCATIONS

Sixty-four cone penetrometer test locations were conducted at the MFFF site. All penetrations measured tip stress, sleeve stress, and penetration pore pressure. Twenty of the penetrations included resistivity data in addition to the above measurements. At fifteen of the locations, seismic shear and compressional wave measurements were recorded on five foot intervals. Pore pressure dissipations were conducted as directed by the Stone and Webster field representative. In addition to CPT soundings, twenty soil samples were collected and five dilatometer tests were performed.

Table 1 lists the penetrations conducted and relevant information about each location. All locations were grouted upon retraction of the rod string or using a standard tremie grout method.

Table 1. Summary of CPT Testing at The MFFF site.

Test ID	ARA Filename	Type of Test	Date of Test	Maximum Depth (ft)	Dissipation Depth (ft)	Northing (ft)	Easting (ft)	Elevation (ft)	G.W.T. Depth (ft)
CPT-01S	409u008	S/P-CPT	6/9/00	104.4	104.4	80784.9	55554.0	258.2	73.4
CPT-02R	414u003	R/P-CPT	6/14/00	112.8	65.3, 101.6	80635.0	55616.4	257.8	57.3
CPT-03S	408u007	S/P-CPT	6/8/00	109.7	64.1, 74.1	80551.4	55700.8	253.2	57.8
CPT-04R	417u002B	R/P-CPT	6/17/00	135.5	80.0, 135.5	80465.4	55320.8	272.6	73.6
CPT-05S	408u004	S/P-CPT	6/8/00	124.8	71.7, 108.5	80499.7	55478.5	264.5	61.9
CPT-06R	415u002	R/P-CPT	6/15/00	103.2	64.8, 78.6	80470.7	55633.2	256.9	58.0
CPT-07R	419u001	R/P-CPT	6/19/00	114.3	78.7, 87.5, 98.1	80438.0	55228.2	280.2	79.6
CPT-08S	402u004	S/P-CPT	6/2/00	140.0	111.4, 140.1	80393.7	55329.1	273.0	74.6
CPT-09R	420u005	R/P-CPT	6/20/00	126.5	50.6, 80.7, 88.1, 112.3	80394.0	55445.7	266.2	67.0
CPT-10R	420u001	R/P-CPT	6/20/00	142.5	45.6, 85.3, 104.9	80406.7	55527.1	261.9	67.0
CPT-11S	402u001	S/P-CPT	6/2/00	106.4	78.0, 106.4	80394.0	55624.1	258.5	62.4
CPT-12R	323u003	R/P-CPT	6/23/00	102.9	67.4, 86.0	80373.1	55747.5	254.5	61.0
CPT-13S	405u005	S/P-CPT	6/5/00	166.5	135.5	80262.2	55233.6	296.7	100.0
CPT-14R	419u008	R/P-CPT	6/19/00	123.7	68.9, 85.9, 123.7	80292.7	55330.8	276.0	75.0
CPT-15R	322u001	R/P-CPT	6/22/00	130.0	79.0, 114.9	80295.0	55462.7	269.1	68.5
CPT-16S	408u001	S/P-CPT	6/8/00	122.1	84.7, 116.1	80281.0	55628.6	260.5	79.0
CPT-17	410u001	P-CPT	6/10/00	106.5	80.1	80259.4	55747.7	255.9	62.0
CPT-18R	322u005	R/P-CPT	6/22/00	120.3	82.9, 97.2	80192.1	55405.9	277.0	73.8
CPT-19S	403u002	S/P-CPT	6/3/00	118.0	98.0, 106.1	80177.3	55467.5	274.8	75.4
CPT-20R	322u003	R/P-CPT	6/22/00	107.0	76.0	80211.3	55570.4	266.9	65.8
CPT-21	412u004	P-CPT	6/12/00	138.7	110.1	80148.4	55060.1	295.4	97.0
CPT-22	412u007	P-CPT	6/12/00	152.6	104.4, 114.6	80143.8	55221.9	297.3	100.0
CPT-23S	406u003	S/P-CPT	6/6/00	123.8	92.9, 104.6	80088.9	55379.4	277.3	69.4
CPT-24	410u003B	P-CPT	6/10/00	63.4	--	80115.0	55548.5	272.6	78.8
CPT-24A	410u005	P-CPT	6/10/00	143.1	102.0	80115.0	55548.5	272.6	78.8
CPT-25	412u001	P-CPT	6/12/00	84.5	76.4	80104.7	55621.7	268.9	68.8
CPT-26S	406u001	S/P-CPT	6/6/00	127.1	85.1, 112.7	80116.2	55726.7	261.9	65.5
CPT-27R	322u008	R/P-CPT	6/22/00	128.6	86.0, 104.5	80001.4	55254.2	277.5	72.0
CPT-28S	431y006	S/P-CPT	5/31/00	150.0	107.0	80001.8	55332.0	279.2	76.5
CPT-29R	413u009	R/P-CPT	6/13/00	119.2	66.8, 89.1	79985.8	55422.4	276.4	68.5
CPT-30R	414u001	R/P-CPT	6/14/00	141.0	60.8, 79.3, 125.3	79973.4	55538.3	274.2	71.0
CPT-31S	401u002	S/P-CPT	6/1/00	126.3	126.1	79977.3	55610.3	271.7	67.0
CPT-32R	324u001	R/P-CPT	6/24/00	130.3	78.0, 82.6	80005.4	55755.6	264.7	63.8
CPT-33R	413u003	R/P-CPT	6/13/00	142.1	81.0, 116.2,	79842.0	54922.7	274.6	71.6
CPT-34S	407u001	S/P-CPT	6/7/00	146.0	111.8, 118.2	79826.9	55323.2	270.8	72.0
CPT-35S	403u005	S/P-CPT	6/3/00	109.4	24.8, 94.9, 141.0	79888.6	55389.0	272.6	71.8
CPT-36R	413u007	R/P-CPT	6/13/00	127.2	84.5,. 97.9, 119.9	79898.9	55478.3	273.4	69.5
CPT-37S	405u001	S/P-CPT	6/5/00	135.5	66.6, 124.0	79886.1	55629.4	268.4	67.0
CPT-38R	323u001	R/P-CPT	6/23/00	133.9	81.7, 93.5, 121.8	79899.9	55568.6	271.3	67.4
CPT-39R	324u005	R/P-CPT	6/24/00	120.4	56.2, 82.1, 99.1	80206.6	55646.9	262.1	64.0
CPT-40R	324u007	R/P-CPT	6/24/00	113.2	91.0	79941.1	55448.0	275.0	72.3
CPT-42	408L001	P-CPT	7/8/00	126.0	87.1	80169.8	55591.7	267.5	69.9
CPT-43	315L055	P-CPT	7/15/00	116.6	--	80257.7	55585.0	264.0	76.0
CPT-44	320L005	P-CPT	7/20/00	118.0	85.2, 95.3	80530.3	55109.3	284.7	85.8
CPT-45	321L001	P-CPT	7/21/00	142.6	94.0, 130.0	80531.1	55194.0	280.5	82.5
CPT-46	320L003	P-CPT	7/20/00	147.3	83.1, 129.1	80482.0	55032.8	284.5	74.0
CPT-47	320L007	P-CPT	7/20/00	116.0	116.0	80456.7	55146.5	284.1	86.1
CPT-48	322L005	P-CPT	7/22/00	110.5	96.5	80463.6	54964.1	281.2	82.4
CPT-49	319L003	P-CPT	7/19/00	123.1	105.8	80332.7	54931.1	292.4	91.5
CPT-50	319L001	P-CPT	7/19/00	134.1	102.5, 108.6, 127.6	80370.9	55140.0	294.4	107.8

Test ID	ARA Filename	Type of Test	Date of Test	Maximum Depth (ft)	Dissipation Depth (ft)	Northing (ft)	Easting (ft)	Elevation (ft)	G.W.T. Depth (ft)
CPT-51	318L008	P-CPT	7/18/00	138.7	95.3, 104.1	80318.7	55198.3	295.5	95.0
CPT-52	319L005	P-CPT	7/19/00	119.9	114.2, 119.1	80277.0	54867.3	293.4	94.7
CPT-53	315L022	P-CPT	7/15/00	124.8	89.0, 106.4	80309.5	55059.9	292.8	90.2
CPT-54	320L001	P-CPT	7/20/00	123.1	96.4, 104.2	80243.1	54940.0	293.7	92.9
CPT-55	318L005	P-CPT	7/18/00	136.5	96.3, 113.0	80259.6	55141.9	294.4	94.1
CPT-56	318L001	P-CPT	7/18/00	120.1	103.5	80207.0	54866.7	294.2	92.5
CPT-57	318L003	P-CPT	7/18/00	128.8	101.2, 115.1	80229.2	55058.2	293.6	91.8
CPT-58	317L004	P-CPT	7/17/00	121.8	103.0, 114.1	80135.1	54866.9	295.1	88.0
CPT-59	415L005	P-CPT	7/15/00	126.0	99.1	80152.7	54956.9	295.5	75.7
CPT-60	415L003	P-CPT	7/15/00	141.0	99.4	80142.2	55140.6	295.7	66.6
CPT-61	321L003	P-CPT	7/21/00	114.6	90.5, 97.1	80037.6	54869.6	279.3	76.3
CPT-62	322L001	P-CPT	7/22/00	115.7	70.8, 95.6	80055.6	54956.3	278.5	75.9
CPT-63	322L003	P-CPT	7/22/00	118.6	104.5	80066.0	55055.5	279.4	90.0
CPT-64	415L001	P-CPT	7/15/00	141.0	--	80034.9	55165.3	279.8	66.6
DIL-10	--	DMT	7/7/00	88.0	--	80398.5	55537.5	261.8	--
DIL-15	--	DMT	6/30/00	103.0	--	80291.5	55466.0	269.1	--
DIL-23	--	DMT	7/6/00	108.0	--	80088.4	55382.8	277.2	--
DIL-25	--	DMT	7/1/00	83.0	--	80108.4	55620.2	268.4	--
DIL-29	--	DMT	6/29/00	95.0	--	79975.5	55420.4	276.2	--
SS-05	--	SS	6/27/00	117.0	--	80499.8	55473.5	264.5	--
SS-10	--	SS	6/28/00	75.0	--	80411.5	55529.9	261.8	--
	--	SS	6/28/00	115.0	--	--	--	--	--
SS-14	--	SS	6/28/00	67.0	--	80292.7	55330.8	276.0	--
	--	SS	6/28/00	94.0	--	--	--	--	--
SS-22	--	SS	6/26/00	130.0	--	80153.0	55221.7	297.0	--
SS-24	--	SS	6/27/00	125.0	--	80112.8	55547.7	272.8	--
SS-26	--	SS	6/27/00	112.0	--	80116.2	55726.7	261.9	--
SS-29	--	SS	6/26/00	70.0	--	79982.6	55417.0	276.6	--
	--	SS	6/26/00	100.0	--	--	--	--	--
SS-36	--	SS	6/26/00	62.0	--	79902.7	55477.0	273.3	--
	--	SS	6/27/00	121.8	--	--	--	--	--
SS-37	--	SS	6/28/00	60.0	--	79882.3	55625.6	268.8	--
	--	SS	6/28/00	69.0	--	--	--	--	--
	--	SS	6/28/00	90.0	--	--	--	--	--
	--	SS	6/28/00	115.0	--	--	--	--	--
SS-39	--	SS	6/27/00	104.0	--	80208.8	55650.3	261.7	--
SS-46	--	SS	7/24/00	114.8	--	80487.6	55036.0	284.2	--
	--	SS	7/24/00	133.0	--	--	--	--	--
	--	SS	7/24/00	142.0	--	--	--	--	--

REPORT OUTLINE

This report is organized into 4 Sections and 4 Appendices. Section 2 discusses the CPT equipment, field procedures, and daily calibrations. Section 3 describes the methods used to interpret the CPT results as well as a discussion of a typical CPT Profile from the MFFF site. Section 4 lists references. Appendix A presents the piezocone data. Piezocone data in tabular format is presented in Appendix B. Seismic test wave histories and velocities are located in Appendix C. Appendix D contains pore pressure dissipation data. Dilatometer data is found in Appendix E.

SECTION 2
TESTING EQUIPMENT AND PROCEDURES

INTRODUCTION

The electric cone penetrometer test (CPT) was originally developed for use in soft soil. Over the years, cone and push system designs have evolved to the point where they can now be used in strong cemented soils and even soft rock. ARA's penetrometer consists of an instrumented probe that is forced into the ground using a hydraulic load frame mounted on a heavy truck with the weight of the truck providing the necessary reaction mass. The probe has a conical tip and a friction sleeve that independently measures vertical resistance beneath the tip as well as frictional resistance on the side of the probe as a function of depth. A schematic view of ARA's penetrometer probe is shown in Figure 2.1. A pressure transducer in the cone is used to measure the pore water pressure as the probe is pushed into the ground (P-CPT).

A resistivity module is attached directly behind the cone to measure the electrical resistance of the subsurface. This probe also includes three geophones aligned along the X, Y, and Z-axis for measuring shear and compressional waves.

PIEZO-ELECTRIC CONE PENETROMETER EQUIPMENT AND TEST

The cone penetrometer tests were conducted using the ARA penetrometer truck. The penetrometer equipment is mounted inside a van body attached to a ten-wheel truck chassis with a diesel engine. Ballast in the form of weights is added to the truck to achieve an overall push capacity of 60,000 lbs. Penetration force is supplied by a pair of large hydraulic cylinders bolted to the truck frame.

A 15-cm^2 penetrometer probe (which has 1.75-inch diameter, 60° conical tip, and a 1.75-inch diameter by 6.5-inch long friction sleeve) was used on this project. This probe size is in conformance with ASTM D 5778 (Ref. 1). The shoulder between the base of the tip and the porous filter is 0.08 inch long as shown in Figure 2.1. The penetrometer is advanced vertically into the soil at a constant rate of 48 inches/minute (2cm/second), although this rate must sometimes be reduced as hard layers are encountered. The electric cone penetrometer test is conducted in accordance with ASTM D 5778 (Ref. 1).

Inside the probe, two load cells independently measure the vertical resistance against the conical tip and the side friction along the sleeve. Each load cell is a cylinder of uniform cross section instrumented with four strain gages in a full-bridge circuit. The forces are sensed by the load cells and the data are transmitted from the probe assembly via a cable running through the push tubes. The analog data are digitized, recorded, and plotted by computer in the penetrometer truck. A set of data is normally recorded each second, for a minimum resolution of about one data point every 0.8 inch of cone advance. The depth of penetration is measured using a string potentiometer mounted on the push frame.

Electronic data acquisition equipment for the cone penetrometer consists of a computer with a graphics monitor and a rack of eight signal conditioners. Analog signals are transmitted from the probe to the signal conditioners where the CPT data are amplified and filtered at 1 Hz. Once amplified, the analog signals are transmitted to a high-speed analog-to-digital converter board, where the signals are digitized; usually at the rate of one sample per second for the penetration data. The digital data are then read into memory and written to the internal hard disk for future processing. Upon completion of the test the penetration data are plotted. The digital data are brought to ARA's New England Division in South Royalton, Vermont, for analysis and preparation of report plots.

Saturation of the Piezo-Cone

Penetration pore pressures are measured with a pressure transducer located behind the tip in the lower end of the probe. Water pressures in the soil are sensed through a 250 micro-inch porous polyethylene filter that is 0.25-inch high and 0.202-inch thick. The pressure transducer is connected to the porous filter through a pressure port as shown in Figure 2.1. The pressure port and the filter are filled with high viscosity silicone oil.

In order for the pressure transducer to respond rapidly and correctly to changing pore pressures during the penetration, the filter and pressure port must be saturated with oil upon assembly of the probe. A vacuum pump is used to de-air the silicone oil before use and also to saturate the porous filters with oil. The probe is assembled with the pressure transducer facing upwards and the cavity above the pressure transducer is filled with de-aired oil. A previously saturated filter is then placed on a tip and oil is poured over the threads. When the cone tip is screwed into place, excess oil is ejected through the pressure port and filter, thereby forcing out

any trapped air. The high viscosity of the silicone oil coupled with the small pore space in the filter prevents the loss of saturation as the cone is pushed through dry soils. Saturation of the cone can be verified with a calibration check at the completion of the penetration. Extensive field experience has proven the reliability of this technique.

Field Calibrations

Many factors can effectively change the calibration factors used to convert the raw instrument readouts, measured in volts, to units of force or pressure. As a quality control measure, as well as a check for instrument damage, the load cells and the pressure transducer are routinely calibrated in the field. Calibrations are completed with the probe ready to insert into the ground so that any factor affecting any component of the instrumentation system will be included and detected during the calibration.

The tip and sleeve load cells are calibrated with the conical tip and friction sleeve in place on the probe. For each calibration, the probe is placed in the push frame and loaded onto a precision reference load cell. The reference load cell is periodically calibrated in ARA's laboratory against instruments traceable to NIST standards. To calibrate the pore pressure transducer, the saturated probe is inserted into a pressure chamber with air pressure supplied by the compressor on the truck. The reference transducer in the pressure chamber is also periodically calibrated against an NIST traceable instrument in ARA's laboratory. Additionally, the linear displacement transducer used to measure the depth of penetration, is periodically checked against a tape measure. All records of device and load cell calibrations are located at ARA's New England Division.

Each instrument is calibrated using a specially developed computer code that displays the output from the reference device and the probe instrument in graphical form. During the calibration procedure, the operator checks for linearity and repeatability in the instrument output. At the completion of each calibration, this code computes the needed calibration factors using a linear regression algorithm. At a minimum, each probe instrument is calibrated at the beginning of each day of field testing. Furthermore, the pressure transducer is recalibrated each time the porous filter is changed and the cone re-saturated. Calibrations are also performed to verify the operation of any instrument if any damage is suspected.

Penetration Data Format

Figure 2.2 presents a typical CPT profile from the MFFF site investigation. This plot presents tip stress, sleeve friction, friction ratio and penetration pore pressure. As shown in Figure 2.1, the piezo-cone probe senses the pore pressure immediately behind the tip. Currently, there is no accepted standard for the location of the sensing element. ARA chose to locate the sensing element behind the tip since the filter is protected from the direct thrust of the penetrometer and the measured pore pressure can be used to correct the tip resistance data as recommended in Reference 2. The magnitude of the penetration pore pressure is a function of the soil compressibility and, most importantly, permeability. In freely draining soil layers, the measured pore pressures will be very close to the hydrostatic pressure computed from the elevation of the water table. When low permeability soil layers are encountered, excess pore pressures generated by the penetration process cannot dissipate rapidly and this results in measured pore pressures, which are significantly higher than the hydrostatic pressures. Whenever the penetrometer is stopped to add another section of push pipe, or when a pore pressure dissipation test is run, the excess pore pressure may begin to dissipate. When the penetration is resumed, the pore pressure quickly rises to the level measured before the penetrometer was stopped. This process causes some of the spikes that appear in the penetration pore pressure data.

Pore Pressure Correction of Tip Stress

Cone penetrometers, by necessity, must have a joint between the tip and sleeve. Pore pressure acting behind the tip decreases the total tip resistance that would be measured if the penetrometer was without joints. The influence of pore pressure in these joints is compensated for by using the net area concept (Ref. 2). The corrected tip resistance is given by:

$$q_T = q_c + u\left[1 - A_n/A_T\right] \qquad (2.1)$$

where:
- q_T = corrected tip resistance (psi)
- q_c = measured tip resistance (psi)
- u = penetration pore pressure measured behind the tip (psi)
- A_n = net area behind the tip not subjected to the pore pressure (1.95 in^2)
- A_T = projected area of the tip (2.405 in^2).

Hence, for the ARA cone design, the tip resistance is corrected as:

$$q_T = q_c + u(.2054) \tag{2.2}$$

Laboratory calibrations have verified Equation 2.2 for ARA's piezo-cone design.

A joint also exists behind the top of the sleeve (see Figure 2.1). However, since the sleeve is designed to have the same cross sectional area on both ends, the pore pressures acting on the sleeve cancel out. Laboratory tests have verified that the sleeve is not subjected to unequal end area effects. Thus, no correction for pore pressure is needed for the sleeve friction data.

The net effect of applying the pore pressure correction is to increase the tip resistance. Generally, this correction is only significant when the measured tip resistance is very low.

Numerical Editing of the Penetration Data

Any time that the cone penetrometer is stopped or pulled back during a test, misleading data can result. For instance, when the probe is stopped to add the next push rod section, or when a pore pressure dissipation test is run, the excess pore pressures will dissipate towards the hydrostatic pore pressure. When the penetration is resumed, the pore pressure rises very quickly to the pressures experienced prior to the pause in the test. In addition, the probe is sometimes pulled back and cycled up and down at intervals in deep holes to reduce soil friction on the push tubes. This results in erroneous tip stress data when the cone is advanced in the previously penetrated hole.

To eliminate this misleading data from the penetration profile, the data is numerically edited before it is plotted or used in further analysis. Each time the penetrometer stops or backs up, as apparent from the depth data, the penetration data is not plotted. Plotting of successive data is resumed only after the tip is fully re-engaged in the soil by one tip length of new penetration. In addition, each time the probe stops, the previous 0.5 inch of penetration data is filtered out. This filter is required to remove data that was recorded while the operator was in the process of stopping the probe. This algorithm also eliminates any data acquired at the ground surface before the tip has been completely inserted into the ground. The sleeve data is similarly treated and this results in the first data point not occurring at the ground surface, as can be seen in the tip and sleeve profiles in Figure 2.2. These procedures ensure that all of the penetration data

that is plotted and used for analysis was acquired with the probe advancing fully into undisturbed soil.

RESISTIVITY TESTING

Resistivity, one of the oldest geophysical exploration techniques, was originally developed to locate mineral and oil deposits and ground water supplies. The measurements principal exploited by resistivity surveying is that an electrical contrast exists between different geological materials and that this electrical contrast can be used to identify and locate geologic materials. Resistivity surveys are being increasingly used in contaminated site investigation programs to delineate the extent and degree of contamination at a site. These surveys rely on the electric contrasts that typically exist between contaminated soils and uncontaminated soils. For example, leachate from a landfill will contain a higher concentration of dissolved solids, which will decrease the resistivity of the groundwater (Ref. 3). Soils contaminated with hydrocarbons (fuel oils, cleaning solvents, etc.) will typically have higher resistivity than uncontaminated soils as the hydrocarbon can act as an insulator.

The Resistivity-CPT (R-CPT) is an adaptation of conventional borehole tools. The R-CPT probe is in intimate contact with the soil and pore fluid which eliminates two problems associated with borehole resistivity surveys; 1) intrusion of drilling fluids into borehole walls which changes the resistivity of the media and 2) the requirement that any casing materials be non-conducting.

Figure 2.1 is a schematic of ARA's R-CPT probe. The probe consists of 4 electrodes separated by high strength plastic reinforced insulators. The outer two electrodes induce an electric current into the soil and the inner two electrodes measure the potential drop, which is proportional to the resistivity of the soil. To avoid polarization effects, the four electrode array is operated at a frequency of 40 HZ. Electronics in the CPT vehicle are used to modulate and demodulate the current and potential measurement signals to and from the probe. The probe is calibrated in a large water solution in which the conductivity is varied. The data from the calibration tests is used to determine the probe calibration factor, which is dependent on the probe geometry.

SEISMIC CONE PENETROMETER EQUIPMENT AND TEST

The seismic cone penetrometer test was developed in the early 1980s and is gaining rapid acceptance in the geotechnical community. As with the conventional electric cone penetrometer test, initial development work has concentrated in weak materials. ARA's seismic cone equipment and field procedures were developed specifically for both weak soils and strong, dry, cemented soils. The seismic cone penetrometer test utilizes three geophones (Geospace Model GS-14-L9 velocity gages) mounted inside the penetrometer probe to detect the arrival at depth of seismic waves generated on the surface. Two horizontal transducers monitor shear wave (S-wave) traces from which the shear wave velocity can be determined. A third geophone, mounted vertically, is used to measure the compression wave (P-wave) traces and to subsequently derive the compressional velocity.

In the Seismic-Electric Cone Penetrometer Test (S-CPT), the cone is stopped at prescribed depth intervals, and S- and P-waves are generated on the ground surface near the push tubes. Both average downhole velocities and velocities between the depth intervals can be computed from the arrival time or time of peak data. The 2.0-inch diameter expander behind the sleeve minimizes coupling between the ground and the push tubes, mitigating problems with wave propagation down the push tubes.

High-energy shear waves are generated by an automated shear wave source in the front pad of the CPT rig (Figure 2.3). This system consists of a double-acting hydraulic cylinder used to horizontally move a large hammer. The hammer impacts either end of the front lifting pad of the penetrometer truck and induces a horizontal shear wave. By striking the pad on either end, polarized shear waves can be generated. This pad is 1 ft wide and about 8 ft long and oriented parallel to the axles of the truck. The point of impact of the shear hammers is 36 inches horizontally from the penetrometer push rod. Typical seismic traces are shown in Figure 2.4, where time of first peak shear wave motions are indicated. The first major shear wave is used to select the shear time of peak as denoted by the arrows. The use of polarized shear waves clarifies this time of peak.

In a similar fashion, compressive waves are generated by hitting a pile cap with an automated P-wave hammer or a sledge hammer. The point of impact is 72 inches horizontally away from the push rod.

Typical compressional wave traces are shown in Figure 2.5. Determining arrival time of the compressional wave (P-wave) is relatively more difficult. However, the time of first peak can usually be determined with consistency.

PORE PRESSURE DISSIPATION RESULTS

At selected depths, the penetrometer is stopped and the dissipation of excess pore pressure is observed. Pore pressures, as sensed by the pressure transducer, are recorded at regular time intervals (typically 1 second, but the sample rate can be adjusted for local site conditions) and plotted on the graphics monitor. Dissipation tests are usually run until at least 50 percent of the excess pore pressure has dissipated. This length of time, t_{50}, can be used to determine the lateral coefficient of consolidation and permeability in the given soil layer. Depending on site conditions, t_{50} can range from a few minutes to several hours. These tests are sometime run to complete dissipation to measure the hydrostatic pore pressure. During the dissipation test, the penetrometer is stationary with no downward force applied by the penetrometer truck.

A classic dissipation profile in a clay soil is shown in Figure 2.6. Total pore pressure is presented on a semi-log plot versus time. The classic dissipation curve will show a dissipation rate that decreases with time. If the dissipation test is allowed to run long enough, the static pore pressure will eventually be reached. The value of P_n at the top of Figure 2.6 is the average of the last ten pore pressure measurements. If the dissipation test is sufficiently long, P_n will be equal to the static pore pressure. This value can also be determined from the water table elevation at some sites. Knowing the static pore pressure (u_o), as well as the peak pressure observed during the test (u_p), the pore pressure at 50 percent of dissipation (u_{50}) can be determined. Time to 50% dissipation (t_{50}) can then be read directly from the dissipation profile.

Many of the penetration profiles from the work at the MFFF site exhibit the classic shape as depicted in Figure 2.6. At some locations, the dissipations start with a vacuum condition due to dilatation occurring during the penetration. From this condition the pore pressures increase as presented in Figure 2.7. This curve shape does not permit the traditional dissipation analysis algorithms to be used to determine hydraulic conductivity. For this reason only the plots of the dissipations as a function of time are presented in the appendix and not analysis tables.

SOIL SAMPLE COLLECTION

ARA has developed its own soil sampler based on extensive field experience with other types of samplers, and has created a more robust sampler (Figure 2.8) that can be deployed with the heaviest CPT rigs. The assembled soil sampler is deployed to the desired depth where a tip release tool is then lowered down the rod string to unlock the sampler tip. Once released, the rods and sampler are advanced and the soils are forced into a stainless steel sleeve or split spoons through the core catcher. The probe is then retracted, bringing the sample to the surface. The sampler collects a sample 1.4 inches in diameter and up to 21 inches in length.

DILATOMETER TESTS (DMT)

Marchetti Dilatometer Tests are conducted to estimate the lateral earth pressures and soil compressibilities. Material properties derived from the DMTs can be used to evaluate settlement, lateral earch pressures and ECR. The dilatometer consists of a flat-plate penetrometer, which is instrumented with a flexible, circular diaphragm mounted on one face of the blade. The test is operated from a console in the penetrometer truck which is used to push the blade into the ground. The dimensions and geometry of the blade are shown in Figure 2.9. A detailed, recommended procedure for conducting the test has been presented by Schmertmann (Ref. 4) and will be summarized briefly here.

Immediately after the blade is forced into the ground to a desired test depth, using the penetrometer truck, the flexible diaphragm is expanded with compressed gas. As gas pressure is slowly increased and the membrane starts to move outward against the soil, an electric signal ("A" reading) identifies the pressure required to lift the diaphragm off the plan of the blade. As diaphragm expansion continues, a second electric signal ("B" reading) denotes when a central diaphragm displacement of 1mm is reached. A third pressure ("C" reading) is read when the diaphragm is deflated back to the plane of the blade.

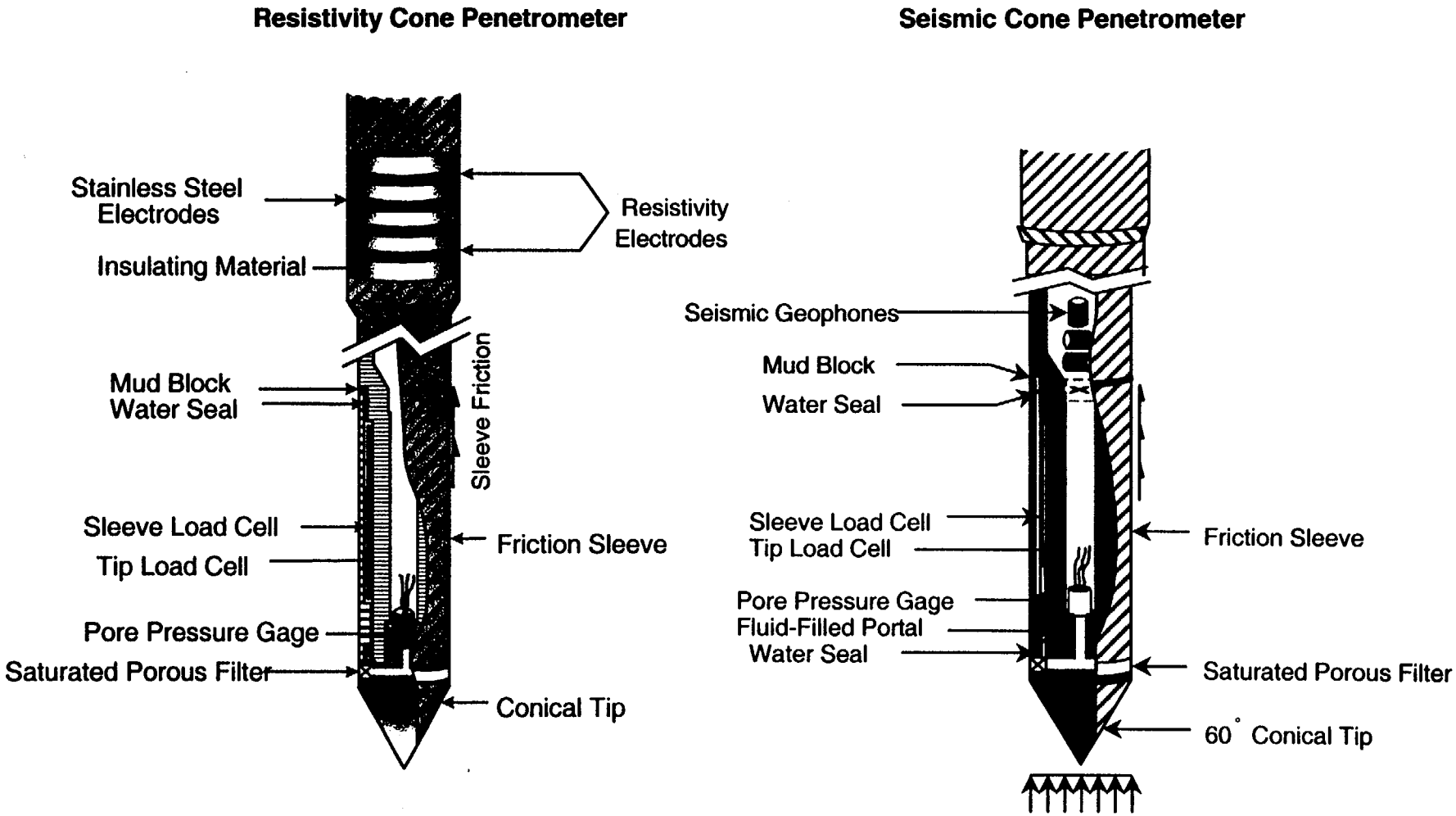


Figure 2.1 Schematic of ARA's Resistivity and Seismic cone penetrometers

CPT-18R APPLIED RESEARCH ASSOCIATES, INC. 06/22/00
North 80192.1 East 55405.9 Elevation 277.0

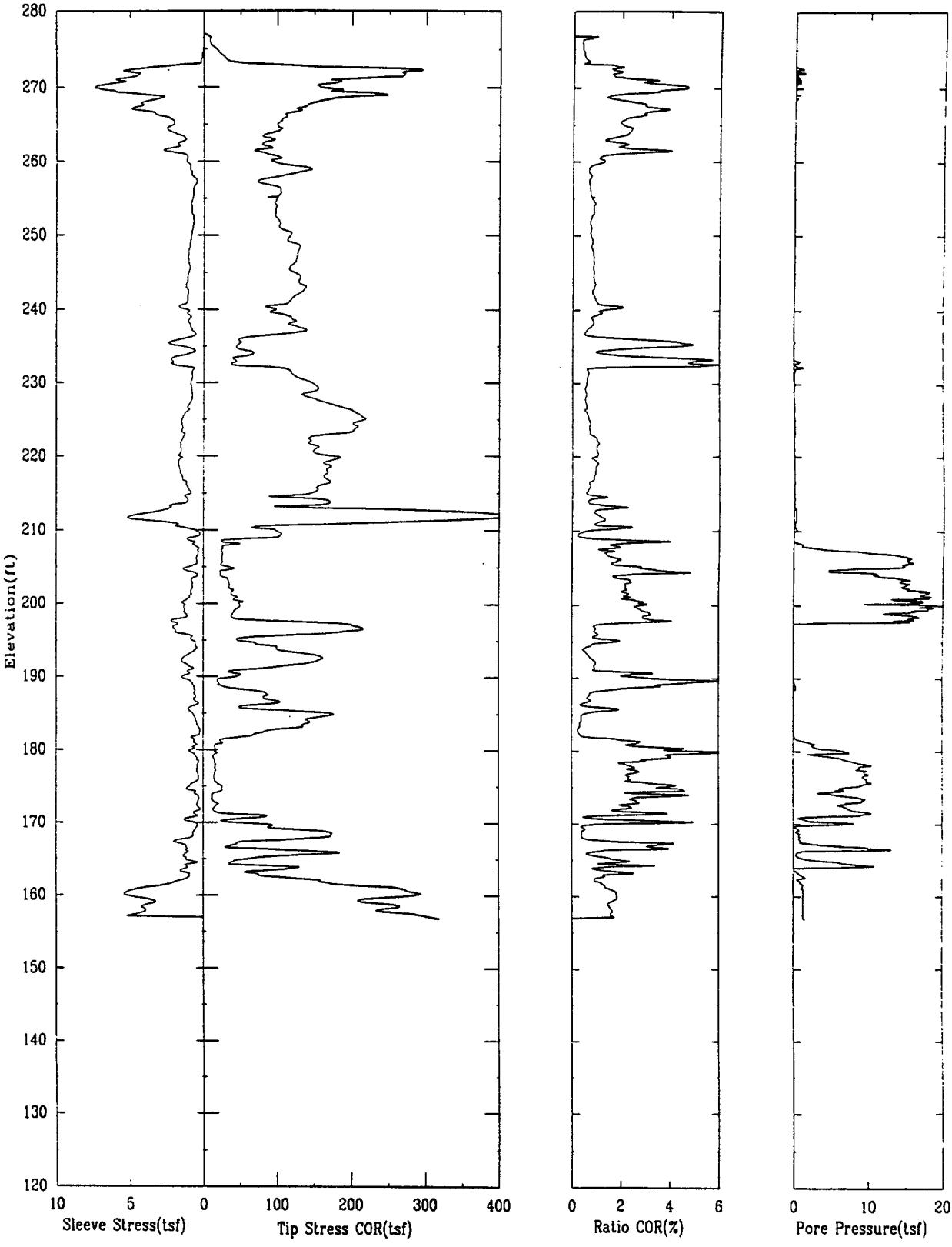
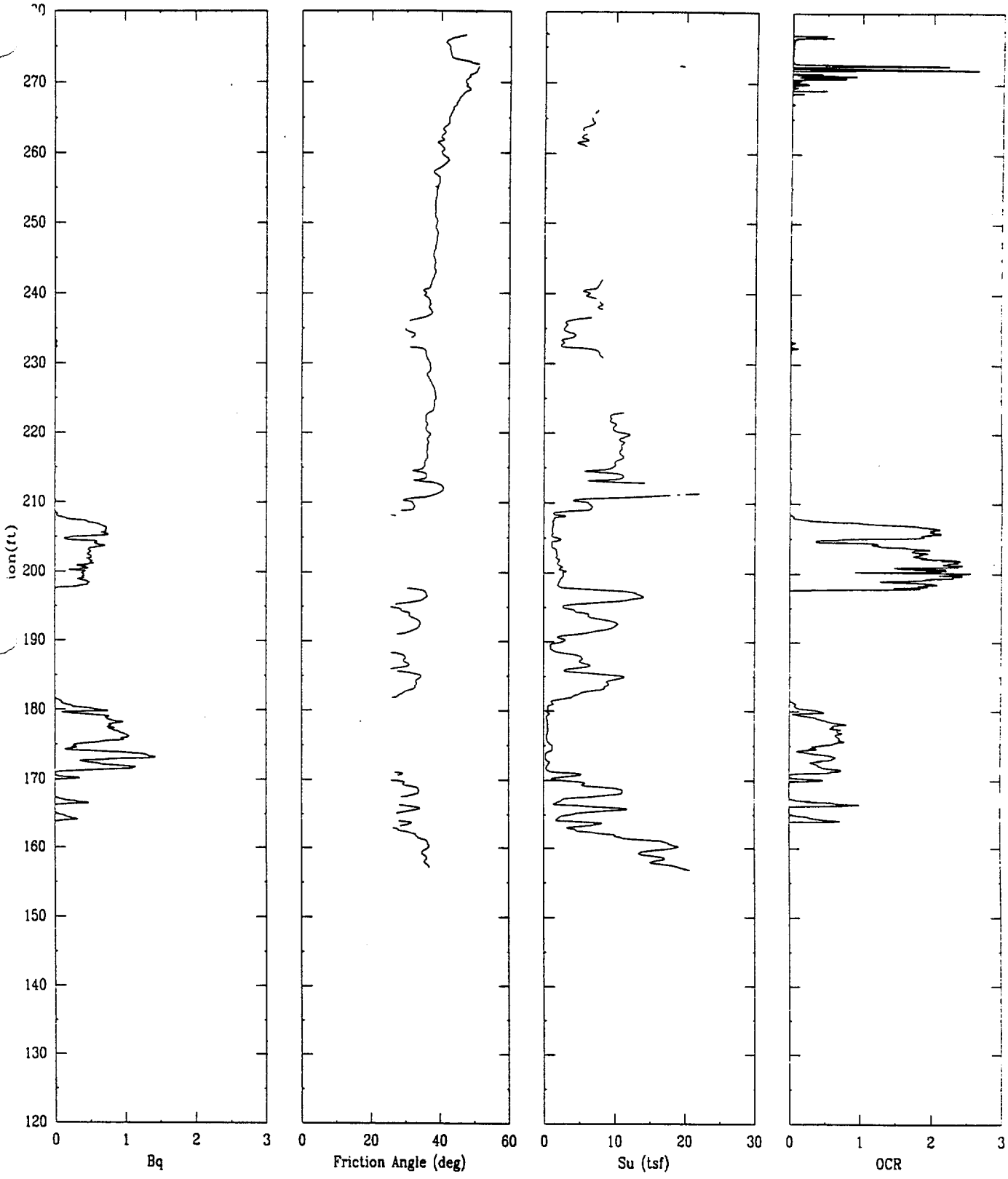


Figure 2.2 Typical CPT profile from the MFFF

File 322u005.ECP

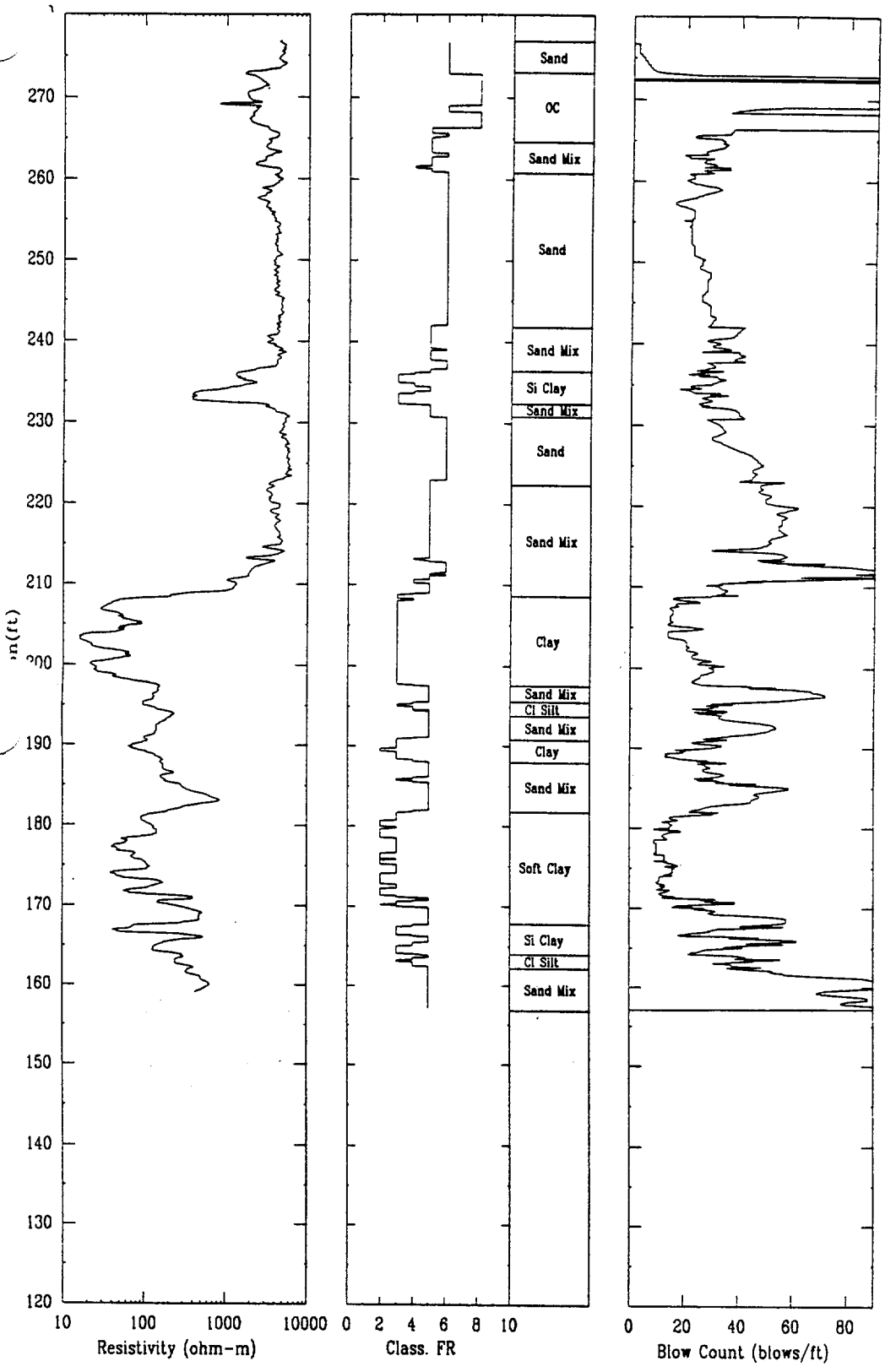
CPT-18R APPLIED RESEARCH ASSOCIATES, INC. 06/22/00
North 80192.1 East 55405.9 Elevation 277.0



File 322u005.ECP

Figure 2.2 Typical CPT profile from the MFFF (continued)

CPT-18R APPLIED RESEARCH ASSOCIATES, INC. 06/22/00
North 80192.1 East 55405.9 Elevation 277.0



File 322u005.ECP

Figure 2.2 Typical CPT profile from the MFFF (concluded)

Seismic Shear Wave Hammer

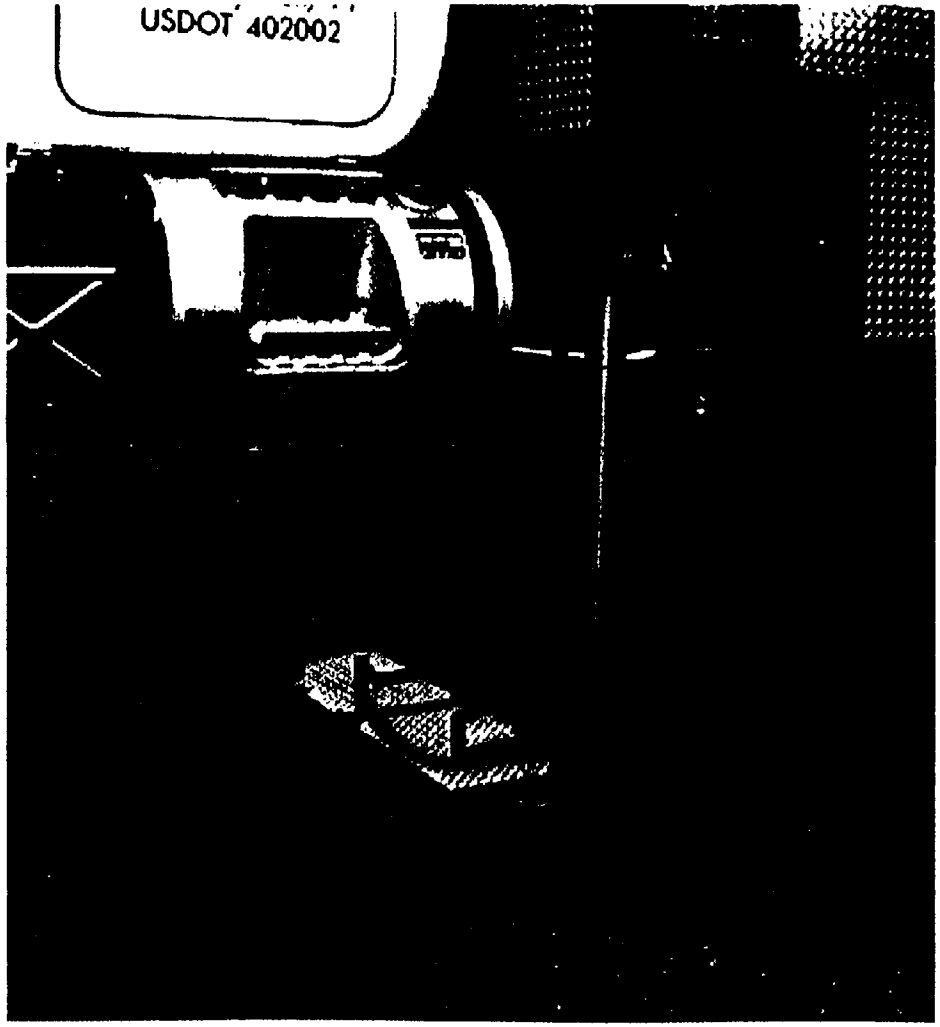


Figure 2.3 High energy seismic shear wave hammer

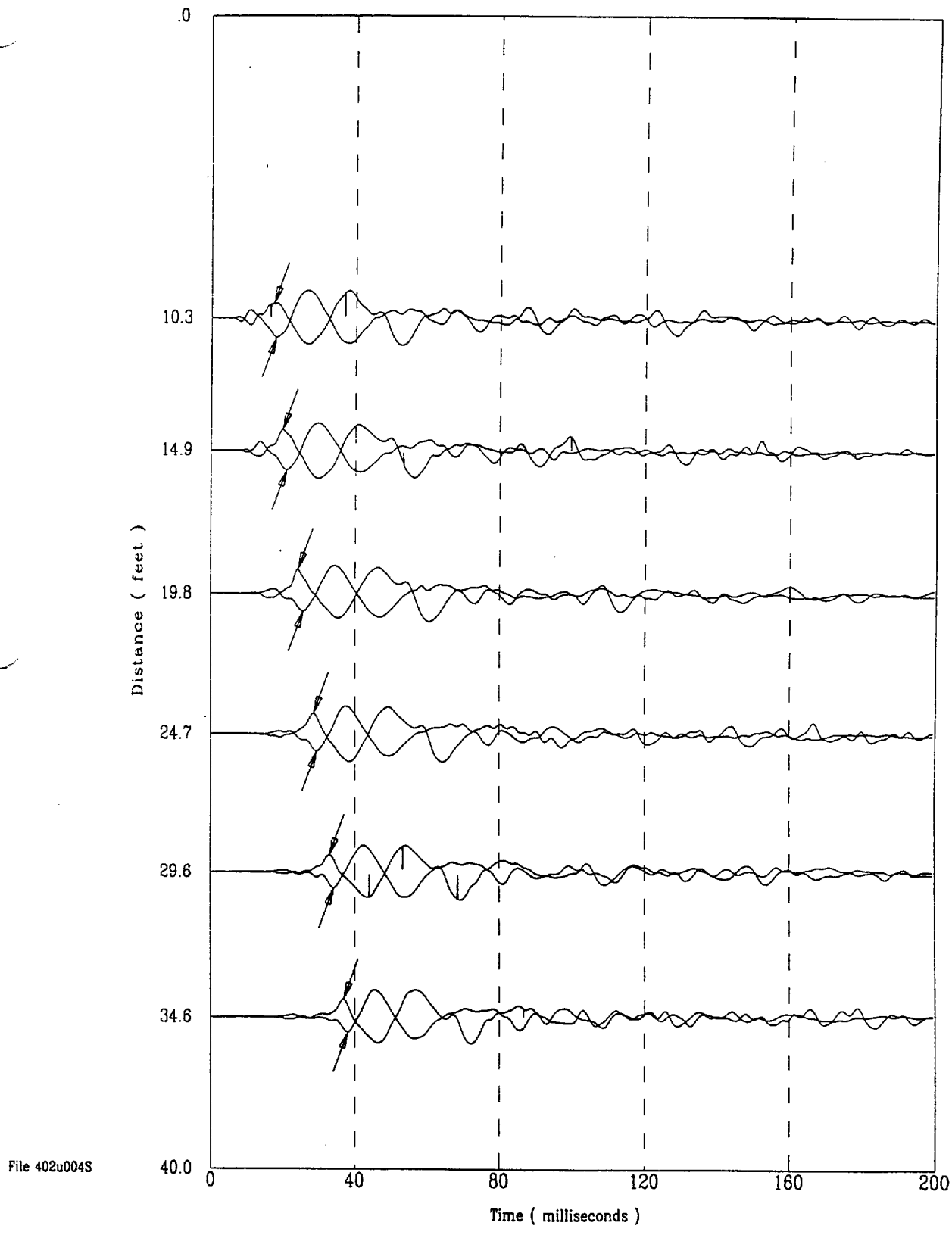


Figure 2.4 Typical shear wave traces

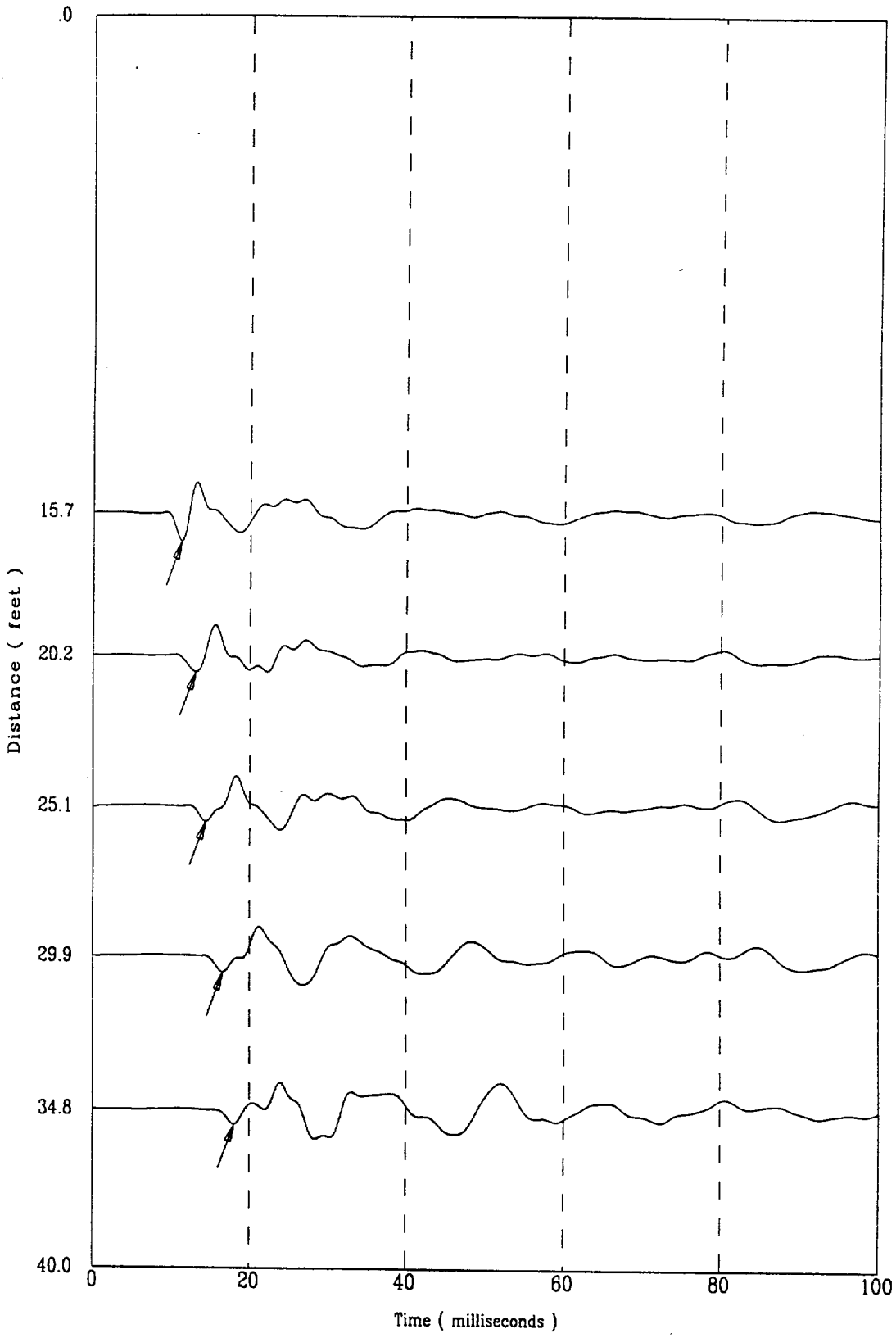


Figure 2.5 Typical compression wave traces

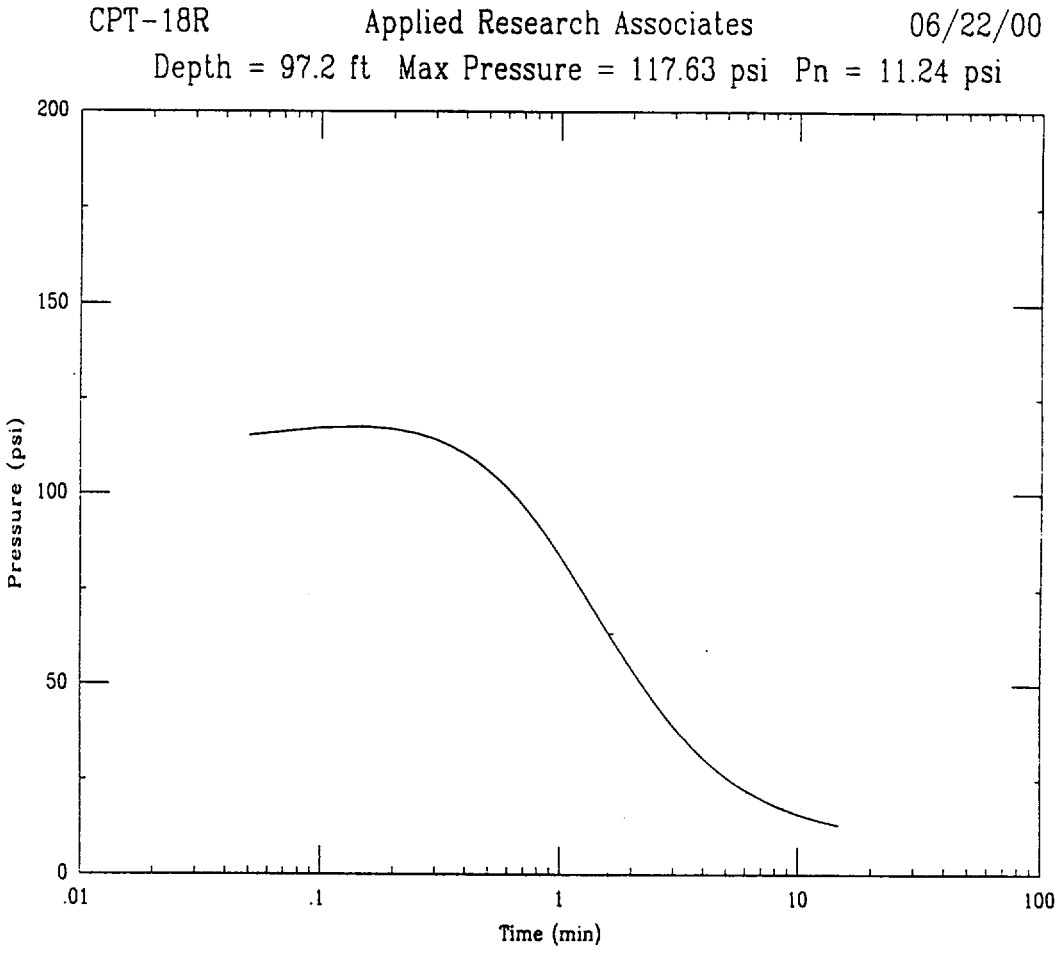


Figure 2.6 Classic dissipation profile from MFFF project

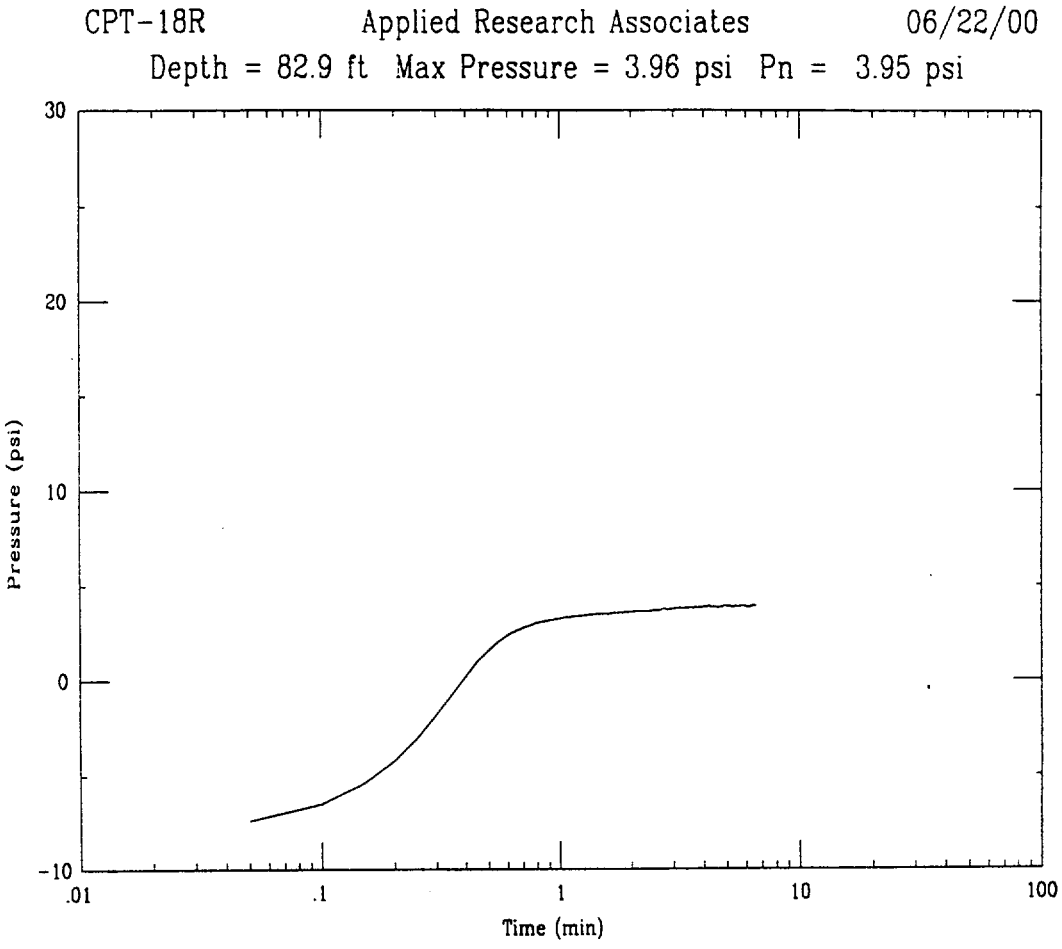


Figure 2.7 Dissipation test showing dilating condition

Soil Sampler
(Patent No. 5211249)

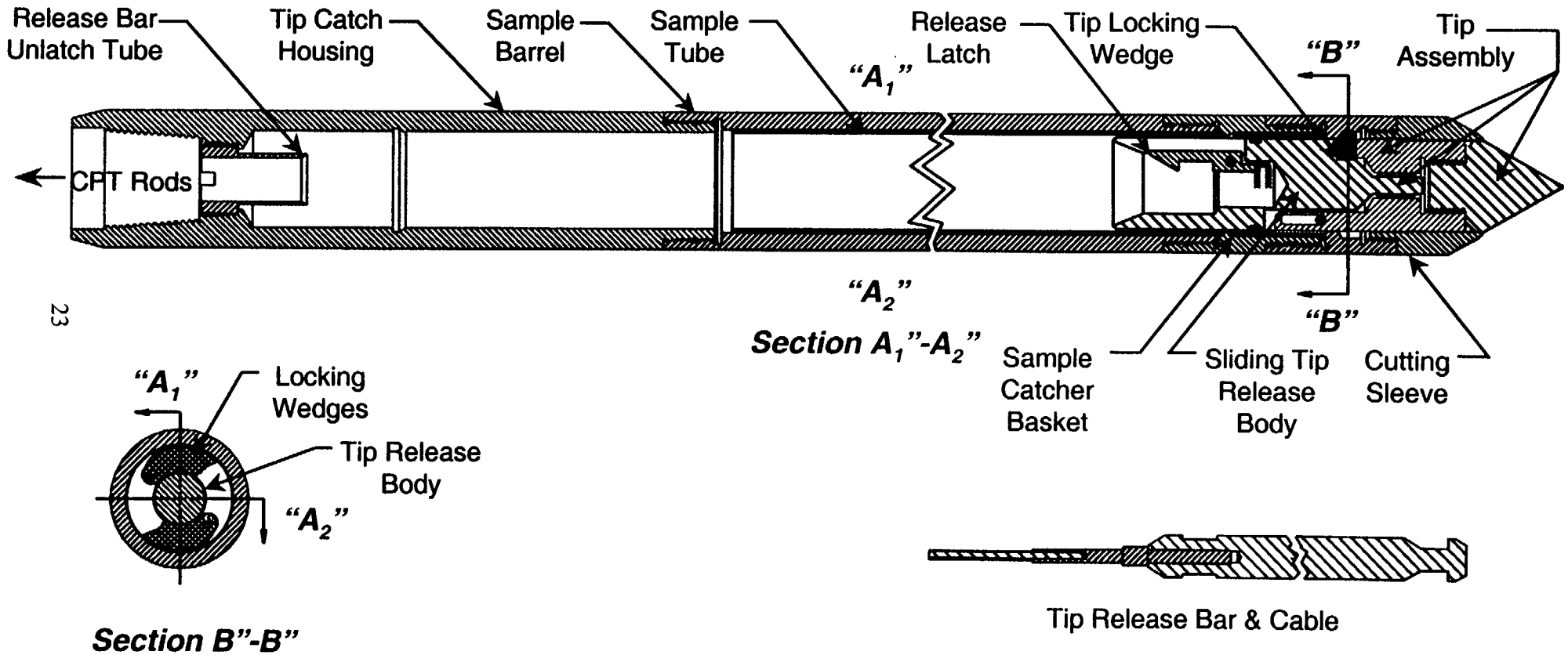


Figure 2.8. Soil Sampler schematic

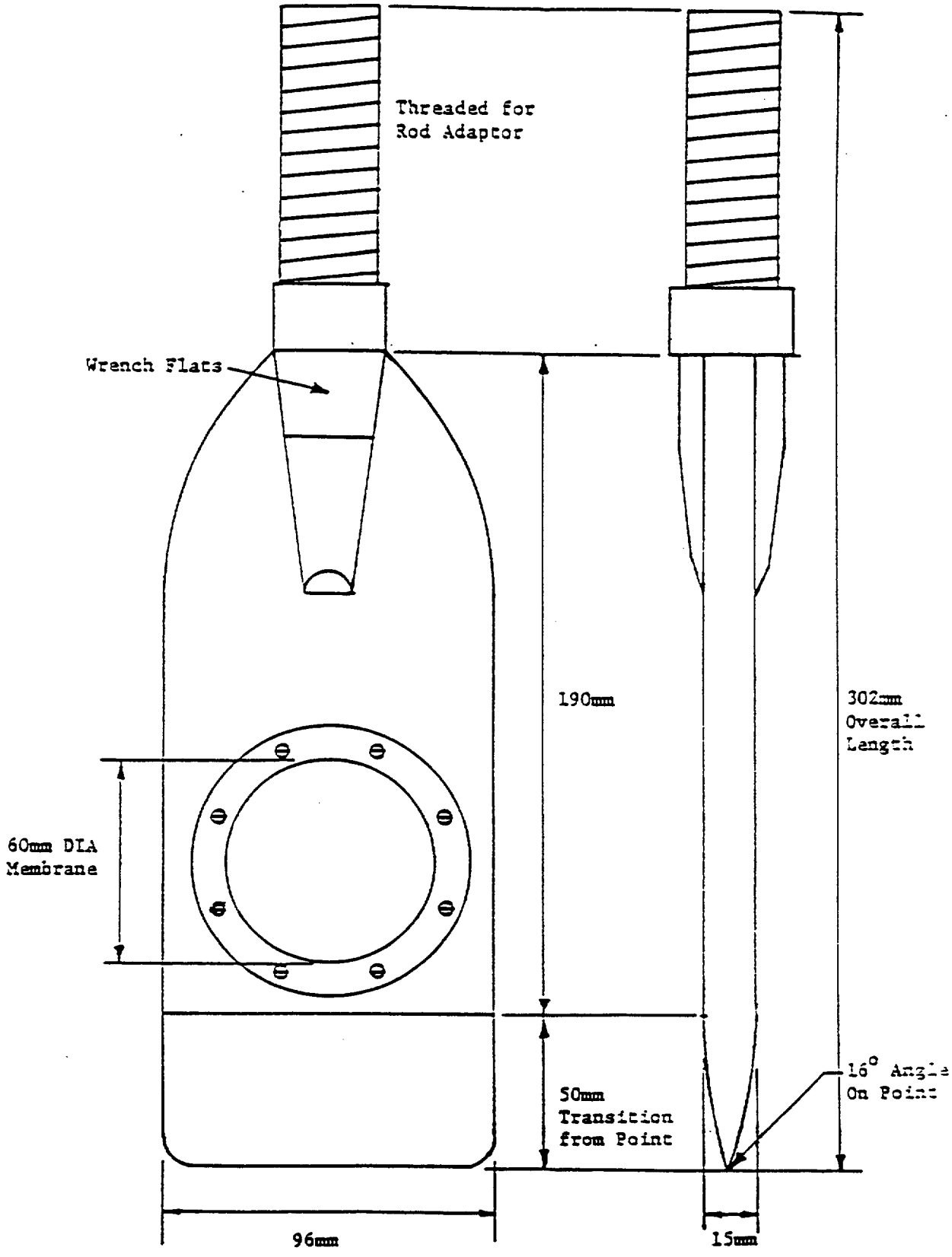


Figure 2.9 Schematic of dilatometer used at the MFFF site

SECTION 3

DATA ANALYSIS TECHNIQUES

OVERVIEW

Presented in this section is a description of analysis techniques used to determine engineering parameters. The methods used to determine the soil type information from the CPT are also discussed. The second portion of this section discusses typical piezo-resistivity and seismic cone penetrometer tests.

LOCATION OF THE SITE WATER TABLE

Generally, the static water table at a given site can be identified from the penetration pore pressures, since it will be equal to the hydrostatic pore pressure in freely draining soil layers. When no such layers are present, pore pressure dissipation tests can be performed to determine hydrostatic pressures. This information was used in the soil classification routines for the calculation of effective stress of the soil materials. A saturated unit weight of 120 pounds per cubic foot is assumed for all calculations.

SOIL BEHAVIOR TYPE

The tip resistance, friction ratio, and pore pressure values from CPT profiles can be used to determine a soil stratigraphy profile. Plots of normalized tip resistance versus friction ratio and normalized tip resistance versus penetration pore pressure can be used to determine Soil Behavior Type, SBT, as a function of depth. Both methods of soil description are based on empirical charts developed by Robertson (Ref. 2). The friction ratio based routines were selected for this project, since this approach is more robust than the pore pressure approach. The friction ratio SBT is determined from the chart in Figure 3.1 using the normalized corrected tip stress and the normalized friction ratio of f_{SN}.

The normalized tip resistance is defined as:

$$q_{NT} = \frac{q_T - \sigma_{vo}}{\sigma'_{vo}} \qquad (3.1)$$

The normalized friction ratio is defined as:

$$f_{SN} = \frac{f_s}{q_T - \sigma_{vo}} x\,100 \qquad (3.2)$$

where: fs = sleeve friction

q_T = corrected tip resistance

σ_{vo} = total overburden stress

σ'_{vo} = effective overburden stress

The intersection point of the q_T and f_{SN} values normally falls in a classification zone. The zone number corresponds to a soil behavior type (SBT) as shown in Figure 3.1. At some depths, the CPT data will fall outside of the range of the chart. When this occurs, no data is plotted and a break is seen in the SBT profile. This occasionally occurs at the top of a penetration as the effective vertical stress is very small and produces normalized cone resistances greater than 1000.

The classification profiles are very detailed due to the high sampling rate of one sample every 2 cm (0.8 in) for CPT profiles. Frequently significant variability in soil types over small changes in elevation can be observed in the profiles. To provide a simplified soil stratigraphy for comparison to standard boring logs, a layering and generalized classification system was implemented. Layer thicknesses are determined based on the variability of the SBT profile. The layer sequence is begun at the ground surface and layer thicknesses are determined based upon changes in the standard deviation of the SBT number. Whenever an additional 6-inch increment deviates from the previous increment, a new layer is started, otherwise, this material is added to the layer above and the next 6-inch section is evaluated. The soil type for the layer is determined by the mean value for the complete layer.

Although not presented on the CPT profiles, the electronic .ecp files contain the pore pressure classification values based on pore pressure ratio. This method uses the normalized corrected tip stress in bars and the pore pressure ration B_q.

$$B_q = \frac{u_{meas} - u_o}{q_t - \sigma_{vo}} \qquad (3.3)$$

where: u_{meas} = measured penetration pore pressure

u_o = static pore pressure, determined from the water table elevation

q_T = corrected tip resistance

σ_{vo} = total overburden stress

The intersection point of the q_T and B_q or f_{SN} values normally falls in a SBT zone. The SBT zone number corresponds to a soil type as shown in the figure. At some depths, the CPT data will fall outside of the range of the chart. When this occurs, no data is plotted and a break is seen in the SBT profile. Close analysis of this chart indicates that as the SBT numbers vary, so does the soil grain size. What is missing in these charts are mixed soils, such as sandy clays or clayey sands. This type of mixed soil represents special cases and may be misclassified as silts.

STANDARD PENETRATION TEST

Correlations between the cone penetrometer tip stress measurements, q_c, and standard penetration test blow count (N) data have been made by a number of researchers. Robertson and Campanella (Ref. 2) have summarized many of these studies and presented a relationship between q_c, N, and soil type. The blow count corresponding to 60 percent of the energy transferred to the sampler can be estimated from a ratio based on the soil type. For this project, the ratios used to compute the N value were as follows:

Soil Classification Number (SCN)	q/N ratio
less than 1.5	2.0
1.5 to 7.5	SCN/1.5
greater than 7.5	1.5

This relationship shows that as the materials increase in grain size up to an overconsolidated or cemented material (SCN = 7.5 or more) the q_c/N ratio increases. The correlation between q_c and N_{60} should be considered an estimate only, due to the rapid fluctuations in tip stress that can result in large changes in the calculated blow count. Also, the techniques used in performing the SPT test in any geographical area need to be considered. If the energy level normally transferred to the sampler is not nearly 60 percent of the theoretical maximum, the local correlation will be either higher or lower than the data presented in this report.

FRICTION ANGLE (ϕ)

The effective stress friction angle in granular soils can be estimated from the tip resistance data using an empirical correlation derived between laboratory triaxial tests on sands and penetration tests through prepared sands in large calibration chambers. The triaxial tests were performed at confining stresses equal to the horizontal effective stress in the calibration chamber. The tip stress data were then correlated with peak effective friction angle as (Ref. 2):

$$\tan \phi' = .38 \log_{10} \frac{q_c}{\sigma'_{vo}} + 0.1 \qquad \textbf{(3.4)}$$

where: ϕ' = effective internal friction angle (deg)
q_c = total measured tip stress
σ'_{vo} = effective overburden stress.

UNDRAINED SHEAR STRENGTH (S_u)

Estimates of the undrained shear strength in fine grained saturated soils can be made using the empirical relationship (Ref.2):

$$S_u = \frac{q_c - \sigma_{vo}}{N_k} \qquad \textbf{(3.5)}$$

where: S_u = undrained shear strength
q_c = total measured tip stress
σ_{vo} = total overburden stress
N_k = cone factor

The cone factor, N_k falls between 11 and 19 with an average of 15. In the absence of field vane shear data, sa is the case for the MFFF site, Robertson and Campanella (Ref. 2) recommend assuming N_k to be 15. If N_k is 19 for a given material, using N_k of 15 overestimates the undrained shear strength by 27%; and if N_k is 11, the strength is underestimated by 27%.

PRESENTATION OF ϕ AND S_u VALUES

Conventional engineering considers only friction angles (ϕ) to be appropriate in granular soil deposits such as sands. Similarly, undrained shear strength (Su) values are used in saturated,

low permeability layers such as clays. The distinction between which parameter is appropriate at a given depth is based on the soil type. When the average SBT number is greater than 4.0, the granular material is assumed to dominate and the friction angle is plotted. Conversely, if the SBT number is less than or equal to 5, the fine grained material is assumed to dominate and the undrained shear strength is plotted. These SBT numbers are found in the electronic files supplied with this report. Both values are plotted for SBT values of 4 and 5. When the data does not fall within the range of the classification system, neither ϕ' or S_u values are presented.

ESTIMATES OF OVERCONSOLIDATION RATIO (OCR)

A soil is termed normally consolidated if the current stress is the maximum to which the material has ever been subjected. The overconsolidation ratio (OCR) is defined as:

$$OCR = \frac{(\sigma_{v'o})_{max.past}}{(\sigma_{v'o})_{present}} \qquad (3.6)$$

where: $(\sigma'_{vo})_{max.past}$ = maximum past vertical effective overburden pressure

(σ'_{vo}) = present effective vertical overburden pressure.

For a normally consolidated soil, $(\sigma'_{vo})_{max.past} = (\sigma'_{vo})_{present}$ and OCR = 1, while an overconsolidated soil has an OCR > 1.

OCR calculations for the MFFF site were based on a publication by Mayne (Ref. 5) where OCR is directly correlated to excess pore pressure. As determined from a linear regression of published data, this equation is:

$$OCR = 0.33 \left[\frac{u_{meas} \bullet u_o}{\sigma_{v'o}} \right]^{1.42} \qquad (3.7)$$

COEFFICIENT OF LATERAL CONSOLIDATION (C_H)

Horizontal coefficients of consolidation can be calculated from the pore pressure dissipation tests using a theoretical model developed by Baligh and Levadoux (Ref. 6) and measured dissipation rates. Calculations are performed at 50% of the excess pore pressure

dissipation, U_{50}. Using the theoretical curves in Figure 3.2, C_H is calculated as:

$$C_H = \frac{T_{50} R^2}{t_{50}} \tag{3.8}$$

where: T_{50} = theoretical time factor at 50% dissipation

R = radius of cone in centimeters

t_{50} = measured time at 50% dissipation in seconds

Pore pressure measurements are made just behind the tip; hence, curve 3 in Figure 3.2 is used to determine a T_{50} of 5.5. Estimates of C_H for both the test locations are contained in Appendix C.

COEFFICIENT OF LATERAL PERMEABILITY (K_H)

This method uses the coefficient of lateral consolidation estimated from the pore pressure dissipation test described above and an estimate of the in situ constrained modulus, M, obtained from measured tip resistance values and soil classification according to:

$$K_H = \frac{C_H \gamma_w}{M} \tag{3.9}$$

where: C_H = coefficient of lateral consolidations

γ_W = unit weight of water

M = constrained modulus

The constrained modulus, M can be estimated using the empirical relationship:

$$M = \alpha q_c = \frac{1}{m_v} \tag{3.10}$$

where: α = empirical factor

q_c = measured tip resistance, not corrected for pore pressure effects

m_V = volumetric compressibility.

The factor α is obtained from Figure 3.3 (Ref. 2) is based on the uncorrected tip resistance and soil type. Estimates of K_H and M are contained in Appendix C.

TYPICAL P-CPT PROFILE

Location CPT-18R represents a typical piezo-resistivity cone penetrometer sounding profile at the proposed MFFF site site (Figure 2.2). Sounding CPT-18R is located at 80192.1 north by 55405.9 east at elevation 277.0 feet. Typical to this site, sands and gravelly sands are encountered in the first 10 feet of penetration from elevation 277.0 to 267.0 feet, as indicated by tip resistance values in excess of 290 tons per square foot (tsf) and friction ratio values ranging from 2% to 4%. Measured soil resistivity remains relatively constant at approximately 4000 ohm-m from elevation 277.0 to 237.0 feet. At elevation 267.0 feet the probe encounters less resistant and less cohesive soils in the form of sands and sand mixes. With the exception of a slight interruption at elevation 237.0 feet, this layer extends approximately 53 feet to elevation 222.0 feet. Sleeve friction values decrease to 1 to 2 tsf and tip resistance in this zone fluctuates between 100 and 200 tsf. This combination of tip stress and sleeve friction results in low friction ratios. As previously mentioned, a fine-grained lens interrupts this layer 4 feet in thickness extending from elevation 237.0 to 233.0 feet. Tip stress decreases while the sleeve friction increases, indicating an increase in soil cohesion. In this less permeable material, the first measurable pore pressure readings are recorded. It is important to note that the soils in this lens are more conductive as is evident by the decrease in measured resistivity. A very resistant soil matrix is encountered at elevation 213 feet. The cone penetrometer typically encounters refusal in such stiff soils, however the thin nature of this lens enabled the crew to cycle the probe through. At elevation 208 to 207 feet, several observations are made. Fine-grained soils are again detected as evident by decreased penetration resistance, elevated penetration pore pressures, and a decrease in soil resistivity. The water table is also encountered at this elevation which is supported by the magnitude of the decrease in soil resistivity. Due to the presence of water below elevation 207 feet, resistivity remains relatively low for the remainder of the sounding. This layer continues to elevation 198 feet where a more resistant, less permeable soil matrix is encountered. Note the dramatic decrease in penetration pore pressure. Dissipation tests were conducted at this location at elevations 194.1 and 179.8 feet. In situ soils at elevation 194.1 feet are best described as fine-grained sands as noted by the elevated tip resistance measurements. The dissipation test conducted at this elevation reveals negative pore pressures for the first 30 seconds of the test, indicating a dilated condition which is consistent with the negative penetration pore pressures measured. At elevation 182 to 171 feet, the soils become

finer and less permeable, resulting in elevated penetration pore pressures. A dissipation test was conducted in this layer and a classic pore pressure profile was obtained supporting the observation of a fine clayey layer. The in situ soils begin to stiffen below elevation 171 feet until penetration refusal is encountered at elevation 156.7 feet.

SEISMIC MEASUREMENTS AND RESULTS

Seismic downhole data of shear and compressional waves were conducted every five feet from the bottom of the pre-augered utility clearance hole to the final depth at six of the CPT locations. The seismic signals were typically recorded at a rate of 10,000 samples per second with the acquisition system set to record a total of 2,500 data points per seismic trace.

The seismic shear wave time histories in Figure 2.4 show several cycles of motion beyond the first peak motion. Any analysis of these late motions should consider the gage frequency response. Geophones are non-linear devices and the amplitude and phase angle are a function of frequency. The data plotted in Figure 2.4 and in Appendix B are presented as the voltage output (vertical scale of each time history trace) of the transducer and have not been corrected for non-linear transducer response. The Geospace transducers (GS-14-L9) used on this project have an undamped natural frequency of 28 Hz, with the transducer sensitivity greatly reduced below 28 Hz. The transducer sensitivity at the natural frequency can be a factor of two greater than the nominal sensitivity below 28 Hz. In addition, there is a phase distortion in the raw data. For the uncorrected seismic time history data presented in this report, the shape of the time histories are qualitatively correct, but the late time motions are exaggerated. The data can be corrected using two methods, the first being a high frequency filter. A second method is to apply a transducer transform function to the data that accounts for the non-linear behavior of the transducer. These corrections were not applied to the data, as only arrival times and wavespeeds were desired.

When the support beam beneath the penetrometer truck is struck on one end, traction between the steel beam and the soil generates a horizontal shear wave. Also generated is a small compressive wave as the energy propagates across the beam. The bulk of the mechanical energy is transferred into shear wave energy at the steel-soil interface. However, the small amount of compressive wave generated will arrive at the velocity transducer first due to its higher wave velocity. This is the source of the small amplitude motion observed in Figure 2.4. The

compression wave contamination is of a very small amplitude when compared to the shear signal, and attenuates rapidly with depth. At greater depths, this compression wave contamination arrives much earlier than the shear wave. The hydraulic shear wave source used by ARA is rich in shear wave energy, and the ability to separate the compression wave from the shear wave is enhanced with the use of polarized shear waves.

The shear wave is identified as the first large out-of-phase motion in Figure 2.4. For shallow locations, the exact arrival time of the shear wave can be difficult to pick. Selection of the first shear wave peak is much easier to accomplish, especially with polarized shear waves. These times are typically more consistent and contain less scatter than the selection of arrival times. The shear wave initial peaks are identified in Figure 2.4 by the small arrows. The times are used in the subsequent analysis to determine the shear wave velocities.

Two methods were used to determine the shear wave velocities. The first method used to determine the wave velocities consisted of visually fitting linear line segments to the travel time data over depth intervals that were interpreted to have the same wave velocity. The second method used least square regression algorithms to determine the peak arrival time data within ±6 ft of a given test depth. A minimum of three data points were required in the ±6 ft zone to determine a wave velocity.

TYPICAL SEISMIC-CPT PROFILE

Location CPT-08S (Figure 3.4) presents in situ conditions and seismic wave velocities typical of the site. Sounding CPT-08S is located at 80393.7 north by 55329.1 east at elevation 273.0. Shear wavespeeds at this location range from 1000 feet per second (fps) to 1530 fps (Figure 3.5). Elevated wavespeeds of 1530 fps are measured in top 5 feet of surface material from elevation 263 to 258 feet. Soil properties change at elevation 258 feet to sands and sand mixes. This layer extends 45 feet to elevation 213 feet where shear wavespeeds range from 1120 fps to 1220 fps. Compression wavespeeds of 2090 fps to 2590 fps are determined is these soils. A less permeable clay lens encountered from elevation 213 to 203 feet slows wavespeeds to 1000 fps. The CPT profile for this location indicates a sand mix layer from elevation 203 feet to 186 feet bgs with an interbedded clay lens at elevation 198 feet, approximately 4 feet in thickness. Seismic tests were conducted on 5-foot intervals making it difficult to disseminate thin layers. As a result, an average shear wavespeed of 1100 fps is measured from elevation 203

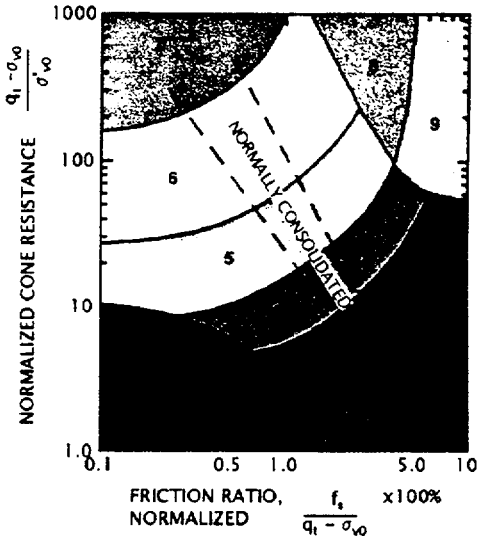
to 188 feet. Compression wavespeeds are estimated to be 2870 fps in this layer. The water table is encountered below elevation 198 feet so compression wave generation was discontinued. Shear wavespeed increases slightly to 1180 fps from elevation 188 to 168 feet as more resistant and less permeable soils are encountered. From elevation 168 to 163 feet, shear wavespeeds decrease to 1060 fps. No seismic traces could be recorded at test intervals 115 feet and 120 feet bgs resulting in a gap in the calculated shear wavespeeds from elevation 163 to 148 feet. In situ materials stiffen dramatically as the probe nears refusal, resulting in shear wavespeeds of 1320 fps from elevation 148 feet to sounding termination at elevation 133 feet.

CPT Soil Classification Legend

Zone		Q_t/N	Description
1		2	Sensitive, Fine Grained
2		1	Organic Soils-Peats
3		1.5	Clays-Clay to Silty Clay
4		2	Silt Mixtures-Clayey Silt to Silty Clay
5		3	Sand Mixtures-Silty Sand to Sandy Silt
6		4.5	Sands-Clean Sand to Silty Sand
7		6	Gravelly Sand to Sand
8		1	Very Stiff Sand to Clayey Sand *
9		2	Very Stiff, Fine Grained *

(*) *Heavily Overconsolidated or Cemented*

Normalized Friction Ratio Classification Chart



(Ref. Robertson, 1990)

Coefficient of Permeability (cm/s)

Zone	Description	Permeability
1	Sensitive Fines	10^{-5}
2	Organic Soils-Peats	10^{-5}
3	Clays	10^{-7}
4	Silt Mixtures	10^{-6}
5	Sand Mixtures	10^{-4}
6	Sands	10^{-2}
7	Gravelly Sands	10^{-1}
8	Very Stiff Sands	10^{-5}
9	Very Stiff Fines	10^{-6}

Applied Research Associates, Inc., South Royalton, Vermont 05068
(802) 763-8348, cpt@ara.com, http://www.ara.com

Figure 3.1 Friction ratio soil classification chart

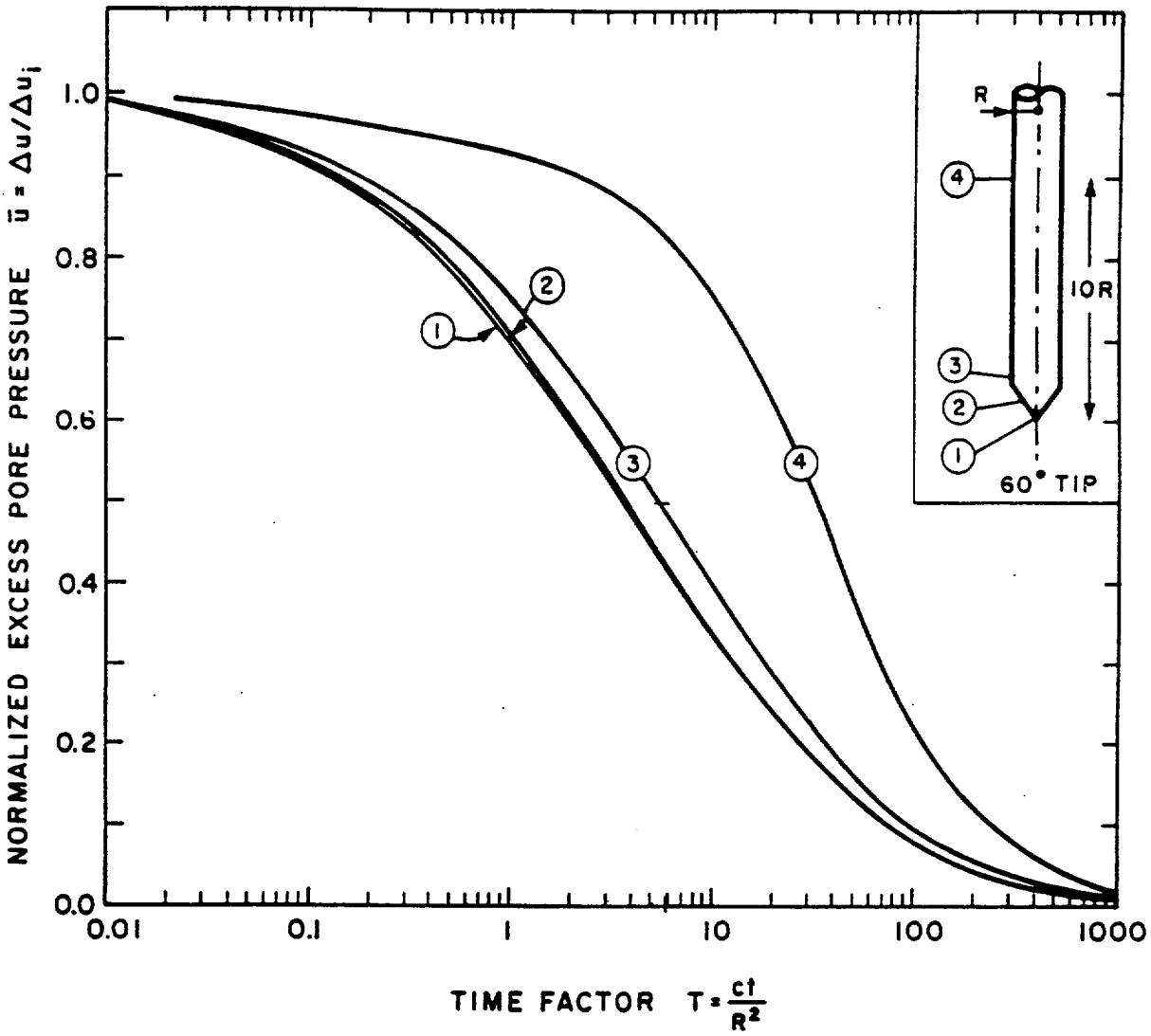


Figure 3.2 Dissipation curves for a 60° cone according to linear isotropic uncoupled solution (after Raligh and Levadoux, 1980)

$$M = \frac{1}{m_v} = \alpha . q_c$$

q_c < 7 bar	3 < α < 8	
7 < q_c < 20 bar	2 < α < 5	Clay of low plasticity (CL)
q_c > 20 bar	1 < α < 2.5	
q_c > 20 bar	3 < α < 6	Silts of low plasticity (ML)
q_c < 20 bar	1 < α < 3	
q_c < 20 bar	2 < α < 6	Highly plastic silts & clays (MH, CH)
q_c < 12 bar	2 < α < 8	Organic silts (OL)
q_c < 7 bar:		
50 < w < 100	1.5 < α < 4	
100 < w < 200	1 < α < 1.5	Peat and organic clay (P_t, OH)
w > 200	0.4 < α < 1	

Figure 3.3 Estimation of the constrained modulus, M, for clays (after Robertson and Campanella, 1988)

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North 80393.7 East 55329.1 Elevation 273.0

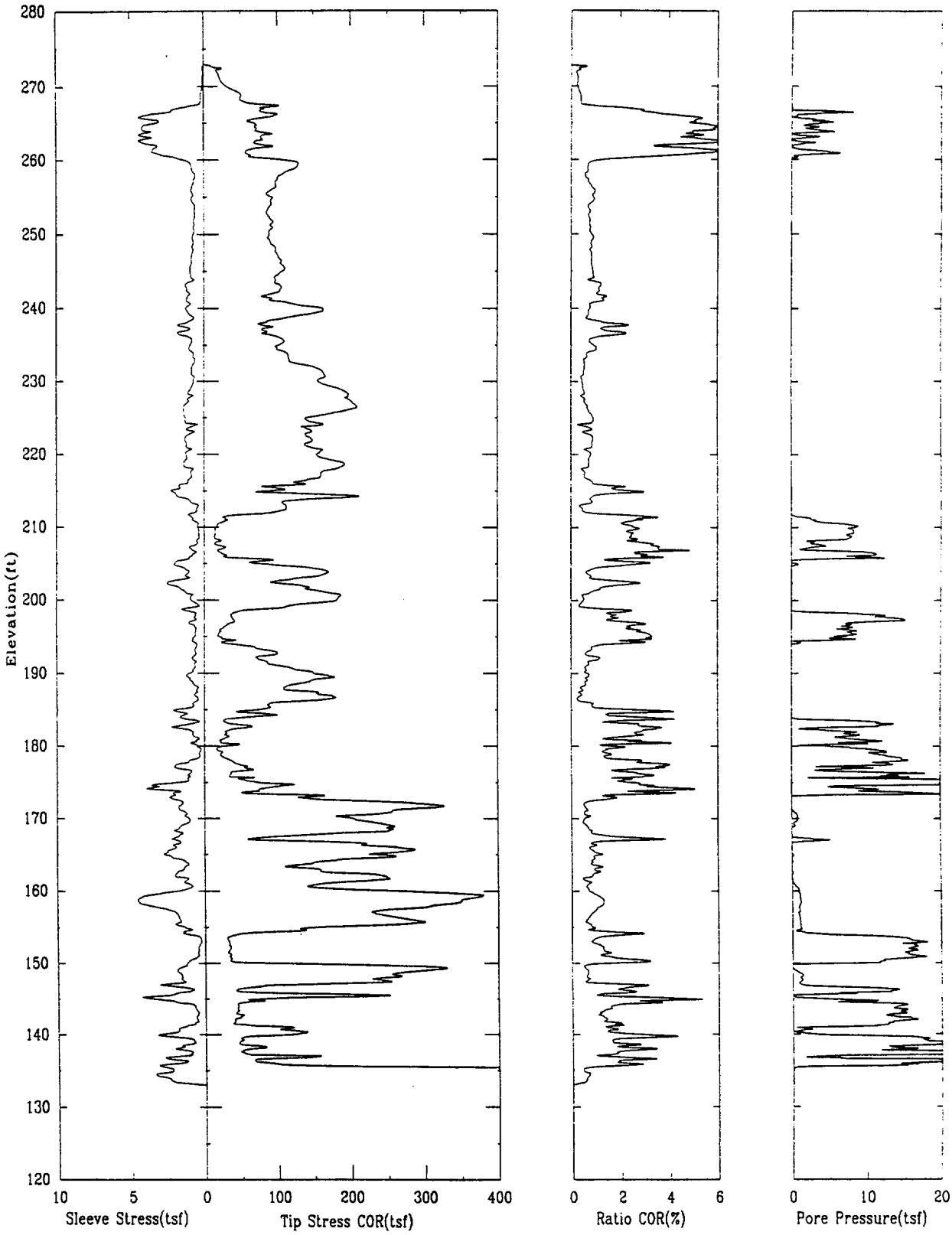
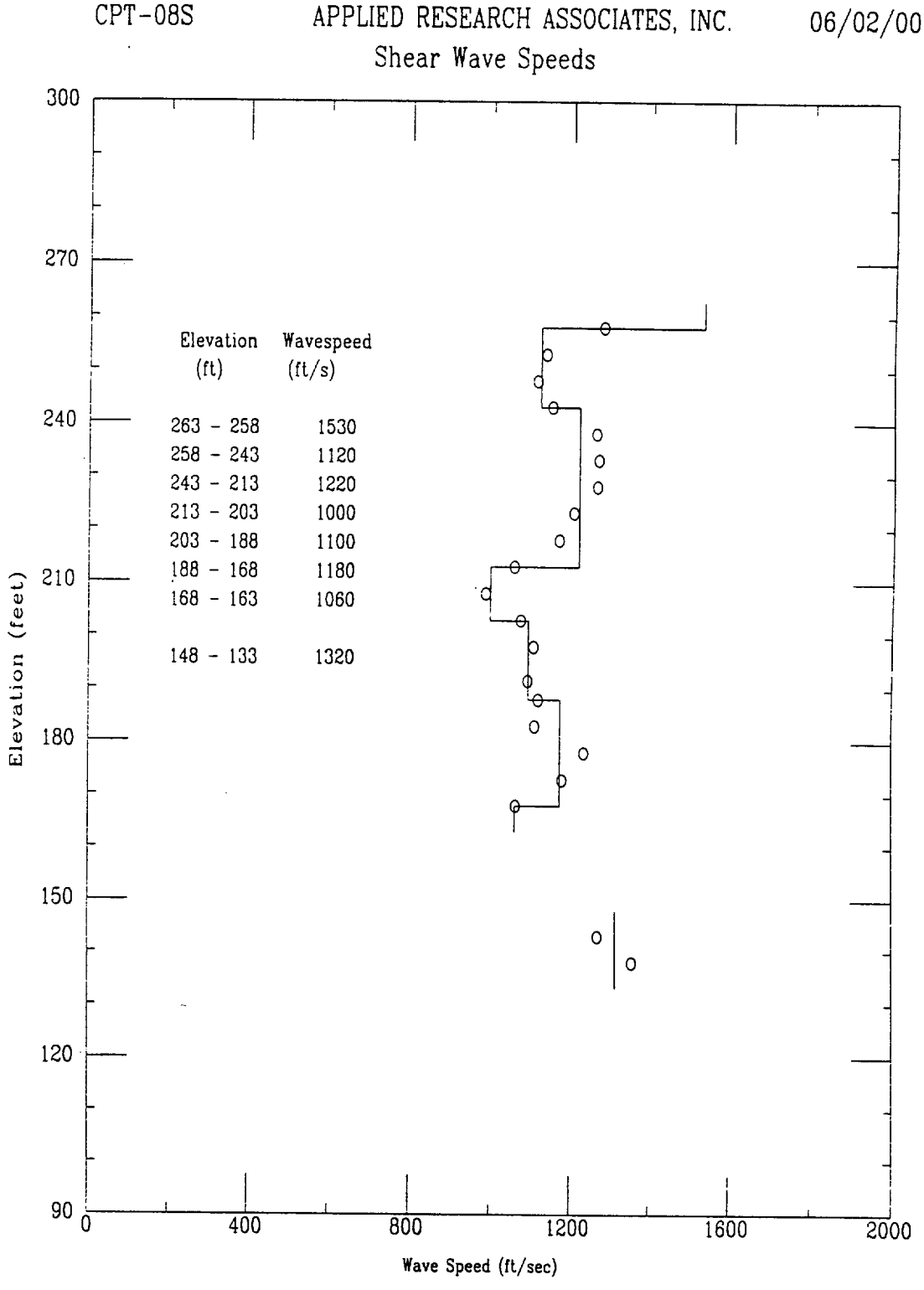
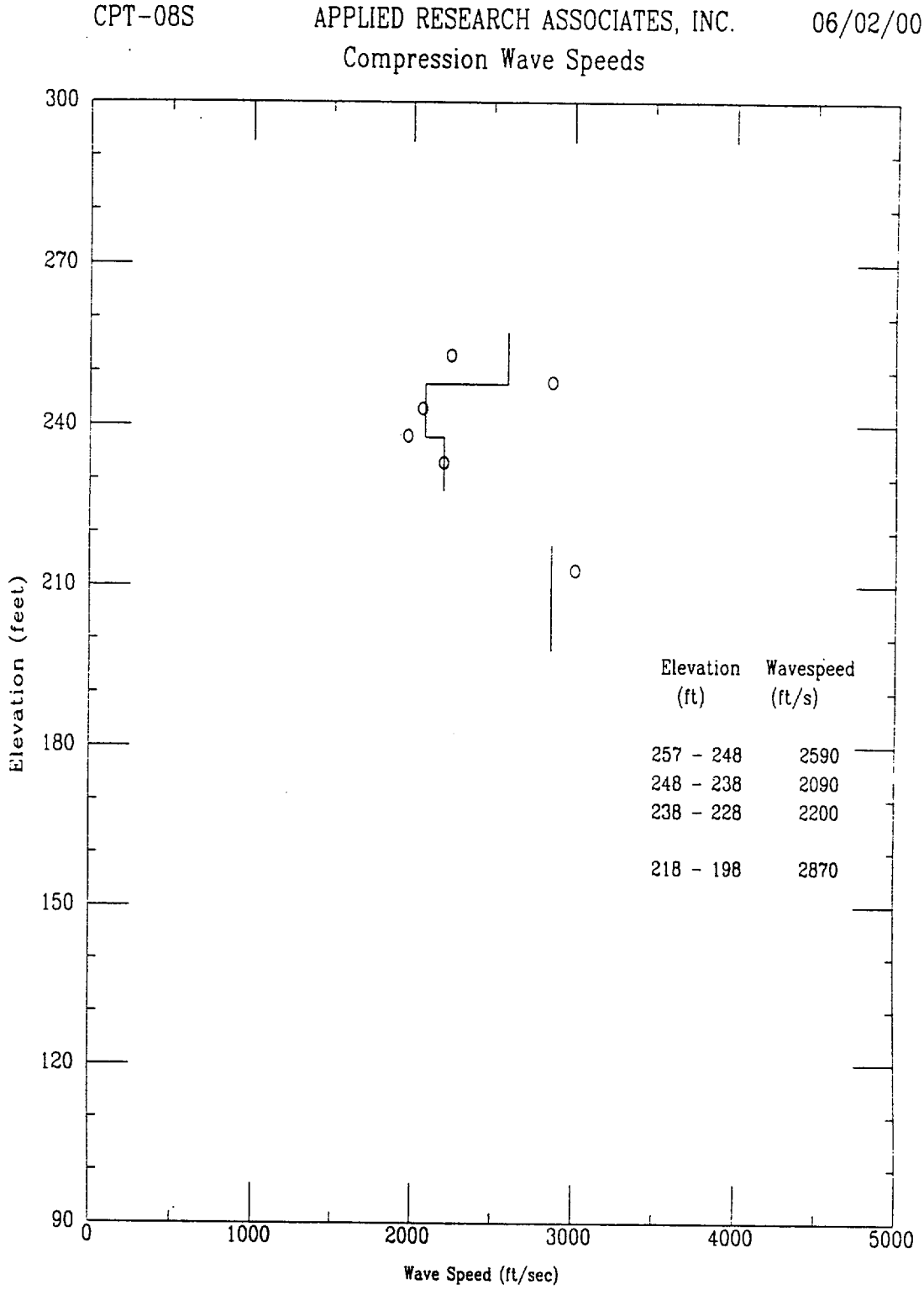


Figure 3.4 CPT profile from location CPT-08S

File 402u004.ECP



File 402u004S Figure 3.5 Shear wavespeeds from location CPT-08S



File 408a004S Figure 3.5 Shear wavespeeds from location CPT-08S (concluded)

SECTION 4

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2. Robertson, P. K. and R. G. Campanella, *Guidelines for Using the CPT, CPTU and Marchetti DMT for Geotechnical Design*, Vol. II, University of British Columbia, Vancouver, BC, Canada, March 1988.

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